Major Hepatic Resection for Neoplasia:

Personal Experience in 108 Patients

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One hundred eight patients have undergone major hepatic resection by the senior author during the eight year period April 1970 to April 1978. Primary liver cancer was present in 36; metastatic colorectal cancer in 25, miscellaneous metastatic cancers in 15, hepatoblastoma in 5, gallbladder cancer in 4, and bile duct cancer in 3. Benign tumors, principally giant hemangioma, were resected in 20 additional patients. The 30 day operative mortality rate was 9% overall. Prior to 1975, 41 of the resections were done using the vascular isolation perfusion technique. The operative mortality rate of 17% for this technique is a reflection of early experience and the advanced stage of disease of many patients. The operative mortality for the standard resection has been only 4%. Subphrenic abscess has developed in only 13% of patients during the past three years. Postoperative hospitalization has been shortened, being a median of 13 days. The resectability rate for malignant disease was 33%. Forty-six per cent of the resections were performed with curative intent. Fifty-four per cent were palliative, performed in individuals with regional spread or distant metastasis. After curative surgery, three year survival was 88% for individuals with primary liver cancer and 72% with metastatic colorectal cancer. After palliative resection, the rates were 31 and 0%, respectively. The three year survival rate is 46% overall, being 81% for the curative resection group and 18% for the palliative group. Tumor markers proved useful in monitoring patients after hepatic resection.

DURING THE PAST EIGHT YEARS, the authors have examined the thesis that most patients with primary or unclassified liver tumors, as well as those with selected types of metastatic cancer, should be subjected to exploratory laparotomy. Exceptions were patients with obvious advanced disease or who were poor operative risks. Resection of the liver tumor for cure or palliation was done when its location permitted. In highly selected cases, total hepatectomy and orthotopic liver transplantation was indicated.[4,6,18] Nonresectability and/or multiple foci of extrahepatic metastasis were usually treated by hepatic artery ligation with cannulation of the artery and/or portal vein for infusional chemotherapy.[9] In unique situations, hepatic isolation-chemotherapy infusion was used.[5,10] Relatively rarely was a biopsy alone performed.

This approach was based on the unacceptably large error, 20–30%, experienced in estimating resectability by the most modern non-operative techniques.[13] Opportunity for cure or worthwhile palliation would otherwise have been denied to large numbers of individuals. Attendant goals of low operative mortality and improved curability, or realistic palliation were necessary for rational application of this concept. This report presents a portion of the surgical experience with 325 patients who were operated upon by the senior author during the eight year period, April 1970 to April 1978 at Memorial Sloan-Kettering Cancer Center. Table 1 indicates that 108 had a major hepatic resection; they are the subject of this report.

Materials and Methods

All patients with suspected or evident surgical liver disease referred to the senior author were considered for exploratory laparotomy. Preoperative evaluation included a detailed history and physical examination; technetium, and frequently, a Rose Bengal liver scan; selective celiac and superior mesenteric arteriograms; blood chemistries including alpha feto protein and carcinoembryonic antigen (CEA) determinations; chest x-ray and selective gastrointestinal radiologic examinations were carried out. In recent years, computerized transaxial tomography (CTT) was often done. Percutaneous liver biopsy or peritoneoscopy was performed only when the patient was judged to be unsuitable for surgery.

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TABLE 1. *Surgical Experience 1970–1978 (325 Patients)*

Operation	Number
Extended lobectomy	27
Lobectomy	57
Segmentectomy	24
Wedge resection	10
Ligation/cannulation	138
Unroofing cyst	5
Chemoperfusion	4
Liver transplantation	8*
Exploratory laparotomy, Liver biopsy	52
Total	325

* Biliary atresia: 4; Bile duct cancer: 2; Post-necrotic cirrhosis: 1; Idiopathic cholestasic syndrome: 1.

