Alcoholic Liver Injury in Baboons: Transformation of Lipocytes to Transitional Cells

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Ultrastructure of the lipocytes (the main perisinusoidal cells) and their alterations in the progression of hepatic fibrosis were studied in liver biopsy specimens of baboons pair-fed with diets containing alcohol, or isocaloric carbohydrate, for up to 112 mo. In control baboons, 97% of the cells in the Disse space were lipocytes characterized by a volume density of lipid droplets occupying >20% of the cell volume and by the presence of microfilament bundles with associated dense bodies and pinocytic vesicles. Intercellular junctions of the adherens type were present between lipocytes and hepatocytes. After alcohol consumption, the number of lipocytes (as assessed by light microscopy) was significantly decreased in fatty livers and at various stages of hepatic fibrosis; this was associated with a decreased hepatic vitamin A content. In baboons fed alcohol, only 48% of cells were lipocytes, whereas 52% were transitional cells defined by a volume of lipid droplets <20% of the cell. Like the lipocytes, transitional cells exhibited microfilament bundles, dense bodies, and pinocytic vesicles, and were attached to the hepatocytes by cell junctions. The rough endoplasmic reticulum in transitional cells was conspicuous and had an area significantly greater than that in lipocytes of controls and alcohol-fed animals (69% and 37%, respectively). There was a significant correlation between the percentage of transitional cells as well as the area of their rough endoplasmic reticulum and the degree of hepatic fibrosis. Thus, in baboons fed alcohol, the progression of hepatic fibrosis is associated with transformation of lipocytes to transitional cells characterized by a depletion of lipid droplets and a hypertrophy of the rough endoplasmic reticulum; these transitional cells may play a role in promoting hepatic fibrosis in alcoholic liver injury.

One of the morphologic features of alcoholic liver injury is the deposition of collagen in the Disse space and in the interstitium around normal or ballooned hepatocytes (1). The cells engaged in the process of fibrogenesis in these areas of the liver lobule have not been defined. In experimental alcoholic liver injury in the baboon, an increased number of myofibroblasts is associated with the deposition of collagen in the perivenular area of the liver, which is an early manifestation of alcohol-induced fibrosis (2). In hepatic fibrogenesis, the origin of collagen may be multicellular, depending on the lobular location of the lesion or stage, or both. Lipocytes (also called fat-storing cells or Ito cells), the principal cells residing in the Disse space (3-5), have been considered to have great potential for fibrogenesis (6-10). Indeed, it has been postulated that stimulation of the lipocytes may result in their transformation to fibroblasts which, in turn, may promote fibrosis (8). Transitional cells with features intermediate between lipocytes and fibroblasts become conspicuous after carbon tetrachloride (CCL₄)-induced fibrosis in rats (8). The purpose of the present study was to define the fine structure of the lipocytes in the Disse space of the baboon liver and to clarify their relationship to transitional cells in the process of hepatic fibrosis induced by alcohol consumption.

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Abbreviations used in this paper: rER, rough endoplasmic reticulum; CCL₄, carbon tetrachloride.
Table 1. Number of Lipocytes in Hepatic Fibrosis of Baboons Fed Alcohol

<table>
<thead>
<tr>
<th>Degree of fibrosis</th>
<th>No. of baboons</th>
<th>Lipocytes per 100 hepatocytes</th>
<th>Lipocytes per field (62,500 μm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatty liver</td>
<td>4</td>
<td>6.1 ± 0.5</td>
<td>7.8 ± 0.4</td>
</tr>
<tr>
<td>Control</td>
<td>4</td>
<td>11.5 ± 0.4</td>
<td>10.3 ± 0.8</td>
</tr>
<tr>
<td>p</td>
<td></td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>1+ fibrosis</td>
<td>4</td>
<td>6.1 ± 0.7</td>
<td>3.6 ± 0.4</td>
</tr>
<tr>
<td>Control</td>
<td>4</td>
<td>11.7 ± 0.4</td>
<td>9.1 ± 0.9</td>
</tr>
<tr>
<td>p</td>
<td></td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>2+ fibrosis</td>
<td>4</td>
<td>2.1 ± 0.5b</td>
<td>1.3 ± 0.2b</td>
</tr>
<tr>
<td>Control</td>
<td>4</td>
<td>10.3 ± 1.2</td>
<td>8.5 ± 0.8</td>
</tr>
<tr>
<td>p</td>
<td></td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>3+ fibrosis</td>
<td>5</td>
<td>1.8 ± 0.2c</td>
<td>1.2 ± 0.2c</td>
</tr>
<tr>
<td>Control</td>
<td>5</td>
<td>10.4 ± 0.6</td>
<td>9.3 ± 1.3</td>
</tr>
<tr>
<td>p</td>
<td></td>
<td>&lt; 0.001</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

