

Preoperative Determination of Operability in Carcinomas of the Pancreas and the Periapillary Region

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DESPITE the development of new diagnostic methods such as splenoportography, selective angiography, the radioisotope scintigram and exocrine function tests of the pancreas, the early diagnosis of pancreatic carcinoma is still a dream of surgeons. At the present time, it is to be stressed, therefore, that every attempt should be made to make a correct diagnosis as early as possible and to choose the best treatment available. The purpose of the present report is to study factors affecting the operability of carcinoma of the pancreas in relation to clinical signs and laboratory findings. It is also believed appropriate to discuss the feasibility of surgical treatment of carcinoma of the head of the pancreas with severe jaundice.

Materials

From the beginning of 1950 to October, 1967, 201 malignant lesions, that is, 150 patients with periapillary carcinoma and 51 with carcinoma of the body and tail of the pancreas were operated upon at our department (Table 1). The term "periapillary carcinoma" is used here in a wide sense and includes carcinoma of the head of the pancreas, of the intrapancreatic bile duct and of the papilla of Vater. As shown in Table 1, the origin or exact location of carcinoma was confirmable in 105 patients but not in 45 in whom the lesion was too far advanced. Among 201 patients, the lesion could be resected in 66 instances of peri-

apillary carcinoma, and in only six of carcinoma of the body and tail of the pancreas. Among periapillary carcinomas, the resectability rate was 38 per cent in carcinoma of the head of the pancreas, 75 per cent in carcinoma of the intrapancreatic bile duct and 87 per cent in carcinoma of the papilla of Vater.

Results

1. Operability Viewed from Clinical Symptoms

The common subjective symptoms of periapillary carcinoma were jaundice, anorexia and upper abdominal pain. In carcinoma of the body and tail of the pancreas, abdominal pain was the most frequent symptom, being present in 90 per cent of cases, and anorexia was complained of by more than half the patients. In periapillary carcinoma, abdominal pain was most frequent in carcinoma of the head of the pancreas, and jaundice was most frequent in carcinoma of the intrapancreatic bile duct.

1) *Abdominal Pain and Resectability.* In 150 cases of periapillary carcinoma, abdominal pain was absent in only 40 (27%), while the remaining patients suffered from pain which was severe in 28 (19%). In 51 instances of carcinoma of the body and tail, abdominal pain was absent in only two (4%). As shown in Table 2, the lesion could be resected in 26 (65%) out of 40 patients with periapillary carcinoma without pain, but in 32 (39%) out of 82

TABLE 1. Cases Operated in Our Department

	No. of Cases	No. of Resected Cases	Re-sectability Rate (%)
Periampullary carcinoma	150	66	44
Carcinoma of the head of the pancreas	42	16	38
Carcinoma of the intra-pancreatic bile duct	40	30**	75
Carcinoma of the papilla of Vater	23	20	87
Uncertain*	45	0	0
Carcinoma of the body and tail of the pancreas	51	6	12
Total	201	72	36

* Advanced tumors with unknown original location.

** Includes two patients who underwent excision of the ampulla of Vater.

with dull pain and only eight (29%) out of 28 with severe pain. With carcinoma of the body and tail of the pancreas, only four out of 45 patients who complained of pain, that is less than 9 per cent, were eligible for resection. In patients with carcinoma of the head of the pancreas, the carcinoma was resectable in six of nine without pain, but in only eight of 26 with mild pain and in two of seven with severe pain. On the other hand, in patients with carcinoma of the intrapancreatic bile duct and of the papilla of Vater, carcinoma could be resected in the majority regardless of the presence or absence of pain. In two patients with carcinoma of the body and tail without pain, carcinoma was resectable in both.

2) *Duration of Illness and Resectability.* When resectability of carcinoma of the pancreas was studied in relation to the duration of symptoms such as abdominal pain, jaundice or anorexia, it was found that resectability rate was lower when the duration of illness was more than 6 months than when the duration of illness was less than 6 months. As shown in Table 3, cases of

TABLE 2. Degree of Pain and Resectability

	Severe Pain	Mild Pain	None
Periampullary carcinoma	28 (8)	82 (32)	40 (26)
Carcinoma of the head of the pancreas	7 (2)	26 (8)	9 (6)
Carcinoma of the intrapancreatic bile duct	5 (4)	20 (15)	15 (11)
Carcinoma of the papilla of Vater	3 (2)	11 (9)	9 (9)
Uncertain	13 (0)	25 (0)	7 (0)
Carcinoma of the body and tail of the pancreas	6 (0)	39 (4)	6 (2)
Total	34 (8)	121 (36)	46 (28)

Numbers in parentheses indicate resected cases.

carcinoma of the intrapancreatic bile duct and of the papilla of Vater had similar resectability trends with the duration from 3 to 6 months and with the duration less than 3 months. However, in carcinoma of the head of the pancreas, resectability was relatively high, 56 per cent when the duration was less than 3 months, but only 11-13 per cent when the longer duration was more than 3 months.

