Laparoscopic Management of Hepaticopancreatic Diseases

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INTRODUCTION

The indications and preparation for laparoscopic liver surgery remain the same as in open hepatic surgery. Visualization is excellent with the laparoscope, and the addition of laparoscopic ultrasound has been shown to help intraoperative plans in 66% of cases when compared to laparoscopic exploration alone. The ability of visual inspection laparoscopy to assess resectability as opposed to inoperability remains relatively low. It can be improved by extended laparoscopy combined with laparoscopic contact ultrasonography. The technique of extended laparoscopy consists of full inspection of the peritoneal cavity, liver with contact laparoscopic ultrasound scanning, entry and inspection of lesser sac, examination of porta hepatis, duodenum, transverse mesocolon, and celiac and portal vessels. This procedure thus entails extensive dissection and is used to assess operability in patients with pancreatic cancer, hepatic neoplasms and gastroesophageal cancers where it often entails lymph node sampling. Laparoscopic hepatic surgery, while technically difficult, still can be performed safely with good results with careful patient selection. Attention to the etiology of the lesion and its location is essential. Ideal candidates have a large solitary cyst or a symptomatic benign mass located superficially, laterally, or far enough from the pedicle to allow direct clamping of the liver or access to the hilum to perform a Pringle maneuver should bleeding occur. Contraindications to this technique include patients with cirrhosis, hepatocellular carcinoma (HCC), or posterior or centrally located lesions. While we have utilized this approach for solitary small metastatic disease, hydatid disease, hepatic abscess, and polycystic liver disease (PCLD), these should be viewed with a great deal of circumspection. Problems can arise to varying degrees should any of these lesions be spilled. Port site recurrences remain a concern when using laparoscopy in any patient with cancer. This is of special concern when considering pairing this approach with cryoablation. With echinococcal cysts, the risk of spillage is also obvious, although less problematic with calcified cysts. If one does use a laparoscopic approach for hydatid disease, we recommend a cholangiogram to rule out a connection with the biliary system. While fenestration of PCLD has been described both by open and laparoscopic approaches, transcystic fenestration of deeper cysts makes the control of bleeding difficult.

Laparoscopic liver surgery provides advantages over open surgery for the liver since the Chevron incision is completely avoided and the surgery is performed through tiny incisions. As a consequence the duration of stay in hospital, the amount and duration of postoperative discomfort, and the length of recovery are much shorter after the laparoscopic procedure as compared to open surgery. To safely perform liver surgery laparoscopically, the surgeon must be both, an accomplished laparoscopist and hepatic surgeon. Few surgeons, however, are as comfortable with open hepatic surgery as they are with the gallbladder, hernia, appendix, or stomach. Furthermore, only a limited number of lesions, depending upon their location and etiology, can be approached by laparoscopy. The most commonly performed procedures are symptomatic solitary hepatic cyst, symptomatic PCLD, hydatid cyst, focal nodular hyperplasia, adenoma, abscess, metastatic breast cancer, and calcified gallbladder.

TECHNIQUE OF LAPAROSCOPIC MANAGEMENT OF HYDATID CYSTIC LIVER

This procedure is performed with the patient under general anesthesia with oro- or nasogastric decompression and a pneumoperitoneum of 12–14 mm Hg **(Fig. 1)**.

The patients can be placed in the "French" position, a modified lithotomy with minimal flexion of the hips, and the primary surgeon positioned between the legs. The first assistant stands on the patient's left side and the scrub nurse between them. For fenestrations, a four-trocar configuration is used. A 10 mm port at the umbilicus houses the 30° telescope. A 5 mm trocar needs to be placed just below the xiphoid process to the right or the left of the falciform ligament, depending on the location of the cyst. This port is used to expose the liver, often using an irrigation aspiration probe. Two other 5 mm or 10 mm ports, in the right and left flank, allows the surgeon to puncture the cyst dome, aspirate its contents, and excise the cyst wall in a careful sequential fashion to facilitate hemostasis. For more extensive procedures, a strong light source (300 W xenon) and

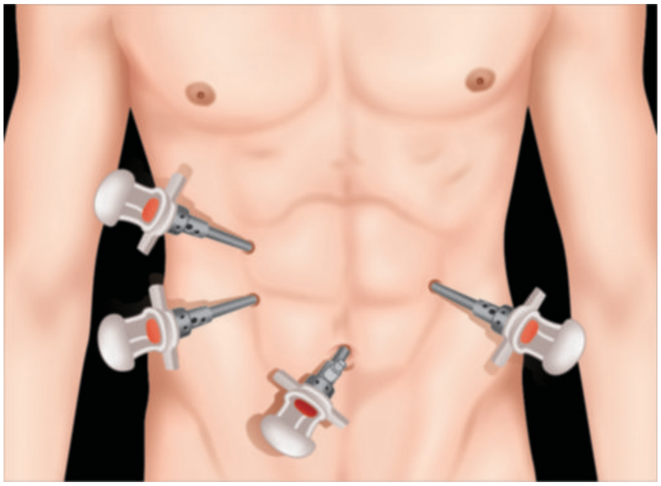
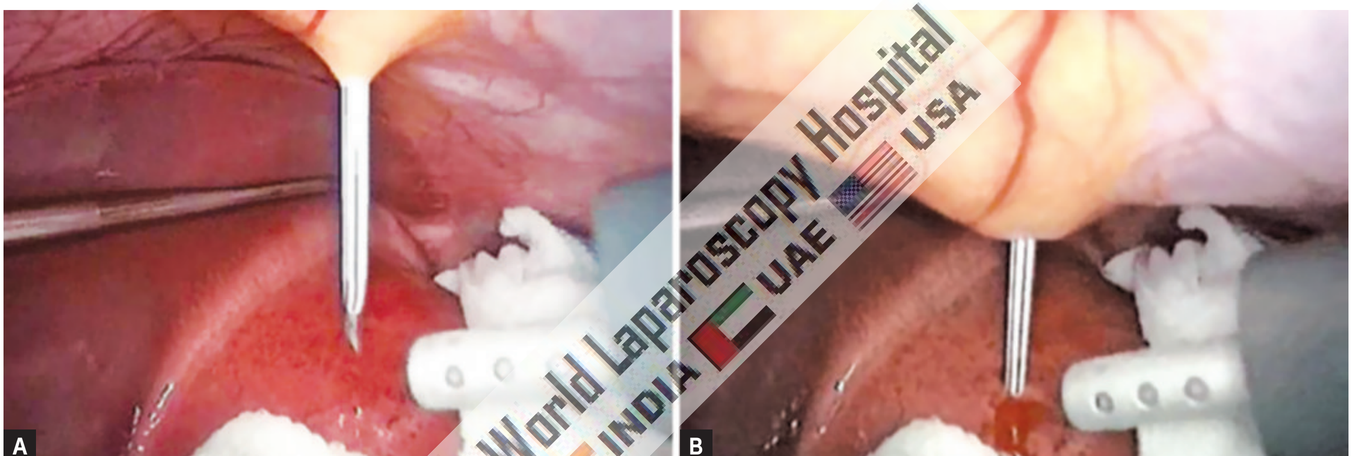


Fig. 1: Port position of the hydatid cyst of left lobe.

