GENERAL GYNECOLOGY

Anterior abdominal wall nerve and vessel anatomy: clinical implications for gynecologic surgery

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OBJECTIVE: We sought to describe relationships of clinically relevant nerves and vessels of the anterior abdominal wall.

STUDY DESIGN: The ilioinguinal and iliohypogastric nerves and inferior epigastric vessels were dissected in 11 unembalmed female cadavers. Distances from surface landmarks and common incision sites were recorded. Additional surface measurements were taken in 7 other specimens with and without insufflation.

RESULTS: The ilioinguinal nerve emerged through the internal oblique: mean (range), 2.5 (1.1–5.1) cm medial and 2.4 (0–5.3) cm inferior to the anterior superior iliac spine (ASIS). The iliohypogastric emerged 2.5 (0–4.6) cm medial and 2.0 (0–4.6) cm inferior. Inferior epigastric vessels were 3.7 (2.6–5.5) cm from midline at the level of the ASIS and always lateral to the rectus muscles at a level 2 cm superior to the pubic symphysis.

CONCLUSION: Risk of anterior abdominal wall nerve and vessel injury is minimized when lateral trocars are placed superior to the ASISs and >6 cm from midline and low transverse fascial incisions are not extended beyond the lateral borders of the rectus muscles.

Key words: iliohypogastric, ilioinguinal, inferior epigastric, nerve injury, vascular injury

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Injuries to the nerves and vessels of the anterior abdominal wall are well-recognized and significant complications of laparoscopic and open gynecologic surgeries. Ilioinguinal and iliohypogastric nerve injury has been reported in up to 3.7% of gynecologic procedures performed through Pfannenstiel incisions, and these nerves may also be damaged during operative laparoscopic procedures with placement of lateral trocars.[1,2] General surgery literature for laparoscopic repair of inguinal hernias using similar port sites quotes an overall nerve entrapment rate of 4.2% and of 1.1% for the ilioinguinal nerve, in particular.[3] Injury to the inferior epigastric vessels occurs in 0.2-2% of operative laparoscopic procedures using lateral trocars and can lead to transfusion, hematoma or abscess formation, and reoperation to control bleeding.[4-6]

A classic manifestation of ilioinguinal/iliohypogastric neuropathies includes lancinating or burning pain in the groin region that radiates to the vulva.[1] This pain may present immediately postoperatively or weeks to months later and may require management with prolonged use of opiates, repeated nerve blocks, or surgical exploration for neurolysis, neuroma resection, or nerve resection.[1,7,8] Proposed mechanisms for these neuropathies involve direct nerve trauma and neuroma formation from transection or entrapment of these nerves. Neural constriction is thought to persist months to years postoperatively as a consequence of the normal scarring/healing process.[9] Ilioinguinal and iliohypogastric nerve injury may also contribute to subsequent formation of direct inguinal hernias.[10] Given that the consequences of these neuropathies can be debilitating, strategies for prevention should prove advantageous.

The ideal approach to avoid inferior epigastric vessel injury during laparoscopic accessory trocar placement is to directly visualize the vessels transperitoneally. However, when unable to visualize the vessels directly, surface landmarks are often employed. One such landmark is the point 5 cm superior to the pubic symphysis (PS) and 8 cm from the midline, which was recommended by Hurd et al[11] after they evaluated normative data of inferior epigastric vessel location relative to superficial anatomic landmarks using computed tomography scans. Their findings have been subsequently replicated.[5]

Although ilioinguinal and iliohypogastric nerve injuries are most commonly associated with Pfannenstiel incisions, injuries have also been described following accessory trocar placement.[1] The relationship of these nerves to the point 5 cm superior to the PS and 8 cm from the midline has not been specifically evaluated. Given that these nerves cannot be directly visualized transperitoneally, precise knowledge of the relative position of the nerves to the inferior epigastric vessels and to commonly used landmarks employed to avoid vessel injury is essential. Thus, the objectives of this study were to: (1) further characterize the relationships of the ilioinguinal/iliohypogastric nerves and inferior epi-

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gastric vessels to each other and to surface landmarks commonly used for gynecologic incisions; and (2) identify optimal locations for accessory trocar entry and laparotomy incisions that would minimize the risk of both nerve and vessel injury.

MATERIALS AND METHODS

Detailed dissections of the anterior and posterior abdominal walls were performed on 11 unembalmed female cadavers obtained from the Willed Body Program at the University of Texas Southwestern Medical Center in Dallas. Further surface anatomy measurements before and after insufflation for laparoscopy were made in an additional 7 unembalmed specimens. This study was exempt from review by the institutional review board. Age, height, weight, and cause of death of the body donors at the time of death were recorded. These specimens had no evidence of prior laparotomy or other anterior abdominal wall incisions.

