

are rarely associated with thrombosis; this is the important point in which animals differ from man.

Turkeys suffer from an interesting condition which is rupture and dissection of the posterior aorta. This is an important disease, because it tends to pick off the biggest and best birds, which are usually the males, and often males that may be needed for breeding purposes. Indeed this was one of the reasons why people turned to artificial insemination in breeding these birds. At the site of the tear there is an atherosclerotic plaque, and the turkey plaque resembles the human plaque closely. It may be that the atherosclerosis is responsible for the rupture in the turkey aorta, but turkeys are also peculiar in that they have a high blood pressure compared with other birds, and this may also be a reason for aortic rupture, particularly in the weakened zone.

We fed turkeys on a variety of diets containing a variety of fats, and we found that they all produced plaques, no matter what type of diet we fed them. However, if they are fed a synthetic diet without fat, they also produce plaques, and rabbits fed a synthetic diet without fats do this too. So perhaps atherosclerosis has nothing to do with fat at all; perhaps it is some deficiency such as pyridoxine, which is known to produce arterial lesions in certain animals, conditioned by dietary lipid.

Lastly, there is no doubt at all that lipids are not the only factor involved. For example, the aorta of young persons with renal hypertension may show atherosclerotic plaques most of whose contents are fibrous in quality. Here the hypertension is undoubtedly the main factor, and any accumulation of lipid purely secondary. Atherosclerosis is then a multifactorial entity. Many factors come into play; one of them is diet but this is far from being the only factor. The lesson to be learned from these experiments is moderation in diet rather than violent change as a possible preventative of ischaemic heart disease.

III

What Can Be Done

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When I qualified in medicine in 1948, the word "cholesterol" meant very little to me. I knew that the blood cholesterol level was raised in myxoedema and lowered in thyrotoxicosis. I knew that

there was a lot of it in the liver, and that it was frequently present in gall stones. Even these small memories from student days had nearly vanished, when four years ago the significance of a raised cholesterol level was brought home to me in an indirect but none the less forcible manner. In my country practice of 3,500 patients in Northamptonshire I have a family whose numbers are thinned in early middle age with the most remorseless and predictable regularity. The menfolk are the main sufferers, and there is many a widow left behind, but sometimes the women suffer. The family bearing this trait arrived in the district about 1890, and it was brought in through the female line by a person whose name was Mary Baily. In the following 70 years, the members of the family grew up in the knowledge that they were liable to die a sudden death in middle age, sometimes as early as the age of 40. There are now a dozen or more families descended from the original, and the tendency is fading in some of them, but it continues quite strongly in others. I know most of the families quite well, and my first acquaintance with the disease with which they are branded was in a man of 42 who suffered from angina. This man developed an infarction subsequently, and spent two months in hospital, where the serum cholesterol was not estimated because at that time, a mere four years ago, the relationship with it to ischaemic heart disease was not so well accepted. When he came home, I found that his serum cholesterol level was 440mg. per 100ml. In other members of the family, I found levels between 200 and 460mg. per 100ml. Some of the levels were normal, some were high normal and some were frankly hypercholesterolaemic.

At this time the epidemiological surveys of Professor Ancel Keys were bearing fruit. They were showing that the cholesterol level in the serum of natives of a country was directly reflected in the incidence of ischaemic heart disease of that country. Here in my own practice was evidence of a high and predictable incidence of ischaemic heart disease, and associated with it was a pattern of elevated serum cholesterol. The question I asked myself, quite naturally, was whether it would be a good idea to reduce the cholesterol levels of this unfortunate family? It seemed to me that in the absence of any other medical suggestion to prevent coronary disease, this was worthy of trial. I started off by reducing the cholesterol level of the man with the 440mg. level. After three weeks of dietary treatment the level was 328mg. and two months later it was 334, while seven months after starting the diet it was 324mg. per 100ml. I then treated other members of the family. His brother, who had also suffered a coronary attack had a level of 450 mg. per 100ml, and after dieting, this level came down to the rewarding level of 250.

Before long I had quite a number on the diet, and with few exceptions I found it possible to bring the cholesterol level down.

