

2. Preoperative Evaluation of Complex Laparoscopic Patients

Dmitry Oleynikov, M.D.

Karen D. Horvath IV, M.D.

Complex laparoscopic patients require careful preoperative planning for optimal outcome. These patients present unique problems that necessitate special consideration and a surgeon experienced in basic laparoscopic cases. This chapter discusses a number of such patient groups, including patients with previous abdominal surgery, significant cardiopulmonary comorbidity, obesity, and pregnancy. When evaluating any of these patients, *six questions* should be asked:

1. *Are there any contraindications to a laparoscopic procedure?*
2. *Does this patient need any additional preoperative testing? Does the surgeon need additional past medical or surgical information before surgery for planning purposes?*
3. *Does this patient need any additional preoperative medical or anesthesia planning? Will a planned postoperative ICU stay be required?*
4. *Should additional nonroutine issues be discussed with the patient as part of the informed consent?*
5. *Will the standard laparoscopic approach need to be altered in any way?*

If the answer to the question is yes, it is recommended that the alteration be dictated into the preoperative evaluation note at the time this decision is made and not left to last-minute consideration on the day of surgery.

6. *Will this procedure require any unique equipment or staffing in the operating room that should be arranged in advance?*

A. Patient with Previous Abdominal Surgery

Few situations command as much respect as a laparoscopic procedure in a heavily scarred abdomen.

1. *Contraindications to a laparoscopic approach:*
The only contraindication to a laparoscopic approach, in regard to patients with a history of prior abdominal operations, is a documented history of a frozen abdomen.
2. *Additional preoperative testing/and pertinent past surgical history:*
 - a. Previous operative records
 1. Note the amount and type of adhesions encountered at the previous surgery.

2. Determine the type and number of prosthetic devices used, i.e., mesh for reoperative hernia or number of stitches in a previous laparoscopic Nissen.
 - b. Radiographic imaging
 1. Standard imaging before reoperative surgery, e.g., UGI for reoperative foregut surgery or CT scan for patient with diverticulitis to determine need for ureteral stenting.
 2. Ultrasound of the abdominal wall may help map adhesions preoperatively.
 - c. Preoperative physical examination to appreciate the number and location of prior incisions and to look for incisional hernia(s).
3. *Additional preoperative medical/anesthesia planning:*

Patients with a prior history of abdominal operations who are to undergo further surgery present no specific medical/anesthetic issues directly related to their past surgery. Standard evaluation should be performed as dictated by the patient's age and comorbidities.
4. *Special issues for the informed consent:*

Regardless of type of procedure, reoperative laparoscopic surgery carries increased risks and patients should be counseled regarding them.

 - a. Increased chance that conversion to an open laparotomy will be necessary.
 - b. Additional ports may be required for adhesiolysis.
 - c. Increased risk of enterotomy or other visceral injury.
 - d. If an incisional hernia is present, patients should be consented for a simultaneous repair, if the primary laparoscopic procedure to be carried out is not classified as contaminated.
5. *Planned alterations from the standard laparoscopic approach:*
 - a. Method of establishing a pneumoperitoneum in the reoperative abdomen. Options include:
 1. Veress needle entry with blind trocar insertion.

One of the more popular methods for gaining entry into the peritoneal cavity. Caution should be used, however, especially in those with history of prior surgery, as evidence suggests a higher complication rate. If this method is to be used, the site chosen for Veress needle insertion should be well away from the prior incisions.
 2. Open/Hasson entry with blunt-tip trocar.

Allows for a more controlled method of gaining access to the abdominal cavity and of establishing pneumoperitoneum and has been shown to have fewer complications compared with blind entry. The open/Hasson method is the preferred method in a reoperative abdomen. Also allows blunt finger dissection of local adhesions through the initial port site.
 3. Optical trocars.

