Outcomes of Reduction Cystoplasty in Men With Impaired Detrusor Contractility

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OBJECTIVE To report surgical outcomes in patients with impaired detrusor contractility (IDC) treated with reduction cystoplasty (RC).

METHODS This was a retrospective study of consecutive patients with IDC who underwent RC. IDC was defined as a bladder contractility index of <100 and/or a detrusor contraction of insufficient duration resulting in a postvoid residual volume (PVR) >600 mL. Bladder outlet obstruction was defined by a bladder outlet obstruction index (BOOI) >40. All patients had preoperative International Prostate Symptom Score, maximum uroflow (Q_{max}), PVR, bladder diary, videourodynamics, and cystoscopy. Patients with prostatic obstruction underwent synchronous open prostatectomy. Postoperative Q_{max}, PVR, need for clean intermittent catheterization (CIC), and Patient Global Impression of Improvement (PGII) score were obtained. Follow-up was at 3 months, 1 year, and yearly thereafter.

RESULTS Eight men met inclusion criteria (mean age, 60; range, 43-75 years). Preoperatively, 3 of 8 patients (37.5%) had moderate-sized bladder diverticula, 4 of 8 (50%) had a bladder contractility index <100, and 6 of 8 (75%) had a BOOI <40. Two patients (25%) fulfilled criteria for bladder outlet obstruction (BOOI, 67 and 72). Three (37.5%) underwent synchronous bladder diverticulectomy, and 3 (37.5%) underwent suprapubic prostatectomy. All patients were available for follow-up at 1 year. Seven of 8 (88%) had a successful outcome (PGII ≤2). One patient was unchanged (PGII, 4) and still needed CIC.

CONCLUSION All but 1 patient who met specific criteria for RC had excellent outcomes after surgery based on the PGII, PVR, Q_{max}, and need for CIC. RC is a viable option for properly selected patients with IDC. UROLOGY 83: 882–887, 2014. © 2014 Elsevier Inc.

Detrusor underactivity is defined as "a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying, and/or failure to achieve complete bladder emptying within a normal time span."[1] We prefer the term impaired detrusor contractility (IDC), which is defined by a low amplitude detrusor contraction and synchronous low uroflow (Q_{max}) and/or a detrusor contraction of insufficient duration to empty the bladder at a normal flow rate.[2] Two indices used to describe detrusor function include the bladder contractility index (BCI) and the bladder voiding efficiency, with a BCI <100 considered to be indicative of IDC.[3] Numerous other descriptive and quantitative definitions of IDC have also been reported.[4-7]

IDC has been associated with aging, prior prostatectomy, and large bladder capacity.[8-13] In a study by Purohit et al,[2] it was found that among 100 patients with bladder capacity greater than 700 mL, 35% had IDC or an acontractile detrusor, and 48% had coincidental bladder outlet obstruction. Detrusor contraction duration is important when evaluating patients with large bladder capacity because from a theoretical standpoint, if the bladder contracts sufficiently to achieve any amount of flow, it should empty if it could contract long enough. Conversely, despite a strong detrusor contraction, if the detrusor contraction duration is insufficient, the bladder will not empty.

For the subset of patients with IDC, large bladder capacity and high postvoid residual, reduction cystoplasty may be of benefit. The finding that chronic overstretching of the bladder occurs mainly in the upper dome region makes this surgical approach feasible because the neurovascular supply to the bladder comes from the more inferior base region.[14] Literature on

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Table 1. Preoperative and postoperative data for each patient including 1 failure

Patient	Preop Q_{max}	Postop Q_{max}	Preop PVR	Postop PVR	Preop Bladder Capacity	Postop Bladder Capacity	Preop BCI	Preop BOO	Need for CIC Postop
1	0	18	950	151	950	527	0	0	N
2	1	30	1860	60	1900	832	12	2	N
3	1	23	3084	242	3084	891	16	16	N
4	13	21	3092	100	4000	483	103	67	N
5	9	29	4150	134	5013	521	116	20	N
6	20	39	950	0	1089	497	160	20	N
7	10	8	2682	375	3341	672	100	72	N
8	3	12	694	245	1065	793	37	2	Y