Fig. 2: Gauge piece introduced soaked with 3% saline.



Figs. 3A and B: Instillation of hypertonic saline inside the cyst though percutaneous spinal needle.

high-quality 30° scopes are required. To perform resections safely with a minimum of wasted motion, the four-hand technique is used by many surgeons. This uses 4–6 trocars and allows for the primary surgeon to expose and dissect the liver while second surgeon obtains control and transects the blood vessels and bile ducts. The procedure entails the same components as in open hepatic surgery. First, the patient is explored, both visually and ultrasonographically. Mobilization of the liver and hilar dissection is performed as necessary to obtain vascular control. Division and ligation of the round ligament followed by freeing of the falciform and the right or left triangular ligaments allow access to perform thorough exploration, dissection, and hemostasis. A gauge soaked with 3% saline is kept around the cyst to prevent contamination by spillage **(Fig. 2)**. Spinal needle is used to administer 10% saline inside the cyst **(Figs. 3A and B)**. Dissection is begun by scoring Glisson's capsule with the high frequency electrosurgery **(Fig. 4)**.

Parenchymal dissection can be performed using the ultrasonic dissector. After extraction, the germinal layer is placed in an impermeable specimen bag for removal **(Figs. 5A to D)**. Cholangiography is very useful to detect possible bile leaks. The raw surface of the liver is then inspected, coagulated and covered with fibrin glue. The specimen is extracted either by partial morcellation,

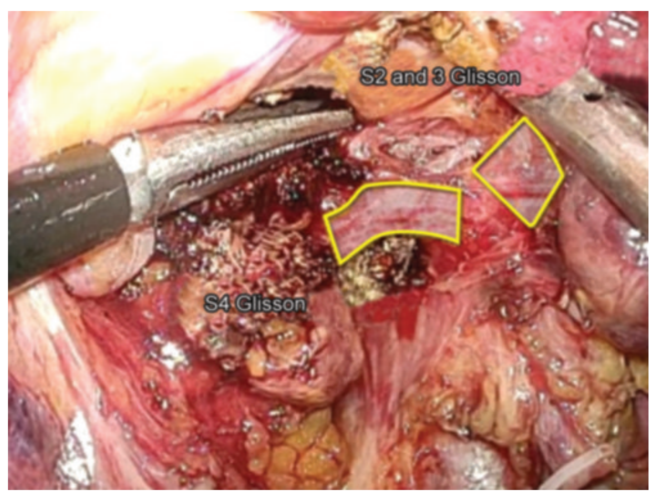


Fig. 4: Glisson's capsule keeps all the lobules together and imparts the liver, some protection from trauma.

dilatation at the umbilicus, enlarging another port site, or by a small McBurney or subcostal incision **(Figs. 6A and B)**.

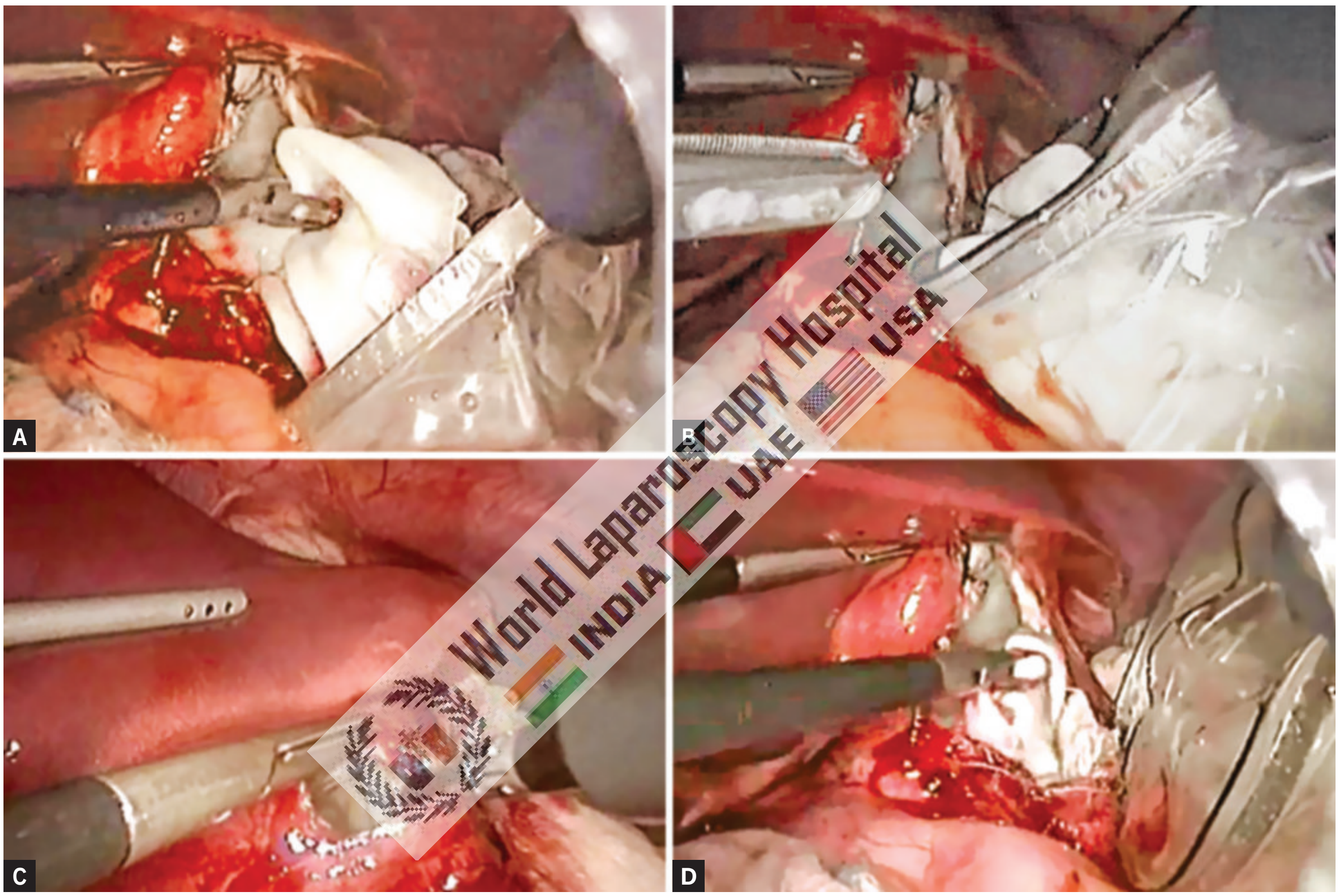
LAPAROSCOPIC LIVER RESECTION

The most common indication for laparoscopic liver resection is a solitary liver metastasis from a colorectal cancer, but it may also be used for HCC and for benign liver tumors or cysts.