3) *Palpable Tumor and Resectability.* An analysis was made of the relationship between resectability of carcinoma and presence of a palpable tumor (excluding gallbladder) in the abdomen (Table 4). Among patients with periampullary carcinoma, resection was done in 59 (53%) of 111 in whom a tumor was not palpable, but in only seven (18%) out of 39 with palpable tumors. With carcinoma of the head of the pancreas, resection was possible in two of 13 patients with palpable tumors while in carcinoma of the intrapancreatic bile duct and of the papilla of Vater, carcinoma could be resected in five of eight patients with palpable tumors. In carcinoma of the body and tail of pancreas with a palpable tumor, tumor could be resected

TABLE 3. *Duration of Illness and Resectability*

	- 3 Ms.	3 - 6 Ms.	6 Ms. -
Carcinoma of the head of the pancreas	25 (14)	9 (1)	8 (1)
Carcinoma of the intrapancreatic bile duct	23 (19)	8 (6)	9 (5)
Carcinoma of the papilla of Vater	6 (5)	13 (13)	4 (2)
Total	54 (38)	30 (20)	21 (8)

Numbers in parentheses indicate resected cases.

TABLE 4. *Palpation of Tumors and Resectability*

	Palpable	Not Palpable
Periampullary carcinoma	39 (7)	111 (59)
Carcinoma of the head of the pancreas	13 (2)	29 (14)
Carcinoma of the intrapancreatic bile duct	3 (2)	37 (28)
Carcinoma of the papilla of Vater	5 (3)	18 (17)
Uncertain	18 (0)	27 (0)
Carcinoma of the body and tail of the pancreas	41 (4)	10 (2)
Total	80 (11)	121 (61)

Numbers in parentheses indicate resected cases.

in four patients of whom three had cysto-adenocarcinoma.

2. Operability Viewed from Laboratory Findings

1) *Splenoportography*. Splenoportography was performed in 74 cases, in which stenosis or invasion of the splenic vein was demonstrated in 19, occlusion in 19 and compression or displacement in three. As shown in Table 5, resection was impossible in all the 22 patients with periampullary carcinoma who had abnormal portographic findings, but resection was possible in 19 out of 30 without abnormalities in portography. In patients with carcinoma of the

TABLE 5. *Splenoportographic Findings and Resectability*

	Positive	Negative
Periampullary carcinoma	22 (0)	30 (19)
Carcinoma of the head of the pancreas	11 (0)	7 (3)
Carcinoma of the intrapancreatic bile duct	2 (0)	12 (8)
Carcinoma of the papilla of Vater	0	8 (8)
Uncertain	9 (0)	3 (0)
Carcinoma of the body and tail of the pancreas	21 (3)	1 (0)
Total	43 (3)	31 (19)

Numbers in parentheses indicate resected cases.

head of the pancreas, resection was not possible in four of seven even though there were no abnormalities in portography. It would seem, therefore, that portography does not help in accurate prediction of resectability in carcinoma of the head of the pancreas. On the other hand, the lesions could be resected in nearly all patients with carcinoma of the intrapancreatic bile ducts and of the papilla of Vater when portography revealed no abnormality. In 21 cases of carcinoma of the body and tail of the pancreas with abnormalities in portography, resection was possible only in three.

2) *Selective Celiac Angiography*. Selective celiac angiography was performed in 35 cases to show morphological changes of vessels near the tumor. Narrowing of vessels was shown in 17 cases, hypervascularity in 12, tortuosity of vessels in 11, compression or displacement of vessels in 10, irregularity in width of vessels in seven, invasion of vessels in five, stretching of vessels in five.

Resectability in relation to the findings of selective celiac angiography was as follows (Table 6). Nineteen of 23 cases of periampullary carcinoma showed abnormalities. Of these, tumor was resectable in only

four in which angiography did not show any abnormalities. Among cases in which angiography showed abnormalities limited to the superior pancreaticoduodenal artery, carcinoma was resectable in four, but in those with abnormalities in other arteries, the lesions could not be resected in any instance.