The number of lipocytes in baboons with fatty liver and various stages of fibrosis was significantly smaller than in pair-fed controls. a p < 0.005 when compared with fatty liver or 1+ fibrosis. b p < 0.01 and 0.005 when compared with fatty liver and 1+ fibrosis, respectively. c p < 0.001 and 0.005 when compared with fatty liver and 1+ fibrosis, respectively. d p < 0.05 and 0.01 when compared with fatty liver and 1+ fibrosis, respectively.

Materials and Methods

Thirty-four adolescent baboons (8 males and 26 females) were used after a quarantine period and verification of normal liver morphology by needle biopsy. They were pair-fed nutritionally adequate diets containing either ethanol (50% of total energy) or isocaloric carbohydrate for a period of up to 112 mo. The composition of the diets and feeding techniques were previously published (11).

Liver biopsy specimens were obtained at regular intervals (at least one a year). After an overnight fast, baboons were anesthetized with ketamine hydrochloride. Liver tissue was obtained by surgical or needle biopsies. For light microscopy, liver tissue was fixed in 10% neutral buffered formalin and embedded in paraffin. Sections were stained with hematoxylin and eosin or chromotrope aniline blue for demonstration of connective tissues. The degree of hepatic fibrosis was graded from 0 to 3+: 0 indicated fatty liver with no evidence of fibrosis in any areas of the liver lobule; 1+ indicated perivenular fibrosis; 2+ indicated the combination of perivenular, perisinusoidal, and pericellular fibrosis, and with 3+ fibrosis, there was septa formation in addition to fibrosis.

A portion of the tissue was also fixed in 2.5% glutaraldehyde or in 2.5% glutaraldehyde and 1.5% paraformaldehyde in 0.1 M cacodylate buffer, pH 7.3. After postfixation in 1% OsO₄, the specimens were dehydrated through graded concentrations of ethanol and embedded in Epon. Sections (1 μm thick) were cut with glass knives on a LKB IV ultramicrotome (LKB Instruments, Gaithersburg, Md.). The sections were stained with uranyl acetate and lead citrate and examined in a Zeiss EM 10 C electron microscope (Carl Zeiss, Inc., Thornwood, N.Y.). For morphometric analysis of lipocytes, micrographs of lipocytes (at ×12,500 or ×20,000 magnification) from the intralobular areas (not including central vein or portal tract) were used. Only lipocytes showing at least a portion of the nucleus were used for the analysis. A point grid with 0.5-μm point-to-point distance was superimposed on the lipocyte and the number of points overlaying the lipid droplets was used for estimating the volume density of lipid droplets by the techniques of quantitative stereology described by Weibel and Bolender (12); this value was expressed as the percentage of the cell volume. The number of points overlaying the rough endoplasmic reticulum (rER) (membranes and cisternal space) was used for estimating the area occupied by this organelle in the cell and the value was expressed as area in square micrometers per cell. In control baboons, the volume density of lipid droplets in 97% of the lipocytes studied was >20% of the cell volume (see Figure 2); therefore, cells were considered to be lipocytes when the volume of lipid droplets was >20% of the cell volume; conversely, cells were considered to be transitional cells when the volume of lipid droplets was <20% of the cell. Other mesenchymal cells that also contained lipid droplets were the myofibroblasts that were characterized, among other features, by basal laminae and indented nuclei (2). The latter features were not present in the lipocytes and transitional cells.

For vitamin A determination, liver samples (20–100 mg) were extracted with a chloroform-methanol mixture (13). Vitamin A was measured by the trifluoroacetic acid method of Dugan et al. (14). Retinyl palmitate (Sigma Chemical, St. Louis, Mo.) was used as standard. The amounts of vitamin A in the samples were expressed as the equivalent weights of retinol.

