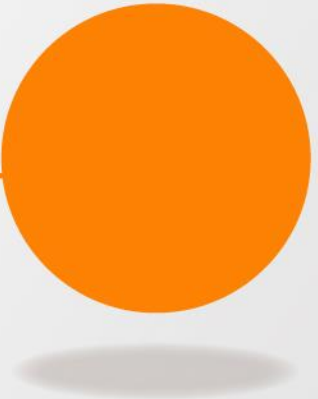
Introduction to Minimally Invasive Surgery



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Note to Countries:
How to update hyperlinks:
1. Select object and right click
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Learning Objectives

SUMMARIZE | the applications and advantages of minimally invasive surgery.

UNDERSTAND | the role of anesthesia and neuromuscular blockers in minimally invasive surgery.

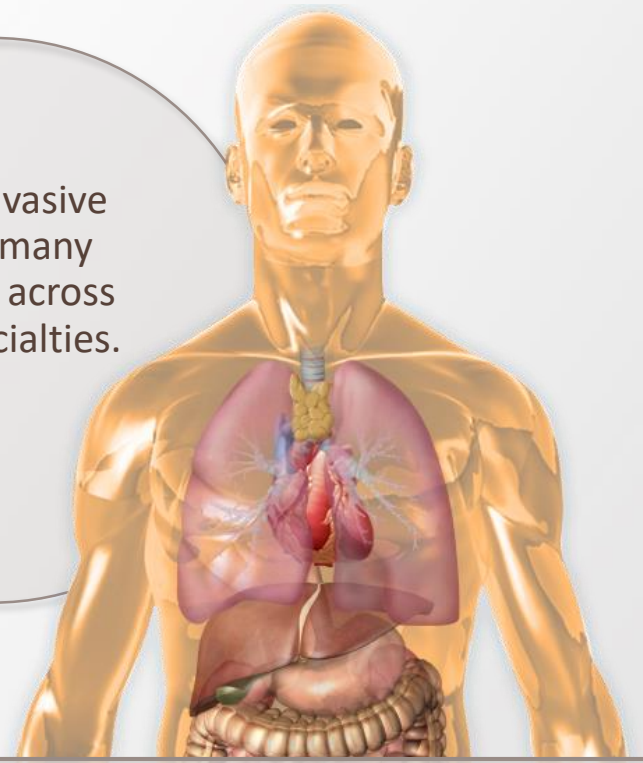
DESCRIBE | the physiologic effects of pneumoperitoneum.

DISCUSS | the advantages and challenges of minimally invasive surgery.

What Is Minimally Invasive Surgery?

Minimally invasive surgery, sometimes referred to as minimal access surgery, involves performing operations through small incisions with specialized instruments and imaging systems. This approach is intended to minimize surgical trauma. For many conditions requiring surgical evaluation or treatment, a minimally invasive procedure may be considered the first-line approach.

Minimally invasive surgery has many applications across surgical specialties.

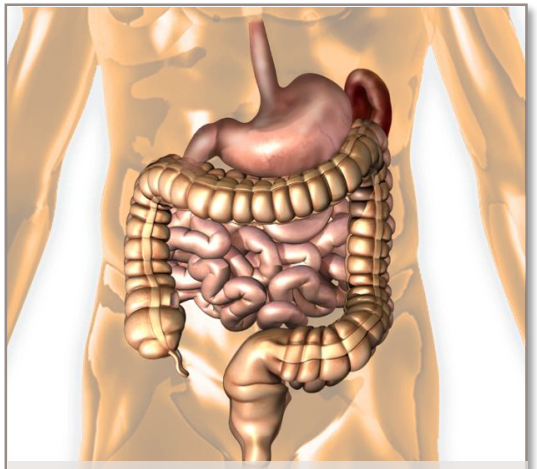


Compared with open surgical procedures, minimally invasive surgery offers many potential advantages:

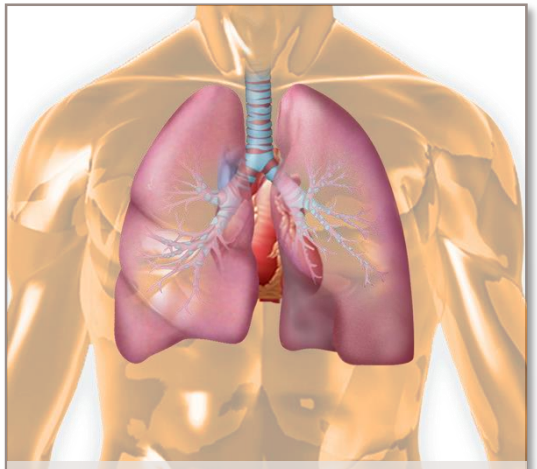
- Less trauma
- Lower intraoperative blood loss
- Lower risk of complications
- Decreased formation of adhesions
- Decreased pain
- Faster recovery time
- More rapid return to normal activities

Types of Minimally Invasive Surgery

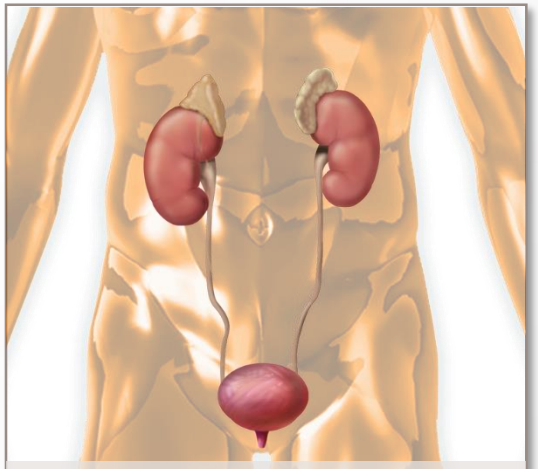
The principles of minimally invasive surgery can be applied to a range of procedures across surgical subspecialties. Over the last 30 years, the variety of procedures performed by minimally invasive surgery has significantly increased. This trend is expected to continue as experience with these methods is expanded and outcomes are analyzed to determine the efficacy of various procedures.



Laparoscopic surgery is applicable to many operations, both basic and advanced, on the organs of the abdomen and pelvis. Some examples include, appendectomy, colectomy, splenectomy, gastrectomy, prostatectomy, and hysterectomy.



Thoracoscopy is used to perform minimally invasive surgery on the region of the chest. Examples are thoracoscopic lung biopsy, lung volume reduction, esophagectomy, and sympathectomy.



Robotic-assisted surgery has become increasingly popular for urologic procedures, particularly radical prostatectomy, cystectomy, and renal surgery.

A-Z Glossary Terms

Laparoscopic surgery: Surgical technique for performing procedures on abdominal, pelvic, or retroperitoneal organs through one or more small incisions. Insufflation of inert gas creates a working space for the surgeon. Instruments are inserted through ports. A video camera with a fiber-optic light source is used to obtain visualization.

Thoracoscopy: A diagnostic or therapeutic procedure performed within the pleural cavity of the chest using an endoscope.

Robotic-assisted surgery: A master-slave system in which a surgeon uses a console to remotely operate robotic arms in order to perform surgical procedures. Potential advantages over conventional laparoscopy include greater range of motion of instruments, 3-dimensional view of the operating field, elimination of tremors, motion scaling, and separation of the surgeon's console from the patient and operating table.

Laparoscopic Surgery

Overview

Laparoscopic surgery entails gaining access to the abdominal and pelvic organs through small incisions, creation of a workspace within the abdomen, and manipulation of instruments within the workspace. The workspace for the surgeon is created by insufflating or filling the abdomen with gas, usually carbon dioxide (CO_2). The gas lifts the abdominal wall off the underlying organs, providing space within which to view the organs and move instruments. This gas-filled space is called a pneumoperitoneum. Once a pneumoperitoneum is established, the surgeon inserts a laparoscope, which contains a video camera and a fiber-optic light source. Video images of the operative workspace are viewed using external video monitors placed around the operating table in view of the surgeon. Surgical instruments are introduced into the workspace through cannulae placed in the abdominal wall.

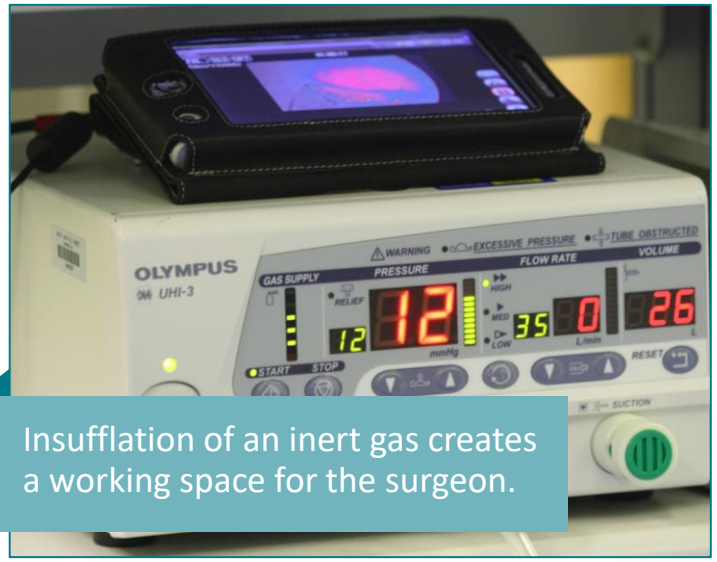
Most laparoscopic procedures are performed under general anesthesia. Neuromuscular blockade established during anesthesia relaxes the muscle of the abdominal wall, which facilitates creation of the pneumoperitoneum and placement of laparoscopic ports. Neuromuscular blockade also prevents sudden involuntary movements by the patients, which can lead to accidental injuries of intra-abdominal structures by laparoscopic instruments.

