PROCEEDINGS

1st National Symposium

on

Clinical Nutrition

28-30 March 1994
Kuala Lumpur

organised by
Institute for Medical Research

co-organised by
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Editors:

Tee E Siong
LT Cavalli-Sforza

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Preface

In an effort to strengthen clinical nutrition research and activities in the country, the Institute for Medical Research convened the 1st National Symposium on Clinical Nutrition from 28-30 March 1994. The Symposium provided a forum for discussing clinical nutrition activities in the country, including research, preventive, curative and training activities. This meeting also facilitated the sharing of experiences and improve linkages between clinicians, nutritionists, researchers, dietitians, pharmacists and nurses. Two round table discussion sessions were also held to deliberate on ways to strengthen the nutrition support team, and training and research in clinical nutrition in the country.

The Symposium was co-organised by the Nutrition Society of Malaysia, and with the support of the World Health Organization. The Organising Committee comprised members from 9 organizations/ departments. The IMR is grateful for the spirit of cooperation exhibited by all members throughout the many months of preparations for the Symposium. Staff members of the Division of Human Nutrition of the IMR played key roles in the organization of this Symposium.

A total of 47 papers were presented by 38 speakers in the 3-day meeting. Thirty-one of these papers were presented by 28 local workers and researchers in clinical nutrition from 11 departments and organizations. In addition, 9 foreign speakers from Australia, Canada, India, Japan, and the United States of America were invited to share their experiences with local participants. Dr Ian Darnton-Hill, WHO Regional Advisor in Nutrition delivered the keynote address.

Some 200 participants were registered for the Symposium. This gathering of the main key persons involved in clinical nutrition research and activities in the country, and the presence of several prominent foreign experts provided a forum for useful interactions and exchange of experiences. This Symposium signifies the commencement of an important chapter in nutrition research and activities in Malaysia.

It was felt important to document the papers presented in the Symposium. The wide variety of papers presented should serve as a useful reference to workers in this field. Reponse from authors to publish their full papers has been very good, enabling a total of 37 full papers to be published in this volume.

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Institute for Medical Research

LT Cavalli-Sforza
WHO Regional Centre for Research and Training in Tropical Diseases and Nutrition
1995

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Obesity in children with particular reference to the Western Pacific Region of the World Health Organization

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ABSTRACT

The proportion of undernourished children has declined in the Region. This has not yet translated into increased levels of obesity in childhood and adolescence in some countries e.g. China. However there is good evidence to suggest children are getting heavier on average and in higher proportions, even in countries such as the Philippines where the number of overweight children has tripled in the last ten years.

In Singapore 12% of school-age children 6-16 years are overweight or obese, a dramatic shift from the supplementary feeding programmes of forty years ago. In Japan levels of childhood obesity have been increasing over the last ten years. In Tonga 23% of schoolchildren were considered obese in the 1986 nutrition survey, and similar figures are likely to be seen in other Polynesian, and also Micronesian populations in the Pacific. In Australia, about 30% of children are overweight, with 5-19% obese. In one State school health system, there is documented evidence that the average weight of the school population has increased.

Early obesity leads to an increased likelihood of obesity later in life, as well as an increased prevalence of noncommunicable diseases. Psychological effects and lower socioeconomic status in later life have also been identified. As the treatment of obesity is so frequently unsuccessful, the prevention of obesity in children and adolescents is critical.

INTRODUCTION

Obesity is a major non-communicable disease in its own right (1). It is also a risk factor for other noncommunicable diseases such as hypertension, diabetes, coronary heart disease, stroke and peripheral vascular disease (1).

Obesity and overweight are becoming increasing problems in developing as well as developed countries (2,3). Data for adults are generally more complete and show that, where trends can be

observed, there are now more adults overweight and obese than 20 years ago, and that populations, on average, are heavier. Data for children are less available, partly because the concern in the past has generally been to look for undernutrition. However there is strong anecdotal and some national evidence to show children in the Region are also getting heavier and that more are obese and overweight.

This paper will look at factors leading to childhood obesity, then look more specifically at available data on obesity and overweight prevalences and trends, and then examine the possible significance of such trends. The paper will be addressing obesity and overweight in children from a public health and epidemiological point of view rather than on an individual or clinical basis.

FACTORS IN CHILDHOOD OBESITY

Why should we be so concerned with overweight and obese children? Briefly, it is because there are negative repercussions, both physically and psychologically, to children being excessively overweight; and because being overweight can lead to higher incidences of adult obesity and noncommunicable diseases. For example, at certain stages of life, such as in youth or adolescence, obesity may be particularly diabetogenic (1).

Children represent the future resources of countries, and in many countries of this Region still constitute a relatively large proportion of the population. Their future health is therefore recognized as being important. Increasingly the major causes of adult mortality in all countries are the nutritionally-related non-communicable diseases. In the on-going demographic and epidemiologic transition taking place in Asia and the Pacific, many of the lifestyle risk factors for the noncommunicable diseases are established early in life, including diet.

In this section, we will look briefly at:

(a) who is at risk;
(b) genetic predisposition; and
(c) environmental factors.

(a) Who is at risk?

The social trends, and hence who are most at risk, change over time and with demographic shifts. In countries with higher levels and longer experience of childhood obesity, it is associated with lower socioeconomic class (4,5,6). In developing countries the reverse is true (6,7). In much of this region, economies are in transition and either the developing country picture is seen or a transitional one.

In a study from Singapore it was found that significantly greater proportions of children who had a relative weight >120% of standard weight for height were from the middle and upper social classes. This was interpreted as reflecting the increased affluence of the society and the accompanying changes in lifestyles and eating habits (8). This would also be true of countries such as Malaysia and the Philippines.

In the Pacific, overweight and obesity appears to be hitting all sectors of society, although the more urbanized populations have higher prevalences. In countries such as Papua New Guinea and Vanuatu, public servants are most at risk and although there are no data disaggregated by socio-economic status for children, given the familial patterns of obesity it would seem likely their children will be at greater risk. In the more affluent countries such as Australia, rural children tend to be heavier, whereas in most other countries, but apparently not Thailand or Japan, urban children tend to be both taller and heavier.

In the larger cities of Asia and the Pacific, the strong visual evidence of acculturation to the global youth culture is striking, including in dress, music and preferred foods and drinks. This must be at least one factor in the increasing obesity. Many countries have data now showing changes in the nature and composition of the diet. It is likely also that total dietary fat and saturated fat intakes are increasing in these adolescents.

Although many studies have failed to show a correlation between individual energy intake and obesity, there are more overweight and obese people in populations that have, on average, higher energy (caloric) intakes (6). Total energy intakes in countries such as Australia and the USA appear to be declining. Given the increasing prevalences of overweight and obesity in these countries, this suggests that physical activity is declining and/or dietary patterns e.g. increased dietary fat, are somehow implicated. In most other countries energy intakes per capita are increasing, at least to some extent.

(b) Genetic factors

The debate about the relative contributions of heredity and environment to the development of obesity continues to be unresolved although there is now considerable information available. It is likely the picture is even more complicated than initially thought and that the relative amount of influence of the genetic make-up probably varies at different stages of life.

Views on the importance of inheritability in the pathogenesis of obesity have been conflicting. Using the sample of Stunkard from the data base of the Danish Adoption Register, Costanzo and Schiffman came to the conclusion that thinness- not obesity - has a genetic component (9). When the body mass of adoptees was compared with the body mass of both biologic and adoptive parents using chi-square analysis, they concluded that biologic heritability was small and confined to thin, not obese, body mass. They concluded that the inheritance of thin body mass constitutes a mild protective factor that mitigates against development of obesity caused by environmental factors (9).

Conversely, an editorial in the Lancet claims that it has been estimated from studies that, at the age of ten or eleven years, more than 70% of the variation in weight for height or skinfold thickness is explained by genetic factors (4). It further claimed that studies have shown that the rearing

environment has only a minor influence on weight for height during childhood (4).

Although it is known that obesity, hypertension, glucose tolerance, and high lipid levels tend to cluster in families, the extent to which this clustering is caused by common genetic influences on multiple risk factors or by shared environmental or behavioural factors is unknown. Sex differences in adolesence have been demonstrated in children: parental obesity appearing to have an effect on more rapid growth but not adiposity in boys, whereas in girls, childhood energy intake/kg predicted both body size and adiposity, but parental obesity had less predictive effect (10).

Obesity is not a single entity, either in its pathogenesis or physical manifestation. There are e.g. the chronically obese and the newly obese, and despite the common conception, not all people remain obese, and obesity can start at any age. Even in middle-age, at least half of the obese comprise the newly obese (11).

Studies with adopted children and identical twins who have been raised apart, suggest that the early family environment plays little or no part in the later development of obesity and body mass (5), although a study by Lissau and Sorensen found that parental neglect during childhood predicted risk of obesity in young adulthood independent of age and body mass index in childhood, sex and social background (12). Nevertheless, Stunkard's group have concluded that genetic factors are far stronger than the early family environment, and that they may be even stronger in obesity of childhood onset than obesity with onset in adult life (13).

(c) Environmental factors

The intrauterine environment is the first environment that might have an effect. Children exposed during the first two trimesters of intrauterine life to the Dutch hunger winter of 1944-45, subsequently showed an increased prevalence of obesity. It was suggested that impaired nutrition at this stage of development might programme subsequent patterns of feeding and fat deposition (14). It might also represent the very strong emphasis, after the War, on feeding high quality diets to the generation born during the conflict.

As indicated above, obesity is unlikely to be a single condition or state. Garn, Sullivan and Hawthorne (11) differentiate between the newly obese and the chronically obese, as they feel that length of time living in an obese family may have greater bearing on chronic obesity than on obesity of recent onset (11). They also feel that familial obesity is best demonstrated in adolescents and their parents (rather than in very young children or after the teenage years), and that this either reflects years spent in common or a specific aetiology for adolescent-onset obesity (15).

A longitudinal study of obesity in Japan concluded that among girls, obesity at 17 years old was related to the build at birth, while among boys it is related to build at 3 years of age. Based on their findings they recommended that

the prevention of obesity should start as early as possible, at least from 3 years of age (16). In another study from Japan, 85% of children with weight in excess of 120% of the standard were obese or overweight as adults (17). A study on fatness and coronary risk factors status in adolescents in Geelong, Australia concluded that for adolescent body fatness and distribution, weight and body mass index in the early school years, between 4-7 years, appeared to be the best predictors for body size and fatness in adolescence (Tienboon, Wahlqvist & Rutishauser, personal communication).

The relationship between physical activity and obesity is important in children as well as adults especially as childhood patterns of activity may continue into adulthood. Generally activity levels decline rapidly with increasing age (18). In a review of studies on activity and exercise, the methodological difficulties in measurement of activity was emphasized, but the authors felt that there is evidence that obese children do less intensive exercise and tend to do less demanding tasks i.e. that overall, obese girls are relatively less active than non-obese girls, although other studies have not necessarily observed this, nor in boys (18).

However two recent prospective studies support a causal relationship between levels of physical activity and obesity in children. One by Roberts (19) using doubly labelled water found that infants who subsequently gained the most weight were those having the least energy expenditure 3 months previously, and this was attributed primarily to physical activity. In prospective studies in babies, adolescents and Pima Indians, a low relative resting metabolic rate and a low 24-hour metabolic rate have emerged as risk factors for weight gain (20), apart from the genetic and physical activity factors. It has also been suggested that the blunted thermic effect of eating in obese children could favour weight gain and that the defect in thermogenesis reported in certain obese adults may originate early in life (21).

A study in Sweden followed up overweight chidren at 10 year intervals for a total of 40 years. The author concluded that the most important factors for weight level in adulthood were the degree of obesity in the family (parents and grandparents) and the degree of overweight in puberty (22). Even when their food intake was in accordance with recommended levels, obese children had greater than normal weight as adults. Although the study by Lissau and Sorensen found that family structure (whether biological or other parents, and number of siblings) did not significantly affect the risk of adult obesity, in the Singaporean context it was found that obese parents tended to have obese children and such families tended to be smaller and better-off (24).

A study in the USA followed up children for 50 years and concluded that the body mass index (BMI) before maturity was a poor predictor of middle-aged BMI status in females but was a good predictor in males (23). They observed better stability of BMI over the shorter term and concluded that body size is a good

predictor of body size in adolescence as well as young adulthood (23). It seems quite likely that both cultural, ethnic and gender differences would affect the ability to predict later obesity from childhood obesity.

Social influences can be traditional concepts related to times when the food supply was less assured. For example, traditional Chinese perceptions are said to include the concept of the plump child as being a healthy child (24). Other social influences include changing dietary patterns and practices and changing exercise and lifestyle practices. Populations with higher energy consumption have more overweight individuals and it has been suggested that is because the lifestyle or diet typical of a particular population challenges the adaptive capacities of the individuals in that population (6). The higher the energy content of the socially accepted diet, the higher the proportion of individuals who are challenged beyond their adaptive threshold (6).

The sort of global diet becoming common is to a large extent modelled on the north American pattern where every second, an estimated 200 people order one or more hamburgers. In the 1970s, fast food sales increased 300%. In most fast-food meals, 40-55% of the energy comes from fat (25). There is concern in countries such as the Philippines, that new nutritional patterns consistent with global food trends are changing the traditions, particularly in the upper socioeconomic groups and be leading to increased obesity in the young (26). As can be seen in the figure, countries like Japan have shown marked changes and these sorts of changes are being reflected in most countries of the Region (Figure 1).

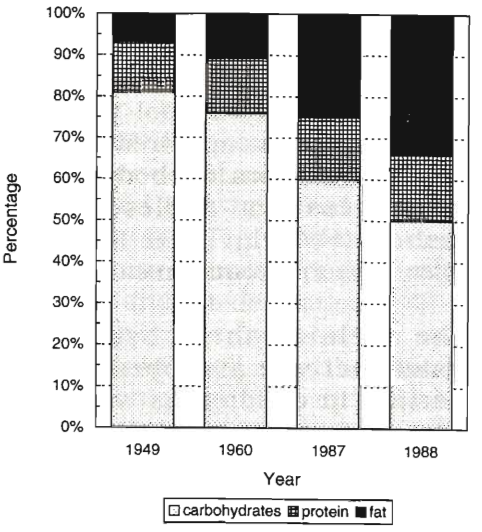

Figure 1. Changes in consumption in Japan

Source: Y. Goto, Nutr. Reviews, December 1992: 398-401

OBESITY PREVALENCE

One preliminary note that needs mentioning are the potential problems with the measures, standards, references and cut-off points used in defining overweight and obesity in children. Depending on the cut-off points used, or the data-base of the reference weight for height chart, very different prevalences will be given. This is particularly so for children passing through adolescence. These problems apply when considering both epidemiological and clinical aspects of childhood and

adolescent obesity and overweight.

One example of this is the use of different standards by countries e.g. the Republic of Korea and the Philippines. Because these countries were previously primarily concerned with undernutrition, they developed growth standards from their own populations, suspecting they might be more appropriate, at least for targetting purposes. However as these populations were relatively undernourished, the standards developed were less than say, Harvard or NCHS standards. Consequently, when problems of overnutrition, at least for some sectors of society, started to be become a problem, the national standards tend to over-estimate the problem. This may not matter when looking at trends, although problems will arise when the standards change as they have done in the Philippines. However it will matter if making intercountry comparisions.

Clinically, although it may be appropriate to use body mass ratios e.g the body mass index, to facilitate comparisons between groups of children and nationally representative data, it is inappropriate to classify individuals as obese on the basis of these distributions. There is great biological variation in weight, height and body mass index (BMI) in children generally, particularly during adolescence years, and it is not therefore possible to set cut-off points for BMI in children which could be used for classifying individuals as overweight or underweight (27). Even when using international standards there may be concern that these may represent over-nourishment, even though it would appear that adequately nourished children in early childhood tend to have similar potentials in growth. A good example of this sort of error is the relatively recent realization that the standards for the first year of life were predominantly based on formula-fed infants and hence not appropriate for assessing adequate growth in the first year of life.

In general terms in the Region and particular in China, the proportion of undernourished children has declined (28). This does not necessarily mean the converse is happening i.e. that the number of over-nourished children is increasing. However, as will be seen, it does appear that this is indeed happening in most countries, certainly for all those for which we have data.

Because of the problems outlined above concerning the use of different standards and cut-off points, and the representativeness of sample populations it has proved impossible to make valid comparisons between countries, so individual data are presented.

In Tonga 23.4% of children under 5 years, were considered obese (>120% W/H using NCHS standards) in the 1986 nutrition survey. The prevalence of obesity is described as alarmingly high in women 30 years of age.

In Australia about 30% of children are overweight, with 5-15% of boys and 8-19% of girls considered obese (29). A recent study showed that the prevalence of overweight in Australian children was lower than that in children of the same age in the

United States (27).

In Brunei Darussalem in 1987-89, one year old children had a 3.1% prevalence of being overweight, 5.9% at 2 years and of 5-9 year olds, 8.9% were overweight, but the criteria used were unclear. Based on trends in other countries the affluence of the country suggests there will be an emerging problem of obesity in the country. A national survey is being planned with the Insitute of Medical Research next year which may give a better idea on the magnitude of the problem.

In two small samples of Republic of Korean elementary school children reported in 1992, more overweight children were seen in the Seoul sample. Using weight for height (W/H) and taking >120% of the standard used as overweight, approximately 14% of the Seoul sample were overweight but none of the rural sample (30). The standards used were Korean and hence may have over-estimated the number overweight.

In Japan, the Ministry of Education has been mainly responsible for collecting data on the development of Japanese schoolchildren. In the 1985 census about 3.1% of 6-year-old children (both sexes) had weight for height measurements greater than 120% of standard, with more girls than boys overweight (3.33% c.f. 2.91%). For 14-year-olds, not only were more overweight (6.6%) but now more boys (7.22%) than girls (5.96%) were overweight (31).

In Singapore approximately 13% of school-age children 6-16 years are overweight or obese. Immediately after the second world war, Singapore instituted supplementary feeding programmes due to the number of undernourished children. Being overweight is now considered to be a problem of public health proportions in Singapore. Like the Japanese pattern, prevalence, at least in the 1983 study, increased with age, almost doubling from primary I level to primary VI level (32) and with a significantly higher rate in boys.

Kiribati, a Micronesian country in the Pacific Ocean, had a prevalence of 11.1% of schoolchildren overweight as defined by >+2SD W/H, and 5.9% as defined by W/A. The Federated States of Micronesia had 4.4% of children under 5 years of age as apparently measured by >100% W/H. As these were mainly in the age group of less than six months, it may be more reflecting the high levels of obesity of the women of FSM where even in 15-19 year-old women, 40% are overweight with a quarter of these young obese. A similar pattern has been described in a hospital sample of Palauan infants and children under 2 years, where 15% were classified as overweight, but again most were under 6 months of age.

OBESITY TRENDS

Even more important than cross-sectional prevalence data are data showing trends, both as a likely predictor of later diseases and disability but also for planning purposes and as a likely model for countries in economic and epidemiologic transition, such as, e.g. Malaysia.

In one State school health

system in Australia, that of Tasmania, there is documented evidence of the school population getting heavier although it is unclear if factors like a lowering of the age of menarche have been taken into account (29).

As indicated above the level of obesity in Singaporean school children is now around 13%. This is an increase from the 8.8% figure in 1985 which in itself, was up from 5.4% in 1980 (33). Undernutrition has been described as fairly common in the early 1970s, it is now almost non-existent (32), with a steady increase in the prevalence rate of obesity over the years as can be seen in Figure 2 (32).

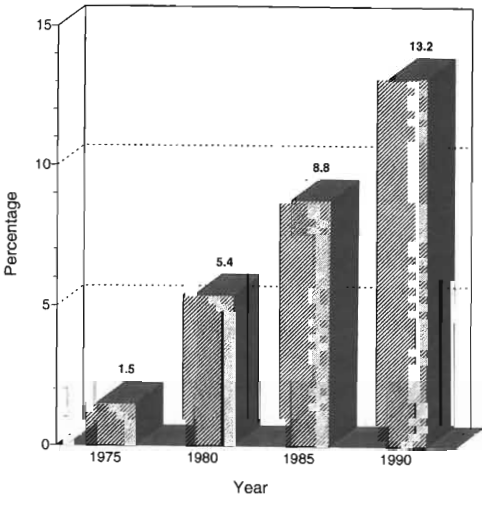

Figure 2. Childhood obesity in Singapore primary schoolchildren

Source: FAO/WHO Nutrition Profiles, 1983.

A Japanese study from Tateyama City in Chiba Prefecture of 8,000 schoolchildren claimed that its findings could be extrapolated nationally, to at least some degree. In this study, elementary school children (6-11 years old) and junior high school students (12-14 years old) were followed for 10 years starting in 1979. In 1979 the prevalence in the 6-11 year olds was approximately 6.3% in both boys and girls. The prevalence had increased by 1988 to 8.8% in girls but with the more prominent increase being in boys to 10.7% (17). Childhood obesity was defined as >120% of the obesity index that was used, one not dissimilar from body mass index. For the junior high school students, boys had a prevalence of 6.9% in 1979 and 9.4% in 1988 whereas in girls, perhaps reflecting fashion, the prevalence actually dropped from 8.5% to 8.2% (17). In the truly national sample of the Ministry of Education, there was a 12% increase in schoolchildren overweight between the relatively short period of 1981 to 1985 (31) and the Ministry of Education, Science and Culture has warned that the number of obese Japanese children is increasing every year.

An increase in the number of obese children has also been reported in the Philippines, a country with still a very significant degree of undernutrition, with the number of overweight preschool children tripling since the 1982 figure of approximately 4.2% (using Filipino standards, 34), although as can be seen in Figure 3, there was a dip in 1985 to 2.6%, almost certainly reflecting political and economic factors. Approximately 9.8 million Filipino children were overweight in 1992.

SIGNIFICANCE OF SUCH TRENDS

The National Institute of Health in the United States of America

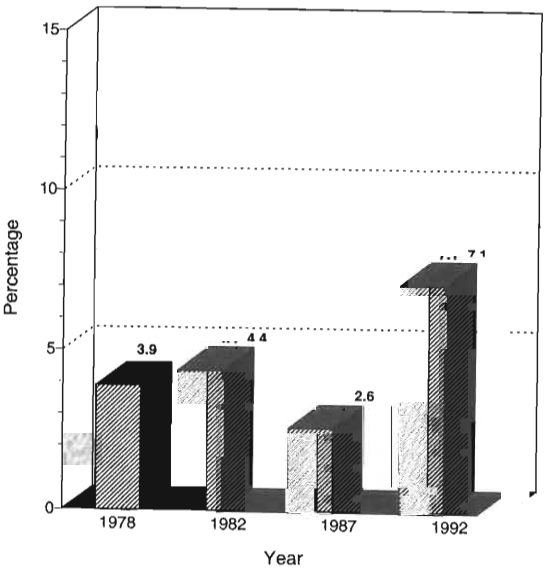

Figure 3. Childhood obesity in the Philippines pre-school children

Source: FAO/WHO Nutrition Profiles, 1993

convened one of its Consensus Development Panels which concluded that: "The evidence is now overwhelming that obesity, defined as excessive storage of energy in the form of fat, has adverse effects on health and longevity. Obesity is clearly associated with hypertension, hypercholesterolemia, non-insulin dependent diabetes mellitus, and excess of certain cancers and other medical problems" (35).

Health status during adulthood has been defined as the 'result of both an individual's growth and development as a child and the continuous influence of genetic, ecological, social, and cultural factors that affect survival and society's productive activity" (36). Never is this so apparent as in childhood obesity.

We saw earlier that there is a body of research now suggesting that health in adult life is conditioned ever earlier, even before birth. Malnutrition during gestation and infancy has been linked with an increased risk of noncommunicable diseases later in life e.g. poor foetal growth has been shown to be followed in later life by increased mortality from cardiovascular disease (37). It has also been plausibly suggested that susceptibility to both type I and type II diabtetes is determined antenatally in reponse to nutritional factors (38). Low birthweight and high BMI at age 36 were found in one study to be independently related to high blood pressure in adulthood but together only represented less than 17% attributable risk (39).

An interesting study looked at twins as a population with lower than average birth weight for reasons that are not a consequence of social disadvantage (40). They found that ischaemic heart disease mortality was not higher among twins. They did find however that the shorter twin was more likely to have died of heart disease than the taller. As this effect was observed within the monozygotic, as well as the dizygotic twins, they concluded that the frequently observed relation between height and ischaemic heart disease does not have a genetic basis (40).

Adolescent obesity has more severe longterm medical and psychological consequences than for almost any other childhood handicap, being particularly related to premature mortality in boys and lower socioeconomic status in girls. In a follow-up of the Harvard Growth Study parti-

cipants, it was found that men and women who had been overweight as teenagers also had a significant increase in the risk of coronary heart disease, diabetes and athersclerosis (41).

In a US Department of Labor longitudinal survey of more than 10,000 people aged 16-24, started in 1979, obese women had rates of household poverty about 10% higher than for the non-obese, and 20% of the obese women had not married. The differences persisted even when baseline characteristics (family income, parental education, chronic health condition, ethnicity and intellectual performance) were considered. Although low rates of education, reduced income or increased poverty can lead to obesity, it also seems likely that obesity is a major determinant of marital status, socioeconomic class and poverty. (41). In Singapore, it was found that the obese children had lower self-esteem and problems related to health, physical size, school performance (even when actual performance was not worse than others) and boy/girl relationships (24).

Reports from the Netherlands have shown that being overweight at age 18 years was associated with increased total and cardiovascular mortality in adult life (cited in 42). Nieto et al. similarly showed that adult mortality was predicted by childhood weight and growth rate and that the odds ratios of mortality increased linearly with prepubertal relative weight (42).

In the Japanese Tateyama City study cited above, obesity was found to be related to hypertension (SBP>130mm Hg) (18.8% in Elementary School and 14.2% in Junior High School), abnormal serum lipid levels and fatty liver. Waist to Hip circumference ratio (>0.9) was more often associated with fatty liver and higher insulin levels than lower type or gynaecoid obesity (17).

Blood pressure of obese adolescents is sensitive to dietary sodium intake and this sensitivity is thought to be due to the combined effects of the hyperinsulinaemia, hyperaldosteronism, and increased activity of the sympathetic nervous system that are characteristic of obesity (43). In studies in Australia, and elsewhere, blood pressure in children has been shown to increase with age and body size (44). A high proportion of children who are at the extreme end of the distribution for blood pressure, lipid levels and obesity, continue to exhibit these coronary risk factors as they grow (45).

Regional distribution of body fat in adult life is also related to foetal growth (4). It is now well recognized that distribution of fat stores is important in the development of chronic disease and that the android distribution is the more dangerous in terms of likelihood of development of both type II diabetes and cardiovascular disease. It has been observed that children with high concentrations of cholesterol fractions have more truncal and less peripheral fat than children with lower lipoprotein cholesterol concentrations (46).

Obese children have been shown to be more likely as adults to suffer from noncommunicable diseases,

and excessive overweight in puberty (>3SD) has particularly been associated with higher than expected morbidity and mortality in adult life (22). For example, in certain populations, obesity is much more likely to precipitate glucose intolerance in genetically susceptible individuals with a parental history of diabetes (1,47). As cited recently by Sjostrom in a comprehensive review of 40 studies, a curvilinear relationship is seen between BMI and mortality, with a BMI greater than 35 kg/m2 associated with an approximately twofold increase in total mortality, and in a several-fold increase in morbidity due to diabetes, cerebrovascular and cardio-vascular disease, and certain forms of cancer (48).

An area not covered here has been treatment. However it is well known that obesity is particularly refractory to treatment, although there are some encouraging indications that perhaps loss of weight is more effective and longer-lasting in children than in adults. It has been suggested that this may be partly related to a shorter history of habits that might lead to obesity and so may allow children to be more responsive to treatment (13). Another study showed a two-year maintenance of dietary changes and a sustained 12% lower weight than at baseline in an admittedly quite intensive intervention in obese children (49). Nevertheless, weight-reducing measures should be started early in life to improve the generally poor long-term prognosis for obese children. There is however a small but real danger of transporting yet another condition of the more affluent nations, that of eating disorders, as young women in particular strive, in the face of conflicting pressures, to achieve shapes neither culturally nor physiologically appropriate.

CONCLUSIONS

The available evidence suggests that childhood obesity and overweight is increasing in the countries of the Region. While genetic influences are clearly important, it must be the changing social, cultural and economic environments in which children are growing up that are responsible for most of the changing rates being observed.

As indicated above there are likely to be major public health consequences of these apparent trends if continued. The first is that there are likely to be more overweight and obese adults. In some countries of the Region e.g. the Federated States of Micronesia over 50% of women 40-49 years are obese, and 80% are overweight. Micronesian countries are known to be experiencing epidemics of type II diabetes e.g. 25.5% of people over 15 years of age in the Marshall Islands are diabetic. In a study from Minnesota, USA there was evidence of early obesity in Hmong migrant children born in the USA of parents from rural Laos, an ethnic group previously considered to be at low risk for obesity (50).

The rising prevalences in virtually all countries means that the levels of noncommunicable diseases in these same countries will also increase. This will have two effects. In countries that still have a major economic burden in preventing, controlling and

treating communicable diseases (both traditional infectious diseases of childhood and the emerging menaces of AIDS and the re-emergence of malaria), these countries will have the additional burden of the chronic diseases. Another possibility, as is happening in eastern Europe, is that the recent trends in improved life expectancies, largely due to a measure of control of the infectious diseases, will be negated by the premature mortality of middle-aged adults.

For all the reasons given above, prevention is more than usually important. Although individual weight reducing measures should be started early in life to improve the unfavourable long-term prognosis for obese children, a more wholistic health promotion approach will also be required. As indicated, although genetic influences are important, it is the social, cultural and economic environments that have changed and are therefore predominantly responsible for the current increasing levels of overweight and obese children. Therefore it is these factors that need to be addressed.

This will require an approach that includes school interventions, perhaps along the Singapore "Trim and Fit" school model; legislation related to labelling and imported foods (particularly in the Pacific) and to ensure appropriate advertising; as well as health education and the promotion of exercise. Although becoming a truism, in this area above many others, prevention is not only preferable to cure, but considerably more likely to be successful!

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Assessment and management of abdominal fatness

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ABSTRACT

Abdominal fatness is emerging as one of the key health issues in transitional societies. Recognising and diagnosing it are critical from public health and clinical points of view. Most simply this requires the measurement of abdominal circumference or of truncal skinfold thicknesses, usually in relation to hip or limb measurements. The WHO expert committee on anthropometry recommends that "abdominal" (midway between the lower bony landmarks of lower rib cage and superior iliac crest), rather than waist (with various meanings), be measured. But increasingly the components of abdominal fatness, subcutaneous, omental and retroperitoneal, will be of interest, presently only measurable by expensive technology like CT scanning or MRI scanning.

There are several possible reasons for the development of abdominal fatness. These include major predisposing factors, age, gender, genetic, short stature and positive energy balance; and various modulators of the expression of fat distribution, namely factors with hormonal like properties (directly or indirectly), both endogenous (sex hormones and glucocorticoids) and exogenous (eg. phytoestrogens, substances of abuse like those in alcoholic beverages and in cigarette smoking), trophic or antitrophic factors for visceral (omental) fat like fatty acid unsaturation (increased saturated, decreased omega-3 unsaturated), growth factors, and environmental residues or other fat soluble substances, and the regulation of metabolically active fat by the Autonomic Nervous System and factors affecting its activity (eg. in CNS) and thermic factors in food. They are worthy of consideration in assessment. Understanding the pathogenesis prepares the way for more effective management. The best evidence so far is for negative energy balance, by reduced intake (of fat especially) and/or of increased physical activity (even moderate in walking) to manage the problem. But as other determinants are better defined, other strategies will become more established. Dexfenfluramine, for example, reduces abdominal fatness, but may do so by reduced energy intake rather than a direct effect.

