

that used by David *et al.* (1970) in that he washed the fingers with ether to remove perspiration. Our failure to do so may be partly responsible for the high proportion of minor abnormalities in the patients studied, but does not explain the high percentage of normal fingerprint patterns in the coeliac patients.

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Spontaneous Rupture of Hepatocellular Carcinoma

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Summary

Forty-two cases of ruptured hepatoma with intra-abdominal haemorrhage were seen over a period of eight years in the professorial surgical unit at the Queen Mary Hospital, Hong Kong. In all, 207 cases of liver cancer were seen during this period, giving an incidence of rupture of 14.5%. There were 37 men and five women. The clinical features were the sudden onset of pain with shock and the presence of blood in the peritoneal cavity. The diagnosis was made before operation on suspicion and by a process of elimination. In cases of doubt paracentesis abdominis was performed to determine whether there was blood in the peritoneal cavity. Treatment was directed to control of haemorrhage and resection.

The prognosis, although extremely poor, is no worse than the hepatocellular carcinoma that has not ruptured. There was one long-term survivor—a patient who had undergone an extensive resection. The man was alive and well after more than five years.

Introduction

On 23 April 1972 a Chinese man, aged 42, was admitted to the professorial surgical unit at the Queen Mary Hospital, Hong Kong. Ten days before admission he was seen in Britain with a history of a sudden upper abdominal pain. He was admitted to one of the local hospitals and at laparotomy the diagnosis was rupture of the hepatocellular carcinoma. The bleeding was from the carcinomatous nodules. An attempt to stop the haemorrhage by sutures failed and it was ultimately controlled by packing the liver with gauze. He was then flown back to Hong Kong and was admitted to this hospital for treatment. An emergency operation was carried out, and he was discharged from hospital six weeks after admission. We record the experience gained in dealing with such cases.

Present Study

Of 207 cases of liver cancer admitted to the professorial surgical unit from May 1964 to April 1972, 30 were admitted because of rupture with haemorrhage. In addition, 12 cases were referred

from the professorial medical unit. The number of cases of this tumour admitted to the professorial medical unit during this period was 451. How many of them, either after discharge from hospital or found at postmortem examination, had actually ruptured is not known. Hence, the percentage calculation of ruptured hepatoma is based on the 30 cases admitted directly to the surgical wards. This gives an incidence of 14.5%.

There were 37 males and 5 females, with a male to female ratio of 7.4 : 1. The youngest patient was a boy aged 12 years and the oldest was a woman of 72. Most were in their third or fourth decade of life.

CLINICAL FEATURES

Pain.—This was present in all 42 cases (100%). The onset of pain was sudden and severe and was situated at the epigastrium or the upper part of the abdomen and occasionally referred to the shoulders. There might be vomiting at the height of the pain. In some cases a feeling of distension in the upper abdomen was experienced for a period varying from a few weeks to one or two months. Then there would be sudden "bursting" pain which might be associated with the rapid onset of shock.

Shock.—Seventeen cases (41%) were admitted in a state of shock with hypotension, pallor, and rapid pulse. The blood pressure varied from normal to non-recordable ones, but the average was 90/40 mm Hg.

Physical Findings.—On physical examination tenderness was present in 36 cases (85%) and was usually confined to the upper part of the abdomen. Rebound tenderness, with a varying degree of abdominal rigidity, was also present. The lower abdomen was usually soft and non-spastic. In addition to the tenderness, a palpable mass connected with an enlarged liver was present in 27 cases (64%). Palpation of the mass, if not too large, was rendered difficult by the presence of spasm in the upper part of the abdomen.

Haemoperitoneum.—Free fluid in the peritoneal cavity was detected in 33 cases (78.6%). The fluid could have been due to the presence of free blood in the peritoneal cavity or to ascites. In cases of doubt paracentesis abdominis was carried out. In 21 of these cases abdominal tapping yielded frank blood or heavily blood-stained ascitic fluid.

In most of these cases, after diagnosis, preoperative preparation was carried out for emergency surgery. When first seen some were in hypovolaemic shock and required blood replacement. They seldom required sedatives as most had a relief of pain after the initial rupture.

