

Carcinoma of the Pancreatic Head and Periapillary Region

Tumor Staging with Laparoscopy and Laparoscopic Ultrasonography

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Objective

The authors performed a prospective evaluation of staging laparoscopy with laparoscopic ultrasonography in predicting surgical resectability in patients with carcinomas of the pancreatic head and periapillary region.

Summary Background Data

Pancreatic resection with curative intent is possible in a select minority of patients who have carcinomas of the pancreatic head and periapillary region. Patient selection is important to plan appropriate therapy and avoid unnecessary laparotomy in patients with unresectable disease. Laparoscopic ultrasonography is a novel technique that combines the proven benefits of staging laparoscopy with high resolution intraoperative ultrasound of the liver and pancreas, but which has yet to be evaluated critically in the staging of pancreatic malignancy.

Methods

A cohort of 40 consecutive patients referred to a tertiary referral center and with a diagnosis of potentially resectable pancreatic or periapillary cancer underwent staging laparoscopy with laparoscopic ultrasonography. The diagnostic accuracy of staging laparoscopy alone and in conjunction with laparoscopic ultrasonography was evaluated in predicting tumor resectability (absence of peritoneal or liver metastases; absence of malignant regional lymphadenopathy; tumor confined to pancreatic head or periapillary region).

Results

"Occult" metastatic lesions were demonstrated by staging laparoscopy in 14 patients (35%). Laparoscopic ultrasonography demonstrated factors confirming unresectable tumor in 23 patients (59%), provided staging information in addition to that of laparoscopy alone in 20 patients (53%), and changed the decision regarding tumor resectability in 10 patients (25%). Staging laparoscopy with laparoscopic ultrasonography was more specific and accurate in predicting tumor resectability than laparoscopy alone (88% and 89% versus 50% and 65%, respectively).

Conclusions

Staging laparoscopy is indispensable in the detection of "occult" intra-abdominal metastases. Laparoscopic ultrasonography improves the accuracy of laparoscopic staging in patients with potentially resectable pancreatic and periapillary carcinomas.

Accurate tumor staging is important for selecting patients with carcinoma of the head of the pancreas in whom it may be appropriate to attempt pancreatic resection with curative intent. Unfortunately, the natural history of ductal adenocarcinoma of the pancreas is such that only a minority of patients prove to be candidates for curative resection. Signs of advanced disease frequently are present at operation, leaving surgical palliation of established or impending duodenal or biliary obstruction the only surgical option. The availability of endoscopic¹ and percutaneous² biliary intubation and, more recently, the development of laparoscopic duodenal and biliary bypass,^{3,4} has reinforced the need to identify patients with unresectable disease who might avoid unnecessary laparotomy. Ideally, the preoperative assessment of patients with malignant biliary obstruction should include investigations that are sensitive in detecting localized and potentially curable lesions, and at the same time, specific enough to identify factors that render the tumor unresectable.

The pancreas is a difficult organ to evaluate radiologically because of its anatomic location within the retroperitoneum and its intimate relationship with the adjacent viscera and major vascular structures. Although the continued development of modern radiologic techniques has been accompanied by an apparent decline in the incidence of "nontherapeutic" laparotomy for pancreatic carcinoma,⁵ it also has been recognized increasingly that imaging modalities, such as ultrasonography, computed tomography (CT), magnetic resonance imaging, and selective visceral angiography, may not always be sufficiently accurate in staging pancreatic cancer, even when used in combination.⁶ Several authors have stressed the inability of these techniques to detect "occult" metastatic deposits within the peritoneal cavity and liver. Discovery of such lesions at the time of laparotomy will curtail the intended operative procedure, whereas their failure to detect them before resection surgery results in early tumor recurrence. These limitations of imaging techniques have supported recommendations for routine laparoscopy as a highly sensitive means of detecting lesions that cannot be resected.⁷⁻¹⁰ Laparoscopic ultrasonography is a new technique that provides the surgeon with a sensitive means of detecting small metastases within the peritoneal cavity by direct inspection and allows assessment of local tumor invasion, regional nodal involvement, and distant metastatic spread to the liver using high resolution, real-time, B-mode ultra-