A-Z Glossary Terms

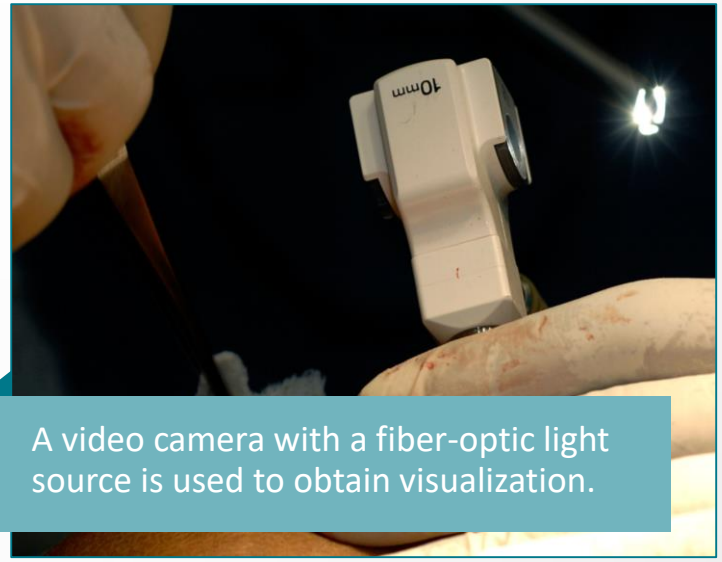
Pneumoperitoneum: Presence of air or gas in the peritoneal cavity as a result of disease, or produced artificially in the abdomen to achieve exposure during laparoscopic surgery.

Cannula: A tube that can be inserted into a cavity and serves as a channel for the transport of fluids or passage of instruments.

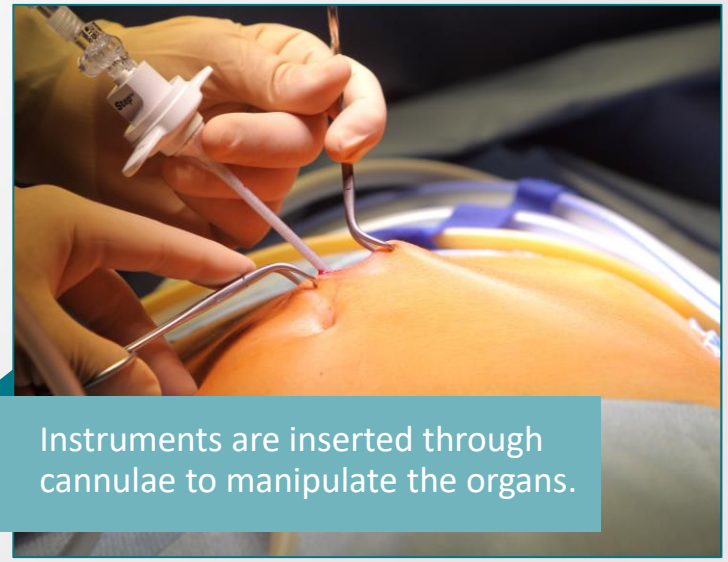
Insufflation: The introduction of gas (eg, carbon dioxide) into a body cavity such as the peritoneal cavity.



Insufflation of an inert gas creates a working space for the surgeon.



A video camera with a fiber-optic light source is used to obtain visualization.



Instruments are inserted through cannulae to manipulate the organs.

Essential Anatomy

Organs of the abdomen and pelvis include those associated with the digestive system (see below), the internal reproductive organs (eg, the uterus and ovaries in females and the prostate gland in males), and organs of the urinary system (eg, the kidneys and urinary bladder). Organs of the upper abdominal cavity are separated from those of the thoracic (chest) cavity by a broad, thin muscle called the diaphragm. The abdominal cavity is lined by a membrane called the peritoneum. This membrane has two parts: the parietal peritoneum lines the wall of the abdominal cavity and the visceral peritoneum covers most of the abdominal organs. The potential space between these membranes is referred to as the peritoneal cavity. When required for laparoscopic surgery, a pneumoperitoneum is created by insufflation of gas into the peritoneal cavity, which expands like a balloon.

Important organs in the peritoneal cavity include:

Not all abdominal organs are enclosed by the peritoneum. Laparoscopic procedures on organs located outside and behind the peritoneum, like the kidney, can be approached without entering the peritoneal cavity.

A-Z Glossary Terms

Peritoneum: The membrane that lines the cavity of the abdomen and covers the abdominal organs.

Parietal peritoneum: The portion of the peritoneum that lines the abdominal walls and the undersurface of the diaphragm.

Visceral peritoneum: The portion of the peritoneum that surrounds and covers the abdominal organs.

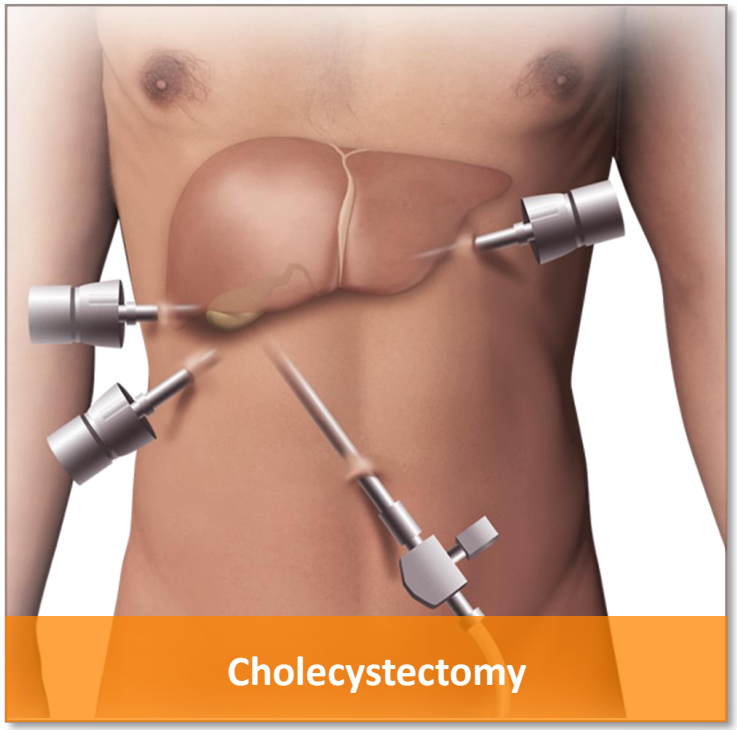
Peritoneal cavity: The potential space between the parietal peritoneum, which lines the abdominal wall, and the visceral peritoneum, which forms the surface layer of the abdominal organs. It contains a lubricating fluid.

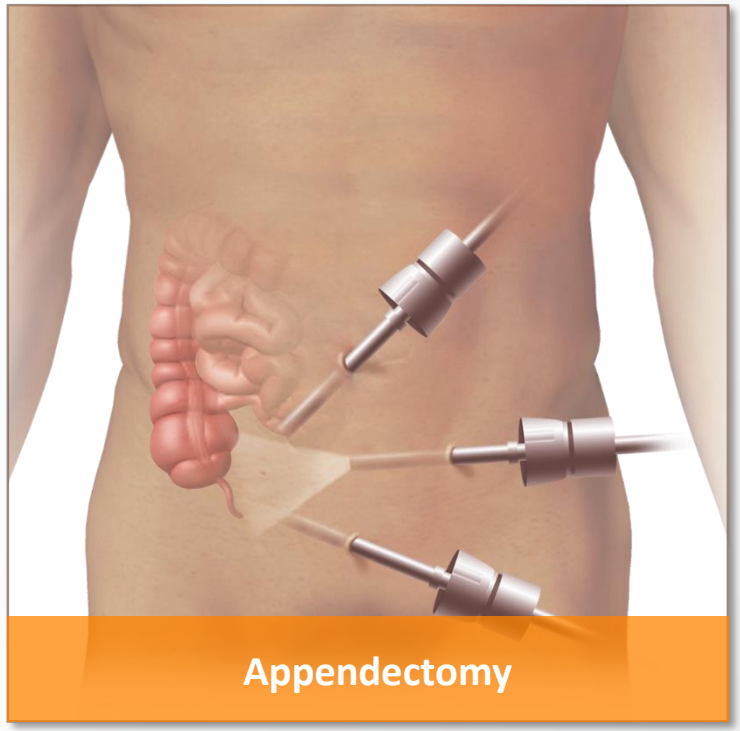
Laparoscopic Surgery

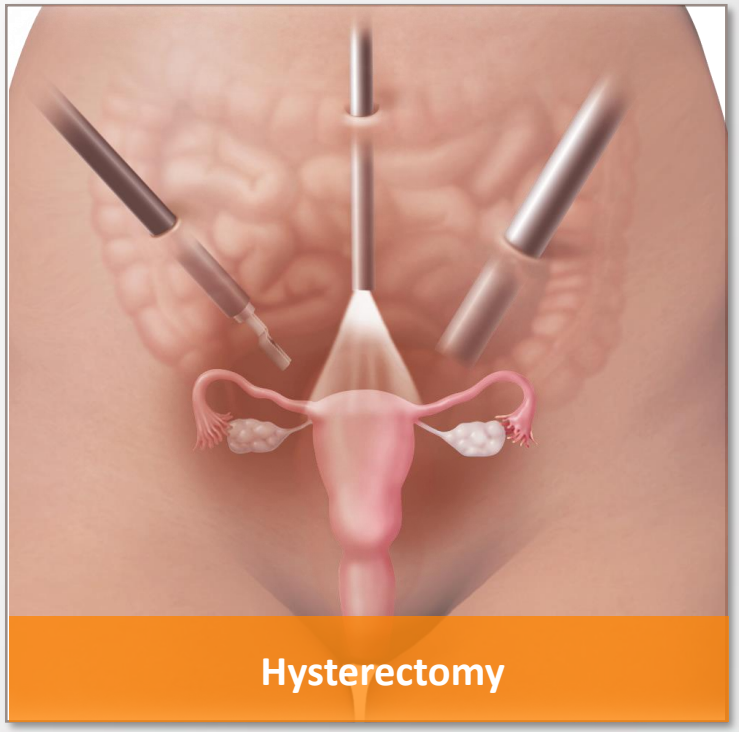
Applications

Laparoscopy has broad applications for a variety of procedures.