Allows visualization of the path of the trocar during insertion (Optiview, Ethicon Endosurgery, Cincinnati, OH; Visiport, USSC/Tyco Corp, Norwalk, CT). This method has not been well studied. The theoretical advantage is that by observing the trocar insertion injuries to the viscera and

- vessels can be avoided. This method requires blind Veress needle insertion and insufflation before trocar insertion. This method should be carefully considered in a patient with a history of multiple prior operations or adhesions.
- b. Port placement in the reoperative abdomen.
 1. Initial port placement should be well away from all abdominal wall scars, even if this port will not be of much use during the laparoscopic procedure. The right or left upper quadrant in the midclavicular line has proven to be a safe starting point.
 2. Additional ports should be placed under direct observation.
 6. *Unique OR equipment or staffing:*
 - a. Increased OR time.
Laparoscopic surgery in a reoperative abdomen often requires additional OR time for establishing the pneumoperitoneum and performing adhesiolysis, similar to reoperative open surgery. If an incisional hernia is found on physical examination, extra time should also be allotted for its repair.
 - b. Open instruments may be needed in case of conversion.
 - c. Special tools for adhesiolysis.
 1. Additional trocars.
 2. Angled laparoscope.
 3. Ultrasonic scissors or bipolar cautery for adhesiolysis. These tools decrease the incidence of the complication known as “arcing” that can be seen with monopolar cautery, i.e., tissue damage from electrical current at a site remote from the intended area of cauterization.

B. Patients with Significant Cardiopulmonary Comorbidity

An important difference between open and laparoscopic surgery are the CO₂ pneumoperitoneum-related intraoperative physiologic effects. The CO₂ gas used for the pneumoperitoneum raises the intraabdominal pressure from 0 to 15 mmHg, resulting in hemodynamic and pulmonary function alterations. Due to the transperitoneal absorption of the insufflated CO₂ gas into the blood, a hypercarbic acidemic state results. The healthy patient is able to compensate for these changes; however, the patient with significant cardiopulmonary disease may not have the physiologic reserve to appropriately compensate. These minor physiologic stressors can have major implications in high-risk cardiopulmonary patients; thus, these patients need very close monitoring during laparoscopic surgery, even for minor procedures.

Preoperative risk stratification may be accomplished using several methods. Eagle formulated guidelines that help identify patients who are at high risk for cardiac events during noncardiac surgery (Table 2.1).

1. *Contraindications to a laparoscopic approach:*

There are no absolute contraindications to a laparoscopic approach in a patient with significant cardiopulmonary disease.

Table 2.1. Clinical predictors of increased perioperative cardiovascular risk (myocardial infarction, congestive heart failure, death).

Major risk	Intermediate risk	Minor risk
Unstable coronary syndromes —Recent MI —Unstable or severe angina —Decompensated CHF	Mild angina pectoris (class I and II) Prior myocardial infarction by history or pathologic Q waves	Advanced age Abnormal ECG Rhythm other than sinus
Significant arrhythmia —High-grade AV block —Symptomatic ventricular arrhythmia in the presence of underlying heart disease —SVT uncontrolled rate	Diabetes mellitus Compensated or prior CHF	Low functional residual capacity History of stroke
Severe valvular disease		

MI, myocardial infarction; CHF, congestive heart failure; AV, atricoulntricular.

Source: Reprinted with permission from Eagle KA, Brundage BH, Chaitman BR, et al. Guidelines for perioperative cardiovascular evaluation for noncardiac surgery. Report of the American College of Cardiology/American Heart Association. 1996;93(6):1278–1317.

2. *Additional preoperative testing/information:*
 - a. Mandatory
 1. EKG
 3. Hematocrit
 4. electrolytes
 5. Chest radiograph
 - b. May be indicated (depending on the patient's history and situation)
 1. Echocardiography
 2. Stress test (standard treadmill, echo stress, thallium, etc.)
 3. Holter monitor or other arrhythmia evaluation
 4. Digoxin levels
 5. Pulmonary function testing
 6. Carotid duplex
3. *Additional preoperative medical/anesthesia planning:*
 - a. Medical clearance.
All patients in this category should be “cleared” by their primary medical doctor or cardiologist. Depending on the patient and the extent of prior cardiopulmonary evaluation, the patient may require one or more of the above-listed tests preoperatively (noted in 2b).
 - b. Anesthesia considerations.
 1. Arterial line for hemodynamic and acid-base monitoring

