Results in 107 Hepatic Lobectomies with a Preliminary Report on the Use of a Clamp to Reduce Blood Loss

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ALTHOUGH the first successful resection of a primary malignant tumor of the liver was performed by Lücke[9] in 1891, during the succeeding six to seven decades surgical treatment of the liver has remained largely within the scope of wedge or partial resection. The reason for the lag in hepatic surgery among all abdominal operations might be attributed to the following three factors: namely,

(1) The surgical inaccessibility of the liver

(2) The vital functions of the liver precluded large excision for fear of lethal consequences.

(3) The liver *per se* constitutes a huge vascular sponge which is friable with a great capacity for bleeding, not easily controlled by conventional clamping or ligating technics.

In 1898 the anatomical structure of the liver was clarified by Cantlie[1] and hepatic lobectomy by the so called "control method" became feasible since then.[8,10,12] Presently, hepatic lobectomies are often reported in the literature and hepatic surgery has emerged to become an important part of general surgery. In the "control method" of hepatic lobectomy, the hilar structures of the liver such as the left or right hepatic artery, portal vein and the hepatic ducts are individually exposed, ligated or snared extrahepatically prior to transection of the interlobar septum. The procedure is similar to that employed in pulmonary resection and for the most part is theoretically and practically effective. However, dissection of the porta hepatis to identify the ramifications of the hepatic artery, the portal vein and the hepatic duct might be extremely difficult or impossible when a huge hepatoma is compressing and covering the hilar area or when the hepatoma is tightly adherent to the stomach and the transverse colon. If surgeons run the risk of dissecting these structures under such conditions, unnecessary injuries, hemorrhage or air embolization may occur. For the aforementioned reasons Lin,[4,5] in 1954, proposed a method of hepatic lobectomy by means of finger fracture dissection of the liver tissue with intrahepatic ligation of the vascular and ductal structures. The author[6] has since performed 82 consecutive procedures of hepatic lobectomy for primary carcinoma of the liver by this technic. It has proved to be a simple and safe method as reflected in its low surgical mortality (12.1%) and reduced requirement for blood transfusion during operation.

Nevertheless, the finger-fracture technic is by no means a perfect method of controlling bleeding. During the period of finger insertion or liver tissue fracturing, there still is considerable unnecessary bleeding that may require rapid replacement of blood by pumping with full speed to overcome the drop in blood pressure. During this particular period a sense of insecurity often plagues the surgeon. To overcome this handicap of finger-fracture dissection technic, the author devised a new technic of bloodless hepatic lobectomy and found it to be most ideal and satisfactory.

In this report the technical detail and the advantages of this new surgical approach is described, pitfalls are discussed along with the presentation of the results of past experiences in 107 hepatic lobectomies.

Technic

(1) The liver is exposed through an upper transverse incision. A satisfactory operative visual field can not be obtained through the longitudinal median incision.

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This transverse incision is best placed at the upper edge of the abdomen, otherwise the exposure of the liver could be hindered by the emergence of the transverse colon, intestines and so forth through the abdominal wound (Fig. 1).

(2) If the tumor is located in the right lobe, the left half of the transverse incision is opened, (and vice versa) first to insert a hand into the abdominal cavity to examine the presence or absence of cirrhosis, contralateral lobe metastatic nodules and also to determine the extent of the disease. If the tumor is found to be resectable, the transverse abdominal incision is then extended to either side and an additional thoracotomy is placed on the side of tumor bearing lobe. The diaphragm should also be split if necessary. However, right or left hemihepatectomy could be easily accomplished solely through the abdominal incision without thoracic extension in children.

(3) The triangular, falciform and coronary ligaments are divided to free the affected lobe from the diaphragm. The round ligament is also divided and clamped. Traction on the cut end of the round ligament may be a helpful maneuver to keep the liver in a suitable position during hepatic resection.

(4) In case of right hepatic lobectomy, the cystic duct and cystic artery should be isolated and transected. The gallbladder is left attached to the right lobe (Fig. 1).