- Cholecystectomy
- Appendectomy
- Hernia repair
- Colon surgery
- Urologic surgery
- Gynecologic surgery







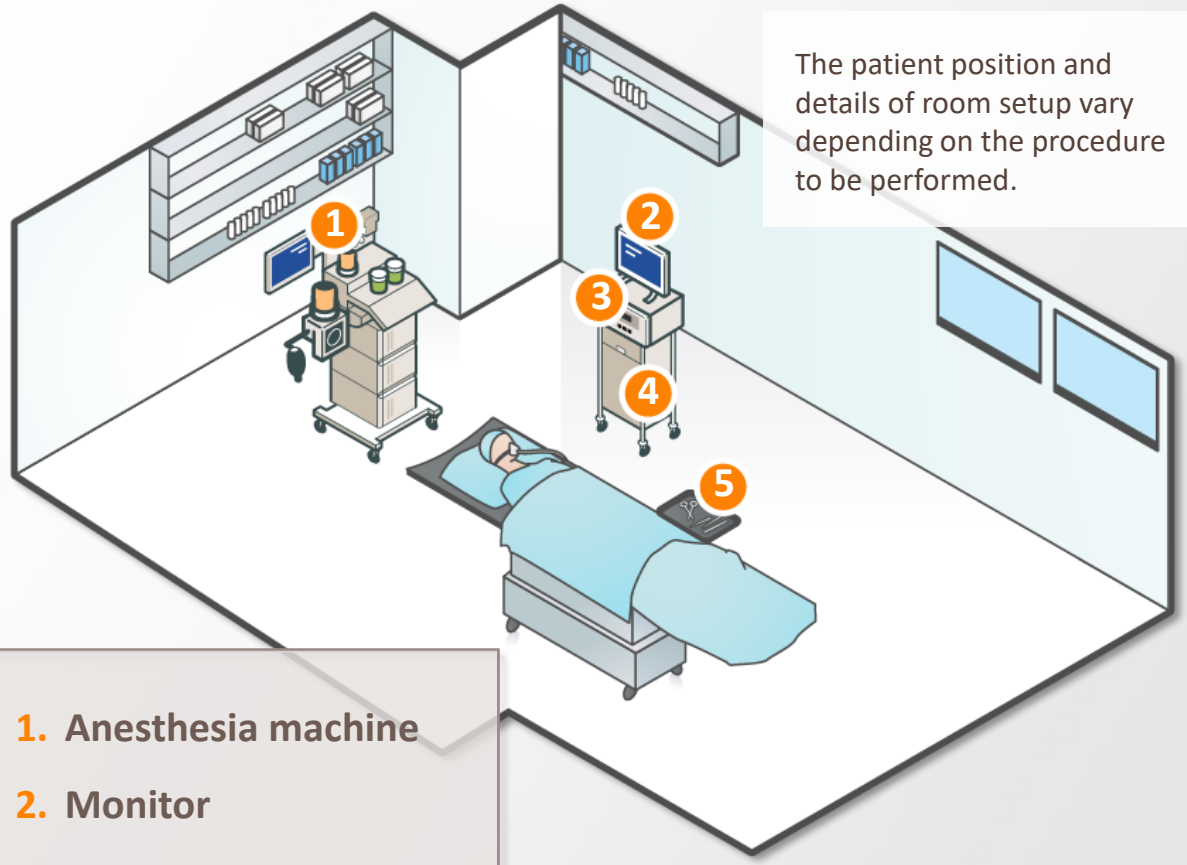
Laparoscopic Surgery

Minimally Invasive Surgery Suite

Specialized equipment is required to perform laparoscopic surgery. Hand instruments for laparoscopy generally duplicate conventional surgical instruments, but are made longer, thinner, and smaller at the tip. Other essential equipment includes a laparoscope, video monitor, and an insufflator.

- A laparoscope equipped with a camera and fiber-optic light source enables the surgeon to visualize the surgical field. Images from the camera are displayed on a video monitor.
- An electronically controlled insufflator is used to pump CO_2 into the abdominal cavity in order to create and maintain a pneumoperitoneum.
- The video monitor and insufflator should be positioned so that the surgeon can easily see the images on the monitor and the pressure readings on the insufflator.

Compared with open surgical procedures, laparoscopic procedures present challenges stemming from deformation of the internal organs, restricted workspace, and limited field of view. Adequate visibility and lighting within the peritoneal cavity are essential. Sufficient space is also required to manipulate surgical instruments. Use of higher insufflation pressures to achieve a larger operative space may help improve surgical conditions during laparoscopic surgery. However, these benefits must be weighed against the potential adverse effects of increased intra-abdominal pressure on the patient.



The patient position and details of room setup vary depending on the procedure to be performed.

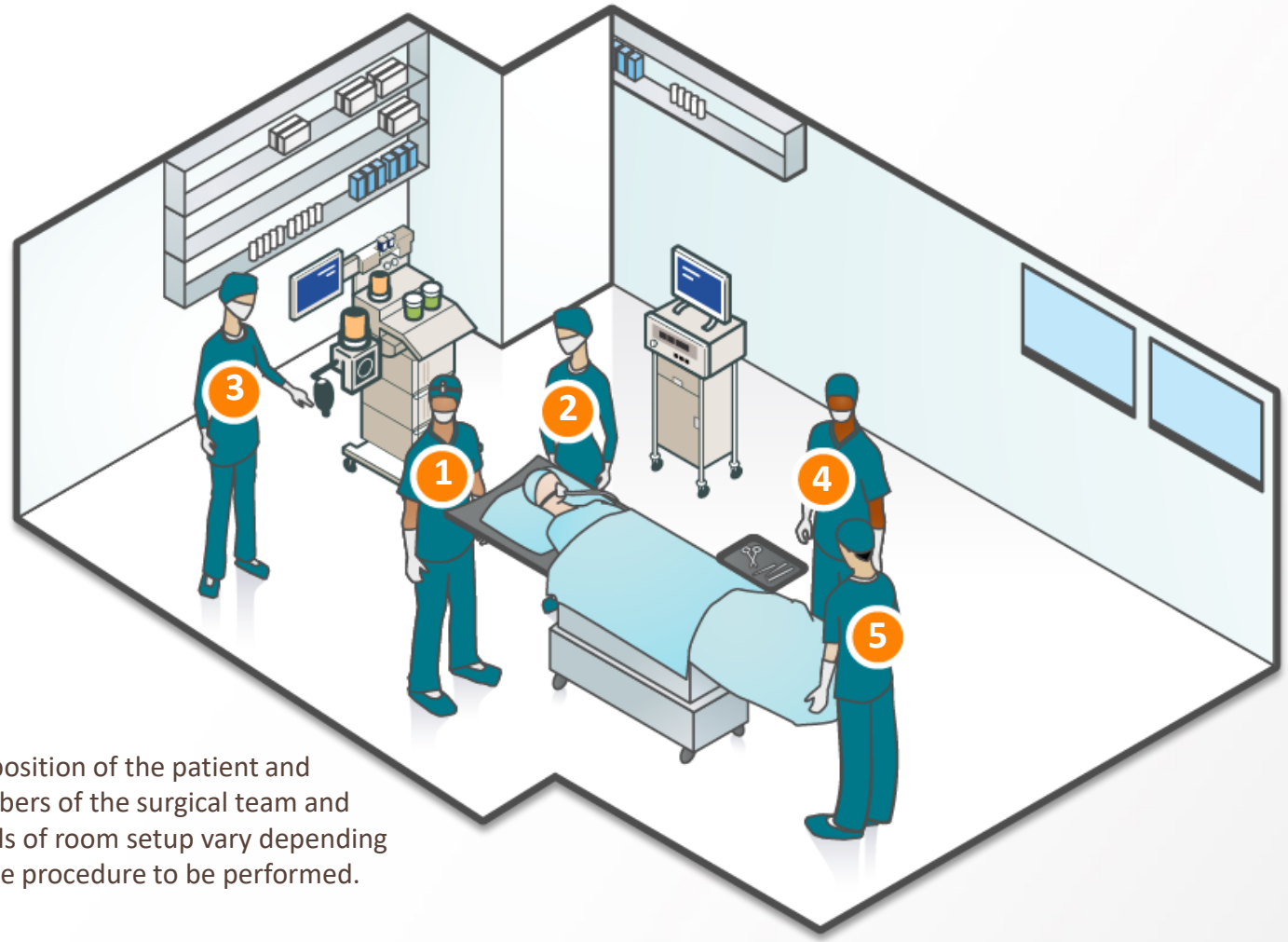
1. Anesthesia machine
2. Monitor
3. Insufflator
4. Stand
5. Equipment tray

A-Z Glossary Terms

Insufflator: A device for blowing gas into a body cavity.

Laparoscopic Surgery

Surgical Team



The position of the patient and members of the surgical team and details of room setup vary depending on the procedure to be performed.

A dedicated team for laparoscopic procedures is beneficial for both the patient and the hospital. A dedicated team can perform laparoscopic surgery with safety and efficiency. Team members should be familiar with laparoscopic equipment and know how to use it properly.

Important members of the team include:

1. **Surgeon**
2. **Operating room nurse**
3. **Anesthesiologist/nurse anesthetist**
4. **Assistant**
5. **Circulating staff**

An important goal of the anesthesiologist or nurse anesthetist is to help improve surgical conditions when possible. As noted earlier, neuromuscular blockade established during anesthesia helps to relax the abdominal wall, which facilitates creation of a pneumoperitoneum and placement of laparoscopic ports. Neuromuscular blockade also prevents sudden patient movement, which can lead to accidental injuries. The anesthesiologist or nurse anesthetist also has the important role of maintaining vital organ function and preventing or reducing the detrimental physiological effects of the specific surgical conditions.

Laparoscopic Surgery

Patient Positioning

Patients undergoing laparoscopic surgery may be placed in a variety of positions, depending on the procedure being performed. Different positions are used to facilitate access to specific organs.

Supine position

Many laparoscopic procedures are performed in the supine position.

Lateral decubitus position

Lateral decubitus position with flexed table is used for nephrectomy. Patients placed in the lateral decubitus position may experience a decrease in blood pressure. Mismatch of ventilation and perfusion can worsen as gravity favors blood flow to the dependent lung and pressure from the abdominal contents favors ventilation of the nondependent lung.

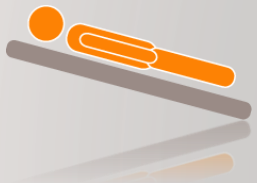
Trendelenburg position

Trendelenburg (head-down) position is used to improve exposure for some lower abdominal procedures. This position shifts the weight of abdominal organs toward the chest, which increases pressure in the thoracic cavity. These changes can impact cardiovasular and respiratory function.

