

Anatomical Study of Pelvic Nerves in Relation to Seminal Vesicles, Prostate and Urethral Sphincter: Immunohistochemical Staining, Computerized Planimetry and 3-Dimensional Reconstruction

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Purpose: Studies of male pelvic neuroanatomy are mandatory to improve functional outcome after radical prostatectomy. We performed a topographical investigation of nerves on the course from the seminal vesicles along the prostate toward the striated urethral sphincter.

Materials and Methods: Serial whole mount sections (1 mm intervals) of pelvic blocks of human adult male autopsy cadavers were investigated after immunohistochemical nerve staining. Computerized nerve quantification and planimetry of the total nerve surface area were performed within defined regions (ventral, ventrolateral, dorsolateral and dorsal) at the levels of the seminal vesicles and prostate, and at the striated urethral sphincter. The distance between the seminal vesicles and the nerves was measured. For improved topographical understanding 3-dimensional reconstructions were created. Differences between 3 independent variables were tested with the nonparametric Kruskal-Wallis test.

Results: We studied a total of 969 whole mount sections of 5 cadavers. Nerves were arranged in a vertical plate lateral to the seminal vesicles. Mean \pm SD distance to the seminal vesicles was 1.68 ± 0.84 , 1.50 ± 0.12 and 1.76 ± 0.37 mm at the tip, middle and base, respectively. Periprostatic nerves were mainly found dorsolaterally. At the striated urethral sphincter 38.9% of nerves had shifted to the dorsal region. The total nerve surface area decreased significantly from the seminal vesicle tip (50.2 mm^2) to the striated urethral sphincter level (13.3 mm^2) ($p = 0.0004$).

Conclusions: Our findings underline that during nerve sparing prostatectomy nerve damage might occur during mobilization of the entire seminal vesicles, apical dissection and posterior reconstruction of the rhabdosphincter. Nerve planimetry revealed that 75% of the nerves from the seminal vesicles do not reach the striated urethral sphincter level and seem to innervate structures other than the corpora cavernosa.

Key Words: prostate, neuroanatomy, prostatectomy, seminal vesicles, urethra

Abbreviations and Acronyms

3D = 3-dimensional

RPE = radical prostatectomy

SS = striated urethral sphincter

SV = seminal vesicle

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Study received local ethical committee approval.

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DETAILED anatomical studies of pelvic neuroanatomy are essential to improve functional results after RPE.

Since the landmark report by Walsh and Donker,¹ there has been ongoing debate on the anatomy of the

neurovascular bundle. Recent studies showed that periprostatic nerves run in a more variable manner than previously thought.²⁻⁵ However, most of these studies were performed in prostatectomy specimens, in which the anatomy of nerves in relation to the SVs and the SS cannot be investigated.^{2,6,7} This can ideally be performed using entire pelvic blocks. Other studies have been done in fetal specimens with the limitation that the results cannot be directly transferred to adult anatomy.⁸

We studied the entire course of the pelvic nerves from the SV along the prostate toward the SS in organ blocks of male adult autopsy cadavers using immunohistochemical staining, nerve quantification and planimetry of the total nerve surface area.

For improved topographical understanding we created 3D reconstructions.

MATERIALS AND METHODS

Specimens

In the initial phase of the study 3 pelvic organ blocks were excised from formalin fixed male cadavers at the end of the anatomy education course at the Institute of Anatomy, University of Regensburg. The material was unsuitable for immunohistochemical nerve staining, most likely due to the long formalin fixation period. Subsequent specimens were then received from fresh adult male cadavers after autopsy. In all cases there was no history of prostate cancer or prostatic surgery. Relatives provided informed consent for scientific processing of the autopsy material after approval by the local ethical committee.