(5) A hepatic clamp (Fig. 2) devised by author is then placed on the liver at the anatomic boundary of both lobes as described by Goldsmith.[3] A section line is made about 1.5 cm. aside from the clamp and the Glisson's capsule is incised for insertion of fingers. The tumor bearing lobe is supported with one hand while the thumb and index finger of the other hand are inserted directly into the hepatic tissue through the serosal incision near the hilum. The liver tissue is fractured and smashed to pieces with the fingers and when any resistant vessels or ducts are encountered, they are clamped, severed and

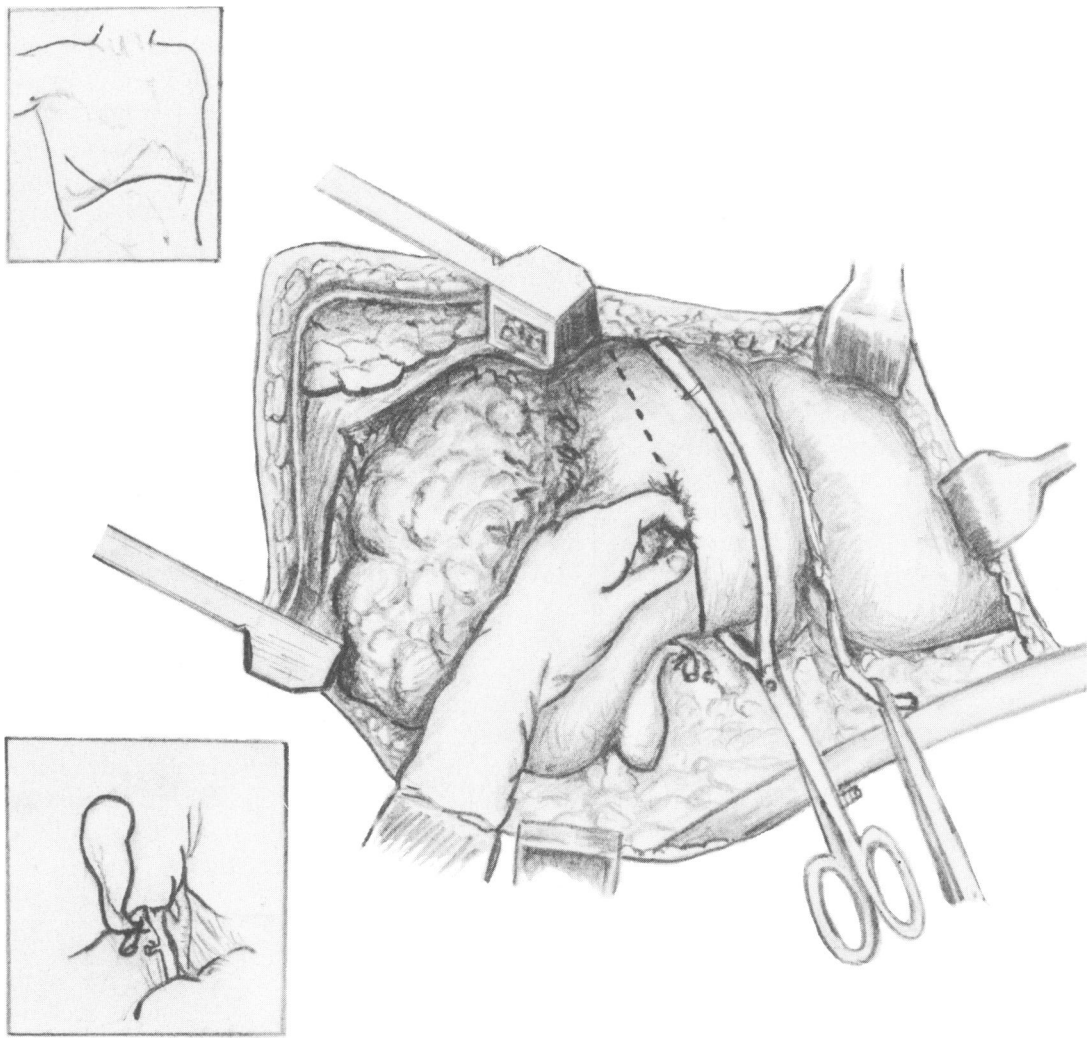

FIG. 1. The right lobe is explored by right thoracoabdominal incision with division of the right leaf of the diaphragm. The hepatoma bearing lobe is mobilized by dividing the ligamentous attachments and the transected lig. teres is used for traction. With the hepatic clamp placed at the anatomical boundary of both lobes, the fingers are inserted directly into the liver tissue.

