

# Trocar Placement - Case Scenario

1. You are called to see a 25-year-old nulliparous female, presenting with acute-onset unremitting left lower abdominal pain. She has had several episodes of this pain in the last month which have resolved spontaneously. She now presents with severe pain that began at 2 AM awakening her from sleep. She vomited on the way to the hospital. Upon presentation, she appears to be in acute distress. She is tachycardic but normotensive. She is tender with localized peritonitis in the left lower quadrant. Her point of care ultrasound shows a simple left adnexal cyst measuring 6.5 x 6 x 6 cm<sup>3</sup> with some surrounding free intraperitoneal fluid. You have a working diagnosis of a left ovarian theca luteal cyst with possible ovarian torsion. You would like to proceed with diagnostic laparoscopy. Which of the following is an absolute contraindication to laparoscopy?
  - a. Current pregnancy
  - b. Prior laparoscopic cholecystectomy
  - c. Patient in Shock
  - d. Patient with BMI >30

Explanation: Refractory hemodynamic instability of any origin is an absolute contraindication to laparoscopy. Absolute contraindications to laparoscopy include: overt peritonitis with gross intrabdominal contamination, intrabdominal visceral/vascular injuries following trauma, abdominal compartment syndrome, shock, evisceration, abdominal wall dehiscence, and uncorrected coagulopathy. Acute intestinal obstruction with dilated bowel > 4 cm is a relative contraindication as bowel injury may occur with the manipulation of dilated bowel laparoscopically. There is a risk of fetal loss and uterine injury with laparoscopy, but pregnancy is not an absolute contraindication to laparoscopy. Recent laparotomy within 4-6 weeks or extensive abdominal adhesions from a prior surgery are relative contraindications to laparoscopy. Obesity poses a challenge with trocar placement and maintenance of insufflation but is not a contraindication to laparoscopy. Additional relative contraindications include very sick ICU patients, infections involving the anterior abdominal wall, and cardiopulmonary compromise.

- Curet MJ. SPECIAL PROBLEMS IN LAPAROSCOPIC SURGERY: Previous Abdominal Surgery, Obesity, and Pregnancy. *Surg Clin North Am.* 2000 Aug 1;80(4):1093–110.
- Soriano D, Yefet Y, Seidman DS, Goldenberg M, Mashiach S, Oelsner G. Laparoscopy versus laparotomy in the management of adnexal masses during pregnancy. *Fertil Steril.* 1999 May;71(5):955–60.
- Nasioudis D, Tsilimigras D, Economopoulos KP. Laparoscopic cholecystectomy during pregnancy: A systematic review of 590 patients. *Int J Surg Lond Engl.* 2016 Mar;27:165–75.
- Exploratory (Diagnostic) Laparoscopy: Background, Indications, Contraindications. 2022 Jun 29 [cited 2023 Feb 24]; Available from <https://emedicine.medscape.com/article/1829816-overview>

2. From your thorough history and physical exam, you have not identified any contraindications to laparoscopy. She is pleased about this option that would leave her with smaller scars. Which of the following clinical concerns should be included in her informed consent?
- a. Risk of vascular injury
  - b. Possible conversion to open surgery
  - c. Risk of bowel injury
  - d. All of the above

Explanation: Risks specific to laparoscopy include: complications of trocar placement and insufflation, visceral injury, vascular injury with uncontrollable bleeding, or other complications that might necessitate conversion to open surgery.

