CONTINENT CUTANEOUS CATHETERIZABLE STOMAS (MERITS AND OUTCOMES)

Essay

Submitted for partial fulfillment of Master Degree in Urology

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2011

INTRODUCTION

Continent, nonorthotopic urinary diversion can be divided into two major categories. **First**, the variations of ureterosigmoidostomy such as ileocecal sigmoidostomy, rectal bladder, and sigmoid hemi-Kock operation with proximal colonic intussusception. These techniques allow for excretion of urine by means of evacuation. **Second**, there is the large category of continent diversions requiring clean intermittent catheterization for emptying urine at intervals from the constructed pouch ***(Benson et al, 2007).***

These generally can be divided into two categories. A CUR completely replaces the bladder, and an intestinocystoplasty (bladder augmentation) uses the bladder in situ ***(Metcalfe and Cain, 2010).***

The first continent urinary diversion was an ureterosigmoidostomy performed by Simon in 1851 although still used; it has fallen out of favor because of the high risk of electrolyte abnormalities and malignancy ***(Simon, 1852).***

Although several other types of continent urinary diversion have been described in the literature, it was not until the late 1970s and early 1980s that significant success was achieved.

This success has, in turn, stimulated interest in adopting and adapting continent urinary diversions ***(Webster and Peterson, 2005).***

The concept of refashioning bowel so that it serves as a urinary reservoir rather than a conduit has become universally accepted. This concept is based on original pioneering observations by Goodwin and others in the development of the cystoplasty augmentation procedure ***(Goodwin et al, 1958).***

The destruction of peristaltic integrity and refashioning of bowel has led to the development of many innovative urinary reservoirs constructed from bowel, utilizing antireflux procedures to avoid upper tract urinary damage by sepsis or reflux and additional surgical techniques to achieve urinary continence ***(Benson et al, 2007).***

The advantage of continent catheterizable stomas include the avoidance of incontinent urinary diversions for patients unable to catheterize through the urethra and achieving independence for developing child, since bladder emptying is facilitated when catheters can introduced through abdominal stoma rather than the urethra ***(Boemers et al,2005).***

In more recent years, the use of the appendix has become popular, particularly in the construction of a catheterizable neourethra as part of a continent urinary reservoir. Most refer to this technique as the Mitrofanoff principle after the Russian surgeon who, in 1980, reported the use of the appendix in order to create a continent vesicostomy ***(Mitrofanoff, 1980).***

In actuality, however, the appendix had been used many years earlier in reconstructive urology. It was used in **1909** by Verhoogen of Brussels and in **1927** the appendix was used in Argentina as a continent catheterizable stoma for right colon reservoirs ***(Webster and Peterson, 2005)***.

In Mitrofanoff's initial report, a series of 16 children underwent implantation of the catheterizable appendix into the native bladde ***(Mitrofanoff, 1980).***

Since that time he has also used the native ureter for similar implantation. Duckett and Snyder of Philadelphia are primarily responsible for the popularization of this technique which becomes known as Mitrofanoff's principle which they summarized as:

1-A narrow conduit (appendix or ureter) brought to the skin.

2-A large, leak proof urine storage reservoir (bladder, augmented bladder, or intestinal segment).

3-An antirefluxing connection to the reservoir to provide continence,

4-An easy self-catheterizing maneuver to drain the system ***(Duckett and Snyder, 1985***).

Although appendix is the most commonly used conduit now days, numerous substitutions have been described, including ureter, fallopian tubes and tabularized colonic or bladder flaps as well as the now popular transversely tubularized bowel segment or Monti channel ***(Monti et al, 1997) , (Thomas et al 2006).***

Aim of the work

Spotlight on catheterizable stomas and Review up the literature to emphasis on indications, surgical principles, outcomes and complications.