Resectability was determined only at laparotomy. A biopsy was not taken if liver resection was feasible although 52% of patients with primary or secondary liver cancer had been biopsied prior to their being referred. The various types of tumors for which treatment of the primary or metastatic lesion was by major hepatic resection are listed in Table 2. The technique of resection was either by the liver isolation cold perfusion method,[7,11] or by normothermic hilar ligation and hepatic clysis along standard lines of resection. Various types of major resection performed are listed in Table 1.

Operative Technique

The abdomen is explored through a right subcostal incision. If the tumor is resectable, the incision is extended to a bilateral subcostal incision with a paraxyphoid extension. The chest is rarely opened, and then only where diaphragmatic involvement is present or massive tumor necessitates more exposure. Biopsy of the liver is not done if the patient is judged potentially curable by hepatic lobectomy.

Right hepatic lobectomy. The falciform ligament is incised to the vena cava. Triangular and coronary ligaments of the right lobe of the liver are severed and the liver is retracted upward and to the left. As the liver is retracted, the right kidney, right adrenal gland and vena cava are exposed. Dissection continues to expose the bare area of the liver to the suprahepatic vena cava. Laparotomy pads are then placed in the hepatic fossa and the liver thus brought to a more convenient level for hilar dissection. Dissection of this area is begun by dissecting out and identifying the right and left hepatic arteries. Following this, the right hepatic artery is ligated and divided. The right hepatic duct and the cystic duct are then ligated and divided. The right branch of the portal vein is then dissected free, ligated and divided. Care must be taken to avoid injury to posterior branches. Isolation and ligation of the major hepatic veins prior to incising the liver capsule is no longer considered necessary. It is time-consuming and potentially dangerous. The capsule is then incised with a Bovie along the line of demarcation which extends from the gallbladder fossa inferiorly to the right of the suprahepatic vena cava. The liver parenchyma is then separated using the handle of the knife, for the most part, with identification of the intrahepatic vessels and periportal structures which are hemoclipped. Larger vessels and structures are individually ligated with chromic catgut. Intrahepatic ligation of major hepatic veins is done under controlled conditions using pressure by the left hand which holds the specimen as it is resected. The liver substance is traversed in the form of a shallow concave cut. Bleeding points are identified and transfixed with catgut sutures and the anterior and posterior lips of the transected surface are approximated using interrupted #1 horizontal mattress stitches. The raw area of the liver is thus covered preventing oozing and bile leakage. A Shirley sump* is placed in the right upper quadrant and the abdomen closed with a Tom Jones closure, using #1 nylon.

Left hepatic lobectomy. The approach is essentially the same as that for a right hepatic lobectomy except that mobilization of the liver is obtained by dividing the triangular ligament. The right lobe of the liver is not dissected; the left lobe is mobilized toward the inferior vena cava care being taken to avoid injury to the inferior phrenic vein and any collateral vessels. The lesser omentum is divided between clamps at the porta hepatis after identification of the major arterial supply. The left hepatic artery, left branch of the portal vein and left hepatic bile duct are individually identified, ligated and divided. In the event that the tumor is confined to the lateral segment of the left lobe, a left lateral segmentectomy can be performed. This procedure is as described for the total left hepatic lobectomy except that the blood supply to the medial segment of the left lobe must be preserved. Transection of the

TABLE 2. *Major Hepatic Resection (108 Patients)*

Primary Tumor	Number
Liver	36
Colorectal	25
Miscellaneous	15
Hepatoblastoma	5
Gallbladder	4
Extrahepatic bile duct	3
Benign	20

* Anpro-Anproline Shirley sump catheter, H. W. Anderson Products, New York.

liver must be made just to the left of the falciform ligament.