- Mishra DRK. Patient consent in Laparoscopic Surgery [Internet]. [cited 2023 Feb 25]. Available from: <https://www.laparoscopyhospital.com/laparoscopy-consent.html>

3. The patient has given her consent for diagnostic laparoscopy. You call your anesthesiologist to review the patient's information. What type of anesthesia is conventionally used for laparoscopy?
- General anesthesia with LMA
  - General anesthesia with endotracheal intubation**
  - Spinal anesthesia
  - Epidural anesthesia

Explanation: Traditionally, laparoscopy is performed under general anesthesia for fear of consequences of pneumoperitoneum on ventilation. The patient is usually paralyzed which may pose a risk of aspiration if the airway is secured with LMA. However, recent studies have challenged the necessity of general anesthesia, suggesting that regional anesthesia may be useful and, in some cases, better than general anesthesia in laparoscopy. This argument is based on the better immediate post-operative pain control, absence of airway manipulation, and ability to maintain spontaneous breathing with minimal side effects that can be easily controlled with medication. Tiwari et al report a 5.9% conversion rate from spinal to GA in laparoscopic cholecystectomy, owing to abdominal discomfort, anxiety, nausea, and vomiting. For the purposes of beginning laparoscopy, general anesthesia with endotracheal intubation is the classical and preferred method.

- Tzovaras G, Fafoulakis F, Pratsas K, Georgopoulou S, Stamatiou G, Hatzitheofilou C. Spinal vs General Anesthesia for Laparoscopic Cholecystectomy: Interim Analysis of a Controlled Randomized Trial. *Arch Surg*. 2008 May 1;143(5):497–501.
- Bajwa SJS, Kulshrestha A. Anaesthesia for laparoscopic surgery: General vs regional anaesthesia. *J Minimal Access Surg*. 2016;12(1):4–9.
- Mishra DRK. Laparoscopy Hospital - Anaesthesia in laparoscopy [Internet]. [cited 2023 Feb 25]. Available from: <https://www.laparoscopyhospital.com/anaesthesia.htm>
- Tiwari S, Chauhan A, Chaterjee P, Alam MT. Laparoscopic cholecystectomy under spinal anaesthesia: A prospective, randomised study. *J Minimal Access Surg*. 2013;9(2):65–71.
- Gramatica L, Brasesco OE, Mercado Luna A, Martinessi V, Panebianco G, Labaque F, et al. Laparoscopic cholecystectomy performed under regional anesthesia in patients with chronic obstructive pulmonary disease. *Surg Endosc Interv Tech*. 2002 Mar 1;16(3):472–5.
- Pursnani KG, Bazza Y, Calleja M, Mughal MM. Laparoscopic cholecystectomy under epidural anesthesia in patients with chronic respiratory disease. *Surg Endosc*. 1998 Aug 1;12(8):1082–4.

4. Before induction of anesthesia, you discuss patient positioning with the rest of the operating room team. What positioning is appropriate for this patient undergoing a diagnostic laparoscopy of the pelvis?
- Supine, Trendelenburg, right tilt, right arm tucked
  - Supine, reverse Trendelenburg, left tilt, left arm tucked
  - Supine, Trendelenburg, left tilt, right arm tucked
  - Supine, reverse Trendelenburg, right tilt, left arm tucked

Explanation: Positioning is a key element in the success of any laparoscopic surgery and is determined by the diagnosis and anticipated procedure. Optimal patient positioning should provide easy access to the operation field for port placement, surgery, and circulation of team members. Proper positioning should also guard against any injuries to soft tissue or nerves and prevent unexpected falls or unwanted patient movements. This includes use of straps, pressure area pads and bracing supports.

For a diagnostic laparoscopy of the pelvis;

The supine position is the most used position in laparoscopy as it provides access to the neck abdomen and groin areas.

The Trendelenburg position lends retraction of the intra-abdominal organs away from the pelvis.

Overall, modifications like Trendelenburg, reverse Trendelenburg, left or right tilt make use of gravity to provide retraction of viscera.

Both arms tucked to the patient's side allows the surgeon and assistant to get closer to the patient.

Other patient positions include; prone position which provides access to the retroperitoneum when a dorsal approach is desired. Lateral decubitus position provides access to the chest and retroperitoneum.

Low lithotomy modification is favored for pelvic pathologies and split legs provide midline access as they allow the surgeon to stand in-between the patient's legs.

