

The Use of ORAL FAT PREPARATIONS in Medicine

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THE IMPORTANCE of supplying the sick patient with an adequate caloric intake is generally acknowledged and has been receiving increased attention in recent years with the recognition of the value of a normal nutritional state in effecting recovery from illness. The sick individual often loses weight because of inability to consume an adequate caloric diet, which in turn exerts a deleterious effect on his recovery. The inability of such patients to consume the large amounts of the ordinary foodstuffs tolerated by the normal individual has long presented the physician with the problem of obtaining foods high in caloric value in a form which can be easily administered and tolerated by the patient. For this reason attention has been directed recently to the elaboration of formulae of various sorts in which fat, because of its high caloric value (9.3 calories per gram), has received special attention. In addition to the value of such preparations because of their caloric content, they have also received attention as a source of material which is completely utilized by the organism and which, being free of salts and of nitrogen, is useful in patients with acute renal failure. The present paper describes these fat emulsions which are now available commercially and which have found application in clinical practice.

FAT METABOLISM

The superiority of fat over other foodstuffs because of its high caloric equivalence has long been known. The sparing action of carbo-

hydrate on protein catabolism and the essential nature of carbohydrate in metabolic processes have also long been recognized. However, it has only recently been realized that the efficiency of energy utilization of diets equal in their protein and energy content increases with their increasing dietary fat content.¹ The combination of fat and carbohydrate accordingly affords a unique combination which furnishes an easily assimilable source of calories, represses endogenous protein catabolism to a minimum, and induces an optimal efficiency in the utilization of administered protein. By adding a sufficient quantity of fat to a diet containing only marginal quantities of protein it is possible to increase the efficiency of utilization of the latter. Nitrogen and potassium deficits due to calorically inadequate diets may also be abolished by supplementary fat feedings.²

A certain amount of fat in the diet usually adds to its palatability. Excessive quantities are usually rejected, except by certain peoples (e.g., the Eskimo). Fat also inhibits gastric peristalsis and delays the emptying time of the stomach. As a consequence, it may induce bloating, a feeling of fullness, and epigastric distress. For this reason, when given as a supplementary feeding, fat should not be administered with meals, but preferably between meals and in the evening. The only absolute contraindication to the use of fat emulsions appears to be the presence of biliary tract calculi or pyloric obstruction with retention.

AVAILABLE FAT-CARBOHYDRATE EMULSIONS

Cream has long been utilized as a naturally occurring source of fat. Synthetic prepara-

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tions of fat and carbohydrate were first utilized clinically in the management of patients with acute renal failure for whom a protein-free diet was desired. Borst³ in 1948 suggested the use of such diets consisting principally of sugar and butter. The unpalatability of such concoctions led Bull, Joeke, and Lowe⁴ to utilize a simple water emulsion containing peanut oil and glucose. Such mixtures may be readily prepared in the laboratory and when supplemented by vitamins, proteins, etc., serve as a convenient foodstuff in experimental studies in which the forced feeding of a diet of constant and known composition is required.⁵

The commercially available fat-carbohydrate emulsions contain 40 and 50 per cent vegetable oil (peanut, coconut) and 10 per cent glucose in water to which is added an emulsifying agent, an antioxidant and a preservative. Two commercial products are marketed: Lipomul-Oral[®] (Upjohn) and Ediol[®] (Schenley). The former is flavored with chocolate in order to mask its taste; the latter requires no flavoring agent and has a pleasant taste faintly suggestive of vanilla. The nauseating "fatty" taste of oil is dissipated by the smallness of the particles (1 micron or less) in which it is dispersed. These small particles coalesce when subjected to the acidity of the stomach contents, but this does not interfere with their efficient absorption, since even gross fat is readily assimilated even when administered in large amounts. However, incubation of one of the commercially available emulsions (Ediol[®]) for 48 hours in 0.1 N hydrochloric acid does not break the emulsion. Examination of the material obtained by gastric aspiration up to four hours after administration also reveals the emulsion to be unbroken.

The available fat-carbohydrate emulsions are well tolerated even in relatively high doses. Thus Van Itallie and his coworkers² gave normal volunteer subjects as much as 250 to 500 ml. of the preparation providing 1000 to 2200 calories per day; many patients tolerate readily 250 ml. in addition to their usual diet. Even when given in such large amounts, fat balance studies demonstrated that the fat was well assimilated and there were only insignificant

increases in the fecal fat content.²

METHODS OF ADMINISTRATION

The fat-carbohydrate emulsions may be administered in various ways, depending on the purpose for which they are being used. They may be given undiluted in doses varying from 15 to 120 ml. at intervals of several hours. They may also be administered, if necessary, by intragastric drip through a nasal tube. The available preparations mix well with water, milk, or fruit juices, and are best administered in this way when used in conjunction with a regular diet. The caloric equivalent of Lipomul-Oral[®] is 4 calories per ml.; that of Ediol[®] about 5 calories per ml. Because of these high caloric equivalences, a high caloric diet may be supplied in smaller bulk than is otherwise possible.

Fat emulsions suitable for intravenous administration are also under investigation but are not available commercially.

