## Question 1

You are called to the emergency room to see a 25-year-old G0P0 woman with a sudden onset of severe lower abdominal pain associated with vaginal spotting for one day. Which of the following questions are important questions to ask?

- Did you pass any tissue?
- What is your sexual history, including history of sexually-transmitted infections?
- When was your last menstrual cycle?
- All of the above

**Correct answer: All of the above**

Abdominal pain and vaginal spotting in a woman of child-bearing age requires a thorough evaluation of menstrual, sexual, and gynecologic history.

A menstrual history includes date of last menstrual period, age at menarche, menstrual pattern (frequency/duration), flow heaviness, associated pain, and intermenstrual bleeding.

A sexual history may be more difficult to elicit in this setting, but it is relevant to the case. A sexual history includes whether the patient is sexually active, the type of sex (vaginal, anal, oral), the number and gender of partners, use of contraception, and history of sexually transmitted infections.

For women who have had previous pregnancies, it is also important to elicit information about route of delivery, history of previous ectopic pregnancy, and previous complications with delivery (pre-eclampsia, gestational diabetes, delivery complications, neonatal jaundice, etc.).

It is also important to ask if she has had any prior abdominal or pelvic surgeries or passed any tissue (which would be more consistent with a spontaneous abortion).

### Deep Dive into Differential Diagnosis:

Not all patients with vaginal bleeding and abdominal pain have ectopic pregnancies. In a study of over 2,000 patients who were in their first trimester and presented to an emergency department with vaginal bleeding and/or abdominal pain, only 18% were diagnosed with ectopic pregnancy.[1] With that in mind, other causes of abdominal pain must be considered. In a person of childbearing age, other common sources of abdominal pain are urinary tract infections, kidney stones, diverticulitis, tubo-ovarian abscess, appendicitis, ruptured ovarian cysts, ovarian torsion, incarcerated hernia, and neoplasms. While ectopic pregnancy should be high on the differential, pregnant patients have other surgical problems as well. While these conditions are unlikely to cause vaginal bleeding, other conditions to consider for vaginal bleeding include physiologic bleeding, spontaneous abortion, traumatic abortion, and subchorionic hematoma.

1. Casanova BC, Sammel MD, Chittams J, Timbers K, Kulp JL, Barnhart KT. Prediction of outcome in women with symptomatic first-trimester pregnancy: focus on intrauterine rather than ectopic gestation. J Womens Health (Larchmt). 2009;18(2):195-200.

## Question 2

Her last menstrual cycle was 10 weeks ago. The patient is married, lives with her husband, and is sexually active. Her past medical history is significant for pelvic inflammatory disease, for which she was treated a year ago. She has not passed any tissue. Out of the answers listed, which physical examination technique would be unnecessary to perform?

- Abdominal exam
- Breast Exam
- Pelvic exam

- Vital Signs

**Correct answer: Breast exam**
Vital signs are of paramount importance in a patient with an acute abdomen and can inform the decision of whether urgent operative intervention is needed. An abdominal exam is important, as peritonitis can also inform the decision of whether urgent operative intervention is needed. Certain physical exam maneuvers which are performed in the diagnosis of appendicitis, such as the McBurney's, Rovsing's, and Psoas signs, could be helpful as well. Pelvic examination allows for the assessment of the amount of bleeding, presence of tissue, and dilation of the cervix. The presence of cervical motion tenderness, an adnexal mass, or adnexal tenderness are the most useful bimanual pelvic exam findings to diagnose ectopic pregnancy; however, the absence of these findings cannot rule it out.[1] A breast exam, while important for a complete gynecologic examination, would not hold relevance for this case.

1. Crochet JR, Bastian LA, Chireau MV. Does This Woman Have an Ectopic Pregnancy? The Rational Clinical Examination Systematic Review. JAMA. 2013;309(16):1722–1729.

