UROGYNECOLOGY

Vascular and ureteral anatomy relative to the midsacral promontory

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OBJECTIVE: The objective of the study was to further characterize the vascular and ureteral anatomy relative to the midsacral promontory, a landmark often used during sacrocolpopexy, and suggest strategies to avoid complications.

STUDY DESIGN: Distances between the right ureter, aortic bifurcation, and iliac vessels to the midsacral promontory were examined in 25 unembalmed female cadavers and 100 computed tomography (CT) studies. Data were analyzed using Pearson χ^2, unpaired Student *t* test, and analysis of covariance.

RESULTS: The average distance between the midsacral promontory and right ureter was 2.7 cm (range, 1.6–3.8 cm) in cadavers and 2.9 cm (range, 1.7–5.0 cm) on CT ($P = .209$). The closest cephalad vessel to the promontory was the left common iliac vein, the average distance being 2.7 cm (range, 0.95–4.75 cm) in cadavers and 3.0 cm (range, 1.0–6.1 cm) on CT ($P = .289$). The closest vessel to the right of the promontory was the internal iliac artery, with the average distance of 2.5 cm (range, 1.4–3.9 cm) in cadavers and 2.2 cm (range, 1.2–3.9 cm) on CT ($P = .015$). The average distance from the promontory to the aortic bifurcation was 5.3 cm (range, 2.8–9.7 cm) in cadavers and 6.6 cm (range, 3.1–10.1 cm) on CT ($P < .001$). The average distance from the aortic bifurcation to the inferior margin of the left common iliac vein was 2.3 cm (range, 1.2–3.9 cm) in cadavers and 3.5 cm (range, 1.7–5.6 cm) on CT ($P < .001$).

CONCLUSION: The right ureter, right common iliac artery, and left common iliac vein are found within 3 cm from the midsacral promontory. A thorough understanding of the extensive variability in vascular and ureteral anatomy relative to the midsacral promontory should help avoid serious intraoperative complications during sacrocolpopexy.

Key words: sacral promontory, sacrocolpopexy, ureter, vascular anatomy

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Hemorrhage and ureteral injury are infrequent but serious complications of sacrocolpopexy, with reported rates of 4.4% and 1%, respectively.[1,2] These complications generally occur during dissection of the presacral space to expose the anterior longitudinal ligament and during suture placement.

Modifications of the sacrocolpopexy, including the location of the graft attachment have evolved as surgeons encountered and reported complications. For example, the report by Sutton et al[3] of a life-threatening hemorrhage during graft fixation at the S3-S4 level led authors to recommend a graft fixation at the S1-S2 level to better visualize the middle sacral vessels.[4] Current descriptions of the procedure advocate graft attachment to the anterior longitudinal ligament at the level of sacral promontory.[1,5,6] However, surgeons often choose the sacral fixation site based on intraoperative findings because the vascular anatomy of the presacral space is highly variable.[7,8]

The incorporation of the laparoscopic and robotic-assisted approach to sacrocolpopexy has introduced further challenges. Because dissection and suturing may be technically difficult due to the marked angle between the lower lumbar vertebrae and the anterior surface of the sacrum, surgeons may choose fixation points above the sacrum. Importantly, 2 previous cadaver studies have shown that the left common iliac vein may course less than 1 cm cephalad to the midsacral promontory (MSP).[7,8] The proximity of the left common iliac vein (LCIV) to the MSP makes it especially vulnerable to injury when dissection and suture placement extends above the upper margin of the sacrum, potentially leading to catastrophic complications.

The lack of haptic feedback with the robot-assisted approach adds to the challenges of identifying important anatomical structures,[9,10] such as the aortic bifurcation and sacral promontory. In addition, electrosurgical energy is widely utilized for tissue dissection with the minimally invasive techniques.[9] This may potentially lead to unrecognized vascular and ureteral injuries that manifest days to weeks postoperatively. Indeed, delayed diagnosis of ureteral injury has been reported with the laparoscopic approach.[1,11]

