Liver Aspiration Cytology

CHARLOTTE J. BRITS

SUMMARY

The cytological morphology of liver cells in various liver diseases is described, and the usefulness of liver aspiration is discussed.

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Liver biopsy by means of the Menghini[1] needle is commonly used as a diagnostic procedure. Although reliable, the method has its complications[2] and contra-indications.[3] Fine-needle aspiration of the liver has been described,[4] but has as yet not been generally accepted as a diagnostic aid.

Information obtained from a liver aspirate can be diagnostic in the hands of an experienced cytologist, especially when the aspiration is done by the cytologist personally, and the clinical data, the observations made during aspiration and the cytological findings are evaluated as a whole.

This method has been used to diagnose porphyria,[5] haematological changes,[6] neoplasms,[7] enzyme defects,[5] siderosis,[8] acute hepatitis and cirrhosis,[9] fatty change,[10] glycogen storage diseases[11] and granulomatous lesions.[12]

Lundquist[7] gave a review of the complications of fine-needle liver aspiration as compared with fine-needle liver biopsy. He considered complications to occur in less than 0,34% of cases. Söderstrom[4] discussed this aspect, concluded that fine-needle aspiration was safe, and strongly advocated the method.

Few studies of liver cytology correlated with the histology are available. This article represents the cytological data obtained over a period of 6 years, and of which one-third of the cases had histological correlation. The cytological findings in various liver conditions are described, and the application of this simple and safe method is evaluated.

PATIENTS AND METHODS

With the patient in a supine position, the outline of the liver is determined as well as the position of nodules or scanning defects. The skin is cleansed, the patient asked to hold his breath, and a 21-gauge hypodermic needle attached to a 10-ml syringe is rapidly introduced into the liver. Brisk suction is applied 3 times with the plunger of the syringe. Ideally no material should be seen in the barrel of the syringe, since the amount of tissue in the needle is sufficient. Stronger suction ruptures blood vessels, which impairs the quality of the aspirate. Before removing the needle from the liver, suction is stopped. The aspirate is then blown onto a glass slide, fixed in 1 : 1 mixture of anaesthetic ether and 95% alcohol, and stained with Papanicolaou's method. Stains for acid-fast bacilli, amoebae, mucus, iron, lipid and amyloid were used on duplicate smears, when indicated.

In a series of 1 105 cases, histological confirmation was obtained in 390 cases. This was obtained at necropsy, by needle biopsy or by open biopsy during laparotomy. Also aspirated were 518 cases of leprosy and 87 outpatients, but without histological correlation.

Complications occurred in 1 case of primary liver cancer where slight intraperitoneal haemorrhage took place. This was controlled by conservative treatment. No other complications were seen in any of the cases.

The conditions examined are shown in Table I.

TABLE I. CONDITIONS EXAMINED

Cytological diagnosis	Histological diagnosis	No. of cases
Metastatic carcinoma		**104**
Primary liver carcinoma		**82**
Siderosis		**68**
Viral hepatitis		**33**
Cryptogenic cirrhosis		**24**
Cholestasis		**19**
Fatty change		**18**
Alcoholic hepatitis		**13**
Tuberculosis		**9**
Congestion		**8**
Hepatofibrosis		**7**
Liver cell necrosis		**7**
Cholangitis		**4**
	Veno-occlusive disease	**3**
	Biliary atresia	**3**
	Syphilis	**2**
Neonatal hepatitis		**2**
Diverse		**35**
Smear of poor quality		**14**
Normal		**45**
		500

In 110 cases no histological diagnosis was obtained, and the diagnosis was made on cytological grounds, while 390 cases had histological correlation.

In 518 smears from leprosy patients, the following were the cytological findings:

Cells containing bacilli	88
Bantu siderosis	51
Fatty change	2
No abnormalities detected	377
	518

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In aspirations of 87 outpatients with large palpable livers, the cytological diagnoses were:

Bantu siderosis	41
Normal	16
Fatty change	10
Hepatoma	7
Inflammatory cells	5
Hepatofibrosis	3
Infectious hepatitis	2
Diagnosis not made	3
	87

These two series had no histological confirmation.

RESULTS

The cells from livers which showed no histological abnormality, and where no clinical illnesses were detected, present a uniform appearance (Fig. 1). The cells are polygonal

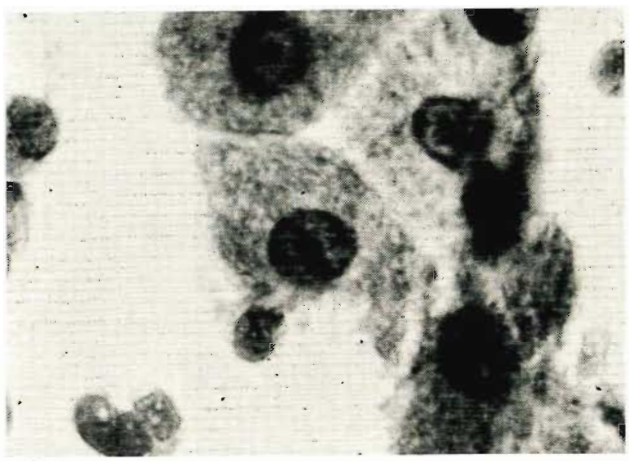

Fig. 1. Normal human liver cells. The cytoplasmic boundaries are adjoining, the cytoplasm finely granular and the nuclei centrally situated (Papanicolaou stain × 4 500).

or round, with a central vesicular nucleus. The cytoplasmic boundaries are clearly defined and the cytoplasm is slightly basophilic and finely granular, with no inclusions. The nucleus has a well-defined nuclear membrane, and chromatin which is distributed finely. The chromatin is of medium density, and one or two circular, eosinophilic nucleoli are usually present.