## Question 3

The patient's blood pressure is 110/70, pulse is 97 beats per minute, temperature is 36.7℃, and SpO2 is 98% on room air. On examination, her abdomen is soft. She has abdominal tenderness in the right lower quadrant without rebound. There are no signs of peritonitis including rigidity or rebound tenderness. On cervical exam, there is blood in the vagina. The cervix is closed, and there is no evidence of passed tissue. There is tenderness and a fullness in the right adnexa. Which of the following studies would take preference in order to establish a diagnosis?

- Basic Metabolic Panel (BMP)
- Erect chest and abdominal x-rays
- Erythrocyte Sedimentation Rate (ESR)
- Urine/serum human chorionic gonadotropin (hCG)

**Correct answer: Urine/serum human chorionic gonadotropin (hCG)**
In an acute abdomen, an erect chest and abdominal x-ray to rule out the finding of free air from a perforated viscus is customarily performed. However, there are other investigations that should take preference in this particular case, as a perforated viscus would be lower on this patient's differential due to her physical exam findings, including the lack of peritoneal signs. Urine/serum hCG is a simple, but important, initial investigation, because a positive test helps narrow the differential towards obstetric causes (but also does not exclude concurrent non-obstetric causes). Other important tests include ultrasonography, which can demonstrate the presence of masses or pregnancy. A complete blood count (CBC) helps inform the need for blood transfusion if hemoglobin is < 7.0g/dL.
ESR is a nonspecific marker of inflammation and thus not necessary. A basic metabolic panel would not be as high yield as hCG if obstetric concerns are high on your differential.

## Question 4

The patient's diagnostic studies begin to return. Her urine hCG is positive. A pelvic ultrasound performed in the Emergency Department shows a uterus with a thickened endometrium but no other intrauterine structures. There is a 3 cm x 3 cm mass in the right adnexa with normal

ovaries and no free intraperitoneal fluid. CBC shows white blood cells (WBC) 10,500, hematocrit (Hct) 38%, hemoglobin (Hgb) 12, and platelets (Plt) 286. What is the most likely diagnosis?

- Incomplete abortion
- Ruptured ectopic pregnancy
- Ruptured ovarian cyst
- Unruptured ectopic pregnancy

**Correct answer: Unruptured ectopic pregnancy**
Last menstrual period of 10 weeks ago, sexual activity, and positive hCG point toward either intrauterine pregnancy or ectopic pregnancy. The key risk factor for ectopic pregnancy is tubal scarring, which can be caused by pelvic inflammatory disease, for which she was treated a year ago. In combination with the presence of a 3 cm x 3 cm mass in the right adnexa with associated tenderness and fullness on examination, unruptured ectopic pregnancy is the most likely diagnosis.

### Deep Dive on Pregnancy of Unknown Location:

While transvaginal ultrasound is one of the key investigative tools for diagnosis of ectopic pregnancy, not all pregnancies will be readily visible on ultrasound. Some scenarios will make locating the pregnancy difficult. For example, it may be too early in the pregnancy to see the embryo. The hCG level can help indicate if a pregnancy should be detectable by transvaginal ultrasound. This is called the discriminatory zone.[1] While no definitive hCG values have been established, most intrauterine pregnancies can be visualized when hCG > 2,000 mIU/mL. An ectopic pregnancy can be more difficult to locate than an intrauterine pregnancy. One study showed that when hCG > 2,000 mIU/mL the sensitivity and specificity for locating an ectopic pregnancy by ultrasound is 10.9% and 95.2% respectively.[2] Another clinical challenge can be ovarian pregnancies. By ultrasound, it is hard to discriminate between a distal fallopian tube pregnancy and a hemorrhagic ovarian cyst. Likewise, a pregnancy in the proximal fallopian tube may appear to be an intrauterine pregnancy. This is called an interstitial pregnancy. Other locations for pregnancies outside the uterus to consider are the cervix, prior hysterotomy scar, and abdominal cavity.

1. Braffman BH, Coleman BG, Ramchandani P, Arger PH, Nodine CF, Dinsmore BJ, Louie A, Betsch SE. Emergency department screening for ectopic pregnancy: a prospective US study. Radiology. 1994;190(3):797-802.