sound. We already have reported encouraging preliminary results with laparoscopy and laparoscopic ultrasonography in the assessment of patients with pancreatic tumors¹¹ and liver malignancy.^{12,13} In this prospective study, we report the use of laparoscopy with laparoscopic ultrasonography in the evaluation of resectability in patients with carcinoma of the head of the pancreas and periampullary region.

PATIENTS/METHODS

From January 1991 to September 1993, 40 patients diagnosed as having pancreatic or periampullary carcinoma were considered, at the time of referral to our department, as candidates for tumor resection with curative intent either by pancreatoduodenectomy or by transduodenal local resection. Patients considered unsuitable for surgical intervention for reasons of advanced age, infirmity, or previously recognized distant metastases were not evaluated laparoscopically or by angiography and have not been included in this study. Failure to achieve laparoscopic access to the peritoneal cavity occurred in one patient with adhesions from a previous laparotomy, and this patient has been excluded from further analysis. The diagnosis usually was made on endoscopic retrograde cholangiopancreatography (ERCP), transabdominal ultrasonography, or dynamic CT scanning, and histopathologic confirmation was obtained in each case. All patients were managed according to an algorithm in which staging laparoscopy with laparoscopic ultrasonography was followed by angiography before assessment of tumor resectability at exploratory laparotomy. Preoperative radiologic assessment typically comprised transabdominal ultrasonography and intravenous enhanced (dynamic) CT scanning. A variety of scanning techniques and equipment were employed by the various referring hospitals, and such investigations were repeated only if our unit radiologist considered them to be inadequate.

After laparoscopy with ultrasonography was performed, selective visceral angiography was undertaken in patients 1) with no evidence of metastatic tumor spread and disease that still was considered operable or 2) a tumor that was considered inoperable because of locoregional extension, but in whom further evaluation of these findings was considered appropriate before surgical exploration. The technique of selective visceral angiography employed in this study has been described previously.¹⁴ Histopathologic confirmation always was obtained, either after examination of the surgically resected specimen, by needle biopsy of the primary tumor, by luminal biopsy of periampullary tumors during ERCP, or after biopsy of metastatic deposits during laparoscopy or laparotomy.

Laparoscopic ultrasonography was performed under

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general anesthesia by a standardized technique that has been described previously.^{13,15} Briefly, two disposable 10/11-mm laparoscopic cannulae (Endopath, Ethicon Ltd., Edinburgh, United Kingdom) were inserted at the umbilicus and right flank, and a thorough inspection of the abdominal cavity was performed using a 30-degree telescope. Particular attention was paid to evidence of metastatic disease involving the liver, mesenteric and hilar lymph nodes, and all visible serosal surfaces. No attempt was made to enter the lesser sac to visualize the pancreas directly.

Laparoscopic ultrasonography was performed using a 9-mm diameter linear-array contact ultrasound probe (Aloka UST-5521-7.5, Keymed Ltd., Southend-on-Sea, United Kingdom), connected to an Aloka SSD-500 B-mode portable ultrasound machine. Both the ultrasound and laparoscopic images were viewed simultaneously using "picture-in-picture" visual mixing. The liver was examined for evidence of metastatic disease, and the hilar, peripancreatic, and para-aortic regions were examined for lymphadenopathy. Identification of regional lymph nodes larger than 10 mm in diameter was interpreted as evidence of tumor unresectability, and where possible, this was confirmed by biopsy during laparoscopy or subsequent laparotomy. The criteria used to define primary tumor advancement and locoregional irresectability were as follows: 1) tumor size of 5 cm or greater; 2) extrapancreatic invasion of adjacent tissues (i.e., duodenum, stomach, common bile duct, retroperitoneum); and 3) occlusion or stenosis of the portal or superior mesenteric veins, or major branches of the celiac trunk or superior mesenteric artery (with the exception of the gastroduodenal artery). Laparoscopic ultrasonography was performed and interpreted by members of the surgical team (OJG/TGJ) and was undertaken as a separate procedure from laparotomy. The entire laparoscopic examination always was completed within 30 minutes.

