Access to the Peritoneum and Avoiding Complications
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Disclosures

• Consultant
  o Applied Medical
  o Olympus
  o Medtronic
  o Caldera Medical
  o Teleflex
Objectives

- Understand relative merits of various methods of laparoscopic entry
- Review laparoscopic entry in challenging scenarios, including non-umbilical primary puncture such as Palmer’s point
- Know relevant anatomy for avoiding vascular complications associated with entry and port placement

Entry techniques

- More than half of complications in laparoscopy occur during ENTRY

- Vascular injuries during entry are associated with a 15% mortality rate

- So what is the best method of entry?
  - Veress needle ("closed")
  - Hasson ("open")
  - Direct
  - Optical

Krishnakumar J Gyn Endosc Surg 2009
Entry techniques

- Systematic review: appropriate for rare outcomes
- 46 RCTs, 7389 subjects
- “No advantage to any one technique in terms of preventing major vascular or visceral complications”
- Open-entry outperformed closed with failed entry
- Direct-trocar entry outperformed Veress with failed entry and vascular injury
- Very small odds ratios, most not serious complications, statistical limitations, many studies excluded subjects w prior surgery, elevated BMI

Ahmad Cochrane 2015
Veress entry

- Principles
  - Have the patient flat
  - Be mindful of distance to great vessels
  - Test the needle before entry
  - Connect insufflation tubing before entry
  - Listen / feel the cadence of the needle through layers
  - Confirmation: aspirate, “drop” test, pressure
  - Settings: 15-20mm Hg for entry
  - Insufflation: time, volume, pressure
  - Risk of injury increases with multiple attempts
  
  Teoh JMIG 2005

Veress entry

- Multiple attempts increases risk of injury

<table>
<thead>
<tr>
<th>Number of attempts</th>
<th>% success</th>
<th>Complications</th>
</tr>
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<tbody>
<tr>
<td>One</td>
<td>86%</td>
<td>Up to 16%</td>
</tr>
<tr>
<td>Two</td>
<td>10%</td>
<td>16-38%</td>
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<tr>
<td>Three</td>
<td>3%</td>
<td>44-64%</td>
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<tr>
<td>&gt; Three</td>
<td>1%</td>
<td>85%+</td>
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Veress entry

Direct entry
Port placement

- Suprapubic “Diamond”
  - Operate two-handed from either side
  - Assistant
  - Cosmetic

- Poor triangulation
- Less ergonomic
Port placement

• **Suprapubic “Diamond”**
  - Operate two-handed from either side
  - Assistant
  - Cosmetic
    - Poor triangulation
    - Less ergonomic

• **Ipsilateral**
  - Improved triangulation
  - Better ergonomics
  - Less cosmetic
Port placement

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Port placement

Palmer’s point

ASIS

Port placement
Port placement

- Fundus
- Placenta

- Placenta
- Vaginal vault
Port placement
Port placement

Port placement
49 yo g3p2012 with years of heavy menstrual bleeding and anemia.
CT: 10cm ventral verna, uterus with innumerable fibroids, 24 x 32 x 27 cm, over 7000 mL in volume.
Surgx: open ventral herniorrhaphy.
Exam: uterus filling the cul-de-sac and extending above both costal margins.
260 lbs (BMI 43 kg/m²)
Jehovah’s witness.
Port placement
Port placement
Abdominal wall adhesions / prior surgery

- Ultrasound visceral “slide-by” test

Kodama et al. showed that 5 patients without a history of previous abdominal surgery had ultrasound-visualized movement of the underlying viscera (visceral slide) of at least 2.5 cm during exaggerated respiration; none had adhesions at time of abdominal surgery. They also tested 13 patients with surgical or other risk factors for adhesions; of the 7 with visceral slides less than 1 cm, all had adhesions beneath the scar.

Caprini et al. studied 30 patients with previous abdominal surgery, successfully identifying all 4 patients with infraumbilical adhesions while excluding the 26 normal patients, using the same cutoff.

In contrast, Uberoi et al. using visceral slide thresholds of 1.2 to 1.5 cm in all 4 abdominal quadrants, studied 48 patients undergoing abdominal surgery. They reported a sensitivity of 21% and specificity of 94%, and expressed concern for the large number of false positives encountered.

The latter 2 studies observed visceral slide during spontaneous respirations, rather than exaggerated respiration.

Although other techniques exist for minimizing bowel injury at initial needle/port placement in high-risk women, such as choosing the left upper abdominal quadrant for primary entry, or performing a small laparotomy for umbilical port placement, none completely eliminates the risk.