As shown in Table 6, carcinoma was resectable in no case of carcinoma of the head of the pancreas with abnormalities in angiography. In carcinoma of the intrapancreatic bile duct and of the papilla of Vater, abnormalities were limited to the superior pancreaticoduodenal artery and the tumors were resectable in all. On the other hand, in carcinoma of the body and tail of the pancreas, three tumors were resectable among 13 cases in which angiography showed abnormalities in the splenic or dorsal pancreatic arteries, but resection was possible in no case in which abnormalities were found in the common hepatic, gastroduodenal or superior pancreaticoduodenal arteries. It would be inferred, therefore, that carcinoma of the pancreas is not resectable when angiography shows abnormalities in the common hepatic or gastroduodenal arteries.

3) *Percutaneous Transhepatic Cholangiography.* Forty-two patients were subjected to percutaneous transhepatic cholangiography. Linear type obstruction was seen in six, U-type obstruction in seven and V-type obstruction in 25. There was no evident relationship between the type of obstruction and resectability. The distance between the junction of hepatic ducts and the site of obstruction, however, were of marked significance. Of the 26 instances in which the tumors were resectable, this distance was more than 5 cm. in 22 (85%). On the other hand, of 42 cases which were not resectable in more than half (64%) the distance was less than 5 cm. and palliative or exploratory operations were performed (Fig. 1). It may be stated, therefore, that the longer the distance between the junction of hepatic ducts and the site of obstruction, the more it is likely that the carcinoma is resectable.

4) *Combined Diagnostic Method.* Other diagnostic procedures including exocrine function test of the pancreas was performed in addition to those mentioned.⁷ By combining several diagnostic methods, we could define as nearly as possible, not only the site of carcinoma but also its resectability.

TABLE 6. *Celiac Angiographic Findings and Resectability*

	No. of Cases	Positive Findings	Site of Abnormality				
			A.h.c.	A.g-d	A.p.s.	A.l.	A.p.d.
Periampullary carcinoma	23 (8)	19 (4)	3	9	18 (4)	3	5
Carcinoma of the head of the pancreas	12	12 (0)	1	6	11	3	5
Carcinoma of the intrapancreatic bile duct	3	1 (1)			1 (1)		
Carcinoma of the papilla of Vater	5	3 (3)			3 (3)		
Uncertain	3	3 (0)	2	3	3		
Carcinoma of the body and tail of the pancreas	12	12 (3)	2	6	9	6 (3)	7 (3)

Numbers in parentheses indicate resected cases.

A.h.c.: A. hepatica communis, A. g-d: A. gastroduodenalis, A.p.s.: A. pancreaticoduodenalis superior, A.l.: A. lienalis, A.p.d.: A. pancreatica dorsalis.

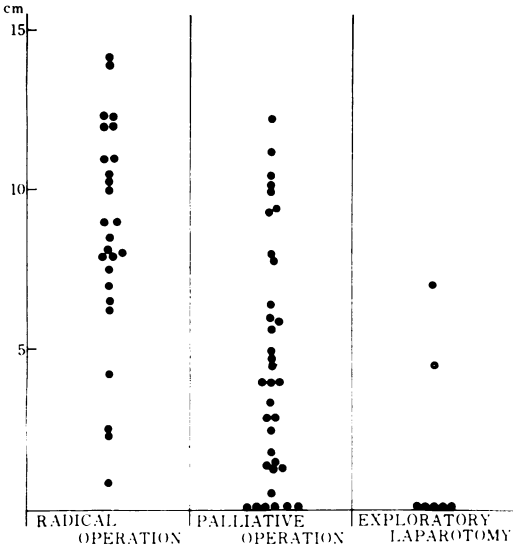


FIG. 1. Resectability in relation to the distance between junction of both hepatic ducts and site of obstruction in percutaneous cholangiography.

