In visual reconstructions, as contained in their remarkable figures, Alsaid and coworkers [1] used computer-aided anatomic “dissection” (CAAD) to follow the nerve fibers distally beyond the prostate apex, finding an anterior division destined for the corpora cavernosa and a posterior division entering the corpus spongiosum. Multiple sequential axial sections were obtained from the level of the seminal vesicles to the penis. They stained the sections with the silver stain for nerves (S-100), and then they used the computer to sum all the sections to reconstruct the course of the nerves three-dimensionally as they proceeded distally. With this method, identification of a split in nerve-fiber direction was possible. The points of termination beyond the apex of the prostate included an anterior group or division associated with the corpora cavernosa and dorsal sensory nerve of the penis and a posterior division entering the superior surface of the bulb of the penis, or corpus spongiosum.

From a physiologic standpoint, just exactly how autonomic nerves of each neurovascular bundle (NVB) [2] heading distally interact and coordinate function, beyond the final result of producing an erection when stimulated, is not precisely clear. “Pro-erectile” nerves accompany other autonomic nerves within the NVBs that depart along the way to innervate seminal vesicles, vasa deferentia, bladder, rectum, and membranous urethra [3]. Some nerves at the apex of the prostate are parasympathetic; some are sympathetic [4]. What then becomes more complicated are concepts such as sympathetic nerves that are not adrenergic, as expected, but cholinergic with vasodilatory potential. To further complicate matters anteriorly at and beyond the penile hilum, there are proven visible neural connections with the dorsal sensory nerve of the penis where direct cavernous nerve penetration begins and proceeds distally [5].

The current study [1] confirms, during radical prostatectomy, the concept of anterior fascial and nerve preservation related to the region of the dorsal vascular (vein) complex (DVC). This tissue contains the anterolateral portion of pro-erectile fibers as they swing forward to continue in concert with the dorsal penile sensory nerves that also act as a scaffold. Demonstrated connections of autonomic nerves and the dorsal sensory nerve strongly suggest coordinated interaction, even though the true functional train of neural events has never been established, as opposed to the vascular events associated with erection. In control of the DVC, it is of utmost importance not to ligate vessels too distally with any means that might trap and destroy this anterior division. This concept is supported in high anterior release of each NVB [6,7]. DVC ligation should not and does not need to be any more distal than the midanterior commissure of the prostate, thus placement of suture material should be well proximal to the apex and the prostatic-urethral junction [8].

The veil of Aphrodite dissection of robot-assisted radical prostatectomy [9] adheres to anterior fascial preservation, and, with the negative carbon dioxide (CO₂) pressure provided during this procedure, some have found that no preliminary venous ligation of the DVC is necessary [10]. “Cold incision” of the DVC under the condition of CO₂ abdominal insufflation resulted in no greater blood loss than ligation of the DVC before apical dissection and led to a decrease in apical positive surgical margins (p = 0.02). How hemostasis is achieved when necessary after cold incision would have direct bearing on preservation of the underlying anterior division of the nerve fibers. If possible, control of a bleeding vessel should cleanly target the vein or artery and not encompass adjacent tissue wherein lie the nerves. Working with the magnification afforded by high-power optical loupes in open surgery or by laparoscopy should assist in this endeavor.

One of the best-illustrated gross anatomic demonstrations of the presumptive pro-erectile nerves adjacent to the
apex of the prostate is found in the work of Costello and colleagues [3]. What is striking in their Figure 6 is the plethora of nerves on the posterior surface of the prostate and prostatic-urethral junction at the junction of prostate, striated urethral sphincter, and membranous urethra. At this location, a dense collection and decussation of fibers are clearly apparent, and it is from these posterior and posterolateral fibers of the NVB that some corpus spongiosum nerves must emanate. That the posterior prostatic-urethral junction is hidden beneath this rich mesh of fibers must have consequences with respect to dissection and urethral transection, placement of a “Rocco” stitch [11], radical perineal prostatectomy to expose that junction, and, in the study by Alsaid and colleagues [1], full preservation of innervation of the corpus spongiosum.

The anterior division of fibers that swings forward beyond the apex of the prostate most likely represents the main pro-erectile innervation of the corpora cavernosa. The posterior division should at least contribute to tumescence of the bulb and proximal third of the corpora cavernosa by neural penetration of the corpus spongiosum and cavernous bodies at the crura. Müller [5], in two cadaveric preparations, described fine autonomic filaments derived from the anterior cavernous nerves that passed over the lateral surfaces of the corporal bodies to run in the groove between the corpus cavernosum and corpus spongiosum “to penetrate into the latter.” In one case, he found a major cavernous nerve posteriorly entering the corpus spongiosum between the penile crura. Minor cavernous nerves were also described entering the corpus spongiosum posteriorly between the crura. However, his study appears to support most of the autonomic corpus spongiosum nerve supply as streaming off laterally from the anterior division. Kaiho and colleagues [12], who monitored penile tumescence response by using an intravaginal pressure transducer while they intraoperatively stimulated periprostatic nerves, were able to take advantage of this widespread nerve distribution. If Müller’s dissections are correct, corpus spongiosum nerves should not be considered to derive just from the posterior division, as more are suggested quantitatively to derive from the anterior division.

What is missing in the current study [1] is the further use of CAAD to track the penetration of cavernous nerves from the penile hilum into the corpora cavernosa and the corpus spongiosum to either confirm or to refute Müller’s [5] gross dissection findings. In particular, the study is intriguing for its CAAD figures and for leading us to wonder what the findings may mean for prudent conduct of radical prostatectomy.

In suitable candidates who desire the best chance for return of erectile function, this work of Alsaid and colleagues [1] makes it clear that the goal of radical prostatectomy by whatever surgical technique should emphasize optimal NVB preservation with as many pro-erectile nerve fibers saved as possible. Both the corpora cavernosa and the corpus spongiosum should have autonomic innervation as full as possible after radical prostatectomy.

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References