Shock had to be combated, and when blood had been replaced and the blood pressure was stable early surgical intervention was undertaken.

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SURGICAL EXPLORATION

As the exact site of rupture is not known, a right transrectus incision would be a suitable one. If on exploration the liver is found to be resectable and the rupture comes from the left lobe, the upper end of the wound can be converted into a Mayo Robson incision. On the other hand, if a right hemihepatectomy is to be carried out the upper end of the incision can be extended to the right side of the chest. The costal cartilages are divided without opening the pleura or splitting the diaphragm. This usually gives sufficient access to the right lobe of the liver for carrying out a right hemihepatectomy.

LIVER RESECTION

In 13 out of the 42 cases resection was possible. If the cirrhosis is mild a right hemihepatectomy may be possible. If it is moderately advanced then only a left hemihepatectomy can be done. An extended right hepatectomy—that is, the removal of the right lobe including the medial segment of the left lobe—can be done when the liver containing the tumour is otherwise healthy. If cirrhosis is present such an extensive resection is seldom successful, as the patient is likely to die of liver failure. If the cirrhosis is severe and it is judged that resection is not possible, then a very limited segmental resection is still possible.

In carrying out a right hemihepatectomy it is wise to explore the back of the liver to determine whether the inferior vena cava has been infiltrated. If it is free then ligation of the hepatic artery, the portal vein, and the right hepatic duct is carried out at the porta hepatis. After dealing with the inflow of blood into the liver, the right hepatic veins are individually dissected out and ligated. There are two main hepatic veins which are large. One is situated at the upper margin of the liver and the other near the lower border. The upper one is very short and dissection into the liver substance will help to show it. Before division of this vein a vascular clamp must be available. If it slips the inferior vena cava may bleed profusely. The upper hepatic vein is then divided between clamps and transfixed with strong sutures. The lower hepatic vein is similarly dealt with. Between these two large veins there are two to four smaller ones. These need to be ligated individually. At times when the patient is in shock these veins may not bleed, but subsequently when recovery takes place bleeding may start afresh. At this stage of the operation the demarcation between the right and the left lobe is very evident. The right lobe of the liver is blue and cyanotic, whereas the left with its intact blood supply is pink. Division is made by cutting through the liver capsule and by teasing the liver substance with the handle of a scalpel; the intrahepatic veins can be caught and sutured individually.

In performing a left hemihepatectomy the left hepatic vein may be divided and sutured first. This can be done by dividing the left coronary ligament, the tip of which may contain some collaterals which need to be caught and sutured. By depressing the liver downwards the left hepatic vein is dissected out. There may be one or two veins, as each segment of the left lobe may have a separate one draining into the inferior vena cava. Attention is now paid to ligating the left hepatic artery, the left branch of the portal vein, and the left hepatic duct. An additional arterial supply to the left lobe of the liver, in about 10% of cases, may come from the left gastric artery. This needs to be ligated also as, without this division, the liver can still be very vascular. After division of the hepatic artery, the portal vein, and the hepatic duct, the liver can be divided. This is done in the same way as in the right hemihepatectomy.

In performing an extended right hepatectomy, in addition to ligating structures at the porta hepatis the left medial segmental vein, artery, and duct have to be divided and ligated. This can be done by dissecting into the liver substance for about $\frac{1}{2}$ to 1 in (1.3 to 2.5 cm) deep to the insertion of the ligamentum teres. By dividing these structures, devascularization of the liver extends from the right lobe to the falciform ligament. The rest

of the operation is carried out in the same manner as for the right or left hemihepatectomy.

In dealing with the raw surface of the liver, Ong *et al.* (1965) advocated suturing the capsule together. While this may be a procedure which is rapid and can be carried out in an emergency, it is, however, not the best method of dealing with the raw surface. Liver necrosis with bile leakage is more likely to happen. It is far better to control every individual bleeding point from the raw surface of the liver by sutures. A piece of Gelfoam is then placed over it and sutured to the capsule at the edges of the raw surface with a continuous atraumatic catgut. If the falciform ligament is preserved it can be folded over and sutured on to the raw surface of the liver after a piece of Gelfoam has been placed on it.