BCI, bladder contractility index; BOO, bladder outlet obstruction; CIC, clean intermittent catheterization; N, no; Postop, postoperative; Preop, preoperative; PVR, postvoid residual volume; Q_{max}, maximum uroflow; Y, yes.

reduction cystoplasty is sparse, with its use described in patients with prune belly syndrome.[15,16] However, investigators have also explored the use of reduction cystoplasty in diabetic patients with large capacity bladders. Watanabe et al[17] performed reduction cystoplasties in a group of diabetic rats with large capacity bladders and found objective improvements in bladder voided volume and decreased postvoid residual volume (PVR). The literature also reports the benefit of treating patients with bladder diverticulectomy, a form of reduction cystoplasty, because there is reported reduction in the incidence of urinary tract infections, stone disease, and lower urinary tract malignancy.[18] In this study, we report surgical outcomes and prognostic indicators in men with IDC treated with reduction cystoplasty.

MATERIALS AND METHODS

This was a retrospective, observational study of consecutive patients with IDC who underwent reduction cystoplasty performed by a single surgeon. Patients who underwent simple bladder diverticulectomy were excluded from the study. Patients were identified by a search of billing records for "reduction cystoplasty."

IDC was defined as (1) BCI <100, derived from videourodynamic evaluation or (2) BCI >100 (typically considered to be normal) but with a detrusor contraction of insufficient duration resulting in a large PVR >600 mL. The BCI and bladder outlet obstruction index (BOOI) were calculated for each patient according to the following formulas: BCI = detrusor pressure (P_{det}) @ Q_{max} + 5Q_{max} and BOO = P_{det} @ Q_{max} − 2Q_{max}.[19] Indications for reduction cystoplasty included IDC as previously defined or refractory PVR >600 mL despite intermittent or indwelling catheterization for at least 6 months. Exclusion criteria included neurogenic bladder, pelvic irradiation, or urethral stricture. Preoperatively, all patients completed a 24-hour bladder diary and International Prostate Symptom Score (IPSS) questionnaire, and underwent Q_{max}, PVR, videourodynamic evaluation, and cystoscopy. Postoperatively, the Patient Global Impression of Improvement (PGII), Q_{max}, and PVR were assessed, and the need for clean intermittent catheterization (CIC) was recorded. Follow-up was scheduled at 3 months and 1 year.

Videourodynamics was performed using a 7F dual-lumen, vesical catheter and a 9F rectal balloon catheter at a medium filling rate (30 mL/min) with room-temperature radiographic contrast medium as the infusant. Bladder capacity was defined as the volume at which the patient felt a strong urge to void and/or voided voluntarily or involuntarily. In those patients who did not experience an urge to void and/or were unable to void, bladder capacity was defined as the volume at which the patient felt comfortably full. If the patient felt comfortably full during cystometry before achieving a maximum voided volume as guided by the bladder diary, filling was stopped, the patient was distracted, and filling then continued until the patient became comfortably full again. Detrusor contraction duration was calculated by determining the time interval between initial rise in P_{det} above baseline once the patient had begun to try to void and the time at which P_{det} returned to baseline at the end of voiding.

Surgical technique for reduction cystoplasty was based on operative findings. The bladder was exposed through a midline infraumbilical incision and filled with saline through a Foley catheter until it was moderately distended. A transverse cystotomy was made about 10 cm cephalad to the bladder neck, and the surgeon's nondominant hand placed inside the bladder, retracting the bladder dome upwards. Using his fingers as a guide, the entire dome and posterior wall of the bladder were dissected free and sharply excised being careful to excise all thinned areas of the bladder. The goal was to excise redundant bladder wall leaving a capacity of approximately 500-600 mL. If any bladder diverticula were apparent in the remaining bladder wall, they were excised using an intravesical dissection. Concomitant suprapubic prostatectomy was done in patients with prostatic obstruction and at the discretion of the surgeon based on operative findings.

RESULTS

The preoperative mean IPSS for the cohort was 11 (standard deviation [SD], 9.5), and mean bladder capacity was 2555 mL (SD, 1530 mL). Preoperatively, mean Q_{max} was 7 (SD, 7) with a median of 6 (range, 0-20), and mean PVR was 2183 (SD, 1260) with a median of 2271 (range, 694-4150). Postoperatively, mean Q_{max} was 23 (SD, 10) with a median of 22 (range, 8-39), and mean PVR was 163 (SD, 120) with a median of 143 (range, 0-375). Outcomes of surgical treatment with regard to Q_{max} and PVR show significant objective improvement in the 7 of 8 successful patients (88%) (Table 1). In improved patients, reduction in PVR from preoperative measurements ranged from 65%-100%.