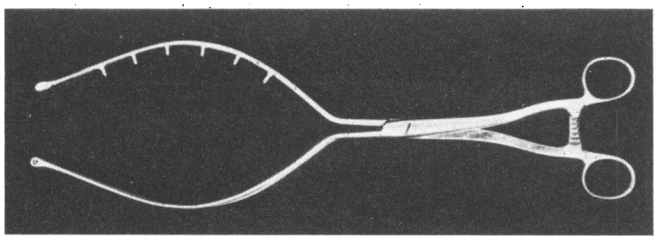

FIG. 2. Photograph shows the hepatic clamp devised by author. The toothed side of the clamp should be placed on the anterior surface of the liver.

ligated individually. Manipulation should begin from the hilar area because the right or left hepatic artery, hepatic branches of the portal vein and the right or left hepatic duct can be isolated and divided, intrahepatically. At this point, the assistant who holds the clamp should exert mild force on the clamp toward the remaining lobe so that the toothed-clamp does not slip down from the remaining liver as hepatic resection continues (Figs. 1, 3).

(6) The technic is continued upward and posteriorly. The middle hepatic vein is commonly encountered at the middle portion of the resection. Then in the same way, the right or left hepatic veins which drain into the inferior vena cava can be exposed, isolated, severed and double ligated intrahepatically at their diverging points. Usually the affected lobe can be completely removed almost bloodlessly in about 10 minutes (Fig. 4).

(7) All vessels are carefully checked and ligated, before the clamp is released. After a piece of Gelfoam has been placed on the raw surface of the liver, a piece of omentum is affixed to the subjacent liver margin (Fig. 5).

(8) If thoracotomy is undertaken at the time of operation a waterseal chest drainage tube must be provided. An intraperitoneal drain was placed in the subphrenic space for 1 to 2 days. The common duct was not drained.

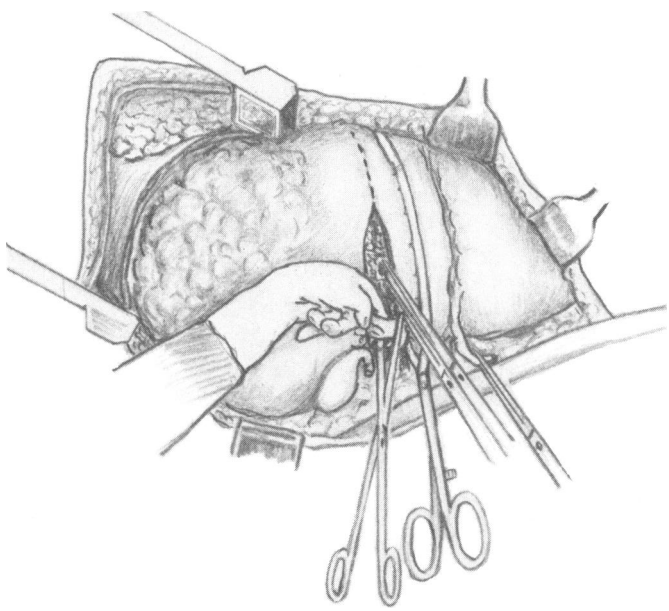

FIG. 3. The right branch of hepatic artery, portal vein and right hepatic duct are isolated, clamped and divided together intrahepatically after fracturing the liver tissue with fingers.

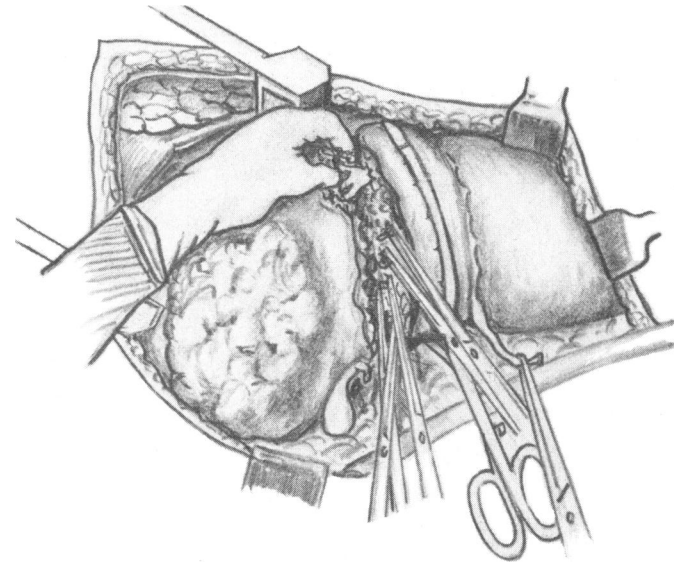

FIG. 4. The right hepatic vein is isolated with the same technic. All vascular and ductal structures encountered during the finger fracture dissection have already been clamped and divided.