Success in this health area should reduce the prevalence and consequences of much non-communicable disease, but long-term clinical and community trials will be required to be certain.

HEALTH SIGNIFICANCE OF ABDOMINAL FATNESS

The health significances of total and abdominal fatness, although overlapping, are not the same (Table 1). In the case of cerebrovascular disease, total fatness is more adverse than is abdominal fatness *(1,5,6,13)*.

Table 1. Health significance of abdominal fatness

1. Cardiovascular disease (and risk factors
2. Diabetes
3. Neoplastic disease
– Breast ?
– Prostate ?
4. Cholelithiasis

In the case of coronary heart disease, abdominal fatness rather than total fatness is the fat which most accounts for the relationship. Several risk factors for vascular disease are determined by abdominal fatness - hypertension, dyslipidaemia affecting triglycerides (TG) and high density lipoprotein cholesterol (HDL-C) (increased TG, decreased HDLC), and hyperglycaemia.

The mechanical effects of abdominal fat and fat elsewhere are different. The ways in which fat affects the risk for neoplastic disease are worked out, but are probably complex and include tumour substrate effects, changed sex hormone profiles, fat storage of mutagens and omental fat as a regulator of hepatic metabolism *(14)*.

ABDOMINAL FAT COMPARTMENTS

Most studies of the health outcomes of abdominal fat have used anthropometric measurements to evaluate it, namely:

(a) truncal skinfolds or
(b) truncal circumferences
(absolute or relative to the hips)

The compartments of abdominal fat are broadly three (Table 2), each with potentially different metabolic and health consequences.

Table 2. Abdominal fat compartments

1. Subcutaneous	
2. Omental	}
(Intraperitoneal)	} Visceral
3. Retroperitoneal	}

The more direct measure of the several compartments of abdominal fat (Table 3) is bound to be of public health and clinical value. In the meantime, the WHO (World Health Organization) has recommended that the popular term "waist circumference", which has various meanings, be dropped in favour of one "abdominal circumference", midway between the lower rib cage and the superior iliac crest (Table 4). Its routine

measurement in clinical practice is both simple and essential whenever nutritional issues arise.

Table 3. Abdominal fatness assessment methods

1.	Anthropometry Skinfolds Circumferences Thicknesses
2.	Ultrasound
3.	CT
4.	MRI

Table 4. Abdominal fatness

Circumferences

(1) Narrowest Truncal (lay "waist")

(2) 12 cm below Xiphisternal Notch (NHF Australia)

(3) Umbilical

(4) At superior iliac crest (SIL)

(5) Midway between lower rib cage and SIL (WHO "Abdominal")

Absolute or relative to Hip Circumference.

PATHOGENESIS OF ABDOMINAL FATNESS

This is not fully understood at present, but the current hypotheses are summarized in Table 5 *(13,15)*. Some of these may arise as possible explanations during assessment on a patient-by-patient basis.

One of the most intriguing possible contributors to abdominal fatness is the cohort effect of those of short stature, through childhood nutritional deficiency and recurrent illness, later being exposed to food abundance (Table 6)*(13)*.

Table 5. Pathogenesis of abdominal fatness

A. Major predisposing factors
   1. Age
   2. Genetic
   3. Gender
   4. Short stature
   5. Positive energy balance

B. Modulators

   1. Factors with hormonal like properties (directly or indirectly)

   (1) endogenous
   - sex hormones
   - glucocorticoids

   (2) exogenous
   - phytoestrogens
   - substances of abuse (in alcoholic beverages, cigarette smoking)

   2. Trophic or antitrophic factors for omental fat

   (1) fatty acid unsaturation (increased saturated, decreased omega-3 unsaturated)

   (2) ? growth factors

   (3) ?? environmental residues or other fat soluble substances

   3. Regulation of metabolically active fat

   (1) Autonomic Nervous System and factors affecting its activity (eg. in CNS)

   (2) Thermic factors in food

Table 6. Stature and abdominal fatness: Relationship between stature and BMI and WHR in Melbourne Chinese

	BMI (kg/m^2)		Waist-to-hip ratio	
	Men (n = 268)	Women (n = 269)	Men (n - 268)	Women (n = 269)
Stature (cm)	–0.08	–0.09	–0.20***	–0.22***
Body weight (kg)	0.83****	0.86****	0.50****	0.43****

Hsu-Hage & Wahlqvist, 1994 *(4)*

MANAGEMENT OF ABDOMINAL FATNESS

As we learn more about pathogenesis, so opportunities for prevention and management become clearer (Table 7) *(2,15)*.

Table 7. Management of abdominal fatness

1. Negative Energy Balance
   (1) Reduced Intake (especially fat) *(3,12)*
   (2) Increased physical activity *(2)*
2. Food Factors *(13,15)* eg. hormonal-like
3. Hormone Replacement Therapy? *(8,9)*
4. Pharmacotherapy Dexfenfluramine *(7)*

Clinical trials in this field using appropriate body compositional technology are urgently required *(11)*.

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Dietary guidelines and personal care

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ABSTRACT

Most countries have Nutritional Guidelines as goals for public health nutrition. However, these guidelines should not be imposed uncritically upon individuals who seek help for nutrition-related problems. An example of a middle-aged man is given, to show that the lifestyle changes associated with meeting the guidelines may outweigh the expected benefits. Our role as nutritionists is to explain both the benefits and problems associated with dietary change so that the subject can make an informed choice that best suits his lifetime goals.

INTRODUCTION

Most countries have developed Nutritional Guidelines to help health and nutrition professionals modify the eating patterns of populations. However, these Guidelines have been designed for populations and when applied uncritically to individuals may cause disruption of lifestyle and pleasure with little or no gain in decreased risk of illness or in prolonged life. Those of us who give dietary advice to individuals should not parrot off the guidelines, but should examine carefully the advantages and disadvantages of each guideline to this person. In the process we may come to question the validity of some of the guidelines and make suggestions for change. To illustrate this, I shall take the example of a typical patient who came for nutritional advice.

The patient was a man who wanted to modify his diet so as to reduce the risk of disability or early death. He was 54 years old and had an executive job with little physical activity. He was 175 cm tall, weight was 95 Kg and his BMI 31. His blood pressure was 125/85, serum cholesterol 6.1 mMol/L and random blood glucose 7.2 mMol/L. His father had died at the age of 86 of carcimoma and his mother was aged 84 years and was physically fit. I looked at the Australian Nutritional Guidelines to see how they would apply to him. At present there are eight guidelines. They are:

1. Eat a wide variety of foods
2. Eat plenty of cereals, vegetables and fruits
3. *Eat a low fat diet, particularly low saturated fats*
4. *Maintain a healthy body weight*

by diet and exercise
5. Limit alcohol intake
6. *Eat only a moderate amount of sugar*
7. *Limit salt intake*
8. Encourage breast feeding

There is a very large literature on each of these guidelines, so I cannot examine it in detail. For the four guidelines I have highlighted, I shall give you facts from reputable sources that are generally agreed by experts in the field.

EAT A LOW FAT DIET PARTICULARLY SATURATED FATS

Fat and oil in the diet enhance taste; a very low fat diet is much less palatable and less interesting. The main reasons to reduce fat, and particularly saturated fat, are to maintain or lower weight and to reduce serum cholesterol. There is a large literature on the relation between serum cholesterol levels and mortality from heart disease. People with lower levels of serum cholesterol are less prone to heart attacks, but do not have a greatly lengthened lifespan. I have calculated (1) the expected lengthening of life if cardiac risk were lowered by reducing serum cholesterol, but other causes of death remained unchanged. If the serum cholesterol were lowered by 10%, then the risk of dying from heart disease in Australia would drop from 47% to 41%, but deaths from other causes would consequently rise. The average increase in life would be about one year. If the people with very high cholesterols dropped the level to lowest level, the proportion dying of heart attacks would drop from 62% to 33%, and the average lifespan would increase by about four years. Such change in serum cholesterol would involve major changes in diet and are probably not practical.

MAINTAIN A HEALTHY BODY WEIGHT WITH DIET AND EXERCISE

No-one would argue with this guideline but it can be difficult to define a healthy body weight and the effects of changing weight. Body Mass Index (weight in Kg divided by height in metres squared) is the usual measure of obesity. Based on international figures, the minimal mortality at any age is in people with BMI levels between 20 and 27, but the increase in mortality rate is slight until the BMI is over 35. Our subject has a BMI of 31 which is within the obese range. To bring his BMI to 28, which is within the "overweight" rather that the "obese" range would involve losing 5Kg in weight. The change in his overall annual mortality risk would go from about 20/1000 to 17/1000. This weight loss would therefore decrease the risk of death by about 3 chances in 1000 for each year (2). Some people may think the benefit not worth the effort. However, if there were other reasons to lose weight such as joint or mobility problems, then this course could be more strongly recommended.

EAT ONLY A MODERATE AMOUNT OF SUGAR

This guideline is a particular example of the first guideline, but

it is not clear why sugar has been separated out for special mention.

In 1986 the Sugar Task Force of the US Food and Drug Authority published its findings (3). The Task Force examined over 900 references in the world scientific literature and their conclusions were:

Evidence exists that sugars, as they are consumed in the average American diet contribute to dental caries.

Other than this there is no conclusive evidence on sugars that demonstrates a hazard to the general public when sugars are consumed in the current amounts and manner.

This represents the best scientific opinion at that time and suggests that the guideline on sugar should be dropped unless there is a special reason why that person should avoid sugars.

LIMIT SALT INTAKE

There is good evidence that at population level lowering salt intake can lower blood pressure. However, the evidence suggests that at least half the population can eat as much salt as they wish and still have a normal blood pressure, while the remainder of the population may have higher blood pressure which comes down when salt intake is reduced.

There is some argument about the actual size of the reduction, but analyses of the INTERSALT data (4) indicates that reducing sodium intake by 6 grammes (100 mMoles) a day will lower the blood pressure between 2 - 6 mmHg depending on the way the change is calculated (5). If we take the risk of stroke of a person with normal blood pressure to be 100%, then lowering the diastolic blood pressure by 3 mmHg would lower the risk of stroke by about 5%. However, lowering body weight and reduction of excessive alcohol intake can have a larger effect and may be more acceptable to the subject, while transcendental meditation has also been shown to be effective.

CONCLUSIONS

Apart from the guideline on sugar consumption, following the guidelines will produce some lowering of the risks of disease and early death. But do the benfits justify the measures that need to be taken?

When we give advice to people who seek our help we should be both honest and humble. Honesty means that when we tell the patient about the dietary measures that can be taken to improve health and longevity, we honestly and objectively explain both the benefits and the problems. We also tell him/her about non-dietary methods of reaching the same goal. Humility means that we should aim to advise the patient and not to direct him/her. Our role is to provide information so that the patient can make his/her own decisions. We must also exercise humility in the advice we give. Our knowledge is far from complete and is likely to change. We should acknowledge our ignorance and uncertainty.

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Gene/diet interactions: lessons from the assessment of hyperlipidaemia

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ASBTRACT

Many chronic diseases including coronary heart disease are the product of an interaction between genetic and environmental factors. For some risk factors such as hyperlipidaemia, the environmental influence of diet seems to predominate. Evidence now suggests that genetic variation is important in a number of ways. For example, major genetic abnormalities may over-ride environmental factors and some genetic polymorphisms may influence disease independent of risk factor levels. From the nutritional point of view, an increasing component of the interindividual variation in response to diet can be attributed to specific genetic effects.

The effect of the apolipoprotein E (apo E) gene on plasma lipoprotein response to diet provides some of the clearest evidence of this interaction. Apo E not only accounts for about 7% of the interindividual variation in total cholesterol, but also appears to explain interindividual differences in cholesterol response to dietary fat and weight gain.

The issue of gene/diet interactions is very important in countries where diet patterns are changing rapidly. Gene inheritance means that there is likely to be a family history in susceptible pedigrees when the diet is stable. If the diet is changing, family history may no longer provide a warning.

INTRODUCTION

Many chronic diseases, including coronary heart disease (CHD), are the product of an interaction between genetic factors and the environment. For some risk factors such as hyperlipidaemia, the dietary component of the environment is critical because it sets the platform which determines the prevalence of CHD in the population. However the individual risk of CHD is determined by the interaction between personal genetic and dietary factors.

The process is best understood by consideration of the factors

which affect the atherosclerotic process which underlies CHD. The "measured genome" approach uses techniques such as polymerase chain reaction (PCR) and restriction fragment length polymorphism (RFLP) to study gene structure directly. This permits the assessment of the interaction between genetic and dietary factors in the determination of levels of risk factor traits or disease.

Some gene / diet interactions do not require special laboratory techniques because the genetic differences are obvious. The differences between X and Y chromosome are reflected in the response to dietary fat and cholesterol. Clifton and others have demonstrated a significantly greater increase in high density lipoprotein cholesterol (HDL) during increased fat and cholesterol intake.

GENE MUTATION

Major genetic effects are evident when gene mutation affects important metabolic processes. Familial Hypercholesterolaemia (FH), which usually involves mutation of the low density lipoprotein (LDL) receptor, is an example in which the genetic component seems to overwhelm the dietary component. Although these patients usually remain hypercholesterolaemic on a cholesterol-lowering diet, evidence will be presented which suggests that gene / gene and gene / diet factors remain important in the expression of clinical CHD.

GENETICALLY DETERMINED ISOFORMS

Some variations in gene sequence result in structurally different gene products which are known as isoforms. The isoforms are capable of performing their metabolic function, but their activities may vary. These subtle differences may affect risk factor traits or disease processes such as CHD. Isoforms of apolipoprotein E (apo E) and apolipoprotein (a) (apo (a)), provide examples of this phenomenon. Apo E has been implicated in nerve cell repair and removal of cholesterol from peripheral cells. It is also responsible for the recognition and removal of dietary and other lipoprotein particles by receptors in the liver. Three isoforms (E2, E3 and E4) are commonly found, resulting in 6 common phenotypes which differ in their affinity for the hepatic receptor. It is therefore possible that variation in apo E genotype may interact with dietary factors and influence lipoprotein metabolism. The E2/E2 genotype can precipitate severe lipid abnormalities in the presence of other disturbances of lipid metabolism such as diabetes. Sophisticated statistical techniques now suggest that more subtle interactions between apo E genotype and diet may occur. The increase in triglyceride (TG) which accompanies weight gain seems more marked in E4 individuals. Likewise, the negative relationship between HDL and abdominal adiposity seems less marked in E2 subjects (1). More importantly, the LDL cholesterol response to dietary fat and cholesterol seems more marked in association with the E4 isoform (2,3,4). This may be due to an increased absorption of dietary

cholesterol (5).

Apo (a), which has features in common with plasminogen, is an independent risk factor for CHD. Plasma levels vary according to the molecular weight of the apo (a) isoform, which is under genetic control. The LDL receptor defect in FH amplifies the genetic difference in apo (a) level. This provides an example of a gene / gene interaction which may strongly affect the risk of CHD. Although there are some reports that trans fatty acids may increase apo (a) levels, there is little evidence to suggest that diet has any chronic effect on apo (a) levels. Dietary fat intake does not affect apo (a) levels, however we have demonstrated that it has a significant effect on the distribution of apo (a) between lipoprotein fractions (6). one of the most elegant demonstrations of the atherogenicity of apo (a) involved a transgenic mouse model, however the increase in the atherosclerotic process in mice which had received the apo (a) gene was only evident when they received a high fat diet (7). We recently discovered that the change in apo (a) distribution following dietary fat is due to the interaction between the apo (a) phenotype and the extent of the postprandial triglyceride rise. It remains to be seen whether or not this process affects atherosclerosis or CHD.

MARKER GENES

When a gene locus can be identified, its association with diseases or risk factor levels can be studied. It may show associations, not because it has a direct effect of its own, but rather because it lies close to another gene locus which does have such an effect. The strength of the association is proportional to the proximity of this so-called marker gene and the magnitude of the effect of the causal gene.

The apolipoprotein B100 (apo B) gene is essential to the structure of most lipoproteins. One causal gene locus is responsible for a clinical condition which resembles FH. Other causal loci are yet to be discovered, but associations have been demonstrated for marker genes which can be easily detected by RFLP and PCR. Apo B RNA is truncated in intestinal cells, so it is difficult to know whether apo B marker genes will be useful in the assessment of response to diet. In the North Karelia study, subjects with the X2 pattern for the Xba1 RFLP showed a significantly greater response to a low fat diet (8). Unfortunately it has been notoriously difficult to reproduce findings from small studies using marker gene associations, and Abbey was unable to confirm this finding. Instead, that study showed a greater response in subjects with an E- pattern for the EcoR1 RFLP (9).

PUBLIC HEALTH ISSUES

The interaction between diet and genetic factors is of major importance in populations where dietary practices are changing. In countries where dietary saturated fat consumption has been excessive, a decrease in fat intake should improve the cardiovascular status of large numbers of subjects who carry genetic traits which increase their sensitivity to dietary fat. It may even delay or avoid the

onset of CHD in some patients with genetic mutations which adversely affect CHD risk. Ideally, avoidance of excess dietary fat intake should restrict hypercholesterolaemia to a small section of the population in whom more severe genetic predisposition is present.

In countries where dietary saturated fat intake is tending to increase, several issues may arise. Genetically determined hypercholesterolaemia and CHD may start to emerge, but this may occur in the absence of a family history. Different risk factor and CHD patterns may arise due to a different gene pool and its interaction with different environmental factors. Routine risk factor measurements should be sufficient to identify high risk individuals if dietary fat intake increases, however the genetic techniques described here may help to anticipate the population's sensitivity to different aspects of dietary change.

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Trans fatty acids: nutritional significance in the diet

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ABSTRACT

In order to formulate margarines, shortenings, bakery and frying fats, conversion of liquid oils to a semi-solid form is necessary through the process called hydrogenation. The nett effect of hydrogenation is the increase in the saturation of fatty acids and the formation of unnatural modified oils and trans fatty acids. Recent clinical and epidemiological studies have linked increase cardiovascular risks and impairment of human development to high trans fatty acid intake. Trans fatty acids increase serum total and LDL cholesterol and decrease the HDL cholesterol. Lipoprotein (a), a potent indicator of CHD risks is also elevated by trans fatty acids. Trans fatty acids have also been shown to interfere in essential fatty acids metabolism and affect perinatal development. Result of a survey of processed foods in Malaysia containing hydrogenated fats and hence, trans fatty acids is presented. An alternative to hydrogenation of food products is also discussed.

INTRODUCTION

Food scientists and nutritionists sometimes come into conflict when discussing edible oils and fats. On one hand, the food scientists look at functionality while on the other, there is concern for nutrition. An example is in the case of highly unsaturated vegetable oils.

As consumers become more concerned with their intake of saturated fats and cholesterol, the use of vegetable oils to replace animal fat in food formulations have increased. The world consumption index for animal fats have not increased as much as in the case of vegetable oils. Unsaturated vegetable oils are thought to be the healthier choice to use in food manufacturing.

HYDROGENATION

Highly unsaturated vegetable oils (soybean, canola, cottonseed and sunflower) pose a problem to food manufacturers. They are unsuitable for many food uses mainly because of two reasons. Highly unsaturated vegetable oils have low melting points and remain liquid at room temperature while in many food applications, solid fats are required. For instance, in the manufacture of

margarines, shortenings, baking and confectionary fats. Secondly, some of these oils contain a high level of linolenic acids which are susceptible to oxidative deterioration and this leads to rapid rancidity of the oil. Thus these oils have poor functionality and shelf-life.

In order to increase the stability of such oils, the process of hydrogenation is applied whereby hydrogen is added to the unsaturated double bonds to produce saturated fatty acids with higher melting points. This will extend the food applications of the oils.

While hydrogenation provides a solution to the food manufacturers' problems, there is now concern over the possible adverse nutritional effect of hydrogenated fats.

In reality, the hydrogenation process is much more complex because the reaction is seldom carried out to completion which will produce very hard solids with limited applications. More commonly, hydrogenation is only partial, ensuring a product with the desired solid contents and plasticity.

With partial hydrogenation, two events occur. First, saturation of double bonds occur and second, many isomeric fatty acids are formed. In oils, double bonds in the fatty acids are naturally in the cis configuration. During hydrogenation many of these are converted into the trans isomers. In addition to cis-trans isomerization, the double bonds may move along the fatty acid chain in both directions and form a whole series of "unnatural" fatty acids in a hydrogenated fat. For example when soybean oil is being hydrogenated, there is tremendous reduction in the polyunsaturated fatty acids and in replacement, there is an increase in the saturated fatty acids, and the formation of trans fatty acids and modified cis fatty acids which make up 53.3% of the uncommon fatty acids in the oil. About 70% of soybean oil in the U.S.A is hydrogenated.

TRANS FATTY ACIDS

Rising incomes and urbanisation have brought in their wake a transformation in the food consumption patterns of developed and many developing countries, an increasing trend of consuming fast foods and processed wheat, dairy and meat products. The main consequences of such trends are decreasing intakes of fibre while there is increased intake of saturated fatty acids and cholesterol. Currently the concern in the dietary fats issue in the Western nations is for trans fatty acids.

Trans fatty acids are primarily found in the food supply as a result of commercial hydrogenation of vegetable oils. Emken(6) estimated that in the American diet 90-95 % of isomeric trans fatty acids came from hydrogenated fats in the form of margarine, shortening and frying fats in various processed foods that contain these fats.

A secondary source of trans fatty acids is from biohydrogenation, which occurs in ruminant animals as a result of bacterial fermentation in the

rumen. Thus dairy products and other foods of animal origin contain small amounts of trans fatty acids.

NUTRITIONAL SIGNIFICANCE

Trans fatty acid intake has been related to several biological effects from a nutritional point of view. The loss of essential fatty acids due to the saturation process that occurs in hydrogenation may be particularly important.

CHD risks

The health effects of trans fatty acids had been reported from as early as the 1960's. Anderson (1) compared the effects of native and hydrogenated oils similar in their proportions of SFA's, MUFA's and PUFA's but varying in their amounts of trans isomers. The oils with higher proportions of trans fatty acids produced higher serum levels of cholesterol and triglycerides than the native oils. However, in another experiment McOsker(14) reported no difference in serum cholesterol concentrations in 6 subjects fed hydrogenated oils containing 15-20% trans fatty acids. Following this a series of experiments done by various researchers (8,13,17) found no significant effects of trans isomers on cholesterol levels.

Two professional committees have reviewed the evidences on trans fatty acids (FASEB 1985 & British Nutrition Foundation 1987). The important conclusions were that there were no clear cut evidences of harmful effects at the levels taken in the U.S.A (10g/day) and in the U.K. (7g/day), provided the amount of essential fatty acids were adequate.

However in the 1990's new data appeared in the literature linking trans fatty acids with increased blood cholesterol. Trans fatty acids was found to not only increase total blood cholesterol levels in human studies but also increased the LDL and reduced the HDL (15,18,24). There were also studies which showed that trans fatty acids increased Lp(a) levels - the potent and independant risk indicator of CHD (16,18).

Mensink & Katan (15) experimented with a diet containing 10% of energy as trans fatty acids and this was criticized to be higher than the normal intake in the diet. Subsequently, Nestel(18) & Zock (24) based their studies on an intake of 7% of energy. Judd and co-workers (unpublished) conducted a controlled clinical study in USDA and compared diets with high trans (6.6% of energy or 20g/day) and moderate trans (3.8% of energy or 10g/day). The results of the study indicated that trans fatty acids raise serum cholesterol intermediate to oleic acid and certain saturated fatty acids (myristic, lauric & palmitic). LDL cholesterol increased 6.0% on moderate trans diet and 7.8% on high trans diet and 9% on the saturated fat diet. HDL cholesterol levels did not change after oleic and moderate trans diet but was slightly lower after high trans diet. The authors concluded overall that trans fatty acids are directionally similar to saturates in raising blood cholesterol; however they do not appear to be as cholesterolemic as the saturated fatty acids.

The link between trans fatty acids and CHD was strenghtened

by epidemiological studies. A study by Troisi (22) showed a link between trans fatty acid intake and CVD and reported that trans was directly related to serum cholesterol and LDL levels and inversely related to HDL levels. Willet (23) reported in the Lancet that trans fatty acids increased the risk of CHD in 85 095 nurses independant of the saturated fat intake in the diet. However Applewhite(2) cautioned that Willet used a semi-quantitative food frequency questionaire to assess the dietary intake and may not show a direct causal link between trans fatty acids and CHD.

In spite of the conflicting data, there was a general consensus by various review committees that trans fatty acids intake should be monitored and further research in this area is needed.

Human development

The concern for trans fatty acids was not only confined to CVD risks but also the effects on fetal development. At the recent International Society for the Study of Fatty Acids and Lipids (ISSFAL) congress in Lugano (1993), data presented demonstrated that high prenatal exposure to trans isomeric fatty acids is linked to poor availability of long chain polyunsaturated fatty acids and lower birthweight in human infants. Houwelingen (11) reported that trans fatty acids can be transfered through human placenta and cause untoward effects on the infant. Trans fatty acids exposure in early life may lead to an undesirable increase of Lp(a) and LDL cholesterol as seen in adults. The degree of intra uterine trans fatty acids exposure was expected to depend on maternal trans fatty acids consumption. The amount of trans fatty acids in the human milk was found to be in proportion with the maternal diet.

Animal studies indicate that in the presence of essential fatty acids deficiency, trans fatty acids can aggravate the condition since EFA activity is strictly confined to the cis-isomers of linoleic and linolenic fatty acids.

These results question the safety of a high dietary supply in the perinatal period, especially among the Western countries where intakes of processed foods are high. A regulation has been proposed for the European Community to restrict the maximum content of trans fatty acids in infant formulas to no more than 4% of total fat.

TRANS FATTY ACIDS INTAKE

In view of the possible detrimental effects of trans fatty acids to health, certain Western countries have begun to look into their populations' dietary intake of trans as well as the trans acid content of their food supply.

Slover(21), Emken(6), Enig(7), Litin & Sacks(12) have reported the trans fatty acids content of various food products. In the U.S., Enig suggested that about 70% of the vegetable oils used in a wide range of processed foods and fried foods are hydrogenated or partially hydrogenated. Trans fatty acids were found in breakfast cereals, baby foods, french fries, hard margarine, doughnuts, pastries, biscuits, breads, etc. Litin and

Sacks(12) reported that the trans intake among Americans can be quite high and easily achieved above 10 g/day. They demonstrated that the intake of trans fatty acids in the U.S. can be high enough to have a detrimental effect on the dietary treatment of hypercholesterolemia. The Centre for Science in the Public Interest (CSPI) in the U.S. held a press conference recently (in December 1993) urging fast food restaurants in the U.S. to switch from hydrogenated vegetable shortenings to 100 per cent vegetable oil when preparing foods such as french fries. CSPI had also approached the FDA to change food labelling rules to include trans fatty acids as saturated fats.

In the U.K.(5), the main sources of trans fatty acids were margarines, spreads, pies, pastries and biscuits. The oils hydrogenated were fish oils as well as vegetable oils. The average intake among the population was estimated at about 7g/day.

In Canada (19), trans fatty acids intake was estimated at 9.6 g/day while in Spain(4) and Japan it was estimated to be much lower at around 2 g/day due to low intake of margarines.

In the Eastern countries, assessment of trans fatty acids intake is scarce mainly because of the lack of data in food composition tables. However, trans fatty acids intake in Malaysia is not expected to be high nor pose any negative health effects to Malaysians for two major reasons. One, our total fat intake of about 40 g/day (25% of total energy) is not as high as the Western countries where fat intake is about 100 g/day. Secondly, 95% of the cooking oils and margarines consumed are palm oil. Palm oil need not be hydrogenated to be used in food formulations as it is naturally in the semi-solid form. However, PORIM(25) has analyzed the trans fatty acids content of some samples of margarine available in the local market as well as imported ones. Local margarines contain significantly lower content of trans fatty acids, within the range of 0.7 - 2.1 %. The low trans margarines are all made from palm oil and palm kernel oil. When compared with figures from margarines in U.S.A. made mostly from polyunsaturated vegetable oils, there is a higher percentage of trans fatty acids content, around the range of 12 - 24%. Other data on trans fatty acid content of margarines showed an even higher content of trans. Due to this high content of trans, the food legislation authorities in Western countries have been urged to label trans fatty acid content in food products.

While intake of trans may be relatively low in Malaysia and poses no health risks, intake of trans in certain countries such as Pakistan, India & Iran using vanaspati or vegetable ghee may be high. Vanaspati, a shortening based on hydrogenated vegetable oil, is the major cooking fat used in these countries and it contains about 27% trans acids and over 50% in India & Iran(3).

ALTERNATIVE TO HYDROGENATION

The evidences on the negative health effects of trans fatty acids may not be conclusive however the loss of essential fatty acids and the

biological activity of poly-unsaturates may still be important nutritionally. Is there an alternative to hydrogenation? Can manufacturers formulate food products with zero trans?

The answer lies in using products which are naturally hard or semi-solid. The alternatives are palm oil, milk fat, tallow and lard. Out of these, palm oil is the only product which is of vegetable origin, cholesterol-free and does not adversely effect the serum lipoprotein and blood cholesterol profiles. Moreover, there is now some evidence that not all saturated fatty acids affect blood cholesterol in the same way and palmitic acid, which is the major saturated fatty acid in palm oil, has been found to be less hypercholesterolemic than myristic acids (10).

In Malaysia and certain other countries, margarine, shortenings, bakery fats and confectionary fats are made from palm oil, hence the low trans fatty acid content. There exists high optimism that palm oil may be increasingly used in food product formulations to provide a healthier alternative to hydrogenated fats.

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Cardiovascular disease prevention: knowledge, attitude and practices regarding cholesterol among general practitioners in Kuala Lumpur

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ABSTRACT

Many epidemiological and clinical studies have established high serum cholesterol levels as among the major risk factors for coronary heart disease in man. Since 1990 efforts by the Ministry of Health have been underway to educate the public regarding the prevention of coronary heart disease through cholesterol lowering. The growing public interest will place considerable demands on general practitioners who can help by screening these people, educating them about diet therapy and treating those with elevated cholesterol levels. This paper reports the results of a study carried out by the IMR to assess the knowledge, attitude and practices regarding serum cholesterol levels among general practitioners in Kuala Lumpur. A total of 320 doctors were contacted and given questionnaires. The response rate however was only 37%. Generally, there appears to be a heightened awareness of appropriate actions, such as diet therapy, needed to control high serum cholesterol levels, and nutrition facts. Few doctors however reported enlisting the help of dietitians for dietary counseling of their patients. 80% of doctors also reported knowing their own cholesterol levels while about 15% admitted having made dietary modifications to lower their serum cholesterol levels. Results of this study could be used as a baseline to observe trends in behaviour modification of doctors in the management of high serum cholesterol levels.

