Hibernoma is a tumor of adipose tissue assumed to arise from brown fat (1). The main reason for this assumption is the morphologic similarity between the tumor and this type of fat: like brown fat, hibernoma is composed, wholly or largely, of multivacuolated fat cells; and both are highly vascular (1).

In this study the lipid composition of 2 hibernomas has been compared with that of ordinary lipomas and of mouse brown fat.

MATERIALS AND METHODS

Two patients were operated on for a soft tissue tumor in the thigh. In both cases, histologic examination showed a hibernoma. The 2 hibernomas thus obtained were used in the present study; they have been described in detail elsewhere (1). In addition, the material comprised 4 ordinary lipomas from 4 different patients, and brown fat from the interscapular fat bodies of 8 male adult white mice; the brown fat was pooled in 2 groups, each consisting of 4 samples. Before the chemical analysis, the hibernomas and the lipomas were fixed in 10 % formaldehyde (formalin) solution.

For extraction of the lipids, about 0.5 gm of each tissue was placed in chloroform:methanol (2:1), disintegrated with a glass rod, and left in the mixture at room temperature for 1 hr. Then extraction and partition were completed as described by Folch et al. (4). Cholesterol (3), lipid phosphorus (9), and triglyceride (2) concentrations were determined on the extract. For comparison between the various tissues, the lipids could not be related to dry weights of whole tissue, because the vessels of the hibernomas had been perfused with barium sulphate for microangiographic studies (1). Instead the lipids were related to protein: the dry weight of total lipids extracted from a sample of tissue was related to the amount of soluble protein found in the same sample. Soluble protein was determined by the method of Lowry et al. (6).

Phospholipids were separated by thin-layer chromatography on silica gel (7). This was free from calcium sulphate binder (Kieselgel H nach Stahl, Merck), and the chromatograms were developed in chloroform:methanol:water (65:25:4) at +4°C. until the solvent front had moved a suitable distance (usually 30 min.). On each plate the sample to be tested was applied centrally with human plasma lipids on one side and nothing on the other side. The plasma sample served as a standard for identification of spots which were made visible by iodine vapors. Seven spots were recognized on the chromatogram of the plasma sample (7): the front region; a faint spot just below the front; spots containing cephalins, lecithin, sphingomyelin, and lysolecithin; and the origin. Areas corresponding to these spots were marked on the unknown sample, and then the silica gel was carefully scraped off these areas into test tubes for lipid phosphorus determination. Digestion was performed in the presence of silica gel. Corresponding areas of the same size on the empty side served as blanks. Recovery of applied lipid phosphorus was about 80 % for all samples analyzed. No further attempt to identify the phospholipids was made because the main interest was in the relative distribution of the spots in question. The phospholipid composition was determined in only 2 of the 4 ordinary lipomas.

RESULTS AND DISCUSSION

Table 1 shows the lipid composition of the hibernomas, lipomas, and brown fat. The amounts of cholesterol and phospholipids, as determined in relation to total fat, were higher in the hibernomas and the brown fat than in the ordinary lipomas. The phospholipid composition of the hibernomas, 2 of the lipomas, and the brown fat was determined using thin-layer chromatography; it was found that whenever the brown fat differed from the lipomas—with an increase or a decrease—the hibernomas did so too. The results are in agreement with the opinion that hibernoma arises from brown fat.
lipomas. Total fat, on the other hand, as determined in relation to soluble protein, was, on the average, lower in the hibernomas and the brown fat than in the lipomas. More cholesterol in hibernoma than in lipoma has been observed previously (5).

Table 2 shows the distribution of phospholipids in the hibernomas, 2 of the lipomas and the brown fat. The concentration of lipid phosphorus in the front region was higher in the hibernomas and the brown fat than in the lipomas. The spot below the front gave similar values. The concentration of cephalin was about the same in the lipomas and the brown fat, and somewhat higher in the hibernomas. The concentration of lecithin, as well as that of sphingomyelin, was lower in the hibernomas and the brown fat than in the lipomas. On the other hand, the concentration of lyssolecithin, as well as that of lipid phosphorus in the origin, was higher in the hibernomas and the brown fat than in the lipomas.

It would have been of interest to compare the lipid composition of the hibernomas and lipomas with that of human brown and white fat, but because of the difficulty of obtaining brown fat in man, data suitable for such a comparison are not available. In mouse the lipid composition of brown and white fat has been studied by Spencer and Dempster (8) who found a higher concentration of polyglycerophosphatide and a lower concentration of sphingomyelin in brown fat than in white fat. Polyglycerophosphatides appear in the front region in the thin-layer chromatographic system used in the present study (7). Thus the hibernomas and lipomas showed differences in phospholipid composition similar to those exhibited by brown and white fat in mouse: the concentration of lipid phosphorus in the front region was higher and the concentration of sphingomyelin was lower in the hibernomas than in the lipomas.

The results presented in Tables 1 and 2 may be summarized as follows: whenever the brown fat differed from the lipomas—with an increase or a decrease—the hibernomas did so too. The significance of the observations is limited by the fact that the material is small and that comparison has been made between different species. However, the results are in agreement with the opinion that hibernoma arises from brown fat.

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The Lipid Composition of Hibernoma as Compared with That of Lipoma and of Mouse Brown Fat

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