Among these procedures, cholangioportography⁷ in which cholangiography and portography are performed at the same time is of help in predicting resectability of the carcinoma. There seems to be a correlation between the shortest distance from the site of bile obstruction to the portal vein and resectability. As shown in Fig. 2, the distance was more than 2 cm. in seven of 11 instances in which carcinoma was resectable, whereas when palliative operation was merely possible, the distance was less than 1 cm. There were four patients in whom only palliative operation could be performed although the distance was more than 2 cm. It is to be noted, however, that resection was impossible not because of local extension of carcinoma but because of presence of metastases to the liver or to lymph nodes. It would seem, therefore, justified to state that resection is likely to be possible when the shortest distance between the site of bile duct obstruction and the portal vein exceeds 2 cm. Figures 3 and 4 illustrate cases in which carcinoma could be resected. In these patients there was ample space between the site of bile duct

obstruction and the portal vein, and there was no infiltration into the portal vein. In cases illustrated in Figs. 5 and 6, there was no tumor invasion of the portal vein but the distance between the site of bile duct obstruction and portal vein was too short to permit resection.

When resectability was predicted on the basis of cholangioportography and angiography, the prediction was correct in 88 per cent of cases of carcinoma of the head of the pancreas and in more than 90 per cent of cases of carcinoma of the intrapancreatic bile duct and of the papilla of Vater (Table 7).

3. Indications for Surgical Treatment in Patients with Severe Jaundice

1) *Jaundice and Operative Mortality.* The relationship between icterus index and operative mortality rate in malignant lesions of the biliary tract is presented in Table 8. The mortality rate was about 10 per cent with the icterus index less than

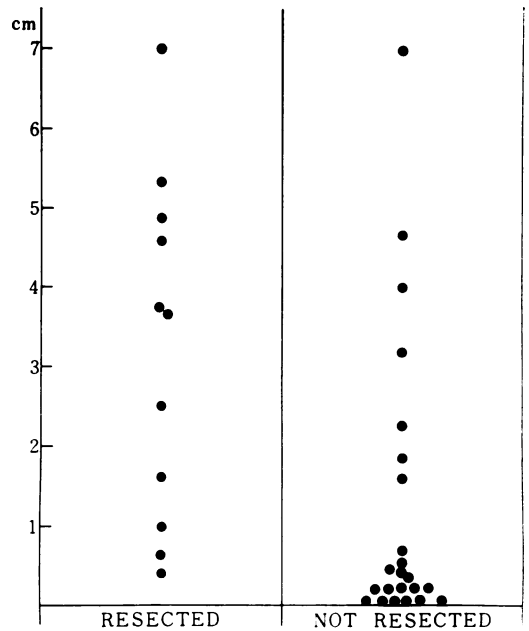


FIG. 2. Resectability in relation to the distance between portal vein and site of obstruction of bile duct in cholangioportography.

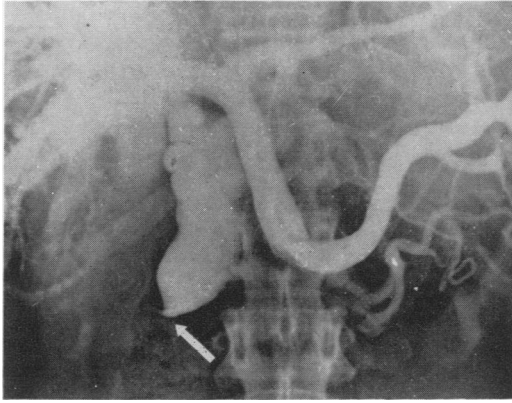


FIG. 3. Cholangiography of a 49-year-old woman with painless jaundice of 5-month duration. There is ample space between the site of common bile duct obstruction (arrow) and the portal vein. Carcinoma of the papilla of Vater could be resected by pancreatoduodenectomy.

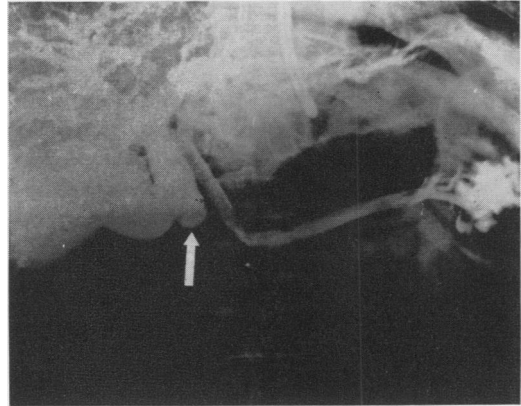


FIG. 5. Cholangiography of a 64-year-old man with jaundice of 3-week duration. The distance between the site of common bile duct obstruction (arrow) and portal vein is too close to be resected. Carcinoma of the head of the pancreas could not be resected.