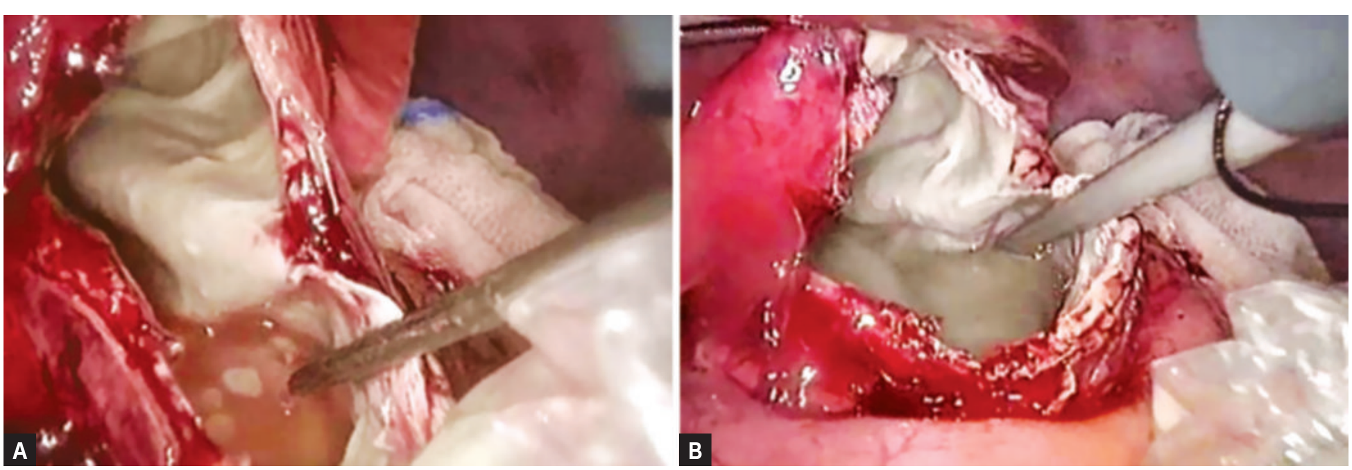
Laparoscopic liver resections, offer advantages over the conventional open approach in two important respects:

1. Reduced operative blood loss.
2. Lower major postoperative morbidity.

Although laparoscopic staging for intra-abdominal cancer including primary and secondary hepatic tumors has been in established practice for many years, laparoscopic liver resections are still in the early clinical evaluation stage. Nonetheless, the results to date have been uniformly favorable



Figs. 5A to D: Opening of the cystic wall and extraction of germinal layer.



Figs. 6A and B: Removal of cyst with the help of endobag.

especially for left lobectomy and pluri-segmentectomies although right hepatectomy has been performed by the laparoscopically assisted or the hand-assisted laparoscopic surgical (HALS) approach.

The HALS approach, by facilitating these dissections and greatly increasing the safety, makes quite a big difference to the uptake among hepatobiliary and general surgeons with an interest in liver surgery. The procedures, which are in established practice by the laparoscopic and HALS approach, are:

- Extended laparoscopic staging
- Hepatic resections
- Laparoscopic in situ thermal ablation
- Laparoscopic cryosurgery
- Radical de-roofing of simple hepatic cysts
- Hepatic surgery for parasitic cysts.

Laparoscopic Staging of Tumors

Laparoscopy can nicely detect seedling metastases and small hepatic deposits missed by preoperative thin slice multidetector CT or magnetic resonance imaging (MRI). Some surgeons add lavage cytology to diagnostic laparoscopic visual inspection. This detects exfoliated tumors cells in gastrointestinal, pancreatic and ovarian cancers.

HEPATIC RESECTIONS

Approaches

Both the laparoscopic and the HALS approach can be used for hepatic resection **(Fig. 7A)**. The hand-assisted approach expedites the operation and provides an effective safeguard against major hemorrhage that may be encountered during the operation. A 7.0 cm incision is necessary for the insertion of the hand access device, such as the Omniport. This may be introduced through midline for operations on the left lobe or right transverse for resections on the right liver. It is important that the optical port is placed such that it is well clear of the internal hand.

Component Tasks in Laparoscopic Hepatic Resections

These component tasks cover all the surgical technical aspects of the various hepatic resections: hepatectomy, pluri-segmentectomies and segmentectomies.

Contact Ultrasound Localization and Mapping of the Intended Resection

Contact ultrasound is indispensable for hepatic resections **(Fig. 7B)**. The precise localization and extent of the lesion especially when this is intrahepatic can only be determined by contact ultrasound scanning, the findings of which determine the extent of resection segments required. In contrast, the mapping of the outlines of the resection is best carried out by the argon plasma spray coagulation.

Division of Falciform Ligament

Division of falciform ligament is needed for major right and left resections **(Figs. 8A and B)**. The division of the falciform ligament close to the liver substance is best carried out with a combination of scissors and electrocoagulation and is greatly facilitated by the use of curved coaxial instruments. The round ligament (ligamentum teres) can be left undivided except in patients undergoing skeletonization for right extended hepatectomy.

