

INVESTIGATIVE UROLOGY

Expansion and fixation properties of a new braided biodegradable urethral stent: An experimental study in the rabbit

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Purpose: Biodegradable spiral urethral stents have been used with favorable results combined with thermal treatments of the prostate and for recurrent urethral strictures but the configuration of the helical spiral is not ideal. We developed a new tubular mesh configuration for the biodegradable urethral stent and evaluated its expansion and locking properties in the rabbit urethra.

Materials and Methods: The stents were made of self-reinforced polylactic acid polymer (Bionx Implants, Ltd., Tampere, Finland) blended with BaSO₄ (Alfa Chem, New York, New York) to achieve radiopacity. Two braiding patterns, that is 1 over 1 and 2 over 2 + 1, were used to produce a tubular mesh structure. Stainless steel stents (pattern 1 over 1) served as controls. The stents were inserted into the posterior urethra of 27 male rabbits. The animals were sacrificed after 1 week, 1 and 6 months, respectively. X-rays were done immediately after stent insertion and at sacrifice. Longitudinal movement and expansion were assessed on the x-rays.

Results: All stents maintained position in the urethra without fixation. Macroscopic disorientation of the structure of the 2 over 2 + 1 braided self-reinforced polylactic acid polymer stents began before 1 month, while 1 over 1 braided stents retained their construction. At 6 months 3 of 6 biodegradable stents were degraded. Average longitudinal movement was 2 mm. (range 1 to 3) in the 1 over 1 self-reinforced polylactic acid polymer group, 2 mm. (range 0 to 7) in the 2 over 2 + 1 polylactic acid group and 3 mm. (range 3 to 3) in controls at 1 month.

Conclusions: Biodegradable polymers are suitable materials for braided urethral stents. The expansion properties of the 2 braiding models tested in this study sufficed to fix the stents in situ in the prostatic urethra. However, the 1 over 1 braiding pattern was superior to the 2 over 2 + 1 pattern, in that it retained its macroscopic construction until the degradation of single self-reinforced polylactic acid polymer fibers.

Editorial Comment

The development and use of biodegradable devices for urological application has increased in the last 10 years. This is an elegant study performed by the group that developed some years ago the first biodegradable spiral stents for urology (1,2). In the present work, the authors produced from biodegradable polymers, a self-expanding, self-reinforced braided biodegradable stent for urological use. The stents were tested after insertion into the prostatic urethra of 27 male rabbits. After stent release into the urethra the device expanded to its original shape due to the viscoelastic memory of biodegradable polymers. The authors found that its expansion property was good and fixed the stent in situ as firmly as metallic devices. Although there are some differences between the 1 over 1 pattern and the 2 over 2 + 1 pattern, in thesis, the developed stents are promising and may be suitable for clinical use in the near future. Nevertheless, clinical trials will be necessary to demonstrate the usefulness and the cost-effectiveness of biodegradable stents in urological practice.

References

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Penile weight and cell subtype specific changes in a post-radical prostatectomy model of erectile dysfunction

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Purpose: We evaluated neurogenic erectile dysfunction, focusing on the post-radical prostatectomy model. We investigated changes in DNA, protein and apoptotic cells of the rat penis after denervation. Gross morphometry was measured to elucidate the impact of chemical changes.

Materials and Methods: Postpubertal male Sprague-Dawley rats were randomized to bilateral or unilateral cavernous nerve transection, or sham operation. Wet weight, DNA content and protein content were measured. Tissue sections were stained for apoptosis by terminal deoxynucleotidyl transferase-mediated deoxyuridine triphosphate nick end labeling and the apoptotic index was calculated. Dual staining was performed for endothelial and smooth muscle cells to identify apoptotic cells.

Results: Penile wet weight was significantly decreased at all time points after bilateral neurotomy ($p < 0.0005$). Unilateral neurotomy allowed much greater preservation of penile weight. DNA content was significantly decreased in bilaterally denervated penes and unchanged in unilaterally operated penes. Protein content was not significantly altered in the bilateral or unilateral cohorts. Bilateral neurotomy induced significant apoptosis, while unilateral surgery caused significantly less apoptosis. Each population had apoptotic clustering just beneath the tunica albuginea, which was mostly smooth muscle cells.

Conclusions: These data suggest the importance of neural integrity to maintain penile homeostasis. The loss in penile weight was consistent with the anecdotal experience of many clinicians. Decreased DNA content may have been due to significant levels of apoptosis in smooth muscle cells. Preserved protein content may suggest an increase in extracellular protein, as postulated in corporeal fibrosis. The subtunical population of apoptotic smooth muscle cells revealed a mechanism for veno-occlusive dysfunction observed after radical prostatectomy. These effects were significantly moderated in the unilateral model, reinforcing the critical nature of neural integrity.

Editorial Comment

This is a sophisticated study of the detrimental effects of denervation on penile function and structure, with clinical applications for further understanding the erectile dysfunction following radical prostatectomy. This is the first study which clearly demonstrated that lesion to the cavernous nerves will result in immediate beginning of apoptosis, primarily in smooth muscle cells. Also, the reductions in smooth muscle cells, mainly in the subtunical position, would explain the significant occurrence of veno-occlusive dysfunction in post-

radical prostatectomy erectile dysfunction. Also, the present study demonstrated a dramatically reduction in the penile weight when bilateral cavernous nerve injury was created. On the other hand, these changes were significantly reduced with preservation of one neurovascular bundles. The authors found that the DNA content remained intact in the unilateral neural lesion, while it altered dramatically in the bilateral model of lesion. These findings reinforced the idea for the clinician, to make all efforts for preserving the neurovascular bundles, at least in one side, during radical prostatectomy.

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