Before describing the diet there are two matters which need comment. The first is the difficulty of getting reliable cholesterol estimations done. When I first began sending blood specimens to the laboratory, it soon became apparent that there was great variability. Either the patient had a cholesterol level which was continually fluctuating, or the laboratory work was inaccurate. All the evidence in the literature goes to show that the blood cholesterol level is remarkably constant, day in day out, whether it is taken before meals or after meals. I planned a little experiment with four hospital laboratories. I took a series of eight blood specimens, divided each into four portions and sent the specimens to each of the four laboratories. The top and bottom levels of the best group of four were 153 and 175mg. per 100ml. The top and bottom levels of the worst groups were 166 and 235. The laboratory error was thus an additional factor to be coped with. These experiences taught me that for the purposes of detecting fluctuations in blood cholesterol the conventional hospital laboratory techniques were not sufficiently refined. It is perhaps no wonder that clinicians are not impressed by the usefulness of cholesterol estimations, and this possibly explains some scepticism in the past about the relationship between cholesterol levels and ischaemic heart disease. I went through a spell of doing my own estimations and I cannot report any conspicuous success, but there are in fact a number of accurate and reliable methods. They are rather time-consuming and expensive, and I think the laboratory would need to have a biochemist on the staff.

The second matter for comment is "What is the normal cholesterol level?" My diary gives the normal range as 100 to 220mg. per ml. and the text-books give similar figures, but the literature reveals that this wide range is not wide enough. A newborn infant has a level of 35mg., and the top range of normal would seem to be over 300mg., about ten times the level in babies. Several surveys of normal American males aged between 50 and 60 reveal that 235 to 250mg. per ml. is an average, but these figures are nothing more than an arithmetic mean. In one survey, 98 per cent of the readings fell between 148 and 364, which clearly indicates the difficulty of defining a normal level. One ought nevertheless to have some opinion of what is normal and what is not. The apparent healthiness or otherwise of an individual is unrelated to his serum cholesterol level. Levels over 1,000mg., although rare, are compatible with excellent health, and so also are low levels of 120. The high cholesterol levels and the abnormal blood lipids associated with them produce no ill-effects on bodily function except for the generation of atherosclerosis

and the liability of blood to thrombose on atherosclerotic plaques and ulcers.

I think, therefore, that a correct definition of what is normal is that level at which ischaemic heart disease becomes uncommon. There is a truly impressive amount of evidence from epidemiological surveys that this level is in the region of 175 to 200mg. per 100ml. At 175, coronary thrombosis is distinctly uncommon, whereas at 200 it is of modest proportion. Such levels are derived from sampling large populations, and although true of such numbers, are less predictive of prognosis in the individual. However, it has been found in the American survey at Framingham near Boston that healthy men with levels of 260mg. will develop heart disease in the fullness of time six times more frequently than men with levels of 200mg. I think that one may reasonably say that a level of 175 to 200mg. is a desirable level, a level of 220 to 250 mg. is an average normal, while 300 represents the upper limit of normal and above this there is an abnormality of fat metabolism, particularly essential hypercholesterolaemia. By this token, the western civilized nations have serum cholesterol levels higher than what is desirable. Perhaps we should talk of reducing existing levels, not to normal, but to an optimum level; that level at which ischaemic heart disease becomes uncommon and the arteries remain in better condition. The rather high level that the Westerner has is the price of a high standard of living. I do not think we should forego our privileges and live as the Bantus do, but we cannot look complacently at the tragedies associated with premature deaths.

In my own practice I have lowered the cholesterol levels in the blood by dietary measures without any great difficulty, and so have many other people, particularly in America, where this type of treatment is carried out on a large scale. In this country there does not seem to be the same acceptance of these methods. There has been a search for chemotherapeutic substances which will do the same job, but in tablet form. It is easier for the doctor to prescribe a tablet to be taken three times a day than to invoke a change in the patient's eating habits. There are in fact a number of substances on the market for this purpose, but they are without exception unsatisfactory. It is not inappropriate to compare elevated cholesterol levels to obesity. Both conditions are frequently associated with an undue consumption of fats. By cutting down on fat intake, a fat person will usually lose weight, and by cutting down on fats, and more particularly by altering the type of fat consumed, the cholesterol level will be lowered in the same manner. The treatment of obesity is essentially dietary, and tablets play a minor role; so also should be the treatment of raised blood lipids. It is interesting to remember

that thyroid hormone was frequently used for weight reduction; it is now being used for cholesterol reduction. In thyrotoxicosis there is loss of weight and lowered blood lipids, and this is the parallel for using thyroid hormone to lower cholesterol. Thyroid hormone is in fact effective, and the reduction recorded in a trial by Dr Oliver in Edinburgh averaged 18 per cent. Unfortunately there is also the side-effect of raising the basal metabolic rate, and this has not surprisingly aggravated angina. Oestrogens have also been used with some success in lowering lipids, but at the cost of feminizing male patients. The dose has to be too high. Research goes on for oestrogens which will lower blood levels but which will not feminize and for thyroid analogues which will not raise the basal metabolic rate.