- Agostini J, Goasguen N, Mosnier H. Patient positioning in laparoscopic surgery: Tricks and tips. *J Visc Surg.* 2010 Aug 1;147(4):e227–32.
- Lee-Ong A, Buenafe AA. Operating Room Setup and Patient Positioning in MIS. In: Lomanto D, Chen WTL, Fuentes MB, editors. *Mastering Endo-Laparoscopic and Thoracoscopic Surgery: ELSA Manual* [Internet]. Singapore: Springer Nature; 2023 [cited 2023 Feb 26]. p. 61–7. Available from: [https://doi.org/10.1007/978-981-19-3755-2\\_10](https://doi.org/10.1007/978-981-19-3755-2_10)

5. Which of the following methods is appropriate to establish laparoscopic access to the abdomen?
- Hasson technique
  - Veress technique
  - Direct optical entry
  - All of the above

Explanation: Access to the abdomen can be performed with an open (Hasson) technique, closed (Veress) technique, or under direct optical entry. The Hasson entry refers to an open method in which an incision (usually periumbilical) is made through the abdominal wall under direct view. This technique increases safety due to direct view of all layers of the abdominal wall. However, it requires a longer operation time. The Veress entry refers to the closed method in which the Veress needle is used to puncture through the layers of the abdominal wall. It is advantageous due to the short amount of time needed for the procedure, but it carries a higher risk of major vascular and viscus injury. In the direct optical entry method, a zero-degree scope attached to a camera is inserted into a clear optical trocar which is advanced through the layers of the abdominal wall, allowing visualization of each layer of the abdominal wall as the trocar is advanced. All methods are acceptable ways of established laparoscopic access.

- Schwartz's Principle of Surgery. 11th edition. Chapter 14: Minimally Invasive Surgery, Robotics, Natural Orifice Transluminal Endoscopic Surgery, and Single-Incision Laparoscopic Surgery. Donn H. Spight, Blair A. Jobe, and John G. Hunter;. Page 459-460.
- Alkatout I, Mettler L, Massss N, Noe GK, Elessawy M. Abdominal anatomy in the context of port placement and trocars. J Turk Ger Gynecol Assoc. 2015 Nov 2;16(4):241-51

6. The patient has an umbilical hernia on exam. Where should the first port be placed?
- a. Right upper quadrant
  - b. Midline lower abdomen
  - c. Midline upper abdomen
  - d. Left lower quadrant

Explanation: If a Hasson entry is chosen, the most common site of entry would be at the umbilicus to maximize exposure and safe entry. However, if the patient has a hernia or a prior incision at the umbilicus which would increase risk of bowel adhesions to the abdominal wall, you choose an alternative site. A safe alternative site would be in the midline above the umbilicus in the linea alba. A Hasson port could be placed off the midline, however, the thickness of the muscle layers may make this more difficult to achieve through a small incision. If a Veress or optical entry is chosen, a general safe location would be in the left upper quadrant below the costal margin (also known as "Palmer's point").

Let it be known:

In the psychomotor component of the module, you will learn how to place a Hasson trocar for initial entry. While there are alternative methods of establishing laparoscopic access, Hasson technique for entering the abdomen under direct vision has become more popular and safer due to its simplicity for beginners in laparoscopy, lesser time of achieving pneumoperitoneum and lesser duration of surgery.

In the psychomotor component of the module, you will learn how to place a Hasson trocar for initial entry. The Hasson entry is the most generalizable and universally applicable in multiple patient situations.

We recommend proficiency in Hasson entry before proceeding to alternative methods.

7. You have successfully placed your first trocar through the Hasson method. Which should be done next?
- Connect the port to the insufflator
  - Place the camera through the port to inspect the viscera
  - Place a grasper through the port to ensure there are no adhesions
  - Place the second port

Explanation: Once the initial port has been placed, the port should be connected to the insufflator. An initial low starting pressure with free flow of gas from the insufflator is reassuring that the port is correctly placed in the abdominal cavity.