2. Condous G, Kirk E, Lu C, Van Huffel S, Gevaert O, De Moor B, De Smet F, Timmerman D, Bourne T. Diagnostic accuracy of varying discriminatory zones for the prediction of ectopic pregnancy in women with a pregnancy of unknown location. Ultrasound Obstet Gynecol. 2005;26(7):770-775.

## Question 5

Which of the following is the best next step for this patient?

- Observation and expectant management
- Methotrexate administration
- Mifepristone administration
- Misoprostol administration

**Correct answer: Methotrexate administration**

Ectopic pregnancy is treated either medically with a single dose of methotrexate (MTX) or surgically with salpingostomy (incision of the fallopian tube to remove the tubal gestation while leaving the rest of the tube intact) or salpingectomy (removal of the fallopian tube). For medical management, all of the following conditions must be met:

1. Hemodynamic stability
2. Serum hCG level < 5000 IU/L
3. Tubal diameter <4 cm with no fetal cardiac activity
4. No intra-abdominal hemorrhage
5. Patient ability to follow up reliably for continued monitoring and observation

While there are different protocols, one example of a methotrexate treatment regimen would be a single dose of 50mg/m2 given intramuscularly. Then, you would serially measure the hCG to make sure it falls appropriately.

Misoprostol (a synthetic prostaglandin), among other uses, is used to treat incomplete or missed abortion. It causes cervical dilation and myometrial contraction to expel intrauterine contents. Mifepristone (a progesterone blocker) is often taken in combination with misoprostol for medical abortion for an intrauterine pregnancy.

**Deep Dive on Heterotopic Pregnancy:**

Heterotopic pregnancy refers to multiple pregnancies implanting at different sites. For example, one embryo implants in the uterus, and the other embryo implants in the fallopian tube. This can present a diagnostic challenge for the physician. The hCG level will appear very high, but the embryos may not be visible. Likewise, if there is a visible intrauterine pregnancy, an additional embryo may not be searched out. This can be especially dangerous in the setting of ruptured ectopic pregnancy and hemodynamic instability. For this reason, often heterotopic pregnancies will be diagnosed at the time of surgery. Heterotopic pregnancies can occur randomly, but they are more likely with in-vitro fertilization. As fertility treatments become more readily available, heterotopic pregnancy is likely to increase as well.

## Question 6

Medical therapies for ectopic pregnancy are not available to you at your hospital. You elect to perform surgical treatment. Which of the following describes a salpingostomy?

- Incision of the fallopian tube to remove the tubal gestation while leaving the rest of the tube intact

- Removal of the fallopian tube
- Removal of the fallopian tube and ovary
- Removal of ovary

**Correct answer: Incision of the fallopian tube to remove the tubal gestation while leaving the rest of the tube intact**
Salpingostomy is incision of the fallopian tube to remove the tubal gestation while leaving the rest of the tube intact, while salpingectomy is removal of the fallopian tube. Salpingostomy and salpingectomy are both utilized in the treatment of ectopic pregnancy with similar results including fertility outcomes. Salpingostomy can be used in most patients with an unruptured ectopic pregnancy with a reasonably undamaged tube. Salpingectomy is indicated for patients with a ruptured tube, uncontrolled tubal bleeding, moderately or severely damaged tube, or large tubal pregnancy > 3 cm. The ovary is not removed with the fallopian tube because the ovaries are an important source of sex hormones. Removal of the ovary(ies) in a premenopausal woman may put her into an early menopausal state.

## Question 7

Which of the following is true of laparoscopic management of ectopic pregnancy over open management?

- Higher operative blood loss
- Longer hospital stay
- Lower anesthetic risk
- Lower overall cost for the patient

**Correct answer: Lower overall cost for the patient**
The risk of anesthesia is similar for laparotomy and laparoscopy. Laparoscopy is associated with lower operative blood loss (79 vs 195 mL), a shorter hospital stay (1-2 days vs 3-5 days), shorter operative time in settings where laparoscopy is commonly performed (73 minutes vs 88), and lower overall cost due to a shorter convalescence time (11 vs 24 days).[1]

1. Hajenius PJ, Mol F, Mol BW, Bossuyt PM, Ankum WM, van der Veen F. Interventions for tubal ectopic pregnancy. Cochrane Database Syst Rev. 2007(1):CD000324.