Exposure of Suprahepatic Inferior Vena Cava and Main Hepatic Veins

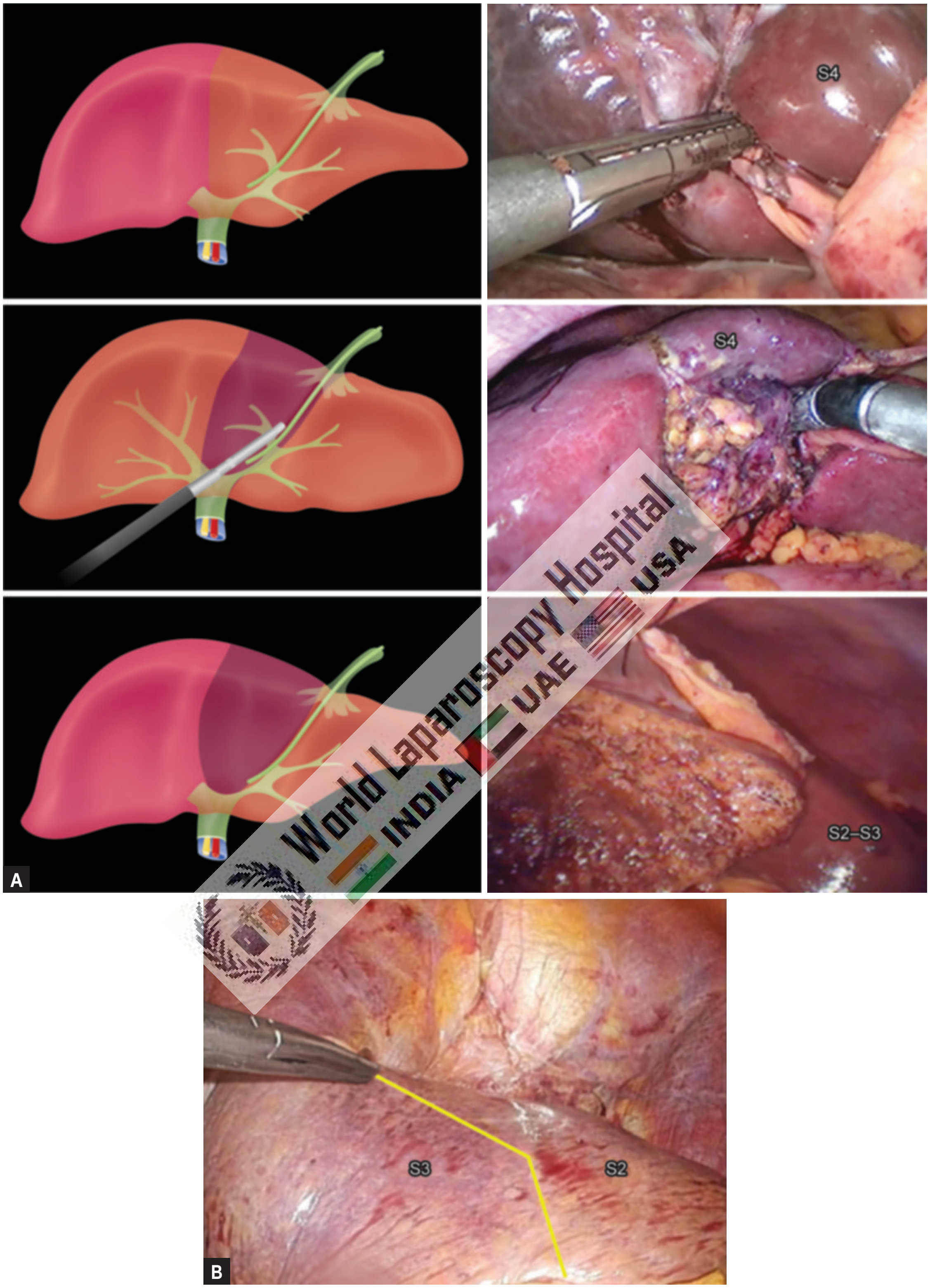
Exposure of suprahepatic inferior vena cava and main hepatic veins are only required for major hepatectomies. The two leaves of the falciform ligament separate posteriorly to envelop the suprahepatic inferior vena cava and the three main hepatic veins. The right leaf becomes the upper leaf of the right coronary ligament of the liver and the left becomes the upper layer of the left triangular ligament. These both leaves are divided after soft coagulation with the curved coaxial scissors. Ultrasonic shears may be used for this purpose, but this is more difficult as this energized device is straight.

The peritoneal division is extended in both directions to open up the retrohepatic caval space, which consists of relatively avascular loose fibroareolar tissue. The upper end of the caval canal is dissected further with a combination of blunt and sharp scissor dissection to divide fibrous bands. As the dissection precedes, about 1.5 cm of the inferior vena cava, the origin of the right hepatic vein are exposed. Further exposure of the right and middle hepatic veins is achieved beneath the liver and from the right side, required for a right hepatectomy. The left hepatic vein is very easily exposed from the left side above the liver.

Exposure of Infrahepatic Inferior Vena Cava and Division of the Posterior Minor Hepatic Veins

Exposure of infrahepatic inferior vena cava and division of the posterior minor hepatic vein is necessary for the skeletonization of the right liver necessary for a right hepatectomy **(Fig. 9)**. It is performed by retraction of the inferior surface of the right lobe of the liver with an atraumatic flexible ring or fan retractor to put the peritoneum sweeping up from the right kidney to the liver, on the stretch. This peritoneum is divided with the curved coaxial scissors and soft electrocoagulation over a wide front and close to the liver edge. There is usually little fat found underneath the peritoneum except in very obese individuals.

Once the peritoneum is divided, the retractor is replaced which gently lifts the inferoposterior aspect of the liver upward to expose the areolar tissue plane covering the vena cava and the minor retrohepatic veins which vary in number from 3 to 5. The inferoposterior aspect of the liver is lifted

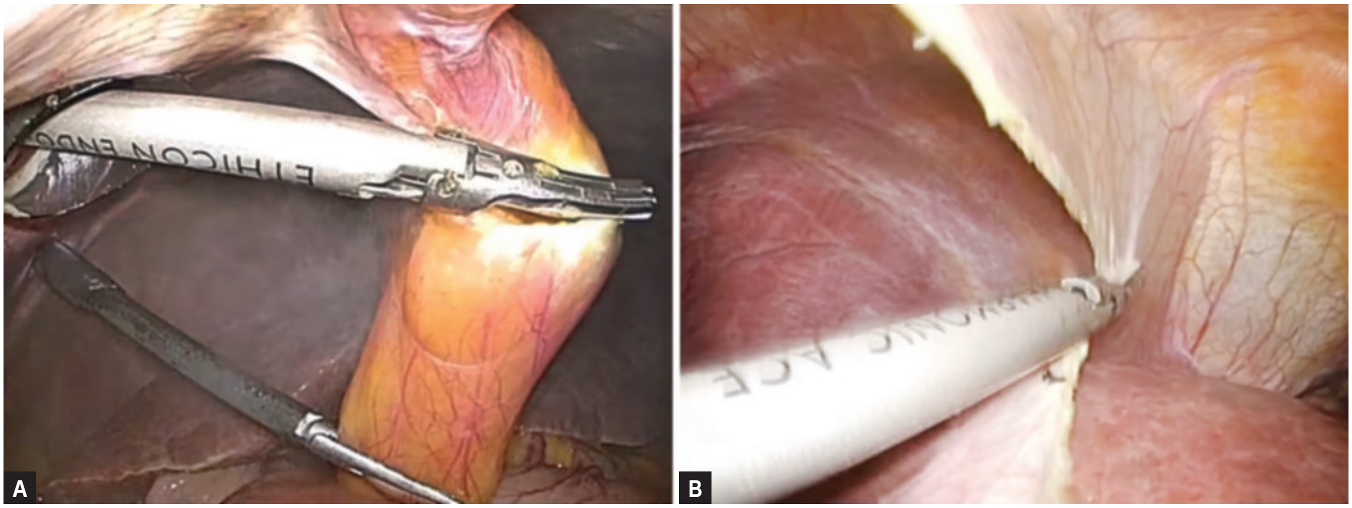


Figs. 7A and B: (A) Laparoscopic liver resection; (B) Mapping of the intended resection.

gently but progressively to expose the vena cava behind the liver. As minor hepatic veins are encountered draining into the inferior vena cava, they are skeletonized by the curved coaxial scissors and then clipped before they are divided. The mobilization continues upward until the right and middle hepatic vein is reached.