30 and 30 per cent with the index over 30. In patients with an icterus index more than 80, higher mortality rate was encountered even though less stressful operative procedures such as intrahepatic cholangio-enterostomy or external biliary drainage were performed (Table 9). The causes of death were purulent peritonitis due to impaired pancreatico-jejunostomy in 15, general debilitation in 19 and hepatic insufficiency in nine. In eight, the death was attributed to

acute gastrointestinal hemorrhage due to stress ulcer or other lesions.

2) *Criteria in Treatment of Periampullary Carcinoma.* In view of the significance of jaundice as a factor affecting operative results, since 1960 we have adopted a two-stage operation for patients with icterus index above 80. As previously reported,⁵ the operation consists of simple cholecystostomy to relieve jaundice to minimize manipulation, and then subsequent pan-

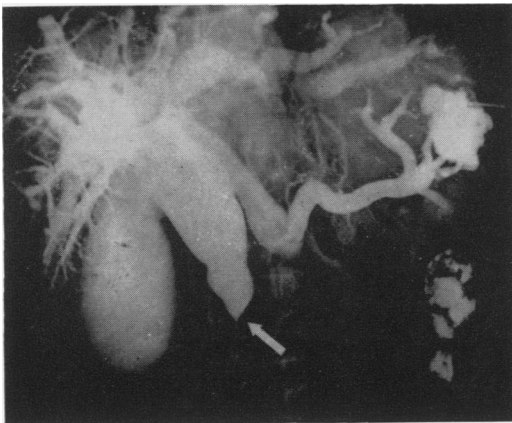


FIG. 4. Cholangiography of a 63-year-old woman with jaundice of 3-month duration. The site of common bile duct obstruction (arrow) is definitely separated from portal vein that is free of invasion. Carcinoma of the head of the pancreas could be resected.



FIG. 6. Cholangiography of a 52-year-old man with epigastric pain and jaundice of 5-month duration. The site of common bile duct obstruction (arrow) is in direct contact with portal vein. Carcinoma of the head of the pancreas was not resectable.

TABLE 7. *Diagnostic Accuracy of the Combined Method as to Resectability*

	No. of Cases	Correct Diagnosis	
		No.	%
Carcinoma of the head of the pancreas	16	14	88
Carcinoma of the intra-pancreatic bile duct	14	13	93
Carcinoma of the papilla of Vater	10	9	90
Uncertain	4	4	100
Total	44	40	92

creatoduodenectomy. Results of one-stage and two-stage operations are shown in Table 10. The mortality rate was 38 per cent (18 of 47) after one-stage operations, and 12 per cent (two of 17) after two-stage operations. Particularly, during the past 8 years only three of 31 patients (9.7%) have died after two-stage operations (Table 11).

In staged operations there seems to be a correlation between reduction of icterus

TABLE 8. *Icterus Index and Operative Mortality*

Icterus Index	10-30	30-80	80-150	150-
Carcinoma of the gallbladder	0/3	3/7	7/14	3/4
Carcinoma of the pancreatic bile duct	0/2	3/9	18/32	3/11
Carcinoma of the head of the pancreas	0/1	3/9	10/18	3/3
Carcinoma of the intrapancreatic bile duct	1/4	4/11	7/17	3/7
Carcinoma of the papilla of Vater	0/2	1/8	4/8	0/1
Uncertain	1/6	2/7	6/17	5/8
Total	2/18	16/51	52/106	17/34
Mortality rate (%)	11.1	31.3	49.0	50.0

No. of deaths/No. of operated cases.

index after preliminary external biliary drainage and prognosis after the second operation. The change of icterus index after external biliary drainage is illustrated in Fig. 7. In the majority of cases, the icterus index decreased considerably after external biliary drainage. In two, however, there was no appreciable change. One of these two patients died after second stage radical operation and the other died after palliative cholecystojejunostomy. In the latter, as illustrated in Fig. 8, histologic study of the liver showed a large number of pseudo-bile-ducts with fibrosis within the Glisson's sheath and bile plugging the perilobular areas indicating intrahepatic cholestasis.

