

The Evolution of the Management of Male Stress Urinary Incontinence

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Introduction: The struggle to treat male stress urinary incontinence (SUI) dates back centuries, with descriptions of male urinary incontinence (UI) in Egyptian manuscripts as early as 1500 BCE. In this review, we chronicle the history of male SUI interventions that have evolved into the modern options available today.

Sources and Methods: A comprehensive literature review was performed to elucidate relevant historical and clinical information. We used PubMed to identify contemporary medical literature at www.ncbi.nlm.nih.gov and JSTOR, the digital library, to access archived, older texts at www.jstor.org.

Results: French surgeon Ambroise Paré is credited with developing the first portable urinals in 1564, which were quickly followed by Hildanus developing the condom catheter and penile clamp in the 1600s. The first documented compression device was developed by Lorenz Heister in 1747. Two hundred years later, Frederic Foley created a urinary sphincter and in 1973, F. Brantley Scott created the first multi-component artificial urinary sphincter (AUS). In the 1960s and 1970s, mesh implants were fraught with complications, including urethral erosion, fistulas, and pain. More recently, the transobturator male sling, which came to market during the 2000s, has become an option for select men.

Conclusions: The modern devices we use for the treatment of male UI are evolutionary byproducts of centuries of experimental designs by pioneering surgeons from around the world. While the materials have improved, barrier, storage devices and bulking agents almost identical to the versions first invented remain in use today.

Keywords: History, Male Urinary Incontinence, Reconstructive Urology, Urinary Incontinence Surgery

Male urinary incontinence (UI) has plagued humanity for generations. Currently, male UI affects up to 32% of elderly men and has a variety of etiologies. The first known mention of male UI is found in an Egyptian manuscript, the Edwin Smith Papyrus, from 1500 BCE. (1) Since that time, attitudes toward incontinence and strategies to address it have changed substantially. The goal of our paper is to outline the progress we have made in the management of male urinary incontinence.

SOURCES AND METHODS

A comprehensive literature review was performed to elucidate relevant historical and clinical information.

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RESULTS

Ancient Descriptions of Urinary Incontinence

The first written account of male UI was found in the Edwin Smith Papyrus, a manuscript written around 1500 BCE.(1) In this Egyptian manuscript, there is a detailed account of patients with various spinal cord injuries. One of the injuries, a cervical dislocation, resulted in motor and sensory loss of the upper and

lower extremities as well as priapism and male UI. While the UI is not described in detail, it is impressive to note the specificity with which the author(s) describe the spinal cord injury level and their association of this individual's injuries, but not the several other spinal cord injuries described in the manuscript, with incontinence. However, this manuscript offers no therapeutic strategies for dealing with the incontinence it describes. Centuries later, Roman physicians described procedures for the management of urinary incontinence, such as the management of urinary fistulas.(2)

Modern Descriptions of Urinary Incontinence

Manuscripts from the 1920s mention male UI resulting from prostate surgeries, lack of bladder contraction, retention, tuberculosis affecting the urinary tract, or continuation of infantile incontinence. By the 1940s, physiologic descriptions of incontinence causes began appearing in the literature. Noted etiologies included iatrogenic causes, hypospadias, and bladder cancer. (3) Additionally, following World War II, incontinence secondary to spinal cord damage and other war-related injuries were described.(4) In the 1960s, it became more widely recognized that urinary incontinence could be the result of psychiatric disease.(5) In the 1970s, urodynamics was developed and aided in further characterizing incontinence in both males and females. Urodynamic studies both helped diagnose incontinent male patients but also led to further understanding of the roles of the various pelvic floor muscles in incontinence. In the 1980s, Edward McGuire refined urodynamics and investigated the technique for evaluating UI.(6) Today, urinary incontinence is

categorized as SUI, urge UI (UUI), mixed UI, or overflow UI and treatment strategies differ depending upon the subtype of the UI.

Attitudes Towards Urinary Incontinence

Attitudes towards incontinence have evolved over the centuries. In the 1860s, Trousseau wrote about incontinence as though it were a remediable weakness in character, recommending punishment of incontinent children and shame for the elderly incontinent individuals.(7) Fortunately, by the 1920s, medical practice acknowledged causes other than flaws in motivation or personality, including iatrogenic causes such as prostate surgery, infectious causes such as tuberculosis, and physiologic weakness of the bladder. However, authors of this period continue to mention "persistence of infantile incontinence," indicating some limitations in understanding of the complexity of continence.(8) In the 1940s, authors began focusing more on physiologic causes of male UI and designing more specific mechanisms for managing incontinence based on etiology. Following World War II, patients with incontinence secondary to war-related injuries, such as spinal cord injuries, became an area of interest. Authors of this time period acknowledged both the physical and also the psychological impact of male UI.(4) Writers in the 1950s began to recommend respecting rather than blaming the incontinent patient. Nursing textbooks from this time period began to focus more on compassion and medical management, describing skin and catheter care, as well as recommending devices to make these patients more comfortable and easier to manage, such as the penile clamp or condom catheter. The 1950s



Figure 1. Early external urinary incontinence devices. (Left) Latex external bag urinary capture device. Right (Pediatric graduating penile clamp (Courtesy, Didusch Museum of Urologic History, Linthicum, Maryland)

is also the first decade in which incontinence began to appear in broader medical journals rather than just urological and gynecological journals. During the 1960s, several papers discussed incontinence secondary to psychiatric illness.(5) These papers typically focused on behavioral management strategies. The 1970s were a period of increasing understanding of the physiology of incontinence with the introduction of urodynamics as a diagnostic test for further characterizing incontinence.