I can state the diet I use in one sentence: consume two ounces of unsaturated oils at the expense of saturated fats. In some hospitals this advice takes the form of telling the patient to swallow two ounces of corn oil a day and giving the patient a prescription for his bottle. To administer corn oil in a dosage of two ounces a day I consider inelegant. It arises from the belief that corn oil is medicinal, but these oils are not medicinal; they are nutritional. A dosage of two ounces a day provides almost 25 per cent of a person's calorific requirements, and such a massive contribution to the diet can hardly be looked upon as medicinal. Moreover, some people cannot stomach oils coldly imbibed by the spoonful. Some are nauseated, and when it is remembered that the dietary changes are for the rest of the patient's life, I think it is important to make them acceptable.

The principle of the diet is to exchange 2 ounces of saturated fats for 2 ounces of unsaturated fats. I believe that the only sensible way to do this is to incorporate the oils into the food, as in frying and baking and so on, and it is quite easy to do this. In France, unsaturated cooking oils are used in cooking almost exclusively. In this country we consume about 4 ounces of fat a day, 2 ounces of which is "invisible", that is, in milk and eggs, lean meat and so on, and 2 ounces of which is "visible" fat, that is, in the form of butter and so forth. It is this latter portion that needs altering.

Most of our daily consumption of visible fat is highly saturated. It consists of butter, the fat on meat, margarine and solid cooking fat. Saturated fats are usually solid and animal in origin. Unsaturated fats are usually liquid and vegetable in origin. This is a rough guide and there are exceptions, but margarine and cooking fat particularly call for comment. They are both solid and saturated, although vegetable in origin, and have no counterpart in nature. They started life as liquid unsaturated fats of vegetable or marine origin, usually a mixture of whale oil, ground nut oil, soya bean oil, and palm oil. They are then purified and hydrogenated in the fac-

ories, which process renders them solid and saturates the fat. This must be borne in mind when margarine and cooking fat are referred to as of vegetable origin. This is true, but they have been saturated, and thus they raise the blood lipids and do not lower them. I believe these edible fats are not entirely blameless for the position we find ourselves in today. The edible fat industry, which is a huge industry, does a great deal of research into this problem, and the published results have not incriminated such fats to any great extent, though it would surprise me if they proved the contrary. One remembers that the tobacco industry remains to be convinced that their product is closely linked with lung cancer.

Be that as it may, for the purposes of lowering serum cholesterol levels there are three main fats to be limited: (1) butter and also cream and cream cheeses; (2) the fat on meat, particularly butchers' meat but to a lesser extent pork products; (3) the solid vegetable shortenings, such as margarine and solid cooking fat. This comprises milk fats, meat fats and shortenings which would seem to be the whole range of our fat consumption, and this is very nearly true, but also it is true of all countries with a high incidence of heart disease. Those countries with less heart disease do not follow this pattern. However, although to lower the cholesterol it is necessary to restrict the conventional fats, it is not true to say that there are no substitute fats. It is just that our cooking is less familiar with them.

The best known unsaturated fat is corn oil, made from the maize seed. It has achieved some prominence in medicine, although it is not of the same significance in the commercial production of edible oils. The maize seed has a relatively low oil content, and is thus more expensive to extract than the more traditional oil-bearing seeds such as ground nut and cottonseed. From the point of view of lowering cholesterol levels, it is not essential to use corn oil; cottonseed oil, sunflower seed oil and safflower oil are equally potent, and ground nut oil is not far behind. It is mainly the degree of unsaturation which determines the ability of an oil to lower blood lipids; those just mentioned are very unsaturated. As olive oil is only slightly unsaturated, it has little effect on blood lipids. Palm oil and coconut oil are two exceptions to the rule that saturated fats are solid. They are liquid, and, although of vegetable origin, they are highly saturated and elevate blood lipids. It is interesting to note that, whilst all European countries import oils, some countries like Germany and Britain hydrogenate the oils into solid fats, and some, like France, consume them without hardening. It may be significant that France has an incidence of ischaemic heart disease well below that of Germany and Britain. In lowering the cholesterol level, it does not matter how the unsaturated oils are taken. They

are perfectly effective taken by the medicine glass, but I think the palate may reasonably be critical. I try to make it clear to my patients that the diet should not be taken as an imposition. I mention this because the patient who diets with conviction is prepared to put up with some unpleasantness, rather on the principle that the nastiest medicine is the best or the strongest.