Extended right hepatic lobectomy. The techniques of dissection of structures in the porta hepatis, mobilization of the right lobe and resection of liver parenchyma are essentially the same as for right hepatic lobectomy. In the extended right hepatic lobectomy, however, care must be taken to preserve the gastrohepatic ligament because it frequently contains an anomalous collateral artery from the celiac axis or left gastric artery to the lateral segment of the left lobe. The bile duct to the lateral segment can be very superficial and small. Therefore, particular attention should be given to identifying and preserving the biliary ducts to the lateral segment in the early stage of the resection. The resection line should be about 1 cm to the right of the falciform ligament because the structures in the portal triad branch extensively in the umbilical fissure with elements to the left lobe being located at the base of the umbilical fissure. These are made readily apparent by transecting the fused lips of medial and lateral left lobe segments which overlie the area.

Unless dictated by the extent of tumor, it is safer and easier to leave some of the posterior portion of the caudate lobe behind. The hepatic vein to the left lobe of the liver usually has medial and lateral branches. The medial branch of the left hepatic vein can be identified, ligated and divided inside the liver parenchyma at the final stage of hepatic resection. The resected liver surface is sutured as described previously. The lateral segment may be anchored in position by suturing the falciform ligament to the anterior abdominal wall if extensive distortion of the structures in the porta hepatis is anticipated after liver resection.

A catheter was placed in the hepatic artery or portal vein in some patients for postresection chemotherapy.[9,14] Intraoperative monitoring and support was as previously described.[7,11] Initial postoperative care was in the intensive care unit where colloid and crystalloid solutions were given as indicated. Broad spectrum antibiotics were given routinely for the first 72 hours postoperatively. Chemotherapy was usually started six weeks after resection in uncomplicated cases. Actinomycin-D, methotrexate, 5-fluorouracil, cytoxan, and levamisole were used in protocol studies as previously described.[9]

Patients were followed postoperatively by sequential physical examination, serum chemistries, liver scan and, occasionally, angiography. Results of the present study were compared with those from a retrospective analysis of the charts of 52 individuals undergoing major hepatic resection during the period 1950 through 1969 in this institution.

TABLE 3. *Resectability Rate—Malignant Disease*

Operation	Number
Resection	95 (33%)
Ligation/cannulation	138
Chemoperfusion	4
Exploratory laparotomy, Liver biopsy	52
Total	289

TABLE 4. *Isolation Perfusion vs Standard Resection*

Resection	Median Values*		
	Duration of Operation (hrs)	Estimated Blood Loss (cc)	Postoperative Hospital Days
Isolation perfusion	8¼ (6–14)	4500 (600–26,000)	24 (14–28)
Standard	5 (2¼–9¾)	3000 (300–11,000)	15 (7–60)

* Excludes 30 day operative deaths.

Results

The resectability rate for malignant disease was 33% (Table 3). Duration of the operation, estimated blood loss and postoperative hospital days for the patients treated with the isolation perfusion technique are more than for the standard resection (Table 4). For the latter technique, the median operative time has been 4¾ hours for the past 3¼ years, with the median postoperative hospital stay being 13 days. This contrasts significantly with the preceding five years when it was 18 days for the standard resection and 23 days when both types of resection are combined. Any hypoglycemia or hypoalbuminea was precluded by administration of 5 or 10% glucose solutions; plasma or albumin.

Operative Mortality

The 30 day operative mortality for the 108 patients is shown in Table 5. The overall incidence is 9%, with a rate of only 4% for the standard type of resection. A 17% rate for the isolation-perfusion technique is a reflection of early experience and the advanced stage of disease of many patients who were resected by this technique prior to 1975. The extended right hepatic lobectomy had an operative mortality rate of 14.2% (4/22); right hepatic lobectomy 2.7% (1/36); left hepatic lobectomy 23.8% (5/21); segmentectomy 0/24. The operative mortality was similar for curative and palliative resections being 10% (4/40) and 12.5% (6/48), respectively. Causes of the ten operative deaths in this series are listed in Table 6.