Locoregional resectability of tumor ultimately was determined by an experienced pancreatic surgeon (DCC or OJG) at the time of exploratory laparotomy. Palpation, mobilization, and trial dissection of the head and neck of the pancreas were performed to assess the extent of the tumor and its relationship with the adjacent vascular and visceral structures as described elsewhere.^{16,17} Intraoperative ultrasound scanning of the liver was performed to detect nonvisible liver metastases and guide needle biopsies (5-MHz linear-array contact ultrasound probe, Aloka UST-587T-5, Keymed Ltd.). In patients whose earlier laparoscopic findings had contraindicated further assessment of resectability at open operation, tumor unresectability always was confirmed by biopsy of intra-abdominal metastases or by selective visceral angiography when vascular invasion was suspected. Data were tabu-

lated using a standard 2 × 2 matrix analysis,¹⁸ whereby the actual tumor resectability (negative) or "irresectability" (positive) was correlated with that predicted by the operator (true or false) after laparoscopy/laparoscopic ultrasonography. The sensitivity, specificity, and overall accuracy of the prediction regarding resectability was expressed for laparoscopy alone, and in combination with laparoscopic ultrasonography. These staging parameters were not assigned to laparoscopic ultrasonography independent of the findings on prior laparoscopic examination.

RESULTS

Forty consecutive patients underwent staging laparoscopy (22 women, 18 men; median age 59 years [range 36–78 years]), 38 of whom also underwent laparoscopic ultrasonography. Endoscopic insertion of a biliary stent had been performed previously in 21 patients (53%). Procedure-related complications were encountered in one patient in whom an asymptomatic port-site hemorrhage had occurred with the discovery of intraperitoneal blood at laparotomy 6 days later (2.5% complication rate).

Laparoscopy (n = 40)

It was not possible to directly inspect the primary tumor in any patient during the laparoscopic examination, although it was occasionally possible to palpate a retrogastric mass with the tip of the ultrasound probe. Tumor resectability was inferred correctly from the absence of signs of dissemination within the abdominal cavity in all 12 patients considered resectable (i.e., 100% sensitivity). Previously unsuspected metastatic tumor spread to the liver (ten patients), peritoneal surfaces (eight patients) (Fig. 1), and hilar lymph nodes (two patients) were identified during laparoscopy in a total of 14 patients (35%). Biopsy material was obtained and metastatic carcinoma was confirmed in each case. Exploratory laparotomy was, therefore, withheld from these patients, who in terms of predicting resectability, were regarded as having undergone "true positive" laparoscopic staging examinations (Table 1).

Laparoscopy failed to detect malignant dissemination to distant sites within the abdominal cavity in three patients (i.e., "false-negative" procedures). In one patient, a cluster of tiny peritoneal tumor deposits were concealed by adhesions in the right subhepatic space and were not recognized by the laparoscopist. Liver metastases were not demonstrated laparoscopically in three patients. In one case, laparoscopic biopsy of a suspicious subcapsular lesion indicated biliary ectasia, although bi-



Figure 1. Preoperative staging laparoscopy performed in a patient thought to have a resectable periampullary carcinoma revealed a small white nodule situated at the junction of the falciform ligament and capsule of the left hepatic lobe. Laparoscopic biopsy confirmed metastatic adenocarcinoma. There was no other evidence for extrapancreatic spread of tumor.

opsy at open operation confirmed metastatic carcinoma. A 10-mm metastasis within the caudate lobe, a region not always readily accessible to laparoscopic inspection, was demonstrated by laparoscopic ultrasonography in another patient. A small tumor deposit on the free edge of the right lobe of the liver was discovered during laparotomy after an unremarkable laparoscopy in a third patient. A delay of 2 months had ensued between laparoscopy and laparotomy in this deeply jaundiced patient. Ultimately, unsuspected small liver and peritoneal tumor deposits were demonstrated after laparoscopy, laparoscopic ultrasonography, or laparotomy in 17 of the 40 patients (43%).