Statistics

Results were expressed as means ± SEM. Statistical significance was analyzed by Student's group t-test; when indicated, correlation coefficients were calculated (15).

Results

Number of Lipocytes in Control and Alcohol-fed Baboons

In toluidine blue-stained plastic sections, the lipid droplets in lipocytes appeared greenish-yel-
Lipocytes had from 1 to as many as 20 droplets in the cytoplasm (Figures 3, 4, and 7). The diameter of these lipid droplets ranged from <1 μm to as much as 10 μm. Lipid droplets were either free in the cytoplasm or membrane-bound. The nuclei of lipocytes appeared heterochromatic and were often deformed into various shapes by the lipid droplets. In most lipocytes, the rER was randomly distributed in the cytoplasm as short, narrowed cisternae. However, we also observed lipocytes that contained fairly dilated rER with cisternae filled with a flocculent or fibrillar material (Figure 4). The Golgi apparatus was relatively small and was never seen to contain any lipid-like material. In the lipocytes, mitochondria were small and few in number. Centrioles in the vicinity of the Golgi apparatus and a single cilium protruding from the cells were visible in some lipocytes. Scattered in the cytoplasm were microtubules, free ribosomes, glycogen particles, and occasional lysosomal bodies. In the peripheral cytoplasm of the lipocytes, there were flask-shaped invaginations of the plasma membranes (or pinocytic vesicles), sometimes arranged in rows (Figure 3B). Occasional coated vesicles were detected in the cytoplasm. Microfilaments were either loosely arranged in the cytoplasm or gathered in small bundles in the peripheral cytoplasm of the lipocytes. Although dense bodies were not seen in the cytoplasm, they were often found in association with the microfilament bundles in close proximity to the plasma membrane of the cells.

The lipocytes possessed cytoplasmic processes of varying thickness that extended from the cell bodies...
Figure 3. Lipocyte from a control baboon. A. The lipocyte (L) contains lipid droplets (F) of variable sizes. F1 appears to be free in the cytoplasmic matrix whereas F2 is surrounded by a membrane. F3 shows fusion into a larger droplet or alternatively partition into smaller ones. The rough endoplasmic reticulum is randomly distributed in the cytoplasm as short, narrowed cisternae (arrows). Small bundles of coarse collagen fibers (C) are present in the Disse space (DS). (H, hepatocyte; E, sinusoidal endothelium.) Details in the boxed area are shown in B. At the cell periphery, microfilaments (arrowhead) are gathered in bundles parallel to the plasma membrane. Dense bodies (D) and pinocytic vesicles (V) in close proximity to the cell surface are indicated. The Golgi apparatus (G) consists of few short, flattened cisternae and some vesicles. Extracellular matrix is visible in the Disse space (DS) between the lipocyte and the sinusoidal endothelium (E). A. x 10,000; B. x 40,000.

into the Disse space along the endothelial lining of the sinusoids (Figure 5). In the Disse space, one also could see segments of cell processes of variable lengths without readily demonstrable continuity with the cell bodies (Figure 6). The cytoplasm of the cell processes was occupied by appreciable numbers of microfilaments, sometimes with dense bodies along their length. There were also a few pinocytic vesicles along the plasma membrane of the cell processes. Few pieces of rER, mitochondria, ribosomes, and microtubules made up the rest of the organelles in the cell processes and occasional lipid droplets were present.

No basal lamina could be detected around the
Figure 4. Lipocyte from a control baboon. 
A. The lipocyte (L) exhibits dilated rough endoplasmic reticulum (ER) and in the Disse space, collagen fibers (C) are present. At higher magnification (in part 4B), the fibrillar nature of the content in the rough endoplasmic reticulum is revealed. At the cell periphery, microfilaments (arrowhead), dense bodies (D), and pinocytic vesicles (V) are evident. The Disse space contains coarse collagen fibers (C1) that appear to be attached to the surface of the lipocyte (at arrow). Note fine fibrils (C2) that appear to be associated with the coarse collagen fibers. (H = hepatocyte.) A. ×10,000; B. ×38,800.
lipocytes. Cell junctions resembling the adherens type were frequently revealed between lipocytes and hepatocytes (Figure 7). No anatomic connection, however, was seen between lipocytes and the endothelium of the sinusoids or between the lipocytes themselves.