In addition, a recent meta-analysis comparing safety of small umbilical laparotomy versus blind needle placement found a lack of evidence to favor one method over the other.

The present study quantifies the test characteristics for preoperative ultrasound measurement of visceral slide as a predictor of infraumbilical adhesions.

Material and methods

We measured visceral slide preoperatively in a series of 60 women with risk factors for intra-abdominal adhesions. Participants were approached between January 1, 2003 and June 13, 2003 for consent to participate in the study while in the UNC Hospitals Women’s and Children’s Hospital preoperative waiting area on the morning of their procedure. Ninety-five percent of women approached gave consent, as shown by the participant flow diagram in Figure 1. Authorization for the study was obtained from the UNC Medical School Institutional Review Board. This nonconsecutive, convenience sample met the following inclusion criteria: age 18 years or older, history of abdominal surgery (including hysterectomy, cesarean delivery, tubo-ovarian surgery, tumor debulking, intestinal resection, gastric bypass, appendectomy, cholecystectomy, or umbilical herniorrhaphy), or history of pelvic inflammatory disease. All participants were scheduled for either laparoscopy or vertical laparotomy for a gynecologic condition (43% hysterectomy, 28% ovarian surgery, 10% adhesiolysis, 8% diagnostic laparoscopy, and 10% other.) Women undergoing vertical laparotomy were included for 2 reasons: first, because visualization of scar tissue underneath the umbilicus could be evaluated equally well with these incisions compared with laparoscopy; second, they enhanced the spectrum of disease within the study population.

This was a cross-sectional study design. A total of 60 participants were chosen for this study based on sample size calculations to achieve narrow confidence intervals.
Abdominal wall adhesions / prior surgery

• Visceral ultrasound “slide-by” test
  o Visceral slide < 1cm to predict adhesions
    ▪ Sensitivity 86%
    ▪ Specificity 91%
    ▪ PPV 55%
    ▪ NPV 98%
  o Works better awake in-office than under GETA

Tu AJOG 2005

Abdominal wall adhesions / prior surgery

• Visceral ultrasound “slide-by” test: Negative test (“good slide”)
Abdominal wall adhesions / prior surgery

- Visceral ultrasound “slide-by” test: Positive test (“bad slide”)
Abdominal wall adhesions / prior surgery

Obesity

- **Underweight**: Median = -0.87
- **Normal**: Median = -0.88
- **Overweight**: Median = -1.20
- **Obese**: Median = -3.50

**C BMI vs. Umbilical Position**

- **Underweight**: 27.7 (27.5–28.0)
- **Normal**: 31.5 (30.5–32.0)
- **Overweight**: 33.0 (32.0–33.5)
- **Obese**: 38.0 (37.0–40.0)

**Ambardar Surg Endosc 2009**
• LUQ entry
• Umbilical insufflation, alternative first puncture trocar site
• Advanced fixation / balloon-tipped trocars
• Port placement
• Trendelenberg “rests” (flatten patient, let out CO$_2$)
• Defer request for steep Trendelenberg until deeper steps (e.g. colpotomy, cuff closure)
• Score posterior colpotomy first
Umbilical entry, alternate entry site

Advanced fixation trocars
Advanced fixation trocars

Port placement
Port placement

Port placement
Inferior epigastric vessels was identified as one of the structures emerging from the superficial inguinal ring in all specimens. The course of this vessel was lateral to the lateral margin of the rectus abdominis muscles, where small nerve branches were noted to perforate the aponeuroses of the internal and external oblique muscles, and traveled between the deep inferior epigastric vessels and the round ligament, as the ligament moved 2 cm superior to the PS (typical starting point for transverse incisions), the ilioinguinal and iliohypogastric nerves terminated above the level 2 cm superior to the PS, common landmark for accessory trocar placement.

The hypogastric (anterior cutaneous) nerve to a point 5 cm superior to the PS and 8 cm lateral to the midline PS with insufflation was 4.4 (8.8) mm medial and 3.1 (8.2) mm inferiorly, and the point on the skin overlying landmarks of interest moved 8.2 (9.3) mm laterally and 3.1 (9.4) mm inferiorly, and the point on the ASIS was 3.7 (2.6 –5.5) cm from midline (9.4) mm inferiorly, and the point on the ASIS (9.2–10.5) cm superior to the midline of the abdomen.