All patients with significant cardiopulmonary disease should have an arterial line during laparoscopic surgery. This line is crucial for accurate hemodynamic monitoring in the face of increased afterload and decreased preload imposed by the pneumoperitoneum. Furthermore, the end-tidal CO_2 is **not** an accurate reflection of the arterial PCO_2 (Figure 2.1). The end-tidal CO_2 lags behind the arterial PCO_2 . Patients with pulmonary disease are less able to effectively eliminate CO_2 and are thus more susceptible to acidemia with its harmful physiologic implications.

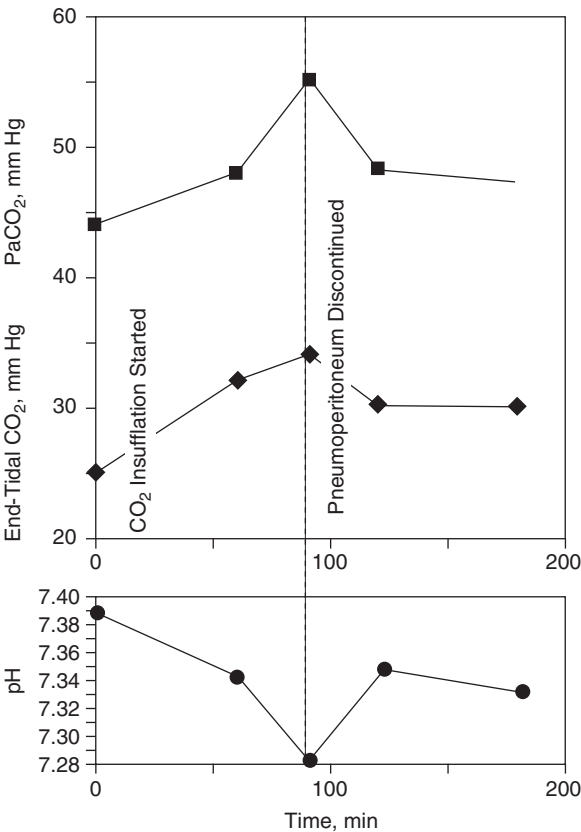


Figure 2.1. Note the nonlinear relationship between ETCO_2 and PaCO_2 . A patient with an ETCO_2 of 35 can easily have a true PaCO_2 of 55 and a pH of 7.28. (Source: Reprinted with permission from Wittgen CM, Andrus CH, Fitzgerald SD. Analysis of the hemodynamic and ventilatory effects of laparoscopic cholecystectomy. Arch Surg 1991;126:997.)

2. Strongly consider central monitoring.
Patients with diminished ejection fraction may benefit from central monitoring of cardiac filling by the anesthetist (Swan-Ganz catheter).
- c. Pulmonary function testing and room air arterial blood gas analysis.
 1. These should be initiated in consultation with the anesthesiologist.
- d. Schedule a postoperative ICU or telemetry bed.
4. *Special issues for the informed consent:*
Regardless of the approach, surgery in this population carries increased risks of perioperative morbidity and mortality and patients should be counseled regarding these.
5. *Planned alterations from the standard laparoscopic approach:*
 - a. Use lower pressures for pneumoperitoneum (10–12 mmHg).
Human and animal experiments have demonstrated that pulmonary and hemodynamic changes are related to the pneumoperitoneum pressure. This is not a linear relationship. At *low pressures* (0–10 mmHg), relatively few changes can be detected in a normovolemic healthy adult. This relationship begins to change rapidly as intraabdominal pressure increases. At *moderate pressures* (10–22 mmHg), preload, afterload, and cardiac function are affected. Patients who are volume depleted (e.g., patients on chronic diuretic therapy) are more prone to developing significant cardiovascular alterations as a result of CO₂ pneumoperitoneum, even at low pressures. Therefore, it is important to adequately hydrate patients preoperatively, especially those patients who have undergone a bowel preparation. For patients with congestive heart failure it is crucial to avoid overresuscitation. These issues should be discussed with the anesthetist.
6. *Unique OR equipment or staffing:*
 - a. Helium or nitrous oxide gas pneumoperitoneum.
If available in your institution, use of these alternate gases for the pneumoperitoneum can minimize the effects of hypercarbia and acidemia. However, the hemodynamic alterations related to the elevated intraabdominal pressure remain the same. Further, there is a theoretical risk of gas embolism. If helium or nitrous oxide gas is to be used to establish and maintain pneumoperitoneum, then special equipment (dedicated insufflators, etc.) is usually required.
 - b. Minimize OR time by soliciting the most senior assistant available.