The cells and nuclei are of uniform size and shape, although an occasional large dark premitotic nucleus is seen, as well as binuclear cells. Cohesion between cells is good, and only a few groups of 6 - 10 liver cells are aspirated. The background contains mainly red blood cells with an occasional leucocyte, Kupffer cell or group of bile duct cells. Kupffer cells present as elongated cells with elongated dark uniform nuclei (Fig. 2). The cytoplasmic membrane is well outlined, and the cytoplasm is translucent and amorphous in the absence of phagocytosis. However, haemosiderin or other pigments are frequently seen as inclusions in the cytoplasm. Bile duct cells (Fig. 3) are ovoid or round in outline, with clear, scanty cytoplasm

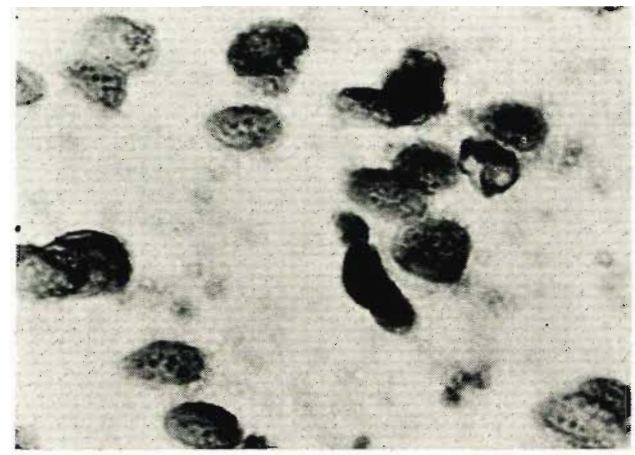

Fig. 2. The elongated dark nucleus of a Kupffer cell (Papanicolaou stain × 4 500).

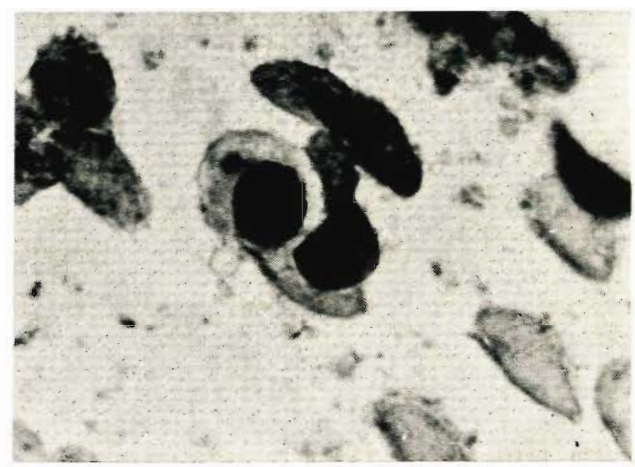

Fig. 3. Bile duct cell with round nucleus. The cytoplasm is poorly defined and scanty (Papanicolaou stain × 4 500).

with ill-defined borders. The nuclei are round to oval, vesicular, and contain little chromatin.

Fatty Change

The liver cells in fatty change exhibit vacuoles of varying size with smooth round boundaries in the cytoplasm. When a vacuole becomes large the nucleus is displaced to one side. In order to confirm that these were indeed lipid-filled vacuoles, smears were stained with scharlach red to demonstrate the presence of lipid in the vacuoles. This was, however, only possible after the smears had been fixed in Schaudinn's solution, as the lipid dissolved in the ether-alcohol fixative. These cells must be distinguished from vacuolated malignant cells, and this is done by assessing the nuclear characteristics carefully. The liver cell nucleus may retain its vesicular character or may become pyknotic. In the last instance the shrinkage and uniform density distinguish the nucleus from a

malignant one, while the vesicular liver cell nucleus shows no malignant characteristics, such as uneven chromatin clumps, hyperchromatism or an aberrant shape. In addition all the cells with fatty change will resemble each other, despite the variation in vacuolar size. Malignant cells, on the other hand, will exhibit pleomorphism.

In smears made from a liver with fatty change (Fig. 4), many cells are found, either singly or in groups. The increased number of cells may be the result of loss of cohesion between cells. Apart from the disturbed metabolism of these cells, distortion owing to large vacuoles is present, and both these factors may cause a loss of cohesion.