The cohort seen between 1993 and 2009 consisted of 8 male patients (mean age, 60; range, 43-75 years) of whom 3 had previously undergone transurethral resection

of the prostate (TURP). Preoperatively, 2 patients fulfilled criteria for bladder outlet obstruction based on BOOI values of 67 and 72. The latter patient had previously undergone TURP. The remaining 6 patients had BOOIs <40 (range, 2-20). The duration of intermittent (7) or indwelling (1) catheterization ranged from 6-24 months with a median of 12 months. A representative urodynamic study is shown in Figure 1. Four patients had BCIs <100 (range, 12-37), and the remaining patients with BCIs >100 (range, 100-115) had detrusor contractions of insufficient duration resulting in a PVR >600 mL. All patients in the study underwent reduction cystoplasty among whom 3 underwent synchronous bladder diverticulectomy (bladder capacity range, 950-1089). Three patients also underwent synchronous suprapubic prostatectomy. A representative pre-operative and post-operative videourodynamic study can be seen in Figures 2 and 3. In 1, the prostatectomy was done because of diagnosis of prostatic obstruction (BOO, 67) and in the other 2, because of nonobstructing benign prostatic hyperplasia in an attempt to lower outlet resistance as much as possible. Another patient with obstruction (BOO, 72) underwent Y-V plasty because of bladder neck contracture subsequent to a TURP done years ago. There were no postoperative complications, but 1 patient underwent transurethral resection of residual prostatic tissue 3 months after suprapubic prostatectomy. One patient, who never underwent prostate surgery, developed prostatic obstruction and underwent TURP 18 months postoperatively.

Mean and/or median follow-up was 6.4 years (range, 2-11 years). At last follow-up, subjective improvement was seen in 7 of 8 patients (88%) based on the PGII (PGII score, 1 in 5; PGII score, 2 in 2). One patient was unchanged (PGII, 4) and still needed CIC. The overall number of patients on CIC decreased from 8 preoperatively to 1 postoperatively, an 88% reduction. One patient who developed severe Alzheimer's disease developed prostatic obstruction, urinary retention, and urosepsis 7 years postoperatively. No other patient required intermittent catheterization or further surgery, and none developed hydronephrosis or stones on renal ultrasound, which was done on the last visit in all patients. The one who remained on intermittent catheterization had a complicated postoperative course from a diagnostic and decision-making standpoint (patient 8 on Table 1). From a mechanical standpoint, he appeared to be voiding well and initially had PVRs as low as 100 mL. At 1-year follow-up, his PVR was 245 mL. He was an 82-year-old man and had an obsessive compulsive personality. His voiding pattern was erratic, and we were never able to wean him off of intermittent catheterization.