C. Obese Patient

Obesity is defined as a body mass index (BMI) over 30 or approximately 50 lb above ideal body weight. By this definition 20% of male and 25% of female Americans are obese. Obese patients may have a number of comorbid condi-

tions including pulmonary, cardiovascular, and metabolic disorders that need to be addressed during the preoperative evaluation. These patients also present distinct laparoscopic challenges.

1. *Contraindications to a laparoscopic approach:*
There is no absolute contraindication to laparoscopic surgery in the obese patient.
2. *Additional preoperative testing/information:*
 - a. EKG.
 - b. CXR.
 - c. Cessation of smoking.
 - d. Attempted weight loss preoperatively, even if minimal.
 - e. Cardiac and pulmonary testing as indicated in those with cardiac or pulmonary comorbidities.
3. *Additional preoperative medical/anesthesia planning:*
 - a. Standard risk evaluation should be performed as dictated by the patient's age and comorbidities. Routine medical clearance is recommended.
 - b. Complete muscle relaxation.
The degree to which the abdominal wall is elevated in response to the pneumoperitoneum is maximized if the abdominal wall muscles are relaxed.
4. *Special issues for the informed consent:*
Regardless of the specific procedure, laparoscopic surgery carries increased risks in obese patients, and the patient should be counseled regarding these.
 - a. Increased chance of conversion to open laparotomy.
 - b. Additional ports may be required to obtain adequate exposure.
5. *Planned alterations from the standard laparoscopic approach:*
 - a. Extralong ports, trocars, and instruments may be needed.
Body weight distribution plays an important role in gaining pneumoperitoneum and selecting appropriate ports and trocars.
 1. Female obese patients commonly have a very thick subcutaneous layer of fat with a relatively thin mesentery and omentum whereas male patients more often have a thin abdominal wall with generous mesentery and omental fat deposition.
 2. The upper abdominal wall is, most often, significantly thinner than the lower abdominal wall. Therefore, for upper gastrointestinal (GI) procedures such as Nissen fundoplication or gastric bypass extralong trocars are usually not needed; however, such trocars may be required for procedures that require lower abdominal ports.
 3. Extralong instruments may be needed for tall patients and those with a long abdominal cavity in those cases that require working in both the upper and lower abdomen. As an example, during left colectomy, splenic flexure mobilization is often necessary. The optimal port placement for the majority of the tasks that need to be accomplished during

the case is one where the most cephalad ports are at a level just above the umbilicus and the lower ports are well below the umbilicus. Standard instruments may not reach the splenic flexure from the lower port locations. The availability of extralong instruments should allow the flexure to be mobilized without having to place additional upper abdominal ports.

- b. Open Hasson technique is preferable to Veress needle entry in morbidly obese patients.

The “cues” and “signs” of correct needle insertion such as initial insufflation pressures (high flow rate and a low intraabdominal pressure) and tympani over the abdomen are harder to gauge in these patients. There is greater uncertainty with blind needle insertion and blind trocar insertion techniques.