Modified lithotomy position

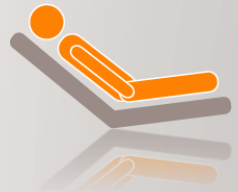
Modified lithotomy position is used for many laparoscopic procedures on the colon. The lithotomy position can cause an increase in venous return accompanied by transient increase in cardiac output or intracranial pressure. Abdominal contents can push the diaphragm toward the head, causing a decrease in tidal volume.

Reverse Trendelenburg position



Reverse Trendelenburg (head-up) position is used for laparoscopic cholecystectomy. This position can have marked effects on the cardiovascular system by reducing blood flow from the lower body back to the heart.

Beach chair position

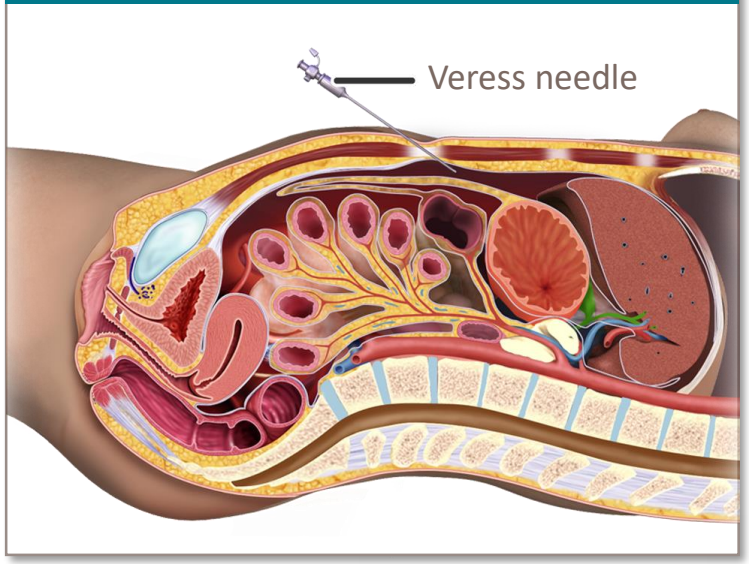


Beach chair position is used for many orthopedic procedures. Advantages for orthopedic surgery include decreased bleeding, maintaining anatomy in the upright position, and the option of using the arm's weight for traction.

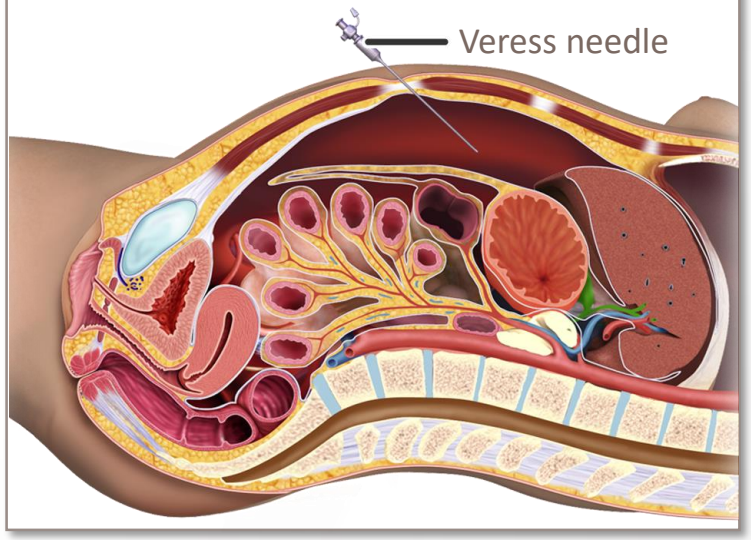
Laparoscopic Surgery

Creating a Pneumoperitoneum

Normal Anatomy



Insufflation of Abdomen



1. To gain access to the peritoneal cavity and create a pneumoperitoneum, the surgeon makes a small incision in or near the umbilicus.
2. A spring-loaded needle, called a Veress needle, is used to puncture the abdominal wall and enter the peritoneal cavity.
3. An insufflator is then used to pump gas, usually CO_2, into the peritoneal cavity. The pressure is carefully monitored during insufflation, and should not exceed 15 mmHg.
4. The pneumoperitoneum creates a working space for the surgeon by elevating the abdominal wall.

Intra-abdominal pressure (IAP)

Normal intra-abdominal pressure (IAP) is under 5 mmHg. As pneumoperitoneum is established, IAP can rise to 12–15 mmHg.

Intra-abdominal hypertension (IAH) is defined as the sustained or repeated pathological elevation of IAP ≥12 mmHg.

IAH has the following grades:

- Grade I, IAP 12–15 mmHg
- Grade II, IAP 16–20 mmHg
- Grade III, IAP 21–25 mmHg
- Grade IV, IAP >25 mmHg

Abdominal compartment syndrome is defined as sustained IAP >20 mmHg associated with new onset of organ dysfunction or failure.

A-Z Glossary Terms

Umbilicus: The navel.

Abdominal compartment syndrome: Sustained intra-abdominal pressure >20 mmHg that is associated with new onset of organ dysfunction or failure.

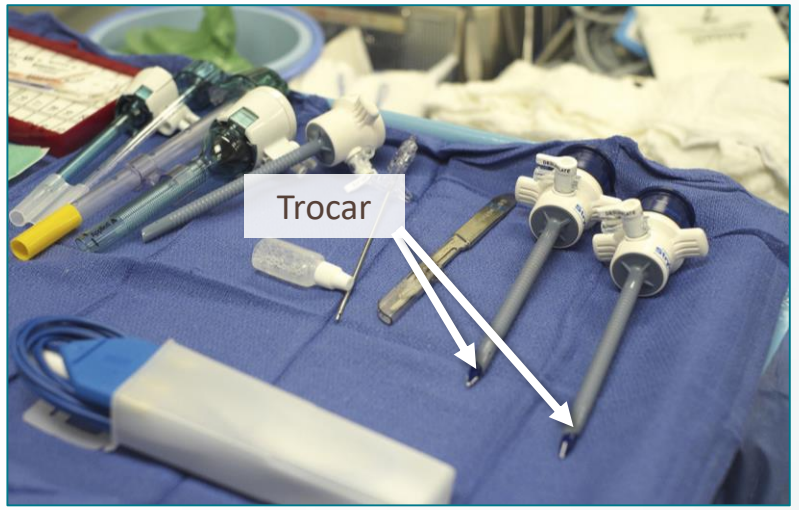
Intra-abdominal hypertension (IAH): A sustained or repeated pathological elevation in intra-abdominal pressure ≥12 mmHg.

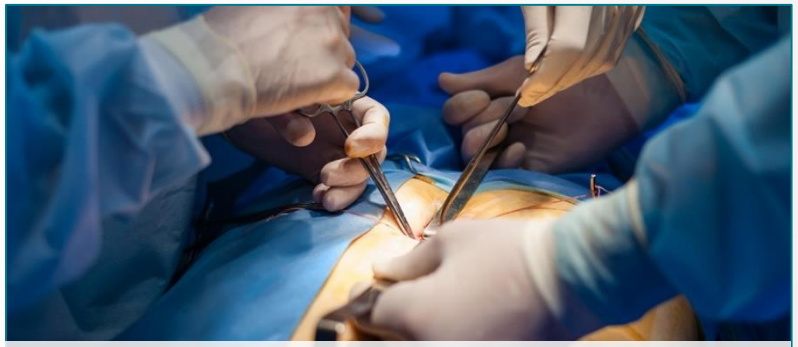
Laparoscopic Surgery

Instruments and Devices

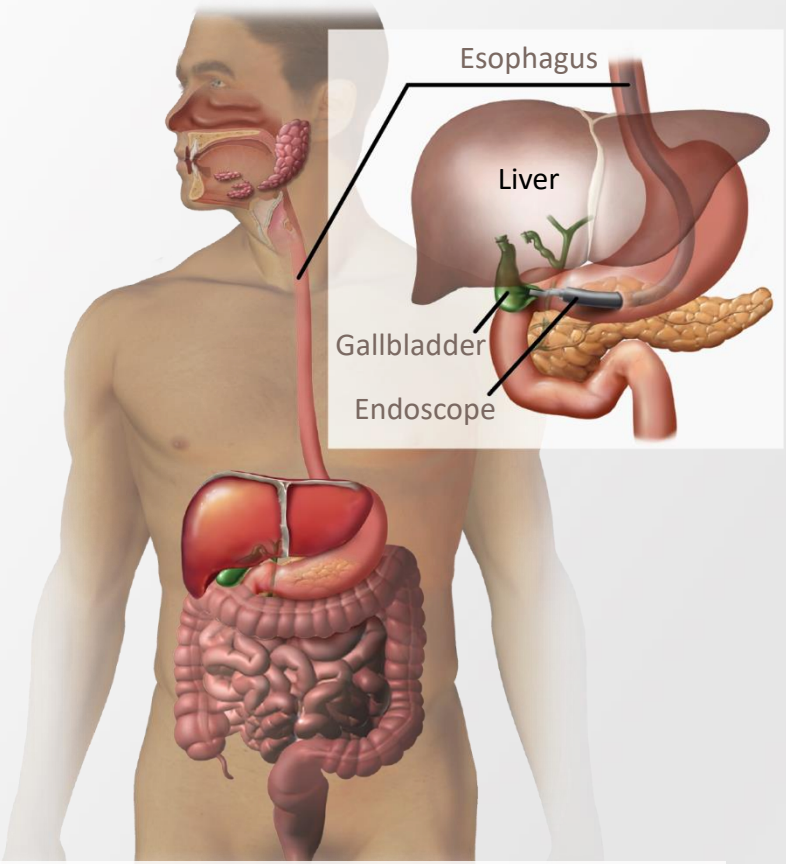
Once pneumoperitoneum is established, sharp-tipped trocars are used to puncture the abdominal wall. The laparoscope and other instruments are introduced into the abdomen through the trocar cannulae.

There are some notable variations of conventional laparoscopic surgery.





Single-incision laparoscopic surgery (SILS) involves the placement of multiple instruments through a single incision in the umbilicus.