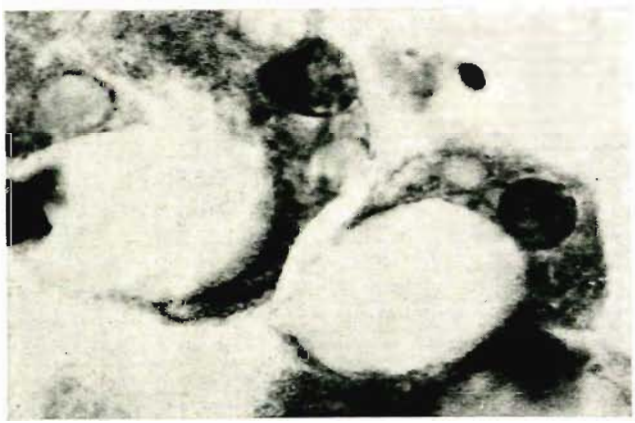

Fig. 4. Vacuolated liver cells in a case of fatty change. The displaced nuclei show no abnormal characteristics (Papanicolaou stain × 3 000).

Atrophy of Liver Cells

Liver cells which show no other deviation from the normal except a reduction in size of both cell and nucleus, are seen in cases where venous congestion or occlusion has impaired the circulation of blood, or where increased sinusoidal pressure is present. These small liver cells have more pyknotic nuclei than are usually seen in groups of liver cells, and cytoplasmic fragments without nuclei are present as well. The background of such smears usually contains many red blood cells. This is seen in cases of chronic venous congestion and veno-occlusive disease.

Liver Cell Necrosis

This is cytologically evident when liver cells with pyknotic nuclei and cytoplasmic changes are present. The cytoplasm becomes eosinophilic and coarsely granular and the cytoplasmic boundary frays. In later stages of cell death the nucleus is lost, and irregular eosinophilic cytoplasmic fragments remain. These smears show, in addition to necrotic cell debris, lymphocytes, leucocytes and red blood cells.

Haemosiderosis

Accumulation of pigment, such as haemosiderin, is frequently seen (Fig. 5). Liver cells containing these granules are less globular in appearance, although there is no reduction in size. The yellow-brown granules in the cytoplasm tend to appear to the side of the nucleus, and seldom obscure the nucleus except in cases where massive aggregates have formed. The nucleus does not change in appearance, and remains in a central position. When these smears are stained with ferricyanide, these granules stain positively for iron.

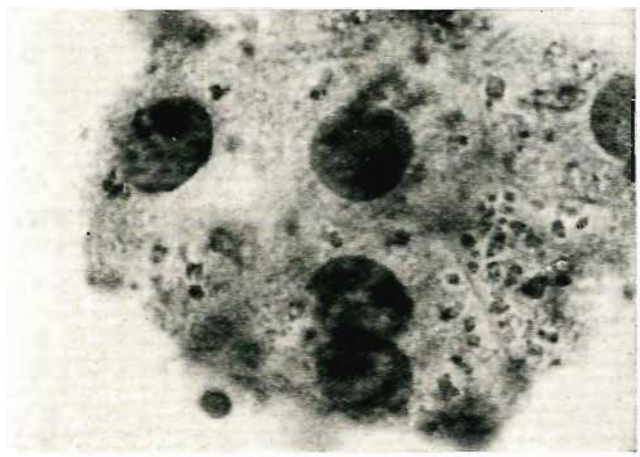

Fig. 5. Liver cells in a case of Bantu siderosis. The nuclei are unchanged, and the yellow-brown granules are seen in the cytoplasm (Papanicolaou stain × 4 500).

On a smear made from a liver in which much haemosiderin pigment is present, the brown granules are seen in the cytoplasm as well as outside in the form of large aggregates.

Cholestasis

This condition can resemble haemosiderosis superficially. When the cells are closely examined, however, marked differences between the two conditions are apparent. The liver cells contain bile droplets of varying size in the cytoplasm, in bile canaliculi between two liver cells, and free on the smear. Bile droplets are amorphous patches of varying size, and they appear smooth and flat, and often branch. These droplets are yellow-green, in contrast to haemosiderin, which appears as yellow-brown, discrete, piled-up granules. The degree of cholestasis is in proportion to the size and number of bile droplets on the smear. When feathery degeneration has taken place the cells show a thin layer of cytoplasm with yellow discoloration and diffuse vacuolation. In most cases, however, the bile is seen as yellow-green droplets in the position of the bile canaliculus (Fig. 6). In these instances the liver cells appear globular, and cytoplasmic bile is often seen over the nucleus, in contrast to siderosis, where the cells appear flattened on the slide, and the pigment does not obscure the nucleus.

