Surgery for cancer carries concerns of tumor dissemination related to tumor manipulation, tumor violation, and wound seeding. Minimally invasive surgery is now standard for several benign conditions, such as symptomatic cholelithiasis and surgical therapy of gastroesophageal reflux. With the minimally invasive surgery explosion of the 1990s, virtually every procedure traditionally performed via laparotomy has been performed successfully with laparoscopic methods, including pancreaticoduodenectomy for cancer. Shortly after the first descriptions of laparoscopic-assisted colectomy, reports of port-site tumor recurrences surfaced, raising concerns of using pneumoperitoneum-based surgery for malignancy. This review covers the development of laparoscopic surgery for cancer. Historical perspectives elucidate factors that helped shape the current state of the art. Theoretical concerns are discussed regarding surgery-induced immune suppression and its potential effects on tumor recurrence with both open and laparoscopic approaches. The concerns of laparoscopic port-site wound metastases are addressed, with a critical evaluation of the literature. Finally, a technical discussion of laparoscopic-assisted resections of hepatic and pancreatic tumors details patient selection, operative approach, and existing data for these operations.

The article by Dr. Kooby is an excellent review of the application of laparoscopy for gastrointestinal cancers, with particular reference to hepatic and pancreatic resections. It is especially appropriate, as we are currently noticing an increase in the need for minimally invasive oncologic surgery.

Immune Function, Malignancy, and Laparoscopy

The effects of pneumoperitoneum-based surgery can be broken down into two categories: (1) mechanical effects due to instrumentation and pressure of pneumoperitoneum, and (2) metabolic effects due to the chemical properties of the particular gas used (such as carbon dioxide). Establishing supraphysiologic concentrations of gas (carbon dioxide) that the body is actively trying to exhale can be associated with short-term and likely long-term metabolic consequences. Some of these include acidosis, alterations in cardiac function, and a differential effect on immune response. While the effects on acid-base balance and cardiorespiratory changes are usually self-limiting, it is not clear whether the effects on immune response have any bearing on the long-term oncologic outcome. In this regard, Dr. Kooby appropriately points out the differential effects of laparoscopy on systemic and local immune mechanisms.

The crucial role of natural killer cells and peritoneal macrophages in tumor immunity is highlighted by Dr. Kooby. It is well known that tumor-associated macrophages have been shown to display both pro- and antitumor activity and therefore are considered to play an important role in tumor immunity. In addition, some authors have also shown a correlation between macrophage counts and long-term outcome in malignancies involving the lung and breast. On the other hand, it has been also shown that CO₂ can significantly impair macrophage function. It remains to be seen if the CO₂ used during laparoscopic cancer surgery impairs the function of tumor-associated macrophages to the extent that it has any bearing on long-term oncologic outcome.

Port-Site Metastasis

The high incidence of port-site metastases reported initially in a small series of patients was alarming.[1] This was followed by a spate of animal experiments that had several drawbacks, as noted by Dr. Kooby, such as injecting cancer cells into nonorthotopic locations, using various routes of cancer cell delivery (cecal mesentry, intraperitoneal, portal vein, renal capsule, and transanal), having variable tumor volume, and using different endpoints for analysis. Finally, analyzing the effects of CO₂ pneumoperitoneum on tumors (located at sites distant from the abdomen) not directly exposed to CO₂ can be misleading. The author appropriately notes that these results are therefore to be interpreted with a measure of caution and may not exactly be extrapolated to the clinical
situation. Subsequent reports in humans with large numbers of patients have noted an incidence of port-site metastases similar to that of open surgery in gynecologic malignancies (1,288 patients, 0.97%), gastrointestinal malignancies (435 patients, 0.5%), and genitourinary malignancies (10,912 patients, 0.09%).[2-4]

It is now clear that the incidence of port-site metastasis is equivalent to open surgery as long as sound oncologic principles are applied. Some additional precautions that are recommended in reducing the incidence of port-site metastasis include the following: Avoid excessive manipulation of the port sites, prevent dislodgement of the trocars, keep pneumoperitoneum at the lowest pressure possible to maintain visibility, use wound protectors when performing extracorporeal anastomoses, deflate the pneumoperitoneum with the trocars in place, and close the peritoneum when possible.