CONTROL OF HAEMORRHAGE

If on exploration it is found that the tumour has spread throughout the liver and no curative treatment is possible, then the control of haemorrhage can be accomplished by packing the tumour. This was carried out in eight of the present cases. After applying Gelfoam, a gauze roll was applied tightly to the bleeding nodule. The end of the gauze was brought out through a separate stab wound. The gauze pack was removed after 24 hours. To control the haemorrhage one patient was treated by the evacuation of the necrotic tumour and suturing of the liver capsule.

Twelve patients had ligation of the hepatic artery. The common hepatic artery was ligated as it ran along the common bile duct. Sometimes when the liver is large there may be difficulty in ligating it at this point. In that event it could be done where the gastroduodenal artery originates.

Enucleation and suture was carried out in one patient. In this particular case there was bleeding from the tumour, and as the rest of the liver was markedly cirrhotic it was judged to be the best procedure possible.

POSTOPERATIVE CARE

Patients with ruptured hepatoma who have undergone emergency surgery will require intensive supportive treatment until the liver has recovered sufficiently to take over its function. It does not differ from care given to patients with any massive resection of the liver. As soon as possible oral intake of food may be given. Large quantities of protein intake should be avoided as this may lead to ammonia intoxication (Pack and Molander, 1960). This is especially liable to occur when the liver is cirrhotic.

Results

EMERGENCY HEPATECTOMY

There were five hospital deaths out of a total of 13 cases. The five deaths were all among cases of right hemihepatectomy and all of them except two were cirrhotic. One patient died of shock four hours after the operation. This was due to improper control of bleeding resulting in hypovolaemic shock. Two died of liver failure, one of bronchopneumonia, and one of septicaemic shock. Two cases of extended right hepatectomy survived the operation with a smooth postoperative course. One patient lived for three months. The liver was not cirrhotic, but three months later a small nodule in the remaining segment of the liver, which could have been overlooked at the time of operation, ruptured and he died of haemorrhage. In the meantime his liver had undergone regeneration and was of normal size.

The second case of extended right hepatectomy had previously been reported (Ong and Leong, 1969). This patient was operated on in December 1966. The tumour had infiltrated the right leaf of the diaphragm and ruptured while he was under investi-

gation. An emergency extended right hepatectomy was carried out and he was alive and well 5½ years after the operation. This patient's liver was also not cirrhotic.

One of the six right hemihepatectomy cases survived for three years and four months and died of secondaries in the lungs, the abdominal wall, and of recurrence in the liver. This case has also been previously reported (Ong and Leong, 1969).

Of the other surviving eight cases, four had left hemihepatectomy. One of them was alive and well over six months after discharge. The remaining three died from 25 days to two months after operation. The livers were cirrhotic and necropsy showed recurrence in the remnants of the livers and secondaries either in the lungs or in the peritoneal cavity. In one case there was severe cirrhosis of the liver, and it was thought inadvisable to perform an extensive resection. It was a ruptured hepatoma arising from the caudate lobe. Excision was done and the patient was alive more than six months after the operation.

Of the 13 cases that underwent hepatic resection seven had cirrhotic livers of varying severity.

CONTROL OF HAEMORRHAGE BY PACKING

Of the eight cases that underwent this procedure the control of haemorrhage was successful in five, but it failed in three. One patient was discharged on the 10th day after operation but was lost to follow-up. The other patients died from four hours to 40 days after operation.

LIGATION OF COMMON HEPATIC ARTERY

Twelve cases underwent ligation of the hepatic artery. The bleeding was successfully controlled in all.

Six patients (50%) died during their hospital stay one to nine days after operation. Five died of hepatic failure and one developed stress ulcer and died of uncontrolled haemorrhage from the ulcer eight days after operation. The other patients with bleeding controlled were discharged from the hospital and their survival time varied from 20 to 148 days.

Of the remaining eight cases, three underwent laparotomy only and all died within two days. Five cases were found to be in such a moribund state that operation was not feasible. They all died within one to 18 days after admission and necropsy confirmed the diagnosis of ruptured hepatoma.