Natural orifice transluminal endoscopic surgery (NOTES) involves access through natural orifices, such as the stomach or bladder.

Laparoscopic Surgery

Anesthetic Considerations

General anesthesia with endotracheal intubation is most commonly used for laparoscopic procedures.

The anesthesiologist or nurse anesthetist can help to optimize surgical conditions during laparoscopic surgery with a good anesthesia level and the use of neuromuscular blockers.

Adequate muscle relaxation can prevent unexpected patient movements that could lead to injury. This is particularly important while the surgeon is establishing access to the peritoneal cavity.

It is crucial to ensure that neuromuscular blockers are fully reversed at the end of the procedure. Even small amounts of residual block can be very distressing to patients. Symptoms can include general weakness, visual disturbances (e.g., blurred vision), and difficulty in speaking, swallowing, coughing, and breathing deeply. Laparoscopy and other minimally invasive procedures are often performed on an outpatient basis. Short-acting agents are usually preferable in this setting.

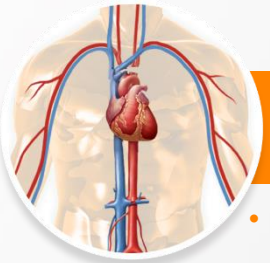
Physiologic Effects of the CO_2 Pneumoperitoneum

Increased abdominal pressure from the pneumoperitoneum pushes the diaphragm upward and hinders lung expansion. Greater airway pressures are required to deliver adequate tidal volume during mechanical ventilation.

Absorption of CO_2 causes hypercapnia and respiratory acidosis. Oxidative stress: Sudden changes in intra-abdominal pressure cause an ischemia/reperfusion reaction and induce oxidative stress to parts of the splanchnic system. This effect occurs during rapid changes even if pressure is maintained in a safe range.

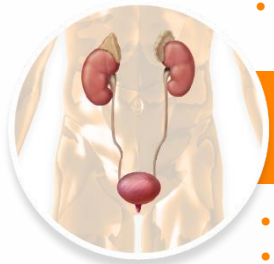
Additional pulmonary effects

- Decreased functional residual capacity
- Ventilation/perfusion mismatch
- Atelectasis
- Hypoxemia



Cardiovascular effects

- Increased systemic vascular resistance and mean arterial blood pressure
- Decreased cardiac output
- Decreased venous return



Renal effects

- Decreased blood flow to the kidney
- Decreased glomerular filtration rate and urine output

Perfusion

- Increasing intra-abdominal pressure from 10 mmHg to 15 mmHg decreases blood flow to the stomach by 40% to 54%, to the liver by 39%, to the colon by 44%, and to the peritoneum by 60%.

A-Z Glossary Terms

Hypercapnia: An excess of CO_2 in the bloodstream.

Respiratory acidosis: Increased acidity of the blood caused by retention of CO_2 because of a respiratory condition.

Functional residual capacity: The amount of air remaining in the lungs at the end of a normal exhaled breath.

Tidal volume: The volume of air that is inhaled and exhaled in a normal breath.

Splanchnic system: The blood vessels that supply the visceral (abdominal) organs.

Ischemia: A temporary deficiency of blood flow to an organ or tissue.

Hypoxemia: Decreased oxygen content of arterial blood.

Atelectasis: Partial or complete collapse of the lung caused by blockage of the airways or by pressure on the outside of the lung.

Physiologic Effects of the CO_2 Pneumoperitoneum

A component of the protective barrier around mesothelial cells is hyaluronic acid (HA). It helps to create a slippery surface on the peritoneum that prevents adhesions and infection. The impact of low-pressure (8 mmHg) versus standard-pressure (12 mmHg) CO_2 pneumoperitoneum on HA synthesis in the surgical peritoneal environment was compared in 68 patients undergoing laparoscopic hysterectomy.

Expression of the HAS-1 and HAS-3 genes for the synthesis of HA was higher in peritoneal cells exposed to an 8 mmHg pneumoperitoneum for 1 hour compared with cells exposed to 12 mmHg.

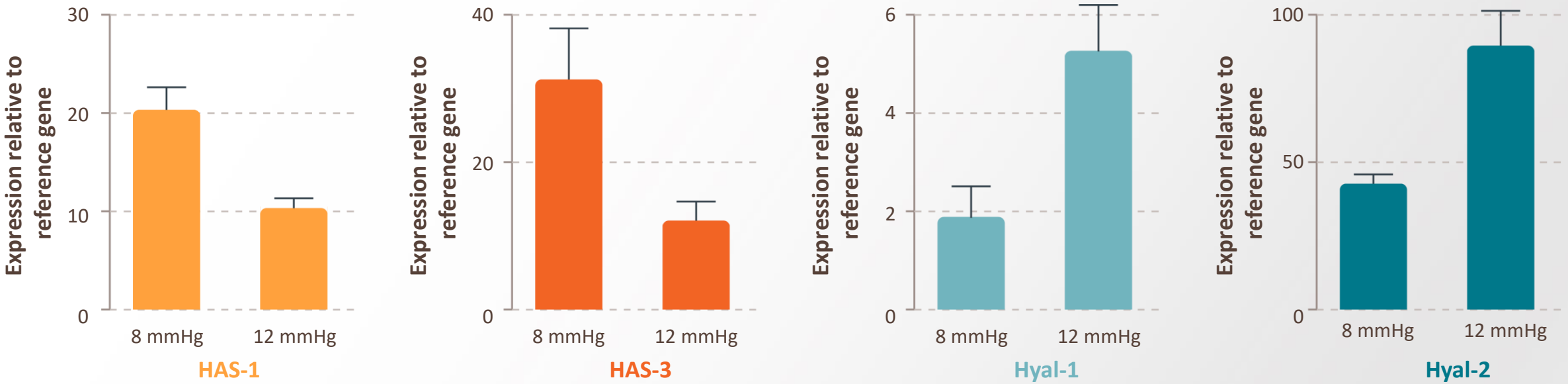
Expression of the Hyal-1 and Hyal-2 genes for hyaluronidase was higher for peritoneal cells exposed to 12 mmHg for 1 hour compared with 8 mmHg.

A-Z Glossary Terms

Hyaluronic acid: A molecule found in connective tissue that acts as a protective agent.

Hyaluronidase: An enzyme catalyzing the breakdown of hyaluronic acid.

Mesothelial cell: The type of cell that lines serous cavities, including the peritoneal cavity.



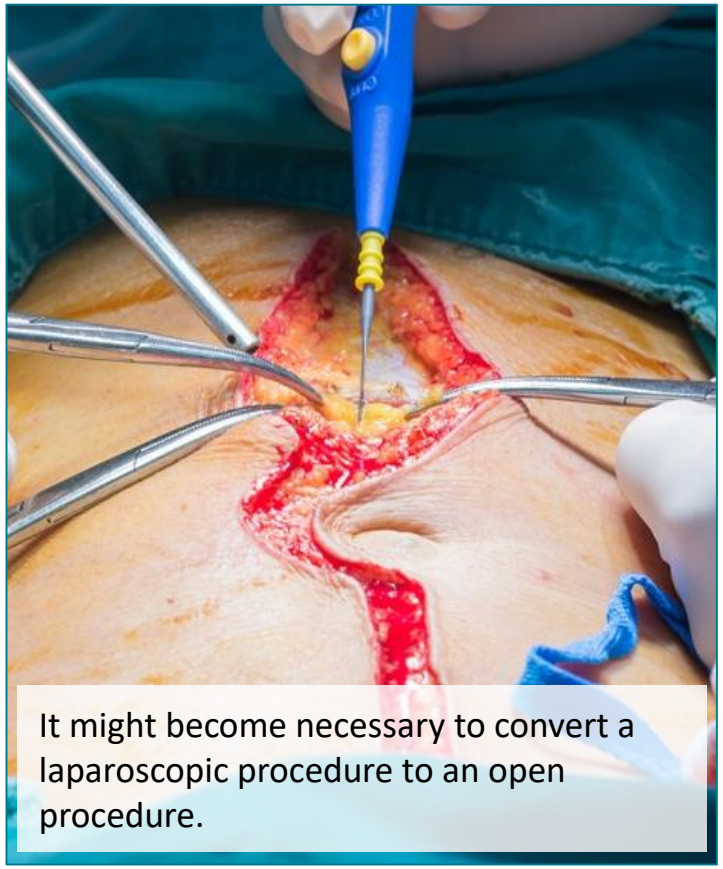
Adapted from: Matsuzaki et al. Human Reproduction, 2012:1613-1623.

Potential Complications of Laparoscopic Surgery

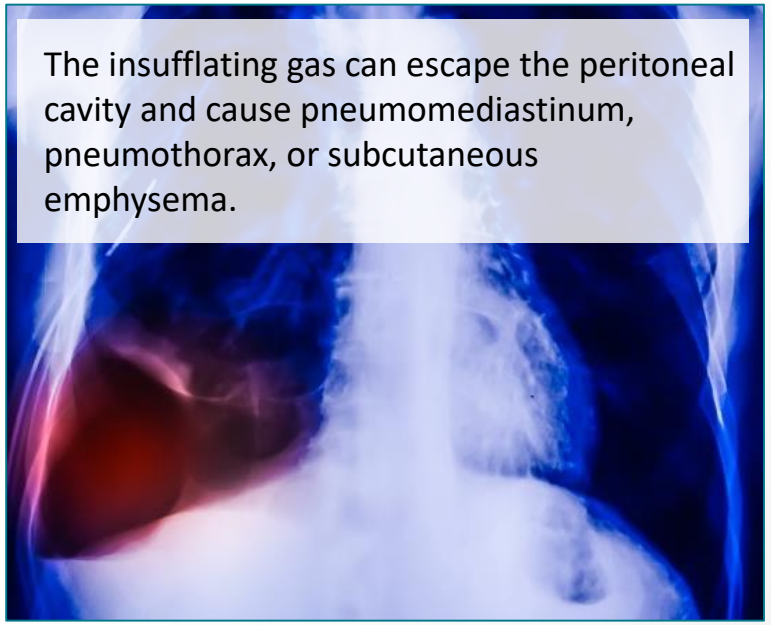
Injuries to blood vessels can lead to hemorrhage or arterial/venous gas embolism.