In the Disse space immediately surrounding the lipocytes, there were coarse banded collagen fibers...
Figure 7. Intercellular junctions (arrows) between lipocyte and hepatocyte. The attachment occurs at the protuberance of the lipocyte (L) and the nonmicrovillus surface of the hepatocyte (H). Inset, the junction (arrow) appears to be the adherens type with electron-dense material in the contiguous cytoplasm of adjacent cells and focal accumulation of cytoplasmic filamentous material at the junction. ×11,250; inset, ×22,500.

(-50 nm in diameter) gathered in small bundles (Figures 3 and 4). In addition, fine fibrils were diffusely arranged in the extracellular space. In tangential sections of the lipocyte cell surface, the association of these fibers with the plasma membrane of the cell could be demonstrated.

Figure 8. Lipocyte from a baboon fed alcohol for 20 mo (1+ fibrosis). The lipocyte (L) contains lipid droplets (F) of variable sizes with a total lipid volume of >20% of the cell volume. The cytoplasm exhibits dilated cisternae of the rough endoplasmic reticulum (arrows). Coarse collagen fibers (C) in small bundles are visible in the Disse space. (H = hepatocyte.) ×10,800.
Figure 9. Transitional cell (TC) from a baboon fed alcohol for 22 mo (1+ fibrosis). The lipid droplet content of the cell is diminished. Sectioned profiles of the lipid droplets (F) are <2 μm in diameter and the lipid volume density amounts to <20% of the cell volume. The rough endoplasmic reticulum (arrows) appears dilated and contains a flocculent precipitate. A dense body (D) and pinocytic vesicles are present along the plasma membrane. Appreciable amounts of coarse collagen fibers (C1) and some fine fibrils (C2 in inset) are visible in the Disse space; the latter appear to be attached to the surface of the cell (arrowheads). (H = hepatocyte. S = sinusoid.) ×14,400; inset, ×35,000.

Ultrastructure of Lipocytes and Transitional Cells in Alcohol-fed Baboons

By electron microscopy, lipocytes in the livers of baboons fed alcohol revealed the same basic features seen in lipocytes of control baboons. When the lipocytes contained voluminous lipid droplets, they were hardly distinguishable from those in control animals (Figure 8) but they were fewer in number (Table 1). Among 104 perisinusoidal cells from

Figure 10. Transitional cell (TC) from a baboon fed alcohol for 61 mo (3+ fibrosis). The cytoplasms shows few small lipid droplets (F) but abundant rough endoplasmic reticulum. An appreciable amount of collagen fibers (C) is present in the Disse space. A cell process (P) is also seen. (H = hepatocyte. S = sinusoid.) ×14,400.
the alcohol-fed baboons, 50 were lipocytes, whereas 54 were classified as transitional cells with a volume of lipid droplets of <20% of the cell. Transitional cells were first observed in a baboon fed alcohol for 4 mo and, subsequently, in all baboons fed alcohol up to 112 mo except in 2 baboons (after 14 and 20 mo, respectively). It is noteworthy that the animal with the transitional cells already at 4 mo of alcohol feeding had undergone biopsy before the start of alcohol feeding and that no transitional cells had been found at that time. Furthermore, this animal subsequently progressed to cirrhosis within 2 yr of alcohol feeding, whereas the 2 animals fed alcohol that did not develop the transitional cells remained at the stage of perivenular fibrosis.

The transitional cells were smaller in size compared to the lipocytes, but the area of their rER per cell was significantly greater than that of lipocytes in controls and alcohol-fed animals (69% and 37%, respectively) (Table 2). In the transitional cells (Figures 9–11), the rER was frequently distended with a flocculent material, sometimes exhibiting a fibrillar nature. The Golgi apparatus showed no marked changes; signs of hypertrophy were observed in some cells whereas a rather inconspicuous Golgi was seen in others.

The plasma membranes of the cells (Figures 9 and 11). These fibrils were present in greater amounts in alcohol-fed animals than in the controls and they became much more abundant as fibrosis progressed. A positive correlation was found between the area of the rER and the degree of hepatic fibrosis in baboons fed alcohol (Figure 14). Figure 15 also illustrates a significant correlation between the percentage of transitional cells and the degree of hepatic fibrosis. With the progression of fibrosis, there was an increased number of transitional cells, whereas the number of lipocytes was decreased. Calculation of the absolute number of transitional cells (per 100 hepatocytes) from the data in Table 1 and Figure 15 revealed that after alcohol feeding, the total number of cells (lipocytes and transitional cells) in the Disse space at various stages of fibrosis did not exceed the number of lipocytes in controls (1+ fibrosis: 9.0 vs. 11.7 in controls; 2+ fibrosis: 7.6 vs. 10.3 in controls; 3+ fibrosis: 10.3 vs. 10.4 in controls).