## Question 8

Which of the following is an absolute contraindication to laparoscopic treatment of ectopic pregnancy?

- Hypotension unresponsive to resuscitation
- Lack of response to intramuscular injection of methotrexate
- Previous pelvic surgery
- Ruptured ectopic pregnancy causing hemoperitoneum

**Correct answer: Hypotension unresponsive to resuscitation**

Laparotomy rather than laparoscopy is recommended for hemodynamically unstable patients with ruptured ectopic pregnancies for prompt control of bleeding and better visualization. Stable patients with ruptured ectopic pregnancy causing hemoperitoneum or those with previous pelvic surgery may prove challenging for laparoscopy, but these are not absolute contraindications. Lack of response (<15% decrease in hCG) to methotrexate is not a contraindication to surgical resection. You can use up to 4 doses of intramuscular methotrexate.

## Question 9

This patient does not have any relative or absolute contraindications for the performance of laparoscopy. You decide to bring this patient to the operating room for a laparoscopic salpingostomy. What kind of anesthesia would you use to perform the surgery?

- General anesthesia
- Local anesthesia
- Procedural sedation
- Spinal anesthesia

**Correct answer: General anesthesia**
General anesthesia is typically used for a laparoscopic procedure as laparoscopy requires analgesia, amnesia, and muscle relaxation. Some physicians have reported successfully using spinal anesthesia to perform laparoscopy. However, this is not common practice and is not recommended by the authors for standard practice.

## Question 10

The patient is now under general anesthesia through an endotracheal tube. Which of the following would be the optimal way to position the patient to perform a laparoscopic salpingostomy?

- Modified lithotomy, arms tucked at patient's sides
- Prone, arms tucked at patient's sides
- Supine, arms abducted
- Supine, arms tucked at patient's sides

**Correct answer: Supine, arms tucked at patient's sides**
A laparoscopic salpingostomy is performed with the patient in a supine position to allow for ease of access. Tucking the arms at the patient's sides allows increased space around the table for the surgeon who would be standing closer to the patient's head in order to visualize the pelvic cavity. The laparoscopic monitor would be by the patient's feet. Having the arms abducted is permissible but reduces the amount of space available to the surgeon to stand. If access to the perineum is needed, a modified lithotomy position may be used. However, access to the perineum is generally not needed for a laparoscopic salpingostomy.
A decubitus or prone position would not be appropriate for this case.

## Question 11

Prior to commencing the operation, you perform a time-out. Which of the following must be part of the time-out?

- Name of the operation
- Patient name
- Site of the operation
- All of the above

**Correct answer: All of the above**
All immediate members of the surgical team should participate in a time-out prior to the commencement of an operation. At minimum, the team members will affirm the patient's identity correct site, and the procedure to be performed.

## Question 12

The patient has been positioned appropriately. She is supine and has been prepped and draped with arms tucked at her sides. Which of the following methods would be an appropriate method to enter the abdomen?

- Hasson technique
- Veress technique
- All of the above: Direct visualization through optical trocar, Hasson entry, and Veress entry are all appropriate methods of entry.

**Correct answer: All of the above: Direct visualization through optical trocar, Hasson entry, and Veress entry are all appropriate methods of entry.**
Access to the abdomen can be performed with an open (Hasson) technique, closed (Veress needle, visual entry trocar) technique, or under direct visualization.

The Hasson entry refers to an open method in which an incision (usually periumbilical) is made through the abdominal wall under direct visualization. This technique increases safety due to direct visualization 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 entry through direct visualization, 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 placed.

All methods are acceptable ways of established laparoscopic access.

## Question 13

You decide to use a Veress needle approach for intra-abdominal access. Where should you place the needle?