Comment

Upper abdominal pain is the most frequent symptom in periampullary carcinomas and may appear as the initial sign of this disease.^{3, 4, 6, 9} In our study, abdominal pain was also the most frequent symptom in carcinomas of the head of the pancreas whereas jaundice was most frequent in carcinomas of the intrapancreatic bile duct. Abdominal pain was present in 90 per cent of cases of carcinoma of the body and tail of the pancreas. Of the total periampullary carcinomas, 19 per cent of patients complained of severe abdominal pain. The resectability rate of periampullary carcinoma was 65 per cent without pain, but 39 per cent with dull pain and only 29 per cent with severe pain. Thus, it is to be noted that resection is frequently impossible in periampullary carcinomas associated with abdominal pain. Warren *et al.*⁹ reported that abdominal pain was present in 73 per cent of periampullary carcinomas in which resection was possible, and in higher percentage in which resection could not be performed.

Concerning the duration of illness, there was no appreciable difference in resectability rate between cases when the duration of illness was less than 3 months and when the duration was between 3 and 6

months in carcinomas of the intrapancreatic bile ducts and of the papilla of Vater. Contrarily, in carcinomas of the head of the pancreas, resectability rate was 56 per cent when the duration was less than 3 months in contrast to 11-13 per cent when the duration was more than 3 months. Resection is likely to be impossible in patients with carcinoma of the head of the pancreas when the duration of illness exceeds three months.

Splenoportography is a valuable diagnostic procedure not only for assessing lesions of the portal system but also for predicting operability of malignant tumors in the upper abdomen. Glenn *et al.*³ pointed out the value of portography in predicting resectability of carcinomas of the head of pancreas. In our experience, the lesion was not resectable in all periampullary carcinomas in which portography showed abnormalities. In four of seven carcinomas of the head of the pancreas resection was not possible even though portography did not disclose any abnormalities. On the other hand, in the majority of carcinomas of the intrapancreatic bile ducts and of the papilla of Vater, resection was possible when portography did not show remarkable abnormalities. It seems, therefore, that resectability is not predictable in carcinomas of the head of the pancreas on the basis of portography alone, and it is necessary to combine direct cholangiography, that is so-called cholangiportography. In carcinomas of the body and tail of the pancreas, resection was possible in only a few instances when there were abnormalities shown by portography.

We previously reported on the usefulness of selective celiac angiography in the diagnosis of carcinoma of the pancreas.⁷ This procedure was employed in the total of 35 cases of carcinoma of the pancreas. When there was no abnormality in angiography, resection was possible in all carcinomas of the head of the pancreas. When angiography showed abnormalities in the common

TABLE 9. Method of Operation and Operative Mortality of Cases with Severe Jaundice

	No. of Cases	No. of Deaths	Mortality Rate (%)
Curative Operation	49	21	43
Anastomosis between extra-hepatic biliary system and gastrointestinal tract	35	14	40
Hepato-jejunostomy or -gastrostomy	19	11	58
External drainage operation	20	14	70
Exploratory laparotomy only	11	8	73

hepatic artery or in the gastroduodenal artery, however, resection was impossible both in periampullary carcinomas and carcinomas of the body and tail of pancreas.

In malignant lesions of the biliary tract, percutaneous transhepatic cholangiography shows obstruction of the linear, U- or V-types. In the present series, the linear type

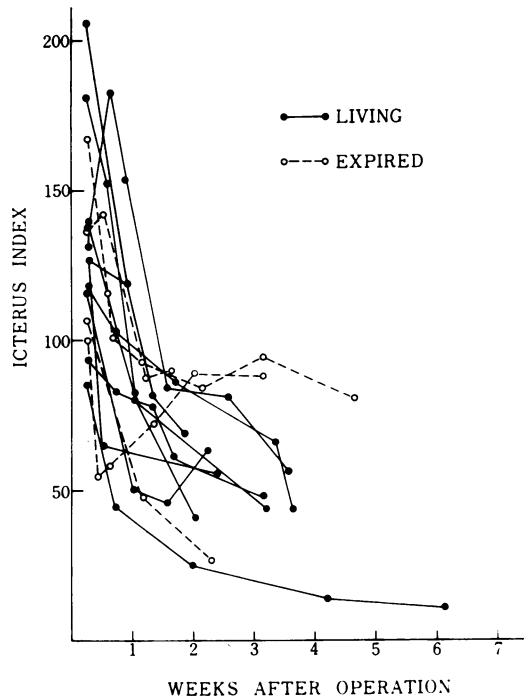


FIG. 7. Icterus index following external biliary drainage.

was seen in 6 cases, U-type in 7 and V-type in 25 among 38 cases in which this method was employed. As previously reported,⁷ there was no definite relationship between the type and the site of an obstruction. It was found that the distance between the junction of both hepatic ducts and the site of obstruction had a bearing upon resectability. In general, when the distance is more than 5 cm., chances for radical resection are enhanced.