The appearance of the background of the smear, and other cells on the smear, may suggest the cause of the cholestasis, but this is not often the case. For instance,

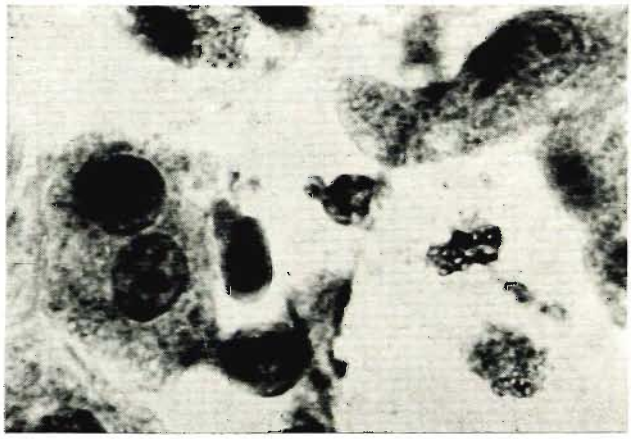

Fig. 6. A large bile thrombus is seen in the left half of the field near the position of a bile canaliculus (Papanicolaou stain × 4 500).

when bile duct cells intermingle with necrotic liver cells and leucocytes are present, the possibility of cholangitis must be considered.

Cholestasis was seen in cases of alcoholic hepatitis, virus hepatitis, biliary atresia, liver cell necrosis, cholangitis and obstruction in the biliary system. Although cholestasis can be the result of either an anatomical obstruction in the biliary system or of biliary retention without obvious obstruction, the cytological pictures do not differ appreciably.

Inflammatory Conditions

In acute infections the liver cells show cytoplasmic changes, which present cytologically as yellow or brown discoloration. In addition there is often an irregular granular appearance. Necrotic cells with eosinophilic cytoplasm and pyknotic nuclei are often present. These cells do not have malignant characteristics, since the nucleo-cytoplasmic proportion is unchanged, and the nucleus is small and shrunken.

A remarkable feature, however, is the variation in nuclear size. Individual necrotic cells with pyknotic nuclei, as well as liver cells with normal vesicular nuclei, are present. In addition large hyperchromatic nuclei are seen, as well as multinucleated liver cells. The large dark nuclei have been interpreted as polyploid or premitotic nuclei which are more common as a result of the liver cell necrosis after the acute inflammatory process. These nuclei are not malignant, for the nucleo-cytoplasmic ratio remains within normal bounds and the chromatin is evenly distributed, although increased. The smear as a whole in cases of inflammatory conditions shows an increased number of liver cells. Where liver cells lie adjacent to one another it can be seen that adjoining cell membranes show loss of cohesion, which explains the fact that more cells are obtained by aspiration. Another feature suggestive of infection is the presence of inflammatory cells such as lymphocytes, leucocytes and histiocytes. These cells, in particular the leucocytes, present as stringy masses of basophilic nuclear material between and over liver cells. Epithelioid cells may be present.

Unusual material such as amorphous necrotic masses or granular necrotic tissue with haemosiderin pigment, calls for more detailed investigation, such as stains for acid-fast bacilli or amoebae.

Additional information about the cause of the inflammatory condition may be present on the smear. For instance, when both bile duct cells and liver cells show signs of necrosis many well-preserved leucocytes are present and signs of cholestasis are found, and the diagnosis of cholangitis must be considered.

In cases of viral hepatitis the liver cells show great variation in size (Fig. 7). Individual necrotic cells with eosinophilic or yellowish cytoplasm and pyknotic nuclei are present, as well as cytoplasmic fragments. The cells appear globular and swollen, but the nucleo-cytoplasmic ratio remains within normal bounds. The most striking

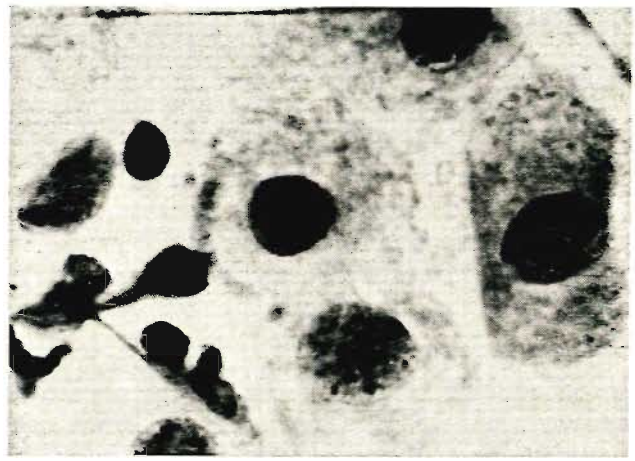

Fig. 7. Liver cells and nuclei which vary in size. Loss of cohesion between the cells is evident and inflammatory cell debris is seen on the right. The liver cell in the centre shows an almost pyknotic nucleus (Papanicolaou stain × 4 500).

feature, however, is the variation in cellular and nuclear size. Large cells often contain two or more nuclei, and these nuclei are often large and hyperchromatic. The chromatin is distributed evenly, and the nucleoli are basophilic and not prominent. These remarkably large and hyperchromatic nuclei in large cells probably belong to proliferating cells. A variation of this large hyperchromatic nucleus is the large normochromatic nucleus with prominent eosinophilic nucleoli. In a given case these regenerative nuclei will be either of the hyperchromatic type without eosinophilic nucleoli, or of the hypochromatic type with bright nucleoli. In both instances the chromatin is evenly distributed, without accentuation of the nuclear membrane. Intranuclear vacuoles are frequently seen.

