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Review – Incontinence

Pathophysiology and Contributing Factors in Postprostatectomy Incontinence: A Review

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Abstract

Context: The incidence and awareness of postprostatectomy incontinence (PPI) has increased during the past few years, probably because of an increase in prostate cancer surgery. Many theories have been postulated to explain the pathophysiology of PPI.
Objective: The current review scrutinizes various pathophysiologic mechanisms underlying the occurrence of PPI.
Evidence acquisition: A search was conducted on PubMed and EMBASE for publications on PPI. The primary search returned 2518 publications. Animal and basic research studies, letters, publications on prostatectomy for benign reasons, pathology of prostatic carcinoma, radiotherapy and hormone therapy of prostatic carcinoma, and review articles were all used as criteria for exclusion from the study. A total of 128 publications were selected for final analysis.
Evidence synthesis: Neuromuscular anatomic elements and pelvic support are known to influence PPI as evidenced by multiple publications. A number of non-anatomic and surgical elements have been postulated as contributing factors to PPI. Biological factors and preoperative parameters include: functional bladder changes, age, body mass index (BMI), preexisting lower urinary tract symptoms (LUTS), prostate size, and oncologic factors. Multiple studies reported the impact of specific anatomic/surgical factors, including fibrosis, shorter membranous urethral length (MUL), anastomotic stricture, damage to the neurovascular bundle, and extensive dissection, all of which have a negative impact on the continence status of patients following radical prostatectomy (RP). Investigation of the impact of techniques to spare the bladder neck and additional procedures to reconstruct the posterior or anterior support structures (eg, the Rocco stitch) on continence status is ongoing.
Conclusions: Anatomic support and pelvic innervation appear to be important factors in the etiology of PPI. Biological/preoperative factors including greater age at time of surgery, preexisting LUTS, high BMI, shorter MUL, and functional bladder changes have a negative impact on continence after RP. Extensive dissection during surgery, damage to the neurovascular bundle, and postoperative fibrosis also have a substantial negative impact on the continence status of men undergoing RP. Sparing of the bladder neck and anterior fixation of the bladder-urethra anastomosis are associated with better continence rates. There is still debate about whether posterior pelvic reconstruction leads to better postoperative continence rates.
Patient summary: Radical prostatectomy is an oncologic procedure and thus requires removal of the entire prostate gland and seminal vesicles, ideally with negative surgical margins. This sometimes results in urinary incontinence. The factors contributing to urinary incontinence are explained in this article.

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1. Introduction

Persistent urinary incontinence (UI) after radical prostatectomy (RP), commonly referred to as postprostatectomy incontinence (PPI), is an adverse event that leads to significant distress. Rates of PPI vary and depend on the definition of incontinence, severity, bother, and the methodology to assess its magnitude. While multiple factors are associated with the development of PPI, surgical modifications also play a role. The influence of advanced surgical techniques such as laparoscopic robot-assisted RP (RARP) on continence remains a point of debate. With the increase in surgery for prostate cancer, there has been a concomitant increase in the prevalence of PPI and thus greater awareness of the problem. The etiology of PPI is multifactorial and has been the subject of much study.

In a systematic review of more than 8000 men who underwent RARP, laparoscopic prostatectomy, or retropubic prostatectomy, Ficarra et al [1] found that for a "no pad" definition of UI, rates ranged from 4% to 31%, with a mean of 16%. Age, body mass index (BMI), comorbidity index, lower urinary tract symptoms (LUTS), and prostate volume were the most relevant preoperative predictors of UI after RARP. The authors concluded that the prevalence of UI after RARP is influenced by preoperative patient characteristics, surgeon experience, surgical technique, and methods used to collect and report data. The techniques purported to provide better functional results were nerve-sparing procedures, bladder neck preservation, preservation of anterior urethral ligaments, and proper urethrovesical reconstruction. RARP appeared to have better continence rates compared to open prostatectomy, whereas bladder neck preservation resulted in better continence rates compared to bladder neck reconstruction.

The natural history of urinary function recovery after RP is such that most patients regain urinary continence within the first year; however, modest improvement in urinary continence can still be observed through the second year [2].

Knowledge about the anatomy of the urethral sphincter complex and its surrounding structures and innervation in relation to urinary continence is well described in the literature. We provide a brief description of the latest understanding of the anatomy in Section 3. The function of these anatomic structures and their specific role in maintaining urinary continence is much less well understood. The role of these structures in urinary continence is mostly inferred from the effect of applying correcting measures to improve urinary continence. More review manuscripts have been published that elucidate the mechanisms underlying PPI. For example, Loughlin and Prasad [3] concluded that the return of urinary continence after surgery is influenced by multiple factors, including patient selection, technical nuances, and definitions. We performed a review of the literature from the start of RP to document the current state of knowledge with respect to PPI pathophysiology.

2. Evidence acquisition

Pub Med and EMBASE were searched for publications on PPI from January 1, 1990 to May 20, 2015. We chose 1990 because this year was approximately when RP was first performed. The search terms were: urinary incontinence, urinary stress incontinence, urinary urge incontinence, and RP. Details of search methods are shown in the Supplementary material. The search was limited to publications written in English. The inclusion criteria were source publications (clinical studies) describing risk factors and potential pathologic mechanisms underlying urinary incontinence following RP and their impact on current surgical correction practice. The exclusion criteria were: animal studies; case reports; letters; publications on simple prostatectomy, transurethral resection of the prostate, cryotherapy, laser vaporization, and other less invasive approaches; articles on the pathophysiology of benign prostatic hyperplasia, the pathology of prostatic carcinoma, and radiotherapy and hormonal therapy for prostatic carcinoma; and review articles. The primary search returned 2518 publications, from which 128 articles were selected for final analysis after applying the inclusion and exclusion criteria. A flow diagram of the selection process is shown in Figure 1. The level of evidence (LE) and sample size for studies included in the final analysis are shown in the evidence synthesis to indicate the strength of evidence for each potential PPI contributory factor.

3. Evidence synthesis

3.1. Anatomic components and impact of RP on continence

3.1.1. Urethral sphincter complex

The urethral sphincter complex consists of two functionally independent components, an internal or lissosphincter of smooth muscle and an outer or external rhabdosphincter of skeletal muscle, that are thought to be responsible for passive and active continence, respectively [4]. The internal sphincter maintains continence during normal activity when there is little stress on the bladder outlet. Its smooth muscle maintains tone for long periods with minimal exertion. The external urethral sphincter is a muscle that is very strong but becomes fatigued very quickly. The action of the external urethral sphincter is often seen when performing cystoscopy after RP and asking the patient to contract. The ability of a patient to circumferentially coapt the urethra on command implies that the muscle tissue and innervations are intact and no hampering fibrosis is present. The two-component model of the urethral sphincter also explains why techniques to spare the bladder neck lead to higher continence rates. Sparing the bladder neck is thought to preserve the majority of the internal sphincter. Preserving this part of the sphincter complex, which is responsible for passive continence, results in earlier return to continence and lower rates of PPI. Multiple studies have shown this to be a contributing factor (LE 3, sample size range 34–240)