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Possible mechanisms in micronutrient chemoprevention of oral carcinoma: considerations in methodology for investigation

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ABSTRACT

Oral cancer is one of the ten most frequent cancers worldwide. Three quarters of cases arise in developing countries where it is the third most common form of cancer after that of stomach and cervix. In developed countries it ranks 8th. In France, however, it is the third most frequent form of cancer in men (after lung and prostate) and second commonest form of cancer death (after lung).

Food constituents that have a role in cancer aetiology and prevention has been under investigation for some time now. The reason for an interest in nutrition is that it is vulnerable to change, thus understanding relationships between dietary constituents and cancer offer scope for prevention and treatment.

This paper presents a hypothesis on the mechanism of cancer prevention by antioxidants and describes a methodology for the investigation of biochemical markers of antioxidant status. Patients with leukoplakia and precancerous lesions of the oral mucosa are identified. Upon pathological confirmation and classification, subjects for the study are selected. Data on history (including family history), dietary intake and practices will be collected. Patients will be stratified according to stage of disease prior to random assignment to receive vitamin A or E or both. Blood will be collected for the determination of selected biochemical markers of antioxidant status that are related to diet and known to have a role in tumor pathogenesis. Follow up examinations will be carried out to study the effects of antioxidant vitamins A and E on the progression of oral leukoplakia.

INTRODUCTION

Cancer is a major health problem in Malaysia today. There are more cases of death certified due to cancer than any other disease - complex, apart from cardiovascular diseases. Oral cancer is one of the ten most frequent cancers worldwide. Three quarters of cases arise in developing countries where it is the third most common form of cancer after that of stomach and cervix. In developed countries it ranks 8th. In France however, it is the third most frequent form of cancer in men (after lung and prostrate) and second commonest form of cancer death (after lung)(1).

In Malaysia the change in population structure has contributed to the increase in incidence of cancer. The other perhaps more important reason is a change in diet and lifestyle.It has been estimated that 80-90% of human cancers are caused by environmental factors (2), and that in the U.S. appropriate dietary changes might reduce cancer deaths by as much as 35%. For cancers of the oral cavity and pharynx, the preventable proportion is estimated to be 60-90% (3).

Interest in the role of diet in cancer started in the late 1960's mainly from epidemiologic studies of migrant population. These studies showed that cancer incidence in a population was not solely a function of genetic constitution since migrant population had incidences that resemble host countries. This was found to be the case for cancers of the gastrointestinal tract and endocrine related cancers such as breast, ovary, uterus and prostate. Food constituents that have a role in induction, promotion and growth has been under investigation for some time now. The reason for an interest in nutrition is that it is vulnerable to change, thus understanding relationships between dietary constituents and cancer offers scope for prevention and treatment.

Chemoprevention is the utilization of defined chemicals, such as pro vitamins (beta-carotene), vitamins (A, C and E), synthetic analogues, or other substance (eg trace metal selenium), for the purpose of reducing cancer incidence. Cancer prevention has been defined as *applied research* to *systematically* test or introduce a specific *intervention* aimed at having a measurable impact on an important cancer problem (4).

ASSOCIATION BETWEEN CANCER AND NUTRITION

The association between vitamin A and cancer was first suggested in the 1920s when it was shown that a diet deficient in vitamin A might be the cause of stomach cancer in rats (5). A subsequent study found that the stomach condition was in fact a precancerous lesion rather than true cancer. From this the link between vitamin A and the development of cancer was established (6). Epidemiologic data support this link. About 20 studies in various parts of the world have shown that there is an inverse association between eating foods containing vitamin A or beta carotene and various types of

human cancer, the risk being reduced by 30-50%. From a number of retrospective dietary studies of vitamin A and cancer risk it was found that significantly increased cancer risk was associated with decreasing vitamin A intake (7). It was speculated that vitamin A might be protective against cancer in such organs as mouth, esophagus, larynx, breast and uterine cervix.

A case control study found that lower levels of beta carotene have been found in patients with cancers of lung, esophagus, stomach small intestine, cervix and uterus. Patients with cancers of breast, colon, prostate and skin however did not have low levels of beta carotene. The same findings have been seen in relatives of patients (8).

ORAL CANCER AND NUTRITION

From a population based case control study of oral and oropharyngeal cancers in the U.S. the major finding was an inverse relationship between fruit intake and risk of cancer (9).

A study of diet and cancer of the mouth has shown differences in intake between women with cancer and those without (10). The protective effect seen for high consumption of fruit and vegetables is consistent with recent findings associating high intake of vitamins A and C with reduced risk of oral and throat cancers (11).

Low Plasma retinol levels have been found in patients with oral cancer (12) but it has been argued that this could be due to low intake as a result of the cancer (13). However low concentrations were also found in leukoplakia (14).

In clinical trials Stitch et al. (15) studied preneoplastic lesions and found that both micronuclei and DNA adducts decrease with beta carotene (180 mg/week) and vitamin A (200,000 IU) administered for 6 months. The remission was longer if beta carotene and vitamin A were administered together. Retinoids such as 13-cis-retinoic acid (isotretinoin) have been shown to suppress leukoplakia (16) and inhibit the development of oral carcinoma (17).

CARCINOGENESIS AND DIET

Cancer describes a large group of diseases characterized by uncontrolled growth and spread of abnormal tissue. Arising in different organs, they differ markedly in growth and spread. There are different extrinsic causes and this is seen in the different clinical presentations, varying in age, sex, occupation and racial incidence. Neoplastic change may be brought about by different mechanisms. Although the cellular processes of a malignant cell has been well described in terms of what and how it occurs, the reason why a cell becomes malignant is still unknown.

The one common feature is that there is disordered cell division and maturation, the cells usually are arrested at a certain stage or may produce abnormal proteins. This being the case it is therefore not surprising that neoplastic change occurs commonly in cells

which are rapidly dividing such as those in the hemopoietic system, growing ends of bone, mucosa and skin.

During growth, cell proliferation or division occurs from a pool of constantly dividing cells. There are many complex models but in the basic scheme, the stem cell compartment supplies new cells. They also undergo self renewal so that the stem cell pool does not expire. The cells that do go into the differentiating pathway (transitional cells) have a definite proliferative ability. The variation in characteristics as they differentiate produce different tissues. In the oral mucosa, this stem cell compartment is found in the basal layer of cells. These newly produced cells undergo differentiation during maturation and in the process the older cells are brought up to the surface. There is rapid cell turnover.

The whole process is dictated precisely by factors intrinsic to the cell and extrinsic by the environment around the cell. Intrinsic factors include inherent genetic information within the cell. Extrinsic factors act by virtue of its influence of microenvironment. This is mediated by cell to cell contact, chemical and perhaps electrical signals. This micro-environment is thus subject to changes and disruptions which may or may not be pathological in origin. Heat, radiation, trauma, infection and aging processes can alter the microenvironment. Dietary factors play an important role because they maintain the body in a state able to carry out normal growth and repair. Alcohol and tobacco on the other hand interfere with these processes. In fact they are carcinogenic.

It is now well known that transformation of normal tissue into malignant tumor is a multistage process. There are many stages of carcinogenesis which include carcinogen metabolism, initiation and promotion, tumor cell progression, tumor growth and development and each stage may be affected by diet (18). Initiation involves a change in DNA, usually as a result of covalent reaction of carcinogens with DNA. The reaction is rapid, dose related and can occur after a single exposure to the initiating compound. Promotion can occur in stages and is initially reversible and requires prolonged exposure. Promoters do not cause tumor in normal cells unless DNA of the cell has been previously damaged. Promotion involves changes at the cell membrane and promoters activate enzyme systems which activate the hitherto latent but initiated tumor producing properties (13). Diet, which may influence all stages, may influence the carcinogenesis by various mechanisms.

ALTERATION IN ENZYME SYSTEMS

Dietary factors affect carcinogenicity of foreign compounds by interfering with conversion of pro-carcinogens to ultimate carcinogens. The increase in activating enzymes such as oxidative chemicals could result in metabolic susceptibility to cancer because these enzymes can activate environmental carcinogens to form highly reactive electrophilic intermediates which can damage molecules and disrupt cellular function.

Various enzyme systems such as Aryl Hydrocarbon Hydrolase (AHH), UDP Glucoronyl conjugations (UDPGT) and Glutathione-S-transferase (GSHT) participate in the conjugation of electrophilic intermediates. UDPGT is found in the endoplasmic reticulum whereas GSHT is found in the cell cytoplasm.These enzymes serve as an effective inactivating and detoxifying system. These liver enzymes are affected by the state of nutrition. The availability of co-factors is also dependent on nutritional stress. Thus starvation and protein deficiency may reduce rate of conjugation because they lower the availability of these enzymes. Inadequate supply of co-factors on the other hand limit the rate of reaction (19).

ALTERATION OF MEMBRANE STRUCTURE AND FUNCTION

Dietary fatty acid modification produces profound changes in membrane phospholipid fatty acids. Increased membrane content of polyunsaturated fatty acids have been associated with increased membrane fluidity (20) and increased cell division (21). Cells derived from proliferating mammary tumors have a higher linoleate content than do normal cells (22). However to date there is no direct evidence of altered membrane fluidity in tumors of animals fed on modified fat diets. The role of dietary fat in the tumorgenesis of breast cancer is at this stage uncertain. One can postulate however that any alteration in membrane structure and function can affect the cell physiology.

ALTERATION OF ANTIOXIDANT STATUS

Free radicals can damage cells. Free radicals and non-radical species are continually being formed in human tissues. These are mopped up or safely sequestered by antioxidants. The defense system is composed of naturally occurring and synthetic antioxidants which may enter the body orally or from foodstuffs or through the skin from cosmetics. They have an important role in the cell and plasma. Natural occurring antioxidants include phenolic compounds such as gallic and chlorogenic acids, the carotenoids, vitamins E and C and the mineral selenium. Antioxidants in plasma include uric acid, reduced glutathione, and enzyme antioxidants such as catalase, superoxide dismutase and glutathione peroxidase.

Free radical attack is probably the initial damage in the process of malignant transformation (23). This occurs initially at the cell membrane. Agents or compounds that act as promoters can generate free radicals (24). Normal biological processes can also generate free radicals. Unsaturated fatty acids because of their double bonds are particularly vulnerable to attack by free radicals to form lipoperoxides. These are active compounds which act on many cellular compounds. They produce cross-links with protein (25), and damage cell membranes (26) and damage DNA (24). Other molecules subject to peroxidation damage are prostaglandins and leukotrienes, derivatives of arachidonic acid, which play a major role in cell growth and differentiation (27).

Antioxidants, particularly vitamin A and retinoids and free radical scavengers could therefore play an important role in maintaining epithelial cells in a state of normal differentiation. This is suggested by the finding that patients with untreated cancer of the oral cavity and oropharynx have low erythrocyte selenium values (28).

In a chemoprevention study, Lasnitzki in 1955 (29) developed a method for growing mouse prostate cells on a glass and then transforming these cells to cancer by adding a carcinogen (methylchloranthene). She showed that the transformation can be prevented by adding vitamin A. Other researches have shown that retinoic acid inhibits development of bladder tumors (30), mammary tumors (31) and skin cancer in mice (32). It must be noted however that animal studies have shown that the effectiveness of chemopreventive agents varies depending on the animal studied, dose, site of cancer and carcinogen. Because of this and the limitations in technique available in studying mechanisms especially in vivo, absolute proof can only be derived from clinical trials in selected `at risk' groups.

ALTERATION IN BIOCHEMISTRY

Although the antioxidant mechanism has received much attention, there are other mechanisms by which dietary constituents affect carcinogenesis. Vitamin E and C appear to prevent formation of nitrosamines which are potential carcinogens resulting from metabolic reactions in the digestive tract for example from nitrites such as sodium nitrite added to meat for color and used in flavors. Nitrogen oxides derived from `smoking' processes are reduced to nitrites in the body. Other processes such as fermentation, pickling and brewing also produce nitrites. Vitamins C and E alter biochemical reactions because they compete with amine or amide for the nitrosating agents, thus blocking the formation of nitrosamines and nitrosamides. The oral cavity being the first receptacle for food is subject to `undiluted' procarcinogens and carcinogens. This would explain higher incidence of oral and throat cancers in communities taking foodstuffs with high carcinogenic properties and a diet lacking in fruit and vegetables. It is therefore possible that patients with oral and the upper gastrointestinal tract cancers would benefit most from chemoprevention with vitamin A, C and E.

ALTERATION OF GENETIC EXPRESSION

The anti-cancer properties of Vitamin A has been attributed to the action as a steroid hormone which reinforces normal phenotype and consequent suppression of tumor cell phenotype (33). Retinoic acid has been shown to promote differentiation of neuroblastoma cell lines (34). Beta-carotene is known for its antioxidant properties. Alpha-carotene on the other hand has been shown to act by inhibiting growth of neuroblastoma. This it does by suppression of N-mycin messenger RNA of the tumor cell and cells were arrested in Go-G1 phase (35). If dietary factors can act directly at cellular level, then chemo-

prevention of oral cancer may be by such mechanism, the leukoplakia representing a stage of arrested progression of a neoplastic lesion. If this is the case then chemoprevention of oral cancer by treating leukoplakia could be only a temporary phenomenon. The oral mucosa cell which had been initiated is merely waiting to express tumor phenotype under the `right' conditions which promote cancer.

The various mechanisms are unlikely to be independent, though in experimental studies they have often been studied as such. Micronutrients act synergetically. Vitamin E for instance is postulated to potentiate the action of selenium by providing a more favorable climate against chemical stress (36). Nutritional factors also influence energy expenditure, immune status and endocrine functions. These interactions are unfortunately not yet fully understood.

BIOLOGICAL MARKERS OF NUTRITION

In investigating the mechanism of carcinogenesis there are several markers that provide useful information for investigating the relationship between diet and cancer. Some markers of diet give a measure of actual intake of a particular nutrient. These include blood levels of vitamin C, different carotenes and vitamin E. Other markers may be related to dietary pattern but do not directly indicate intake. However they are relevant to carcinogenesis. These include lipid peroxidation products (eg malondialdehyde) and indicators of oxidation status (eg plasma levels of ceruloplasmin, transferrin, glutathione and the total antioxidant capacity of the serum). These markers could shed light on some of the postulated mechanisms. New markers relevant to nutrition may have to wait until some of the biological processes are clear and techniques become available, for instance, to look at cellular markers of nutrition.

RESEARCH PRINCIPLES

In the 50s and 60s the importance of lifestyle and environment in the etiology of cancer was realized. Research data support the estimate that these factors contribute to development of 90% of cancer incidence (4).

The National Cancer Institute (NCI) in the U.S. requires that cancer control interventions follow an orderly sequence of research phases. The sequence begins with discovery of new knowledge through research which is translated into new technology. This then has to be validated by clinical trial to determine safety and efficacy. The professional community is then educated on its use and the public is informed.

To this end the NCI has designed cancer control in phases to enable it to assess the rigor of proposed interventions as outlined below.

Phase 1- hypothesis development

This phase involves assessing and identifying evidence from laboratory, clinical and epidemiological data for the formulation of a hypothesis.

Phase 2 - methods development

In this phase the methodology of research is designed. Outcomes and variables of study are chosen. Activities in this phase may include pilot testing to determine the acceptability or feasibility of the study. Interventions must be assessed in terms of their effectiveness and cost, as well as risk to subjects. Of particular concern is, for example, the assessment of whether long term dietary habits can be changed and monitored accurately.

Phase 3 - controlled intervention

The hypothesis is then tested in a carefully controlled study on a group. A Homogeneous group may be easier to manage and compare with controls. The group chosen may be a high risk group and thus may not necessarily be representative of the general population.

Phase 4 - defined population studies

This phase further validates the methods developed in phase 2 and the efficacy determined in phase 3. Preventive intervention is applied to a carefully controlled defined population chosen that the results can be extrapolated to the ultimate target population with particular characteristics. This is to allow identification of risk factors and the calculation of changes that are to result from intervention.

Phase 5 - demonstration and implemantion

Finally studies introduce the proven intervention and evaluate the impact of such intervention. A system of evaluation and quality control must be in place at this stage. These studies may be part of another public heath programme.

DESCRIPTION OF STUDY

A clinical study is currently going on at the Institute For Medical Research (IMR) with the participation of patients from the Dental Department of Hospital Kuala Lumpur. Patients with leukoplakia and precancerous lesions of the oral mucosa are identified and recruited. Pathological confirmation is carried out by the Division of Stomatology at the IMR. Blood is collected for determination of selected biochemical markers of nutrition (Vitamins A, C and E) and markers of antioxidant status that are related to diet and have a role in cancer pathogenesis. Data on relevant history and dietary practices will be collected. Patients will then be randomly selected to receive supplementation of oral vitamins A and E. Patients and controls who have not received supplements are followed up 3 monthly by clinical and 6 monthly for biochemical assessment. Analysis will then be done after the patients have been stratified according to stage of the disease.

ADVANTAGES OF CLINICAL TRIAL

Two research concepts are essential to the study of prevention research. First, human trials must be conducted to test the effective relationship of a hypothesis. Second, the sum of research data must meet the epidemiologic criteria before human trials may be conducted.

Human trials often are the most rigorous way to test a hypothesis that an intervention has a specified effect. Because of their prospective nature, they provide a specificity not possible in epidemiologic studies. They also serve as a test to see whether such interventions are feasible, applicable and acceptable. Trials also allow for behavior research and gives an indication of duration of time for results to appear. Prevention trials also enable side effects to be observed.

LIMITATIONS IN CANCER CHEMOPREVENTION

Cancer prevention intervention trials are still in their infancy. Current trials may show negative or uncertain results because of a number of technical and design problems.

Despite several research findings, we are only at a stage where we can make associations, causal relationships and possible preventable role of micronutrients. It is however clear that a number of essential nutrients can significantly modify the carcinogenic process.

The difficulty in identifying the role of particular nutrients is due to the heterogeneity of etiological and modifying factors in the carcinogenic process. Furthermore micronutrients most likely act in synergy rather than independently. The absence of well defined molecular stages makes it difficult to identify specific markers.

Another important limitation is due to measurement difficulties of for example the concentration at target tissues. The narrow range of concentrations within which molecules exert physiological effect makes this a difficult task at least for now. The mixed evidence from studies of serum vitamin A for instance is not surprising, since homeostatic control maintains serum retinol within a narrow range and serum levels may not reflect what is in the tissues (37). Sometimes total carotenoids, rather than the active but less stable beta carotene, is measured. It should also be remembered that the level of some nutrients, eg beta-carotene, varies with blood lipids and thus depends on diet.

If chemoprevention does produce results, an important consideration is whether it is really cure or merely lengthening of the latency period. It has been shown for instance the effects of retinoids in rodents treated with bladder carcinogen N-butyl-N-(4-hydroxyl) nitrosamine could be explained in terms of lengthening of the latency period before tumor starts its exponential growth (38). This might still be useful in human cancer prevention if the invasive or malignant phase can be delayed.

Investigations on humans are severely limited and must be carried out with care. Animal models have been used to study mechanisms at three levels of organization: the whole animal, the whole organ and at molecular level. It has been shown that retinol itself is toxic in high doses because it is avidly taken up by the liver with consequent destruction of parenchymal cells. For this reason a large number of synthetic retinoids have been produced with vitamin A like activity but less toxic. It should be

noted that antioxidants can both be chemopreventive and carcinogenic (39).

Finally there is an application problem. Studies in chemoprevention with micronutrients should be with the long term aim of identifying substances in the diet so that it can be modified as a measure to reduce cancer incidence. Unfortunately supplementation may have to involve large pharmacological doses for its protective effect to be evident. The question then arises as to whether such an effect can be achieved by diet intervention. If prolonged supplementation is required, compliance is a problem.

Evidence for a protective role of micronutrients in humans has been obtained from epidemiological studies in human populations and indirectly from investigations of biochemical mechanisms. These unfortunately have limitations. Though there are setbacks, future understanding may need human population studies so that such interventions can provide absolute proof of effectiveness. At the same time tools are required for molecular studies to be carried out.

CONCLUSION

It is clear and must be emphasized that nutrition is not the sole cause of cancer. For this reason it may take time to elucidate the role of nutrients in cancer prevention or promotion. Nevertheless as more is learned from trials on human populations, it should be possible to design the studies more precisely so that special target groups can benefit most. It is interesting to note that risk for certain cancers seem more prone to reduction by dietary intervention. It has been reported that it should be possible to prevent up to 75% of all cases of oral cancer in western countries by changes in dietary and lifestyle habits.

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Adult degenerative diseases in children: prevention and treatment of obesity in children from Japanese experiences

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ABSTRACT

Obesity is now a prevalent and quite serious nutritional disease in Japan. From 5-8% of school children may be affected. And it seems to show the same trend in other Asian countries. Even in children, obesity is associated with hyperlipidaemia, hypertension, NIDDM and fatty liver, which are called "adult degenerative disease". It is well known that primary lesions of atherosclerosis, which will ultimately cause coronary heart disease or stroke in adults, are already present in children in their teens. Many studies including ours in Japan demonstrated that several percent of school-age children (aged 6-14 years) had abnormalities of serum lipids (serum total cholesterol, HDL-cholesterol). Based on these results, it has been proposed that attempts should be made to prevent atherosclerosis by decreasing hyperlipidaemia and at the same time, reducing the prevalence of obesity in infants and children. In order to achieve these, the importance of health education from early childhood, especially measures that modify national diet and activity, has been emphasized. In this paper, Japanese experiences and tasks in progress to prevent adult degenerative disease, which should begin to develop from children, will be introduced and discussed.

INTRODUCTION

Obesity is associated with increased serum levels of cholesterol, total triglyceride and LDL and VLDL cholesterol, but lower levels of HDL cholesterol (1). In addition, obesity also tends to be associated with hypertension and non insulin dependent diabetes mellitus (NIDDM), which are called "adult degenerative diseases".

It is well known in adults that obesity, hypertension, DM and smoking are the major risk factors of coronary heart disease. Coronary heart disease is caused by coronary atherosclerosis, a slowly progressive process that starts early in life and that can

lead to the gradual occlusion of the coronary arteries by middle age.

Obesity is now a prevalent and quite serious nutritional disease in Japan, and 3.5 to 10% of school children (aged 6-14 yrs) may be affected. Many studies demonstrated that several percent of school children had abnormalities of serum lipids such as higher level of total cholesterol or lower level of HDL - cholesterol in the serum. Based on these results, it has been proposed that attempts should be made to prevent atherosclerosis by decreasing hyperlipidemia and, at the same time, reducing the prevalence of obesity in infants and children. In order to achieve these, the importance of health education from early childhood, especially measures that modify national diet and activity, has been emphasized. In this paper, Japanese experiences and tasks in progress to prevent adult degenerative diseases, which begin to develop from childhood, are introduced and discussed.

RELATIONSHIPS BETWEEN DIET, SERUM LEVEL OF TOTAL CHOLESTEROL AND ATHEROSCLEROSIS

Currently it is believed that most hypercholesterolemia is of dietary origin. This concept is derived from investigations in laboratory animals and from worldwide epidemiologic studies (2). As part of a study on environmental influences on health, Dr Yamakida et al. have investigated a relationship between diet and serum total cholesterol level and atherosclerosis in Japanese living in Hiroshima and Japanese American who are genetically pure Japanese and live in Los Angeles, California (3). The results showed that the American's dietary habits involved high consumption of protein of animal source, fat of animal source and fine sugar but low complex carbohydrate, although total calorie intake was not different, compared with those of the Japanese. In particular, the American had twice as much animal fat as the Japanese (Table 1). The mean total cholesterol level in the American was 20 to 30 mg/dl higher throughout the ages investigated than those of Japanese (Figure 1). Pulse wave velocity of aorta (PWV), a noninvasive diagnostic method of atherosclerosis, values were significantly higher in the American from 40 years to 80 years old compared with the Japanese. Namely, the Japanese American's atherosclerosis advanced 10 years earlier than in Japanese (Figure 2). This study confirmed that different dietary habits bring the people different serum cholesterol levels and atherosclerotic progress even in the same genetic groups after decades.

EPIDEMIOLOGY OF OBESITY AND HYPER-CHOLESTEROLEMIA IN SCHOOL CHILDREN

The incidence of obesity (obesity index => 20%) in Japanese school children aged 6 years to 14 years is shown in Figure 3. In the last 20 years, obesity increased approximately twice to three times and 3.5% to nearly 10% of the children were obese in 1990. Similarly, the mean serum cholesterol levels in children increased 10 mg/dl in the 10 years

Figure 1

The Mean Serum T.Cholesterol Levels in Japanese and Japanese American

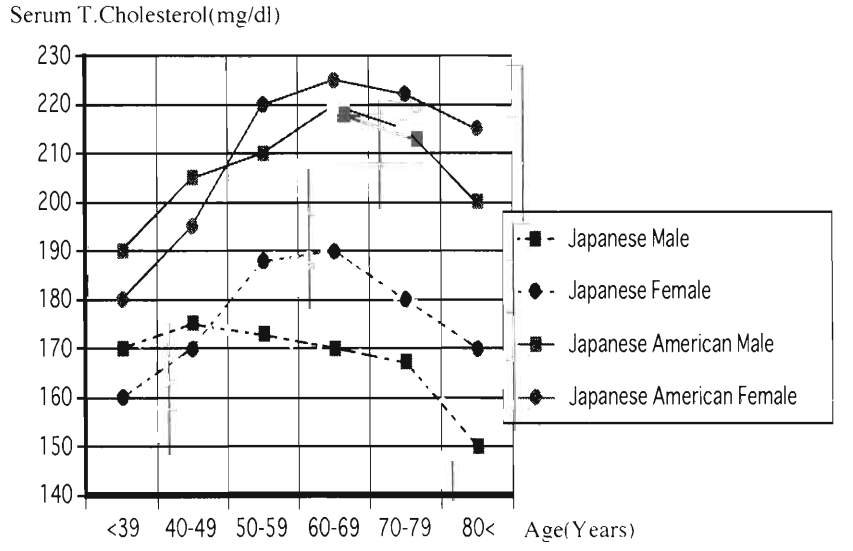


Figure 2

The Mean Pulse Wave Velocity of Aorta in Japanese and Japanese American

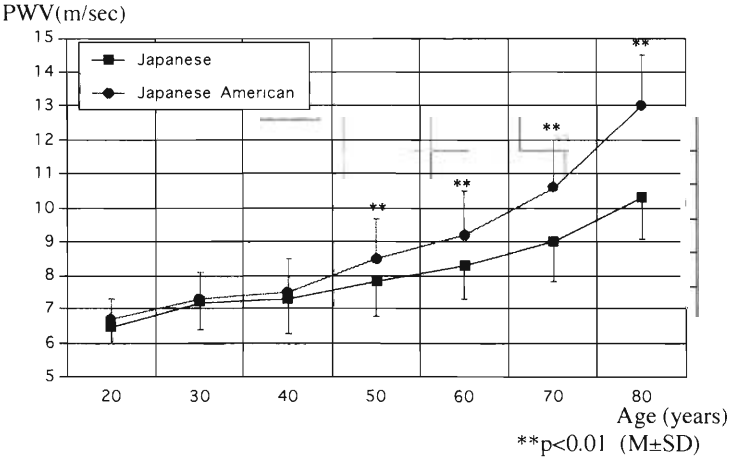


Figure 3

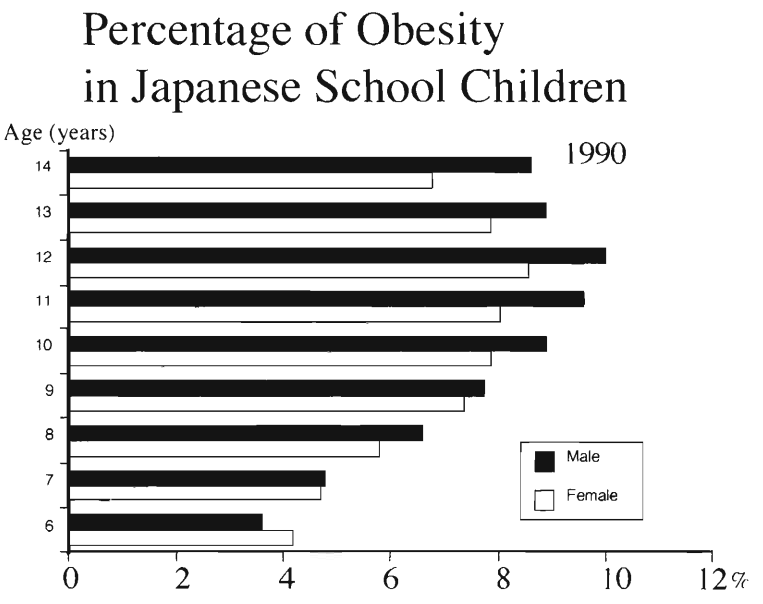


Figure 4

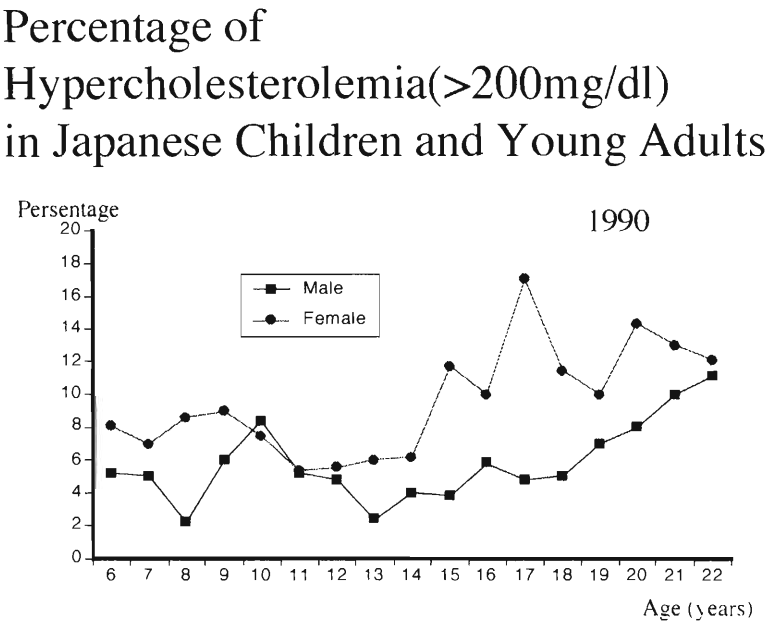
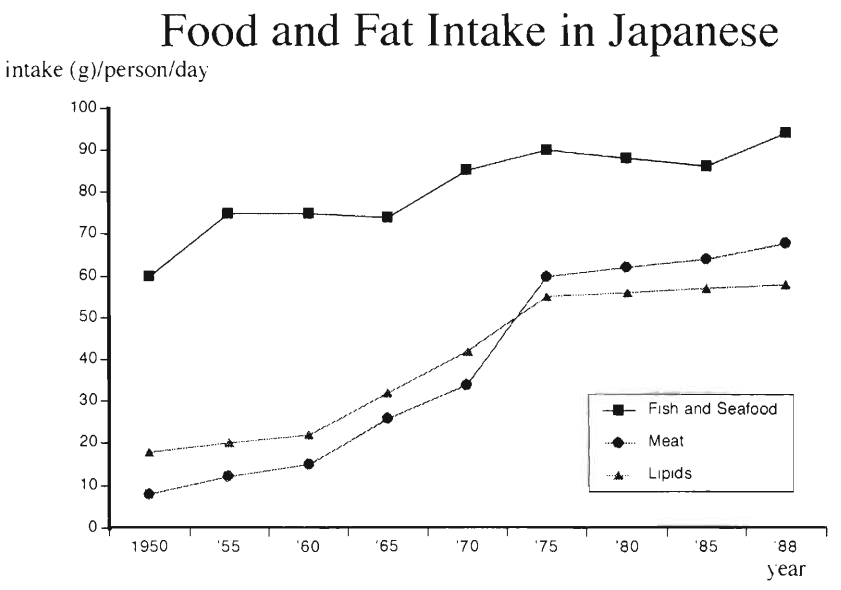


Table 1. The Mean Nutrient Intake in Japanese and Japanese American

	male		female	
	Japanese American	Japanese	Japanese American	Japanese
Total Calorie (kcal)	2421	2426	1754	1925
protein	88	72	68	60
animal (g)	54	32	40	25
plant (g)	34	40	27	35
Fat	86	52	64	44
animal (g)	46	23	32	18
plant (g)	40	29	32	26
Carbohydrates	301	370	230	320
refine sugar (g)	100	57	86	58
complex carbohydrate (g)	201	314	146	262

Figure 5



from 1978 to 1987, 1 mg/year, and hypercholesterolemia (>200 mg/dl) was found in about 6% junior high school children (12-14 years) in 1990 (Figure 4). These epidemiological results reflect the people's lipid intake, particularly of animal origin (saturated fatty acids) which were prominently increased with the economical development in the period (Figure 5). From the preventive standpoint of atherosclerosis, obesity and hypercholesterolemia in school children with increased lipid intake require careful monitoring. Therefore, attention has been directed to advisable diets of

school children.