Advantages and Precautions of the Proposed Operative Methods

The technics proposed herein constitute one of the most feasible, simple and safe technics available at the present time. Detachment of the falciform, coronary and triangle ligaments is all this technic requires before proceeding to actual resection of the liver. Since the extrahepatic vascular and ductal structures do not require individual isolation with scrupulous precaution, the operative time is shortened significantly. Secondly, since the short hepatic veins do not require extrahepatic isolation, vascular injuries or massive hemorrhage which might be caused by this isolation could be avoided. If hepatic resection was done by extrahepatic dissection of large vessels, hemostasis would be fairly difficult in case of hepatic vein or vena caval injuries because the undetached huge liver would obliterate the operation field and preclude one from applying a large clamp to forestall hemorrhage. In the proposed technic the thick hepatic tissue which has been dissected by finger fracture has exposed the vascular system to direct vision. There-

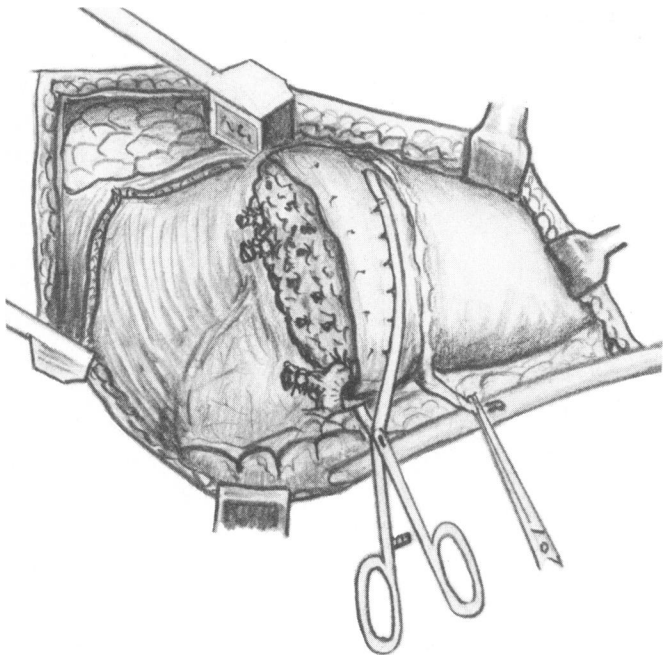

FIG. 5. After completing ligation of the vascular and ductal structures, the hepatic clamp is released. Any bleeding from the raw surface of the liver should be stopped by suture ligature.

fore, application of clamps to secure hemostasis could be easily accomplished. Thirdly, in this technic the liver does not require extreme traction and elevation in order to dissect the hepatic veins. As a result there is no danger of causing cardiac arrest due to vena caval obstruction.

Blood Replacement

Since injuries to the larger vessels is less frequently encountered by this technic, the amount of blood replacement at operation can be reduced to a minimum. We routinely institute two venesections at the antecubital and the saphenous veins shortly before operation. Before the hepatic clamp was used, there was still considerable bleeding during finger insertion or fracture of the liver tissue which usually requires about 500 to 750 ml. of blood to be pumped in via both venous lines with full speed in order to overcome a drop in blood pressure. When the hepatic clamp is used, blood loss can be effectively controlled and the operator can proceed with finger fracture dissection slowly without unnecessary tension in an almost bloodless field. Blood replacement if required, chiefly compensates the loss from raw surface of separated adhesions from the diaphragm or retroperitoneum. In the past, of course there have been some exceptional cases in which large amounts of blood were needed, for instance in a sealed-off central bleeding hepatoma and/or accidental vena caval tears (5000–7000 ml.). It is of paramount importance that large amounts of blood should be pumped in through an arm vein rather than through the saphenous vein in case of injuries of the inferior vena cava or hepatic veins.

Fibrinolysis

Before hepatic resection is scheduled, prothrombin time, coagulation time and plasma fibrinogen level and euglobulin lysis time should be determined. Any kind of trauma to the liver, including liver resection, may activate the fibrinolytic system, deplete fibrinogen and cause bleeding. In fact fibrinolysis occurs some times at or immediately following hepatic resection despite an apparently normal coagulation mechanism before operation. We have encountered three patients with severe fibrinolysis who succumbed soon after resection regardless of administration of large doses of fresh blood, transamine (DaiIchi Sei Yaku. Epsilon-Aminocaproic Acid) and fibrinogen. The first such patient bled considerably through thoracic and abdominal tube drains after operation and was reoperated upon to secure hemostasis. However, no definite bleeding point was found and the hemorrhage was thought to be due to oozing. A blood sample taken at that time revealed that the clot lysed within 2 minutes. Transamine, fibrinogen and fresh blood were administered. Notwithstanding, the patient died of continuous bleeding ultimately. The remaining two patients with the same episodes also had unfortunate courses even after the administration of fibrinogen and blood. Based on the aforementioned experiences, it is mandatory to examine the clotting mechanism routinely at the end of operation to eliminate the possibility of fibrinolysis in order that this complication might be prevented and treated in due time.

