Hepatic Resection in the Elderly

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Between July 1, 1970 and December 31, 1988, 453 patients underwent hepatic resection by the senior author. Ninety of these patients were more than 64 years old and are the subject of this review. The 30-day operative mortality rate for all patients undergoing hepatic resection was 3.3%: major hepatic resection was 4.4% and subsegmental resection was 1.4%. The operative mortality rate for patients undergoing major hepatic resection increased incrementally with age: for patients up to age 55 years it was 0.70%, for those between 55 and 64 years it was 3.6%, and for patients older than 64 years it increased to 11.1%. This higher operative mortality rate in the elderly reflects the mortality rate for extended right hepatic lobectomy in this age group of 30.7%. If this procedure is excluded, the operative mortality rate for patients older than age 64 was 7.6%. Sixty per cent of the operative deaths were due to hepatic insufficiency. The data presented demonstrate that major hepatic resection can be performed in the elderly with a low but somewhat increased mortality risk. However, because of its markedly increased operative risk, extended right hepatic lobectomy should be performed in elderly patients only in selected cases until better methods of estimating hepatic reserve are available.

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The operative risk of hepatic resection for noncirrhotic livers is now generally low, with 5-year survival estimates for many hepatic neoplasms being relatively high (*i.e.*, stage I metastatic colorectal cancer 49%; stage I hepatocellular carcinoma 69%).[1,2] These advances in the 1980s have led to a need to consider candidates who might have been denied the procedure previously because of the presumed surgical risk in individuals who were older than their mid-sixties. The need is heightened by the apparent better health of older individuals today, and by a proportional increase of older individuals in the general population.

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Studies on age-related mortality rates for hepatic resection are rare. The overall mortality rate is about 5%, but patient ages have either not been reported in most studies or were a mean between 49 and 62 years.[3-7] One report linked age with postoperative abdominal infections.[8] A later study found no relationship with age but attributed an increased infection rate in older individuals to certain diseases associated with aging.[9] Two reports from Japan on the risks of hepatic resections for hepatocellular carcinoma in cirrhotic livers show an increased morbidity and mortality in patients older than 65 years.[10-11]

To better evaluate the possible effects of aging on recovery from hepatic resections, 453 consecutive hepatic resections performed by the senior author (JGF) at one institution during the past 18 years were reviewed. It became apparent during the review that an increasing number of patients in the series were more than 64 years of age (Fig. 1).

Materials and Methods

The data were derived from a review of the records of the 1199 patients undergoing hepatic surgery by the senior author between 1970 and 1988. Four hundred fifty-three individuals had hepatic resections, of which 231 were for metastatic colorectal cancer, 71 for noncolonic or primary biliary tract cancer, 60 for hepatocellular carcinoma, 33 for nonhepatocellular primary liver cancer, and 58 for benign disease. Ninety of the 344 patients who had a major hepatic resection were older than 64 years and are the subject of this review. Information was collected with regard to sex, age, diagnosis, preoperative evaluation, stage of disease, operative procedure, size of lesion, perioper-

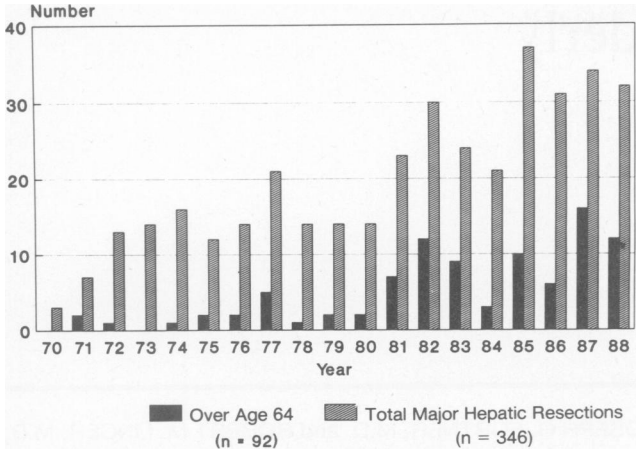

FIG. 1. Major hepatic resections in patients older than 64 years according to year of operation.

ative weight gain, operative blood loss, fluid replacement, postoperative complications, 30-day mortality rate, as well as long-term follow-up. Follow-up was complete in 93% of patients. Survival estimates were determined by the product limit (Kaplan–Meier) method. The operative technique has been previously described.[12] The data were analyzed for the group as a whole as well as for three different age groups: group I: ages 65–68 (n = 44); group II: ages 69–74 (n = 34); and group III: ages 75–82 (n = 14).