In addition to these strikingly large and multinucleated cells, there are usually many liver cells of normal size in which the cytoplasm appears more granular than normal. Green intracytoplasmic bile droplets are seen, as well as bile thrombi in bile canaliculi, which appear branched or

are present as large droplets outside cells. The smooth contour of these droplets indicates their canalicular origin. Stringy debris which is present overlying and between cells is the result of many degenerated leucocytes. Loss of cohesion between cells is evident where groups of cells are found, and is also manifested by the large number of cells present.

The histological appearance of viral hepatitis is shown in Fig. 8. There is a disturbance in the architecture of the liver cell trabeculae, spotty necrosis is present as well as an inflammatory cell infiltrate, and bile thrombi are evident. Multinucleate liver cells are seen. Very large multinucleate liver cells were seen in cases of neonatal hepatitis and in biliary atresia. In the latter instance large bile thrombi as well as cytoplasmic degeneration were evident.

Fig. 8. The histological appearance of the liver in a case of viral hepatitis. There is a disturbance in the trabecular pattern, and spotty necrosis and an inflammatory cell infiltrate are seen. The cells and nuclei vary in size and in areas there is loss of cohesion between cells (H. and E. × 320).

Hepatofibrosis and Cirrhosis

The liver cell in hepatofibrosis does not show any variation from the normal. The most suggestive feature of smears from cases of marked hepatofibrosis is usually the paucity of cells, since liver cells held fast by much fibrosis are not easily aspirated. However, this is hardly sufficient for any conclusion, and these cases can only be evaluated when the clinical data as well as the consistency of the liver at aspiration and the quality of repeated smears are taken into consideration.

There are, however, cases of cirrhosis in which more definite cellular changes are apparent.

Alcoholic Cirrhosis

Various liver cell patterns are found:

(a) normal liver cells with vesicular nuclei which sometimes appear shrunken due to folds in the nuclear membrane;
(b) normal liver cells with bile-stained cytoplasm, which sometimes appear attenuated;
(c) liver cells with finely dispersed lipid in the cytoplasm;
(d) distorted liver cells with large lipid-filled vacuoles and eccentric nuclei;
(e) liver cells with poorly-defined basophilic bodies, which may be discrete or confluent. These bodies may appear granular or hyaline, and have been interpreted as alcoholic hyalin.

In addition to these liver cells, groups of small cells with indefinite cytoplasm and small, uniform, dark nuclei are seen. These cells are found in groups of 10 - 20 cells, lying closely together (Fig. 9). It is thought that these cells may be proliferating bile duct cells. On the histological sections these cells are seen in the fibrous tissue surrounding cirrhotic nodules (Fig. 10).

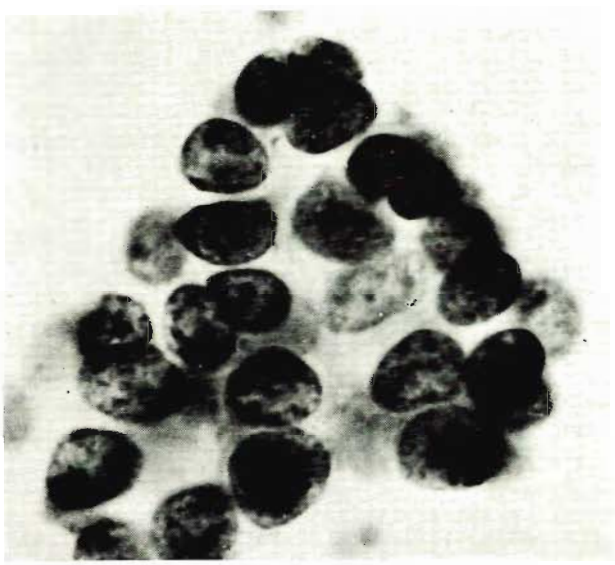

Fig. 9. Groups of small cells with uniform hyperchromatic nuclei from a case of cirrhosis (Papanicolaou stain × 3 000).

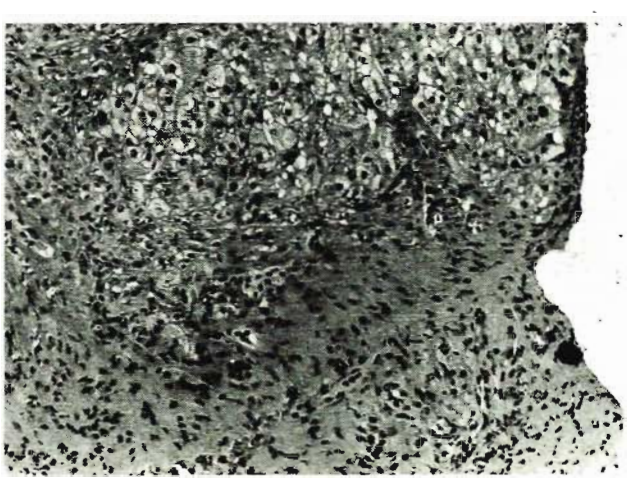

Fig. 10. Groups of small cells are seen in the fibrous tissue from a case of cirrhosis (H. and E. × 128).