The following are the essential constituents of the diet that I prescribe and have found successful:

Cottonseed oil—this is sold under the trade name of “Twirl” and is the most elegant vegetable oil on the market.

Corn oil—one of the trade names is “Mazola”; this oil is perfectly satisfactory. Incidentally, there is a B.P. preparation of corn oil which is not really to be recommended; besides, there might be some difficulty in justifying one’s prescribing this when the oil will probably be used for frying potatoes.

There are a number of other oils advertised and available, such as sunflower seed oil, but they have no advantage and are usually more expensive. As well as those two oils, there are a specially prepared margarine and specially prepared milk; they are by no means essential to the diet but they are useful. The margarine is made from emulsion of corn oil and contains only a minimum of hydrogenated fats; the milk, which is tinned, is made from skim milk to which has been added the cream made from an emulsion of corn oil in the same proportion as the natural milk cream which has been removed.

I hand to the patient a diet sheet with these instructions:

Your normal diet may be taken at all times with the exception of the fat content, which will be altered. Animal fats must be avoided. This means that you should trim the fat off your meat and avoid fatty bacon. Lard and beef dripping must not be used for cooking. Butter is forbidden. Drink only skimmed milk or the special tinned milk. Consumption of margarine and solid fats must be brought to a minimum. The fats which are good for you are contained in the recommended cooking oils, special margarine and special milk. Take a half to three quarters of a pint of this milk and 2 ounces of the margarine daily. These amounts may be exceeded with benefit, but if you take less you can make up by consuming a half to one ounce of cooking oil in your food. It is possible to consume, if desired, 2 ounces a day of cooking oil in which case it is not necessary to take the special milk or margarine.

I have found that the patients quite like the milk, and it is taken regularly to replace natural cow’s milk; on the other hand I have not found anybody who has enjoyed the margarine. It is perhaps the main hardship of the diet. Butter is forbidden and there is only a very inferior substitute for it, but as there is no alternative, its place in the diet is justified.

Further on in the diet sheet, I advise that beef and lamb should

not be taken more than once a week, but other meat can be taken as often as desired. The fat contained in pork products is not as saturated as other animal fats, and for this reason there is less restriction on eating pork. All fish is recommended, particularly those fish with high oil content, such as herring, sardines, pilchards, salmon, tunny. Up to one egg a day is allowed on the diet. It is frequently advocated that eggs should be restricted on account of their high cholesterol content, but in fact eggs have little effect in raising lipid levels. The rise they produce is attributed to the yolk lipids because it has been found that the naturally occurring cholesterol in the diet has little or no effect in raising blood cholesterol.

I give a word of warning on the high content of saturated fat in pastry or cake made with margarine or shortening, and the diet sheet ends with advice on how the cooking oil may be taken, such as in frying, in green salad tossed with oil and vinegar, in cake and pastry, in piecrust and so on. It has been repeatedly shown in America that this type of diet will lower the cholesterol level. It is quite predictable in action and only two things are required to achieve success—the understanding and co-operation of the patient, and reliable blood lipid estimations. I have found that the average rate of lowering is 25 per cent overall; where the level was abnormally high, say 400mg. per 100ml. or more, the degree of lowering has been more than this. Levels of 280mg. or so have come down to 210 or 220, and even low levels of under 200 usually come down, but routine hospital estimations are too erratic to show these reductions clearly.