8. When performing a laparoscopic procedure, which gas is preferred for insufflation?
- CO<sub>2</sub>
  - 100% H<sub>2</sub>
  - Room air
  - 100% O<sub>2</sub>

Explanation: CO<sub>2</sub> is the most used gas for insufflation because it is non-flammable, colorless, and highly soluble in blood. Room air can be used in resource-limited areas (usually with an air compressor connected to the insufflator). Both hydrogen and oxygen should not be used due to their flammability.

- Schwartz's Principle of Surgery. 11th edition. Chapter 14: Minimally Invasive Surgery, Robotics, Natural Orifice Transluminal Endoscopic Surgery, and Single-Incision Laparoscopic Surgery. Donn H. Spight, Blair A. Jobe, and John G. Hunter;. Page 455-56.
- Yu T, Cheng Y, Wang X, Tu B, Cheng N, Gong J, et al. Gases for establishing pneumoperitoneum during laparoscopic abdominal surgery. Cochrane Database Syst Rev. 2017 Jun 21;2017(6):CD009569

9. What insufflation pressure would you use to achieve adequate pneumoperitoneum?
- 10 mmHg
  - 15 mmHg
  - 20 mmHg
  - 25 mmHg

Explanation: A pressure of 15 mmHg is commonly used, allowing sufficient insufflation without compromising respiration or hemodynamics in a patient with normal cardiovascular reserve. Lower pressures can make it difficult to achieve adequate working space and view, and higher pressures can create concern for compromising hemodynamics. However, in patients with abnormal reserves or in pediatric patients, the optimal pressures may differ.

- Schwartz's Principle of Surgery. 11th edition. Chapter 14: Minimally Invasive Surgery, Robotics, Natural Orifice Transluminal Endoscopic Surgery, and Single-Incision Laparoscopic Surgery. Donn H. Spight, Blair A. Jobe, and John G. Hunter;. Page 456.

10. You have established pneumoperitoneum to 15 mmHg CO<sub>2</sub>. What is the next step?

- a. Place the camera through the port to inspect the surrounding viscera
- b. Place the second port through Hasson technique in the lower abdomen
- c. Reduce the pneumoperitoneum to 10 mmHg
- d. Place a grasper through the port to ensure there are no adhesions

Explanation: Once the first port is placed, the camera should be placed through the port and used to inspect the surrounding viscera to affirm that no injury was created through the placement of the first port. Additional ports can then be placed under direct laparoscopic view in appropriate locations in the abdominal wall to triangulate to the operative target. Port locations for various operations are discussed in Modules 1-4.

11. After you insert your laparoscope, you visualize a copious amount of blood pooling in the abdominal cavity. The anesthesiologist tells you that the patient remains stable. How would you proceed?

- a. Continue with exploration of the ovaries and tubes
- b. Convert to open surgery to explore for source of bleeding
- c. Increase pneumoperitoneum to 25 mmHg for hemostasis
- d. Insert an additional trocar to assist identification of bleeding source

Explanation: Given the concern for major bleeding, conversion to open surgery with exploration for and repair of the source of bleeding is necessary. Though the patient remains hemodynamically stable, the safest option would be to address any potential injury. This would hold true for the concern for a bowel injury as well. The safest option to address a potential bowel injury would be to convert to open surgery to explore and/or repair. As expertise in laparoscopy is accrued and appropriate instrumentation is available, these injuries may be able to be addressed laparoscopically. However, the safest, most generalizable approach to complications of laparoscopic entry is through conventional open surgery.

12. You begin a laparoscopic case and insufflate the abdominal cavity with CO<sub>2</sub>. The insufflation process should be halted if the patient develops:

- a. Immediate tachycardia
- b. Mild hypertension
- c. Lower extremity edema
- d. Rise in peak airway pressure

Explanation: The direct effect of the pneumoperitoneum on increasing intrathoracic pressure increases peak inspiratory pressure, pressure across the chest wall, and the likelihood of barotrauma.

- Sackier JM, Nibhanupudy B. The pneumoperitoneum physiology and complications. In: Toouli JG, Gossot D, Hunter JG, eds. Endosurgery. New York/London: Churchill- Livingstone; 1996:155.