### Discussion

This study revealed that, in baboons fed alcohol, lipocytes in the Disse space are transformed to transitional cells in the process of hepatic fibrosis. The transformation is characterized by a depletion of lipid droplets and a hypertrophy of the rER in the cells. Lipocytes were found to be the principal cells residing in the Disse space of control baboon livers. The lipid droplets, associated with vitamin A storage (16,17) were the most prominent element in these cells. In addition, there were other notable features including microfilament bundles and dense bodies; the latter served as anchoring sites for the thin filaments (18). The presence of these structures suggests that the lipocytes are contractile cells. In view of the close proximity of the cells, particularly the cell processes to the endothelial lining of the sinusoids, it has been suggested that the contractility of the lipocytes may enhance the contraction of the sinusoids in regulating the flow of blood in the liver lobules (19). In addition, the lipocyte cell processes that were found to underlie the sinusoidal endothelium may serve as a supportive structure for the endothelium. Cell junctions between lipocytes and hepatocytes that have been described before in the livers of fish (20,21) were also found to be present in the baboon livers. The attachment of lipocytes to the parenchymal cells indicates that the former are fixed or stationary cells. The linkage probably serves as an anatomic anchorage for the lipocytes and may contribute to the spatial organization of the lipocytes in the Disse space. The pinocytic vesicles were consis-
tent features of the lipocytes but their function is not known. The lipocytes appeared to be postmitotic cells because mitoses were not observed.

Many lipocytes exhibited a rER with short, narrowed cisternae. There were also lipocytes that contained dilated rER enclosing a flocculent or fibrillar material in their channels indicative of synthetic activity. Both coarse banded collagen fibers and fine fibrils were present in the Disse space immediately surrounding the lipocytes, and sometimes these fibers appeared to be attached to the plasma membranes of the cells. The morphologic features of the rER and the spatial relationship of the collagen fibers to the lipocytes suggest that the latter possess a capacity for collagen production.

The name "transitional cell" was first coined by Kent et al. (8), in association with CCl4-induced hepatic fibrosis in the rat, to describe a cell with ultrastructural features intermediate between lipocytes and fibroblasts, possibly in transition between the two cell types. Subsequently, such cells were observed in the livers of alcohol-fed baboons (22) and of rats fed a high vitamin A-ethanol diet (23). More recently, Minato et al. (10) noted the appearance of these cells in association with Disse space fibrosis in alcoholic liver disease. In the present study, we adopted the name transitional cell because of the evidence that these are cells derived from lipocytes that have acquired fibroblastic features. Heretofore, morphologic criteria for transitional cells have not been defined. We now propose that a transitional cell is a perisinusoidal cell with a volume density of lipid droplets ~20% of the cell volume. Defined in this way, there was an increased percentage of transitional cells in association with the progression of hepatic fibrosis in baboons fed alcohol. Furthermore, the development of the rER in transitional cells correlated with the progression of hepatic fibrosis in these animals. The abundance of collagen fibers in the extracellular space in close proximity to the transitional cells can be taken as further evidence that the latter may promote collagen deposition in the Disse space. It is also possible that some of the collagen is made by the hepatocytes, which have been shown to have the capacity to produce collagen in primary culture (24).

A decreased number of lipocytes has been observed in alcoholic fatty liver and cirrhosis in humans (5) and in rats after chronic alcohol feeding (23), whereas an increase was noted in patients with
alcoholic hepatitis (5). In the development of hepatic fibrosis in the alcohol-fed baboons, the number of lipocytes visible by light microscopy was found to be decreased. Because one largely relies on the presence of lipid droplets in the cytoplasm for the detection of lipocytes by light microscopy, the diminished number of visible lipocytes may in fact reflect an impairment in their detection due to the appearance of transitional cells that displayed a fewer number as well as smaller lipid droplets. Indeed, we found by ultrastructural analysis that there was an increased percentage of transitional cells in association with the progression of fibrosis in the liver parenchyma. The facts that the appearance of transitional cells was associated with a corresponding decrease in lipocytes and that the sum of transitional cells plus lipocytes in alcohol-fed animals did not exceed the number of lipocytes in controls are consistent with the hypothesis that the appearance of transitional cells represents transformed lipocytes.