The closest distance of the vessels to the PS, common landmark for accessory trocar placement, was 1.3 (0 –3.7) cm. In the majority of specimens, the ilioinguinal nerve terminated above the level 2 cm superior to the PS, and 8 cm from midline was 0.6 (0 –1.6) cm inferior to the pubic tubercles. Along with the iliohypogastric nerve, it gave off a branch of the iliohypogastric nerve that moved 8.2 (9.3) mm laterally and 3.1 (9.4) mm inferiorly, and the point on the ASIS was 3.7 (2.6 –5.5) cm from midline (9.4) mm inferiorly, and the point on the ASIS (9.2–10.5) cm superior to the midline of the lower abdomen at the inguinal ring into the inguinal canal.

The closest distance of the iliolumbar vessels to the ASIS, was 5.5 (3.5 - 8.5) cm. At this level, the inferior epigastrics were lateral to the lateral margin of the rectus abdominis muscles 2.5 (0 – 4.6) cm medial and 2.0 (0 – 4.6) cm inferior to the midline of the lower abdomen at the inguinal ring into the inguinal canal.

Vessel injury

Think of abdomen like a dome
Insert perpendicular to the fascia

Rahn AJOG 2010

> 6cm from midline at or above the ASIS

Rahn AJOG 2010
Vessel injury

- Epigastric vessels
  - Superficial epigastric vessels
    - Variable in location
    - Visible by transillumination ~50%
  - Inferior epigastric vessels
    - Visible laparoscopically ~50%
    - Always between medical umbilical ligament and round ligament
- Injury:
  - Foley catheter
  - Suture passer (Endoclose, Carter-Thomason)
  - Keith needle
  - Proximal and distal control

Vessel injury

The inferior epigastric vessels are observed lateral to medial umbilical ligaments and just medial to round ligament. They then course in plane between transversus abdominis muscle (TA) and internal oblique muscles (IO) and then move medially and inferiorly, piercing IO, and travel between aponeuroses of IO and external oblique (EO). Inferior epigastric vessels are observed lateral to medial umbilical ligaments and just medial to round ligament.

Near iliac crest, both nerves pierce deep or posterior surface of transversus abdominis muscle (TA). They then course in plane between TA and internal oblique muscles (IO) and then move medially and inferiorly. Most importantly, for this final portion of the vessels, they course laterally with respect to the rectus muscles. This is the region known as Hesselbach triangle, bounded anteriorly by the rectus muscles. At a point 2 cm above the pubic symphysis (PS), the inferior epigastrics were all 2 cm medial to the PS. In our study, we found the average, 3.1 cm medial and 3.7 cm inferior to the ASIS, and the iliohypogastric entered 2.1 cm medial and 0.9 cm inferior to the ASIS, and the iliohypogastric entered 2.1 cm medial and 0.9 cm inferior to the level of the ASIS. As the ilioinguinal and iliohypogastric nerves course medially and inferiorly from their entry point in the anterior abdominal wall, low transverse incisions and laparoscopy trocars placed inferiorly from their entry point in the anterior abdominal wall is best avoided by placing the trocars under direct visualization. In contrast to the subcostal approach which may increase the likelihood of entrapping these nerves, it may place the inferior epigastric vessels at risk as they course medially toward the umbilical region.

While our study confirms that placement of accessory trocars 5 cm superior to the PS and 8 cm lateral to the midline from midline at the level of the ASISs, this may increase the likelihood of entrapping these nerves. However, in both studies the nerves were consistently close to the anterior abdominal wall, low transverse fascial incisions ideally will spare if these fascial incisions remain within 5.5 cm from the midline. One should take care not to place fascial closing stitches lateral to the angle/apex of Hesselbach triangle, bounded anteriorly by the rectus muscles. This is the region known as Hesselbach triangle, bounded anteriorly by the rectus muscles. At a point 2 cm above the pubic symphysis (PS), the inferior epigastrics were all 2 cm medial to the PS. In our study, we found the average, 3.1 cm medial and 3.7 cm inferior to the ASIS, and the iliohypogastric entered 2.1 cm medial and 0.9 cm inferior to the ASIS, and the iliohypogastric entered 2.1 cm medial and 0.9 cm inferior to the level of the ASIS. As the ilioinguinal and iliohypogastric nerves course medially and inferiorly from their entry point in the anterior abdominal wall, low transverse incisions and laparoscopy trocars placed inferiorly from their entry point in the anterior abdominal wall is best avoided by placing the trocars under direct visualization. In contrast to the subcostal approach which may increase the likelihood of entrapping these nerves, it may place the inferior epigastric vessels at risk as they course medially toward the umbilical region.

While this practice may prevent injury to the anterior abdominal wall nerve and vessel anatomy. Am J Obstet Gynecol 2010. Reproduced, with permission, from Mr Corbyn Beach, Dallas, TX.