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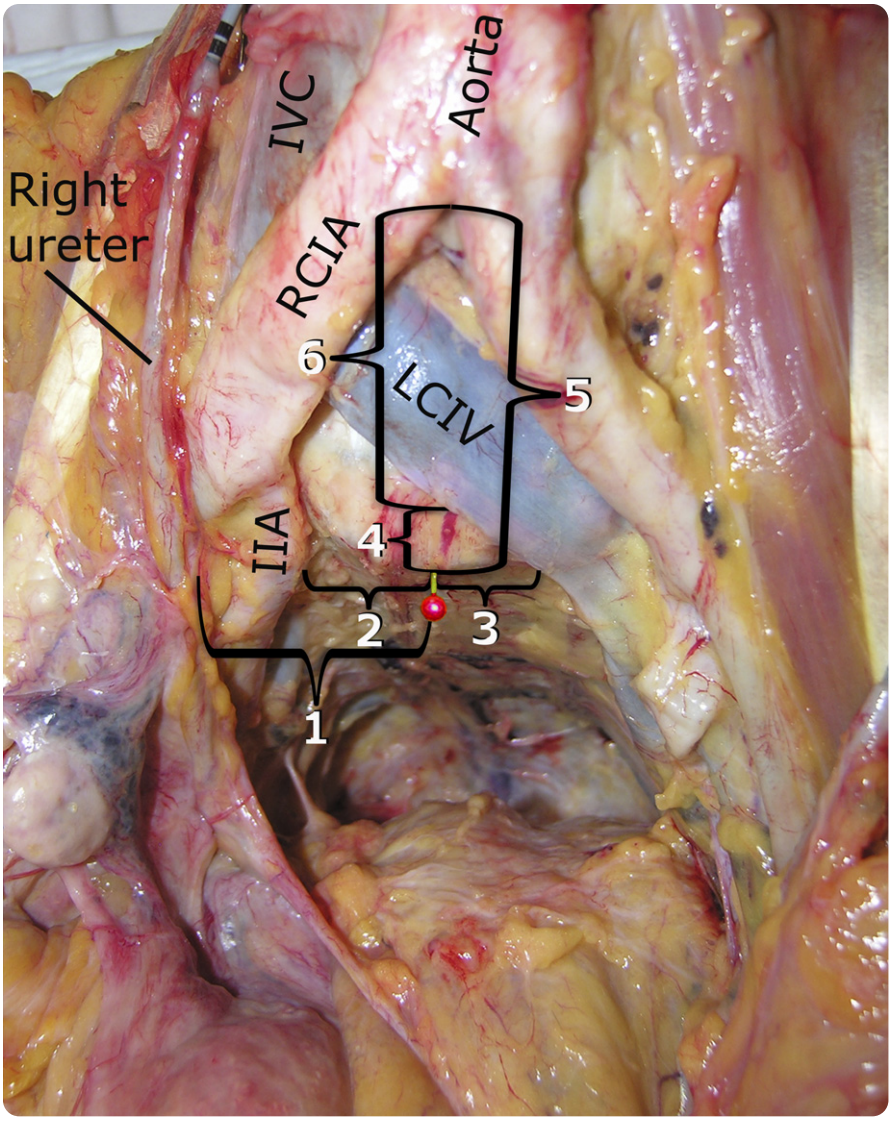
FIGURE 1
Exposed presacral space in unembalmed cadaver



Red metal pin marks the MSP. Distances measured from the MSP included those to the following: (1) medial aspect of the right ureter; (2) closest great vessel on the right; (3) closest great vessel on the left; (4) closest cephalad vessel; and (5) aortic bifurcation. The number 6 indicates the vertical distance from the aortic bifurcation to the inferior margin of the LCIV.

IIA, internal iliac artery; *IVC*, inferior vena cava; *LCIV*, the left common iliac vein; *MSP*, midpoint of the sacral promontory; *RCIA*, right common iliac artery.

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Few studies have evaluated the vascular anatomy of the presacral space using the midpoint of the sacral promontory as a reference point, and even fewer have examined the relationship of the ureter to this important anatomic landmark. Two studies assessed the relationship of the great vessels to the MSP and correlated these findings to the sacrocolpopexy.[7,8] Other studies from the orthopedic literature described measurements from the great vessels to the S1-S2 level[12] and the distance from the aortic bifurcation to the inferior margin of L5.[13] Additionally, only 2 studies evaluated the relationship of the ureters to the MSP, one in 10 cadavers[8] and the other in 38 computed tomography (CT) urograms.[14]

In our review of the literature, no studies concurrently evaluated the vascular and ureteral anatomy in cadavers and CT images using the midpoint of the sacral promontory as a reference point. In addition, no studies have assessed the distal extent of the left common iliac vein from the termination point of the abdominal aorta, a landmark that surgeons may be able to see or palpate intraoperatively. Thus, the objectives of this study were to further characterize the vascular and ureteral anatomy using the midsacral promontory as a reference point and to correlate the findings with a safe dissection and sacral mesh attachment during sacrocolpopexy.

Materials and Methods

Presacral space anatomy was examined in 25 unembalmed female cadavers and 100 CT studies. The cadavers were obtained from the Willed Body Program at the University of Texas Southwestern Medical Center in Dallas. Unembalmed female cadavers used for educational courses not involving pelvic dissection and without evidence of pelvic malignancy were examined, with permission from the Willed Body Program and the course directors.

All available cadavers that met the above criteria from August 2011 to August 2012 were evaluated. All CTs obtained for the evaluation of hematuria or recurrent urinary tract infections in women from February 2011, the time at which this radiological technique was introduced in our institution, to May 2012 were eligible for inclusion. Studies were excluded if evidence of urogenital malignancy, bony metastasis, or previous pelvic surgery was identified because these conditions are known to significantly alter anatomy.

The cadaveric portion of this study was considered exempt by the University of Texas Southwestern Institutional Review Board in accordance with the Code of Federal Regulations. Review of radiographic images and demographic data was approved by University of Texas Southwestern Medical Center and Parkland Hospital Institutional Review Boards. Age, race, height and weight, and cause of death were collected.