TABLE 5. *Thirty-Day Operative Mortality*

Year	Isolation-Perfusion	Standard	Total
1970	1/2	0/1	1/3
1971	0/4	0/3	0/7
1972	3/11	0/4	3/15
1973	1/13	0/1	1/14
1974	2/11	0/5	2/16
1975	0/0	1/12	1/12
1976	0/0	0/14	0/14
1977	0/0	2/23	2/23
1978	0/0	0/4	0/4
Total	7/41 (17%)	3/67 (4%)	10/108 (9%)

Complications

The most common was subphrenic abscess which developed in 22 patients (20%) (Table 7). Since 1974, only seven of 53 (13.2%) patients have developed this complication.

Pathological Findings

Fifty-four per cent of the liver lesions were solitary. The median size of primary liver cancers was 12 cm and that of the colorectal metastasis 6.5 cm. The 36 primary liver cancers were predominantly hepatocellular (26); four were mixed hepatocellular and cholangiocarcinoma; three were sarcomas; one a cholangiocarcinoma; one carcinoid and one was unclassified. Five children with hepatoblastoma were evaluated separately. Metastatic cancers were predominantly colorectal (25), but 15 were of other types; melanoma: three, sarcoma: three, breast: two, carcinoid of the rectum: two, embryonal carcinoma: two, adenocarcinoma of the kidney: one, adenocarcinoma of the stomach: one, islet cell carcinoma of the pancreas: one. In addition, there were four patients with primary gallbladder cancer and three with major bile duct cancer. The 20 benign liver tumors resected were giant hemangioma of the liver: seven, focal nodular hyperplasia: five, cysts: three, hamartoma: three, adenoma: one, Carroli's disease: one.

TABLE 6. *Thirty Day Operative Deaths (108 Resections)*

Causes of Death	
Coagulopathy with hepatic failure	4
Portal vein thrombosis (indwelling catheter)	1
Warm ischemia (40 min); postnecrotic cirrhosis	1
Unrecognized operative hemorrhage	1
Uncontrollable operative hemorrhage	1
GI bleeding, hepatorenal syndrome	1
Pulmonary embolus	1
Total	10
Type of Surgical Procedure	
Left lobectomy	4
Extended right lobectomy	4
Right lobectomy	1
Left lobectomy + major bile duct resection	1
Total	10

CEA Levels

CEA levels were determined preoperatively in 15 patients with metastatic colorectal cancer. Ten, or 67%, had CEA levels which ranged from 5.7 to 4900 ng/ml with a median of 28 ng/ml. Five or 33%, had serum levels which were 5 ng/ml or less. Values were available for eight patients postresection. Seven of the eight returned to normal levels postoperatively. The one patient whose value remained elevated developed clinically evident recurrent disease within one year postoperatively although all gross disease had been removed at the time of resection. The median time elapsing after resection for the values to become normal was one month.

Alpha Feto Protein

This was detected preoperatively in eight of 33 patients (24%) having hepatic resection for primary hepatoma. Immediately postoperatively, it could not be detected in five of the seven individuals. The two exceptions had a dramatic drop in titer which rose with progression of disease. One of the two was a palliative resection and one developed pulmonary metastasis about two months after resection. Interestingly, of the five who became negative, two developed recurrence without alpha feto protein being detected. The remaining three are alive and well. One patient was an operative death.

Splenomegaly

Although not evident clinically, splenomegaly was found on liver scans. This was demonstrated preoperatively in 18% (11/62) of patients. Reduction in spleen size was noted in four of these at six weeks to 24

TABLE 7. *Complications*

Subphrenic abscess	22
Pleural effusion	15
Wound infection	9
Intraabdominal bleeding	5
Thrombophlebitis	4
Bile leakage	3
Hepatitis	2
Upper GI bleeding	2
Enterocutaneous fistula	2
Portal vein occlusion	1
Acute renal failure	1
Hypokalemia	1
Bile duct stricture	1
Hydrothorax with cardiac arrest secondary to subclavian vein puncture	1

months postresection. Splenomegaly became evident on postoperative liver scan in 20 of 46 patients who had liver scans two weeks to 18 months postresection. Hypersplenism was evident in only one patient.