Discussion

INCIDENCE

Hepatocellular carcinoma is rare among Occidentals but common among the Chinese and Bantus. Most of the papers that have dealt with this topic were limited to case reports (Jenks *et al.*, 1939; Bunch, 1943; Young, 1944; Hanna and Colville, 1965). At necropsy Heuper (1942) reported the incidence of primary carcinoma as 0.12% in England, 0.14% in America and Canada, 0.3% in Hungary, 2.3% among the Chinese and Javanese, and 2.0% in South Africa.

There is evidence that the incidence of primary hepatoma is rising in places like Sweden (Ohlsson and Norden, 1965), Denmark (Glenett, 1961), Greece (Symeonides, 1964), and possibly other European countries. So far the incidence in Britain has been low. However, with the migration of Chinese from Hong Kong to the United Kingdom, the number of cases of primary hepatoma encountered in Britain may be expected to increase. Occasionally rupture of this tumour may take place and will require emergency treatment.

The incidence of ruptured hepatoma has been given variously as 8% (Berman, 1951), 10.2% (Balasegaram, 1968), and 12.8% (Ong *et al.*, 1965). The present series shows an incidence of 14.5%.

DIAGNOSIS

In places where hepatocellular carcinoma is prevalent, a sudden appearance of an upper abdominal catastrophe should lead one to suspect a ruptured hepatoma. If the subject has been suffering from liver cancer and is undergoing either treatment or investigation, the sudden onset of pain with shock and pallor should help diagnosis. The presence of free fluid could be due to ascites, but this would have occurred before the onset of pain. The difficulty of diagnosis is in those healthy patients who have had no previous suggestion of either cirrhosis or hepatoma.

A rupture of the empyema of the gall bladder, rupture of the liver abscess, acute haemorrhagic pancreatitis, and perforated duodenal ulcer could all be confused with ruptured hepatoma. When free fluid in the peritoneal cavity is present, paracentesis abdominis should be carried out. Pure blood suggests the rupture of a solid organ. There are a few conditions in the abdomen that may give rise to a pure blood in the peritoneal cavity. Ectopic pregnancy in women may be one of the causes, and this can usually be ruled out by the history and the presence of pain in the lower abdomen. Spontaneous rupture of the spleen may take place in a previous diseased organ, especially in countries where infectious fevers are common. Haemangioma of the spleen may give rise to haemorrhage. These are relatively rare conditions and such errors are not so important, as the bleeding would have led to an exploration of the abdomen. Diagnosis of ruptured hepatocellular carcinoma is therefore based on clinical findings and the awareness of its presence. There are a few conditions of acute abdominal emergencies which may mimic it, but they can usually be ruled out.

TREATMENT

Emergency Resection.—B. N. Brooke (personal communication, 1972) suggested that after ligation of the hepatic artery, even if the lesion were favourable, resection should not be carried out as an emergency. After bleeding had stopped the patient could be left to recover sufficiently to undergo a second operation. This staging of the operation is appealing, especially in places where facilities for resection of the liver are not available. Having stopped the bleeding, the patient may have recovered sufficiently to warrant transportation to a centre where the services of surgeons who are familiar with the technique of liver resections are available. There is a drawback to this proposition, however, as the spread of the tumour may be very rapid, especially after a rupture. The pathogenesis of rupture had been worked out by A. J. S. McFadzean (personal communication, 1963) and reported by Ong *et al.* (1965). Rupture of the tumour is due to the sudden obstruction to the outflow of blood from the growth. This sudden obstruction is usually caused by tumour thrombus or embolus in the portal vein. This being so, a delay of two or three weeks may render the case non-resectable.

Control of Haemorrhage.—Packing of the bleeding hepatoma is usually possible to control haemorrhage. The pack should be left in for not more than 24 to 48 hours. If the pack has been left longer infection would invariably take place. Among the present eight cases packing failed to control haemorrhage in three. There is also a possibility that when the pack is removed bleeding will recur. In 1965 Ong *et al.* advocated packing of the liver as the most efficient method of controlling haemorrhage. This has not been found to be so in the present series. Evacuation of the necrotic tumour and suture of the liver capsule can sometimes be done. The necrotic tissue usually is avascular, and can be removed by suction or scooping with a spoon. During the manoeuvre, however, severe loss of blood does take place. The bleeding is lessened by applying a clamp across the hepatic vessels at the porta hepatis and releasing it every few minutes. This is an inefficient method, and is not recommended. The only patient who underwent this operation died 11 days later of liver failure. It is known that the cancer draws its blood supply from the hepatic artery and bleeding originates from it. Therefore, the

most sure method of controlling haemorrhage from a ruptured hepatocellular carcinoma is to ligate the hepatic artery.