Alcoholic Hyalin

This is seen in the individual liver cell as large irregular blueish-grey granules or bodies which may be confluent. These bodies are unremarkable, in contrast to the striking eosinophilic alcoholic hyalin in haematoxylin and eosin sections. The diagnosis of alcoholic hyalin is seldom possible unless some pointer is present as well. Concomitant features are the presence of fatty degeneration, necrotic cells, leucocytes and cholestasis. When most or all of these features are present the diagnosis of alcoholic hepatitis is suggested.

Cryptogenic Cirrhosis

In cases of cryptogenic cirrhosis, where there is a measure of regenerative activity on the periphery of cirrhotic nodules, the smears show certain features. The cells on these smears vary from liver cells which do not differ from the normal, to liver cells which show a decreased nucleo-cytoplasmic ratio. The shape of these cells remains polygonal and the structure of the cytoplasm seems unchanged. Some nuclei are enlarged, as has also been shown by nuclear measurements.[13] These enlarged nuclei have an accentuated nuclear membrane, and the chromatin is arranged in clumps. These clumps are still arranged in a symmetrical manner, but tend to aggregate centrally in the nucleus, or around the nucleolus. Empty areas of parachromatin are often evident around these clumps. In the normal smear there is variation in the number of nucleoli from case to case, but the number of nucleoli tend to be constant in one smear. In these cases, however, there is an increase in both the number and size of the nucleoli in the changed liver cells. Finally, vacuolation becomes evident in these large nuclei.

Although not all the above-named distinguishing features may be present in a particular case, several features are usually evident. Both large and small cells are strikingly different from the population of normal liver cells on the smear, and the large atypical cells are also prominent on histological sections (Fig. 11).

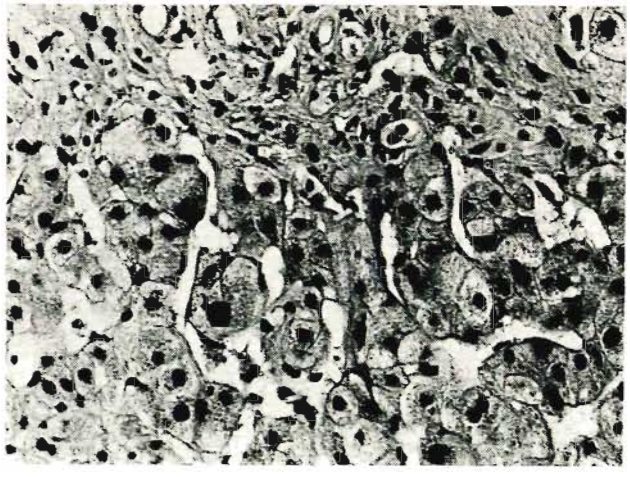

Fig. 11. The histological picture of a cirrhotic nodule in which large polyploid nuclei are seen at the periphery (H. and E. × 320).

By reason of the characteristics which seem to be steps in the direction of malignant transformation, these liver cells may be designated as dysplastic on cytological grounds (Fig. 12). These characteristics were reminiscent of those seen in the rat liver during the early stages of carcinogenesis,[13] and furthermore, the liver with pre-existing cryptogenic cirrhosis is the type most often found in cases of hepatocellular carcinoma.

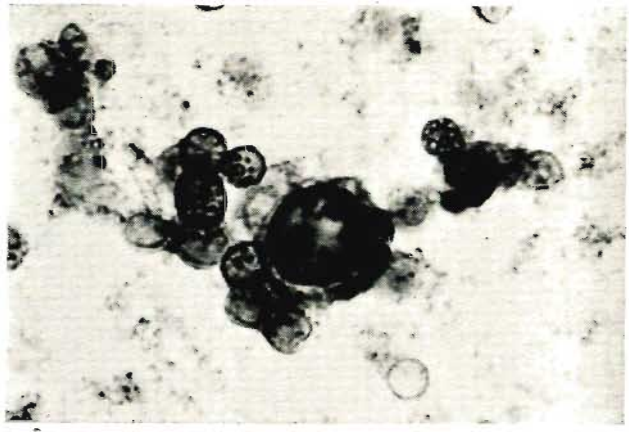

Fig. 12. A cell with a decreased nucleo-cytoplasmic ratio from a case of cryptogenic macronodular cirrhosis. The chromatin is arranged around the nucleolus and against the nuclear membrane. The nucleus is not asymmetrical (Papanicolaou stain × 4 500).

Although these nuclei exhibited atypical characteristics not to be explained within the limits of normal variation, they were not frankly malignant. These changes are difficult to define, and cytologists often compromise by naming them 'dubious' or 'suspicious of malignancy'.