As reported previously,⁷ we employ combined diagnostic technics of percutaneous transhepatic cholangiography, portography, selective celiac angiography and exocrine function tests of the pancreas in defining the site of obstruction in cases of jaundice due to possible malignant tumor. Among

these technics, the most useful media for predicting resectability is cholangiography in which percutaneous cholangiography and portography are performed at the same time. Our results of cholangiography suggest that if the distance between the site of biliary tract obstruction and the portal vein is more than 2 cm., resection is likely possible.

When angiography is interpreted in combination with cholangiography, resectability can be more accurately predicted. In our experience, predictions based upon these technics were correct in 88 per cent of carcinomas of the head of the pancreas and in more than 90 per cent of carcinomas of the intrapancreatic bile ducts and the papilla of Vater.

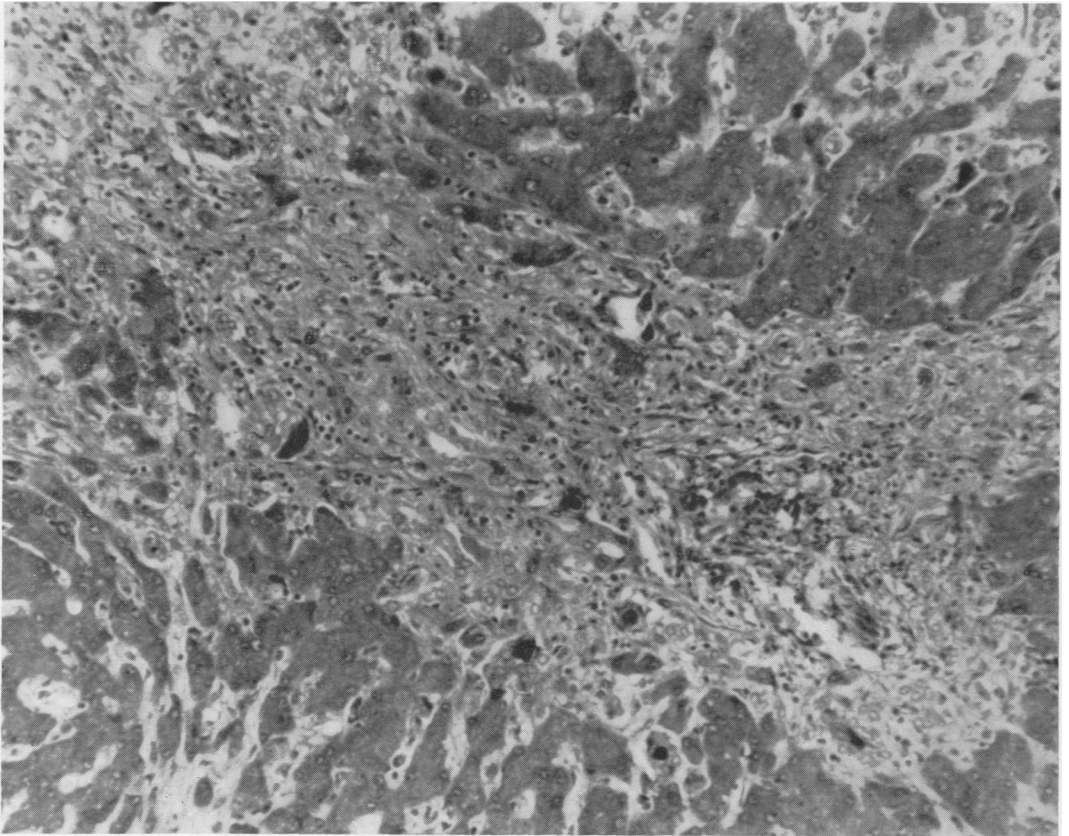


FIG. 8. Photomicrograph of liver of case (56-year-old man) died after cholecystojejunostomy. Note fibrosis with a large number of pseudo-bile-ducts within the Glisson sheath and bile plugging in the perilobular area.