Results

The patients in the study group ranged in age from 65 to 82 years (mean, 69.9 years; median, 69 years). Fifty-eight patients were men (64.4%) and 32 were women (35.6%). There were 92 hepatic resections in 90 patients because 2 patients underwent a second resection at a later date. There were 45 right hepatic lobectomies, 11 left hepatic lobectomies, 20 lateral segmentectomies, 13 extended right lobectomies (trisegmentecomies), and 3 extended left lobe resections, with some being combined with other procedures (Table 1). Resections were performed for the following hepatic tumors: metastatic colorectal cancer (66); hepatoma (11); gallbladder cancer (4); breast cancer (2); cholangiocarcinoma (2); and once each for metastatic carcinoid, gastric carcinoma, renal cell carcinoma, embryonal sarcoma, hepatic abscess, hepatic cyst, and hemangioma.

Operative Mortality Rate

The 30-day operative mortality rate for patients undergoing hepatic resection was 3.3%: major hepatic resection was 4.4% and subsegmental resection was 1.4%. There was, however, an incremental risk with age. Patients up to 55 years of age had an operative mortality rate of 0.70% for major hepatic resection (Table 2). The rate increased to 3.6% in the group who were 55 to 64 years old. It was 11.1% in individuals older than 64 years.

Mortality rates in individuals older than 64 years varied with the magnitude of the operative procedure. Extended right hepatic lobectomy had an operative mortality rate of 30.7% (4 of 13 patients), left hepatic lobectomy had a rate of 9.1% (1 of 11 patients), right hepatic lobectomy had a rate of 8.9% (4 of 45 patients), and lateral segmentectomy had a rate of 5% (1 of 20 patients), and extended left hepatic lobectomy had a rate of 0% (none of 3 patients). The latter death was in a patient who underwent a lateral segmentectomy and subsegmental resection of the right lobe with removal of an infusaid pump as an emergency procedure for hemobilia.

The ten postoperative deaths were due predominantly to hepatic insufficiency after resection. Six patients (60%) died of this disorder, with three having undergone a tri-

TABLE 1. *Hepatic Resection Performed in Patients Older than Age 64 Between July 1, 1970 and December 31, 1988*

Operation	Age Group (years)		
	65–68 (Men/Women)	69–74 (Men/Women)	75–82 (Men/Women)
Right lobectomy only	18 (12/6)	12 (7/5)	8 (5/3)
Right lobectomy with			
Adjacent viscera	3 (0/3)	0	2 (0/2)
Left lateral segment	0	1 (1/0)	0
Subsegment	1 (1/0)	0	0
Extended right lobectomy (trisegmentectomy)	5 (4/1)	3 (2/1)	0
Extended right lobectomy with adjacent viscera	1 (1/0)	3 (1/2)	1 (0/1)
Left lobectomy	4 (4/0)	7 (7/0)	0
Extended left lobectomy	1 (1/0)	1 (1/0)	1 (0/1)
Lateral segmentectomy	9 (3/6)	6 (5/1)*	2 (0/2)
Lateral segmentectomy with subsegment right lobe	2 (2/0)†	1 (1/0)	0
Total	44 (28/16)	34 (25/9)	14 (5/9)

* Two patients had a right hepatic lobectomy initially with a lateral segmentectomy at a second operation.

† One patient had a lateral segmentectomy and resection of a subsegment with removal of an infusaid pump.

TABLE 2. *Age-Related Operative Mortality Rates for Major Hepatic Resection*

Age Group (years)	Operative Mortality Rate		
0–54	1/142 (0.70%)		
55–59	2/46 (4.3%)	4/112 = 3.6%	
60–64	2/66 (3.0%)		
65–69	6/53 (11.1%)	8/76 = 10.5%	10/90 = 11.1%
70–74	2/23 (8.6%)		
75–82	2/14 (14.3%)		

segmentectomy, two a right hepatic lobectomy, and the sixth underwent emergency lateral segmentectomy as described above. Their preoperative liver function tests were normal or minimally deviated (Table 3). Examination of nontumor portions of their resected livers revealed essentially normal findings in five patients with grossly fatty liver in the sixth. One individual died of a myocardial infarction. He had no previous cardiac history and a normal preoperative electrocardiogram. He developed a fatal myocardial infarction 12 hours after uneventful surgery. Postmortem examination revealed 90% stenosis of four cardiac vessels. Two other patients died of pneumonia and one of massive gastrointestinal bleeding.