DIETARY RECOMMENDATION AND SCHOOL LUNCH

Because dietary habits are thought to develop early in life, and because diet contributes to the development of adult degenerative diseases through years of exposure, school lunch is important for the prevention of these diseases. School lunch is provided to 98.2% of primary school children and 62.4% of junior high school children in Japan. Therefore, school lunch has a substantial impact on the overall nutrition of Japanese children and may play an important role in the formation and reinforcement of dietary habits.

The dietary guideline for school lunch of the Japanese Ministry of Education is shown in Table 2. A comparison of the fat content of foods provided in primary school lunch was made between the Japanese and the American. The average lunch provided to Japanese children had 31% of calories from total fat and 18.1% from animal fat, whereas the lunch selected by American children had 35.9% from total fat and 12.6% from saturated fat. The Japanese figures nearly met the guidelines but the American ones exceeded the guidelines (Table 3). As mentioned, American dietary habits involve high consumption of animal fat and refined sugar, but low complex carbohydrate, which contrast with the ordinary traditional eating pattern in Asia. The school lunch data from the USA suggests the difficulty of change in national diet. The current recommendation for a low fat diet to prevent coronary heart diseases is well founded. A major question about this recommendation, however, is whether it will be accepted widely by people despite being perhaps the most desirable diet. Therefore, the author, as an Asian, strongly recommends to maintain your own traditional foods, rather than introducing European/American foods on the dining table. When Asian countries start to provide school lunch to children, it may be worthwhile to consider modifying the national diet, if necessary, through the school lunch, and then their own traditional foods should be structured food.

SCREENING FOR PREVENTION OF ADULT DEGENERATIVE DISEASES

One third of obese adults were obese children and 50% of obese adolescents were obese in infancy. A reduction in the prevalence of obesity in infants and children could be an important adjunct to the prevention of obesity later, and ultimately atherosclerosis. Similarly, childhood cholesterol levels are variable but tend to maintain rank order so that young children with high cholesterol levels tend to become older children with high cholesterol levels.

In Japan, a screening programme for the prevention of adult degenerative diseases started in some areas in 1986 and more than 30,000 school children were enrolled in the screening in 1993 in Tokyo. One of the screening results is shown in Figure 6. One point eight percent of children screened were asked to have regular medical checks because of

Table 2. Comparison of Fat Content of School Lunch between in Japan and in U.S.A.

	Japan	U.S.A.	Dietary guideline	
			Japan	U.S.A.
Fat (% kcal)	31	35.9	25 – 30	< 30
Saturated fat		12.6		10
or Animal fat (% kcal)	18.1		17.8	

* Fat content of average school lunch selected by children

**Fat content of average school lunch provided to children who have no choice.

Table 3. Dietary Guideline for School Lunch

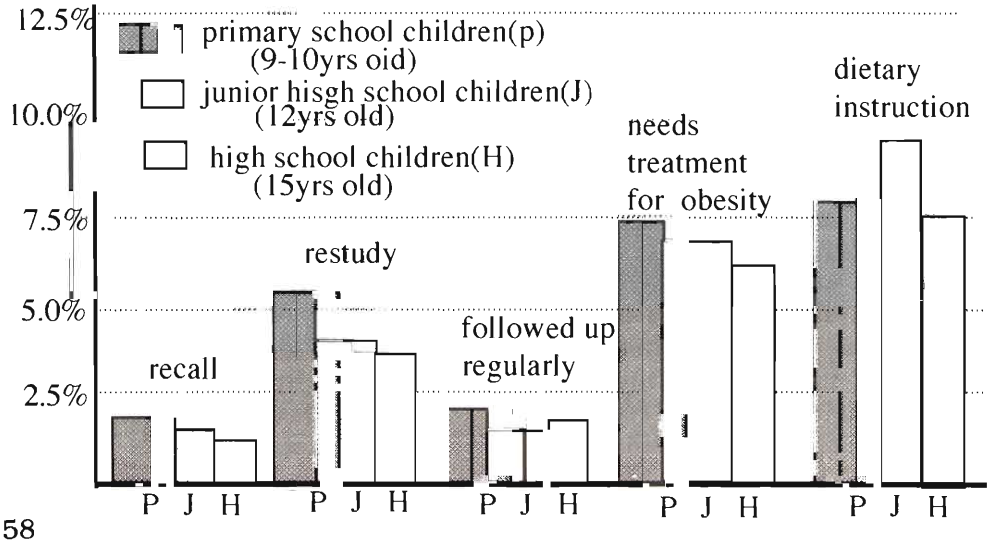
Japanese Ministry of Education 1986

Nutrients	Age (years)			
	6 – 7	8 – 9	10 – 11	12 – 15
Energy (kcal)	590	640	720	820
Protein (g)	22	24	27	31
Lipid (%)	Percentage of energy intake from lipids to total energy: 25–30%			
Calcium (mg)	240	290	370	430
Iron (mg)	30	3.2	3.5	4.0
Vitamin A (IU)	600	675	750	750
Vitamin B1 (mg)	0.34	0.36	0.41	0.47
Vitamin B2 (mg)	0.51	0.55	0.63	0.70
Vitamin C (mg)	22	22	22	27

Figure 6

Results of Screening for Prevention of Adult Degenerative Diseases in Japanese School Children

PERCENTAGE OF REQUIRING MANAGEMENT



their family histories of "high risk" and 0.6% of children screened were found to need medical interventions. Apart from these, 4.5% of children were asked to manage their obesity and 8.7% were advised to modify their eating habits.

In this screening programme, when serum T-cholesterol level exceeds 200 mg /dl, restudy is advised. Restudy includes measurements of serum total and HDL-cholesterol and triglyceride. The results of this screening programme support that those children who have "high risk" family histories and/or hypercholesterolemia (=> 200 mg) should check their triglyceride and HDL-cholesterol levels in the serum. They may need special dietary instruction and close supervision with evaluation of other risk factors.

RECOMMENDATIONS

I would recommend the following items based on Japanese experience together with reported data from other countries.

1. It is desirable to begin prevention of adult degenerative diseases in childhood.

2. Measures that modify dietary habits and activity of the entire population may be most efficient way.

3. Emphasize the importance of health education from early childhood, and school lunch is a good means of the education.

4. It is advisable to maintain Asian traditional foods rather than introducing European/ American foods on the dining table.

5. Children at "high risk" should be screened primarily by family histories.

6. Those children with hypercholesterolemia (=> 200 mg/dl) on two occasions should check their triglyceride and HDL-cholesterol levels, and require special dietary instruction and close supervision with evaluation of other risk factors.

7. Maintenance of ideal weight, a regular exercise programme, and avoidance of smoking as well as dietary intervention should be part of total management of children with hypercholesterolemia.

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Nutritional support in cancer: is it oncologically logical?

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ABSTRACT

Studies to determine the effect of nutritional support (NS) on morbidity and survival in cancer patients are difficult to conduct due to the several variables involved, including types of cancer, organs involved, cell type, histologic characteristics and biologic behavior of tumor cells. The ethical issues of withholding NS for study purposes is also a problem.

NS, either parenteral or enteral, does not selectively stimulate growth of tumor. The metabolism of cancer patients is somewhat similar to that seen in stressed patients as compared to simple starvation. It is easier to prevent weight loss by early intervention than to attempt repletion.

Parenteral nutrition is indicated if meaningful anti-cancer theraphy in terms of surgery, chemotherapy or radiation therapy, is planned and if enteral nutrition cannot be used. Enteral nutrition via nasoenteral, gastrostomy or jejunostomy tubes is ideal for head and neck, and upper gastrointestinal tract malignancies where oral nutrition is not optimal.

Properly administered NS allows the physician to complete the planned course of chemotherapy and radiation therapy. Aggressive surgery can also be planned. The quality of life improves with NS as patients can be sent home on enteral NS. However, the decision to provide aggressive NS in terminally ill cancer patients should be individualized. Thus, NS in cancer patients is oncologically logical.

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Nutritional supplementation: a new approach in diabetes mellitus management

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ABSTRACT

Non-Insulin Dependent Diabetes Mellitus (NIDD) has traditionally been managed by carbohydrate and dietary restriction, either by itself in non-severe cases, or in combination with oral hypoglycaemic agents in more persistent cases.

In two case studies, both females, aged 54 and 67 years, clinical response with the above dual line of management had not been encouraging in controlling blood sugar levels over a 10 and 23 year period. An alternative modality in management was carried out by dietary supplementation with a Glucose Tolerance Factor (GTF) of 100 mg niacin, and 200 mcg elemental chromium given once a day.

After two weeks on the GTF regime, fasting sugar levels in both cases fell to under 5.5 mmol/L followed by normal GTT curves. The serum fructosamine level also indicated good diabetic control limit.

The objective of this paper is to review the current status of diabetic treatment using nutritional medicine as options to current drug intervention with or without dietary restrictions.

INTRODUCTION

Diabetics can be classified into two types: primary and secondary diabetes. Most cases belong to the primary type where a number of etiological factors are operative. Among them are heredity, age, with about 80% of the cases occurring after the age of 50, obesity (1-4), diet (5,6), infection, and stress.

The minority of cases of secondary diabetes involve impaired insulin secretions, caused by pancreatitis, haemochromatiosis, carcinoma of the pancreas and pancreatectomy; endocrine causes include acromegaly, Cushing's Syndrome, phaeochromocytoma and hyperthyroidism. Diabetes can also

appear during pregnancy. Drugs like corticosteroids and thiazide diuretics may precipitate diabetes in those genetically susceptible, as does liver disease.

The current approach in NIDDM management includes dietary measures, with or without hypoglycaemic agents (7). Glucose intolerance as one of the signs of chromium deficiency, and the use of chromium in controlling hyperglycaemia have been described (8-13).

The preventive and therapeutic effects of large-dose nicotinamide injections on diabetes associated with insulinitis has been shown by Yamada et al. (14). Nicotinamide may also extend the remission phase in insulin dependent diabetes (15). Niacin is a component of the glucose tolerance factor (GTF) when combined with chromium, and a deficiency of niacin has been shown to interfere with GTF synthesis and impaired glucose uptake (16). Similar protective effects of nicotinamide against nephropathy in diabetic rats has also been demonstrated by Wahlberg (17).

This paper records two case studies where two females, aged 54 and 67 years with long history of NIDDM were given GTF supplementation consisting of niacin 100 mg, trivalent chromium (polynicotinate) 200 mcg, L-cystine 2 mg, and L-glycine 2 mg given in a single dose capsule o.m ante cibum when dietary and pharmacological intervention (with sulfonylureas and biguanides as oral hypoglycaemics) did not show satisfactory results over many years of treatment.

SUBJECTS AND METHODS

Case studies were conducted on two females, both with long history of unsatisfactory control of NIDDM.

In case 1, the patient was 65 years of age, a Chinese housewife, 1.575 m (5'2") in height and weighing 75.6 kg (166 lbs). This was 40% overweight for height. She also lead a sedentary life-style.

In case 2, the patient was an Indian female over 68 years of age, whose height was 1.549 m (5'1") and whose body weight was 60 kg (132 lbs). She was a housewife living in sedentary life.

Both patients were counselled about their disease after careful examination. They were advised on the need to reduce weight, to exercise, on the importance of lifestyle modification, and were given advice and education as part of physical therapy. In term of dietary adjustment, they were explained the need to equate energy intake with physiological requirements, and to restrict refind carbohydrate so that 60-70% of the energy is derived from complex carbohydrates, and no more than 30% from fat. They were also advised to scatter food intake into small feeds, reducing saturated fats and increasing the intake of polyunsaturated fatty acids. The need to formulate carbohydrate "exchange" portions was explained to them as part of diabetic control. So was advice given on the need to reduce salt or alcohol intake, or the use of artificial sweeteners as part of calorie - controlled reducing diet. The patients were encouraged to consume onions which contain diphenylamine and

Table 1. Moderate energy, well balanced nutrient intake for diabetes mellitus.

60 – 75% from complex carbohydrates
15 – 20% from protein
10 – 20% from fats

Proximate principle	Wt in g	Kcal	MJ	% total energy
CHO	300	1200	5	68.6
Protein	70	280	1.2	16.0
Fat	30	270	1.1	15.4
Total	400	1750	7.3	100.0

tolbutamide, beans which have insulin-like properties, apples, corn etc which have hypoglycaemic properties. A guide on nutrient intake containing moderate energy and well balanced nutrients for diabetes mellitus was explained and given to both patients as shown in Table 1. In addition to the medication already given by their physicians, both patients were also given a nutritional supplement containing a glucose tolerance factor (GTF) comprising of niacin 100 mg, trivalent chromium (polynicptinate) 200 mcg, L-cystine 2 mg, and L-glycine 2 mg in one formulation. This was given in one dose, o.m ante cibum. In addition to the GTF, additional nutritional therapy containing vitamin C 500 mg, bioflavonoids 120 mg, beta carotene 10,000 IU, cod liver oil 5 ml (tid post cibum) were provided to the second patient (Case 2).

The patients' presenting symptoms and history of other illness were noted and recorded along with the other medication they were taking. Investigations included glucose tolerance test (GTT) and serum fructosamine. Urine glucose tests were also carried out. The degree of diabetes according to GTT results was classified according to WHO recommendation (Table 2). Fluid intake per 24-hr was recorded by the patient using a glass of known measure throughout the trial.

RESULTS AND DISCUSSION

Case 1. Her pre-treatment symptoms were polydipsia (fluid intake was about 280 dl each time, drunk every 2 hours throughout the 24 hr). She had nocturnal polyuria, passing out about 3 litres of urine/24 hr, mostly at night. She complained of hunger, and her daily total energy intake was over 2000 kcal. She also complained of vague fatigue, and possibly weight loss according to her daughter. Clinical features included diminished or absence of ankle and other reflexes. On examination, Argyll - Robertson pupils and Charcot's joints was seen. Hepatomegaly and nephro-megaly/pyelonephritis was not evident on palpation. Fruity odour of the breath due to keto-acidosis and hyperventilation was not noticeable.

The patient's history and clinical

Table 2. Criteria used to assess diabetic status

1. GTT (WHO Classification)

	Venous Plasma Glucose mmol/Litre (mg/dl)	
	Fasting	2 hrs
Diabetes unlikely	5.5 (100) or less	7.8 (140) or less
Impaired Glucose Tolerance	7.8 (140) or less	7.8 – 11.1 (140 – 200)
Diabetic	7.8 (140) or more	11.1 (200) or more

2. Glycosuria: 20 – 40 mmol/L (350 – 700 mg/dl)

3. Fructosamine: Good diabetic control: < 300 umol/L
Fair diabetic control: 300– 400 umol/L
Poor diabetic control: > 400 umol/L

examination did not suggest any other clinical findings of significance except that she was hypercholesterolaemic (serum cholesterol was 278 mg/dl), with obvious elevated fasting plasma glucose (9.4-16.1 mmol/L) over the past 4 yrs despite being on metformin (glucophage) 500 mg tds and glibenclamide (Daonil) 5 mg daily, over this period. Polydipsia (3.3 $\pm$ 0.2 L/24 hr) and polyuria (mainly nocturnal) was her main symptomatic presentation. Her clinical history and medication prior to her seeking nutritional approach is given in Table 3.

Despite being advised on the need for dietary modification, her actual energy intake measured over a period of one week showed a consumption of over 2000 kcal per day, derived mainly from rice, kuih, bread, noodles and meat dumplings. The sample of the food and nutrient intake showed her protein consumption was over 220% of the United States RDA, while the total energy intake was 126% with 20.7% of total energy derived from protein, 30.8% from fat and 48.5% from carbohydrate (Table 4).

When given a supplementation of GTF once a day, the patient's fasting blood glucose fell from 251 mg/dl (13.9 mmol/L) in the pre-treatment stage to 156 mg/dl (8.6 mmol/L) after 25 weeks, and continued to fall to 142 mg/dl (7.9 mmol/L) after 34 weeks. It continued to drop further to 131 mg/dl (7.3 mmol/L) and 136 mg/dl (7.5 mmol/L) after 56 and 105 weeks of treatment respectively. When the GTF supplementation was stopped at 105 weeks and the fasting glucose level measured after 109 weeks, it was found to have gone up to 178 mg/dl (9.9 mmol/L). When supplementation was resumed immediately, the fasting glucose level measured at 113 weeks from pre-treatment stage, fell again to

Table 3. Clinical history and medication of NIDDM Case 1

Clinical History

NIDDM for 4 yrs
Fasting plasma glucose 9.4 – 16.1 mmol/L
Hypercholesterolemia – 278 mg/dl
Elevated liver enzymes – AST/SGOT: 220 U/L
– ALT/SGPT: 196 U/L
– Alkaline phosphatase: 489 U/L
(No hepatomegaly, no jaundice)
Hepatitis B Surface Antigen : detected
Hepatitis B Surface Antibody : negative
Resting BP: mean ± SD : 148 ± 2.1 mm Hg (Systolic)
85 ± 1.0 mm Hg (Diastolic)
Resting PR: mean ± SD : 76.5 ± 3.5 b/m
Polydipsia (3.3 ± 0.2 L/24 hrs
Polyuria (mainly nocturnal)

Medication

* Metformin (Glucophage) 500 mg t.d.s.
* glibenclamide (Daonil) 5 mg daily

Table 4. Sample dietary intake of NIDDM Case 1

Food consumption	Nutrient intake/day				
	Wt (g)	Protein	Fat (g)	CHO (g)	Energy (kcal)
Breakfast (8.00 am)					
1 Char Siew Pau	120	14.6	3.1	49.9	287
1/2 Tai Pau	120	14.6	3.1	49.9	287
2 Siew Mai	50	6.1	1.3	20.8	119
Lunch (2.00 pm)					
2 bowls fried mee hoon	150	6.4	10.1	35.9	259
3 pieces chicken	150	33.6	29.8	5.4	424
Vegetables	100	2.4	4.0	9.7	84
Dinner (7.00 pm)					
Bamboo shoots	120	1.9	5.2	5.9	78
Vegetables (salad)	50	0.8	3.6	5.8	59
Fried fish	50	19.7	8.9	1.8	166
Rice	200	4.6	0.2	60.0	260
Total	1110	104.7	69.3	245.1	2023
% RDA	–	225.0	–	–	126
% Total Energy	–	20.7	30.8	48.5	–

151 mg/dl (8.4 mmol/L). Similar pattern of declining blood sugar level was observed 2 hrs after ingestion of 75 mg of glucose as shown by GTT. Blood glucose level were: 216, 202, 211, 191 and 201 mg/dl after 25, 34, 41, 56 and 105 weeks respectively of supplementation. The level went up to 223 mg/dl after GTF was stopped, and again dipped to 211 mg/dl at 113 weeks, when supplementation was resumed after 109 weeks from the initial pre-treatment period. Long term assessment of diabetic status by fructosamine levels also showed a decline from the initial 410 mmol/L at pre-treatment to 308, 305, 298, 295, 280, 286 mmol/L after 25, 34, 36, 41, 56 and 105 weeks respectively on GTF supplementation. There was a temporary rise to 320 mmol/L in fructosamine levels when supplementation was stopped at 105 weeks, but went down again to 280 mmol/L when measured at 113 weeks or 4 weeks after the resumption of GTF supplementation.

Clinically there was also less evidence of polydipsia during treatment. The pre-treatment fluid intake was 3.5 litres/24 hrs down to 2.8, 2.5, 2.0, 2.2, 1.7 and 1.8 litre per 24 hrs after 25, 34, 36, 41, 56 and 105 weeks of supplementation. When treatment was stopped at 105 weeks, polydipsia became evident with the fluid intake increasing to 2.8 litres a day but down to 2.1 litres/day, 4 weeks after resumption of supplementation. Results of the trial are tabulated in Table 5.

Case 2. This patient presented with left ventricular hypertrophy due to her history of hypertension

Table 5. Changes in major parameters with treatment of NIDDM Case 1

Status	Pre-Treatment	Weeks							
		25	34	36	41	56	105	109	113
Wt (kg)	75.6	74.2	74	74	74.1	74	73.8	74.3	74
Ht (m)	1.58								
FB Glucose									
mg/dl	251 ± 23.1	156	142	145	150	131	136	178	151
mmol/L	13.9 ± 1.2	8.6	7.9	8.1	8.3	7.3	7.5	9.9	8.4
GTT: 2 hr Level									
mg/dl	–	216	202	–	211	191	201	223	211
mmol/L	–	12	11.2	–	11.7	10.6	11.2	12.4	11.7
Glycosuria	+++	++	+	+	+	–	–	++	+
Fructosamine									
mmol/L	410	308	305	298	295	280	286	320	280
Fluid Intake									
L/24 hrs	3.5	2.8	2.5	2	2.2	1.7	1.8	2.8	2.1

Note:

4 weeks after stopping the supplement

4 weeks after reintroducing the supplement

of more than 15 years, but with medication, her mean resting blood pressure taken in the morning before rising over a period of a month was 128 ± 7.2 mm Hg (systolic), and 78 ± 6.3 mm Hg (diastolic). She also often suffers from spells of dyspnea probably due to cardiac asthma, related to her cardiac condition. Even at rest, and with medication, her resting pulse was often over 100 beats/minute. In addition, she has hiatus hernia and from non-insulin dependentdiabetes mellitus for more than 23 years. As a result, she has skin ulceration on her lower extremities, and at one stage before being given GTF supplementation, she developed gangrene on both legs where the skin ulceration were. She showed classical symptoms of polydipsia, drinking on average 600 ml of tea and other beverages, and about 1200 ml of water a day.

She was put on medication by her physician, digoxin 0.25 mg omni mane, Moduretic 1 tab omni mane, isosorbide dinitrate (Isordil) 10 mg. ter in die, furosemide (Lasix) 40 mg.pm and potassium chloride (Slow K) 600 mg bis in die. Her polyuria was partly due to the diuretic (Lasix) she was taking.

On examination, she showed signs of Kussmaul's breathing, mild onycholysis, mild lens opacity (cataract), and skin infection.

Her food pattern and nutrient intake was closely examined over a period of a week, and it was found that her protein intake was about 60 gm per day, her fat intake was around 55 gm per day and her total energy intake was over 1500 kcal. Her food consumption consisted mainly of rice, noodles, bread, fish, pork, a little vegetable and some milk. Her food consumption pattern and nutrient intake, taken at random for one day, is given in Table 6.

The patient's medication was augmented by a blend of herbal medicine given in a capsule at a dose of capsule bid (om/on). The herbal mixture was (18): Tilia

Table 6. Sample dietary intake of NIDDM Case 2

Food consumption	Nutrient intake/day				
	Wt (g)	Protein (g)	Fat (g)	CHO (g)	Energy (kcal)
Breakfast					
2 slices bread	90	8.7	0.9	46.8	230
1 slice cheese	60	12.5	16.2	0.5	198
Lunch					
Mee Rebus	150	8.3	3.8	16.3	137
Asam Laksa	150	0.3	0.2	57.3	233
Pork	50	4.4	15.3	8.7	196
Dinner					
2 slices bread	90	8.7	0.9	46.8	230
2 fish finger	90	12.2	11.4	15.5	210
1/2 cup of milk	150	4.8	6.5	5.1	98
Total	830	59.9	55.2	197	1532
% RDA	–	146.1	–	–	95.8
% Total Energy	–	15.6	32.4	51.4	–

platyphyllos (lime flower) 750 mg, Achillea millefolium (Yarrow) 750 mg, Crataegus oxyacanthoides (Hawthorn Berries) 500 mg, Allium sativum (garlic) 500 mg, Salix alba (White willow bark) 250 mg and Ulmus fulva (Slippery elm) 500 mg. Crategus oxyacanthoides main active constituents are oligomeric procyanidins (OPC's), flavone glycosides anthocyanins (which are responsible for the red colour) and crataegus acid (triterpene acid). The action of the OPC's is enhanced by the other constituents, especially the flavonoids. The hypotensive action of Crataegus in essential hypertension was shown by Graham. The action is two fold, a mild decrease in cardic output and peripheral vasodilation. Crategus increases coronary blood flow and has a favourable effect on the myocardium, to better withstand hypoxic conditions. In addition, it has been shown to augment recovery from myocardial infarction. A recent clinical trial supported the above findings by demonstrating the value of Crataegue in ischaemic heart disease. This benefit was in addition to the conventional treatments which patients were also receiving and no adverse interactions with conventional drug were observed, as with this case study. The herb also has a mild positive inotropic action, and is beneficial in the treatment of functional arrhythmias. The herb also asserts a mild sedative action, and is indicated as the herb of choice for heart disease, as in this case. Other herbs used such as Tilia platyphyllos, are thought to be protective against atheroma formation, while Achillea millefolium is also considered to be hypotensive and spasmolytic, this action being possibly due to the combined action of the essential oil, flavonoids and lactones. In the English herbal tradition, Achillea is thought to particularly lower diastolic pressure although the patient's BP is under control with medication. They were used in combination to augment the medication the patient was already receiving for many years but without much clinical improvement (18).

When this patient was put on a GTF supplementation there was a considerable decrease of her pre-treatment fasting blood glucose of 205 mg (11.4 mmol/L) to 153 mg (8.5 mmol/L) in the first 4 weeks of treatment, decreasing further to 130 mg (7.2 mmol/L), 112 mg (6.2 mmol/L), 104 mg (5.8 mmol/L) and 102 mg (5.7 mmol/L) after 8, 12, 16 and 20 weeks respectively. The blood glucose levels registered 2 hours after the ingestion of 75 gm of glucose ('Locozade') dissolved in 300 ml water was prescribed for the GTT also showed a considerable drop in the serum glucose level from 14.7 mmol/L (pre-treatment) to 11.2, 10.0, 8.7, 8.0, 7.9 mmol/L after 4, 8, 12, 16 and 20 weeks of supplementation. A week after supplementation was stopped, there was a temporary rise in fasting glucose level (6.9 mmol/L) as well as the 2 hour level (9.7 mmol/L). When supplementation was resumed immediately, and GTT done another 6 days later (25th week), the glucose level again fell to 5.5 mmol/L (fasting) and 7.7 mmol/L (2 hour later). Although the fructosamine level was not determined in the pre-supplementation stage, the level observed between the 4 and 8 weeks of treatment was 350 and 320 mmol/L, and decreased

further to 280 and 250 mmol/L, 12 and 16 weeks later, before increasing again to 310 mmol/L when the GTF supplement was stopped, finally dropping again when GTF was resumed. There was also a marked decreased in fluid intake and symptoms of polydipsia and polyuria. The fluid intake was 2.8L/24 hr in the pre-supplementation period, but decreases to 2.2, 2.0, 1.8, 1.6, 1.5 litres/24 hr during the 4 weeks intervals of monitoring, going up to 1.7L/24 hr on ceasation of supplementation, before dropping to 1.5L/24 hr with GTF resumption. The details of the study on Case 2 are presented in Table 7.

CONCLUSION

It appears from observation on both case studies, there may be a role of nutritional supplements in the management of NIDDM when pharmacological intervention has not been helpful. Sulfonylureas such as chlorpropamide, tolbutamide and glibenclamide have been used routinely in thin patients, while biguanides such as metformin and phenformin have been indicated for obese diabetics. These range of drugs though useful in a large variety of patients, do have limitations when patients fail to respond, giving temptation to switch to insulin injections. Nutritional intervention with chromium-niacin therapy should be considered before the patient is advised to go on insulin. The

Table 7. Changes in major parameters with treatment of NIDDM Case 2

Status	Pre-Treatment	Weeks 4	8	12	16	20	24	30
Wt (kg)	70.4	70.0	66.5	63	60	60.2	60	60.6
Ht (m)	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
FB Glucose								
mg/dl	205	153	130	112	104	102	125	100
mmol/L	11.4	8.5	7.2	6.2	5.8	5.7	6.9	5.5
GTT: 2 hr Level								
mg/dl	265	203	180	157	144	142	175	140
mmol/L	14.7	11.2	10	8.7	8	7.9	9.7	7.7
Glycosuria	+++	++	+	–	–	–	–	–
Fructosamine								
mmol/L	–	350	320	280	250	–	310	260
Fluid Intake								
L/24 hr	2.8	2.2	2	1.8	1.6	1.5	1.7	1.5

Note:
one week after stopping the supplement
one week after reintroducing the supplement

mode of action of GTF (chromium-niacin) therapy is not clear. It is believed to (1) increase glucose uptake, (2) decrease glycogenesis and (3) enhance insulin bioactivity.

However more studies, notably properly placebo-controlled, double-blind trials need to be carried out before their benefits can be evaluated for large scale treatment. It may be worthwhile considering it as an alternative mode of treatment in certain diabetic patients who may also be on steriods, oral contraceptives and thiazide and loop diuretics for which oral bypoglycaemics may be contraindicated due to the risk of further impairing glucose tolerance.

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Indirect calorimetry in clinical studies

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ABSTRACT

The role of indirect calorimetry has been investigated for the past decade, focusing on its application to the clinical setting. It is not uncommon to find patients being "over fed" with good intentions. Energy requirement of sick patients are "ill-defined" and "guess-work" at best. Overfeeding of patients is often accompanied by hyperglyceamia, excessive CO_2 production and fluid overload. Clinicians are likely to blame TPN when such events occurs. With the increase in sophistication in the medical services, it is imperative that we approach energy prescription as serious as we approach medication prescription, with precision based on scientific evidence. The objective of this paper is to briefly introduce the indirect calorimeters available (room respirometer and Deltatrac), some on-going studies and more importantly to explore the prospect of collaborating with clinicians for improved patient-care in the future.