- Periumbilical
- Right flank
- Right lower quadrant
- Right upper quadrant

**Correct answer: Periumbilical**
The most common site of entry for either open or closed techniques is at the periumbilical region due to the absence of fat or muscle between the skin and peritoneum at this location. When there is concern for an umbilical hernia or adhesions, alternate sites may be used. The midline abdominal wall is absent of important vessels and nerves and is thus a preferred initial access site.

Alternative locations include the medial costal margin specifically Palmer's point (3 cm under the left costal margin, lateral to the rectus muscle along the midclavicular line, and its equivalent location on the right side of the abdomen. Less commonly, the ninth left intercostal space may be utilized.

## Question 14

As you are inserting the Veress needle in a different patient's case, the needle slips out of your hand and goes deep. The chamber of the Veress needle fills with blood, and blood begins to squirt from the end of the needle. What would you do?

- Abort the procedure immediately and close the skin
- Insert a second trocar to control the bleeding laparoscopically
- Make a vertical midline incision to allow surgical access to the great vessels and apply direct pressure on site of bleeding
- Perform balloon aortic occlusion

**Correct answer: Make a vertical midline incision to allow surgical access to the great vessels and apply direct pressure on site of bleeding**
Large vessel lacerations cannot generally be repaired laparoscopically, and thus, the safest approach would be to perform an exploratory laparotomy through a midline incision. The bleeding can be controlled and repaired directly in an open fashion. Small bleeding may be controlled laparoscopically . Aortic balloon occlusion would assume an aortic injury. However,

this bleeding could be venous or from a mesenteric vessel. Furthermore, balloon occlusions are not the fastest way to achieve hemorrhage control.

## Question 15

You have successfully established entry to the abdominal cavity with a Veress needle for this patient. Which gas would be preferred for insufflation?

- $CO_2$
- Room air
- 100% $O_2$
- 100% $H_2$

**Correct answer: $CO_2$**
$CO_2$ is the most commonly used gas for insufflation because it is non-flammable, colorless, and highly soluble in blood. Room air can be used in resource-limited areas. Both hydrogen and oxygen should not be used due to their flammability.

## Question 16

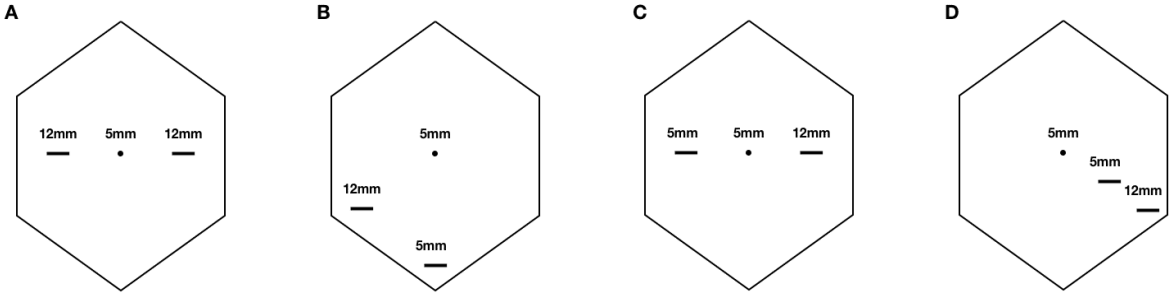
What insufflation pressure would you use to achieve adequate pneumoperitoneum?

- 10 mm Hg
- 15 mm Hg
- 25 mm Hg
- 35 mm Hg

**Correct answer: 15 mm Hg**
A pressure of 15 mmHg is commonly used, allowing sufficient insufflation without compromising respiration or hemodynamics in a patient with normal cardiovascular reserve.

## Question 17

Upon diagnostic laparoscopy, you determine that the patient has an ectopic pregnancy on the right tube. Which of the following would NOT be an effective laparoscopic port configuration for the laparoscopic treatment of this patient's ectopic pregnancy?




