

VARIATIONS IN THE FEMALE PELVIC FLOOR INNERVATION: AN ANATOMIC STUDY

Hypothesis / aims of study

Knowledge of the precise location of the pudendal nerve (PN) and its branches is important for vaginal vault suspension surgery. Our primary objective is to describe the anatomic variations in the location of the PN and its branches and their relation to the ischial spine (IS) in female cadavers. Despite the importance of pelvic floor innervation for maintenance of pelvic visceral support and continence, there is a substantial degree of confusion regarding the innervation of levator ani muscles (LAM). Our secondary objective is to describe the innervation of the human female LAM.

Study design, materials and methods

Detailed pelvic dissections with photo documentation were performed exposing the pelvic floor, PN and the sacral nerve roots of 15 formaldehyde-fixed female cadavers, ages 62-95, using abdominal, gluteal and perineal approaches. The PN and the sacral nerves entering the pelvis (S3 and S4) were traced from the PN plexus (S2, S3, and S4) and the anterior sacral roots in the spinal cord respectively, and their course at the level of the sacrospinous ligament was described in relation to the IS. The branches of the PN were identified as the inferior rectal nerve (IRN), the perineal nerve and the dorsal nerve of the clitoris. The LAM were identified as the pubococcygeus (PC), the iliococcygeus (IC) and the puborectalis (PR) muscles. The cadaver height and weight were recorded, and all cadavers were measured for sacrospinous ligament length, the diagonal conjugate of the pelvis, and the distance from the posterior symphysis pubis to the IS. SPSS 12.0 (SPSS, Chicago, Ill) was used to perform an analysis of variance using these variables to test for anatomic correlations.

Results

In 40% (6 of 15) of cadavers, the IRN originated directly from the PN plexus and passed through the posterior fibers of the sacrospinous ligament and medial to the IS at a mean distance of 1.9 cm (SD=+/-0.7) to the IS. In 60% (9 of 15) of cadavers, the IRN originated from the PN inside the pudendal canal. The PN was found to pass posterior to the sacrospinous ligament and medial to the IS in 80% (12 of 15) of cadavers at an average distance of 0.6 cm (SD=+/-0.4) from the IS. In the remaining 20% (3 of 15) of the cadavers, the PN was situated lateral and posterior to the IS at a mean distance of 0.8 cm (SD=+/-0.5). No variations were noted in the location of the perineal nerve or the dorsal nerve of the clitoris in relation to the IS.

The LAM were innervated by the PN branches (perineal nerve or inferior rectal nerve) in 80% (12 of 15) of cadavers as follows: the perineal nerve innervated the PC muscle in 60% (9 of 15) of cadavers, the IC muscle in 27% (4 of 15) of cadavers, and the PR muscle in 53% (8 of 15) of cadavers; the inferior rectal nerve innervated the PC muscle in 33% (5 of 15) cadavers, the IC muscle in 27% (4 of 15) and the PR muscle in 73% (11 of 15) of cadavers. The sacral nerves S3 and S4 originated directly from the sacral foramina and entered the pelvis traveling anterior to the coccygeus muscle at a mean distance of 2.5 cm (SD=+/-0.7) medial to the IS and extended branches to the LAM in 67% (10 of 15) cadavers, as follows: to the PC muscle in 33% (5 of 15) of cadavers, to the IC muscle 60% (9 of 15) of cadavers, and to the PR muscle in 20% (3 of 15) of cadavers.

The mean sacrospinous ligament length and thickness were 4.4 cm (SD=+/- 0.7), 0.3 cm (SD=+/-0.1) respectively. The mean cadaver age was 77.7 years (SD=+/-11.7), the mean height was 161 cm (SD=+/-8.1), the mean weight was 62.1 kg (SD=+/-10.8), the mean diagonal conjugate diameter of the pelvis was 13.7 cm (SD=+/-1.4), the mean distance from the posterior symphysis pubis to the IS was 9.3 cm (SD=+/-1.4). Multivariate regression analysis of cadaver height and weight did not significantly correlate with any of the measured variables.

Interpretation of results

A safe zone for placement of sacrospinous ligament sutures for vaginal suspension is situated more than 3.0 cm medial to the IS to avoid potential injury to the IRN and to the intrapelvic S3 and S4 nerves because of their anatomic variations at the level of the sacrospinous ligament. This study suggests that branches of the PN, primarily perineal and inferior rectal nerves, provide innervation to the LAM, in particular to the PC and to the PR muscles. The sacral nerves S3 and S4 also extend branches to the LAM, mostly to the IC muscle.

Concluding message

This study demonstrates that anatomic variations exist which challenge the classic anatomic descriptions of the PN and IRN location. The LAM receives dual innervation, both from the PN and its branches, and from the intrapelvic sacral nerves. Further studies are necessary to confirm our findings.

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