Complications

The most common nonfatal complications were of cardiac origin. These occurred in 10 patients (12%; Table 4). Symptomatic pleural effusions developed in five patients. Transient jaundice and subphrenic abscess each occurred in four patients (4.3%), and pneumonia occurred in two.

Operative Blood Loss and Fluid Replacement

Patients who died within the 30-day postoperative period and those patients who survived were not significantly different with regard to estimated blood loss (3442 cc +/− 1919 cc *vs.* 2297 cc +/− 2123 cc), crystalloid (4305 cc +/− 2069 cc *vs.* 3005 cc +/− 1644 cc), and blood replacement (3180 cc +/− 2581 cc *vs.* 2654 cc +/− 2662 cc). Peak mean serum bilirubin levels were significantly higher in the postoperative mortality group (17.6 mg/dL +/− 16.0 mg/dL on postoperative day 9) when compared to the group that survived (4.3 mg/dL +/− 3.1 mg/dL on postoperative day 2) ($p < 0.00001$).

Length of Hospitalization

The mean postoperative hospitalization for patients older than 64 years was 15.1 +/− 9.3 days. This has lessened since 1983 to 12.8 +/− 5.2 days for elderly patients.

TABLE 3. *Postoperative Death from Hepatic Failure*

		Preoperative Laboratory Values				
Patient Data and Procedure	HBsAg	Bilirubin 0–1.0 mg/dL	Alk Phos 1–115 U/L	SGOT 0–25 U/L	Albumin 4.0–5.2 gd	LDH 60–200 U/L
Pt. 1, 66 F Extended right Gallbladder CA	−	0.5	74	16	4.6	160
Pt. 2, 69 M Right lobe Metastatic colon CA	−	0.5	101	14	4.2	239
Pt. 3, 69 M Extended right Metastatic colon CA	+	0.4	164	25	4.6	209
Pt. 4, 67 M Extended right Metastatic colon CA	+	0.4	146	142	4.2	324
Pt. 5, 74 M Lat. segment, right subsegment, removal infusaid pump Metastatic colon CA	−	1.0	381	53	3.2	206
Pt. 6, 67 F Right lobe Metastatic colon CA	+	0.5	76	25	4.8	163

Pt., patient; CA, ; SGOT, serum glutamic oxaloacetic transaminase; Alk Phos, alkaline phosphate; LDH, lactic dehydrogenase.

TABLE 4. *Nonfatal Complications*

Complication	Number of Patients
Cardiac	
Arrhythmias	5
Congestive failure	4
Myocardial infarction	1
Pleural effusion	5
Temporary jaundice	4
Subphrenic abscess	4
Pneumonia	2
Wound infection	2
Phlebitis	2
Pulmonary embolism	2
Intraperitoneal hemorrhage	2
Postoperative confusion	2
Biliary fistula	1
Colocutaneous fistula	1
Brachial plexus injury	1
Slow return of pulmonary function	1
Sepsis	1
Electrolyte imbalance	1
Thrombocytopenia	1
Coagulopathy	1
Prolonged ileus	1

Survival

The survival estimate for patients older than age 64 years is presented in Figure 2. The 5-year survival estimates for the various types of resection were lateral segmentectomy, 55%; extended right hepatic lobectomy, 40%; right hepatic lobectomy, 28%; and left hepatic lobectomy, 19%.

Discussion

Age proved to be a major determinant of mortality in this series of 453 hepatic resections. These procedures are safe up to age 65, with an operative mortality rate of 2.0% in 254 patients. The rate increased to 11.1% in patients 65 years of age or older, but was 7.6% if extended right hepatic lobectomy (trisegmentectomy) were avoided. These rates appear acceptable but they must be evaluated in an effort to improve the results.

Preoperative evaluation of the 90 individuals who were older than 64 years showed that only 14 patients had cardiac disease. This was treated to bring the patients into the best possible condition before operation. Only 11 patients (12.2%) developed cardiac complications after operation. Most were atrial fibrillation or supraventricular tachycardia and responded promptly to treatment. Two fatal myocardial infarctions occurred. One was fatal in a 76-year-old man who was asymptomatic and had a normal electrocardiogram before operation and an uneventful right hepatic lobectomy. The other, a nonfatal infarction, was in a patient who had a long history of cardiac disease, including a myocardial infarction, but required emergency surgery for hemobilia.