Transverse fascial incisions that begin 3.5 cm from the midline at the level of or superior to the ASIS. Placement of trocars in this region minimizes risk of injury to both the ilioinguinal/iliohypogastric nerves and the inferior epigastric vessels. This cadaver study substantiates the recommendations of other studies using computed tomography to guide lateral trocar placements of other studies using computed tomography to guide lateral trocar placements.
repair. Treatment challenges are likely greatest when an injury occurs at an outpatient surgical center or at a smaller hospital distant from a major medical center.

The objectives of this article were to review the early signs of major vessel injury during laparoscopy and to provide gynecologists and other surgeons with recommendations for treating these injuries. Recommended treatment approaches are reviewed for presumed gas embolism in patients who are either hemodynamically stable or unstable. Treatment of major vessel injury resulting in massive hemorrhage consists of rapid laparotomy with control of hemorrhage using direct pressure until a surgeon experienced in vascular surgery arrives. When a major vessel injury occurs in an outpatient surgical facility distant from a full-service hospital and no surgeon with vascular experience is immediately available, based on the trauma literature, we recommend temporary control of blood loss using abdominal packing and closure (i.e., ''damage control surgery'') and judicious resuscitation (i.e., ''damage control resuscitation'') before transportation of the patient to a medical center.

Major Vessel Injury during Laparoscopy

Major Vessels of Lower Abdomen and Pelvis

Major arteries that lie in the retroperitoneal space of the lower abdomen and pelvis include the distal abdominal aorta and the common, external, and internal iliac arteries (Fig. 1).

In most patients, the aortic bifurcation is located just cephalad to the umbilicus; however, in the thinnest patients, the aorta can lie immediately beneath the umbilicus. At the bifurcation, the common iliac arteries diverge laterally. In approximately the midline, the right common iliac artery crosses over the left common iliac vein. Near the pelvic brim, the internal iliac artery branches off posteromedially, and the external iliac artery continues anterocaudally to enter the inguinal canal.

The major veins lie posterior to these arteries in the lower abdomen and pelvis. Analogous to the arteries, the vena cava bifurcates into the common iliac veins. These lie almost directly behind their associated arteries, whereas the internal and external iliac veins transition to a posteromedial position compared to that of the corresponding arteries.

Mechanism of Injury

Veress Needle and Umbilical trocar Injuries

Most retroperitoneal vessel injuries at laparoscopy occur during blind placement of the Veress needle or primary trocar through a periumbilical incision. Based on anatomical considerations, it is likely that the risk of retroperitoneal vessel injury is minimized by inserting instruments through the umbilicus parallel to the spine in the midline. However, the midline can be difficult to accurately determine when the patient is draped, and the margin of error between successful intraperitoneal placement and vessel injury can be surprisingly small, in particular in thin patients.

A second important variable when inserting periumbilical instruments is the angle of insertion. It seems that the risk of major vessel injury can be minimized in most patients by inserting instruments at a 45-degree angle from the plane of the patient's spine. In obese patients, this angle must be increased to as much as 80 to 90 degrees to enter the peritoneal cavity; however, the increased distance from the skin to the major vessels in these patients makes this approach reasonably safe. In patients who are not obese, insertion of instruments at an angle greater than 45 degrees is likely to increase the risk of major vessel injury. In all patients, the insertion angle can only be approximated, and placing the patient in the Trendelenberg position (head down) might increase the risk of placing instruments at a greater angle than anticipated in relation to the patient's spine.

Lateral Port Injuries

Major vessel injury can also occur during placement of secondary ports. In an effort to avert injuring abdominal wall vessels, trocars for secondary ports are often placed 8 cm or farther from the midline. This area, which approximates the McBurney point on the right, often lies immediately anterior to the external iliac vessels. Although secondary port trocars are placed under direct visualization, it is possible to inadvertently injure a major vessel during this procedure. The angle of insertion is also critical in this location; it is likely that a lateral portal inserted at a 45-degree angle from the plane of the patient's spine is associated with a significantly lower risk of injury compared to an angle greater than 45 degrees.
Vessel injury

- Major vessel laceration
  - If the patient is stable, evaluate injury, expanding hematoma
  - If present, put pressure and perform emergency (vertical) laparotomy while maintaining pressure on the area of bleeding
  - Call for vascular surgeon, blood and product
  - Don’t be tempted to further evaluate yourself
  - In stand-alone center, may need to pack with lap sponges, quickly close abdomen w towel clips or running Nylon, transfer to hospital
Vessel injury

[Image: Image of vessel injury]
Vessel injury

References


References