Conservative Strategies

In the 1940s, there was an increasing interest in the rehabilitation of incontinent patients.(4) This was likely due to the increase in young and otherwise healthy individuals suffering from incontinence secondary to injuries sustained in combat during World War II. In 1951, Arnold H Kegel described pelvic floor muscle exercises as a therapy for incontinence.(9) Also in 1951, Alice Morrissey, a nurse now well-known for her focus on the role of nursing in the rehabilitation of various ailments, proposed a strategy for bowel and urinary bladder rehabilitation.(10) The employment of pelvic muscle exercises for UI management was further refined in the 1960s.(11) Some of these techniques are still practiced as part of pelvic floor rehabilitation today.

Storage and Drainage Devices

The renowned French surgeon Ambroise Paré is credited with developing the first portable urinals in 1564 (Figure 1). He developed a variety of portable urinals, which could be used by incontinent men, such as the "artificial yards," which were phallus-shaped and made from wood. In the 1600s, Wilhelm Hildanus, also known as the 'father of German surgery', created the first documented condom catheter made from pig bladder and strapped to the hips. Paré also developed catheters for insertion into the urethra. Paré was also the first to describe the

coudé, or curved-tip catheter, for easier insertion.(12) Early urethral catheters, such as those developed by Paré, were rigid and used for intermittent catheterization only. Auguste Nelaton (1807-1873) designed the first rubber flexible catheter in the mid-19th century but the rubber dried too easily.(13) Frederic Foley, an American urologist, developed the first more flexible catheter out of latex in the 1940s. These and other more flexible catheters were not commonly used until a few decades later.(14) Flexible catheters were not only used for straight-catheterization but could also remain in place for longer-term drainage especially after the development of the 'bag' or 'balloon' catheter by Foley in 1929 and Hobert D Belknap in 1933.(13)

Barrier Devices

Barrier devices, including penile clamps and condom catheters, are now commonly used for male SUI (Figures 1 and 2). Penile clamps for external coaptation of the urethra were first invented by Hildanus. Subsequently, clamps were described in the 1740s-50s in a surgical textbook titled *Institutiones Chirurgiae*, authored by the German physician Lorenz Heister, which resulted in wider use of such devices. The Cunningham Clamp, introduced in 1910 by JH Cunningham, was based on these initial clamps, and became more popular throughout the 20th century (Figure 2). An alternative penile clamp, the Baumrucker clamp, was developed in 1979 and is also available on the market today.(15) Heister's text also described an external compression device for the bulbar urethra, by perineal compression. Another device for external urethral compression, the Vincent apparatus, was introduced by Vincent in 1960. This inflatable device is worn externally as a belt and compresses the perineum to coapt the urethra.(16)

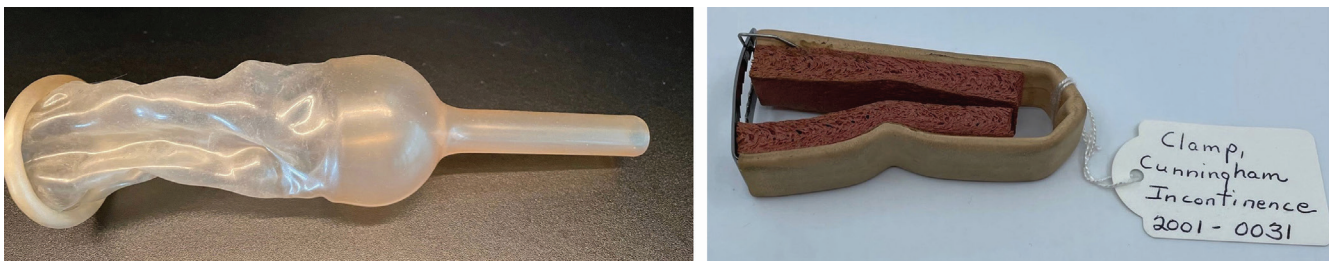


Figure 2. (Left) The condom catheter, later incorporated in the April, 1967 patent by R. D. Davis (#3520305) to a collectible device and known thereafter as a 'Texas' catheter. **(Right)** Simple Cunningham Clamp (Courtesy, Didusch Museum of Urologic History, Linthicum, Maryland)