Cardiac Arrest

In this series there was only one *adult* patient who had cardiac arrest during operation because of acute massive blood loss from a tear of the vena cava. However, in *pediatric* patients (under 15 years of age) the intraoperative cardiac arrest occurred in five of 15 patients despite minimal bleeding. The cause of cardiac arrest in those children might well be attributed to torsion of the small calibre of the vena cava even if scrupulous attention seems to have been directed toward careful handling of the tumor bearing lobe. Because of this hazard in pediatric patients the heart rate is monitored through a visioscope and immediate cardiac resuscitation is instituted as soon as cardiac arrest occurs. The lobe must be excised as quickly as possible while the external cardiac massage is being done. The first two children with hepatoma in this series died of brain hypoxia and acute renal failure because the occurrence

of cardiac arrest was not found in due time and resuscitation was delayed. The remaining three patients were salvaged by continuous cardiac massage instituted immediately after arrest and rapid completion of hepatic lobectomy.

Vascular and Bile Ductal Problems

Besides the aforementioned technical precautions on hepatic lobectomy there are two more points which should be mentioned here. Firstly, since the main branches of the hepatic artery, portal vein and bile ducts are double ligated en masse, transection of these structures must be done 1.5 cm. apart from the ramification of either side and ligation is best done after careful dissection of the adjacent hepatic tissue. This procedure is of particular importance in pediatric cases in which vascular and hepatic ductal calibres are too small to facilitate proper identification. We have encountered a child in whom a huge right sided hepatoma was excised with en masse ligation of the right hepatic vascular and ductal structures. As the ligation was placed too close to the point of branching and the surrounding hepatic tissue was also not properly dissected, the massive ligation caused torsion and obstruction of the left branches of hepatic artery, portal vein and hepatic duct. This particular patient died 3 days after operation of hepatic failure with severe jaundice. The pathologic findings were confirmed at autopsy. Secondly, one should also pay attention to the postoperative formation of bile fistula. When more extensive resection is required, the scope of resection usually involves parts of the contralateral lobe. Often, the bile leaks from the raw surface of the contralateral lobe through cholangioles which forms a bile fistula. Therefore, in case of extensive resection a mattress suture ligation should also be added to the treatment of those surfaces. One such bile fistula was encountered in our series.

Considering all of the points mentioned above, this technic can be applied simply, safely and almost without hemorrhage for resection of either right or left hepatic lobe.

Complications, Mortality and Postoperative Care

Of 107 hepatic lobectomies (105 with the old finger-fracture technic, two with the new technic), we have encountered cardiac arrest in six instances (death in two cases), hemorrhage in two (death in one case), contralateral hepatic artery, portal vein and bile duct obstructions in one instance (death in one case) which might be directly related to operation. The operative mortality was 3.7%. These complications were avoidable if greater precautions had been exercised and in this sense the mortality could be further decreased and the feasibility and reliability of this technic could be more widely accepted. There were a few more patients who succumbed within 30 days after operation but their deaths were assumed not to be related to the operative technic. The causes of death were hepatic failure in three cases, ruptured esophageal varices in one case, suspected cerebral cancer embolization in one case and fibrinolysis in three cases. Those with fatal hepatic failure were associated with moderate liver cirrhosis and generally underwent right hepatic lobectomy. They responded well for the first 5 days. Deterioration of liver functions ensued from the 6th to 7th postoperative day and then they died of hepatic failure within 30 days after operation. Rupture of esophageal varices occurred in one patient in this series who underwent left lobectomy and died of suffocation 7 days after operation. Although not proved by autopsy, cerebral cancer embolization was suspected in one patient who died suddenly 4 days after operation with manifestation of spastic paralysis of the extremities and deep coma. Fatal hemorrhage due to fibrinolysis occurred in three cases as aforementioned. Therefore, of 107 cases of hepatic lobectomy, deaths occurred in 12 patients within 30 postoperative days resulting in an overall surgical mortality rate of 11.2% (Table 1).