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Analysis of energy metabolism in patients undergoing peripheral blood stem cell transplantation for malignant disorders

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ABSTRACT

The effects of various therapeutic modalities on resting energy expenditure (REE) and respiratory quotient (RQ) were investigated with indirect calorimetry in an adult with choriocarcinoma and a child with acute lymphoblastic leukemia (ALL). The REE during the consolidation chemotherapy and radiation therapy increased to approximately 120% and 170%, respectively, of that in the non-treated period. During a period of high-dose cytoreductive chemotherapy, the REE peaked at 120% and returned to nearly the baseline level before the peripheral blood stem cell autograft (PBSCT) procedure. Total parenteral nutrition (TPN) was started on day 1 or 3 after PBSCT and continued for 2 weeks. Until 7 to 8 days after PBSCT, the REE remained between 110% and 120%. Interestingly, the REE increased to 140% and 170% in the two patients, respectively, at 10 to 14 days post-PBSCT, in conjunction with the recovery of marrow function. REE returned to basal levels 3 to 4 weeks later, by which time gastrointestinal (GI) function had recovered. RQ tended to decrease during cytoreductive chemotherapy and PBSCT, possibly reflecting energy imbalance and/or impaired glucose metabolism. These results indicated that intensified therapeutic modalities affected energy metabolism and the need for a carefully constructed nutritional support program in this patient population.

INTRODUCTION

Nutritional support for the patient with cancer is an important part of the overall treatment regimen, because nutritional status has a prognostic effect on outcome in patients with cancer[1,2]. Nutritional status is particularly important in determining the resting energy expenditure (REE) in patients, since it reflects changes in body composition due to undernutrition

and changes caused by intermittent semistarvation which is known to directly decrease the REE(3,4). Malnutrition is often a consequence of therapy and its complications, although the direct effects of cytotoxic therapy and other drugs on energy metabolism are variable and poorly documented.

A nitrosourea-based high-dose chemotherapy regimen in conjunction with peripheral blood stem cell transplantation (PBSCT) which has been extensively developed in our hospital, has significantly improved the rate of survival of children with leukemia(5). In this study, we have attempted to determine the effects of various therapeutic modalities on energy metabolism in a longitudinal study of patients undergoing PBSCT for malignant disorders.

MATERIALS AND METHODS

Patients

A 31-year-old patient with choriocarcinoma (Case 1) had received consolidation chemotherapy [pirarubicin (30 mg/m^2), VP-16 (100 mg/m^2 x 5 days), carboplatin (50 mg/m^2 x 5 days)] 3 times. An 8-year-old patient with acute lymphoblastic leukemia (ALL) (Case 2) had received induction therapy and consolidation chemotherapy [VP-16 (100 mg/m^2 x 4 days), Ara-C (100 mg/m^2 x 4 days)] 9 times. Subsequently, both patients were treated with high-dose cytoreductive chemotherapy and then rescued by the PBSCT procedure.

PBSC were collected 2 to 3 weeks after completion of consolidation chemotherapy, and stored in liquid nitrogen. High-dose chemotherapy was used as follows: carboplatin (150 mg/m^2 x 3 days), VP-16 (300 mg/m^2 x 3 days), and thiotepa (200 mg/m^2 x 3 days) for case 1, and ranimustine (MCNU) (250 mg/m^2) on days -8 and -3, VP-16 (200 mg/m^2) plus Ara-C (2 g/m^2/d) on days -7 through -4, and CY (50 mg/kg) on days -2 and -1 for case 2.

Energy-metabolism studies

REE was studied by open-circuit indirect calorimetry (CALORIE SCALE, CHEST.M.I., Tokyo) in these patients at different intervals in the various phases of treatment. REE was measured for 15 min (between 14:30 and 15:30) at 2 to 3 hours after lunch. Energy expenditure was calculated from the respiratory gas exchange using a standard equation(3). The nonprotein respiratory quotient (RQ) and protein oxidation were calculated from measurement of daily urinary nitrogen excretion. Fat and carbohydrate utilization were calculated from the nonprotein RQ(3). The Harris Benedict equations were used to calculate basal energy expenditure (BEE). Informed consent for this study was obtained from the parents and both patients.

RESULTS

1. *Effect of consolidation chemotherapy on REE (Figure 1)*

Following initial induction and consolidation chemotherapy, the REE (mean ± SD) in the non-treated period was 77±7% and

74±11% of the BEE in cases 1 and 2, respectively. During the period of administration of consolidation chemotherapy in case 1, REE increased to 143±6% of that in the non-treated period. In case 2, the REE during chemotherapy and following radiation therapy, respectively, increased to 121±15% and 164±12% of that in the control period.

2. *Effect of high-dose cytoreductive chemotherapy and PBSCT on energy metabolism*

In case 1 during the administration of high-dose cytoreductive chemotherapy, the REE peaked at 120% and returned to nearly the baseline level before the PBSCT procedure (Figure 2). Total parenteral nutrition (TPN) was started on day 1 and continued for 12 days. Until day 7 after PBSCT, REE remained between 110% and 120%. The REE increased to 138±11% between days 10 and 14 post-PBSCT, in conjunction with the recovery of marrow function after 10 days of marrow aplasia. REE returned to the basal level 3 to 4 weeks later by which time GI function had recovered. Cytoreductive chemotherapy decreased the carbohydrate oxidation rate and increased both the fat oxidation rate and protein degradation.

In case 2 during cytoreductive chemotherapy, the REE was 128±10% of the basal level. TPN was started on day 3 after PBSCT and continued for 2 weeks. REE remained between 133% and 145%. Interestingly, as also observed in case 1, the REE increased to 172±7% between days 8 and 15 post-PBSCT. This increase was also closely related to recovery of marrow function after 8 days of marrow aplasia. Protein catabolism was significantly elevated by aggressive chemotherapy and continued until day 5 after PBSCT. In addition, carbohydrate oxidation was suppressed during and after high-dose chemotherapy and this also improved with marrow recovery.

DISCUSSION

Several studies have investigated energy expenditure in patients with cancer (6-8) and leukemia (9,10). However, there is little information regarding WBC counts or the timing of REE measurement with relation to chemotherapy and radiation therapy. It has been generally accepted that patients with a greater tumor burden show increased energy expenditure and the REE returns to normal in response to chemotherapy. In this study, the REE in the non-treated period after induction therapy and repeated consolidation chemotherapy was lower than the BEE and clinical signs of cancer were not observed, suggesting inactive or small tumors in our two patients. Therefore, our results demonstrate the effects of various treatments on energy metabolism without the influence of an active tumor.

Nutritional deficiency in PBSCT resulted from the combination chemotherapy used in our cases. Nitrogen loss also occured both as a result of poor nutritional intake and as a direct result of the catabolic effect of cytoreductive therapy. Furthermore, substrate utilization was altered by chemotherapy with a decrease in

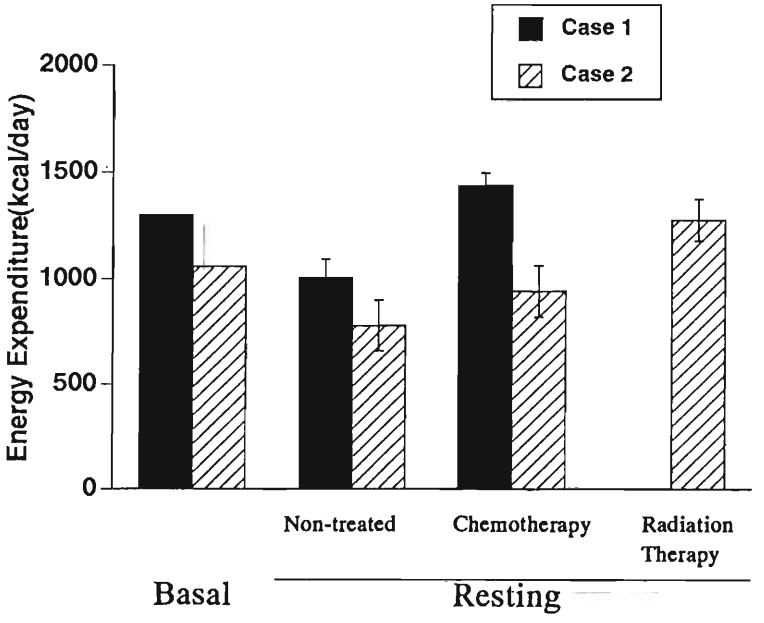

Figure 1. Effect of consolidation chemotherapy on REE

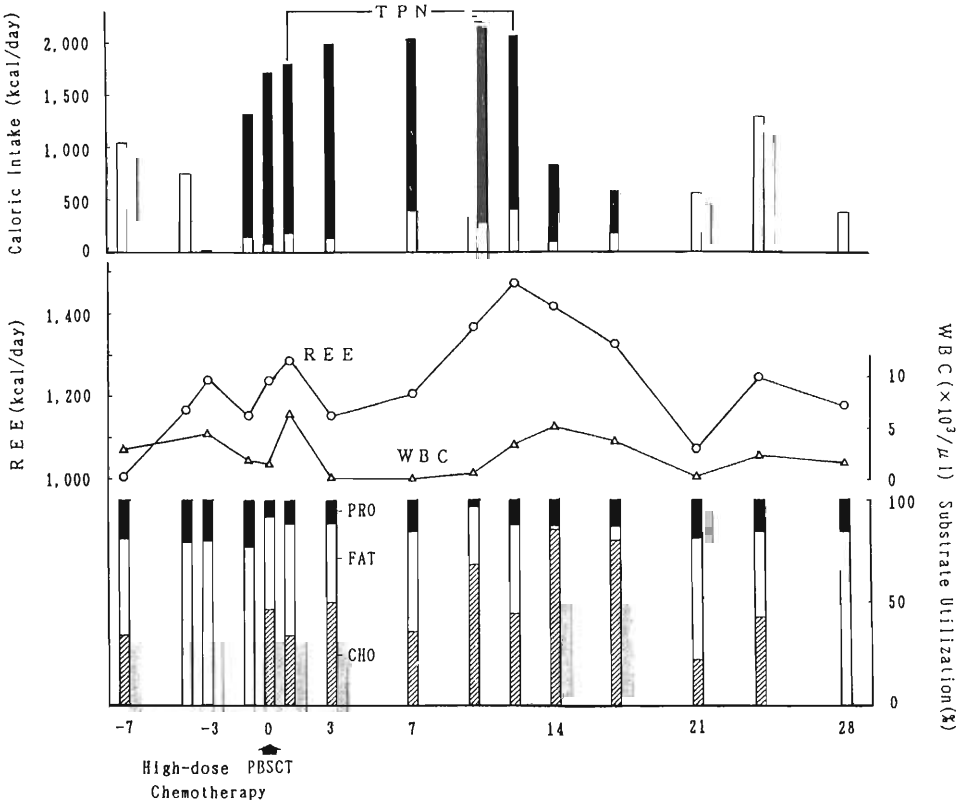

Figure 2. Effect of high-dose cytoreductive chemotherapy and PBSCT on energy metabolism.

carbohydrate oxidation. Moderately increased REE observed from day 0 to day 8 after PBSCT in our patients might be explained by the severe metabolic stress and inflammation resulting from the conditioning regimen, with maximum clinical expression in the first week after the procedure. Increased fat utilization is the result of either hormonal changes(11-14) promoting lipolysis or possibly intracellular effects promoting fatty acid oxidation. Therefore, it is conceivable that patients undergoing PBSCT are at severe risk of malnutrition. This finding agrees with the results of previous bone marrow transplantation studies showing that aggressive chemotherapy and radiotherapy(15-17) in the conditioning regimens and the duration of malabsorption resulting from gastrointestinal lesions(18) could cause weight loss due to acute catabolism and worsening of other anthropometric parameters(19).

Furthermore, it is interesting that our patients showed marked increases in REE at 10 to 17 days post-PBSCT, in conjunction with the recovery of marrow function after 10 days of marrow aplasia, and that REE returned to basal levels 3 to 4 weeks later, by which time GI function had recovered. These findings strongly suggest that the increased REE reflected the enhanced status of hematopoietic cell proliferation, and that bone marrow recovery required a greater nutritional supply. From the above results, increased REE after PBSCT might consist of a first phase of severe metabolic stress from aggressive chemotherapy and a second phase of recovery in marrow function.

Therefore, we conclude from the present study that intensified therapeutic modalities affect energy metabolism and the need for a carefully constructed nutritional support program in this patient population.

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Parenteral nutrition in paediatric patients undergoing bone marrow transplantion at University Hospital, Kuala Lumpur

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ABSTRACT

Since the first bone marrow transplantation on a paediatric patient in UHKL in March 1987, the total number performed until today is 92, out of which 68 are still alive. The proportion of these patients requiring parenteral nutrition (PN) is approximately 68.5%. The major indications for parenteral nutrition are severe nausea and vomiting and significant oro-pharyngeal mucositis leading to inadequate oral intake for prolonged periods of time. On average, the duration of time for which parenteral nutrition is required is 25.6 days in 1991, 24.3 days in 1992 and 19.7 days in 1993.

The major complication of PN seen is catheter sepsis. Between 1991 and 1993, there were 9 cases of proven catheter sepsis. They were all treated with the appropriate antibiotics and none of the catheters had to be removed as a consequence of the sepsis. From our group of patients we find that abnormalities of liver function that can be attributed to PN are mild in children undergoing bone marrow transplantation. Greater abnormalities usually indicate another cause of liver toxicity such as septicaemia.

The numbers of bags of PN dispensed were 252 in 1991, 442 in 1992 and 298 in 1993. The cost incurred was RM17,202.00, RM33,760.50 and RM29,476.00 respectively.

INTRODUCTION

Since the first bone marrow transplantation on a paediatric patient in UHKL in March 1987, the total number performed until today is 92, out of which 68 are still alive. Of these 92 patients, 63 (68.5%) required parenteral nutrition (see Table 1)

Indications for parenteral nutrition (PN)

Children undergoing bone marrow transplantation often

Table 1. Percentage of BMT requiring PN (1987–1993)

Year	No. of BMT	No. Given PN (Percentage)
1987	8	5 (62.5%)
1988	6	2 (33.3%)
1989	22	13 (59.1%)
1990	5	2 (40.0%)
1991	12	11 (91.7%)
1992	21	18 (85.7%)
1993	18	12 (66.7%)
TOTAL	92	63 (68.5%)

cannot tolerate oral food intake for a number of reasons. The immune-suppressant and chemotherapy drugs (eg. cyclophosphamide melphalan and bulsulphan) that these children start receiving from about a week before transplant, cause severe nausea, loss of appetite and vomiting. It is also not uncommon for them to get oropharyngeal mucositis. Although in general, we try to use the gastrointestinal tract for alimentation, the above problems often make parenteral nutrition necessary. In most of these children, poor nutritional status prior to transplant is not the major indication for PN.

Length of parenteral nutrition

The sex ratio, average age and average duration of parenteral nutrition for the years 1991, 1992 and 1993 are summarised in the table below (Table 2):

PN Formula

Parenteral nutrition is usually started a few days after the transplant procedure. In severe cases, it may have to be started even before the transplant itself.

The general formulations for PN are shown in the table below (Table 3)

Catheter sepsis

A central venous line such as a Cook's catheter is used for PN administration. The incidence of catheter sepsis between 1991 and

Table 2. Duration of PN

	1991	1992	1993
Number needing PN	11 (91.7%)	18 (85.7%)	12 (66.7%)
M : F	6 : 5	12 : 6	8 : 4
Average Age (Years)	6.8	6.4	7.9
Average duration of PN (days)	25.6	24.3	19.7

Table 3. Standard Pn Formula for Paediatric Bone Marrow Transplant Patients

Composition	Paeds Standard Solution	Special Request for the Day
Dextrose %	10 – 23%	
Nitrogen g/kg	0.2 – 0.3	
Na mmol/kg	3	
K mmol/kg	2	
Ca mmol/kg	0.5	
Mg mmol/kg	0.2	
PO4 mmol/kg	0.5	
Ped-El ml	4/10/20	
Soluvit ml	1 ml/kg	
Fat g/kg	3	Tues & Fri only
Total energy	110 kcal/kg/day	

1993 is 9 (During this period there were 41 patients receiving PN). The organisms isolated on these 9 occasions are listed below:

1. Staphylococcus aureus
2. Staphylococcus aureus
3. Staphylococcus epidermidis
4. Staphylococcus epidermidis
5. Enterobacter
6. Staphylococcus epidermidis
7. Salmonella
8. Staphylococcus aureus/staphylococcus epidermidis
9. Staphylococcus epidermidis

These infections were treated with the appropriate antibiotics and none of the catheters had to be removed as a consequence of the sepsis.

Changes in liver function tests

In general, there is a tendency for the liver enzymes to rise when chemotheraphy drugs are used. The abnormalities of liver function with total parenteral nutrition are mild in children undergoing bone marrow transplantation. Our patients do not tend to develop cholestatic jaundice as a result of PN. This is illustrated in Table 4 which summarises the liver function test results before and after PN in 8 patients who received PN in 1991.

Greater abnormalities of liver function usually indicate another cause of liver toxicity such as septicaemia.

Cost of PN

The number of bags of PN dispensed were 252 in 1991, 442 in 1992 and 298 in 1993. The cost incurred was RM17,202.00, RM33,760.50 and RM29,476.00 respectively.

Table 4. Changes in liver function tests following PN

Case	Underlying Disease	Indication for PN	Duration of PN (Days)	Liver Function Test (Before/After Completion of PN)				
				Total Bilirubin (μmol/L)	ALP (iu/L)	AST (iu/L)	ALT (iu/L)	Comments
1.	Diamond-Blackfan Syndrome	poor appetite ↓ oral intake	19	16/12	159/170	29/59	60/83	Well
2.	Acute non-lymphoblastic Leukaemia	poor appetite ↓ oral intake	22	9/15	133/400	24/106	17/153	Initially well, Leukaemia relapsed after 2 yrs. Died.
3.	Chronic Myeloid Leukaemia	poor appetite ↓ orak intake	23	18/15	127/109	38/60	22/275	Well
4.	Severe aplastic Anaemia	poor appetite ↓ oral intake	21	9/13	215/147	13/42	7/48	Well
5.	Thalasseamia	severe mucositis ↓ oral intake	24	10/6	120/119	48/70	81/118	Well
6.	Osteopetrosis	poor appetite ↓ oral intake	33	9/4	470/140	18/23	3/14	Well
7.	Severe aplastic Anaemia	No TPN given		11/8 (Values are at the start of BMT and 30 days after BMT)	66/153	16/84	23/58	Well
8.	Severe aplastic Anaemia	poor appetite ↓ oral intake	19	28/289 (conj 166)	144/118	17/63	93/164	died of Klebsiella septicaemia

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Nutritional management of gestational diabetes mellitus

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ABSTRACT

There is an increasing trend in the number of patients with gestational diabetes mellitus (GDM) seen at the antenatal clinic at Universiti Kebangsaan Malaysia (UKM). In light of this, the objective was to review articles and international research papers on the nutritional management of GDM. Nutrition counselling is the cornerstone of the management of women with GDM and is based on the standard nutritional recommendations for pregnant women. There is no consensus of opinion regarding the criteria used for diagnosis and initiation of insulin; it has been suggested that the cut-off levels are too low and would over diagnose GDM. Energy requirement during pregnancy remains a controversy. A recent study indicated that the total energy requirement is in the range of 22,000 kcal for the whole pregnancy. An allowance of an extra 100 - 150 kcal/day during the second and third trimester is adequate. Individualization of the diet, depending on the body weight of the pregnant women, is recommended. Carbohydrate should account for about 50% - 60% of the total energy intake; most of the carbohydrate should come from complex sources as they are high in natural dietary fibre. Even distribution of carbohydrate to avoid post prandial hyperglycemia is needed. Fibre intake should follow the diabetes recommendation of 30 g/day and emphasis should be put on soluble fibre. Sucrose and fructose intake is limited to 30 g/day and 50 g/day respectively and to be consumed as part of a mixed meal of high complex carbohydrate, high fibre and low fat. Two types of non-caloric sweetener saccharin and aspartame, are approved during pregnancy, however they should be used in moderation. Fat intake should be reduced to 30% - 35% of the total energy intake, of this only 10% saturated fats, 10% polyunsaturated fats and 10% - 15% monounsaturated fats. The fat reduction will not only assist in weight management but also reduces the risk of coronary heart disease among noninsulin-dependent diabetes mellitus (NIDDM) as women with GDM have a high risk of developing NIDDM later in life. Total abstinence from alcohol is

recommended to women with GDM. Exercise should be considered as an adjunct to diet; the type of exercise recommended is the non-weight-bearing exercise. Nutrition counselling should be stressed in the first trimester

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as a carbohydrate intolerance of variable severity with onset or first recognition during the pregnancy (1). Dietary management has been used for the treatment of pregnancies complicated by diabetes since the 19th century. Since 1898, diets prescribed for persons with diabetes have ranged from extremely high-fat to under nutrition and fasting (2). GDM occurs in about 3% of pregnancies and usually disappears after delivery (3). However, it is known that women with GDM are at increased risk for developing noninsulin-dependent diabetes mellitus (NIDDM) later in life (1-7). Women who are at risk for GDM are those who have a family history of diabetes mellitus, previous delivery of large babies, maternal age above 30 years and poor obstetric history (1,6). The infants of mothers with GDM are at significant risk for fetal macrosomia. Consequences of excessive fetal growth include birth trauma and maternal morbidity from operative delivery (1,4). Other significant neonatal morbidities include hypoglycemia, hypocalcemia, hyperbilirubinemia and polycythemia (1).

The purpose of this paper is to review current knowledge on nutritional management for women with GDM.

SCREENING

All pregnant women should be screened for glucose intolerance because selective screening based on clinical risk factors or obstetric history has been shown to be inadequate (1,3-5,8). Pregnant women who have not been identified as having glucose intolerance before the 24th week should have a screening glucose load between the 24th and 28th week consisting of 50g oral glucose given without regard to time of the last meal or the time of day. A value of 7.8 mmol/L or above is recommended as a threshold to indicate the need for a full diagnostic oral glucose tolerance test (OGTT) (1).

DIAGNOSIS

There is no consensus of opinion regarding the criteria used for diagnosis (1,9-11). The Australasian Diabetes in Pregnancy Study Group has recommended that a 75 g OGTT be used as the diagnostic test. GDM is diagnosed if either the fasting value is > 7.2 mmol/L or the 2 hour value is > 11.0 mmol/L (10). These cut-off values are used because the diagnostic criteria recommended by the American Diabetes Association (11) and the Third International Workshop-Conference on GDM (1) are too low and would over diagnose GDM (9)

NUTRITIONAL RECOMMENDATIONS FOR MANAGEMENT

Nutritional recommendations for women with GDM are based on the nutritional recommendations for diabetes and also following the standard nutritional recommendations for pregnant women [1,11-13].

Energy requirements

There is considerable controversy about the energy requirements in pregnancy. National and international bodies [13] have adopted different views about how much extra energy is required in pregnancy.

Recently a study by Durnin [14] provided evidence that total caloric needs of 80,000 kcal to 85,000 kcal are an overestimate. Durnin found that the total energy cost during pregnancy reached 69,000 kcal. The extra amount of energy provided by the diet was only 22,000 kcal leaving a deficit of 47,000 kcal. The deficit may be due to a reduction in physical activity accompanied by an increase in the mechanical efficiency of physical movement. Following this, an allowance of an extra 100-150 kcal/day during the second and third trimeter are adequate.

Javonovic - Peterson and Peterson [2] reported that women with GDM maintain ketone clearance and prevention of postprandial hypoglycemia with a caloric intake of 30 kcal/kg for normal weight women (i.e 80 - 120% of prepregnancy ideal body weight), 40 kcal/kg for under weight women who are less than 80% of prepregnancy ideal body weight and 24 kcal/kg for those greater than 120% of prepregnancy ideal body weight. Several studies [15-19] have adopted these guidelines in determining the caloric requirement of all women with GDM. In practical terms, the best guide to individual energy requirements for women with GDM is the rate of weight gain [1,20].

Weight gain

Maternal obesity and high weight gain in pregnancy contribute the greatest risk [3,4]. Studies have shown that the incidence of macrosomia decrease [17], insulin sensitivity improves [2,20] and a lower requirement for insulin treatment occurs [7,20] when weight gain of GDM women was curtailed through calorie restriction [2,15,20].

There is no general agreement regarding the desirable weight gain during pregnancy [1,2,20]. The Third International Workshop Conference on GDM [1] issued a recommendation for weight management. An inverse relationship between prepregnancy body weight and average weight gain during pregnancy is considered appropriate with a maximum increase of 7 kg recommended for the very obese (body mass index (BMI) > 29 kg/m^2), a greater weight gain up to 18 kg for those who are underweight (BMI < 19.8 kg/m^2) and 11.5 kg to 16 kg for the normal weight (BMI = 19.8 - 26 kg/m^2). The panel stressed that each GDM women be assessed individually and the diet tailored specifically (to them) for weight management.

Carbohydrate

The American Diabetes Association (ADA) (11) recommends that all GDM women should follow the carbohydrate distribution proposed for the management of diabetes. The amount of carbohydrate recommended is 50 - 60% of the total energy (21). The emphasis is to distribute the carbohydrate throughout the day to avoid postprandial hyperglycemia.

The knowledge on the effect of food to glucose response is important as different carbohydrate foods produce different glycemic response (22). The glycemic index (GI) may help GDM women to select the most appropriate foods to minimize postprandial hyperglycemia and aid in mixed meal planning.

When carbohydrate percentage was kept between 30 - 40% of the total energy, women with GDM were able to sustain their postprandial glycemia (2). Generally the concern has arisen that lowering carbohydrate content would automatically increase fat intake (to 40%) and protein intake (to 20%). Higher fat intake would lead to an undesirably high intake of saturated fat (21).

It was found that to maintain a 1 hour postprandial blood glucose level of < 7.78 mmol/L, the following percentages of energy from carbohydrate needed to be used, 45% at breakfast, 55% at lunch and 50% at dinner. For a postprandial blood glucose of < 6.67 mmol/L, the respective carbohydrate values for breakfast, lunch and dinner were 33%, 45% and 40% (19). The glycemic response to a mixed meal in subjects with GDM is highly correlated with the percentage of energy derived from carbohydrate (along with the type of carbohydrate) and varies among individuals and also meal times.

The most difficult meal to ingest without inducing postprandial hyperglycemia was breakfast (2). Only 10% of total energy was recommended and the meal should preferably be devoid of starch. This is due to the glucose intolerance usually seen in the morning as a result of peaking of growth hormone and cortisol. This is known as the `Dawn Phenomenon' (23) and can be corrected by insulin only.

Dietary fiber

Extensive studies of high fiber, high complex carbohydrate and low fat diets have shown beneficial effects in glycemic control of diabetes mellitus (25,26). This benefit was also observed in women with GDM. Paisey et. al (27) followed a GDM woman during her 3 pregnancies. The first pregnancy was managed by insulin but, the subsequent pregnancies were successfully managed by a high fiber low fat diet alone. Soluble and insoluble fiber was used to maintain normal blood glucose levels. This study, however is not representative of all women with GDM as only one subject was followed. The addition of soluble fiber to glucose blunted the rise in postprandial blood glucose levels among women with GDM (28). Soluble fiber in the diet not only improves the glycemic control but also improves blood lipid profile, reducing serum

cholesterol and triglyceride while maintaining high density lipoprotein cholesterol (22). Dietary fiber assists with weight control in women with GDM.

There is no specific fiber recommendation for women with GDM. The recommendations of 30g/day suggested for nonpregnant diabetic individuals may be followed (21); and the type of fiber to emphasize is soluble fiber.

Protein

The metabolism of protein in pregnancy has been summarised elsewhere (29,30). The protein requirement specific to pregnancy is 54g/day (13). All women with GDM should follow this requirement (1).

Vitamins and minerals

The recommended dietary intakes of vitamins and minerals for women with GDM are similar to the requirements of normal pregnant women (13).

Fat

Maternal obesity is common among women with GDM (1,3-7). Restricting fat intake to 30 - 35% of the total energy, with saturated and polyunsaturated fats to be less than 10% respectively (21) will not only control weight increase (15,16) but also improve insulin sensitivity (2,20). Emphasis has been given to saturated fatty acids because high intake has been associated with coronary heart disease and atherosclerosis among individuals with NIDDM (21); women with GDM have a high chance of developing NIDDM as they age (1-6).

Sugars and artificial sweetners

Studies (30,32) have shown that dietary sucrose does not cause a greater postprandial rise in plasma glucose than isocaloric amounts of other common carbohydrates. Sucrose when consumed as part of a mixed meal of high carbohydrate, high fiber and low fat does not cause any deterioration in glycemic control or blood lipid levels (32). A recommendation of 30 g/day was put foreward by the BDA (21).

The use of fructose is limited to 50g/day and like sucrose has to be consumed as part of mixed meal. Fructose intake in the diabetic diet may infact improve glycemic control (31).

There are two federally approved non-caloric sweetners, saccharin and aspartame for use during pregnancy (33,34). Epidemiological studies have shown no evidence of bladder cancer in humans who used saccharin (34). The ADA (33) assures that the hazards of ingestion at moderate levels are considered extremely small. Maternal ingestion of saccharin proved of no harm to the fetus, however heavy use during pregnancy should be avoided (33). Aspartame usage during pregnancy is not considered toxic to the fetus eventhough aspartame crosses the placenta (36,37).

Alcohol

The most important effect of alcohol is fetal alcohol syndrome (FAS), characterized by mental and

physical retardation. Consequences of FAS have been documented by several studies (38,39). The avoidance of alcohol throughout pregnancy remains controversial. Thomas (40) stated that the occasional drink would not cause any harm and that total abstinence is unnecessary. Several studies (38,39) however oppose this view, providing evidence that FAS is dose related. Moderate alcohol consumption is associated with a higher incidence of congenital abnormalities. Even two drinks a day may cause minimal risk. For women with GDM alcohol should be avoided (38-40).

EXERCISE

Exercise has been recognised as an adjunct therapy for the control of blood glucose in nonpregnant NIDDM individuals because it increases insulin sensitivity and responsivity (41). The benefits of exercise to individuals with NIDDM could be utilized to reverse the insulin resistance associated with GDM. This has proven to be effective. Horton (42) agreed that regular physical exercise is a potential approach to the prevention and treatment of GDM. Women who exercise did infact improve their glycemic levels significantly; had normalised glycosylated hemoglobin (HbAlc) of 4.2%, fasting blood glucose of 3.89 mmol/L and postprandial glucose level of 5.9 mmol/L on a 50g OGTT (43). These levels obviate insulin therapy (44).

No adverse maternal or fetal response have been reported so far in pregnant women with diabetes engaging in mild to moderate exercise (43,44) Javanovic-Peterson and Peterson (43) found that exercise is infact safe during pregnancy and that non-weight-bearing exercise, upper-arm ergometer and recumbent bicycling can be recommended during pregnancy.

No episodes of hypoglycemia were noted in either of the studies. This was due to a well planned diet balanced with the exercise program.

The Third International Workshop-Conference on GDM endorsed the concept that pregnant women with diabetes may continue a program of moderate exercise but under medical supervision (1).

INSULIN MANAGEMENT

Dietary manipulation is the mainstay of management for GDM. However if normoglycemia is not achieved, insulin therapy is initiated to sustain fasting and postprandial blood glucose levels within normal limits.

Insulin therapy was initiated when fasting blood glucose (FBG) was greater than 6mmol/L and the 2 hour postprandial below 7 mmol/L (10). This criteria is higher than the recommendation put forward by the ADA (11) and the Third International Workshop-Conference (1). Most of the studies (15-19) used the levels recommended by the ADA (11). This review, however, covers the cut-off levels of < 5.8 mmol/L for insulin initiation.