Figure 3. A British external device available after 1960 worn as 'Texas' catheter but with the ability to custom fit the ringed latex molding with helpful directions (Left) and a preserved sample (Right) (Courtesy, Didusch Museum)

Medical therapies

Oral medications to reduce male SUI began to appear in the 17th century. Over the centuries, a variety of oral therapies were tried, including opium, strychnine, and atropine, some of which produced anticholinergic and antidiuretic effects. Various topical treatments have also been tried to remedy incontinence as well. For example, in 1858, J. Rhodes described instilling a mixture of carbonic acid and chloroform into the bladder of an elderly male, resulting in improvement of nocturnal incontinence.(17) More recently, several studies have demonstrated the efficacy of duloxetine in managing post-prostatectomy SUI in men.(18) Duloxetine was associated with a dry rate of 25-89% and reduced mean pad number 12-100% after 1-9 months in various studies.(18) Adverse events associated with duloxetine therapy in this population included gastrointestinal

symptoms, fatigue, dry mouth, insomnia, and reduced libido, and 21% of study participants discontinued duloxetine due to these side effects.(18)

Bulking agents

In the late 19th century, the Austrian surgeon Robert Gersuny began experimenting with injected paraffin for a variety of applications. One application he described was the use of paraffin as a urethral bulking agent. While the results were not particularly successful, this concept has continued to be explored. Subsequently, in the 1970s-1990s, other urethral bulking agents have been described, including Teflon, collagen, microsphere hydrogels, chitosan hydrogels, alginate hydrogels, and silicone.(19, 20) A randomized controlled trial comparing macropastique to bulbar artificial urinary sphincter, found a success rate of the bulking agent to



Figure 4. Towards modernity. (Left) Inflatable cuff device for external penile use and (Right) a Rosen inflatable device, both circa early 1970s (Didusch museum)

be 47% at a mean follow up of 48 months (range 6 to 84 months).(21) A three-site injection technique was used and repeat injections were offered to patients who did not achieve continence after the first one. Retrospective studies on other agents report dry rates between 5.3 and 83%.(22)

More recently, the injection of stem cells has been described. Instead of serving as bulking agents to promote urethral coaptation, the injected cells are thought to decrease fibrosis and replace damaged cells, thus representing a step forward in injectable therapies.(23)

Surgical Approaches

One early surgical approach, described in the 1960s by Urologist Frank Hinman, involved the removal of the 7th rib and its subsequent attachment to the ischia of the pelvis to raise the urogenital diaphragm into a position that reduces the leakage of urine.(24) Also in the 1960s, John L Berry first described the implantation of acrylic mesh for the treatment of male UI.(25) The mesh was placed ventral to the bulbar urethra and fixed to the pubic ramus. Joseph J Kaufman, who worked closely with Berry, further refined this procedure, introducing hydrogel materials and different surgical approaches.(26) Kaufman's procedures included the Kaufman I, repositioning the crus of the penis to promote continence, the Kaufman II, which used a polytetrafluorethylene mesh, and the Kaufman III, which used an implanted silicone gel.(26) More recent sling implantations include the bone-anchored, adjustable retropubic, and trans-obturator approaches. Figure 4 demonstrates an early urethral sling. In 1947, the first artificial urinary sphincter (AUS) was described by

Foley.(27) This pneumatic device was worn around an externalized, isolated portion of the corpus spongiosum. In the early 1970s, F. Brantley Scott demonstrated the first modern multi-component implantable AUS (Figure 5).(28) These devices had high success rates of continence and patient satisfaction. Further refinement of the AUS, with the addition of antibiotic coatings and redesigned cuffs, have improved outcomes for male UI sufferers. Other AUSs have also been described. The ZSI 375 made by Zephyr Surgical Implants is available outside the United States and has been shown to have low failure and complication rates.(29) Rosen et al created a silicone artificial sphincter, in which a three-pronged clamp compresses the urethra upon the inflation of an attached balloon.(30) However, trials of this sphincter have not been as successful as the sphincter initially created by Scott. The electronic version of the AUS is in development and greatly anticipated.

CONCLUSIONS

Male SUI is a long-standing problem that has been addressed by evolving strategies over time. Future studies of novel medical therapies or combination drug therapies will likely yield promising strategies for those seeking a medical solution to their incontinence. Implantable materials for the sling and AUS will likely continue to evolve, with the addition of more effective antibiotic coatings and materials that are less likely to erode. A bluetooth-based electronic AUS would represent a significant improvement, especially for those without the dexterity to operate a traditional AUS. Thus, as physicians and scientists continue to develop therapies, male UI management will continue to improve.



Figure 5. The first fully functional multi-component implantable artificial urinary sphincter by F. Brantley Scott (1930-1991) which, at the time of his death, had been placed in 25,000 patients (New York Times, 9/1/91 D, p 20) (Courtesy, Didusch Museum)



Figure 6. 'Incontinence controller', 1973, which was a transrectal means of providing electrical stimulation to the bladder (Didusch museum)

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