Survival Rates

Forty-six per cent of the resections for malignant disease (Tables 8 and 9) were done with curative intent. Palliative resections were done by virtue of regional spread in 23 patients or of distant metastasis in 19. The most common type of regional spread was vascular, either vena caval invasion or intrahepatic vascular. The most frequent type of extrahepatic metastasis was lymph nodal.

Actuarial survival rates are available for only the first three postoperative years and exclude the 30 day operative deaths. Table 10 shows that of the 36 curative resections, 100% were alive at one year and 81% at three years. Palliative resections done with regional spread had a 74% one year actuarial survival rate and 17% lived three years. Patients with distant metastasis had similar rates. Primary liver cancer had a somewhat better survival rate than that of other tumors. One hundred per cent of the 13 subjected to curative resection lived two years, with 88% living three years. Palliative resection for this type of cancer resulted in a 31% three year actuarial survival rate. Curative resection of metastatic colorectal cancer was nearly as successful. The two and three year actuarial survival rate was 72%. About half lived for one year after palliative resection, but none survived two years.

Twenty-three per cent (6/26) of individuals with other types of cancer underwent curative resection. Their survival rate was comparable to that of metastatic colorectal cancer, being 83% at three years. All three of the three year survivors were children, two having hepatoblastoma and one embryonal carcinoma.

TABLE 8. *Hepatic Resections*

Primary Tumor	Number of Patients*		
		Palliative	
	Curative	Regional Spread	Distant Metastasis
Liver	13/29 (45%)	10	6
Colorectal	17/23 (74%)	3	3
Miscellaneous	4/15 (27%)	5	6
Hepatoblastoma	2/5 (40%)	2	1
Bile duct	0/3 (0%)	2	1
Gallbladder	0/3 (0%)	1	2
Total	36/78 (46%)	23	19

* Excludes 30 day operative deaths.

TABLE 9. *Palliative Hepatic Resections*

	Frequency*	Number
Regional Spread (23 patients)		
Vascular	10	
Direct extension	8	
Residual disease	8	
Tumor rupture	3	
Bile duct	1	
Distant metastasis (19 patients)		
Lymph nodes		9
Pulmonary		4
Adrenal		1
Diaphragm		1
Ileum		1
Omentum		1
Flank		1
Humerus		1

* More than one type of regional spread in six patients.

Survival for the 20 patients undergoing palliative resection was 35% at two years, with none living three years. Median survival was 15 months for individuals with miscellaneous metastatic cancers; 31 months for hepatoblastoma; 12 months for gallbladder cancer, and 19 months for bile duct cancer.

Discussion

The technique of hepatic resection has been greatly simplified. A thoracoabdominal incision is rarely used. Morbidity of the operation has been greatly reduced by the abdominal approach which is now utilized. Preresection ligation of the major hepatic vein is tedious and hazardous. This is no longer practiced. Adequate control is readily exercised by intrahepatic ligation of these vessels when they are normally reached during the dissection. T-tube drainage of the common bile duct with rare exception has not been practiced.

The results of this study compare favorably with those obtained in 37 patients resected in the preceding 20 year period at Memorial Sloan-Kettering Cancer Center (1950 through 1969) as a collective experience of surgeons on the Gastric and Mixed Tumor Service, as well as the Rectal and Colon Service. The one year actuarial survival for those 37 patients was 57%; the three year actuarial survival was 23%; the five year actuarial survival rate was 20%. The operative mortality experienced during that period was 27%.