PROGNOSIS

The prognosis of primary hepatoma is extremely bad. Ong and Leong (1969) reported only 22 resections of liver in 76 cases of hepatocellular carcinoma. Balasegaram (1968) reported 10 cases of ruptured hepatocellular carcinoma, and of those that underwent resection none survived more than six months.

The prognosis of the disease may rest on whether the liver is cirrhotic or not. If the liver is markedly cirrhotic then survival, either immediately after resection or on a long-term basis, is poor. It is possible that because of the cirrhotic liver the tumour may be multicentric in origin, and despite adequate resection it may recur in the hepatic remnant.

So far as the control of haemorrhage is concerned, the longest period of survival in the present series was 148 days. This was contrary to what Berman (1951) had written, and in his small series of six cases none survived more than 40 days.

The outcome of hepatocellular carcinoma is usually fatal. From the time of diagnosis to death the period of life is on average six months. Of the 20 cases originally reported by Ong *et al.* in 1965, one was alive and well at the time of writing after

having had a left hemihepatectomy done in 1962. Of the present series of 42 cases one was well after 5½ years. There is no evidence of recurrence of the disease or metastases.

These cases show that long-term survival, even with rupture, does occur. Provided resection can be done an average of nine months to a year of a good life is possible.

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PRELIMINARY COMMUNICATIONS

Primary Hepatoma and Hepatitis-associated Antigen in a Young White Woman

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Summary

A young woman whose serum was positive for hepatitis-associated antigen (H.A.A.) and alpha-fetoprotein developed a malignant hepatoma. Though the light-microscopical appearances of the surrounding liver tissue were normal, electronmicroscope examination of the tumour tissue disclosed both C-virus-like particles and H.A.A. particles. Possibly there was a causal connexion between one of these particles and the hepatoma.

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Introduction

An association between hepatitis-associated antigen (H.A.A.) and chronic liver disease has been documented (Fox *et al.*, 1969; Wright *et al.*, 1969). It has also been suggested that hepatocellular carcinoma might in some patients be the end stage of a process beginning with viral hepatitis (Smith and Blumberg, 1969; Sherlock *et al.*, 1970). At present the evidence suggests that H.A.A. may be related to the appearance of primary liver cell carcinoma in Africans (Vogel *et al.*, 1970; Bagshawe *et al.*, 1971), but not related to this in Chinese (Smith and Blumberg, 1969; Simons *et al.*, 1971), or in the cases that occur in Caucasians (Alpert and Isselbacher, 1971).

We report a case of primary hepatoma occurring in a 22-year-old white woman, whose serum was positive for H.A.A. and alpha-fetoprotein. The appearances of liver surrounding the tumour were normal on light microscopy, but electronmicroscopy of the tumour and serum showed particles characteristic of H.A.A. Electronmicroscopy of apparently normal liver around the tumour showed occasional similar particles.

Case Report

A 22-year-old white woman presented in Hobart for routine antenatal care in November 1970, when 36 weeks pregnant. She had been born and lived in Adelaide until 18 and had never lived or travelled outside Australia. No physical abnormality was detected, and she was delivered of a normal infant in December 1970. Three days after delivery she complained of mild right upper quadrant pain, and the liver edge was palpable. Liver function tests showed nothing abnormal except for a raised serum alkaline phosphatase (26 K.A. units). Her symptoms subsided, and she was not seen again until February 1971, when she complained that she had been aware of a lump in the right upper abdomen since the baby was born. At this time the right lobe of the liver was easily palpable, firm, and not tender 6 cm below the right costal margin. A cholecystogram showed normal function of the gallbladder, but it was displaced. A liver scan with the use of ^{99m}Tc (Fig. 1) showed a spherical region of diminished uptake in the right lobe about 10 cm in diameter.