Relevant physiology of urinary and GI tracts

I- physiology of urinary storage and emptying

The micturition process can be visualized as a complex of neural circuits in the brain and spinal cord that coordinate the activity of smooth muscle in the bladder and urethra These circuits act as on-off switches to alternate the lower urinary tract between two modes of operation: storage and elimination ***(Yoshimura and Chancellor, 2007).***

RELEVANT ANATOMY AND BIOMECHANICS

The bladder can be divided into two parts: a body lying above the ureteral orifices and a base consisting of the trigone and bladder neck**.** Histologic examination of the bladder body reveals that myofibrils are arranged into fascicles in random directions. This architecture differs from the discrete circular and longitudinal smooth muscle layers in the ureter or gastrointestinal tract ***(Donker et al, 1982).***

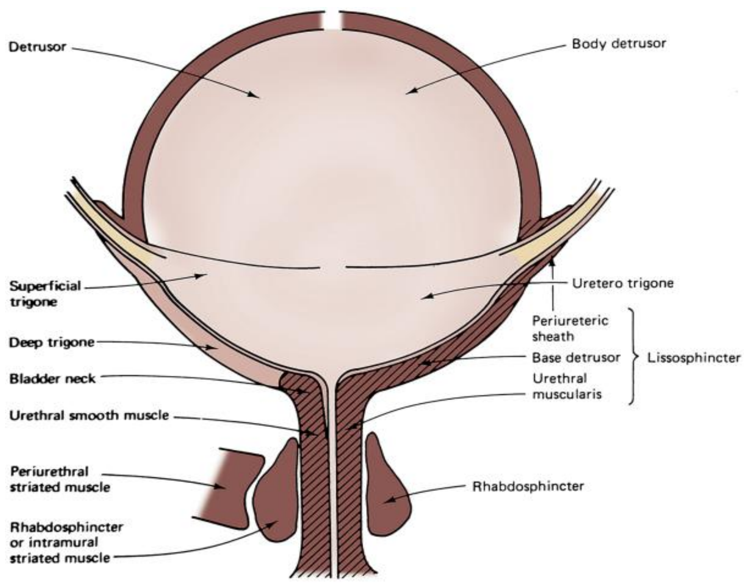

Fig. 1-1: Anatomy of the bladder and its outlet as defined by Gosling and Dixon *(left)* versus Elbadawi andcoworkers *(right)* ***(Yoshimura and Chancellor, 2007)***

The contractile properties of bladder smooth muscle cells are well suited for either urine storage or release. Filling the bladder at a slow physiologic rate maintains an intravesical pressure of less than 10 cm H_2O. Acute denervation of the bladder does not appreciably alter this low filling pressure. This concept has been used to support the hypothesis that the intrinsic myogenic or viscoelastic properties of cellular and extracellular components are major contributors to low pressure bladder filling and compliance. Conversely, neural input is required for the rapid and sustained smooth muscle contraction accompanying voiding. ***(Yoshimura and Chancellor, 2007).***

Bladder biomechanics

The relationship between bladder shape, size, pressure, and tension follows the principle of Laplace's law. Laplace states that the tension in the wall of a container necessary to contain a given pressure is directly proportional to the radius of curvature at any point **(Chancellor et al, 1996)**.

Laplace's equation states that there is a direct relationship between wall tension and intravesical pressure and bladder size. In this equation, **(T)** is tension**, (P)** is intravesical pressure**, (R)** is bladder radius, and **(d)** is wall thickness. During bladder filling, **Pves** is relatively constant. With a fully distended bladder, d, because of its relative thinness, is ignored relative to the other parameters unless a hypertrophied wall exists. Thus: **T = P • R/2** approximates tension in the full normal bladder ***(Yoshimura and Chancellor, 2007).***

Filling Mechanics

The viscoelastic behavior of the bladder and urethra depends on both neuromuscular and mechanical properties. Mechanical properties vary with the magnitude of stretch (distention). Mechanical properties are extremely sensitive to tissue structure and composition. Besides smooth muscle, the human bladder is composed of roughly 50% collagen and 2% elastin. Bladder compliance (C) is defined as the change in volume (V) relative to the corresponding change in intravesical pressure (P): C= change V/change P ***(Yoshimura and Chancellor, 2007).***

Bladder Accommodation:

The bladder surface undergoes incredible change in size from empty to full. The change is accommodated by both the urothelium and the bladder wall smooth muscle and connective tissue. These changes are mechanical requirements for the bladder to accommodate increasing urine volume. During filling, it has been proposed that bladder wall thinning during filling is the result of a rearrangement of the muscle bundles and also alteration of collagen coil structure **(Macarak and Howard, 1999)**.

Voiding Mechanics

Intravesical pressure reflects the combined factors of abdominal (Pabd) and detrusor (Pdet) pressures. Therefore, **Pdet = Pves – Pabd**. Micturition relies on a neurally mediated detrusor contraction, causing Pdet to rise without a significant change in Pabd. A muscle can use energy either to generate force or to shorten its length.