The resectability rate could not have approached the 33% in this series although the precise rate cannot be determined at this time for that 20 year period; but the operative mortality and survival figures compare most favorably with those of the earlier series as well as with those of reports in the literature.[1,3,12,15–17]

Hepatic resection using the vascular isolation and

TABLE 10. *Actuarial Survival*

	Number	Actuarial Survival 1 year	2 year	3 year
Primary Liver				
Curative	13	100%	100%	88% (7)*
Palliative	16	78%	47%	31% (3)
Total	29	89%	72%	57% (10)
Colorectal				
Curative	17	100%	72%	72% (2)
Palliative	6	56%	0%	0%
Total	23	88%	48%	48% (2)
Other				
Curative	6	100%	83%	83% (3)
Palliative	20	70%	35% (2)	0%
Total	26	78%	49%	33% (3)
All Cases				
Curative	36	100%	87%	81% (12)
Total palliative	42	71%	36%	18% (3)
Regional spread	[23]	[74%]	[41%]	[17%] (1)
Distant metastasis	[19]	[68%]	[32%]	[21%] (2)
Total	78	85%	59%	46% (15)

* Numbers in parentheses represent number of patients alive beyond that time interval.

hypothermic perfusion technique was performed in the majority of patients in the first years of this study. The limits of this technique were deliberately sought and individuals having massive tumors with vascular invasion and/or involvement of adjacent organs were resected. Four patients, not included in the present report, were part of a feasibility study. Three of these have been reported elsewhere.[8] Extensive liver resections with resection of portal vein, and extrahepatic bile ducts, and reconstruction of the free hepatic segment were done. Coagulopathy and death resulted in all and this approach was abandoned. Some patients with diseased livers in whom the risks of resection were recognized as being high, were also resected. This approach is reflected in the 30 day operative mortality rate of 17%. None of the 14 patients resected using the standard technique died during that period, for their lesions were generally smaller and more favorably situated. With experience, it became evident that the risk/reward ratio was not generally favorable for the patient with a massive tumor requiring isolation of the liver in order to resect it. Furthermore, a larger proportion of the patients referred had less advanced lesions so that the isolation perfusion technique has not been used during the past 3¼ years. It would appear to be indicated now for highly selected patients where gross vascular invasion of the vena cava or involvement of the caudate lobe by neoplasm might warrant its use. The three deaths experienced in the 67 patients having a standard hepatic resection were unique in each circumstance. One death was due to technical error which resulted in hepatic vein and vena caval tears at multiple sites when the caudate lobe and lateral segment of left lobe were being removed. A second death resulted from portal vein thrombosis secondary to a catheter which had been placed in the portal vein for postoperative infusional chemotherapy. The resection had been otherwise smooth and uneventful. The third death was in a patient who had a hilar node dissection and extended lobectomy for carcinoma of the gallbladder. An uneventful resection resulted in postoperative bleeding from coagulopathy and eventual death of the patient from liver insufficiency.

The decreased incidence of subphrenic abscess in the past three years appears to be a reflection of various factors. A large dead space after resecting large tumors invites this complication. A shortened operating time using the standard technique when compared with the isolation perfusion technique would appear to be an important factor in decreasing the incidence of subphrenic abscess. Another factor seems to be recent use of a closed system for drainage of the subphrenic space. Use of a Shirley sump having a Millipore filter tends to prevent entrance of airborne contaminants. The complications of pleural effusion and wound abscess were usually secondary to a subphrenic collection. A near fatal subclavian puncture and hydrothorax at surgery, secondary to placing a central venous line, was successfully reversed without prolonged ill effects.

The gratifyingly high survival figures for patients

with primary hepatoma confined to the liver are most encouraging. Nearly half of the patients with this cancer were resected for cure. Their actuarial survival was 88% at three years. Even the palliative resections had a good result with an actuarial survival rate of 31%. These results are undoubtedly a reflection, in part, of the type of cancer which was treated. Cirrhosis was considered a contraindication for major hepatic resection with only three patients being in this series.

The splenomegaly observed in 18% of patients preoperatively and 43% postresection is interesting. Hypersplenism was evident in only one patient postoperatively. Its cause is undetermined but may be due to hemodynamic changes secondary to tumor or resection. Compensating reticular hyperplasia might be a factor in postresection patients.