Laparoscopy alone failed to identify the 12 patients (30%) with locoregional tumor unresectability, which subsequently was demonstrated by laparoscopic ultrasonography, angiography, or operative assessment. Overall, there were 14 false-negative laparoscopic examinations, including those where distant metastases were overlooked, resulting in a specificity of only 50% in predicting resectability and an overall accuracy of 65% for staging laparoscopy (Table 1).

Laparoscopic Ultrasonography (n = 38)

Satisfactory images of the primary pancreatic/periampullary lesion were obtained using laparoscopic ultrasonography in 31 patients (82%) (Figs. 2 and 3). The pancreatic duct was identified proximal to the obstructing

mass lesion in 31 cases, in 23 (74%) of whom duct dilatation >3 mm was observed. In each case, the sonographic appearance of the primary tumor was of a predominantly heterogeneous hypoechoic mass (Fig. 3). Factors indicating tumor unresectability were identified correctly by laparoscopic ultrasonography in 23 cases (61%), namely the following: liver metastases (10 patients); locally invasive tumor measuring >5 cm (12 patients); and vascular involvement with tumor (12 patients) (Fig. 3). In addition, regional lymph node enlargement >10 mm was identified in 14 patients (Fig. 4), and biopsies were obtained to confirm malignant infiltration in three cases. In those patients without biopsy proof of malignant lymphadenopathy, tumor unresectability always was confirmed by the other criteria outlined above. In 20 patients (53%), information relevant to the assessment of tumor stage—and not apparent after laparoscopy—was derived from the laparoscopic ultrasound examination. This new staging information altered the decision concerning tumor resectability based on laparoscopy alone in 10 patients (25%). Six of these ten patients had locally advanced tumors >5 cm in diameter, eight had invasions of the adjacent superior mesenteric and portal venous trunk (Fig. 3), and, as detailed above, one patient had metastatic liver disease, which had remained undetected during laparoscopy. Enlarged regional lymph nodes also were demonstrated in six of these patients, although biopsies were not obtained. Having correctly predicted tumor unresectability in 23 of 26 patients, these factors were responsible for increasing the specificity and accuracy to 88% and 89%, respectively (Table 2).

Failure of the surgeon performing laparoscopic ultrasonography to recognize tumor invasion of the superior mesenteric and main portal vein in one patient and tumor infiltration of the common bile duct and pylorus in another yielded false-negative results for laparoscopic ultrasound. In another patient, laparoscopic ultrasonog-

Table 1. PREDICTION OF RESECTABILITY BY STAGING LAPAROSCOPY IN 40 PATIENTS WITH PANCREATIC AND PERIAMPULLARY CARCINOMA

	Laparoscopy	
	Resectable	Nonresectable
Outcome		
Resectable	12	0
Nonirresectable	14	14

Sensitivity = 12/12 = 100%; specificity = 14/28 = 50%; accuracy = 26/40 = 65%.