Abdominal organs can be injured.

Ureters can be injured or transected.



It might become necessary to convert a laparoscopic procedure to an open procedure.



The insufflating gas can escape the peritoneal cavity and cause pneumomediastinum, pneumothorax, or subcutaneous emphysema.

Postoperative complications can include nausea and vomiting or shoulder pain.

A-Z Glossary Terms

Gas embolism: Obstruction of a blood vessel caused by an air or gas bubble.

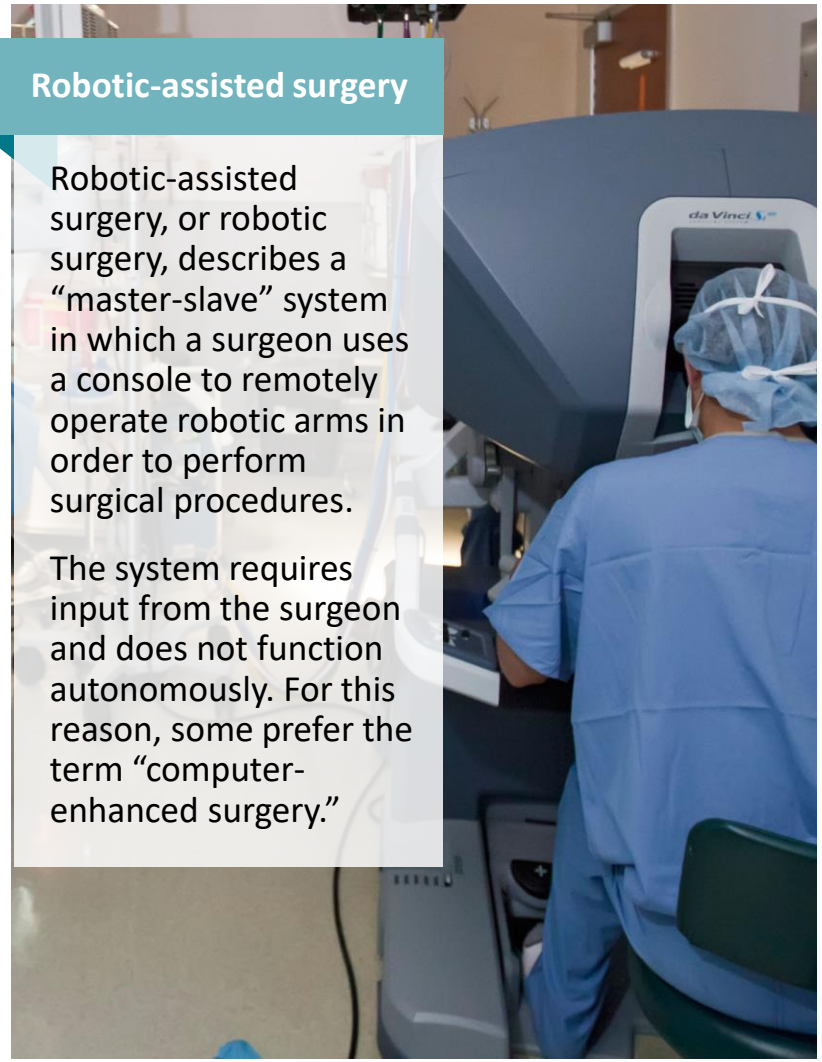
Pneumomediastinum: The presence of air or gas in the tissues located between the lungs and around the heart.

Pneumothorax: The collection of air or gas in the pleural cavity (the potential space between the pleural membranes, which line the chest cavity and cover the lungs).

Subcutaneous emphysema: The presence of air in subcutaneous tissue (tissue beneath the skin).

Robotic-assisted (Computer-enhanced) Surgery

Overview



Robotic-assisted surgery

Robotic-assisted surgery, or robotic surgery, describes a “master-slave” system in which a surgeon uses a console to remotely operate robotic arms in order to perform surgical procedures.

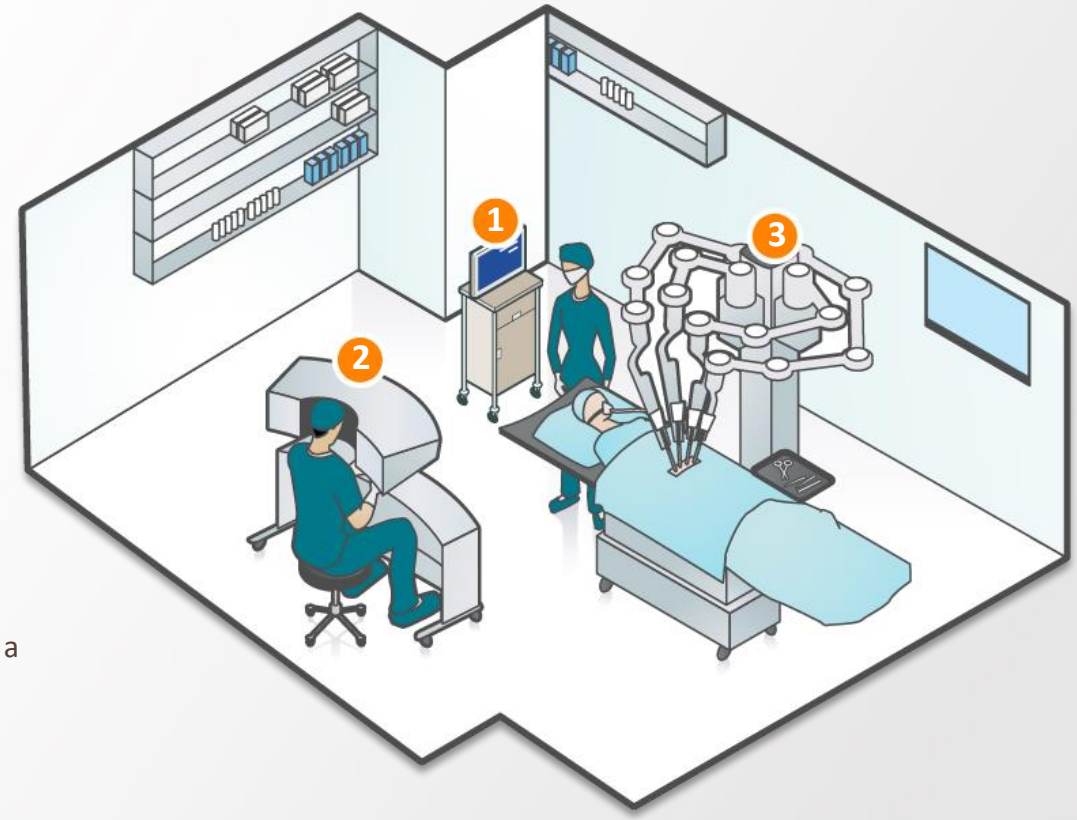
The system requires input from the surgeon and does not function autonomously. For this reason, some prefer the term “computer-enhanced surgery.”

Components of the da Vinci® Surgical System include:

1. **Vision cart:**
   This unit contains equipment for processing images and a touch screen monitor. It also serves as the connection point for additional audiovisual connections and auxiliary equipment.

2. **Surgical console:**
   This console contains the master controls used by the surgeon to manipulate the robotic arms and a viewing screen.

3. **Patient cart:**
   This unit contains the operative robotic arms, the camera arm, and the systems required to support them.



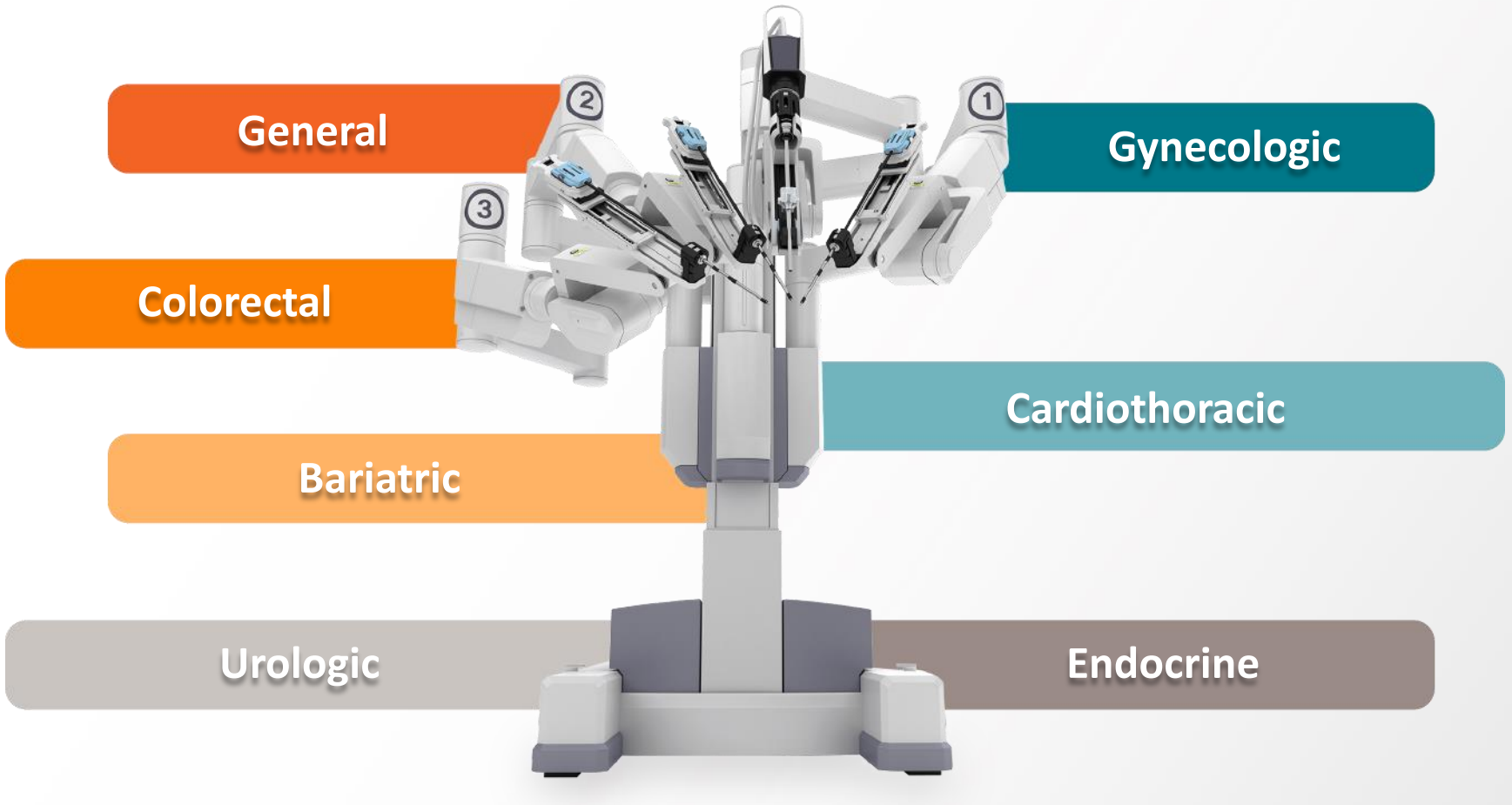
A-Z Glossary Terms

Neuromuscular blockers: Pharmacologic agents that induce paralysis by interfering with the action of acetylcholine at the neuromuscular junction.