The overall incidence of infectious complications was 10% (9 of 90 patients). These included 4 subphrenic abscesses, 4 pneumonia, 2 wound infections, and 1 case of sepsis treated successfully with broad spectrum antibiotics. Most of the subphrenic abscesses occurred early in the series before closed drainage was used. This advance, when used in combination with meticulous hemostasis and prevention of bile leaks, has made subphrenic abscess a rare complication. The incidence of pneumonia in this series mandates renewed efforts to maintain pulmonary toilet, particularly in the older patients. Other infections appear to be at an irreducibly low frequency.

Fatal postoperative hepatic failure occurred in six patients, which accounts for more than one half of the postoperative deaths. Hepatic failure was manifest as hepatorenal syndrome in one individual and as progressive cholestatic icterus in five patients. This type of cholestatic icterus previously has been called posthepatectomy idiopathic cholestatic icterus.[12] Three patients with this condition underwent extended right hepatic lobectomy, one had a right hepatic lobectomy, and the fifth underwent emergency lateral segmentectomy with subsegmental resection of the right lobe and removal of an infusaid pump for hemobilia. Preoperative evaluation of the liver in these patients revealed normal or minimally elevated screening profiles (Table 3). Special liver function tests were not used. Gross examination at laporatomy revealed normal findings, except in one patient with a grossly fatty liver.

Hepatic failure in patients older than 64 years undergoing hepatic resection may be a reflection of less functional reserve and possibly a decreased ability to regenerate in the older liver. This could result in diminished capacity to tolerate the stresses of surgery, including hypovolemia, anesthesia, hypotension, or sepsis. Functionally there is pharmacokinetic evidence in elderly patients for a reduction in the metabolism of drugs metabolized by oxidation, but not those metabolized by conjugation. Separate from a decrease in hepatic blood flow there appear to be alterations in intrinsic hepatic clearance, which may result in

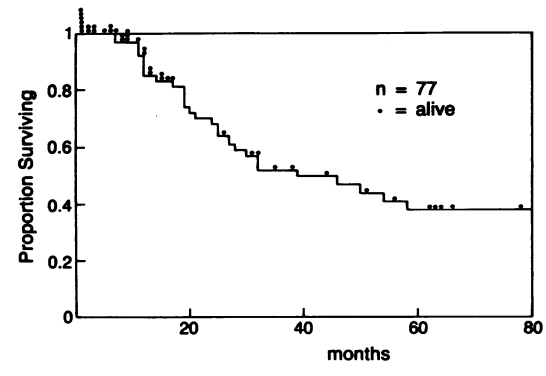

FIG. 2. Survival after major hepatic resection in patients with malignant disease who were older than 64 years.

altered first pass clearance and therefore changes in bioavailability.[13]

It is difficult to separate the cumulative effects of smoking, alcohol, and other possible adverse life style practices from those of aging alone. Associated medical illnesses, for example, infection, congestive heart failure, and diabetes mellitus may have an adverse effect. It is known that the relative weight of the liver to total body weight falls from approximately 4% in the neonate to approximately 2% in the elderly. The absolute weight of the liver also decreases throughout adult life. Blood flow also decreases with advancing age, in part, corresponding to this decrease in liver weight, but also as a result of the decrease in cardiac output with advancing age.[14]

Diminished hepatic reserve seems to be reflected in the finding that in the elderly, extended right hepatic lobectomy was the procedure with the highest operative mortality rate (30.7% [4 of 13 patients]). If extended right lobectomy had not been performed, the operative mortality rate would have been 7.6% (6 of 79 patients), which is comparable to the reported operative mortality rate of 5.8% for other major abdominal procedures in patients older than 65 years.[15] However this must be balanced against a 5-year survival estimate for extended right lobectomy of 40% (Fig. 1). Routine liver function tests have not predicted liver failure and they may be normal or show minimal deviations in spite of a decreased hepatic reserve. Better methods of estimating hepatic functional reserve, particularly in the elderly, are needed before trisegmentectomy should be done routinely in individuals who are 65 years or older.

The data presented here demonstrate that major hepatic resection can be performed with a low but somewhat increased risk of postoperative death in patients older than 64 years. This risk is commensurate with that for lesser major operative procedures. There is a markedly increased risk for trisegmentectomy and this procedure should be performed with caution until reliable methods of estimating hepatic reserve have been established. The 5-year survival estimate for patients older than 64 years undergoing hepatic resection for all types of tumors is about 40%, with an even better survival estimate for selected tumors.

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