- c. Place the skin incision for the initial port at the umbilicus, which is the thinnest part of the abdominal wall. Caution should be used in patients with a large pannus where the umbilicus may lie at the level of the pubic symphysis.
- d. Angle ports toward the quadrant or area where the operation is to be carried out.
Normally, ports are placed perpendicular to the abdominal wall. In morbidly obese patients, a perpendicular trocar may result in excessive torquing of ports with gas leakage and bending of instruments.
- e. Suture ports to the abdominal wall to prevent slippage.
Port slippage can lead to gas leak and subcutaneous emphysema, which further thickens the anterior abdominal wall. There are several methods for securing a port.
 - 1. One method is to place a skin suture near the port, tie it loosely, then wrap one end around the insufflation arm of the port and secure it to the other end of the suture with a clamp.
 - 2. Threaded port grips are another method of securing a port.
 - 3. The port can be secured via a heavy suture that is passed through the entire abdominal wall from the outside and then repassed back outside, after which one end is wrapped around the insufflation arm of the port and then secured with a clamp to the other end. This latter method, although a bit more time consuming, also prevents the abdominal wall in the area of the suture from increasing its girth as may occur when subcutaneous emphysema develops.
- f. Use of increased pneumoperitoneum pressures (15–20 mmHg) to elevate a heavy anterior abdominal wall.
Elevated pressures may enlarge the operative field and improve visualization; however, the increased pressure may decrease venous return and cardiac output in patients with cardiovascular disease. For this reason, increased pneumoperitoneum pressures should only be used selectively, for brief periods. The patient must be monitored more closely when elevated pressures are utilized.

Changes in insufflation pressures must be communicated to the anesthetist. The anesthetist should be told at the start of the case to keep the surgeon informed of end-tidal CO₂ elevations, the need for high inspiratory pressures, and hypoxia. Close communication between the surgeon and the anesthetist will allow for timely adjustments of peak insufflation pressures, patient position, and the respirator settings. At times, when the end-tidal CO₂ is very high, it may be appropriate to desufflate the abdomen altogether and put the patient in reverse Trendelenburg position.

- g. Deep venous thrombosis (DVT) prophylaxis.
Pneumatic compression devices + preoperative subcutaneous heparin (unless contraindicated).
Obesity is an independent risk factor for perioperative DVT formation, and therefore all patients should receive prophylaxis.
- 6. *Unique OR equipment or staffing:*
 - a. Increased OR time.
Laparoscopic surgery in the morbidly obese patient often requires additional OR time.
 - b. Special large-size OR table.
 - c. Foot boards and safety straps to avoid shifting during intraoperative positioning.
 - d. Angled laparoscopes.
 - e. Additional ports for exposure.
 - f. Postoperative "Big Boy Bed."

D. Pregnant Patient

The pregnant patient may develop appendicitis, cholecystitis, torsion of the ovary, or a number of other problems that may require urgent or emergent surgery. When surgery is necessary in this population, minimally invasive methods can be used. Pregnancy may either lower or heighten the threshold for surgical exploration and treatment. The surgeon must determine the status of the pregnancy and inform the patient of both the routine risks and the pregnancy-related risks of surgery. The height of the gravid uterus can alter the position of the intestine and other intraabdominal organs and may necessitate a different port arrangement.

- 1. *Contraindications to a laparoscopic approach:*
 - a) At what gestational age can laparoscopy be performed safely and effectively? Most authorities recommend avoidance of pneumoperitoneum and laparoscopy until the second trimester for indicated nonemergent operations. However, some recently published series report the safe performance of laparoscopic cholecystectomy in patients beyond the 21st week. In the second and third trimesters, because of the size of the gravid uterus, the location of the intestine and other viscera shifts in a cephalad direction. It is important to avoid manipulation of the uterus during surgery, which can induce preterm labor.