Robotic-assisted (Computer-enhanced) Surgery

Types of Surgery

The da Vinci® Surgical System can be used for a variety of procedures:



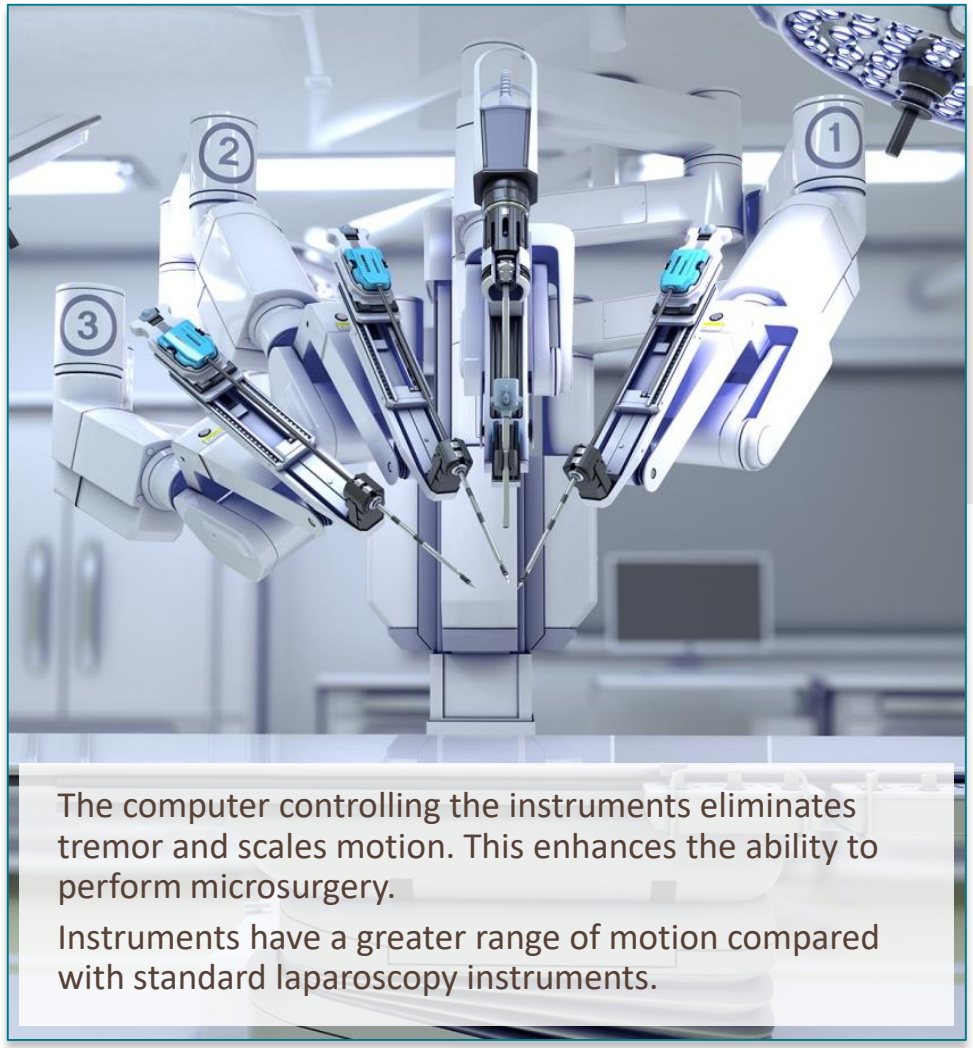
A-Z Glossary Terms

Bariatric: Pertaining to the prevention, control, and treatment of obesity.

Endocrine: Pertaining to the endocrine system, which consists of glands that produce hormones that regulate growth and development, metabolism, sexual function, and reproduction, among other functions.

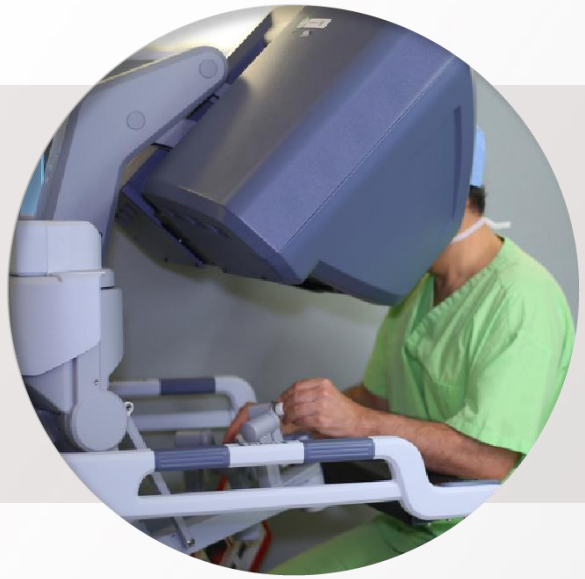
Robotic-assisted (Computer-enhanced) Surgery

Potential Advantages

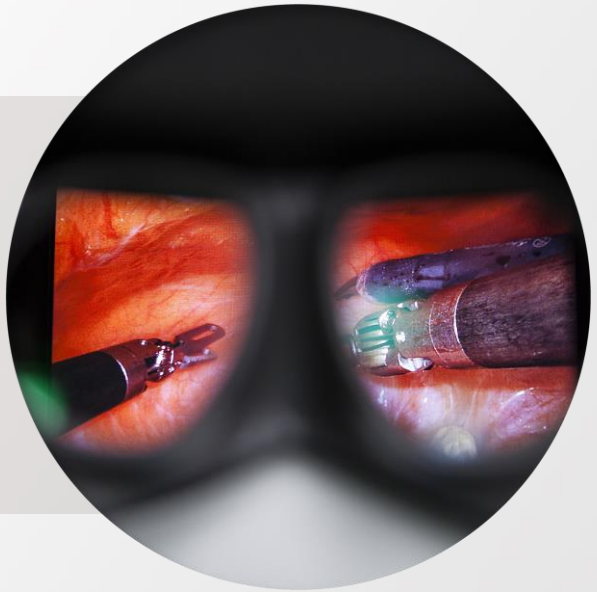


The computer controlling the instruments eliminates tremor and scales motion. This enhances the ability to perform microsurgery.

Instruments have a greater range of motion compared with standard laparoscopy instruments.



The surgeon's console is separated from the patient and operating table. This presents the intriguing possibility of telesurgery, which would allow a surgeon to operate on a patient in a remote or distant location.

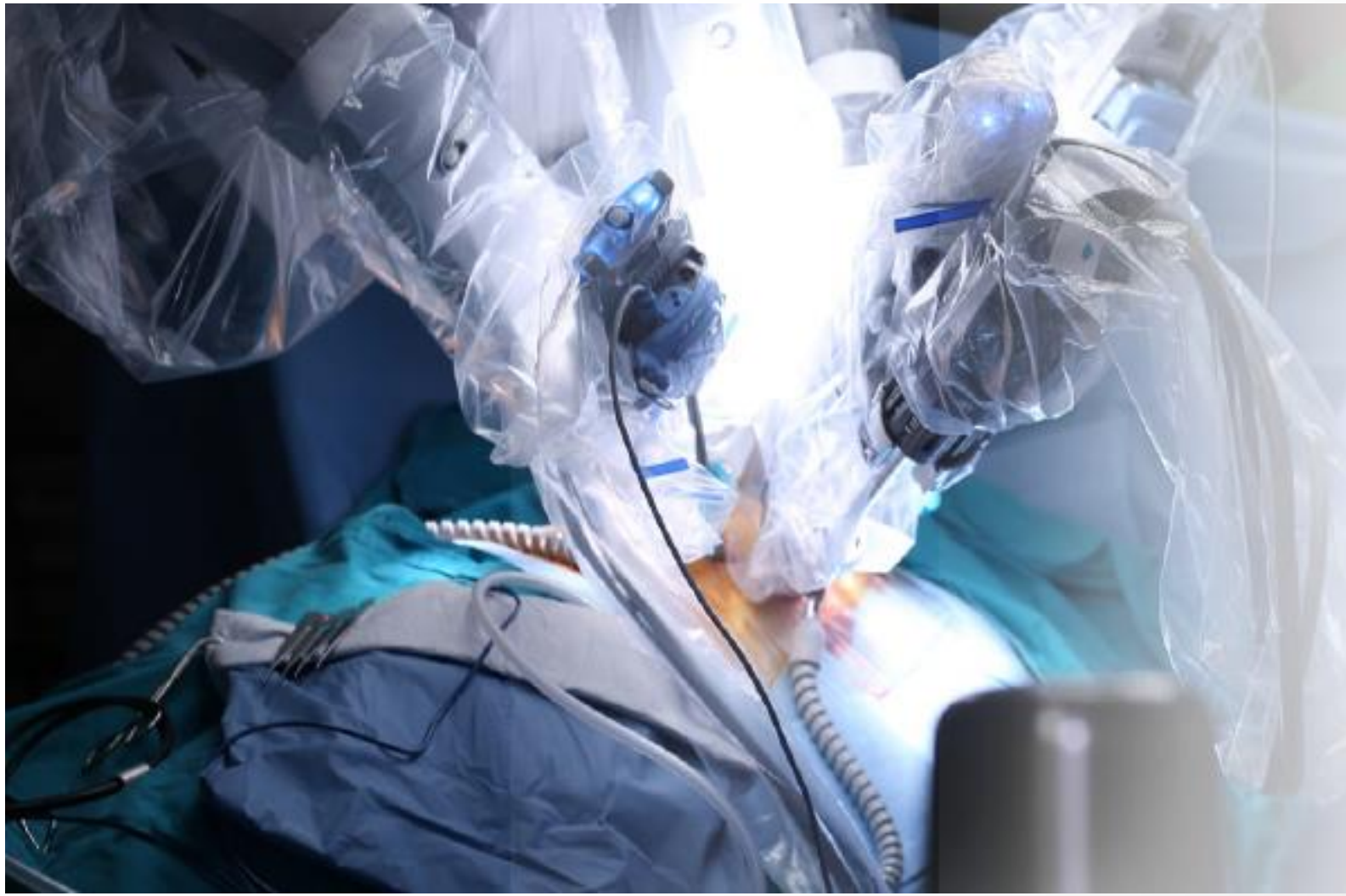


Surgeons have a 3-dimensional view of the operating field.