EXPERIMENTAL AND CLINICAL USES

Fat-carbohydrate emulsions have been used for a variety of experimental and clinical purposes. They serve as a basis for diets which must be administered by stomach tube in experimental animals.⁵ Because of their negligible salt content they are ideal for the maintenance of the nephrectomized animal.⁶ By their use one can maintain such animals for a much more prolonged period than is otherwise possible without resort to such artificial measures as peritoneal lavage or the artificial kidney.⁷ For other experimental studies where a diet of known composition is desired, the fat-carbohydrate emulsions may be modified by the addition of protein, salts, vitamins, etc., as are indicated.⁶

Clinically, one of the first applications for the use of fat-carbohydrate emulsions has been in the management of patients suffering from acute renal failure.^{3,4,7} In such patients it is desirable to administer food of sufficient caloric value to depress the endogenous protein catabolism to a minimum. Such food must also be free of protein and salts. Fat-carbohydrate emulsions have served admirably for this purpose. Approximately 250 ml. of the



emulsion will furnish 1000 calories, which may be further supplemented by a sufficient amount of glucose in water administered orally or intravenously to furnish the water requirement of the patient. By this means, patients with complete anuria have been kept in good condition with a slowly rising nonprotein-nitrogen level of the blood for periods of 10 to 30 days.^{4,7}

For patients who are underweight, supplemental feedings of commercially available fat-carbohydrate emulsions have resulted in satisfactory weight gains. For this purpose, the emulsions are administered in doses of 30 to 120 ml., diluted if desired in a glass of milk or water between meals and before retiring.

There are many clinical conditions in which a liquid supplemental feeding of high caloric value is desirable. Most illnesses are characterized by anorexia, which leads to a deficient diet, weight loss, and a negative nitrogen balance. The resulting undernutrition in turn accentuates the anorexia, thus leading to a vicious cycle. In many patients—for example, those suffering from febrile disorders, hyperthyroidism, or burns, fractures, surgical operations, etc.—there is also an increased rate of endogenous protein catabolism which can be counteracted only by the ingestion of a caloric intake higher than the normal basal requirement.

The effectiveness of fat emulsions in the dietary management of severely burned patients has been demonstrated by Levenson, Lounds, and Morris,⁸ who were able to maintain their patients in positive nitrogen balance by the use of a liquid diet, 25 per cent of the calories of which were supplied by emulsified fat. These authors have demonstrated the capacity of such alimentation to maintain the patient in a good state of nutrition, which in turn contributes to good healing and the avoidance of potentially fatal complications.

In surgical patients with obstructing lesions of the upper gastrointestinal tract (mouth, esophagus, and stomach) only a liquid diet can usually be consumed. For such cases, Goldberg, Stein, and Meyer⁹ found that the administration of 400 Gm. of fat daily in the form of a 40 per cent fat emulsion was well tolerated and absorbed and permitted a posi-

tive nitrogen balance with a moderate protein high caloric intake. Although undesirable side-effects—nausea, vomiting, diarrhea, and constipation—occurred in about half of their 76 patients, these symptoms were mild and transitory and did not require cessation of the therapy.

The importance of maintaining a good state of nutrition in the prevention as well as in the management of the tuberculous patient has long been recognized. Dailey¹⁰ has used dietary supplements containing 2 oz. of fat-carbohydrate emulsion homogenized with milk and milk protein twice daily and at bedtime in 63 patients with pulmonary tuberculosis. In patients in whom the disease was static, this regimen resulted in an increased rate of weight gain; in those with progressive disease, the rate of weight loss was reduced.

Nutritional care also constitutes an important aspect in the treatment of poliomyelitis. To spare body protein and enhance the utilization of ingested protein, oral fat emulsions have been found of value by Boines¹¹ in this condition. Likewise in children with rheumatic fever, the inclusion of fat emulsions and protein concentrates in the diet has been found effective in offsetting the catabolic effects of cortisone and corticotropin therapy.¹²

The above-cited publications exemplify some of the clinical conditions in which the use of fat emulsions has proved of value. They may be used with advantage in many other conditions. Restoration or maintenance of body weight, a positive nitrogen balance, and an adequate caloric mineral and vitamin intake can be achieved by the use of liquid diets which may be readily prepared and which are well tolerated and assimilated.¹³ In chronic illnesses, in the preparation of patients for surgery, and in the management of patients with chronic or acute renal failure in whom control of the protein and salt intake is essential without too great restriction of the caloric intake, the use of fat emulsions as a dietary adjunct is of greatest value.

SUMMARY

Fat is an important constituent of the diet. Its uniquely high caloric value renders it an



ideal substance for supplying in a ready assimilable liquid form an adequate amount of calories which permits optimal utilization of protein. The commercially available emulsions of fat and carbohydrate have been used to advantage in a variety of clinical conditions: acute renal failure, burns, surgical conditions requiring a liquid diet, tuberculosis, poliomyelitis, etc. They are also effective when used as supplementary feedings in underweight or malnourished individuals and are useful in experimental laboratory or clinical studies in which a diet of known composition and high caloric value is desired.

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RESUMEN

El uso de las preparaciones orales de grasas en la medicina

Las grasas constituyen un factor importante de la dieta. Por su altísimo valor calórico las grasas son sustancias ideales para la provisión, en forma líquida y fácilmente asimilable, de una cantidad adecuada de calorías, permitiendo la utilización óptima de la proteína. Los hoy disponibles preparados comerciales de emulsiones de grasas e hidratos de carbono se han empleado con provecho en una variedad de condiciones clínicas: claudicación renal aguda, quemaduras, condiciones quirúrgicas que requieren una dieta líquida, tuberculosis, poliomiélitis, etc. Asimismo son efectivos cuando se los emplea como suplementos alimenticios en individuos delgados o malnutridos, y son útiles en experiencias de laboratorio o clínicas en que se quiere emplear un régimen de composición conocida y alto valor calórico.

Disease and Divinity

"It seems to me that the disease is no more divine than any other. It has a natural cause, just as other diseases have. Men think it divine merely because they do not understand it. But if they called everything divine which they do not understand, why, there would be no end of divine things."

—Unknown Hippocratic physician, Fifth Century B.C.; cited by B. Farrington in *Greek Science; Its Meaning for Us (Thales to Aristotle)*, Penguin Books, Harmondsworth, England, 1948.