TABLE 10. *Operative Mortality of Pancreatoduodenectomy*

	One-stage Operation			Two-stage Operation		
	No. of Cases	No. of Deaths	Mortality Rate (%)	No. of Cases	No. of Deaths	Mortality Rate (%)
Carcinoma of the head of the pancreas	13	6	46	3	0	0
Carcinoma of the intra-pancreatic bile duct	19	9	47	9	1	11
Carcinoma of the papilla of Vater	15	3	20	5	1	20
Total	47	18	38	17	2	12

Concerning operative mortality of icteric patients, it was reported that the risk was high in direct proportion to elevation of icterus index.⁵ Malignant tumors of the biliary tract showed a mortality rate as high as 50 per cent when the icterus index was more than 80. Extreme care should be exercised, therefore, in operations with severe jaundice. It has been our practice since 1960 to perform pancreatoduodenectomy in two stages when the icterus index is more than 80; the head of the pancreas is resected in a second stage operation after jaundice has been decreased by simple cholecystostomy.⁵

The result of pancreatoduodenectomy is generally poor. A postoperative mortality rate of about 20 per cent is usually reported from most medical centers with better results from the Lahey Clinic.^{1, 2, 4, 6, 9, 10} Since adopting the two-stage operation, only three of 31 (9.7%) postoperative deaths occurred in the past 8 years. Up to the present, pancreatoduodenectomy has usually been carried out in one stage. Warren *et al.*⁹ and Mongé *et al.*,⁶ however, pointed out that two-stage operations give better results in certain cases. Amelioration of hypoproteinemia, improvement in the nutritional state and decrease in bleeding tendency as the result of the first stage operation seem to have a beneficial effect in preventing rupture of anastomoses and postoperative complications. Better results

of pancreatoduodenectomy are to be expected if appropriate measures are taken to decrease jaundice prior to radical operation.

Patients are frequently encountered in whom jaundice does not decrease after internal biliary drainage and occasionally after external biliary drainage. We have seen two patients in whom no appreciable changes of icterus index followed external biliary drainage performed in preparation for pancreatoduodenectomy. One patient died after pancreatoduodenectomy and the other after cholecysto-jejunostomy. Persistence of jaundice after biliary drainage was studied by Takahashi and Hayama⁸ and seems relevant. Serial sections of the liver of cholangiolitic hepatitis showed interruption at the site between bile capillaries and bile canaliculi in Glisson's sheath. This finding offers a morphological explanation of intrahepatic cholestasis, and it seems that similar processes are taking place in jaundice due to malignant tumors which does not decrease after biliary drainage.

TABLE 11. *Operative Mortality of Pancreatoduodenectomy*

Year	No. of Resected Cases	No. of Deaths
1950-1959	34	18
1960-	31	3

Summary

Reviewing experience in operations on 201 cases of carcinoma of the pancreas and periampullary region, the following results were obtained:

1) In so-called periampullary carcinomas, resection was possible in 26 (65%) of 40 patients who had no pain, but in 32 (39%) of 80 with dull pain and in only eight (29%) of 28 with severe pain. Concerning the duration of illness, pancreatoduodenectomy could be performed in 56 per cent of cases when the duration was less than 3 months in carcinomas of the head of the pancreas in contrast to only 11-13 per cent when duration exceeded 3 months. In patients with periampullary carcinoma and a palpable tumor resection was possible in only 18 per cent, but was possible in 53 per cent of those without a palpable tumor.

2) Abnormalities in portography indicated that resection was not possible in all instances of periampullary carcinoma. It seems, however, that resectability cannot be accurately predicted on the basis of portography alone in carcinomas of the head of the pancreas. In periampullary carcinomas and carcinomas of the body and tail of the pancreas, the lesions could not be resected when selective celiac angiography showed abnormalities in the common hepatic or gastroduodenal arteries. In most instances of periampullary carcinoma in which there was more than 5 cm. distance between the junction of both hepatic ducts and the site of obstruction in percutaneous transhepatic cholangiography, pancreatoduodenectomy was possible.

3) It was possible to accurately predict resectability in 88 per cent of carcinomas of the head of the pancreas and in more

than 90 per cent of carcinomas of the intra-pancreatic bile ducts and of the papilla of Vater on the basis of angiographic and cholangiographic findings.

4) The postoperative mortality rate in malignant tumors of the biliary tract was 10 per cent when the icterus index was below 30, but as high as 50 per cent when the index was above 80. Only three deaths occurred in 31 cases (9.7%) since we made it a rule to perform staged pancreatoduodenectomy when the icterus index is above 80. Special care should be taken when there is no appreciable decrease in jaundice after preliminary cholecystostomy.

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