Twenty-four per cent of patients with hepatoma had elevated serum alpha feto protein preoperatively. After resection, it could not be detected in five patients. Two of these patients eventually developed recurrence but serum alpha feto protein could not be detected. Two other patients had a dramatic drop in titers. One of these had a palliative resection and one developed pulmonary metastasis two months after resection. CEA determinations were also useful in identifying metastatic colorectal cancer. About two-thirds of patients who had a liver resection had elevated titers. These returned to normal postresection in all but one patient tested postoperatively. This patient proved to have unrecognized persistent disease. These studies clearly show that tumor markers are valuable for clinical management of patients but they are not infallible. The data represent yet another indication of the biochemical and biological heterogeneity of a given cancer.

Metastatic colorectal cancer to the liver had an excellent survival rate when all disease in the liver could be encompassed by the resection, and there were no other sites of disease; the three year actuarial survival rate being 72% in this group. It would appear that although only six patients were resected with extrahepatic disease, palliative resection here does not appear to be generally indicated. No patient in this category lived as long as two years. About half (48%) of patients with resected colorectal metastasis had multiple metastatic lesions. These results can be compared with those reported by Attiyeh et al.,[2] on results of resection of metastatic olorectal cancer to the liver. They reported on 25 patients of whom 19 treated over a 26 year period had a wedge resection of metastatic colorectal cancer to the liver. The median size of the lesions was 1.5 cm, 84% were solitary lesions. The three year actuarial survival for this group was 56%, not significantly different from that of 48% where a major hepatic resection was carried out. This substantiates the concept that obligatory lobectomy is not necessary for metastatic disease; that resection of the metastasis with a margin of normal liver tissue is satisfactory. The decision to carry out a wedge resection or a formal lobectomy is decided by the size and location of the tumor. A large mass of metastatic cancer does not preclude cure.

The other types of cancer which were resected are too few in number to provide meaningful survival figures for the various individual primary cancers. Their overall survival rates were lower, however, reflecting a larger number of palliative resections.

The therapeutic effectiveness of adjuvant chemotherapy after hepatic resection cannot be evaluated since only four of 30 patients with primary liver cancer or metastatic colorectal cancer who had a curative resection have died of recurrent diseases. In the palliative resection group, two few patients have been treated for valid statistical analysis of the data.

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Discussion

Dr. Martin A. Adson (Rochester, Minnesota): I want to compliment Dr. Fortner on his accomplishment and his presentation and to agree with him by presenting briefly data that confirm his experience with malignant hepatomas.

(Slide) This first slide summarizes the results of my experience with resection of primary, solid liver tumors as of a year ago. On your left are the survival rates for resected primary hepatic malignancies, a 60% three-year survival and a nearly 40% five-year survival.

(Slide) On this next slide data are shown of comparative experiences before and since 1970, more than can be discussed in detail now. However, as the first line shows, there has been but one operative, hospital or early postoperative death. In the past year, nine additional major primary resections have been done for primary malignancy with no deaths, bringing the total for hepatomas to 35 cases.

I have had one additional postoperative death following a completion trisegmentectomy for recurrent tumor, done years after a right lobectomy. This is a sad and complicated story without time for telling, but has led me to believe that I will probably not try that operation again. However, clearly, an aggressive surgical approach to primary hepatic malignancies is justified by encouraging survival rates and acceptable operative risks, without resorting, as Dr. Fortner has said, to isolation-perfusion techniques. The extent of resection in our series is similar to Dr. Fortner's series.

Finally, I wanted to ask Dr. Fortner how aggressive we should be in dealing with larger metastatic hepatic tumors.

(Slide) Three years ago, we evaluated retrospectively survival following resection of colorectal metastases. Twenty patients who had multiple lesions removed were not benefited. However, of the forty patients who had apparent solitary lesions, most of which were removed at the time of the primary operation and 75% of which were two inches of less in diameter, 40% lived for five years and 28% lived for ten years after resection.