Aside from the above mentioned type of immediate morbidity, postoperative complications by this technic were relatively insignificant. In non-cirrhotic group there were several less significant complications such as pleural effusion on the operated side in seven cases, pneumonia in one case, cystitis in one case, bile fistula in one case and fever of unknown origin in three cases. Whereas in the cirrhotic group, ankle edema, hypoalbuminemia and ascites occurred in seven patients with six right and one left instance of hepatic lobectomy.

With regard to post-hepatectomy therapy, nothing particular should be mentioned other than general postoperative care. Pleural effusions are generally treated by one or two procedures of thoracentesis. However, two patients with voluminous effusion required water-sealed bottle drainage. Fever of unknown origin has been frequently encountered. Notwithstanding the patients responded very well to the administration of prednisolone. Postoperative ankle edema or ascites are mainly due to hypoalbuminemia and are alleviated by administration of human albumin. In no instance was a T-tube used to

TABLE 1. *Mortality in 107 Hepatic Lobectomies*

Total no. Resections	Death in Op. Room	Death on 1st op. day	Total Death within 30 days	Surgical Mortality
107	1	4	12	11.2%

drain the common bile duct and yet no complication developed by omission of such drainage.

Results

From April 1954 through November 1971, 107 hepatic lobectomies were performed at the National Taiwan University Hospital. In 105, the old "finger fracture technic" was used and in two the new technic proposed herewith was employed.

The disease entities in this series were predominated by primary carcinoma of the liver in 92 cases; followed by severe hepatic trauma in seven cases; metastatic hepatic cancer in four cases; benign hepatic tumor in two cases; and one case each of hemobilia and hepatic stone.

In regard to the hepatic lobes which were resected, there were 55 right and 37 left lobectomies in primary hepatic cancer, and five right and two left lobectomies in hepatic trauma. All of the four metastatic cancers of the liver and one each of hemobilia and hepatic stone required left hepatic lobectomy. Whereas the two benign hepatic tumors were treated by right hepatic lobectomy.

The age of the patients ranged from 19 to 64 years with an average of 45.3 years in adults and from 4 months to 15 years in children (Table 2). All but one of the 15 pediatric patients underwent right hepatic lobectomy.

Eighty-eight were males and 19 were females in this series. The operative mortality (death related to operative procedure) and overall surgical mortality (death within 30 days after operation) stood at 3.7% and 11.2% respectively.

The most important factor that influences the result of hepatic lobectomy is undoubtedly the nature of the disease process that requires hepatic resection. But the underlying condition of the liver, that is whether or not cirrhosis is present, also plays a significant role in the results of hepatic lobectomy. As shown in Table 3, in those hepatomas not combined with cirrhosis of the liver, none of the left hepatic lobectomies and only two of 45 right hepatic lobectomies (4.4%) resulted in hepatic failure and death. Whereas, in those patients with hepatomas combined with cirrhosis, three of 11 with left hepatic lobectomies (27.2%) and six of 10 with right hepatic lobectomies (60.0%) developed hepatic insufficiency which led to death in 1 week to 4 months, postoperatively.

TABLE 2. *Age by Decade in 107 Hepatic Lobectomies*

Age	Primary Carcinoma of the Liver	Benign Tumor, Metastatic Hepatic Carcinoma	Trauma & Benign Liver Disease
1–10	8	0	3
–20	4	0	2
–30	8	0	4
–40	24	0	2
–50	23	0	0
–60	20	4	0
–70	5	0	0
70+	0	0	0
Total	92	4	11

TABLE 3. *Liver Cirrhosis and Post-lobectomy Hepatic Failure in Malignant Hepatoma*

	Non-cirrhotic			Cirrhotic		
	Resection Cases	Hepatic-failure Cases	%	Resection Cases	Hepatic-failure Cases	%
Right hepatic lobectomy	45	2	4.4	10	6	60.0
Left hepatic lobectomy	26	0	0	11	3	27.2
Total	71	2	2.8	21	9	42.8

As might be expected, the best end results of hepatic lobectomy have been obtained in those patients with benign hepatic tumors or disease of benign nature. There was no single operative death and all of the 11 patients have responded well after hepatic resection. In contrast, the end results of hepatic lobectomy for hepatic malignancies have been generally poor. All four patients with metastatic hepatic cancer died within 1 year of metastases. One patient with cholangiocarcinoma survived left hepatic lobectomy for 5 years and then died of cancer 'peritonitis.' Of 80 patients with primary carcinomas of the liver who survived hepatic lobectomy, 53 died within 1 year either of cancer recurrence, or of metastasis, or of hepatic failure. Local recurrence was noted in 24 instances (26.0%) in this series, which developed mainly from intrahepatic spread to the contralateral lobe and usually became manifest within 1 year after operation. However, one patient developed hepatoma again in the remaining right lobe 8 years after left hepatic lobectomy for a hepatoma. In this case, probably it is not judicious to say that the original hepatoma in the left lobe had spread to the right lobe and slowly grew in 8 years. More likely it was a new hepatoma that developed in the remaining right lobe.