Opening the Cave of Retzius

Opening the cave of Retzius is common to both right and left resections. The cave of Retzius refers to the umbilical fissure bridged by variable amount of hepatic tissue anteriorly, which overlies the ligamentum teres containing the obliterated umbilical vein on its way to join the left branch of the portal



Figs. 8A and B: Division of falciform ligament.

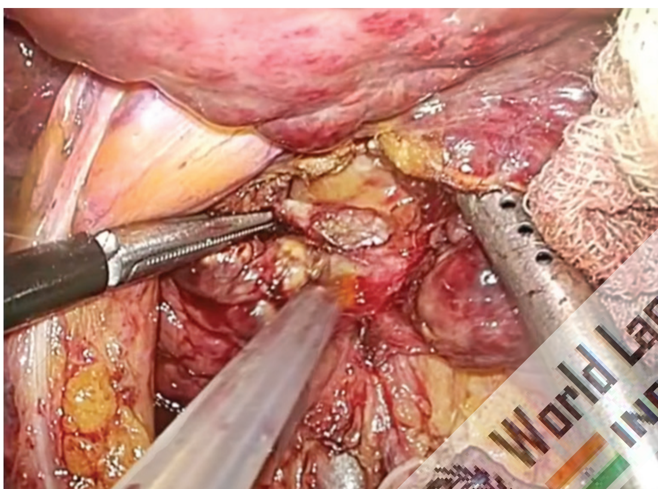


Fig. 9: Exposure of infrahepatic inferior vena cava and division of the posterior minor hepatic veins.

vein at the bottom of the pit. The bridge of liver tissue is crushed and coagulated by an insulated grasping forceps, after which it is divided which will separate segment III on the left side from the quadrate lobe opening up the cave of Retzius, and exposing the terminal segment of the round ligament.

Hilar Dissection

The dissection of the hilum commences by division of the peritoneum along the margin of the hepatic hilum to expose the common hepatic duct and its bifurcation, and the right and left branches of the common hepatic artery. Further dissection is needed to bring down the hilar plate and to skeletonize the right and left hepatic ducts, the two branches of the common hepatic artery and, more posteriorly, the two branches of the portal vein for right and left hepatectomy.

Removal of the Gallbladder

Removal of the gallbladder en bloc with the hepatic substance constitutes an integral part of right hepatectomy and segmentectomy involving segments IVa and V. The dissection of the cystic duct and artery is followed by ligature or clipping of the medial end of the cystic duct and clipping of its lateral end before it is divided.

Inflow Occlusion Prior to Hepatic Resection

Temporary inflow occlusion of the vascular supply to the liver is necessary for major hepatic resections and also to reduce the "heat-sink effect" of the substantial blood flow through the liver during in situ ablation by cryotherapy or radiofrequency thermal ablation. Several types of clamps are available for this purpose but the most suitable are the parallel occlusion clamps, which are introduced through 5.5 mm ports by means of an applicator, which is used to engage and disengage the clamps. Thus, when the clamp is in use it does not occupy a port, which can thus be used for dissection. The application of these parallel occlusion clamps is very easy particularly with the hand-assisted approach and minimal dissection is required. The surgeon just makes a small window through an avascular area of lesser omentum just proximal to the hepatoduodenal ligament enveloping the bile duct, hepatic arteries, and portal vein.

The parallel occlusion clamp is introduced from the right by means of its applicator. The jaws are opened as the hepatoduodenal ligament is reached and applied across the full width of the hepatoduodenal ligament and then released to occlude the bile duct, portal vein, and hepatic arteries. It is extremely important that the period of inflow vascular occlusion to the liver does not exceed 30 minutes at any one-time period.

For removal of the clamp, the introducer is inserted through the port and used to engage the clamp, which then is opened and removed through the same port by the introducer.

Transection of the Hepatic Parenchyma

The transection of the hepatic parenchyma for all the major resections should be carried in the absence of a

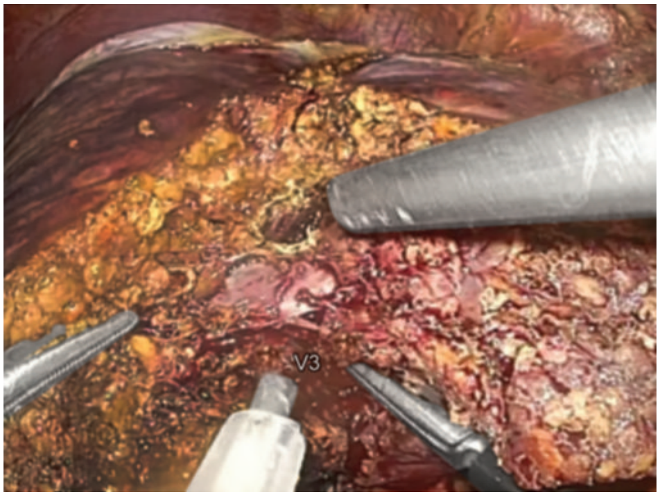


Fig. 10: Transection of the hepatic parenchyma.

positive-pressure pneumoperitoneum **(Fig. 10)**. In hand-assisted laparoscopic surgery, this translates to replacement of the hand access device with a disposable retractor that also acts as a wound protector preventing its contamination by malignant cells during the hepatic resection and removal of the specimen.

The hepatic resection must also be carried out with a low patient central venous pressure (CVP), produced by a head-up tilt and appropriate vasodilator medication by the anesthetist.

The hepatic artery to the resection area is best secured by clips or ligatures in the liver substance rather than extrahepatically. The vascular stapling or ligature and division of the main hepatic veins draining the liver during hepatectomy are carried out at the end of the parenchymal transection.

The actual technique of liver resection varies from simple finger or forceps fracture with individual clipping or ligature of bile ductules to use of energized systems such as ultrasonic dissection or LigaSure□ . The liver parenchymal surface is first coagulated and then crushed using a long-jawed crushing laparoscopic forceps to fracture the liver parenchyma exposing sizeable vessels and ducts.

All sizeable blood vessels and bile ducts are clipped before being cut. As the cleft deepens, bands of liver tissue, which are not severed, are presumed to contain large vessels which may be obscured by adherent layer of liver parenchyma. In this situation, palpation of the bridge between the index finger and thumb of the assisting hand will identify the nature of the structure.

All sizeable veins can be transected using an endolinear cutting stapler mounted with 35 mm vascular cartridge introduced through the minilaparotomy wound.

In the case of plurisegmentectomy, after the segment has been separated on three sides, it often remains attached to the liver by bridge of liver tissue. If this connection is no thicker than 1.0 cm, it is simply staple transected by the application of the endolinear cutting stapler to detach completely the area from the liver.

After resection, the specimen is removed through the open minilaparotomy wound. The final stage consists in securing complete hemostasis.

Hemostasis of the Cut Liver Surface

Only minor oozing happens from the cut liver substance if the technique of hepatic transection has been performed correctly and in the presence of a low CVP of patient. Complete hemostasis is achieved by argon plasma coagulation. Application of fibrin glue or other synthetic sealants are very helpful in achieving hemostasis.