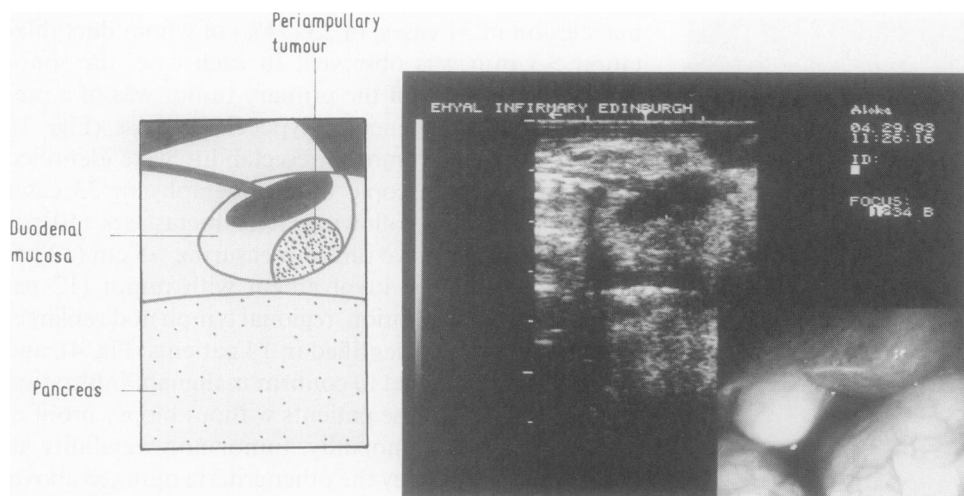


Figure 2. Laparoscopic ultrasonography was performed in a patient suspected of having a periampullary tumor, causing obstructive jaundice, although no mass lesion was identified by other investigations. The linear-array probe has been placed on the duodenum (insert), and the rectilinear sonogram obtained defined a 10-mm periampullary carcinoma. This tumor was deemed to be resectable and subsequently was excised by transduodenal local resection.

raphy suggested local infiltration of the duodenum with tumor, but this finding was not confirmed at laparotomy, and the patient underwent a Whipple operation. This represents the only false-positive laparoscopic ultrasound examination, accounting for the sensitivity of 92% observed for laparoscopic ultrasonography in recognizing resectable disease (Table 2).

Outcome

Twenty-two patients (55%) progressed to laparotomy and operative assessment of resectability; 12 were considered to have resectable tumors (30% overall resectability). Pancreatoduodenectomies were performed in ten patients, and one patient underwent transduodenal resection of a periampullary adenocarcinoma. Another pa-

tient, in whom resectability of a periampullary carcinoma was confirmed at laparotomy, became profoundly hypotensive, and it was considered appropriate to perform a biliary bypass rather than attempt pancreatic resection on this occasion. This patient is alive and well at 8 months, with no evidence of disease progression. The patient has refused further surgery and for the purposes of this study, has been classified as having resectable disease. Palliative biliary and duodenal bypass procedures were performed in ten patients in whom tumor unresectability was confirmed at laparotomy.

DISCUSSION

For the majority of patients with ductal adenocarcinoma of the exocrine pancreas, the outlook is bleak.¹⁹ It