All measurements were taken twice using a digital caliper sensitive to 0.01 mm (General Tools, New York, NY), and the average value was recorded. Descriptive statistics including means, SD, and ranges were performed.

Surface landmarks

Common placement sites of laparoscopy and laparotomy incisions used in gynecologic surgery were marked with straight metal pins placed through the anterior abdominal wall. These sites were measured from 2 clinically identifiable bony landmarks: the upper surface of the mid-PS and the most anterior surface of the anterior superior iliac spines (ASISs). The midline of the abdomen was defined as the vertical line connecting the PS to the umbilicus. Other sites marked included (1) a point 5 cm superior to the mid-upper surface of the PS and 8 cm lateral from the midline of the abdomen, a point often used as a landmark for insertion of accessory trocars;[11] and (2) a point 2 cm superior to the mid-upper surface of the PS, a typical starting site for Pfannenstiel incisions.[12] Additional annotations included the distance from the PS to the midpoint between the right and left ASISs, distances from the PS to the umbilicus, and from ASIS to ASIS.

In an attempt to account for the variability of measurements on the skin with abdominal insufflation relative to the landmarks above, in 7 additional specimens, the abdominal skin was marked over 3 sites bilaterally: (1) the point 5 cm superior and 8 cm lateral from the midline PS; (2) McBurney point, or the point one-third of the distance from the ASIS to the umbilicus, bilaterally; and (3) the ASIS. After insufflation with carbon-dioxide gas to 15-20 mm Hg, the skin was again marked at these 3 sites, and the distances medial/lateral and superior/inferior between corresponding points before and after insufflation were measured.

Ilioinguinal and iliohypogastric nerve dissection-anterior abdominal wall

Bilateral incisions were made parallel and approximately 1 cm inferior to the inguinal ligaments, from the level of the ASISs to the pubic tubercles. The skin and subcutaneous tissue of the anterior abdominal wall were reflected superiorly, the superficial inguinal ring was identified, and the structures that emerged from this ring were isolated en-block and held with a suture for further characterization at subsequent steps of the dissection. The aponeurosis of the external oblique muscle was incised just superior and parallel to the inguinal ligament and sharply dissected upward. The iliohypogastric and ilioinguinal nerves were identified as they emerged through the anterior surface of the abdominal wall muscles and the distance and relationship of each nerve at this point to the ASIS was recorded. The course of the nerves was then followed and the distances and anatomic relationships of these nerves to the previously marked sites were documented. Nerve widths nearest the ASIS and the midline were also recorded.

Inferior epigastric vessels

The rectus sheath was incised vertically just lateral to the midline. The anterior abdominal wall muscles were reflected laterally to identify the inferior epigastric vessels. Care was taken that the peritoneal cavity was not entered at this time. The inferior epigastrics were traced from the external iliac vessels to a level just superior to the umbilicus. The closest distance of the vessels to the initially marked and above-mentioned points was documented.

Ilioinguinal and iliohypogastric nerve dissection–posterior abdominal wall

The abdominal cavity was opened. The small bowel and a portion of the large bowel to the rectosigmoid were tied, transected, and removed. The peritoneum overlying either side of the aorta was sharply transected and reflected laterally to a level just inferior to the iliac crest. The ilioinguinal and iliohypogastric nerves were identified on the posterior abdominal wall and their course traced through the anterior abdominal wall layers. The relationship of the nerves to the muscle layers was documented.

RESULTS

Demographic data were available on all cadavers. Mean age at time of death (SD; range) was 88 years (9.5; 65–101 years); height was 162 cm (6.4; 152–170 cm); weight was 47 kg (9.9; 32–64 kg); and body mass index was 18.1 kg/m^2 (3.9; 13.7–26.5 kg/m^2). All cadavers were white.

Main findings of the study are shown in Figure 1.

Ilioinguinal and iliohypogastric nerves

In the posterior abdominal wall, the ilioinguinal and iliohypogastric nerves were identified as they emerged from the upper part of the lateral border of the psoas muscles. They coursed laterally over the anterior surface of the quadratus lumborum toward the iliac crest. In 50% of the specimens, a common trunk perforated the psoas muscle and divided into the 2 nerves near the iliac crest. In the remaining specimens, the ilioinguinal nerve coursed through the posterior abdominal wall just inferior to the iliohypogastric nerve. Near the iliac crest, both nerves pierced the deep or posterior surface of the transversus abdominis muscle and then coursed in the plane between the transversus abdominis and internal