Insertion of Drains

Once the resection is complete before the retractor is removed and the wound closed using mass closure with monofilament polydioxanone, a silicon drain should be introduced. It is advisable to insert even two large silicon drains one above and the other below the liver. These must be sutured to the abdominal wall to prevent accidental dislodgment after the operation. Effective drainage is crucial to prevent postoperative biloma.

Postoperative Management

It is important to stress that these patients should be nursed postoperatively in a hepatobiliary unit with immediate access to high dependency and intensive care if needed. The management remains the same as after any other laparoscopic surgery with daily monitoring of the liver function tests, hematology and blood urea nitrogen and serum electrolytes. Opiate medication and sedation are avoided in patients with compromised liver function. Repeated ultrasound scans should be carried out in all patients after hepatic resection. This is necessary to identify early fluid collections most usually bile, which if found are monitored by serial ultrasound studies and aspirated or drained percutaneously under radiological control if persistent.

Using right technique, necessary expertise and appropriate technology, laparoscopic and especially hand-assisted hepatic resections can be carried out safely. The data from the published reports to date indicate benefits over the open approach and these include reduced blood loss and lower postoperative morbidity.

LAPAROSCOPIC PANCREATIC SURGERY

The laparoscopic management of pancreatic disease is one of the most challenging in laparoscopic surgery. This is especially true when considering the procedure of pancreatic resection. Well-trained laparoscopic surgeons have found that operating on the pancreas, such as virtually all intra-abdominal procedures, is technically feasible. Laparoscopic principles suggest that the patient will probably benefit from less postoperative pain, improved wound cosmetics, quicker return to routine activities, and shorter hospital stay. Ultimately the acceptance of many laparoscopic operations is determined by their degree of difficulty, the operating time, the cost (both hospital and societal), and patient outcomes.

In comparison with the literature available on other laparoscopic operations, the information available on pancreatic resection is too scant to draw firm conclusions. However, leaders in the field have demonstrated that pancreatic resection is feasible, and are carefully examining their outcomes to further elucidate the role of this technically demanding procedure.

Laparoscopic procedures for the pancreas fall into four main categories:

1. Laparoscopic staging of pancreatic malignancy.
2. Bilioenteric or gastroenteric bypass.
3. Pancreatic resection.
4. Management of pancreatic pseudocysts.

Anatomic Considerations

The majority of the pancreas lies in a retroperitoneal position, transversely oriented from the second and third portions of the duodenum to the hilum of the spleen. Anterior access to the gland (body and tail) is readily obtained by division of the gastrocolic omentum. This division may be performed by electrocautery, multiple individual clip applications or vascular stapling devices, or ultrasonic dissection.

Access may be obtained through the gastrohepatic ligament, although the exposure is usually less adequate. The patient is positioned in slight head-up position to allow gravity retraction of the viscera. An oblique angle (30° or 45°) telescope is necessary for adequate visualization. Laparoscopic ultrasound is proving to be an essential tool for many aspects of pancreatic surgery.

Laparoscopic Staging of Pancreatic Malignancy

Patients with pancreatic malignancy generally present at later stages of disease. Frequently the disease is unresectable due to tumor size or tumor metastases by the time symptoms occur. Surgical resection for pancreatic cancer still offers the only reasonable chance at a cure. Historically, many patients underwent unnecessary laparotomy in an effort to assess resectability. CT scans have helped many patients avoid the morbidity of a nontherapeutic laparotomy. However, even with this modality, unresectability rates at laparotomy can approach 60%. This is most often due to the presence of unrecognized peritoneal metastases (<1 cm) and tumor invasion not appreciated on CT scan. Spiral CT and MRI are more reliable for predicting unresectability, but are still not adequate in our opinion. Megibow and coworkers reported a sensitivity of 77%, a specificity of 50%, and an overall accuracy of 73% for dynamic CT scanning. Also in their study, they found no additional benefit from MRI.

Diagnostic laparoscopy further narrows patient selection for therapeutic laparotomy. Warshaw and coworkers found that an additional 35% of patients could avoid laparotomy with the use of diagnostic laparoscopy. Despite improving noninvasive imaging methods since Warshaw and coworker's early reports, more recent studies confirm Warshaw and coworker's initial findings that a significantly number of patients (22–35%) can avoid laparotomy with the use of staging laparoscopy.

Further, the sensitivity for evaluation of unresectable disease appears further enhanced with the addition of the laparoscopic ultrasound to the laparoscopic staging procedure. Callery and coworkers use a multifrequency laparoscopic ultrasound probe to search for occult metastases and assess posterior invasion into vascular structures such as the portal vein. Tumors other than pancreatic were also included. Fifty patients were referred for staging laparoscopy after interpretation of conventional noninvasive imaging modalities had determined the tumor to be resectable. Laparoscopic ultrasound established unresectability in 11 patients (22%) in whom staging laparoscopy alone was negative. In another study by John and coworkers involving 40 consecutive patients with pancreatic cancer presenting for diagnostic laparoscopy, laparoscopic ultrasound found an additional 25% (10 patients) whose disease was unresectable when compared with laparoscopy alone. They found the use of ultrasound significantly improved specificity and accuracy as compared with laparoscopy alone (88 and 81% vs. 50 and 60%, respectively).

Staging Laparoscopy Technique

Patients generally undergo staging laparoscopy on the same day they are scheduled for resection. Patients are placed in the supine position on an electrically equipped bed (preferably). A 10 mm trocar is placed in the infraumbilical position to serve as the camera port. The abdomen is insufflated to 15 mm Hg. A 30° laparoscope is used. A second port of 5 mm is placed in the right midclavicular line several centimeters from the subcostal margin. A four-quadrant exploration is then carried out. Grasping devices, biopsy forceps, or electrocautery instruments may be alternatively introduced through the 5 mm port. Important peritoneal surfaces to visualize for areas of metastases include the undersurface of abdomen including falciform, diaphragm, and liver. The omentum must be examined thoroughly and when possible retracted superiorly to evaluate the base of the transverse colon, its mesentery, and the ligament of Treitz (this may require an additional port).

If there is evidence of unresectability, the procedure is terminated. Otherwise laparoscopic ultrasound is carried out. A second 10 mm port is placed in the right midclavicular line at the level of the umbilicus. Laparoscopic ultrasound is then performed using a 9 mm in diameter linear array 7.5 MHz contact ultrasound probe with Doppler flow capability. The liver is systematically scanned (anterior, lateral, inferior) at penetration depths of 7 cm for evidence of metastatic spread or extent of primary tumor invasion. Frequently, biliary and pancreatic metastases to the liver have a characteristic bulls-eye appearance with an echoic rim encircling a mixed-echo tumor center. If found, biopsy for such lesions may be attempted percutaneously, under laparoscopic ultrasound guidance.