Metastasis to the lung was noted in 15 patients (18.7%) which manifested as multiple nodular, round shadows in chest films. Most of the lung metastasis developed within 1 year after hepatic lobectomy. In one patient, lung metastasis appeared 5 years after hepatic resection.

Hepatic failure was another cause of late mortality and was encountered in 11.9% of patients subjected to hepatic lobectomy for hepatoma.

Nevertheless, hepatic lobectomy for primary carcinoma of the liver has yielded survival for 1 to 2 years in ten cases, 2 to 3 years in five cases, 3 to 4 years in three cases,

TABLE 4. *Comparison of Results of Major Hepatic Resection*

Total Cases	Pack Medical Group 81	Mayo Clinic 17	Lahey Clinic 23	National Taiwan University 107	Total 228
Extended right hepatic lobectomy					
Benign	6	1	0	0	7
Malignant-primary	10	3	0	0	13
Malignant-metastatic	25	4	0	0	29
Right hepatic lobectomy					
Benign	6	1	2	7	16
Malignant-primary	0	0	1	55	56
Malignant-metastatic	4	0	1	0	5
Middle hepatic lobectomy					
Benign	0	0	0	0	0
Malignant-primary	0	2	0	0	2
Malignant-metastatic	3	1	0	0	4
Left hepatic lobectomy					
Benign	3	0	5	2	10
Malignant-primary	4	5	0	37	46
Malignant-metastatic	14	0	2	4	20
Left partial hepatic lobectomy					
Benign	2	0	5	2	9
Malignant-primary	2	0	3	0	5
Malignant-metastatic	2	0	4	0	6
Survivors*	24	8	5	38	75

* Patients living over one year.

and more than 5 years in nine cases (Table 4).[11] At present, 18 patients undergoing hepatic lobectomy for primary carcinoma of the liver are still alive and well; 10 within 1 year, two for 2 to 3 years, one for 3 to 4 years, and five for 5–11 years.

To date, 47 patients in this series have been eligible for 5-year study after undergoing hepatic lobectomy for primary carcinoma of the liver. Nine have survived this period to give a 5-year survival rate of 19.1%.

Discussion

The new technic of hepatic lobectomy proposed herein is similar to the previously described finger fracture technic in its performance, simplicity and safety. In finger fracture technic as well as the new technic, detachment of the coronary, triangular, and falciform ligaments is the only procedure needed before actual hepatic resection can be undertaken. Many complicated maneuvers are avoided and thus the operation time is reduced. Another advantage of both technics is the fact that a less amount of blood transfusion is required than that of various technics used by other investigators, because of less damage to the hepatic artery, portal vein branch or hepatic vein during operation. Moreover the new proposed technic bears another great advantage over the previous finger fracture procedure. In the new technic a hepatic clamp is applied to the liver before hepatic resection, so that the surgeon can proceed to fracture the hepatic tissue and isolate the main vascular and ductal structures intrahepatically without hemorrhage. The feasibility of the finger fracture technic and its new modification was reflected in its low operative mortality rate of 3.7% with few significant postoperative complications in 107 hepatic lobectomies done by these methods.

The end result of hepatic lobectomy depends largely on the nature of the primary disease *per se*. In a series of 130 hepatic lobectomies for malignant hepatoma over a period of 20 years collected from ten teaching hospitals in China, Wang *et al.*[13] reported pessimistically that only two patients survived more than 5 years. Conversely, Domeiri *et al.*[2] reported a 15.6% of 5-year survival rate among 32 cases of hepatic lobectomy for primary malignant hepatic tumors over a 20-year period at Sloan-Kettering Hospital.

In our series, the 5-year survival rate of hepatic lobectomy for 92 cases of malignant hepatoma was 19.1%. This may indicate that malignant hepatoma, which has been considered as a hopeless disease, can be cured by surgical treatment to a significant extent.

From the experience gained in performing hepatic lobectomy for malignant hepatoma we feel several points deserve special mention and call for further investigation in the future.