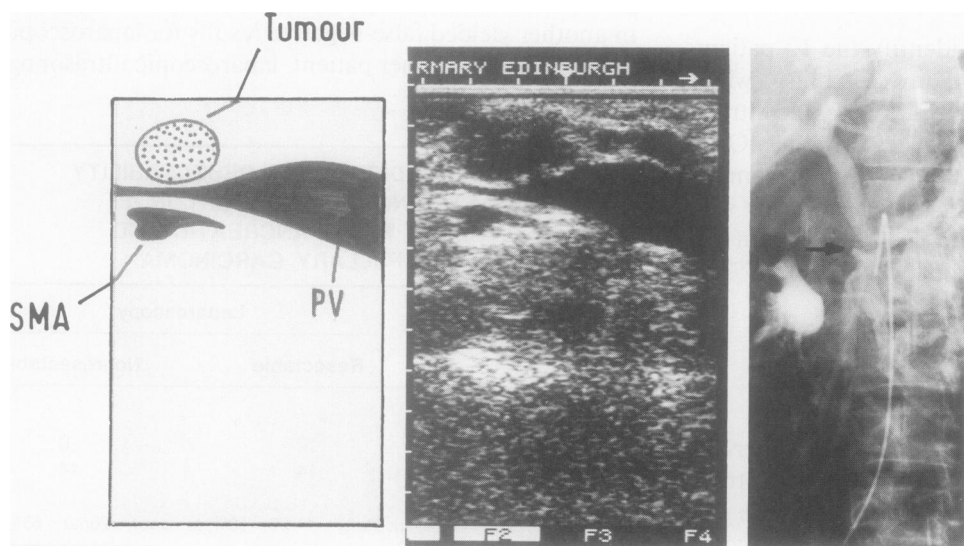
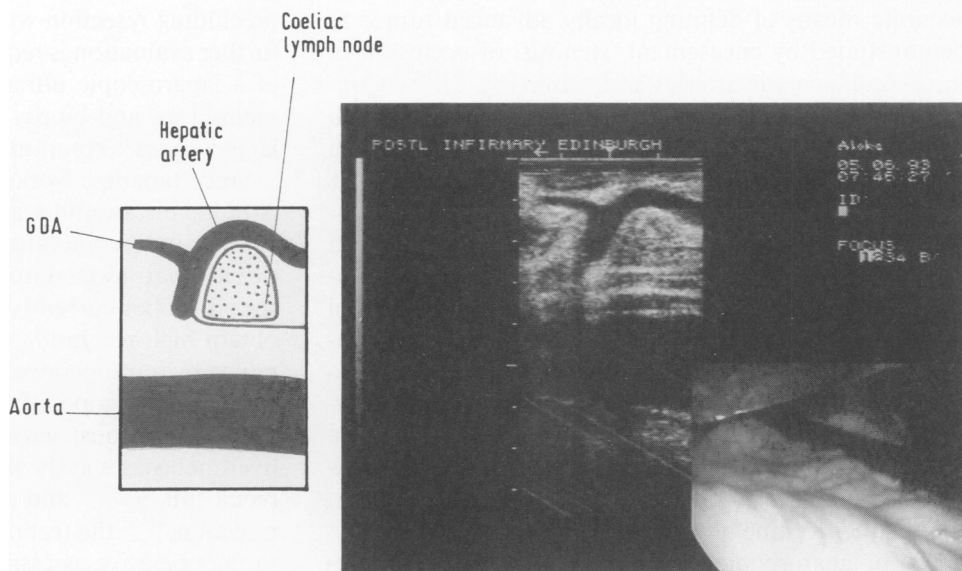


Figure 3. A laparoscopic sonogram in the region of the neck of the pancreas (parasagittal cut) has defined a 20-mm diameter hypoechoic carcinoma within the head of the pancreas, causing a stenosis of the adjacent superior mesenteric—portal vein. The constant appearance of a venous stenosis during real-time scanning in several planes was interpreted as “irresectable” vascular involvement. Selective visceral angiography with portography (right) corroborated the appearances of tumor invasion at the confluence of the portal, superior mesenteric and splenic veins (arrow). PV = portal vein; SMA = superior mesenteric artery

Figure 4. With the laparoscopic ultrasound probe placed on the stomach (inset), a sagittally orientated sonogram defining the origin of the celiac axis from the aorta has been obtained. A cluster of enlarged para-aortic lymph nodes were identified; their malignant infiltration was confirmed after laparotomy and biopsy. The node depicted measures 15 mm and has a hypoechoic and well-circumscribed appearance, typical of malignant lymphadenopathy.



is one of the causes of death from cancer encountered most commonly in surgical practice, its incidence appears to be rising,²⁰ and most patients exhibit local invasion of tumors and distant metastatic spread by the time symptoms occur. Nevertheless, recent reports indicate that in experienced hands, potentially curative pancreaticoduodenectomy (Whipple operation) can be undertaken with negligible perioperative morbidity and mortality^{16,21-23} and a prospect of prolonged survival if it is discovered an early stage.²⁴