- A
- B

- C
- D

**Correct answer: B**
When placing ports, the target (in this case the right fallopian tube) should serve as the point of the triangle. Usually the camera will be placed in the center trocar which points towards the target, and the dissection and retraction trocars will be placed 5-7 cm (the width of the average hand) to the left and to the right of this trocar respectively. This concept is called triangulation. The trocars are usually placed approximately 15 cm away from the target to allow ergonomic use of the instruments with the "fulcrum" of the instrument roughly at the middle of the shaft. The exact port placement for this operation can vary depending on where the surgeon stands. However, the trocar sites and instruments must point down to the side of the ectopic pregnancy. If a 5 mm laparoscope is being utilized, two ports can be 5 mm. However, one larger port (10 mm and 12 mm) must be placed to allow for extraction of the specimen. If a 10 mm laparoscope is being utilized, you should use one 5 mm port and two larger ports (10 mm or 12 mm).

In the case of answer B, this would not allow for triangulation as the surgeon would be operating directly on top of the right fallopian tube.

Supe AN, Kulkarni GV, Supe PA. Ergonomics in laparoscopic surgery. J Minim Access Surg. 2010;6(2):31-36.

## Question 18

You have finished your laparoscopic surgery and just before you take your instruments out, the patient starts to have mild bleeding from the mesosalpinx. Which of the following would be the next best step?

- Conversion to laparotomy
- Direct pressure
- Removal of ovary
- Wait for the bleeding to stop

**Correct answer: Direct pressure**
Although conversion to laparotomy is a good option when there is major bleeding that cannot be controlled laparoscopically, other options to control the bleeding would be attempted for mild bleeding from the mesosalpinx prior to conversion to open surgery.

To apply direct pressure, apply an atraumatic laparoscopic grasper to the site of bleeding. For larger bleeding sites, insert 4x8 in. gauze sponges through a 10 mm port and hold pressure against the bleeding area.

Cautery is probably the most commonly used technique to control minor bleedings laparoscopically and controls the majority of cases. Ligation is also an alternative method to control intraoperative bleeding, although it might be technically difficult for many surgeons.

Removal of the ovary or simply waiting for bleeding to stop are not appropriate.

## Question 19

You have completed the salpingostomy and evacuated the ectopic contents. You have assured hemostasis. Which of the following would be your next step?

- Evacuate pneumoperitoneum by inserting suction into the abdomen
- Increase pneumoperitoneum to 20 mmHg to check for hemostasis
- Remove all instruments, followed by the camera, followed by the trocars
- Remove all instruments, followed by the trocars, followed by the camera

**Correct answer: Remove all instruments, followed by the trocars, followed by the camera**
All trocars should be removed under direct visualization with the camera to ensure that there is no bleeding from the abdominal wall after the trocars are 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 actually making it more difficult to accurately assess hemostasis.

## Question 20

The fascia underlying which of the following incision need to be closed with suture?

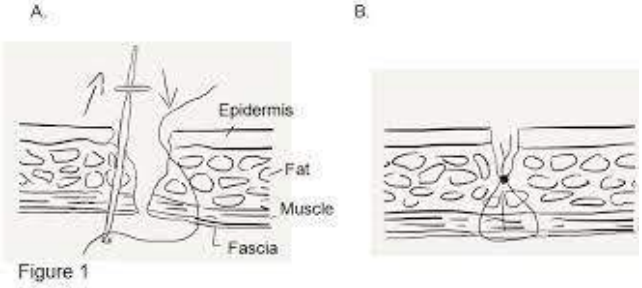


Figure 1

- 12 mm port incision
- Lateral 5 mm port incision
- Medial 5 mm port incision
- Veress needle incision site

**Correct answer: 12 mm port incision**
The fascia to 12 mm port sites needs to be closed. The fascia is typically closed with an absorbable suture, either with a port closure device or under direct visualization in an open fashion. The fascia to a 5 mm port does not typically need to be closed, though some surgeons will close the fascia at a 5 mm port incision at the umbilicus because of the predisposition to hernia. The skin to 5 mm port may be closed, but may also simply be covered with tape and left to heal by secondary intention.