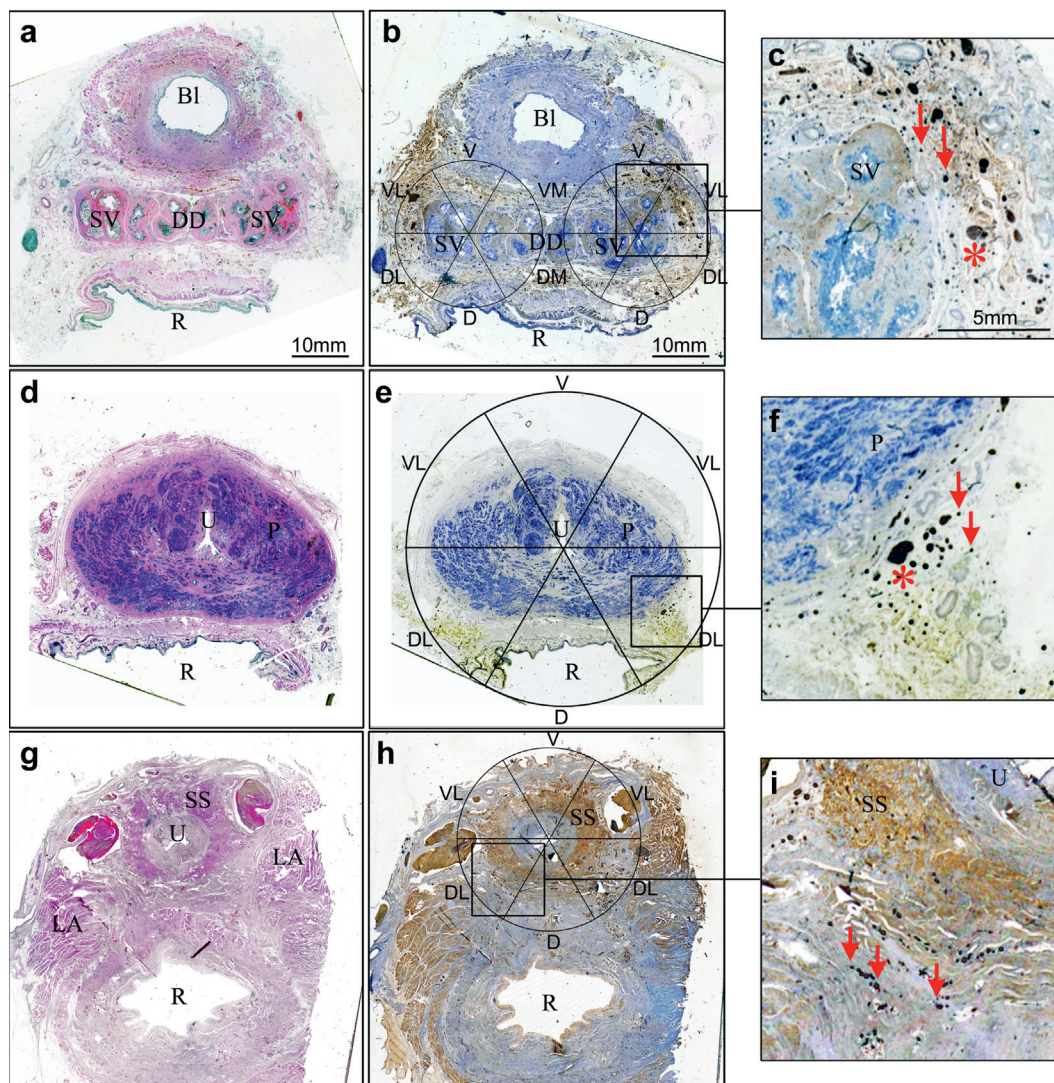


Figure 1. Transverse whole mount sections show regions of nerve quantification and computerized planimetry. *a* to *c*, middle of SVs. *d* to *f*, middle of prostate. *g* to *i*, SS middle. *Bl*, bladder. *DD*, deferential ducts. *R*, rectum. *VM*, ventromedial. *DM*, dorsomedial. *V*, ventral. *VL*, ventrolateral. *DL*, dorsolateral. *D*, dorsal. *U*, urethra. *LA*, levator ani muscle. Arrows indicate small diameter nerves. Asterisk indicates larger diameter nerves. H&E (*a*, *d* and *g*) and S100 stain (*b*, *e* and *h*).

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