13. You continue the procedure, and you are informed by the anesthesiologist that the patient has an arrhythmia. What is the most common arrhythmia seen during laparoscopic procedure?
- Atrial fibrillation
  - Sinus tachycardia
  - Sinus bradycardia**
  - Ventricular fibrillation

Explanation: The most common arrhythmia that occurs during laparoscopic insufflation is bradycardia. A rapid stretch of the peritoneal membrane often causes a vasovagal response with bradycardia and occasionally hypotension. The appropriate management of this event is desufflation of the abdomen, administration of vagolytic agents (e.g, atropine), and adequate volume replacement.

- Soper N.J., Scott-Conner C.E.H., (2012) The SAGES Manual Volume 1 Basic Laparoscopy and Endoscopy, 3rd Edition, Springer
- Borten M, Friedman EA. Choice of anesthesia. In: Laparoscopic Complications: Prevention and Management. Toronto:BC Decker; 1986:173.

14. You decide to proceed with a salpingectomy using an endoscopic stapler that you had in supply at your hospital. What size port should be used for the stapler?
- 5 mm
  - 8 mm
  - 11 mm
  - 12 mm**

Explanation: 5 mm ports will accommodate most laparoscopic instruments including graspers, needle drivers, and advanced energy such as ultrasonic shears or advanced bipolar. 11 mm ports would be used to accommodate 10 mm laparoscopes as well as larger suctions. A standard endoscopic stapler will only fit through a 12 mm port. 5 mm laparoscopic instruments can also be used through larger ports without issue. A diaphragm at the top of the larger ports will prevent the release of pneumoperitoneum. The fascia of the 11 mm and 12 mm port site should be closed at the commencement of an operation to prevent port site hernia.

15. As you proceed with your laparoscopic surgery, the anesthesiologist informs you that the patient's blood pressure has acutely dropped. The anesthesiologist auscultates a "mill wheel" murmur over the pericardium. What should be done next?
- Immediate resuscitation with isotonic fluid and proceed with procedure if stability achieved
  - Discontinuation of insufflation with positioning of the patient in left lateral decubitus position with the head down followed by insertion of central venous catheter
  - Discontinuation of laparoscopy and performance of immediate exploratory laparotomy to check for hemorrhage
  - Administration of IV epinephrine, diphenhydramine, and steroids

Explanation: Gas emboli are rare but serious complications of laparoscopic surgery which should be suspected if hypotension develops during insufflation. Diagnosis may be made by auscultating (with an esophageal stethoscope) for the characteristic "mill wheel" murmur. The treatment of gas embolism is to place the patient in a left lateral decubitus position with the head down to trap the gas in the apex of the right ventricle. A rapidly placed central venous catheter then can be used to aspirate the gas out of the right ventricle.

- Schwartz's Principle of Surgery. 11th edition. Chapter 12: Quality, Patient Safety, Assessments of Care, and Complications. Martin A. Makary, Peter B. Angood, and Mark L. Shapiro;. Page 416.

16. You have concluded your laparoscopic case, having successfully detorsed the patient's ovary. Which of the following should be done at the conclusion of the case?
- Evacuate the pneumoperitoneum by inserting suction into the abdomen before removing the instruments
  - Increase the pneumoperitoneum to 20 mmHg to check for hemostasis before removing the instruments
  - Remove all instruments, followed by the camera, followed by all of the trocars
  - Remove all instruments, followed by the trocars, followed by the camera and its remaining trocar

Explanation: The trocars should be removed under direct view with the camera to ensure that there is no bleeding from the abdominal wall after trocars are removed. After the camera is removed, its trocar can then safely be removed. It is unnecessary to evacuate the pneumoperitoneum by direct suction, as the majority of the air will evacuate on its own after removal of trocars. The remaining air will be absorbed over the next 48-72 hours. Increasing the pressure of pneumoperitoneum is unnecessary and can temporarily tamponade small bleeding points making it more difficult to accurately assess hemostasis.