Of those investigations traditionally employed in the selection of patients with pancreatic and periampullary carcinoma for resection surgery, ultrasonography is non-invasive, repeatable, and relatively inexpensive, although it is highly operator dependent. Its usefulness as a first-line test in confirming extrahepatic biliary obstruction

and for screening the liver for metastatic disease is widely recognized, and it can be at least as accurate as CT scanning in determining local resectability of pancreatic cancer.^{25,26} However, these results have not been reproduced widely, and in practice, suboptimal imaging of the retroperitoneal structures caused by overlying bowel gas and body-wall tissues may limit the usefulness of this modality.²⁷ High-resolution dynamic CT scanning is regarded widely as the diagnostic and staging investigation of choice in the assessment of pancreatic cancer^{28,29} and has been shown to be more accurate than transabdominal ultrasonography.³⁰ However, most studies of CT in the diagnosis and staging of pancreatic cancer have been subject to some degree of bias. In a blind analysis of dynamic CT scanning in a random population of patients with cancer of the pancreas or periampullary region, Bryde Anderson and colleagues showed that CT was too inaccurate to recommend its use alone as a staging investigation.³¹ Similarly, Ross and co-workers concluded that predictions of tumor unresectability based solely on the CT diagnosis of locally advanced disease were unreliable,³² although not all scans were enhanced with intravenous contrast. There is no evidence that magnetic resonance imaging currently confers any advantage over dynamic CT scanning in this context^{10,28}

Although some surgeons have successfully resected segments of the superior mesenteric and portal vein to achieve extirpation of tumors in the head of the pancreas,^{16,33-35} most would regard tumor invasion of these vascular structures as a contraindication to pancreatic resection with curative intent, and this philosophy was observed in selecting patients for resection in this study. Selective visceral angiography has been reported as an

Table 2. PREDICTION OF RESECTABILITY BY COMBINED STAGING LAPAROSCOPY/LAPAROSCOPIC ULTRASONOGRAPHY IN 38 PATIENTS WITH PANCREATIC AND PERIAMPULLARY CARCINOMA

	Laparoscopy/Laparoscopic Sonography	
	Resectable	Nonresectable
Outcome		
Resectable	11	1
Nonresectable	3	23

Sensitivity = 11/12 = 92%; specificity = 23/26 = 88%; Accuracy = 34/38 = 89%.

accurate means of defining locally advanced tumor as demonstrated by encasement, stenosis, or occlusion of the extrapancreatic arteries and veins (Fig. 3).^{36,37} Conversely, angiography can be potentially misleading in predicting tumor unresectability,^{16,38} and has been shown to confer little additional benefit to dynamic CT scanning.^{14,29} Nevertheless, it may be of value in confirming tumor unresectability in selected cases in which doubt persists.¹⁶ In the current study, we used angiography primarily as a means of validating the findings of laparoscopic ultrasonography regarding vascular invasion. Selective visceral angiography also provides a vascular road map of the abdomen, but although recognizing that peripancreatic vascular anomalies may occur in 30% to 35% of patients with pancreatic and periampullary carcinoma,^{14,39,40} not all surgeons would accept that this justifies routine preoperative arteriography.

