UTILIZATION AND TOLERANCE OF INTRAVENOUS FAT EMULSIONS

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Emulsions of fat have been the subject of much research in the field of parenteral nutrition because they offer a concentrated source of calories in a moderate volume without the complications of hypertonic solutions. It is generally accepted that a suitable emulsion would be highly desirable in those instances where caloric requirements are high and excessive amounts of fluid must be avoided. Much of the effort in this area during the past three or four decades has been devoted to proving intravenously administered fat is utilized, is efficacious, and is devoid of serious reactions when properly formulated (Geyer, 1960; Wretlind, 1972; Geyer, 1970). This presentation is concerned with the utilization and tolerance of parenteral fat emulsions.

In principal, fat emulsions are simply minute fat droplets well dispersed in an aqueous medium. To aid in the preparation and stabilization emulsifiers such as phospholipids are employed. Although a number of procedures have been used to disperse the triglyceride, high pressure homogenization has proved to be the most satisfactory, especially for large quantities. The products have particle diameters of approximately one micron and below, and withstand sterilization in a rotating autoclave. Stability is sufficient to allow shipment anywhere in the world and storage can be for as long as a year or more. Oxidative and hydrolytic changes are minimal.

Since the purpose of these emulsions is to furnish calories, and from 10 to 20% fat (w/v) is usually employed, the fat of the triglyceride is obviously of prime interest. On the other hand, even though the emulsifying agent is present in much lower con-
centration (usually 1 to 2%), its fate is also of concern. Depend­
ing on its chemical character it may be metabolized, as in the case of lecithin, or excreted, as is the synthetic polyl, Pluronic F68 (Wyandotte Chemical Corp., Wyandotte, Michigan). Injection of the emulsified fat particles causes a lipemia, the degree of which depends upon the rates of administration and utilization. The disappearance of Intralipid (Vitrum, Stockholm, Sweden) (Hallberg, 1965a and Hallberg, 1965b) from the blood has been shown to follow first order kinetics when the concentration is below maximum. Above this concentration the rate is constant and independent of actual concentration. In the case of Intralipid there is good agreement between the kinetics of removal of the artificial fat droplets and normal chylomicrons whether compared in the presence of heparin-induced lipoprotein lipase or not (Hallberg, 1965a; Hallberg, 1965b; Boberg and Carlson, 1964). The size distribution of Intralipid particles is also quite similar to that of chylomicrons (Schoefl, 1968; Fraser and Hakansson, in press).

Intravenously administered triglycerides can be hydrolyzed by means of lipoprotein lipase present in the blood. Entrance of the intact triglyceride into cells and its subsequent hydrolysis by intracellular enzymes has not been demonstrated to date. Stoffel and coworkers have presented evidence that intact phospholipid can be taken up by many different cells when given intravenously (LeKim, Betzing and Stoffel, 1972). The products of lipase action, unesterified fatty acid, and intact monoglyceride, are known to be taken up by cells and metabolized (Lynch and Geyer, 1972). There are a number of indications that the intravenously injected fat is utilized (Geyer, 1960; Wretlind, 1972; Geyer, 1970) and these are summarized in Table 1.

Table 1: Observations supporting the concept that parenteral emulsions are utilized.

1) The fat particles quickly leave the bloodstream.
2) Little accumulation of lipid occurs in the tissues.
3) Essentially no lipid is lost via excretion.
4) Body weight responses are favorable.
5) RQ values shift towards fat oxidation.
6) Blood ketone values rise.
7) Labeled triglyceride is rapidly metabolized.
8) Fat can furnish an important percentage of calories in complete parenteral nutrition.

The rapid removal from the blood stream, the lack of significant losses through excretion, and the lack of accumulation of the