Hepatic and Pancreatic Resections

Laparoscopic liver and pancreatic resection requires expertise in both open liver/pancreatic surgery and advanced laparoscopic surgery, and therefore should be performed only in centers with a history of excellence in both. Liver resection has remained one of the last barriers in the use of laparoscopy due to several concerns, such as the inability to control bleeding in a rapid fashion, the difficulty of handling soft and friable tumors in the liver to assess margins, and the lack of proper instrumentation.

The risk of embolism through injured hepatic veins is present in both open and laparoscopic liver resection (LLR). This risk can be aggravated when using the argon beam coagulator during LLR due to the pressure of pneumoperitoneum and the inertness of argon gas. However, with improved instrumentation, several reports have shown that LLR is feasible and safe with short-term outcomes similar to or slightly better than open liver resection. Studies have documented that LLR can be performed with blood loss similar to or less than open liver resection. With the help of laparoscopic ultrasound, it has been noted that adequate margin width can be obtained with LLR. There have been no documented cases of CO2 embolism in the recently published series of LLRs.[5]

It must be emphasized that the availability of technology should not broaden the indications for LLR. Liver lesions that appear questionably benign should be operated on only in the presence of symptoms or due to uncertainty of diagnosis. The majority of LLRs are currently performed in patients with lesions involving the accessible segments of the liver (II, III, IVa, V, VI, and left lateral segmentectomies). Some centers have reported their experiences with right-sided resections as well. The laparoscopic approach is also ideally suited for patients with primary liver malignancies with extensive comorbidities. With increasing experience and demonstration of similar long-term outcomes in large series of patients, it is likely that we will witness an increase in LLRs.

Laparoscopy is currently utilized mainly for distal pancreatectomy (LDP) and several studies have documented the feasibility and safety of this approach. In the era of increasing detection of indeterminate cystic lesions of the pancreas, the laparoscopic approach has been a timely addition to the management algorithm. The current topics of controversy in laparoscopic pancreatic surgery include indications for surgery and splenic preservation. It is generally agreed that patients with a clear-cut preoperative diagnosis of adenocarcinoma should not be approached via the laparoscope due to the inability to perform an oncologically adequate operation. Current data are inadequate to support the role of laparoscopic distal pancreatectomy in patients with pancreatic adenocarcinoma. While the oncologic benefits of splenectomy in patients with pancreatic adenocarcinoma are questionable, at the same time it is unlikely that splenectomy will be of any benefit to patients with a benign diagnosis on final histopathology. This is important, as the majority of patients with suspicious cystic lesions of the pancreas that undergo operative intervention are noted to have a benign diagnosis. Although technically demanding and cumbersome, an attempt to preserve the spleen should be made in patients undergoing laparoscopic distal pancreatectomy. Several studies have shown that spleen-preserving laparoscopic distal pancreatectomy is feasible with acceptable morbidity.

The hand port is a useful tool for several reasons, as Dr. Kooby elucidated, and can also act as bridge along the learning curve between open and laparoscopic surgery. With increasing experience, studies have shown that distal pancreatectomy can be performed via a complete laparoscopic approach. Lastly, some reputed centers of excellence have shown that laparoscopic pancreaticoduodenectomy is safe and feasible.[6] However, current data are inadequate to justify the role of laparoscopic pancreaticoduodenectomy.
The value of any new oncologic procedure, such as laparoscopy, relies on its ability to produce similar or better short- and long-term outcomes when compared to the traditional open approach. Evidence exists in the literature to support similar or better short-term outcomes with laparoscopy. These procedures require skill in both complex open operations and advanced laparoscopy and should be performed only in centers that can combine both areas of expertise. Further studies with larger numbers of patients are required to demonstrate any true benefits in long-term oncologic outcomes when compared to open surgery. Until then, the indications for minimally invasive surgery for malignancy should be carefully weighed against its oncologic adequacy in each individual patient.

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Disclosures:
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