Because the bladder is a hollow viscus, the force developed contributes to Pdet, whereas the velocity of shortening of muscles relates to urine flow **(Q).** There is a trade-off between generating Pdet and urine flow. During micturition, **Pdet** reflects outlet resistance in as women with sphincter insufficiency**, Pdet** may be almost undetectable; and yet, these women with modest **Pdet** would have normal flow rates. The trade-off between **Pdet** and **Q** resembles a curve for constant mechanical power ***(W)*** in which: ***W = Pdet × Q***, so low voiding pressure does not equate with impaired detrusor contractility ***(Yoshimura and Chancellor, 2007)***.

NORMAL LOWER URINARY TRACT FUNCTION

The micturition cycle involves two relatively discrete phases: bladder filling and urine storage, and bladder emptying. For these two components of bladder function to occur normally, the following concepts must apply.

A) Bladder Filling and Urine Storage

1. Increasing urinary volumes at low pressures must be accommodated with appropriate sensation.
2. The bladder outlet must be closed at rest and remain so during increases in intraabdominal pressure.
3. Involuntary bladder contractions must not be present.

B) Bladder Emptying

1. There must be a coordinated contraction of the detrusor smooth muscle that is sustained and of adequate magnitude.
2. There must be a concomitant relaxation of the bladder neck and lowering of urethral resistance at the level of the smooth and striated sphincter.
3. There must be no anatomic obstruction. **. (Wein2007)**

Neural control of lower urinary tract

Micturition is a complex function that involves coordinated interactions between the smooth muscle of the detrusor, bladder neck, and urethra. The central and peripheral nervous systems serve to coordinate these actions:

I. Peripheral Nervous System

The lower urinary tract is innervated by three sets of peripheral nerves involving the parasympathetic, sympathetic, and somatic nervous systems.

1. Pelvic parasympathetic nerves arise at the sacral level of the spinal cord, excite the bladder, and relax the urethra.
2. Lumbar sympathetic nerves inhibit the bladder body and excite the bladder base and urethra.
3. Pudendal nerves excite the external urethral sphincter.

These nerves contain afferent (sensory) as well as efferent axons. **. (Wein2007)**

A) Parasympathetic Pathways:

Parasympathetic preganglionic neurones located in the intermediolateral region of the sacral spinal cord a region termed the sacral parasympathetic nucleus send axons via the pelvic nerves to ganglion cells in the pelvic plexus and in the wall of the bladder. **(De Groat, 2006).**

Parasympathetic preganglionic neurons send axons through the ventral roots to peripheral ganglia, where they release the excitatory transmitter acetylcholine **(De Groat and Booth, 1993).**

Parasympathetic postganglionic neurons in humans are located in the detrusor wall layer as well as in the pelvic plexus. This is an important fact to remember because patients with cauda equina or pelvic plexus injury are neurologically decentralized but may not be completely denervated **(De Groat et al, 1996)**.

B) Sympathetic Pathways:

Sympathetic pathways to the lower urinary tract originate in the lumbosacral sympathetic chain ganglia as well as in the prevertebral inferior mesenteric ganglia Input from the sacral chain ganglia passes to the bladder via the pelvic nerves, whereas fibres from the rostral lumbar and inferior mesenteric ganglia travel in the hypogastric nerves **(De Groat, 2006).**

Sympathetic efferent pathways in the hypogastric and pelvic nerves elicit an effect in the bladder, consisting of **(1)** inhibition of detrusor muscle via β- adrenoceptors; (2) excitation of the bladder base and urethra via α1-adrenoceptors which help urine storage ***(Andersson & Arner, 2004).***

C) Somatic pathways

The external urethral sphincter motoneurons are located along the lateral border of the ventral horn, commonly referred to as Onuf's nucleus. Sphincter motoneurons also exhibit transversely oriented dendritic bundles that project laterally into the lateral funiculus, dorsally into the intermediate gray matter, and dorsomedially toward the central canal **(Thor et al, 1989).**

Onuf's nucleus in the second to fourth sacral spinal segments is the center of somatomotor innervation. These nerves travel in the sacral nerves to the pudendal nerve to innervate the external urethral sphincter **(Lue, 2007)**