Langer et al. (17) reported that GDM women who were on diet therapy achieved an incidence of 5.3% large for gestational age

(LGA) babies. However, when insulin therapy was used to optimise the control, an incidence of 3.5% LGA babies was noted. The first group of patients were not able to achieve the same optimal glycemic control as the group treated with insulin. This was supported by Maresh et. al (18). They observed that patients on diet alone did not show such a marked reduction in plasma glucose concentrations. Fifteen patients who were in the diet treated group had to switch to insulin to achieve acceptable plasma glucose control (16).

The elevations of blood glucose level do not suggest that patients are not complying with dietary treatment but are a result of metabolic abnormalities. In fact the women who were in the diet treated group showed only limited weight gain (15,18-20). These findings emphasizes that women during pregnancy are highly motivated and that changes in dietary eating patterns are achievable.

CONCLUSION AND RECOMMENDATION

Nutritional management is the cornerstone of the management of women with GDM. The aim of the diet is to provide the caloric and nutrient needs for pregnancy and not cause starvation ketonuria or postprandial hyperglycemia. More research studies are needed to determine the ideal diet for GDM.

Dietitians have an important role to play as pregnancy is the time of greatest nutritional vulnerability and even more so with GDM. Therefore nutrition counselling should be stressed in the first trimester.

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Effect of group diet counselling in blood glucose control (preliminary findings)

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ABSTRACT

The aim of this study is to determine the effectiveness of group diet counselling on blood glucose control among non - insulin dependent diabetes mellitus (NIDDM) individuals in a rural area. Subjects were recruited from a list of NIDDM who were patients of Sg. Koyan Health Centre. Sixty one people participated and they were divided into six groups. Group counselling sessions were conducted monthly by a dietician. The effectiveness was assessed by anthropometry measurements and total HbA1 levels. The mean BMI, total HbA1 and cholesterol levels were found to be significantly different from the baseline ($p<0.05$) by using paired t-test. The mean intake of energy, carbohydrates and fats were also significantly different from the baseline during the same period. The result of this observation indicates that group counselling is a useful method in educating NIDDM individuals in rural areas. However, further follow up is necessary to assess sustainability.

INTRODUCTION

Amongst non-communicable diseases, diabetes mellitus has always been recognized by the World Health Organization (WHO) as a problem of public health importance. Succesful management of diabetes is often difficult to achieve among NIDDM individuals because the prescribed health regimen is complex and difficult to follow(1). The usual management techniques used in clinic are based on advice and education (2). Education alone has had very little effect on health regimen compliance (3,4); however, group counselling is an efficient way to communicate general principles of nutrition and behavioral change(5). Time can be used most effectively by counselling patients in groups. Various studies designed to assess the effect of the group approach have revealed a correlation between group participation and behavioral change for improved disease management (2,6,7,8). In this study, group nutritional counselling was done. Through the group counselling, personal interaction can develop. The interaction process takes place mostly among group members. Sharing of experiences enhances

awareness that others have similar problems. Furthermore, group members can teach one another, provided they commit themselves (9).

The objective of this study is to determine the effect of group diet counselling on blood glucose control among NIDDM individuals in a rural area.

METHODS

One hundred subjects were taken from a list of adults with NIDDM who were patients of Sg. Koyan Health Centre, Raub, Pahang. They were contacted to determine their interest in participating in this program. Agreement to participate in the study was indicated by signing a consent form. Sixty one of these patients were recruited for the study. The objectives of the study were explained to each participant.

A questionnaire was completed for all participants by the researcher. Weights, heights and total glycohemoglobin (total HbA1) values of the participants were obtained prior to group counselling and again at every two months to determine the effectiveness of group diet counselling. Total cholesterol and triglyceride levels and food intake were also obtained. Total HbA1 was measured using the micro-colorimetric method and reported as a percentage of total glyco-hemoglobin (10). Body mass index (BMI) was calculated as BMI = weight (kg)/height (m^2). Total cholesterol and triglyceride levels were measured using the Reflotron analyzer (Boehringer Manheim). Twenty four hour dietary recall was used to determine food intake of each participant (11).

The participants were divided into six groups. Initially, group sessions were conducted twice a months for a period of one hour and later at one month intervals. The six sessions covered nutrition education relating to diabetes. Topics discussed by the groups were definition of diabetes, food groups for meal planning, types of carbohydrates, snacks, weight control, role of fiber and exercise, dietary fats and cholesterol, and complications of diabetes. Groups were led by a dietician who conducted the session. Following each session, participants were encouraged to discuss with each other to facilitate support.

The SAS statistical package was used to analyze the results (12). Paired t-test were used to determine if pre- and post-intervention measurements differed significantly. A probability of $p<0.05$ was considered statistically significant for all statistical procedures. This paper only analysed the data from the first four sessions of group diet counselling.

RESULTS

Sixty-one NIDDM individuals participated in this study. There were 25 females and 36 males. Their mean age was 52 $\pm$ 7 years (Table 1). 57 individuals were treated by diet and oral hypoglycemic agents (OHA) and 2 individuals were treated by diet alone. Most of them (n=52) had received advice on diabetes treatment from doctors or nurses (Table 1).

Table 1. Characteristics of subjects prior to group diet counselling

Item	Values
Mean age (years) (n = 61)	52 ± 7
Years since diagnosed (n = 59)	6 ± 6
Gender (n)	
male	36
female	25
Types of treatment (n = 59)	
diet	2
diet + OHA	57
Advice (n = 61)	
Yes	51
No	10

Table 2 shows changes of BMI, blood glucose control and blood lipids levels. The mean BMI value was reduced significantly ($p<0.05$). The mean total HbA1 after 4 sessions of group diet counseling was reduced to 7.3 ± 0.2% ($p<0.05$) from 7.5 ± 0.2%. Total cholesterol level was significantly different ($p<0.05$) from the pre-group diet counseling.

Changes of food intake are shown in Table 3. Calories and percentage of energy from carbohydrate intake increased

Table 2. Comparison of before and after 4 sessions of group diet counseling (GDC) for BMI, total HBA1, total cholesterol and triglyceride levels.

Item	Pre-GDC	After 4 GDC
BMI (kg/m^2)	29.3 ± 0.6 (n = 61)	28.2 ± 0.5* (n = 56)
Total HbA1 (%)	7.5 ± 0.3 (n = 61)	7.3 ± 0.2* (n = 61)
Total cholesterol (mmol/l)	5.8 ± 0.2 (n = 61)	5.5 ± 0.1* (n = 61)
Triglyceride (mmol/l)	1.8 ± 0.2 (n = 61)	1.7 ± 0.1 (n = 61)

Mean ± SEM
* $p < 0.05$; paired t-test

Table 3. Pattern of food intake before and after 4 sessions of group diet counselling

Item	Pre-GDC	After 4 GDC
	(n = 55)	(n = 55)
Calories (kcal)	1349 ± 52	1529 ± 34*
Carbohydrates (% of total energy)	48.3 ± 1.7	50.0 ± 1.1*
Fat (% of total energy)	28.2 ± 1.5	24.0 ± 0.8*

mean ± SEM
* $p < 0.05$; paired t-test

significantly ($p<0.05$) whereas the percentage of energy derived from fat intake was reduced ($p<0.05$) compared to the group before diet counselling.

DISCUSSION

Participation in group diet counseling resulted in a statistically significant reduction in mean BMI, total HbA1 and cholesterol levels. Others have reported that group education programmes are effective in blood glucose control and weight reduction. Mount et al. (13) reported a significant reduction of BMI and HbA1c following ten sessions of a group education programme. Warren-Boultan et al. (7) found a significant decline in HbA1c following group intervention in a study conducted with adolescents and young adults.

There are some limitations in this study. The mean HbA1 levels were fairly good both before and after group diet counselling. Glycosylated hemoglobin levels reflect diabetic status over a longer period of about 2-3 months (10). HbA1 usually declines with improvement in weight. This is probably due to the increase in activity level. Furthermore, some of them might have normal BMI at pre-group diet counseling. The change in pattern of food intake may also have influenced the HbA1 values at after group diet counselling. The increased energy and carbohydrate intake and the decline of fat intake showed that patients were trying to follow the 1500 kcal diabetic diet.

CONCLUSIONS

The study showed that group diet counselling for the education of older persons with diabetes was a useful and practical way to control blood glucose in rural areas.

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Enteral and parenteral nutrition in infancy and childhood

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ABSTRACT

Nutritional management of infants and children differs from adults because of growth consideration and organ maturation. Even in developed countries, the highest incidence of malnutrition is in the hospitalised patients and it adversely affects their illness or injury. During the past two decades rapid advancement in clinical nutrition has led to safer and newer enteral and parenteral nutritional support. This paper outlines the need for nutritional support of young infants and children and the current indications and contraindications for enteral and parenteral nutrition. The availability of enteral and parenteral nutritional products and the delivery systems in Malaysia will be reviewed. Monitoring of infants and children who receive nutritional support and complications with specific reference to infants will be discussed briefly. The recent advances in enteral and parenteral nutrition and its application in infants and children with sepsis, organ failure and cancer will also be discussed.

Nutritional support is one important component of the overall management of patient care. Patients will derive maximum benefit with minimal complications by choosing the specific nutrition intervention strategy at the appropriate time by a well coordinated nutritional support team.

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Enteral and parenteral nutrition: an overview

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ABSTRACT

Up to 30% of hospitalized patients are found to be malnourished by anthropometric measurements and by biochemical testing. Malnutrition results in increased morbidity, mortality, length of hospitalization and duration of convalescence as well as poor quality of life. It is easier to prevent malnutrition by early intervention than to wait for it to develop. Patients should not be allowed to starve for more than 5 days.

If support is needed, enteral nutrition is the first choice even if the entire caloric needs cannot be met. This prevents atrophy of the gut with its attendant translocation of bacteria and toxins through the intact walls of the bowel resulting in the so-called "septic syndrome". Enteral nutrition can be given via the nasoenteral route or via surgically placed feeding tubes into the stomach or jejunum. Enteral feeding is available in polymeric, elemental or semi-elemental forms.

Parenteral nutrition is given via peripheral veins or central veins when the gut cannot be used.

Components of nutritional support include carbohydrates, fats, proteins, electrolytes, vitamins and trace elements. These must be given in proper forms, proportions and dosages. Caloric requirement is between 30 to 70 kcal/kg/day depending on the stress factors, provided as fat or carbohydrate. Protein requirement is between 1 to 3 grams of protein/kg/day.

All patients are closely monitored with clinical examination and biochemical parameters. Complications of EN include aspiration pneumonitis, constipation, and diarrhea. Complications of TPN include catheter sepsis. Electrolyte imbalance and hyperglycemia should be closely watched for. Nitrogen balance estimations help to determine the efficacy of nutritional repletion.

A well organized nutrition support team helps the clinicians to provide optimal nutritional and metabolic support to patients.

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Parenteral and enteral nutrition outside the hospital: is it safe and cost effective?

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ABSTRACT

Home parenteral nutrition was first attempted in the late 1960s. It was used initially for patients with extreme short bowel syndrome or severe gut motility disorders and resulted in long term, high quality rehabilitation. Several patients have now lived as long as 20 years on this therapy. In the United States, the initial success of this therapy led to the rapid expansion of HPN to patients with short term clinical needs, many in the terminal phase of cancer or AIDS.

While tube enteral nutrition in non hospital setting is not a new technique, recent advances have made the enteral approach far more user-friendly and unfortunately also more expensive. Even so there is a growing body of evidence showing that HEN, compared to HPN, has many physiological benefits, fewer clinical complications and is only one tenth of the cost. In the United States, these improvements in modern enteral nutrition have also led to an expanded use of this therapy both at home and in nursing homes.

While data will be presented to show that HPN and HEN outcome chiefly reflect the natural history of the underlying disease, it will also be emphasized that certain patients with cancer and AIDS also have long survival and therefore functional criteria would appear more useful than the specific disease classification of determining the appropriateness of these expensive therapies.

INTRODUCTION

Home parenteral nutrition was first attempted in the United States in 1967(1). Although the first patient survived only a few months, the feasibility of transferring a very complex therapy from hospital to home, was clearly demonstrated. During the next few years there were several reports of patients going home on parenteral nutrition (HPN) who had extreme short bowel syndrome from Crohn's or ischemic bowel disease, or severe gut motility disorder, experiencing long term, high quality

rehabilitation (2-7). In the United States this initial success of the therapy led to a rapid expansion of HPN to many other types of bowel diseased patients. This growth particularly occurred in diagnostic groups such as cancer or AIDS, that usually have short term clinical prognoses (8-12). With major health care reform in the USA imminent, the need for medical consensus about the appropriate use of such an expensive technology has become urgent (13,14).

While tube enteral nutrition in non-hospital settings is not a new technique, recent advances have made the enteral approach far more user-friendly, even for patients with upper gastrointestinal obstructive cancers (15-16). There is a growing body of evidence showing that enteral nutrition, compared to parenteral nutrition, has many physiologic benefits, fewer clinical complications and is only one tenth the cost. In the United States these factors have all led to an expanded use of tube enteral nutrition both at home and in nursing homes (14, 17).

FACTORS INVOLVED IN PROVIDING HOME PEN SAFELY

There are both immediate needs of the patient and their family and then larger needs to insure the therapy is properly regulated. The immediate needs are:

(1) A knowledgeable medical team

who are familiar with the practical issues facing the patient and who can recognize therapy complications, including nutrient imbalance [see chapter on the Clinical and Laboratory Diagnosis of Micronutrient Deficiency Syndromes].

(2) A patient and family learning center

where the technique of self-infusion is taught in a calm, friendly atmosphere(18,19) away from the bustle of an in-patient ward or out-patient clinic.

(3) A reliable pharmaceutical provider of the nutrient solution and infusion supplies

such as dressing kits and pumps. These supplies are usually delivered to the patient's home and arranged for them on shelves and refrigerated where necessary.

(4) A 24 hour emergency medical and technical backup

is essential for although the acute management of complications such as a line break or air embolus must be handled by the patient and family, once the immediate crisis is over the patient frequently needs to discuss the problem and decide the next step (Table 1). Also equipment, such as the infusion pump can fail requiring an emergency replacement. The pharmacy service usually has specially trained nurses who help the patient during their first few days at home and revisits if a problem develops, relaying their findings to the responsible physician. If nursing support is required on a more constant daily basis, a home nursing service becomes involved.

(5) Assured financial coverage

Since these are very expensive therapies, beyond the private financial means of most families, a

Table 1a.

HPN Complication Chart

The Oley Foundation
For Home Parenteral and Enteral Nutrition

1-800-776-OLEY

MECHANICAL *(Metabolic information on back)*

PROBLEM:

❶ Air Embolism

SYMPTOMS: • Coughing; shortness of breath; chest pain; loss of consciousness.
CAUSE: • IV tubing disconnected; injection cap fell off.
IMMEDIATE ACTION: *Prevent further air intake:* A) clamp catheter; B) lie on left side with head down; C) call your doctor.
PREVENTION: • Use luer lock attachments on tubing; use an adequate length of tubing for connection; tape junctions in children.

❷ Blood in Catheter

SYMPTOMS: • Blood in tubing.
CAUSE: • Injection cap not attached securely; cracking of hub; tear in line; if needle is used for hookup an accidental disconnection of needle hub from IV tubing when infusing.
IMMEDIATE ACTION: *Injection cap not attached securely:* A) clamp catheter; B) remove injection cap; C) heparinize again; D) replace injection cap snugly; E) tape securely; F) unclamp catheter.
Cracking of hub (see category 4 below)
Tear in line (see category 5 below)
Needle separation when infusing: A) clamp line; B) remove needle from injection cap; C) replace contaminated tubing and attach new needle; D) clear air out of tubing; E) reinsert needle via cap taking usual precautions; F) unclamp line; G) resume HPN infusion; H) if clotted see category 6 below.
PREVENTION: • Attach injection cap properly.
• Apply pressure while injecting last 0.5 ml of heparin-saline solution.
Cracking of hub (see category 4 below)
Tear in line (see category 5 below)
Separation of needle hub: A) tape needle and tubing securely; B) loop tubing and tape skin/pin clothing to avoid accidental pulling of line when infusing; C) use an adequate length of tubing to avoid pulling on line.

❸ Broken tubing inside hub

SYMPTOMS: • Broken tubing.
CAUSE: • Glucose solution crystallized; excessive twisting of tubing in hookup/disconnection; faulty tubing.
IMMEDIATE ACTION: • Clamp catheter before the break (that is, side closest to your body; call your doctor to schedule repair).
PREVENTION: • Avoid excess HPN solution at end of tubing by flicking; Carefully wipe IV tubing with alcohol before inserting if necessary; Avoid excessive pressure with hookup/disconnection.
If unable to dislodge tubing (unbroken): A) apply padded clamp to IV tubing (holding catheter hub firmly in hand or use another padded clamp) and gently twist tubing to dislodge from hub; B) if repeated incidences happen due to faulty tubing save boxes with product code and lot # and report to provider.

❹ Cracking of hub

SYMPTOMS: • Cracking sound with insertion of IV tubing upon hookup or disconnection of tubing; Fine cracking in hub upon close inspection.
CAUSE: • Excessive pressure in hookup/disconnection; Faulty hub.
IMMEDIATE ACTION: *Cracking of hub:* A) clamp catheter; B) unclamp catheter and instill heparin; C) clamp catheter; D) attach injection cap; E) notify MD for repair of hub by hub change.
PREVENTION: • Avoid excess pressure in hookup/disconnection; Faulty hub with repeated cracking — report to primary supplier of catheter; Type and lot # of catheter should be noted in chart upon insertion.

❺ Catheter tear

SYMPTOMS: • Visible break or leak.
CAUSE: • Frequently manipulated; indiscriminate use of clamps causing weakening and tear; grabbing pair of scissors/unpadded clamp; accidentally leaving clamp on catheter while infusing; pump fails to pick up line obstruction.
IMMEDIATE ACTION: • Try and instill heparin into line to keep patent; clamp catheter before break (side closest to body); do not place tape over tear; if infusing follow precautions to prevent hypoglycemia; call doctor to schedule repair.
PREVENTION: • Handle catheter gently; clamp catheter at different places on tubing; remove scissors/unpadded metal clamp from area before procedure; always check gravity flow of line prior to starting pump (pump can have faulty alarm system).

❻ Catheter clot

SYMPTOMS: • Unable to heparinize; unable to infuse HPN solution; cracked hub/tear in line without patient aware of catheter damage; if needle used via injection cap, accidental disconnection of solution.
CAUSE: • Catheter not heparinized; solution not infusing.
IMMEDIATE ACTION: • Clamp catheter; call your doctor for further directions; if infusing follow precautions to prevent hypoglycemia.
PREVENTION: • Heparinize properly; maintain prescribed drip rate; daily inspection of line/hub for weakness, tears, cracking; secure needle and tubing to injection cap and catheter by taping.

❼ Pump or power failure

SYMPTOMS: • Unable to start pump; broken pump (unable to start, incorrect alarming).
CAUSE: • Inadequate or loss of power source; malfunction of pump.
IMMEDIATE ACTION: • Regulate infusion by gravity to prevent hypo/hyperglycemia; check to see if pump is plugged into wall socket; call your supply company for replacement/loan.
PREVENTION: • Contact local power company for inclusion on list of customers having durable medical equipment at home in case of major power loss; follow recommendations by pump manufacturer for routine service and maintenance (whether it be rental/purchased equipment); at times, despite above, unpreventable.

❽ General Safety-Prevention

SYMPTOMS: • Misunderstanding of and lack of knowledge about pertinent device.
CAUSE: • Inadequate information.
IMMEDIATE ACTION: • Show individual ID card/Medic Alert bracelet.
PREVENTION: • Catheters/ports-carry ID cards with type of catheter/port and other pertinent information in case of emergency and personally unable to provide information regarding device/self; wear Medic Alert bracelet/necklace providing basic information regarding health status, line/port in case of emergency.

Table 1b.

HPN Complication Chart

The Oley Foundation
For Home Parenteral and Enteral Nutrition

A-23 Hun Memorial, Albany Medical Center
Albany, N.Y 12208
(518) 262-5079
1–800–776–OLEY

METABOLIC *(Mechanical information on back)*

PROBLEM:

❶ Infection

SYMPTOMS: • Redness; pain;swelling or drainage at insertion site; temperature above 100° F (37.7° C); chills; sweating; lethargy; urine spot checks may show glucose levels greater than 1/2%.

CAUSE: • Possible poor asceptic technique; contaminated tubing or heparin; contaminated IV solution; exposure to outside source of illness (flu, cold, communicable diseases — chicken pox etc.); other source in body — urinary tract infection, dental abcess/caries, fistulae, ileostomy/colostomy/gastrostomy sites; routine dental work without prophylactic antibiotic coverage.

IMMEDIATE ACTION: • Call MD immediately, if unavailable go to local emergency room.

PREVENTION: • Use proper asceptic technique at all times; take heparin/IV solution with you to hospital for culturing; inspect all solutions beforehand for clouding/ particulate matter; avoid if possible individuals with known illnesses or possible exposure to communicable diseases; routine dental checkup report to MD abnormal symptoms regarding above; inform dentist of indwelling catheter/port and follow protocol for prophylactic antibiotic coverage for dental work as prescribed by primary MD/dentist.

❷ Port-a-cath/ Mediport Infection/Leak

SYMPTOMS: • Local pain/redness; swelling at site/arm — pain upon infusion — discoloration.

CAUSE: • Infection; hematoma; fluid leak into tissue.

IMMEDIATE ACTION: • Discontinue infusion; call your doctor for evaluation.

PREVENTION: • Maintain asceptic technique at all times; maintain positive pressure on syringe when flushing; firmly fix syringe plunger to prevent leak of fluid into tissue as needle withdrawn. Avoid burying needle tip against metal floor of reservoir.

❸ Hyperglycemia

SYMPTOMS: • Nausea; weakness; thirst; headache; urine spot checks show glucose levels greater 1/2%; anxiety spells, nightmares.

CAUSE: • Fluids infused too fast; too little insulin in infusion solution if known diabetic; improper mixture of HPN solution; infection (hyperglycemia a very early warning sign, even before fever is present); certain medications (steroids, some chemotherapy agents CL-asparaginase).

IMMEDIATE ACTION: • Call MD immediately; may need to decrease infusion rate or add insulin as directed by MD.

PREVENTION: • Maintain prescribed drip rate — never try to "catch up" if rate slows; maintain asceptic technique at all times; inspect labels of all HPN bags closely for consistency in formula; changes in formula should be indicated to you by your primary MD prior to shipment of new bags; any questions call MD/pharmacist at provider facility; if requested return bag to MD/pharmacist for analysis of solution; monitor temperature; alert nutrition MD if started on any new medications by other physicians.

❹ Hypoglycemia

SYMPTOMS: • Sweating; pale facial color; heart palpitations; nausea; headache; shaking feeling; blurred vision; hunger pangs; lightheadedness.

CAUSE: • HPN fluids stopped abruptly without adequate period of tapering; HPN bag finishing early due to malfunction of pump or decreased volume in bag; too much insulin in infusion solution; hypoglycemia can come on during infusion but is more likely to come within 15–30 minutes of stopping.

IMMEDIATE ACTION: • Call your doctor immediately; you may need to adjust infusion rate or decrease insulin in infusion; if you suspect hypoglycemia, drink a glass of orange juice with 2 teaspoons of sugar in it; if you are unable to tolerate fluids by mouth, place hard candy or cake decorating gel under tongue or let a teaspoon or two of sugar dissolve in mouth; stay in bed; replace empty HPN bag with dextrose 10%/water solution and taper as per usual routine (if pump functioning) or via gravity drip (with malfunction of pump); **follow instructions as indicated for individual mechanical problems.**

PREVENTION: • Close monitoring of glucose tolerance during tapering process in hospital before discharge; monitor blood glucose levels monthly or as directed by MD; always cycle off infusion at least over 1 hour period decreasing rate by 50% every 15 minutes or as directed by your MD. Depending upon pump used, this feature may be done automatically for you by pump program; observe volume of bag prior to hanging; in case of pump failure, manually adjust infusion rate accordingly; report to provider discrepancy in volume or pump failure.

❺ Fluid/Electro-lyte/Mineral Imbalance

SYMPTOMS: • Rapid weight loss or weight gain; thirst; weakness; edema; shakiness; fine tremor; muscle cramping; numbness; tingling of hands or around mouth; palpitations; unexplained sense of not feeling right; loss of taste; skin changes.

CAUSE: • Dehydration and depletion of electrolytes/mincrals due to increased losses from vomiting, diarrhea, fistulae/astomy output; inadequate intake due to noncompliance of taking HPN infusion/extra fluids as ordered; decrease in urinary output and kidney function; hypo/hyper kalemia; natremia; calcemia; magnesemia; phosphatemia; zincemia; improper mixture of HPN solution.

IMMEDIATE ACTION: • Call MD and relate signs and symptoms, describe any change in fluid intake or output; take along HPN bag to MD for analysis of contents against label.

PREVENTION: • Infuse complete volume of HPN and fluids as ordered by MD; keep daily input and output log — note any significant changes from usual pattern and call MD; follow orders and guidelines given to you during training period and upon discharge from hospital; monitor weight at least 3 times a week; report any discrepancy in HPN solution to MD and provider.

payment mechanism must be worked out in advance. The patient also needs assistance from their pharmacy service with all the complicated billing and reimbursement. Any uncertainties in the financial area are a great distress to patients and their families.

To safeguard and regulate home PEN programs, several other components need to be present on a national level. Consumer advocacy implies a collective voice so that patients and their families, who usually bear the major responsibility for the day-to-day management of their complex treatment, participate in health care decisions that influence their treatment. This in turn requires patient education. In the United States the national home PEN consumer advocacy organization is the Oley Foundation For Home Parenteral and Enteral Nutrition (20). The Foundation publishes a monthly Lifeline newsletter, organizes an annual consumer/clinician conference, supports a network of regional volunteers and provides an information clearinghouse. All these services are provided free to consumers and their families. As summarized in Table 2 therapy safeguards also depend on organizations that set standards of care; monitor therapy outcome and promote research; credential home PEN programs and the involved professionals and establish reimbursement guidelines.

OUTCOME MONITORING RESEARCH

In the late 1970's a number of clinicians saw the importance of gathering outcome information about patients on these expensive therapies. The initial Registry gathered cross sectional information and was supervised by Dr Maurice Shils at the New York Academy of Medicine (21). In 1984, outcome monitoring became the responsibility of the Oley Foundation (20) and the American Society For Parenteral and Enteral Nutrition (22). This North American Home PEN Patient Registry, publishes an annual report describing clinical outcome in terms of 4 measures: survival on therapy, duration on therapy, rehabilitation on therapy and complications of therapy that result in rehospitalization. Outcome profiles are now available for 11 HPN and 2 HEN disorders (17). Figure 1 is an example of the outcome profile for patients on HPN with Crohn's disease. Table 3 gives a description of clinical outcome of HPN patients in 7 diagnostic categories. Several European countries (23,24) and Japan have also developed registries for HPN outcome monitoring.

Data from these registries all confirm that home PEN is a safe undertaking, with a readmission for sepsis about once every 2 years.

UNRESOLVED ISSUES

There are many unresolved issues that relate to home PEN therapy. These issues can be divided into problems that are **metabolic, mechanical** and **social.** Table 4 summarizes the concerns in these three areas.

Table 2.

National and State Organizations Supporting and Regulating HPEN

1. Patient / consumer advocacy
   - Oley Foundation for Home Parenteral and Enteral Nutrition, Albany, NY

2. Standards for home nutrition support
   - American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Silver Spring, Maryland

3. Outcome monitoring and guidelines
   - North American HPEN Patient Registry, Oley Foundation

4. Program credentialling
   - Joint Commision on Accredation of Health Care Organizations,Chicago, Illinois
   - National League for Nursing: Community Health Accredation Program, New York, New York
   - State Health Departments
   - Health Care Finance Administration: Medicare Program. Conditions of participation for home intravenous drug therapy providers. Federal Registry 1984

5. Professional credentialling
   - State Boards
   - A.S.P.E.N.: Nutrition support nurses (CNSN) and dietitians (CNSD)
   - American Dietetic Association, Chicago, Illinois: RD Nutritionists
   - American Board of Nutrition, Bethesda, Maryland, M.D. & Ph.D. clinical nutrition specialists
   - Board of Pharmaceutical Specialties, Washington, D.C.: Pharmacists (BCNSP)

6. Reimbursement policy and guidelines
   - Federal: Medicare Part B
   - States: Medicaid High Risk Pool
   - Private sector:
     - Health Insurance Association of America, Washington, D.C.
     - Blue Cross and Blue Shield Association, Chicago, Illinois
     - American Managed Care and Review Association, Washington D.C.
     - Group Health Association of America, Washington D.C.

Figure 1.