A-Z Glossary Terms

Microsurgery: Surgery in which various types of magnification, specialized instrumentation, fine sutures, and meticulous techniques are used to repair, connect, or restore delicate tissues.

Robotic-assisted (Computer-enhanced) Surgery



Anesthetic Considerations

Access to the patient is limited.

Operative time is frequently longer with robotic surgery compared with conventional laparoscopy.

Robotic procedures typically require CO_2 pneumoperitoneum.

The patient must not move once the robot is docked. Movement can cause injury to the patient or damage to the robot. It is critically important to provide adequate neuromuscular blockade to ensure the patient remains immobile. Neuromuscular blockade should not be reversed until the patient has been completely disconnected from the robot.

Summary

- Minimally invasive surgery involves performing surgical procedures through small incisions with specialized instruments. It has many applications across a broad range of surgical specialties. Laparoscopic surgery, thoracoscopic surgery, and robotic-assisted surgery are examples of minimally invasive surgery. (See pages 4 and 5.)
- Laparoscopic surgery entails gaining access to the abdominal and pelvic organs through small incisions, creation of a workspace within the abdomen, and manipulation of instruments within the workspace. The workspace for the surgeon is provided by insufflating the peritoneal cavity of the abdomen with CO_2 to create a pneumoperitoneum. Most laparoscopic procedures are performed under general anesthesia. Neuromuscular blockade established during anesthesia relaxes the muscle of the abdominal wall, which facilitates creation of the pneumoperitoneum and placement of laparoscopic cannulae. Neuromuscular blockade also prevents sudden involuntary movements by the patients, which can lead to accidental injuries of intra-abdominal structures by laparoscopic instruments. (See pages 6 and 7.)
- Examples of procedures that can be performed laparoscopically include cholecystectomy, appendectomy, hernia repair, colon surgery, urologic surgery, and gynecologic surgery. Compared with open surgical procedures, laparoscopic procedures present challenges stemming from deformation of the internal organs, restricted workspace, and limited field of view. Use of higher insufflation pressures to achieve a larger operative space may help improve surgical conditions during laparoscopic surgery. However, these benefits must be weighed against the potential adverse effects of increased intra-abdominal pressure on the patient. (See pages 8 and 9.)
- The anesthesiologist or nurse anesthetist also has the important role of maintaining vital organ function and preventing or reducing the detrimental physiological effects of the specific surgical conditions. (See page 10.)
- Normal intra-abdominal pressure is less than 5 mmHg. As the pneumoperitoneum is established, IAP can rise to 12–15 mmHg. Pneumoperitoneum associated with laparoscopic surgery can have significant physiological effects on the patient, including mechanical compression of the lungs, hypercapnia from absorption of CO_2, hypoxemia, decreased cardiac output, and decreased renal blood flow. (See pages 12 and 15.)
- Laparoscopy and other minimally invasive procedures are often performed on an outpatient basis. Short-acting agents are usually preferable in this setting. It is crucial to ensure that neuromuscular blockers are fully reversed at the end of the procedure. Even small amounts of residual block can be very distressing to patients. (See page 14.)
- Operative time is frequently longer with robotic surgery compared with conventional laparoscopy. Adequate neuromuscular blockade is essential to ensure the patient remains immobile once the robot is docked. Movement can cause injury to the patient or damage to the robot. Neuromuscular blockade should not be reversed until the patient has been completely disconnected from the robot. (See page 21.)

Progress Check

1. Which of the following features distinguishes laparoscopic surgical procedures from open surgical procedures? (Choose all that apply.)
   - A. Less need for anesthesia with neuromuscular blockade
   - B. Need to establish a pneumoperitoneum for most procedures
   - C. Lower risk of complications
   - D. Decreased formation of adhesions

2. What type of anesthesia is most commonly used for laparoscopic surgery?
   - A. Local anesthesia
   - B. Regional anesthesia
   - C. Epidural anesthesia
   - D. General anesthesia

3. What is a normal intra-abdominal pressure?
   - A. ≤5 mmHg
   - B. 7–10 mmHg
   - C. 12–15 mmHg
   - D. 16–20 mmHg

Answers appear on page 25

4. Which of the following levels of sustained pathological intra-abdominal pressure defines intra-abdominal hypertension?
   - A. ≥10 mmHg
   - B. ≥12 mmHg
   - C. ≥15 mmHg
   - D. ≥20 mmHg

5. Which of the following is a potential physiologic effect of pneumoperitoneum? (Choose all that apply.)
   - A. Decreased systemic vascular resistance
   - B. Decreased cardiac output
   - C. Decreased lung functional residual capacity
   - D. Decreased urine output

6. Which of the following are potential benefits of neuromuscular blockade during minimally invasive surgery? (Choose all that apply.)
   - A. Optimization of surgical conditions
   - B. Prevention of injuries to the patient
   - C. Prevention of damage to equipment
   - D. All of the above

Glossary

A-Z

Click on each term to see the page it appears on

Abdominal compartment syndrome: Sustained intra-abdominal pressure >20 mmHg that is associated with new onset of organ dysfunction or failure.

Atelectasis: Partial or complete collapse of the lung caused by blockage of the airways or by pressure on the outside of the lung.

Bariatric: Pertaining to the prevention, control, and treatment of obesity.

Cannula: A tube that can be inserted into a cavity and serves as a channel for the
transport of fluids or passage of instruments.

Endocrine: Pertaining to the endocrine system, which consists of glands that produce hormones that regulate growth and development, metabolism, sexual function, and reproduction, among other functions.

Functional residual capacity: The amount of air remaining in the lungs at the end of a normal exhaled breath.

Gas embolism: Obstruction of a blood vessel caused by an air or gas bubble.

Hyaluronic acid: A molecule found in connective tissue that acts as a protective agent.

Hyaluronidase: An enzyme catalyzing the breakdown of hyaluronic acid.

Mesothelial cell: The type of cell that lines the peritoneal cavity.

Hypercapnia: An excess of CO_2 in the bloodstream.

Hypoxemia: Decreased oxygen content of arterial blood.

Insufflation: The introduction of gas (eg, carbon dioxide) into a body cavity such as the peritoneal cavity.

Ischemia: A temporary deficiency of blood flow to an organ or tissue.

Insufflator: A device for blowing gas into a body cavity.

Intra-abdominal hypertension (IAH): A sustained or repeated pathological elevation in intra-abdominal pressure ≥12 mmHg.

Laparoscopic surgery: Surgical technique for performing procedures on abdominal, pelvic, or retroperitoneal organs through one or more small incisions. Insufflation of inert gas creates a working space for the surgeon. Instruments are inserted through ports. A video camera with a fiber-optic light source is used to obtain visualization.

Mesothelial cell: The type of cell that lines serous cavities, including the peritoneal cavity.

Microsurgery: Surgery in which various types of magnification, specialized instrumentation, fine sutures, and meticulous techniques are used to repair, connect, or restore delicate tissues.

Neuromuscular blockers: Pharmacologic agents that induce paralysis by interfering with the action of acetylcholine at the neuromuscular junction.

Parietal peritoneum: The portion of the peritoneum that lines the abdominal walls and the undersurface of the diaphragm.

Glossary (continued)

A-Z

Click on each term to see the page it appears on

Peritoneal cavity: The potential space between the parietal peritoneum, which lines the abdominal wall, and the visceral peritoneum, which forms the surface layer of the abdominal organs. It contains a lubricating fluid.

Peritoneum: The membrane that lines the cavity of the abdomen and covers the abdominal organs.

Pneumomediastinum: The presence of air or gas in the tissues located between the lungs and around the heart.

Pneumoperitoneum: Presence of air or gas in the peritoneal cavity as a result of disease, or produced artificially in the abdomen to achieve exposure during laparoscopic surgery.

Pneumothorax: The collection of air or gas in the pleural cavity (the potential space between the pleural membranes, which line the chest cavity and cover the lungs).

Respiratory acidosis: Increased acidity of the blood caused by retention of CO_2 because of a respiratory condition.

Robotic-assisted surgery: A master-slave system in which a surgeon uses a console to remotely operate robotic arms in order to perform surgical procedures. Potential advantages over conventional laparoscopy include greater range of motion of instruments, 3-dimensional view of the operating field, elimination of tremors, motion scaling, and separation of the surgeon's console from the patient and operating table.

Splanchnic system: The blood vessels that supply the visceral (abdominal) organs.

Subcutaneous emphysema: The presence of air in subcutaneous tissue (tissue beneath the skin).

Thoracoscopy: A diagnostic or therapeutic procedure performed within the pleural cavity of the chest using an endoscope.

Tidal volume: The volume of air that is inhaled and exhaled in a normal breath.

Umbilicus: The navel.

Visceral peritoneum: The portion of the peritoneum that surrounds and covers the abdominal organs.

Progress Check Answers

1. B, C, D *(See pages 4 and 6.)*
2. D *(See page 14.)*
3. A *(See page 12.)*
4. B *(See page 12.)*
5. B, C, D *(See page 15.)*
6. D *(See pages 6, 14, and 21.)*