First, hepatoma tends to spread intrahepatically from the portal vein system from an early stage of the disease. Removal of a hepatoma-bearing lobe might leave

some hepatoma cells in the remaining lobe which could cause subsequent cancer recurrence. This was evident in 24 of our 92 cases (26.0%) and constituted the most important cause of late death following hepatic lobectomy. For the purpose of preventing local recurrence of hepatoma, we have tried one dose of 20 mg. Mitomycin C given into the hepatic artery immediately after hepatic resection in three patients. One survived 1 year and 5 months and then died of lung metastasis. The other two patients have survived 2 years and 8 months and 3 years and 5 months respectively and are still living and well. It is felt that local chemotherapy with Mitomycin C deserves some further trial.

Secondly, the lungs are the most frequent site of remote metastasis in malignant hepatoma. In our patients, 18.7% developed lung metastasis 2 weeks to less than a year after hepatic lobectomy and constituted another important cause of late death in surgically treated hepatoma. It is presumed that the lung metastasis came from dislodged hepatoma cells that passed up through the hepatic vein into the right heart and then reached the lung. Surgical manipulation may actually squeeze out or enhance the dislodging of hepatoma cells through the hepatic venous system. Since the hepatic clamp was applied at a point before the main hepatic vein drained into the vena cava in our new operative method, the dislodged hepatoma cells might be prevented from migrating by the clamp. This new technic might be of value in the prevention of lung metastasis. Again, in view of the prophylactic effect of hepatic intra-arterial infusion of chemotherapeutic agents on local recurrence, we speculate that the same preventive effect for lung metastasis might be achieved by routine use of systemic intravenous infusion of chemotherapeutic agents such as Mitomycin C or 5 FU after hepatic resection.

Third, the problems associated with hepatic lobectomy for hepatoma combined with cirrhosis are of interest. As mentioned in the foregoing section, hepatic failure was noted in none of the left lobes, and only 4.4% of the right hepatic lobectomies in non-cirrhotic hepatomas. Whereas, 27.2% of 11 left hepatic lobectomies and 60.0% of ten right hepatic lobectomies in cirrhotic hepatomas resulted in postoperative hepatic failure. The wide discrepancy in these results might be explained by the fact that no effective regeneration of the residual lobe or functional improvement over the preoperative levels could be expected in cirrhotic patients after hepatic lobectomy.[7] The cirrhotic residual lobe would fail to regain normal liver function and could even permit hepatic failure after loss of a large portion of the liver tissue especially in case of right hepatic lobectomy, in which almost 75% of liver tissue has been removed. Based on these observations, an index for selection of patients with cirrhosis for hepatic lobectomy is formulated as follows: Hepatic lobectomy is indicated for either the right or left lobe if the cancer-free lobe is macroscopically normal or only very mildly cirrhotic; in the presence of moderately advanced cirrhosis, hepatic lobectomy of the left lobe but not the right lobe can be performed without much danger; in case of advanced cirrhosis hepatic lobectomy for either lobe is absolutely contraindicated.

Fourth, postoperative fibrinolysis presented as a most serious complication and threatening problem in hepatic lobectomy. It occurred despite normal preoperative clotting mechanisms, normal plasma fibrinogen levels, normal euglobulin lysis times, and normal prothrombin times. There was little effective treatment and patients always died once fibrinolysis occurred. Further investigation for an effective preventive measure is mandatory. At present, early detection of fibrinolysis by frequent check of the blood clotting mechanisms during or at completion of hepatic lobectomy seems to be most important.

Summary

A new technic for bloodless hepatic lobectomy is proposed. With a clamp devised by the author to be applied at the anatomical boundary of the hepatic lobes, finger fracture dissection of the affected lobes can be performed almost bloodlessly with ease. The technical details, advantages and precautions in the use of the method are discussed.

The results of 107 hepatic lobectomies performed in the past 17 years are reported. No surgical mortality was encountered in 11 patients with benign lesions (trauma and tumor etc.) and all are presently living and well after operation. Of four patients with metastatic hepatic cancers, none died of operation, but all succumbed to cancer recurrence within a year. Of 72 primary carcinomas of the liver, 12 patients died within 30 days and 53 died within 1 year after operation. Nevertheless, two patients survived more than 10 years, three more than 5 years, one more than 3 years, two more than 2 years. The 5-year survival rate is 19.1%.

Addendum

After completion of the manuscript, this special clamp has been used for hepatic lobectomy in ten more patients with the same promising result of extremely low blood loss. The experiences obtained from the twelve patients (two in the original manuscript and ten after the manuscript) seem to support strongly the advantage and feasibility of the new technic of utilizing the hepatic clamp for hepatic lobectomy.

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