I have about two dozen people taking the diet. Of these, twelve have had a myocardial infarction. Most of these had been on the diet for three to four years, covering 25 to 30 patient-years. So far, there have been no recurrences of infarction. This proves nothing, but it is encouraging. The administration of a cholesterol-lowering diet is very much an affair of general practice. It is necessary to know the patient, gauge his intelligence and understanding of the diet, and have some idea if he is telling the truth if he says he is sticking to it, when quite possibly he is doing nothing of the sort but merely wishes to give you the answer he thinks you want. It is also necessary to know the wife, for she will be doing the cooking and if she does not know what she is doing one is not likely to get far. What I usually do is to explain to the patient the principle of the diet, telling him where he can purchase the food (incidentally, the cost of following this diet is very little more than the cost of an ordinary diet). I then hand out the diet sheet and the hints it contains. I ask the patient and his wife to come back in a week or so, so that they may raise points which have not been covered. In many

instances, it has proved convenient for the whole family to partake of the diet in a greater or lesser degree. This applies particularly to the oils for frying and salad dressing.

I have found from experience that the most co-operative patients are those who have had a myocardial infarction. They have some life-span in front of them, and are rather anxious to take avoiding action. Elderly patients with angina are not so rewarding to treat. Being older, they are less adventurous with food; frequently their serum cholesterol levels are quite modest, and it is possible that their angina is due to some extent to the natural ageing processes of the body and arteries. Moreover, if the patient is not too intelligent, he may tend to add the oils to his diet rather than substitute; this makes him gain weight and the angina tends to be worse because of this. There are two categories of patients with ischaemic heart disease who need special attention. First, there are the diabetics; they are very much in need of a cholesterol-lowering regime, and I have found no conflicts between a diabetic diet and this. I have two patients, both quite intelligent, and it has been possible to restrict carbohydrates and lower cholesterol at the same time. Rather more difficult to control are the second group, the obese who develop coronary disease. They must lose weight, but there is a conflict between reducing weight and prescribing two ounces of oil a day. I think the primary consideration is to lose weight, but at the same time what little fat is consumed should be unsaturated. When weight has been lost, it may be possible to increase the oil consumption to two ounces, but on balance it is far better to keep the patient on a low fat diet to control his weight rather than to encourage the taking of oils. Fat people tend to relish the oil diet, which can be made very appetizing.

Finally, I wish to make what I believe to be the most relevant point concerning the consumption of unsaturated vegetable oils. It seems very probable that they can be used preventively, and it cannot be seriously disputed that severe coronary atherosclerosis is a product of a life-time of eating. The degree of atherosclerosis and liability to thrombosis depend on three factors: diet, the time factor, and the person's predisposition. Of these, only the diet is amenable to change. We can make changes in our foods and make these changes over a long period. I suggest, therefore, that if a young person wishes to diminish his chances of dying of coronary artery disease, he should consume a small portion of his daily fat intake in the form of unsaturated fat. On a long-term basis, there will be no call for the fairly stringent diets indicated; it will be a matter of balancing up the saturated fats with a proportion of unsaturated fats. The way to do this would be to alter the intake of cooking fat brought into the kitchen. Solid cooking fats and margarine would

be to some extent reduced, and their place taken by cooking oils. In this way, the oil consumption might be half an ounce a day, and this, to my way of thinking, is a far more potent way of battling with this disease than to administer a strict diet after the damage has been done.

THE RIGHT FOOD FOR THE RIGHT AGE

I

Children

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It seems almost inevitable that a lecture of this sort should begin with the quotation of a few aphorisms, a text or two, whilst a Sunday morning audience settles down and the lecturer loses his first nervousness. The first of my texts is a much-quoted phrase from Sir Robert McCarrison's lecture of 1936. He said then that "The great single factor in the acquisition and maintenance of good health is perfectly constituted food." Almost equally well known is the following conclusion of the United Nations Conference at Hot Springs in 1943: "The first essential of a decent standard of living is provision to all men of those primary necessities which are required to promote freedom from disease and for the attainment of good health. The most important of these fundamental necessities is adequate food." In passing, let me call your attention to what seems to be a significant difference in phrasing between these two utterances. The first speaks of "perfectly constituted food" and the second of "adequate food". A world war, widespread famine, and an enormous volume of nutritional research took place between these two statements. We are less certain now of perfectly constituted food, and we are satisfied if a diet be adequate.

If statements like these be true of populations generally, they must be especially true of the young, because growth makes extravagant demands upon nutrition. Though the effects of an adequate diet appear slowly even in actively growing children, and though mothers everywhere will starve themselves before their young go hungry, the children of any community are especially susceptible to the effects of malnutrition. How then do we judge the nutritional state of the