- b) Although there are reports of successful laparoscopic procedures during the first 16 weeks of gestation, there are too few data to permit a recommendation for such an approach. All nonemergent surgery should be postponed until the second trimester.
- 2. *Additional preoperative testing/information:*
 - a. Evaluation stage of pregnancy
 - 1. First trimester (1–14 weeks after last menstrual period).
Organogenesis occurs during this time period.
 - a. The viability and current location of the pregnancy should be evaluated preoperatively.
 - b. Once an intrauterine pregnancy is confirmed, cardiac activity can be seen on ultrasound at the estimated gestational age of 6–7 weeks.
 - 2. Second trimester (14–28 weeks)
 - a. Preoperative evaluation should include determination of viability and confirmation of dates.
 - b. Early second trimester has traditionally been favored for elective surgical intervention because the risk of preterm labor is less than in the third trimester and because organ development is complete.
 - c. Ultrasound is the best modality to document gestational age.
 - d. The gestational age beyond which survival of the neonate outside of the uterus is feasible is now approaching 23 weeks in certain centers. When operating at or close to the age of viability, the opinion of an obstetric specialist should be sought. Depending on the facilities available, postoperative recovery should be carried out in the hospital obstetrics unit.
 - 3. Third trimester (28–42 weeks)
 - a. Preoperative evaluation begins with close consultation with the treating Ob/Gyn.
 - b. Due to an increased risk of preterm delivery (<37 weeks estimated gestational age), every effort should be made to postpone surgery until after delivery of the fetus, except for emergent indications.
 - a. *Additional preoperative medical/anesthesia planning:*
 - a. An obstetrician should evaluate all pregnant patients perioperatively.
 - b. Avoid fetal acidosis.
 - 1. Keep end-tidal CO₂ between 25 and 33 by changing minute ventilation.
 - 2. Consider arterial blood gas monitoring.
 - c. Special anesthetic precautions should be used to avoid aspiration and hypotension.
 - 4. *Special issues for the informed consent:*

Large studies on the safety of laparoscopic surgery in the pregnant patient do not exist. Poor fetal outcomes and complications after laparoscopic surgical procedures are thought to be underreported. The

precise risk of premature labor and loss of pregnancy after laparoscopic surgery is unknown at this time. Despite this lack of data, patients should be informed of the following:

- a. Increased chance of conversion to open laparotomy.
 - b. Before 14 weeks, up to 30% of known pregnancies undergo spontaneous abortion, in the absence of surgery. This is an important point that should be documented in the preoperative consent.
 - c. The risks relating to surgery during the first trimester include teratogenesis and a miscarriage rate of approximately 12%.
 - d. The risks of surgery during the second trimester include a 5%–8% risk of preterm labor.
 - e. The risks of surgery during the third trimester includes a risk of preterm labor and premature delivery.
 - f. The possibility of damaging the gravid uterus with laparoscopic instruments, ports, or trocars.
5. *Planned alterations from the standard laparoscopic approach:*
- a. Minimize operative time so that fetal acidosis is minimized. Solicit the most senior assistant available even for a “minor” case.
 - b. Open/Hasson entry above the umbilicus to avoid injury to the gravid uterus.
By the 20th week of gestation, the uterus is generally at the level of the umbilicus.
 - c. Minimize pneumoperitoneum pressures to the 10–12 mmHg level.
 - d. Elevation of the patient’s right side during positioning to avoid inferior vena cava compression by the gravid uterus.
 - e. Use angled laparoscopes to facilitate seeing around the uterus.
 - f. Maternal monitoring with end-tidal $\text{CO}_2 \pm$ arterial blood gas monitoring
Fetal acidosis is known to occur with CO_2 pneumoperitoneum, although the short- and long-term effects of this are unknown. Should the mother become acidemic, the pneumoperitoneum should be released and the patient hyperventilated to expel the CO_2 gas before continuing the procedure. It is important to note that the fetus is usually more acidemic than the mother.
 - g. Routine use of pneumatic compression devices. The risk of thromboembolism is increased during pregnancy.
 - h. Use a lead shield to protect the fetus during cholangiography.
 - i. Fetal monitoring.
Significant controversies in the literature exist on the merits and techniques of intraoperative fetal monitoring. At the least, pre- and postoperative fetal heart tones should be obtained and carefully documented when surgery is performed during the second and third trimesters.
6. *Unique OR equipment or staffing:*
- a. Special OR equipment is not needed for the pregnant patient.
 - b. Senior assistance should be sought in the OR to minimize operative time.

E. Selected References

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