(Slide) Encouraged by this, we have taken a more aggressive approach to metastatic colorectal cancers, and in the past three years have done more than twenty *major* hepatic resections for larger metastatic lesions; many of these lesions have been detected some time after resection of the primary tumor, and many were symptomatic. There have been no operative deaths, but we have been disappointed to encounter either multiple lesions or extrahepatic spread in most of these cases, despite the use of angiographic techniques and computerized tomography.

I have two complicated slides tabulating early results which I will not burden you with, but they show that we will not know the result of our more heroic efforts for another year or so. However, we appear to be reaching a point of diminishing returns in our aggressiveness. I do have the feeling that we have helped significantly only about 15–20% of these patients with larger, symptomatic lesions. I'm interested to know Dr. Fortner's thoughts about management of these larger metastatic tumors.

Dr. John Terblanche (Cape Town, South Africa): I thought that I would remind the audience of the experience we have with black South African patients, in whom I believe this tumor is a different disease.

Almost all of the patients we see—and there are many of them—are inoperable. We have found peritoneoscopy useful in the investigation of these patients to prevent unnecessary laparotomies on a large group of patients who are inoperable. The majority of our patients have either multicentric disease throughout both lobes of the liver and this has usually been easily visible through the peritoneoscope, or severe associated cirrhosis. I would like to ask Dr. Fortner what his view is with regard to major resection of the liver in a patient who has severe cirrhosis.

The patients that we see in the black South African group are invariably dead within four to six months of the time of diagnosis. Almost all of them are young males who have been well until near the time of admission to hospital.

Of the major hepatic resections that we perform at Groote Schuur Hospital, the patients do not usually belong to this common group; they are the same type of patients that you are operating on here.

Dr. Richard E. Wilson (Boston, Massachusetts): I want to corroborate the fact that patients with colorectal cancer certainly deserve a chance at resection of metastases.

I'd like to direct two questions to Dr. Fortner. First, in such patients, when you talked of curative hepatic resection, did those include patients with multiple nodules as well as single nodules?

Second, what has been the pattern of recurrence after liver resection in these patients? Have the tumors recurred in the liver at the additional site, or have they recurred distantly?

Dr. Thomas Earl Starzl (Denver, Colorado): I've developed a personal series of hepatic resections, much smaller than Dr. Fortner's, but in agreement with many, although perhaps not all, of his points.

In 1975, the techniques that we used for hepatic resection were described in Surgery, Gynecology & Obstetrics employing careful hilar dissections and individual control of the hepatic veins, but with no special isolation-perfusion methods, which I think unnecessarily complicate the operation. We do not use the Lin-type clamps which some believe obviate the need for hilar dissection and control.

(Slide) We had 43 resections, abut half the size of Dr. Fortner's series. I draw your attention to the fact that almost half of these patients, 21 in all, have had extended right hepatic lobectomies (80% to 85% resection or trisegmentectomy). Nine and six, respectively, had true right and left lobectomies. Five had lateral segmentectomy and the rest were local excisions. There was no operative mortality.

We had a large number of trisegmentectomies because many of these patients were referred for liver transplantation after previous operation at which the lesions were thought to be nonresectable. In fact, the lesions could be removed with trisegmentectomy.

You will note that 11 of the 43 patients died two months to five years later of metastatic disease. However, the results in terms of control were encouraging, just as Dr. Fortner has indicated. Even of those patients who had localized hepatic metastases, five of nine are still alive after 2-½ to 3-½ years, and two of these five are free of all residual disease at follow-ups three years or later. When death occurs, after resection of isolated hepatic metastases, it tends to be from extrahepatic spread, to comment on Dr. Terblanche's question.

With primary hepatic malignancy, eight of 15 patients are alive, with follow-ups of one to 5-½ years, and seven of these eight patients have no evidence of residual disease. Thus, the figures from Dr. Fortner, those from Dr. Adson, and those which I am citing are all similar. They indicate that the pessimistic views about the