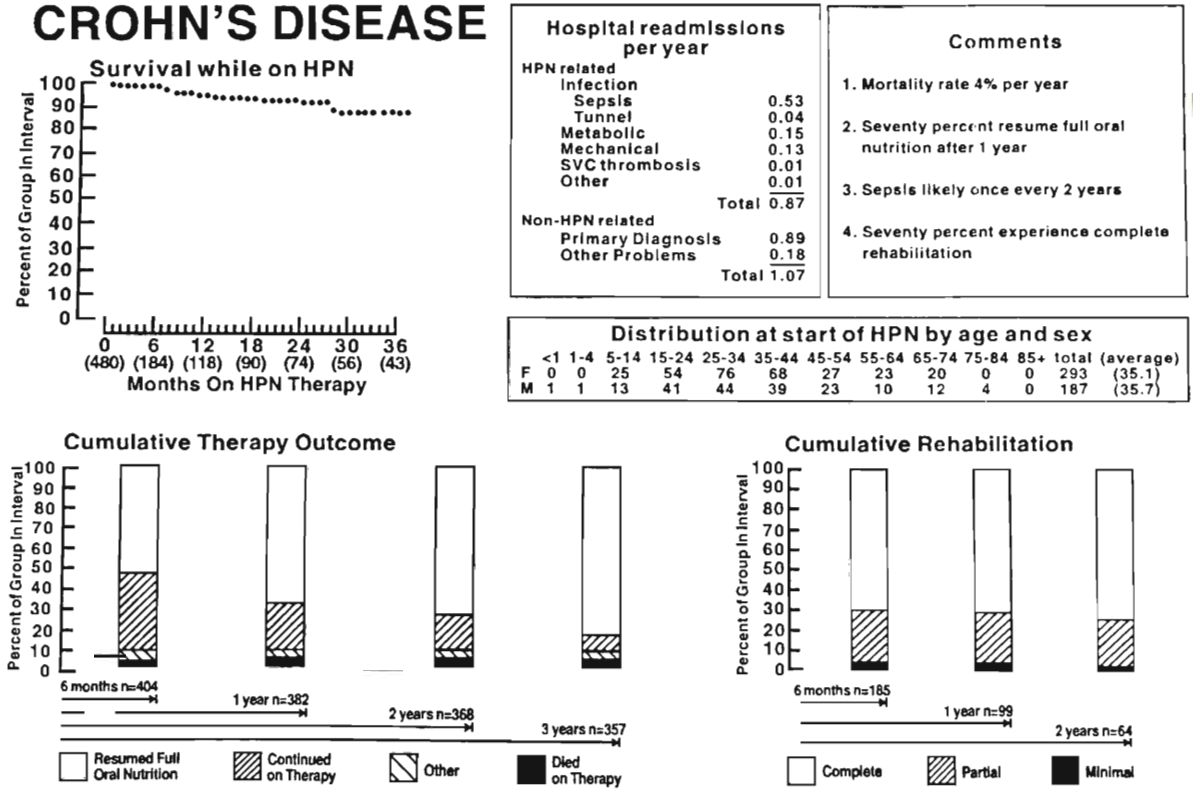
CROHN'S DISEASE
Survival while on HPN
Percent of Group In Interval
100
90
80
70
60
50
40
30
20
10
0
0 6 12 18 24 30 36
(480) (184) (118) (90) (74) (56) (43)
Months On HPN Therapy
Hospital readmissions per year
HPN related
Infection
Sepsis 0.53
Tunnel 0.04
Metabolic 0.15
Mechanical 0.13
SVC thrombosis 0.01
Other 0.01
Total 0.87
Non-HPN related
Primary Diagnosis 0.89
Other Problems 0.18
Total 1.07
Comments
1. Mortality rate 4% per year
2. Seventy percent resume full oral nutrition after 1 year
3. Sepsis likely once every 2 years
4. Seventy percent experience complete rehabilitation
Distribution at start of HPN by age and sex
<1 1-4 5-14 15-24 25-34 35-44 45-54 55-64 65-74 75-84 85+ total (average)
F 0 0 25 54 76 68 27 23 20 0 0 293 (35.1)
M 1 1 13 41 44 39 23 10 12 4 0 187 (35.7)
Cumulative Therapy Outcome
Percent of Group In Interval
6 months n=404
1 year n=382
2 years n=368
3 years n=357
Resumed Full Oral Nutrition
Continued on Therapy
Other
Died on Therapy
Cumulative Rehabilitation
Percent of Group In Interval
6 months n=185
1 year n=99
2 years n=64
Complete
Partial
Minimal

Table 3. Description of Clinical Outcome of HPN Patients in 7 Diagnostic Categories

Diagnosis	Survival Rate / yr	Therapy Status (1st annual follow-up period)	Complications / yr	Rehabilitation over 2 yrs
Crohn's Disease Aver. age at HPN onset 36 yrs.	95%	About 1/2 the survivors stay on HPN and 1/2 resumed full oral nutrition	1 due to HPN (0.5 sepsis) 1.5 due to non-HPN	70% complete 25% partial 5% minimal
Ischemic Bowel Aver. age at HPN onset 57 yrs.	90%	The majority of survivors stay on HPN only 1/6 resumed full oral nutrition	1 due to HPN (0.5 sepsis) 1.5 due to non-HPN	30% complete 50% partial 20% minimal
Motility Disorder Aver. age at HPN onset 51 yrs.	90%	The majority of survivors stay on HPN, only 1/4 resumed full oral nutrition	2 due to HPN (1.0 sepsis) 1 due to non-HPN	35% complete 50% partial 15% minimal
Radiation Enteritis Aver. age at HPN onset 57 yrs.	85%	The majority of survivors stay on HPN, only 1/6 resumed full oral nutrition	1 due to HPN (0.5 sepsis) 1 due to non-HPN	40% complete 50% partial 10% minimal
Congenital Bowel Disease Aver. age at HPN onset 1.6 yrs	90%	About 1/2 of survivors stay on HPN 1/3 resume full oral nutrition	2.5 due to HPN (1.25 sepsis) 1.5 due to no-HPN	60% complete 35% partial 5% minimal
Neoplasm Aver. age at HPN onset 45 yrs.	25%	About 1/2 of survivors stay on HPN, 1/2 resume full oral nutrition	1 due to HPN (0.5 sepsis) 4 due to non-HPN	20% complete 40% partial 40% minimal
AIDS Aver. age at HPN onset 29 yrs.	0%	No survivors	1 due to HPN (0.5 sepsis) 3.5 due to non-HPN	5% complete 40% partial 55% minimal
For easier comparison, all numbers above: are rounded to the closest value.	5%	1/10	0.5/yr	5%

Table 4. Unresolved issues in HPEN

Metabolic
- Bone loss
- Liver disease
- Conditionally essential nutrients
- Catheter care
- Use of anticoagulants
- Prevention and treatment of line infections

Mechanical
- Catheters
- Tubes
- Pumps
- Bags
- Poles
- Storage and transport

(Need for more user-friendly equipment)

Social
- Who should get home PEN?
- Catastrophic medical coverage needed so:
  - Rehabilitated patient can return to work
  - Medical coverage of rest of family not used up

COSTS OF HOME PEN

The cost of home PEN treatment in the United States is quite wide ranging. The only standardized reimbursement is that paid by Medicare, the federal program which covers persons eligible for social security either by virtue of reaching 65 years of age or younger, if they contributed to the social security system, but are judged totally disabled. In 1992 the Medicare allowable charge was $240-390 per day for HPN and $25-50 per day for HEN. The reimbursement range reflects differences in the amount and type of the nutrient solution provided. These costs translate into $88-136 thousand per year for HPN and $8-16 thousand per year for HEN.

These costs do not include nursing costs provided by certified health agencies, physician and laboratory costs or the costs related to therapy complications which may result in patient rehospitalizaton. As shown in Table 5, in 1992 the USA spent 1% of all health care dollars on home PEN and other home infusion therapies.

Table 5. What does home PEN cost?

Compared to treatment in hospital
1. home parenteral nutrition is 50%
2. home enteral nutrition is 5%

In 1992, 1% of <u>all</u> USA health care dollars ($8 billion of $800 billion) were spent on infusion therapies in non-hospital settings. (IV antibiotics, pain medication, chemotherapy, and nutrition support).

IS HOME PEN COST EFFECTIVE?

For each country this must be a societal decision that reflects both the economic realities and social priorities of that country.

In the United State there has been a tremendous expansion in the use of these therapies. The reasons for this expansion are probably both appropriate and inappropriate (25,26). As a result use of home PEN in the United States is 20-50 higher than in any other medically advanced country (14).

In medically advanced countries other than the USA, HPN is not used in active cancer or AIDS patients. In countries with very considerable economic restraints, HEN may be the only therapy that is feasible and affordable outside the hospital.

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Total parenteral nutrition in neonates

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ABSTRACT

Major advances have been made in decreasing the mortality of infants born prematurely, including improved obstetrical care, improved pulmonary care, the use of new antibiotics and the provision of early nutrition. A major challenge today is improving the quality of life in the survivors of preterm birth. In this paper, the role of parenteral nutrition in meeting the nutrient needs of preterm infants will be discussed. For infants who receive all nutrients intravenously, the intravenous formulation must provide a source of energy along with adequate amounts of amino acids, essential fats, minerals, trace elements and vitamins. I will present research done in my laboratory and Neonatal Unit which examined the nutrient needs of parenterally fed infants. Nutrient recommendations should take into consideration, whenever possible, that needs differ for infants of different birthweights and post-conceptional ages. According to this principle, two birth weight groupings (<1000 g and > 1000 g) and three-post-conceptional age categories (transitional -birth to 7 days; stable and growing; and, post hospital-discharge) have been used to determine the nutrient and feeding recommendations. Examples of the appropriate use of parenteral nutrition will be provided in the paper.

INDICATIONS AND TIMING FOR THE START OF TOTAL PARENTERAL NUTRITION

Nutrient reserves in infants and children are minimal; thus, the ability of this population to withstand an inadequate nutrient supply is markedly less than that of the older child, and certainly less than that of adults. Whenever possible nutrients should be provided via the gastrointestinal tract. If oral intake is precluded or inadequate, nasogastric (NG), nasojejunal (NJ), gastrostomy, or jejunostomy feeds should be considered before starting total parenteral nutrition (TPN). TPN is indicated only if it is not possible to provide an adequate nutrient intake via the gastrointestinal tract.

For those needing TPN for short periods of time, the goal is to provide the minimal amount of nutrients necessary to prevent

acute nutrient deficiencies. For those needing long-term TPN, the goal is not only to prevent nutrient deficiencies, but also to provide an adequate amount of nutrients for growth.

Premature infants, especially those with respiratory distress syndrome (RDS) who are incapable of full oral feeds, often receive TPN because of their extremely limited substrate reserve, very rapid growth rate, and perceived susceptibility to irreversible brain damage secondary to malnutrition.

If one considers the nutrient stores of very small infants (Table 1), it becomes quite clear that the ability of a small premature infant to withstand an inadequate energy supply is markedly less than that of an older child and certainly less than that of adults. For example, a 70-kilogram adult has a fat reserve of approximately 141,000 kcal, while a full-term infant weighting 3.5 kg has a fat reserve of only about 4800 kcal, assuming that 15% of its weight is adipose tissue. In contrast, a one-kilogram infant at birth contains approximately 2.3% adipose tissue, representing only 200 kcal of energy reserve.

If one assumes that the energy needs of the newborn premature infant are about 120 kcal/kg/d, it becomes evident that the newborn premature infant cannot withstand starvation for more than a day or two.

For the small premature infant, who has limited nutrient reserves, TPN should be started as soon as the infant is made NPO. For the premature infant who is tolerating partial enteral feeds, supplemental parenteral nutrition should be started if the enteral (NG or NJ) intake is not meeting nutrient intake requirements within 2 to 4 days of the start of feeding. For the

Table 1. Endogenous Fuel Composition of Man

Tissue	Body wt (kg)		
	70	3.5	1.0
Fat (adipose triglyceride)			
kg	15 (21%)	0.53 (15%)	0.023 (2.3%)
kcal	141,000	4,800	200
Protein (mainly muscle)			
kg	6	0.45	0.85 (8.5%)
kcal	24,000	1,800	340
Glycogen (muscle)			
kg	0.15	–	–
kcal	600	–	–
Glycogen (liver)			
kg	0.75	–	–
kcal	300		

older infant with good nutrient reserves, TPN should be started if the child is left NPO for 3 days or longer.

For the malnourished infant, TPN should be used whenever oral (NG or NJ) intake is not meeting total nutrient intake recommendations for age and size. Although the published indications for TPN in the infant are extensive, there is only limited documentation of the efficacy of TPN in affecting the outcome of specific diseases. If one contended that TPN should alter the course of an illness in some quantifiable way, apart from restoration of nutritional integrity, then the indications for TPN would be few. Table 2 lists the numbers and disease categories of all patients receiving parenteral nutrition during a 6 month period at the Hospital for Sick Children, Toronto, Canada.

The majority of conditions were found in infants who were unable to tolerate oral nutrients because

Table 2. Diagnosis of infants receiving TPN in the neonatal intensive care unit at the Hospital for Sick Children (Toronto) during a six month period

Diagnosis	N	%
Surgical[a]		
Gastroschesis	8	12
Small bowel atresia	17	25
TEF[b]	8	12
Obstruction with/without distention	24	35
Omphalocele	3	4
Imperforate anus and fistula	1	1
Large bowel atresia	1	1
Diaphragmatic hernia	1	1
Malrotation	2	3
Hirschprung's	1	1
Multiple anomalies	2	3
Total	68	100
Medical[c]		
NEC[d]	19	17
Premature ? RDS[e]	84	76
Sepsis	1	1
Malabsorption	3	3
Other	4	4
Total	111	100

[a] 38% of total
[b] TEF = Tracheoesophageal fistula
[c] 62% of total.
[d] NEC = Necrotizing enterocolitis
[e] RDS = Respiratory Distress Syndrome

of surgery, gastrointestinal complications, prematurity, or metabolic imbalance, in whom intravenous nutrition was employed to prevent rapid starvation. In newborn infants, the unique nutritional requirements imposed by a particular disease state are superimposed on the relatively high requirements for growth and on the extra requirements arising from limited endogenous nutrient stores. Despite the lack of "proven" efficacy, therefore, when oral intake is precluded and starvation or semi-starvation is the likely alternative, use of parenteral nutritional support is a justified current practice.

It is interesting to note that although parenteral nutrition for infants has been used successfully for the past 16 years, there is still a lack of agreement on specific nutrient requirements of the intravenously fed newborn. This is due primarily to the difficulty of designing experiments that can be conducted on this sick, and often heterogenous, group of patients. In addition, because of marked differences in the metabolism of nutrients directly absorbed from the gut and that of intravenously infused nutrients, intravenous requirements cannot be simply extracted from recommended oral intakes. As a result, there is a large variation in current practice. For example, in the recent literature, intravenous formulations delivering 1.5-4 g/kg/d of amino acids and 50-140 kcal/kg/d of energy are described, depending on the clinical circumstances and whether the infusion was by central or peripheral vein.

TPN SOLUTIONS

If TPN is routinely used, then a manufacturing system that produces standard solutions is recommended. A standard solution contains amino acids, dextrose, minerals and trace minerals at a concentration appropriate for a specific age group. The use of standard solutions makes the ordering and maintenance of TPN much simpler, safer, and more economical. Standard solutions can be manufactured by the pharmacy in large batches in anticipation of patient needs. Depending on the age range of the patient population, one or more sets of standard solutions may be prepared.

At the Hospital for Sick Children in Toronto, three standard solutions are routinely manufactured for low birth weight infants (Table 3). These solutions differ in their amino acid content, dextrose content, or mineral content. For example, solutions intended for use in premature infants (the P solutions) generally contain less amino acids, dextrose, and electrolytes than solutions intended for use in older infants and children. The nutrient concentration of the standard solutions should meet the needs of most patients within the particular age group when infused at an appropriate rate. The nutrient solutions are placed in clear plastic intravenous bags, similar to those used in commercially prepared intravenous solutions.

When the nutrient content of the standard solution is inappropriate for a particular patient (e.g., a child whose diarrhea results in

Table 3. Parenteral solutions for preterm and fullterm Infants

Nutrient	P-5	P-7.5	P-10
Amino acids (g)	15	15	20
Glucose	50	75	100
Energy (kcal)[a]	248	340	455
Na (mmol)	20	20	14.7
K (mmol)	20	20	18.9
Cl (mmol)	21.1	21.1	15.7
Ca (mmol)	9	9	9
P (mmol)	9	9	9
Mg (mmol)	3	3	4
Zn (μmol)	46	46	46
Cu (μmol)	6.3	6.3	6.3
Mn (μmol)	1.8	1.8	1.8
I (μmol)	0.47	0.47	0.47
Cr (μmol)	0.076	0.076	0.076
Se (μmol)	0.25	0.25	0.25
Fe (μmol)[b]	–	–	–

[a]The energy content is expressed as total energy and thus includes the potential energy from the protein as well as that from the dextrose.

[b]Iron can be included in the P solutions and is generally ordered if an infant has been receiving TPN for 1 month or longer.

excessive electrolyte losses) a special solution can be prepared by the pharmacy that contains nutrients specific to the needs of an individual patient. Because of the increased cost and burden to the pharmacy, if the nutrient content of the special solution is not significantly different from the standard solution, then the standard solution should be used.

A complete mixture of vitamins is added to the TPN solution by the pharmacy each morning. The daily vitamin dose is added to one amino acid/dextrose bag per patient per day. For patients who receive more than one bag daily, the pharmacy should send one bag with the vitamins and the rest of the ordered volume without.

When more than one bag is ordered, the vitamin bag should always be given to the patient first to ensure that the daily vitamin requirement is infused. The amounts of each vitamin added per day are listed in Table 4.

Ordinarily, each patient on TPN will receive two types of infusate: a standard amino acid/dextrose/ mineral solution and an intravenous fat emulsion. The fat emulsion is available as a 10 or 20 percent solution. Most patients will tolerate 2 to 4 g lipid per kilogram per 24 hours. Both strengths can be given by either peripheral or central vein infusion.

Table 4. Daily Vitamin Additions to TPN*

Vitamin	Concentration per bag
A (IU)	2300.0
D (IU)	400.0
E (IU)	7.0
C (mg)	80.0
Thiamin (B1) (mg)	1.2
Riboflavin (B2) (mg)	1.4
Pyridoxine (B6) (mg)	1.0
Niacinamide (mg)	17.0
Pantothenic acid (mg)	5.0
Folic acid (μg)	140.0
Biotin (μg)	20.0
K1 (mg)	0.2
B12 (μg)	1.0

*If more than one bag is used per 24 hours, the vitamins are added only to the first bag given to the patient.

ROUTE OF INFUSION

The use of peripheral veins for TPN is preferred because of lower rates of infection, easier nursing care, and lower cost. Due to the small size and relative fragility of peripheral veins, the infusion volume will be limited as will the concentration of the nutrient mixture. In general, for infants the maximum infusion volume by peripheral vein is 150 to 170 ml per kilogram per day.

When the concentration of dextrose is greater than 10 percent combined with an amino acid concentration greater than 3 percent, the solution is hypertonic to the point where peripheral veins will be intolerant of even short-term use. Thus, the peripheral nutrient solution must contain no more than 10 percent dextrose and 3 percent amino acids.

Failure to deliver an adequate nutrient intake (particularly energy) is an indication for switching from peripheral to central line TPN. If the patient is volume restricted, necessitating the use of very hypertonic solutions, then a central line must be used. Finally, if it is anticipated that a patient will need TPN for a prolonged period of time, central line TPN should be used.

PERIPHERAL TPN

For appropriate solutions to be used with peripheral TPN, refer to the preceding section on solutions. Metal butterfly needles are preferred over plastic cannulae for peripheral TPN. Since metal needles seldom remain in position for longer than 1 to 2 days, the risks of infection are minimized. With butterfly needles, especially, the nursing staff must frequently monitor the infusion site for early signs of extravasation of parenteral

fluids and/or thrombophlebitis. Early detection of extravasated fluid can minimize the serious complications of skin and tissue necrosis that can occur after extravasation of large amounts of TPN solution. Thrombophlebitis may be prevented if the infusion site is changed every 72 hours and hyperosmolar solutions are avoided.

Plastic cannulae should be used only when it is not possible to maintain TPN with the repeated replacement of butterfly needles. If a plastic cannula is used, the following guidelines for skin preparation should be followed: (1) the operator should perform a basic hand wash before starting; (2) the skin at the entrance site should be prepared with povidone-iodine 10 percent solution and allowed to air dry for 60 seconds; and (3) the operator should also prep the hand that will be palpating for the vessel. As with the butterfly needle, the plastic cannula should normally not be left in place for longer than 72 hours. Color-coded dates on the cannulas can be used to note the day of insertion. If the only way of maintaining a peripheral line is by the continued use of plastic cannulae, then a central line should be inserted.

CENTRAL VENOUS LINE TPN

Since hyperosmolar solutions are most often used with central line TPN, the infusate should be delivered through a central, large-bore vein with high volume blood flow to minimize the risk of venous thrombosis and phlebitis. Placement of the catheter should be performed under full aseptic conditions, preferably in an operating room by a surgeon. The use of polyethylene or polyvinyl catheters has been associated with "sterile" inflammation due to tissue reactions with the plastic and, more importantly, venous perforations resulting in potentially life-threatening intrapleural or intracardiac collections of TPN solution or blood. Silicone rubber catheters (Silastic) which have a higher degree of flexibility and a soft nonwetting surface that works to resist clotting and is extremely durable, should be used whenever possible.

The choice of sites for insertion include the scalp, common facial, internal jugular, external jugular, cephalic, and subclavian veins. After the catheter is inserted and advanced into the superior vena cava to the junction of the right atrium (it should remain in the superior vena cava rather than in the right atrium), a separate incision is made on the chest or abdomen so that the distal end of the catheter can be directed through a subcutaneous tunnel between the two incisions.

To decrease the risk of infection, the skin exit site for the catheter should be located in an easily accessible area away from any natural or acquired orifices, such as gastric or intestinal stomas, tracheostomies, and suprapubic catheters, and from any skin lesions, burns, etc. Care of the TPN system and catheters should be performed only by nurses and doctors who have specific training in this area. A procedures manual for the maintenance of central lines should be prepared and made available on the ward.

ADDITIONS TO TPN SOLUTIONS

Additions to TPN bags or bottles should not be made outside the pharmacy because of the risk of contamination. Urgent electrolyte additions to the amino acid/dextrose solutions may be made on the nursing unit only through the volume control set using appropriate aseptic techniques. If a patient requires frequent changes in electrolytes in order to remain metabolically stable, then TPN should be temporarily discontinued. If a patient requires individualized electrolyte additions (or deletions) on an ongoing basis, a special solution should be ordered and prepared in the pharmacy.

When drugs need to be administered to a patient receiving TPN, they should be given through a separate IV site. If a separate site is not possible, the drug may be administered through a separate line that has a Y connection to the TPN system as close as possible to the patient's infusion site. The TPN solutions should not be running and the common tubing must be adequately flushed before and after the drug administration. Only if the patient's clinical status requires uninterrupted TPN administration can certain drugs be administered through a separate set and Y connection with the TPN solutions still running. TPN solutions are of varied composition, and drug compatibility's can never be guaranteed. Lists of compatible drugs are available.

COMPLICATIONS

The major complications associated with TPN are related either to the catheter or to infections or metabolic imbalances. The purpose of monitoring patients on TPN is to detect and treat potential or actual complications.

An individual or group of individuals, with training in the administration of TPN should be directly responsible for TPN monitoring. Each monitoring procedure should be linked to a specific complication. For example, as indicated in Table 5, urine and blood glucose determinations are made to rule out both hyper- and hypoglycemia. (Other examples are shown in Table 5).

When monitoring procedures are not readily available, or the likelihood of complications occuring in association with the inclusion of the nutrient in the TPN solution are extremely low, such as with the use of zinc, copper, iodine, chromium, and selenium, the nutrients are included at recommended dosages, and monitoring is carried out only if signs or symptoms of excess or deficiency are present.

Catheter-related complications such as perforation or venous thrombosis have been markedly reduced with the use of silastic catheters.

Sepsis, however, remains the major complication of central venous line TPN. Organisms may enter the bloodstream along the catheter tract, from contaminated solutions and additives, during catheter insertion, or from the manipulation of the administration system and catheter. Prevention of infection is the key to a successful

Table 5. Monitoring Recommended for TPN-Associated Complications

Complication	Monitored By	Frequency
Inadequate or excessive intake	body weight, fluid balance, urea	Daily Daily Weekly
Protein depletion	Serum albumin	Weekly
Hypo / hyperglycemia	Urine glucose Blood glucose	Daily Daily (2 x week)
Electrolyte imbalance	Serum Na, Cl, K Urine Na, Cl, K	Daily (2 x week) As necessary
Mineral imbalance	Serum Ca, P, Mg	Weekly
Iron depletion	Blood count with smear	Weekly
Acid-base imbalance	Blood gases	Weekly
Lipid overload	Exogenous lipids Triglycerides	2 x week 2 x week
Hepatic cholestasis	Liver function tests	2 x month

TPN program. The rate of infection can be kept under control only if strict and carefully monitored infection control measures are employed. For example, fever in a patient receiving TPN should always be assumed to be of bacterial origin until proven otherwise.

Appropriate samples from the patient and the TPN system should be sent for bacterial and fungal culture. Blood samples should be taken from both the central line and peripheral vein. If purulent drainage is present at the catheter exit site, the pus should be cultured and gram stained. While removal of the central line with appropriate antibiotic therapy is almost always curative, the use of appropriate antibiotic therapy without removal of the central line is often curative as well; however, careful long-term monitoring is mandatory to ensure that the infection has been totally eradicated. When antibiotic therapy must be started before culture results are available (as in infants and children less than 1 year of age), broad-spectrum coverage should be provided, since both gram-positive and gram-negative bacteria are frequent causes of TPN-associated infection. A semisynthetic penicillinase-resistant penicillin should be used in combination with an aminoglycoside.

Although fungal infections are associated with TPN, antifungal therapy is usually not started until positive cultures are obtained. It is important to remember that malnourished and immunosuppressed patients with indwelling catheters and patients on long-term TPN are at increased risk for opportunistic infections.

STARTING AND STOPPING TPN

Very small neonates (less than 1000 g) are intolerant of high and low glucose loads. When starting TPN, they should receive a nutrient solution with 7.5 percent dextrose at a maintenance fluid intake rate of 120 to 150 ml per kilogram per 24 hours, run in over 24 hours. If blood glucose levels remain normal, then a 10 percent dextrose solution (P-10 solution, Table 1) may be given. Lipids may be concurrently started if the bilirubin level is within normal limits. Lipids should be started at 0.5 to 1.0 g per kilogram per 24 hours (infused over 24 hours) and increased slowly at increments of 0.5 to 1.0 g per kilogram per day. Serum lipid levels should be monitored daily while the lipid intake is being increased.

TPN should initially be infused over a 24-hour period. For patients on long-term TPN who need time away from their infusion pumps, the time on TPN may be gradually decreased. Each day, the time on TPN may be decreased by 2-hour intervals with commensurate increases in the infusion rates over the shorter time period. For those with central lines receiving 20 percent dextrose-nutrient solutions, the infusion rate should be halved over the last 2 hours to prevent rebound hypoglycemia.

TPN can be discontinued rapidly only in patients who are receiving an adequate concurrent oral intake. For the neonate, TPN should be tapered slowly in concert with an increase in enteral intake calculated to meet daily nutrient requirements.

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Parenteral nutrition in low birthweight infants

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ABSTRACT

Total parenteral nutrition plays a very important role in improving the mortality and morbidity of the sick low birthweight infants. From January 1992 to January 1994, 42 low birthweight infants treated in the Special Care Nursery, University Hospital, Kuala Lumpur, needed parenteral nutrition. Of these 31 (73%) survived, 11 (27%) died. The overall mean birthweight was 1149 g (range 650-2450g). The mean birthweight of the survivors was 1172 g (range 710-1900g) while that of those who died 1100 g (range 650-2450g). The overall gestational age was 29.4 weeks (range 25-36 weeks), that of survivors 29.4 weeks (range 25-33 weeks) and for the deceased 29.3 weeks (range 27-34 weeks). The main conditions the babies suffered from were hyaline membrane disease, necrotizing enterocolitis and recurrent apnoea.

Among the survivors, the mean duration of parenteral nutrition was 23.2 days (range 4-76 days). The overall weight gain (mean ± SD) was 13.5 ± 2.8 g/kg body weight per day with a percentage weight loss (mean ± SD) of 11.1 ± 3.8%. The babies took (mean ± SD) 13.3 ± 4.1 days to recover their birthweight. The cost of providing parenteral nutrition per survivor was RM1030 (range 164-4804).

Complications observed included: hyperglycaemia, hyponatraemia, hypercalcaemia, cholestasis with alteration of liver enzymes, metabolic bone disease and sepsis.

INTRODUCTION

Among the major factors contributing to the improved survival of low birthweight infants, especially very low birthweight infants (i.e. birthweight < 1500 g) and extremely low birthweight infants (i.e. birthweight < 1000 g), is the ability of modern medicine to provide nutritional support to these sick neonates whose body reserves are very limited. In these sick neonates, very often enteral route of nutrition is either not possible, inadequate or potentially hazardous, as a result of gastrointestinal malformation, disease, immaturity or systemic illness, which are often prolonged

and life-threatening. However, as parenteral nutrition is costly and not without complications, its use has to be carefully balanced between its benefits and disadvantages and the availability of resources. It is the aim of this paper to describe our experience in the use of parenteral nutrition in low birthweight infants.

MATERIALS AND METHODS

It is a restrospective analysis of low birthweight infants admitted to the Special Care Nursery (SCN), University Hospital, Kuala Lumpur requiring parenteral nutrition (PN), from January 1992 to January 1994, inclusive.

PN is indicated in infants who are unlikely to establish full enteral feeds within a week after birth or who are likely to have their enteral feeds withheld for more than a week. Thus hyaline membrane disease (HMD) or idiopathic respiratory distress syndrome (IRDS), recurrent apnoea of prematurity, neonatal necrotizing enterocolitis (NEC), and gastrointestinal malformations (like gastroschisis, omphalocele) are the main clinical conditions requiring PN.

Preparation of PN Solution:

Daily requirements of the infants requiring PN are calculated based on their weight, clinical conditions (such as need for phototherapy, nursed under warmer, presence of patent ductus arteriosus) and laboratory results such as urea, sodium, potassium, calcium.

For calculation of daily requirement, the birthweight of the child was used if the current bodyweight was less than the birthweight; and if the current bodyweight had exceeded the birthweight, the current bodyweight would be used. The glucose concentration in the PN solution depended on the blood glucose concentration of the babies and the glucose concentration in the intravenous (i/v) solution. The initial glucose concentration was usually 5-10%, gradually increased to 17.5 - 20%. If the blood glucose is > 7 mmol/L the glucose concentration was reduced accordingly. Lipid was started with 1 g/kg/day gradually increased to 3 - 3.5 g/kg/day. If blood urea concentration is < 8 mmol/L,amino-acids were started with 1 gm/kg/day, gradually increased to 3-3.5 g/kg/day. Fluid requirement depended upon the postnatal age of the babies and the clinical conditions e.g. extreme prematurity (< 28 weeks of gestation), under phototherapy, radiant warmer, abnormal fluid loss, particularly in surgical neonates, and the presence of patent ductus arteriosus (PDA).

Vitamins, minerals and trace elements were prescribed according to the bodyweight. Modifications in the mineral intake would be made according to the laboratory findings (Parenteral vitamins were occasionally omitted when stock was not available).

Preparation of parenteral nutrition solution

It was performed by one of us (HKD) in laminar flow, under aseptic condition. The resulting solution was filtered through a 5m filter before introducing into the

bag prior to delivery to the ward. Such solution has an expiry date of 3 days, and it was not used for more than 48 hours. Lipid was syringed out and capped before sending to the ward. It was not premixed with parenteral nutrition solution.

Administration of parenteral nutrition solution

Parenteral nutrition solution was infused continuously via central venous catheters in almost all cases. The central venous catheters (Vygon : Epicutaneo-cave catheter, ID 0.3 mm, OD 0.6 mm) was inserted percutaneously through peripheral veins of the scalp, antecubital fossae, sapheneous veins and axillae. The tip of the central venous catheters was located in the superior or inferior vena cava (SVC or IVC) or the right atrium. The position of the tip of the central venous catheter was confirmed radiologically with contrast injection. Occasionally peripheral venous cannulae were used to infuse the parenteral nutrition solution.

The parenteral nutrition solution was further passed through a bacterial filter (0.22 m) before entering the central venous catheter and the infant's circulation. Lipid solution was also infused continuously (over 24 hours) by a syringe pump and joined the parenteral nutrition solution via a three way tap before entering the central venous catheter.

Monitoring

Initially full blood count, urea and electrolytes levels were checked daily or on alternate days, subsequently twice a week. Blood glucose levels were measured twice a day. Lipid turbidity, liver function test and rickets screen were performed weekly.

The neonates were weighed on alternate days, according to the nursing routine of the ward. In addition the neonates were assessed clinically twice a day looking for evidence of sepsis in particular.

Introduction of enteral feeding

When the clinical conditions of the baby permitted, milk feeds via nasogastric tube were introduced in small amount and gradually increased in small increments, while parenteral nutrition solution and lipid were proportionately decreased and finally discontinued.