An attempt was made to assess the nuclear and nucleolar sizes in different liver conditions, in order to substantiate some of the subjective impressions of atypicality. These findings showed that the cells from livers with cryptogenic macronodular cirrhosis constituted a group with nuclear size intermediate between normal and neoplastic liver cells, the difference in sizes being statistically significant.[13]

Neoplastic Conditions

Metastatic carcinoma in the liver yields aspirates in which there are two strikingly different cell populations. The liver cells do not exhibit gross abnormality. The neoplastic cells are usually intermingled with the liver cells, but conform to their own characteristics. When distinctive features such as large mucin-containing vacuoles or melanin pigment are present in the cytoplasm of malignant cells, the diagnosis is obvious. In most cases the diagnosis of metastatic carcinoma is possible, although the origin of the metastases is often obscure.

Table II shows the histological and cytological diagnoses of 85 cases in which histology was available.

In cases of lymphoma the uniformity of lymphocytic-type cells is a prominent feature, while the nuclei exhibit

TABLE II. HISTOLOGICAL AND CYTOLOGICAL DIAGNOSIS OF METASTATIC NEOPLASMS

	Histological diagnosis	Cytological diagnosis
Hodgkin's disease	2	1
Lymphoma	8	9
Adenocarcinoma of colon	6	0
Adenocarcinoma of stomach	6	0
Adenocarcinoma of pancreas	5	2
Adenocarcinoma of ovary	3	0
Adenocarcinoma of kidney	1	0
Adenocarcinoma of gall bladder	2	0
Adenocarcinoma of rectum	2	0
Adenocarcinoma of prostate	3	0
Adenocarcinoma origin unknown	3	26
Mesothelioma	1	0
Choriocarcinoma	1	0
Adrenal carcinoma	1	0
Melanoma	3	1
Lung carcinoma	11	2
Mammary carcinoma	11	2
Teratoma	1	0
Sarcoma	4	2
Transitional cell	1	1
Cervix	5	0
Oesophagus	3	0
Squamous carcinoma	1	9
Undifferentiated malignant	1	30
	85	85

lobulated or irregular shapes, and often contain large nucleoli. When two symmetrical nuclei are present in one cell, or large lobulated nuclei are present in combination with a mixed cell population of histiocytes, lymphocytes, eosinophils and polymorph neutrophils, Hodgkin's disease must be considered.

In adenocarcinoma metastatic to the liver the cytological diagnosis is obvious, unless the tumour is poorly differentiated, when a diagnosis of an undifferentiated malignant tumour should be made.

Two cases of leiomyosarcoma were correctly identified on the basis of spindle-shaped tumour cells with very atypical elongated nuclei. Two other cases were diagnosed as undifferentiated malignant tumours. In cases of bronchogenic carcinoma and mammary carcinoma the diagnosis can seldom be made with certainty on cytological grounds alone, but when the history and the clinical picture are taken into account, the diagnosis is facilitated.

Squamous carcinoma is readily recognisable, especially the keratinising type. Malignant melanoma, when pigmented, is obvious. In amelanotic melanoma, however, the diagnosis can merely be undifferentiated carcinoma. This was the cytological diagnosis in the cases of mesothelioma, adenocarcinoma, carcinoma of the adrenal gland, and transitional cell carcinoma.

A series of 38 cases of hepatocellular carcinoma was examined cytologically and confirmed in 16 cases at necropsy and in 22 cases by biopsy.

The cytological picture of primary liver cancer is one that varies according to the histological type of primary liver cancer. Cytologically three well-delineated cellular populations are seen. These are (*a*) cholangiocellular carcinoma; (*b*) well-differentiated hepatocellular carcinoma; and (*c*) poorly-differentiated hepatocellular carcinoma.

A purely cholangiocellular carcinoma has frequently been described histologically, but in our series only one such case was found. In this series both poorly- and well-differentiated hepatocellular carcinomas show areas of cholangiocellular differentiation histologically, but the cholangiocellular component was not always seen cytologically. The reason for this may be that the areas of cholangiocellular carcinoma are frequently desmoplasmic, and this may prevent cells from being aspirated freely.

The cytological appearance of hepatocellular carcinoma with mainly cholangiocellular differentiation is that of large groups of relatively small, uniform hypochromatic malignant cells. These cells resemble bile ductular epithelium and the cytoplasm is often poorly outlined, pale and structureless. The nuclear membranes are accentuated, and the chromatin is distributed unevenly, though finely.

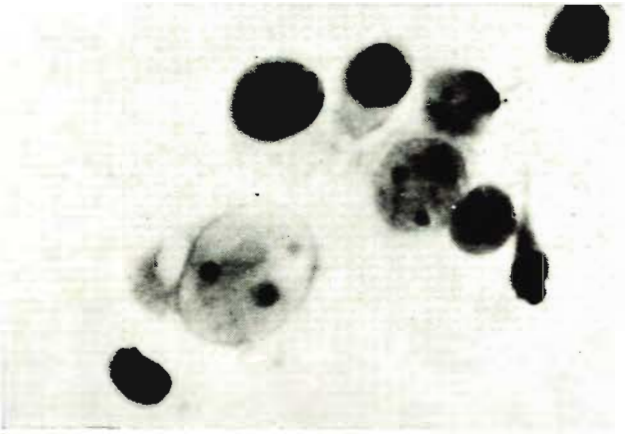

Fig. 13. Relatively small, uniform and hypochromatic nuclei seen in a case of cholangiocellular carcinoma (Papanicolaou stain × 4 500).