Attention is then turned to ultrasonic evaluation of the porta hepatic, peripancreatic, para-aortic, and celiac axis for evidence of nodal disease. Lymph nodes greater than 10 mm may be biopsied. Laparoscopic ultrasound with Doppler flow capability is then used to help locate and assess the potential for tumor extension to surrounding peripancreatic vascular structures (primarily portal vein, but also superior mesenteric vein and artery, and celiac axis).

Bilioenteric or Gastroenteric Anastomosis for Pancreatic Malignancy

Unresectable patients might be candidates for biliary or enteric bypass. The risk and benefits of bypass must be weighed against existing palliative options, the patient's condition, existing or impending obstruction, and expected length of survival based on tumor burden. For most patients with unresectable disease, life expectancy can be expected to be <1 year. Proper management tailored to the individual patient's needs is important so as to offer as much quality of life free from hospitalization as possible.

Commonly, patients will present with some degree of biliary obstruction or will suffer from it during the course of the disease. Most patients with obstructive jaundice are best treated by placing an endoscopic or percutaneous stent. The success rate is high (85%), with a low associated mortality (1–2%). Studies comparing open bypass with those stented endoscopically for obstructive jaundice found no advantage to the surgical approach. Morbidity from stent placement includes potentially frequent admission to hospital (occlusion, infection) and significant cost for endoscopic retrograde cholangiopancreatography (ERCP) and stent. However, repeat placement has become less necessary with the use of improved techniques and stent design. Patients may present or develop distorted duodenal anatomy that makes initial or subsequent stent placement impossible. This finding may be coupled with gastric outlet obstruction. In these patients, bypass procedures may be offered after evaluation of surgical risk or life expectancy.

The morbidity of open surgical bypass is substantial (19%). Laparoscopic biliary (cholecystojejunostomy) or gastric bypass (gastrojejunostomy) is feasible. There is potential for shorter recovery, shorter return to activity; and low morbidity, as evident in several small studies. Nathanson suggests that the bypass should be reserved for a later date from the diagnostic laparoscopy at such time when duodenal obstruction precludes repeat stent or there is stent failure (blockage, recurrent sepsis). For the stomach, failure would include when symptoms of gastric outlet arise. Conditions at initial laparoscopy that might argue for immediate bypass include inability to stent the biliary system in the preoperative setting, endoscopic or radiologic evidence of impending duodenal obstruction, or laparoscopic impression of large locally advanced mass with minimal to no evidence of metastatic spread.

Biliary and Gastric Bypass

Cholecystojejunostomy may be carried out if the gallbladder is present and suitable for anastomosis, and the cystic duct is patent and its junction to the common bile duct (CBD) is far from the tumor. Frequently this information is available by preoperative imaging studies (ERCP or percutaneous transluminal cholangiography). If not, patency of cystic duct and its relation to primary tumor location may be obtained by performing a cholangiogram after cannulation of the gallbladder. Similarly, laparoscopic ultrasound may be used for such an assessment.

For either anastomosis, patients are positioned supine and the port placement is the same. A 10 mm trocar is placed at the inferior umbilical region and a 30° telescope is used. Additional ports and operating room personnel are positioned.

The omentum and transverse colon are elevated with instruments introduced through the epigastric and either 12 mm port. The small bowel is traced back to the ligament of Treitz. A loop of small bowel is then chosen that will comfortably reach stomach and gallbladder without tension (note that this is true once the transverse colon and omentum are allowed to return to normal position). For the biliary bypass, a cholecystotomy is performed with electrocautery on the gallbladder fundus. The biliary contents are then aspirated. An enterotomy is performed on the antimesenteric surface of the chosen small bowel loop. A 30 mm endoscopic stapler is introduced through the right 12 mm port. The jaws of the stapler are opened and one arm of the stapler is inserted into the enterotomy. The jaws of the stapler are then closed to function as a large grasper. The stapler and small bowel contained within are then maneuvered adjacent to the cholecystotomy. The jaws of the stapler are opened again and the free arm of the stapler maneuvered into the cholecystotomy. Assistance is provided by a blunt grasping instrument inserted through the additional ports (epigastric). After proper alignment is assured, the stapler is fired to complete the anastomosis. The original sites may be closed with additional firings of the stapler. At this point the endoscopic stapler will be introduced through the left

12 mm port. Care must be taken not to narrow the anastomosis or the lumen of the small bowel significantly.

To fashion the gastric bypass, a dependent site is chosen along the greater curvature. The gastrocolic omentum is divided close to the greater curve within the gastroepiploic arcade for a distance of approximately 3–4 cm with the ultrasonic scalpel or by electrocautery. A gastrotomy is made on the greater curvature. The anastomosis will be formed along the greater curve but will extend into the posterior wall of the stomach. Typically, the stapled anastomosis will be created by introducing the stapler through the right 12 mm port. The anastomosis should consist of two firings of the 30 mm endoscopic linear cutter.

Ideally, the stapled anastomosis should be aligned to cross the greater curvature to the posterior surface (i.e., through the area of divided gastrocolic omentum). If fashioned in this way, the original puncture sites will be easier to close and the anastomosis more dependent.

Laparoscopic Pancreatic Resection (Figs. 11A to E)

Indications for complete or partial pancreatic resection include:

- Adenocarcinoma
- Insulinoma (neuroendocrine)
- Chronic pancreatitis.

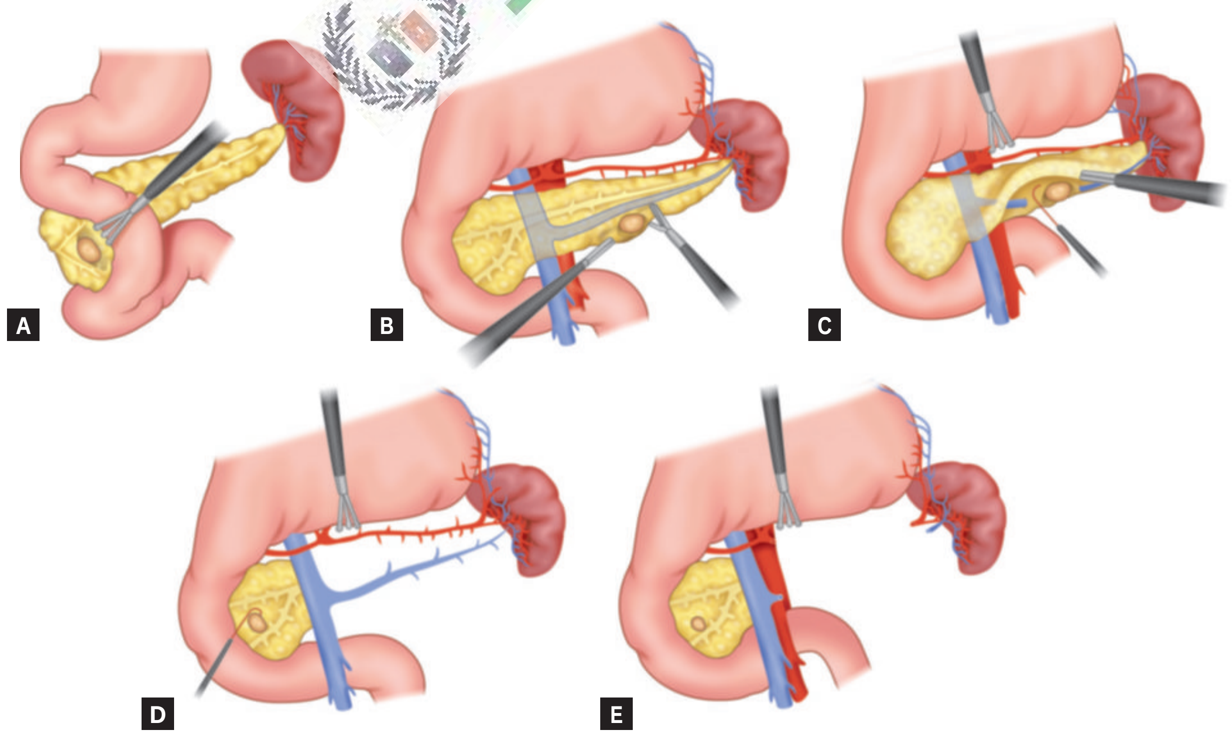
Improved technique and postoperative care have rendered morbidity and mortality for pancreatic resection, including Whipple's procedure, to <5%. Laparoscopic techniques could potentially lower this rate even more or at least accord less pain and a more rapid recovery **(Figs. 11A to E)**.