Use of laparoscopic ultrasonography to assess pancreatic malignancy seems logical. The detailed view of the peritoneal cavity at laparoscopy is superior to that provided by any other contemporary investigation in detecting tiny peritoneal tumor deposits and liver metastases (especially subcapsular lesions measuring less than 10 mm in diameter) (Fig. 1).^{11,31} Although abdominal ultrasound and CT scanning revealed no metastatic disease in those patients in the current study, this characteristic pattern of intra-abdominal tumor dissemination ultimately was demonstrated in 42% of patients. In 83% of these cases, laparoscopy had been confirmatory, a finding that supports previous observations.⁷⁻¹⁰ Nevertheless, the laparoscopist is limited in his/her ability to assess the primary tumor directly. Although direct laparoscopic inspection of pancreatic tumors from within the lesser sac has been described well by both infragastric^{41,42} and supragastric routes,⁴³⁻⁴⁵ and although recognizing that this may be useful in the diagnosis and biopsy of tumors of the body and tail of the pancreas, it is not, in practice, a suitable means of assessing resectability of small inaccessible tumors within the head of the gland. However, we found that direct apposition of a high-resolution, linear-array ultrasound transducer at laparoscopy consistently provided highly detailed images of the pancreas and neighboring retroperitoneal structures (Figs. 2 and 3). Accordingly, it was possible to demonstrate the signs of local tumor invasion, peripancreatic lymphadenopathy (Fig. 4), and vascular invasion (Fig. 3) so that the combination of laparoscopy and laparoscopic ultrasonography gave a more reliable prediction of tumor unresectability than laparoscopy alone (specificity 88% vs. 50%). A tissue diagnosis was not always obtained in those cases in which the inability of tumor resection due to malignant lymphadenopathy was diagnosed, although this finding of its own always was supported by other features

precluding resection with curative intent. Nevertheless, further evaluation is required to determine the reliability of a laparoscopic ultrasound diagnosis of lymph node metastases, and biopsy or fine-needle aspiration of enlarged nodes is recommended in cases of doubt.

Since Japanese workers described the combination of A-mode ultrasound scanning with laparoscopy 30 years ago,⁴⁶ laparoscopic ultrasonography has evolved to the extent that ultracompact linear-array B-mode ultrasound probes currently can be used laparoscopically to obtain high resolution images comparable to those obtained by intraoperative ultrasonography at laparotomy. Although intraoperative ultrasound has gained acceptance as the most sensitive method of detecting occult liver metastases at the time of resection of primary colorectal tumors^{47,48} and as an indispensable tool in liver resection,⁴⁹⁻⁵² the technique has had limited application to the operative assessment of pancreatic carcinoma. It has been proven useful in the localization of neuroendocrine tumors within the pancreas,⁵³⁻⁵⁷ and others have reported its use in the operative assessment of pancreatic cancer.^{58,59} Machi and colleagues recently reported⁶⁰ that intraoperative ultrasound was significantly more specific (86.4% vs. 54.5%) and accurate (89.7% vs. 64.1%) than a combination of preoperative transabdominal ultrasound, dynamic CT scanning, and angiography in assessing portal vein invasion by pancreatic cancer, findings that reflect our current experience in this context. Several authors have reported the use of laparoscopic ultrasonography to confirm the presence of primary pancreatic tumors and accurately define hepatobiliary and pancreatic anatomy,⁶¹⁻⁶³ and our experience demonstrates its potential for accurate staging assessment of patients with pancreatic and periampullary cancer, both in relation to distant metastatic spread and locoregional invasion.

Endoscopic ultrasonography offers another impressive alternative to conventional imaging in evaluation of the pancreas. Rösch and colleagues assessed tumor size, lymph node status, and vascular invasion in defining local tumor stage in patients with pancreatic and periampullary carcinomas,³⁰ whereas Tio and colleagues report overall accuracies of 92% and 88%, respectively, in the assessment of local tumor infiltration from pancreatic and periampullary cancers.⁶⁴ However, endosonography cannot be expected to detect peritoneal and liver metastases, and this is reflected in its overall accuracy of 66% in TNM staging of pancreatic cancer.⁶⁴

In this study, we examined the role of staging laparoscopy with laparoscopic ultrasonography in a cohort of patients who would otherwise have been regarded as suitable for operative assessment of tumor resectability. Although preceding patient selection increased the proportion of patients with resectable disease and introduced

an element of bias, we believe that this is representative of clinical practice if laparoscopic staging were to be introduced at this point in an investigative algorithm. Our results suggest that staging laparoscopy is a valuable routine undertaking before laparotomy and operative assessment of resectability in patients with pancreatic and periampullary cancer. Comparative studies between conventional investigations and this new technology are indicated to fully evaluate of the precise role of laparoscopic ultrasound.

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