The transitional cells maintained virtually all the...
characteristic organelles seen in the lipocytes, in particular the microfilament bundles, dense bodies, and pinocytic vesicles. Like the lipocytes, the transitional cells were attached to the hepatocytes by adherens-type junctions. As the transitional cells were nonmobile, the transformation most likely occurred in situ and there is no reason to believe that these cells were derived from other locations of the liver lobules or from extrahepatic sources. The transformation also appeared not to involve cell mitoses as mitotic lipocytes were not observed.

The present study also reveals that there was a positive correlation between the number of lipocytes and the vitamin A content of the liver. This finding supports the view that lipocytes are associated with vitamin A storage (16,17). As the transformation of lipocytes to transitional cells is associated with a depletion of lipid droplets in the cells, agents that have the propensity to deplete vitamin A in the liver could be responsible for the initiation of the transformational process. Alcohol or its metabolites may play a role in this process as alcohol feeding in baboons resulted in a depletion of vitamin A in the liver (25). To explain this effect two mechanisms have been proposed: (a) increased mobilization of vitamin A from the liver to the peripheral tissues or (b) increased metabolism of retinoic acid (a metabolite of vitamin A) by a microsomal enzyme system, or both (26).

Myofibroblasts have been described in the fibrotic bands of human liver cirrhosis (27,28), in 2 patients with vitamin A intoxication (29), in CCL4-induced liver cirrhosis in rats (30), and, more recently, in the fibrotic perivenular tissue in rats fed a high vitamin A-ethanol diet (23). In addition, Nakano et al. (2,31) have shown that these cells increased in number in conjunction with deposition of collagen around the terminal hepatic venules in baboons and humans after chronic alcohol consumption. These myofibroblasts possessed abundant microfilaments with conspicuous dense bodies and pinocytic vesicles and were surrounded by a basal laminalike structure. Although a folded-nucleus was not always manifested, when present, it was a useful identifying feature. Thus, myofibroblasts have characteristics of typical smooth muscle cells. The characteristic cell bodies of myofibroblasts were located in the perivenular area; we did not see them in the Disse space. In the latter, we observed lipocytes and transitional cells that lacked basal laminae and which we consider to be transformed lipocytes. Although microfilaments, dense bodies, and pinocytic vesicles were present, they were not as conspicuous as those seen in the myofibroblasts. Moreover, the nuclei of the transitional cells were ovoid or irregular in shape. Nevertheless, lipocytes, transitional cells, and myofibroblasts share some common features and it would seem, therefore, that they may belong to one family of cells. Furthermore, the possibility that transitional cells finally evolve into myofibroblasts at the cirrhotic stage cannot be excluded. All these cells appear to possess a capacity for collagen production, but, depending on the lobular location of the lesion, each type of cell may be involved to a different degree. In the fibrotic process surrounding the terminal hepatic venules, it has been shown before that proliferation of myofibroblasts predominates (2,31). In the present study, myofibroblast processes were also found in the perisinusoidal spaces of the Disse, but no cell bodies of the myofibroblasts were observed to reach them. Instead, the present study revealed that in the liver of baboons

Figure 14. Correlation between the area of the rough endoplasmic reticulum (rER) in transitional cells and the degree of hepatic fibrosis in baboons fed alcohol. The area of the rER was expressed as square micrometers per cell. Each point represents results obtained in one alcohol-fed baboon. A significant correlation was found between the area of the rER in transitional cells and the degree of hepatic fibrosis.

Figure 15. Correlation between the number of transitional cells and the degree of hepatic fibrosis in baboons fed alcohol. The number of transitional cells was expressed as the percentage of total perisinusoidal cells. Each point represents results obtained in one alcohol-fed baboon. A significant correlation was found between the number of transitional cells and the degree of hepatic fibrosis.
fed alcohol, the development of the fibrotic process in the Disse space is accompanied by the transformation of lipocytes into transitional cells.

References