Laparoscopic Whipple's procedure was first carried out by Gagner in a small series of three patients with various diseases (pancreatitis, ampullary cancer, adenocarcinoma). He subsequently has reported on a pylorus-preserving technique performed in one patient with pancreatitis. The initial experience indicates that it is technically feasible, but because of its operative time, complexity, and as yet no demonstrated improvement in outcome, this procedure must be considered investigational. Hand-assisted laparoscopic surgery may make pancreatic resection more practical.

Laparoscopic pancreatic procedures involving distal pancreatectomy appear to hold more promise at present. Soper and coworkers reported success with his technique in the pig model. Gagner and coworkers successfully performed distal pancreatectomy for a variety of disease processes including islet cell tumors, cystadenocarcinoma, and pseudocyst. The spleen was preserved in all cases and operating times ranged from 2.5 to 5 hours. Cases were managed with the patient in the left lateral position, with pancreatic division carried out with a 60 mm linear cutter. Others are reporting initial success with distal resection.

Laparoscopic Management of Pancreatic Pseudocyst

Pancreatic pseudocysts may be defined as a collection of pancreatic secretions, serous fluid, or necrotic debris surrounded by a nonepithelialized wall made up of



Figs. 11A to E: Laparoscopic pancreatic resection.

granulation tissue and variable degree of fibrous tissue. Pancreatic pseudocysts must be distinguished from true cysts of the pancreas, which are characterized histologically by the presence of an epithelial lining. Pseudocyst formation is the result of a postinflammatory process arising from patients with acute or chronic pancreatitis. An understanding of the natural history of pancreatic pseudocyst is important when deciding on invasive therapy versus expectant management. Studies like those by Bradley and coworkers had a great influence in the management of pseudocystic disease. Bradley and coworkers suggested the likelihood of regression diminished and the likelihood of complications rose dramatically after a 6-weeks period. More recent data suggest that this patient population may be watched safely for longer periods. Yeo and coworkers followed asymptomatic patients with pseudocysts by CT scanning for 1 year (48% were successfully observed with only a 2.7% complication rate). The only predictor for intervention was size >7.4 ± 0.6 cm.

General asymptomatic patients with pancreatic pseudocyst may be followed up for extended periods of time. This conservative approach is more likely to be successful in patients with small 6 cm pseudocysts. Other options are available for drainage procedures (e.g., percutaneous transgastric, ERCP).

LAPAROSCOPIC PSEUDOCYST DRAINAGE

Preoperative decision making and subsequent laparoscopic operative approach should mimic that of open operative planning. The selection of procedure will depend on the anatomic location of the pseudocyst, pseudocyst size, and associated pancreatic duct or distal CBD abnormalities **(Fig. 12)**.

Reports by Newell and coworkers document that pseudocyst-gastrostomy is technically easier than pseudocyst-jejunostomy, while remaining equally efficacious. Laparoscopic pseudocyst-gastrostomy is technically easier, but cyst-jejunostomy is also technically feasible for the cyst not amenable to gastric drainage by standard surgical principles.

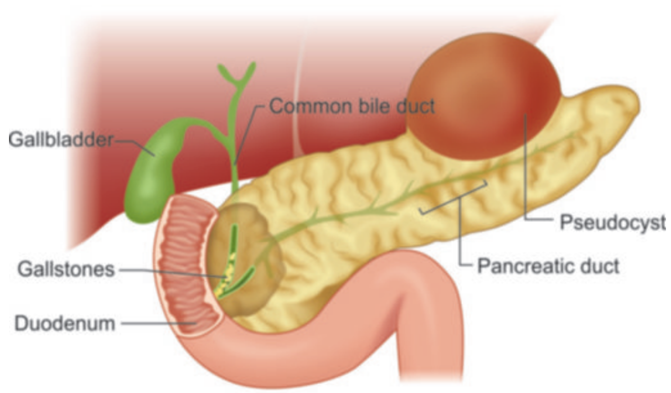


Fig. 12: Pancreatic pseudocyst.

Laparoscopic pseudocyst-gastrostomy was first performed by Petelin in 1991. Principles of operative drainage include biopsy of cyst wall to rule out neoplasm, dependent drainage, and precise hemostatic technique to avoid hemorrhage.

The patient position and port placement are the same as described for the bypass procedure. The pseudocyst may often be seen pushing the stomach forward. A small gastrotomy is established with cautery over the most prominent portion of the pseudocyst. Ultrasound may be helpful in locating the pseudocyst and the site of the initial gastrotomy. The gastrotomy is then extended for several centimeters with electrocautery.

A small window is developed through the posterior wall of the stomach with electrocautery. One must remember that the posterior wall of stomach and cyst capsule will be fused and that this requires a deeper dissection with cautery than felt comfortable by the surgeon. Ultrasound may be helpful to plan dissection where the stomach wall or cyst is thinnest. The window is made large enough to accommodate the endoscopic stapler. A biopsy of the wall may be carried out at this time. Two firings of the stapler are used to create a substantial anastomosis (stapler insertion through the more comfortable 12 mm port, usually the right). Hemostasis at the staple line should be assured. The gastrotomy is closed with either sutures or staples.

CONCLUSION

The laparoscopic approach to hepatic and pancreatic surgery has rapidly been shown to be of considerable value. The laparoscopic approach to the pancreas has value with respect to staging, bypass procedures, and pseudocyst drainage. Pancreatic resection is feasible, but must still be considered investigational.

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