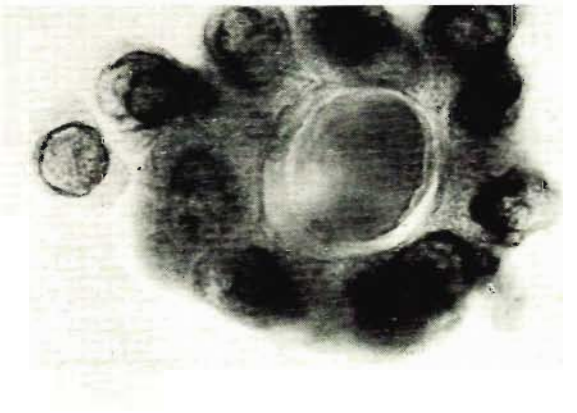

Fig. 14. Malignant liver cells from a case of well-differentiated hepatocellular carcinoma. A large bile canaliculus is seen with a large bile thrombus. The nuclei show cytoplasmic intranuclear inclusions (Papanicolaou stain × 3 000).

One or two eosinophilic nucleoli are present. These hypochromatic nuclei (Fig. 13) contrast strongly with the hepatocellular carcinoma cells, in which the nuclei are hyperchromatic.

In well-differentiated hepatocellular carcinoma the cytological picture is dominated by pleomorphic hyperchromatic malignant cells, which resemble liver cells closely. In some cases only the degree of pleomorphism and occasional very atypical cells indicate the malignant nature of these cells. In some instances evidence of the function of liver cells is present, such as the production of bile (Fig. 14). Nuclear vacuolation is present in 82% of cases.

The malignant cells in poorly-differentiated hepatocellular carcinoma have less cytoplasm (Fig. 15). This characteristic, as well as the marked hyperchromatism, tends to diminish the similarity of these cells to liver cells, but some degree of similarity remains. The nuclei tend to be small and nuclear vacuolation is evident in 57% of cases.

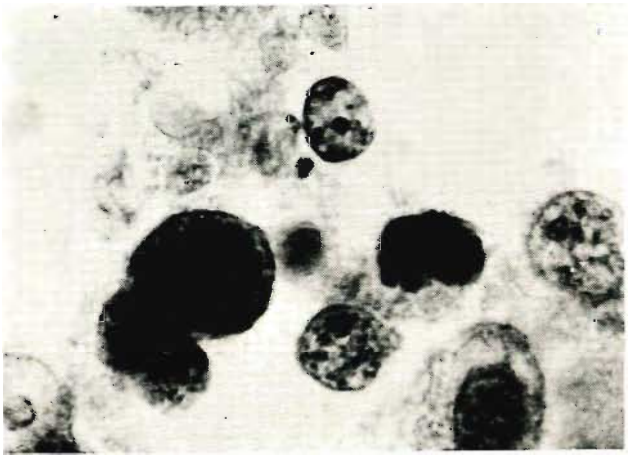

Fig. 15. Small hypochromatic malignant cells indicative of cholangiocellular carcinoma are seen as well as the hyperchromatic cells of poorly-differentiated hepatocellular carcinoma in the left half of the field (Papanicolaou stain × 4 500).

DISCUSSION

Decisive diagnostic information would not result from all liver aspirates, but mainly from cases with metastatic carcinoma, primary liver cancer, siderosis, fatty change, and infections where the causative agent can be demonstrated. In this respect liver aspiration is inferior to liver biopsy. However, as Söderstrom[4] pointed out, the information obtained could be used as a complement to the clinical and laboratory findings, and also to screen patients on whom liver biopsies are contemplated. One very important facet in which the liver aspirate transcends the liver biopsy, is the safety and ease of the procedure.

Factors which minimise the general usefulness of liver aspiration are, firstly, the fact that clinicians tend to regard the liver aspirate as an easy but doubtful type of liver biopsy, as pointed out by Söderstrom.[4] Secondly, the terminology for cytological changes in the liver has not yet been established. The final point is that although the technique of liver aspiration is far easier for both patient and doctor, the interpretation of the cytological material is entirely another matter. Recognition of the various changes of the cytological material is only possible after a great many cases have been examined, and is in fact a very specific field of cytology which can only be valuable when assessed by experienced cytologists.

No clinician can afford to disregard any additional information about a patient which is obtainable by a simple and safe diagnostic procedure. When liver aspiration cytology is seen in its proper place as constituting a diagnostic aid of which the usefulness will vary from case to case, but also as a diagnostic aid which cannot simply be disregarded, it may in time prove to be invaluable.

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