RESULTS

Between January 1992 and January 1994 (inclusive) 42 low birthweight neonates needed parenteral nutrition. All were totally dependent on parenteral nutrition initially, but as the neonates' conditions improved or stabilised, enteral nutrition was gradually introduced via nasogastric tube. Of these 42 neonates, 31 (73%) survived, 11 (27%) died. The overall mean birthweight was 1149 g (range 650 - 2450 g). The mean birthweight of the survivors was 1172 g (range 710 - 1900 g) while that of deceased 1100 g (range 650 - 2450 g). The overall gestational age of the study group was 29.4 weeks (range 25-36 weeks), that of surviving children 29.4 weeks

(range 25-33 weeks), and that of the deceased 29.3 weeks (range 27-34 weeks). The distributions of the study population by gestational age and birthweights are shown in Figures 1 and 2. The conditions from which these neonates suffered are listed in Table 1. These included hyaline membrane disease (24 cases),

Table 1. Condition from which the neonates in need of parenteral nutrition suffered

	Overall	Surviving	Deceased
• Hyaline membrane disease	24	19	5
• Recurrent apnoea	4	4	–
• Congenital pneumonia	2	0	2
• Sepsis	2	1	1
• Necrotizing enterocolitis	2	2	–
• Hyaline membrane disease and necrotizing enterocolitis	3	3	–
• Meconeal disease	2	1	1
• Gastroschisis	1	1	–
• Myotonia dystrophica	1	–	1
• Hydrops fetalis (Bart's)	1	–	1
Total	42	31	11

Fig. 1. Distribution of study population by gestational age (n = 42)

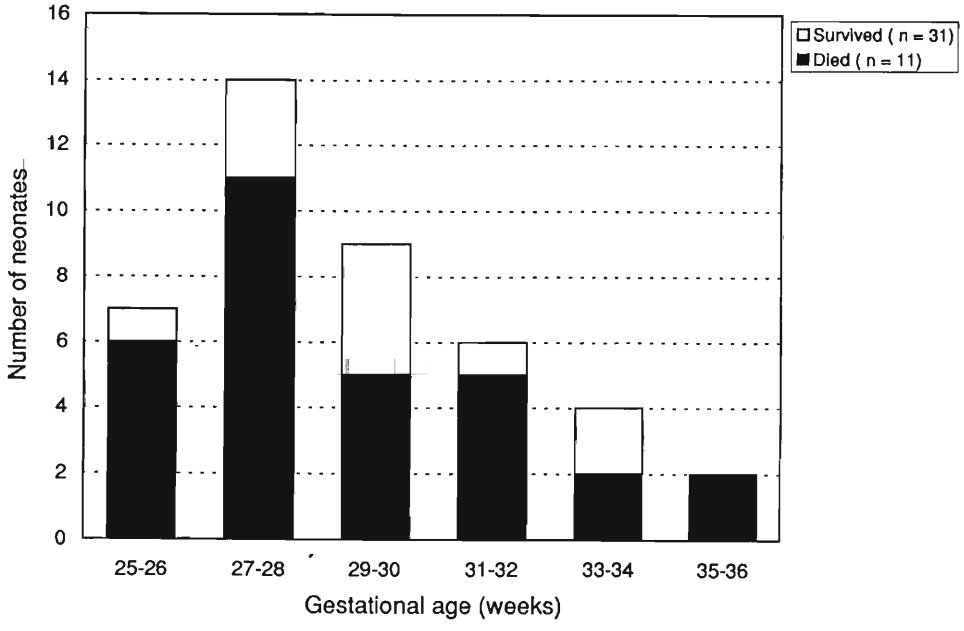
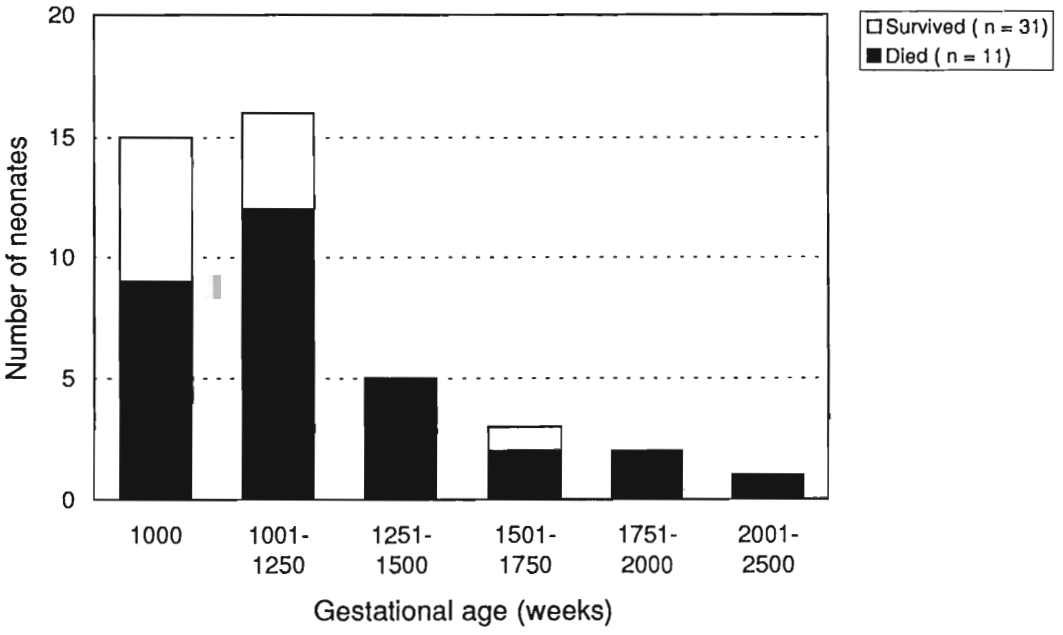


Fig. 2. Distribution of study population by birthweight



recurrent apnoea (4 cases), hyaline membrane disease with necrotizing enterocolitis (3 cases), necrotizing enterocolitis (2 cases), congenital pneumonia and sepsis (2 cases each).

The overall mean duration of parenteral feeding in this study group was 20 days (range 3-76 days). Among the survivors, the duration of parenteral nutrition was 23.2 days (range 4-76 days), and among the deceased, 10.0 days (range 3-20 days). The overall weight gain (mean ± SD) among survivors was 13.5 ± 2.8 g/kg body weight per day. The weight gain is defined as the mean of the daily weight gain for the week. The weight gain occurred normally after an initial period of weight loss. The percentage weight loss (mean ± SD) observed was 11.1 ± 3.8% and the time of recovery of birthweight (mean ± SD) was 13.3 ± 4.1 days.

The cost of a bag of parenteral nutrition solution was (mean ± SD) RM42 ± 11.50 and the cost of providing parenteral nutrition per baby was RM1030 (range 164-4864).

Complications related to parenteral nutrition are listed in Table 2. Commonly encountered complications included - cholestasis, alteration of liver enzymes, metabolic bone disease of preterm babies (rickets) and sepsis. *Staphylococcus epidermidis* was isolated in four instances and thought to be catheter-related as well.

DISCUSSION

Low birthweight infants particularly those very low birthweight and extremely low birthweight infants (weighing < 1500 g and < 1000 g at birth),

Table 2. Complications related to parenteral nutrition among survivors (n = 31)

• Hyperglycaemia (> 10 mmol/L)	3
• Hyponatraemia (< 125 mmol/L)	4
• Hypokalaemia (< 3 mmol/L)	3
• Hypercalcaemia (> 2.5 mmol/L)	4
• Bilirubin (> 200 μmol/L)	6
• A.S.T.* (> 55iu/L)	6
• Alkaline phosphatase (IU/L) > 600	10
• Urea (> 8 mmol/L)	2
• Sepsis – *S. epidermidis*	4
S. fecalis	1
• Metabolic bone disease of prematurity	5

*AST: aspartate aminotransferase

have very low body reserves (1) and they often suffer from severe diseases or conditions which are life-threatening or required prolonged period of gut rest. In sick LBW infants, over enthusiatic early introduction of milk feeds and excessive increase in volume of milk can result in aspiration pneumonia (2) and cardio-respiratory disturbances (3). It has been demonstrated that early postnatal malnutrition may permanently affect the brain growth and thus developmental outcome (5,6). As modern neonatal intensive care has supported ill LBW infants through their critical period of illness, when enteral feeding is inadequate, the need for parenteral nutritional support will become more pronounced.

Parenteral nutrition is thus indicated in neonates whose disease make enteral feeding impossible, inadequate or potentially hazardous. In our experience the commonest condition for which parenteral nutrition was indicated was respiratory distress such as in hyaline membrane disease and congenital pneumonia. These infants are very ill, the majority of them requires respiratory support and their gastrointestinal tract is immature; as enteral feeding is either impossible or inadequate, parenteral nutrition is vital, to support life before enteral feeding is attempted, or to supplement enteral feeding while it is being gradually increased or established. In general, the more premature the infants, the higher is the frequency and severity of respiratory failure; the more prolonged is the illness and the more there are complications of ventilatory management (7); the longer is the period of catabolism (8) and the greater is the difficulty in establishing adequate nutrition (9).

Conditions such as intestinal atresia, gastroschisis, omphalocele, necrotizing enterocolitis, often entail extensive intestinal resection, or multiple intestinal surgical procedures or prolonged gut rest, thereby precluding enteral feeding.

Parenteral nutrition solution consists of glucose, fatty acids, amino acids, electrolytes, minerals, trace elements, vitamins and water. The initial concentration of glucose prescribed is based on the glucose concentration in the intravenous fluid the baby is receiving - usually 10% dextrose or in the case of extremely low

birthweight infants (weighing < 1000 g at birth), 5-7.5% dextrose. This will provide 5-10 g of glucose per kg body weight per 24 hours, if 100 ml per kg bodyweight per 24 hours of solution is infused. It is possible to gradually increase the glucose concentration to 20% by 7-10 days after commencing parenteral feeding. This concentration of glucose will supply 80 Kcal per 100 ml of solution. It has been shown that neonates can tolerate 3 g per kg body weight per 24 hours of amino acids (equivalent to approximately 2.6 g protein)(10), and 3 g per kg per 24 hours of fatty acids by the second week of parenteral nutrition (11). Thus the main sources of calories are hypertonic glucose solutions and lipids. Together with 3 g per kg body weight of amino acids, using a total fluid volume of 100-120 ml/kg per 24 hours it is possible to achieve a caloric intake of 95-110 Kcal per kg per 24 hours. This amount of calories indeed is comparable to the recommended enteral calorie intake of 100-120 Kcal per kg per 24 hours. The parenteral intake recommended is less than that recommended for enteral intake because factors of malabsorption, and nutrient loss in the gastrointestinal tract (10) are eliminated. Under this regime, the neonates receiving parenteral nutrition were able to meet the basal metabolic needs and requirement for physical growth. A mean weight gain of 13.3 ± 2.8 g per kg body weight per 24 hours was observed, with weight loss (mean SD) of 11.1 ± 3.8% of birthweight and time of regaining birthweight (mean ± SD) 13.3 ± 4.1 days. This daily weight gain is comparable to that reported by Gill et al (12). The gain in weight is due to actual tissue accretion rather than fluid and water retention (14).

The recommended amount of fluids prescribed is usually 100-180 ml/kg/24 hours. This intake is affected by the clinical conditions of the baby such as extreme prematurity, the presence of significant PDA, nursing under radiant warmer or under photo-therapy. In our experience, in the first week of life, the amount of fluid intake was in the range of 100-120 ml per kg per 24 hours and for the subsequent weeks the volume was between 120-150 ml/kg/24 hours, mainly because of the presence of PDA and occasionally because of oedema due to hypoalbuminaemia. Minerals and trace elements are added to the parenteral nutrition solution accordingly.

The parenteral nutrition solutions were prepared in the pharmacy unit (HKD) employing strict aseptic techniques in a laminar flow hood. As a terminal filtration with a 5 m filter was inadequate to filter bacterial particles, a filter (0.22 m) was interposed in the delivery system.

Parenteral nutrition solution can be given via peripheral veins, using short catheters or scalp vein needles (16). Small diameter silastic catheter can be inserted by cutdown of the peripheral veins or internal jugular vein (17) to administer the parenteral nutrition solution. Percutaneously inserted silastic catheters (ID-0.3 mm, OD - 0.6mm) using scalp veins and veins of the extremeties are often preferred (18), the catheter tip placed centrally, either in subclavian veins, SVC, IVC or in

the right atrium. The position of the tip of the central venous catheter was checked with contrast injection after insertion. Almost all of the parenteral nutrition solutions in our cases were infused via percutaneously placed central venous catheters, by syringe pumps, having been filtered again (see above) before entering the central venous catheters. Although lipid solution and parenteral nutrition solution can be premixed, they were infused separately because lipid can clog up the bacterial filter if it were to pass through one. Lipid was infused continuously over 24 hours as such infants attain better lipid profiles when compared with those infused with lipid intermittently (19).

It is important to monitor the various biochemical parameters such as sodium, potassium, chloride, urea, creatinine, glucose, calcium, phosphate, liver function and lipid turbidity as the daily management and the prescription of parenteral nutrition depends on these biochemical values. Blood glucose levels need to be checked twice a day and the electrolyte levels daily or alternate day initially, and when stable once or twice weekly. Liver function should be monitored weekly and screening for metabolic bone disease of prematurity should also be performed weekly. The infants should be weighed daily or alternate day, and the head circumference and the length of the baby measured weekly to assess the physical growth of the baby.

As the sick neonates on parenteral nutrition are susceptible to infection, clinical and laboratory evaluation of the condition of the infants should also be done frequently. Changes in blood biochemistry such as hypo-or hyperglycaemia or drastic changes in serum electrolyte levels should also be taken seriously as there may be associated infection. Whenever infection is suspected, the possibility of catheter-related sepsis should be considered, evaluated and managed accordingly.

The complications of parenteral nutrition we experienced included: hyperglycaemia, hyponatraemia, hypokalaemia, hypercalcaemia, metabolic bone disease of prematurity, cholestasis, and sepsis. Hyperglycaemia or hypoglycaemia was not a major problem in our series — two of the cases of hyperglycaemia were thought to be due to catheter - related sepsis, but not proven. Hyperglycaemia was managed by reducing the glucose concentration in the parenteral nutrition solution. Hyponatraemia was seen in 5 neonates and high sodium intake of 10 mmol/kg body weight/24 hours was needed. This is thought to be related to renal immaturity, reduced renal tubular sodium reabsorption (20). Hypercalcaemia seen in this series was without obvious cause, probably related to the use of calcium early in the management of the underlying disease and in some cases associated with the use of furosemide diuretic. Hypercalcaemia was overcome by using low or minimal amount of calcium in the parenteral nutrition solution. Cholestasis was observed in 25 % of the cases in this series.

The incidence of cholestasis

among infants on parenteral nutrition is between 10-40%. It is however higher among infants who had been on prolonged (more than 2 months) total parenteral nutrition (21). Several mechanism for cholestasis have been postulated, including immaturity of the hepatobiliary system, prolonged fasting, impaired bile secretion and bile salt formation, coexisting sepsis, and excessive amino-acids and glucose intake.

In most cases of cholestasis, resolution follows initiation of enteral feeding but progression to liver cirrhosis has been documented (22). Phenobarbitone therapy (23) and biliary irrigation (24) had also given good results. Metabolic bone disease of prematurity was seen in 5 babies in the course of the stay in the ward. This could have resulted from inadequate calcium or phosphate, and vitamin D intake and the use of diuretics in these preterm infants (25). It must be pointed out that because parenteral vitamins had not been budgeted for in the pharmacy, they have been occasionally omitted when the stock was not available, thus vitamin D deficiency might have been a contributing factor.

Sepsis was observed in 5 babies on parenteral nutrition, 4 catheter-related and due to *Staphylococcus epidermidis* while one was due to *Streptococcus faecalis*. It has been well documented that *Staphylococcus epidermidis* is related to TPN and long term indwelling i/v catheters (26).

The survival rate of the VLBW in University Hospital, Kuala Lumpur has increased from 64.6% (27) in 1978-81 to 95% (28) in 1991 and that of ELBW from 13.3 % (27) to 40% (28) during the same period. Certainly parenteral nutrition played a significant role. The additional survivors might have succumbed to starvation if parenteral nutrition was not feasible or had not been provided. However, the cost of a bag of parenteral nutrition ranged from RM35 to 50 and the cost of supporting a sick LBW infant with parenteral nutrition in this series range from RM164 to RM4864, with a mean of RM1030. It is thus a costly venture to undertake.

In conclusion, parenteral nutrition is an important supporting tool in modern neonatal intensive therapy, helping to improve mortality and morbidity.

However it is expensive and not without hazards. Thus the use of parenteral nutrition has to be carefully considered.

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Trace elements in enteral and parenteral nutritional support

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ABSTRACT

Nine trace elements (TE) have been identified as being essential for humans and are available for clinical use in parenteral and enteral forms. They include Zn, Cr, Cu, Mn, Se, Fe, I and Mo. Co is used as a component of vitamin B12.

The proximal ileum is the site of absorption of most TEs. TE present in enteral diets are not always bioavailable. Several interactions between TEs result in decreased absorption. To avoid clinical deficiency states, commercially available enteral nutrition products and TE supplements must contain TE in bioavailable forms.

TE deficiency in total parenteral nutrition (TPN) patients have been recognised but rarely seen if TE supplementation is routinely given. TEs for TPN use are available as combination solutions containing Zn, Cu, Cr, Mn and Se or as single entities. The latter are of use to tailor TPN to suit the needs of individual patients.

Zn deficiency is commonly seen in various gastro-intestinal disorders and commonly presents with altered taste sensation, and skin changes. Se deficiency results in myositis and cardiomyopathy. Cu deficiency presents as anaemia and pancytopenia.

Other points about the clinical significance of variouis TEs, recognition and correction of deficiency states, and guidelines for safe, efficacioius and cost-effective nutritional support will be discussed.

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Central venous access

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In parenteral nutrition, a good central venous line is essential for the infusion of the parenteral solution. Central venous access devices can be permanent or temporary, implanted or external. The indications of central venous access devices are total parenteral nutrition, chemotherapy, long-term intravenous antibiotic therapy, and exhaustion of peripheral veins.

There are many types of central venous devices available in the market. There are the external Broviac or Hickmann type of catheters, and the subcutaneous ports which are implanted. Which type of device is chosen depends on the duration of therapy, whether MRI may be required later, hence the material used must be MRI compatible, and also the cost involved.

The device can be inserted by surgical cutdown on a suitable vein, such as the internal jugular, external jugular or the cephalic vein, or by percutaneous puncture of the subclavian vein under radiological control.

Careful care and maintenance of the central venous line is essential once the device is in place to prevent complications from occuring. Post-operatively, a chest X-ray is obtained to check that the line is in place. The ideal position is in the junction between the superior vena cava and the righ atrium. Sometimes the catheter enters the right ventricle causing arrhythmias.

The catheter needs to be flushed regularly to maintain patency. The heparin concentration and the flushing protocol varies in different centres. Commercial preparations of heparin are available in concentrations of 10U per ml. Flushing protocols vary from twice a day to once a month.

The exit site needs to be cleaned daily. When the device needs to be accessed, aseptic techniques are essential, and for subcutaneous ports, the use of non-coring needles are important, as this will prolong the usage of the port. The needle must be anchored firmly and secured with a dressing.

Complications of the central venous devices are:

1. Bleeding

This is a complication of the insertion occurring in patients with bleeding disorders.

2. Air embolism

This can occur during the insertion of the catheter.

3. Infection

This is one of the commonest complications seen. It usually occurs in the first three weeks. There are four types of infection:

a) Local infection at the exit site has been reported in 0-56% cases.
b) Tunnel infection presents as erythema along the tract and sometimes as pus coming out of the exit site.

If there is no evidence of systemic infection, the lines can sometimes be salvaged with these 2 types of infection.

c) Septic thrombophlebitis
d) Septicemia alone

The last two are more serious infections that usually require the device to be removed.

The route of infection is usually by direct invasion of organisms at the exit site. This can be decreased by the use of an antimicrobial collagen cuff at the exit site. Haematogenous spread is rare, occurring in 1-4% of cases. The organisms involved are usually endogenous organisms, eg Staph epidermidis, Staph aureus, Gram-negative bacilli and enterococcus.

4. Occlusion

Occlusion is defined as the inability to flush or withdraw from the system. Rates vary from 2-24%. The causes of occlusion are:

a) Thrombosis
b) Precipitation of drugs, etc.
c) Kinking
d) Lipid deposits
e) Malposition
f) Catheter lodged against the vein wall.

5. Disconnection

6. Extravasation

7. Dislodgement of needle; Incorrect placement of needle.
8. Erosion of port through the skin.

9. Venous thrombosis

This presents as superior vena caval obstruction. The incidence of pulmonary embolism from this complication is reported as 6%. It is usually related to the thrombogenicity of the cathether material used.

The advantages of the central venous device is that it is more comfortable for the patient. There is no need for constant pricks for blood taking and drips, and there is no danger of ulceration from extravasation from peripheral veins.

However, the disadvantages are the cost involved, and in children, the insertion requires general anaesthesia. Care and maintenance of the device requires special training, and nurses and the house officers dealing with such devices have to be familiar with all the possible complications and how to deal with them.

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Setting up a nutritional support service in the University Hospital, Kuala Lumpur

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ABSTRACT

Nutritional support has become a vital component of the medical treatment of home and hospitalised patients and is considered to be one of the most significant medical advances in recent decades. A nutritional support service is essential for hospitals treating a range of typical patients. Nutritional support in hospitals involves parenteral and enteral services. These services usually operate independently of each other. The time has come where both the services have to merge under one umbrella of a Nutrition Support Service for cost-effective management and for better patient care.

This paper outlines the following:

1. the development of nutritional support in the University Hospital, Kuala Lumpur;
2. the problems faced by the Parenteral Nutrition Service and the Enteral Nutrition Service working independently;
3. reasons for establishing a Nutrition Support Service;
4. the benefits to the hospital of having a Nutrition Support Service;
5. its composition, purpose, objectives and functions.

INTRODUCTION

Is there a need for a nutrition support service in the University Hospital, Kuala Lumpur?

Patients in this hospital, like many other hospitals throughout the world, present nutritional problems. Studies on a range of conditions have suggested that the incidence of malnutrition in hospital is often as high as one patient in three. The consistency of these findings, even in affluent areas like the U.S.A. and Western Europe shows that this is a major and inadequately addressed problem.

The growing recognition of specific nutritional requirements in

disease and trauma has led to many clinical studies of the benefits of available nutritional regimens. Nutritional support has become a vital component of the medical treatment of home and hospitalised patients and is considered to be one of the most significant medical advances in recent decades. Nutritional support involves the use of specialised equipment and techniques that need specialisation. It is also expensive. This requires close cooperation between all disciplines involved. To formalise this relationship throughout our hospital, the concept of the nutrition support service was evolved. The team includes those interested and closely involved in clinical nutrition. I would recommend that the composition, functions and policies of the nutrition support service established in your hospital should be tailored to the needs and facilities available there.

The development of the nutrition support service in the University Hospital, Kuala Lumpur

Brief history of the parenteral nutrition service of the University Hospital, Kuala Lumpur

October 1980 - The Medical Advisory Council after having considered a paper UHC-264/80 submitted by Prof Iyngkaran agreed in principle to the establishment of the Total Parenteral Nutrition team.

March 1981 - The MAC was informed that the hospital's board of management had approved RM 50,000 to establish the team and appoint Prof Inygkaran as team leader.

August 1982 - The adhoc team designated as the Nutrition Support Team was formed to prepare and administer parenteral nutrition solutions. The service was started by the Paediatric Department and the solutions were prepared by the lecturers and medical officers.

February 1986 - The Pharmacy unit began to prepare parenteral solutions for paediatric cases only.

August 1990 - A specific preparation room for preparing TPN solutions was established and the Pharmacy started to prepare TPN solutions for adults too. The Pharmacy Unit has been closely involved with the development of this nutrition support service, in the supply of the parenteral nutrients in multi-bottles on request from the wards, and in the preparation of complete intravenous nutrient supply in single bags.

Data in Table 1 show the production of total parenteral nutrition bags and the number of patients treated by the nutrition support service in the University Hospital, Kuala Lumpur for the last 8 years. In 1986 the exact number of patients is not known, but is estimated at 7. The average number of bags per patient in 1993 is approximately 16, indicating that on average a patient is on TPN for 16 days. In 1992, this number was approximately 17 bags per patient.

Table 1. Production of total parenteral nutrition bags and the number of patients treated

Year	No. of Bags	No. of Patient
1986	130	-
1987	205	11
1988	250	19
1989	330	24
1990	581	45
1991	972	58
1992	1324	78
1993	1196	73

The Pharmacy supplies total parenteral nutrition solutions in single bags to the following areas, in the following order of priority:

1. Bone Marrow Transplant Unit (paeds and adults)
2. Special Care Nursery
3. Paediatrics Department
4. Intensive Care Unit
5. Selected surgical cases

Problems faced by pharmacy and dietary units in providing enteral and parenteral nutritional support :

1. Manpower

With our present manpower of one pharmacist and one trained pharmacy assistant, we are only able to provide total parenteral nutrition to 6 patients throughout the whole hospital, in order of priority as listed above. The other patients who are not able to take nutrition enterally are provided nutrition via the multi-bottle system. There is a need to expand the service to meet increasing demands.

2. Operational costs

Operational costs automatically go up as preparing total parenteral nutrition solutions in single bags is very expensive. Maintaining the cleanroom and the laminar flow cabinet is also expensive. The cost of a TPN bag including the lipid for a neonate is approximately RM60.00; a paediatric bag costs on average RM80.00; for an adult the cost of a TPN bag is around RM150.00. This does not include overheads or labour costs.

3. Lack of coordination and collaboration between the dietary and the pharmacy units

As a result of lack of coordination and collaboration between the dietary and the pharmacy units, patients received non-optimal nutritional care. For example, whenever enteral feeding failed, due to the method of delivery, total parenteral nutrition was initiated, further increasing cost and workload.The dietary unit was facing problems of their own. Although the best available formula was used, the method of delivering the feed was found to be wanting. Numerous problems such as diarrhoea, abdominal distension, regurgitation and nausea were encountered. Furthermore, a considerable amount of nursing time is required and feeds were sometimes accidentally omitted.

Reasons for establishing a nutrition support service

The purpose of a nutrition support service is to provide adequate nutrition to every patient in the hospital.

Purpose

1. To provide optimum nutritional care to all patients in the hospital.

2. To provide safe and effective nutritional support to the patients in the most cost-efficient manner.

Objectives

The following list of objectives were developed to provide nutritional support in our hospital:

1. To standardize the management of patients receiving parenteral and enteral nutrition.

2. To identify patients at nutritional risk so as to reduce the incidence of malnutrition as a complicating morbidity/mortality factor.

3. To provide clinical expertise in monitoring and ensuring adequate, safe and cost-effective nutritional support.

4. To provide continuous in-service education in parenteral and enteral nutrition of personnel and medical staff.

5. To establish infection control protocols to ensure safe preparation and delivery of all forms of nutritional support products.

6. To establish appropriate guidelines for the use of specialised nutritional support solutions.

7. To provide quality assurance in the areas of enteral and parenteral nutrition.

8. To minimize waste and inappropriate use of expensive nutritional support solutions.

9. To act as liason between all hospital departments and the nutrition support team.

Functions

Collectively the nutrition support service would accomplish the following in the short and long term:

1. Serve as a consulting service for the primary physician whose patient may require some form of enteral or parenteral nutritional therapy.

2. Provide in-service education to physicians, pharmacists, dietitians, nurses and ancillary personnel on the principles and applications of enteral and parenteral nutrition.

3. Hold regularly scheduled nutrition rounds to monitor and identify problems with parenteral and enteral nutrition.

4. Make reports and recommendations to pharmacy and dietary units, the director and the Medical Advisory Committee regarding the use of parenteral and enteral nutrition.

5. Develop policies and procedures for the safe and effective use of parenteral and enteral nutrition.

6. Promote improved standards of care and infection control in

the practice of clinical nutrition.

7. Maintain cost-effectiveness in nutritional support and aid in cost containment.

Composition of a nutritional support team

There is no ideal structure for a nutrition support service team. Each institution must decide according to their own needs, resources and the expertise available. Each member in the nutrition support service utilizes his or her own special training to provide the highest quality care while minimizing complications. In the University Hospital, the nutrition support team consists of a main group and a liason working group or a core group.

The nutrition support team consists of :

1. Deputy Director (Professional Services) - head of team
2. surgeon
3. anaesthetist
4. general physician
5. paediatrician
6. pharmacist
7. dietitian
8. nurse

Responsibilities of the various members

1. Head of the nutrition support team

The head of the nutrition support service assumes complete responsibility for the normal functioning of the main and core teams. He oversees the nutritional support provided to patients requiring it and supervises the administration of the entire program. The head plays an important role in the educational programs offered by the nutrition support service. He is also required to develop relevant research projects in clinical nutrition.

2. Nutrition support team pharmacist

The pharmacist provides important information and suggestions as to the daily formulations for patients needing nutritional support, by participating in the assessment, evaluation and monitoring of all patients under the medical direction of the nutrition support service. The pharmacist also contributes to the development of protocols for the preparation and administration of parenteral solutions and providing in-service education to all those involved with nutritional support. In the University Hospital, Kuala Lumpur, the secretariat of the nutrition support team is held by the pharmacy.

3. Nutrition support team dietitian

The dietitian has many responsibilities beyond the usual food service liaison. The dietitian is the principal resource for the design of enteral and modular nutrition therapies, involving the transitional feeding regimens from enteral to parenteral and vice-versa. Another function of the dietitian is to develop protocols and guidelines for the usage of enteral feeds and to ensure compliance with established protocols and techniques. In addition, the dietitian provides in-service education to health care professionals, patients and their

families on topics regarding clinical nutrition.

4. Nutrition support team nurse

The nurse is the major member involved in the team especially in the area of quality control. The experienced nurse serves a major function in establishing and implementing protocols in catheter care and in infection control. Another major function is to coordinate and assist in in-service education of nursing staff in management of enteral and parenteral formulations and to prevent complications. She is the expert in handling the equipment for administering the nutritional products. The nurse is also involved in educating the patient and their families on the nutritional therapy administered.

The nutrition support team has been officially formed since February 1993. It meets three times a year. A sub-committee called the Liason Working Group has been formed to carry out various tasks and activities for the year.

Composition of Liaison Working Group

1. anaesthetist
2. paediatrician
3. pharmacist
4. dietitian
5. nursing sister

The Liaison Working Group meets once a month and reports to the main team. One of the first tasks of the Group was to arrange the purchase of more pumps for enteral and parenteral feeding. Current activities are preparing nursing protocols on caring of TPN lines to reduce infection, and preparing booklets on guidelines for parenteral and enteral nutrition for doctors and in-service education. Clinical nutrition rounds by the Liaison Working Group will start in May this year after the approval by the main team. This is to ensure full cooperation from the primary physician and to prevent overlapping care of the patient. The main purpose of the clinical rounds is to monitor the patients to ensure that the regimen provided is achieving its goal and to identify potential problems.

With the formation of the nutrition support team, the number of patients on TPN and the number of bags prepared has decreased from 78 patients and 1324 bags in 1992 to 73 patients and 1196 bags in 1993. This is due to the fact that there is better coordination, especially between the pharmacy and dietary units and other disciplines; patients are getting improved nutritional care and this will prove to be more cost-effective to the hospital in the long term. There is also increased awareness within the hospital regarding the importance of nutritional support; this is shown by the numerous requests for lectures and information by the various disciplines in the hospital.

Providing adequate nutrition to patients needing nutritional support is a challenge that requires the skillful input of several disciplines. A nutrition support team can provide the guidelines, monitoring and education that are necessary for the safe and effective administration of both parenteral and enteral nutrition. The team

concept of nutritional support is becoming the standard of care for the hospitalized patient to promote health and healing.

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