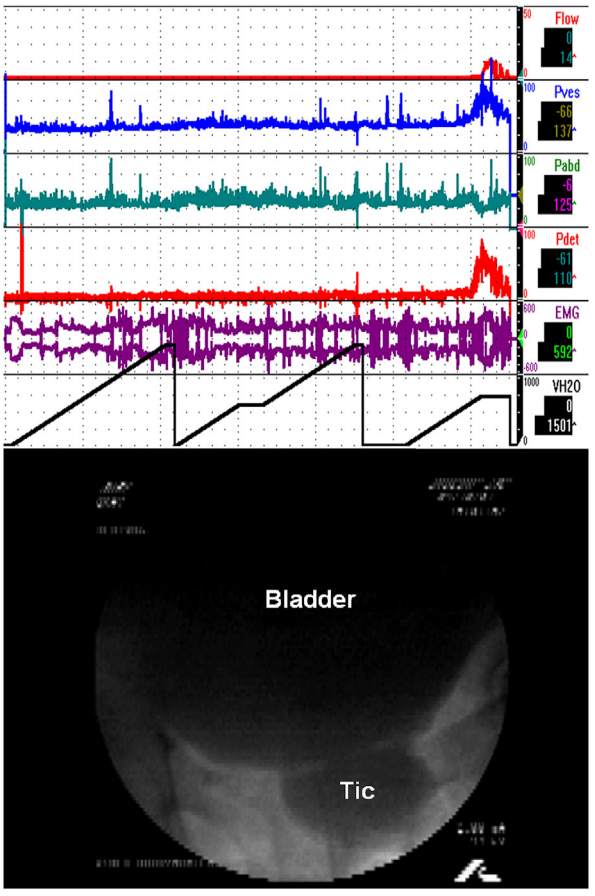

Figure 1. Videourodynamic study of a 59-year-old man referred for the evaluation of large residual urine after developing gross hematuria with clots and clot retention subsequent to cardiac stent placement. Patient had a bladder capacity of 5013 mL and a postvoid residual volume (PVR) of 4177 mL. He underwent a synchronous bladder diverticulectomy and reduction cystoplasty with bladder neck incision and V-Y plasty. He had a postvoid residual volume of less than 200 mL with a uroflow of >25 mL/s and no urinary complaints at 5 years follow-up. (Color version available online.)

COMMENT

Among urologists, the prevailing view is that the benefit of surgical treatment for patients with IDC is uncertain with mixed results demonstrated for prostatic reductive surgery.[20-23] In the study by Thomas et al,[21] there was no long-term symptomatic benefit (as measured by self-reported symptoms or urodynamic improvement) from TURP in men with IDC. However, in another study by Masumori et al,[22] TURP was shown to provide a symptomatic improvement in men with IDC with IPSS and quality of life index scores that were significantly better than baseline. Two-third of those patients who had undergone TURP reported that they were satisfied with their urinary condition at 12 years follow-up. There is only sparse literature studying the role of reduction cystoplasty in treating IDC.[14,17] As a result, in some patients whose pressure-flow evaluations demonstrate IDC, surgical intervention is often not pursued, and reduction cystoplasty is almost never considered. Nevertheless, in the present series, 7 of 8 carefully selected patients (88%) with IDC had a successful outcome after reduction cystoplasty based on PGII assessment, Q_{max}, PVR, and the need for CIC. The ideal candidate is a man with very large bladder capacity, IDC, and no urethral obstruction.

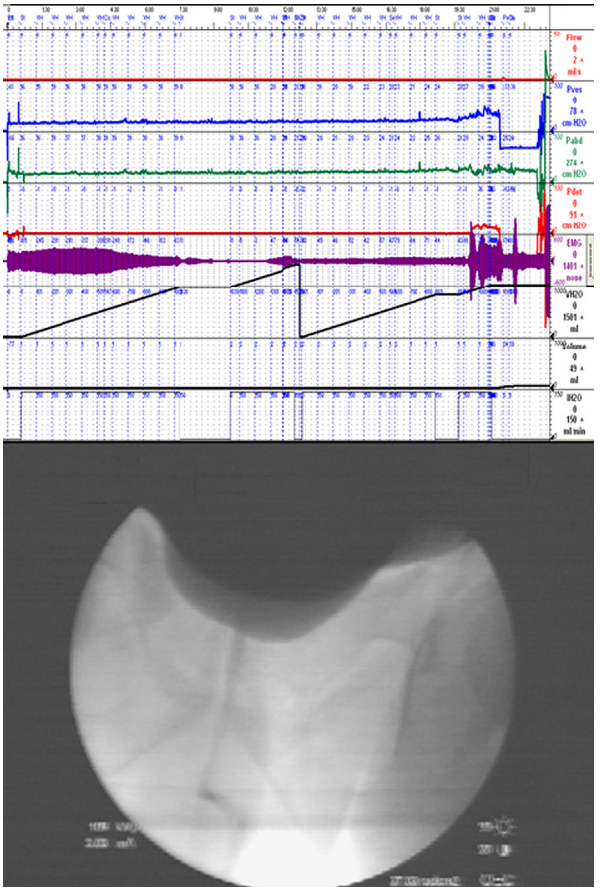

Figure 2. Preoperative videourodynamic study of a 43-year-old man who on presentation had a bladder capacity of 3084 mL and a postvoid residual volume of 3011 mL. (Color version available online.)

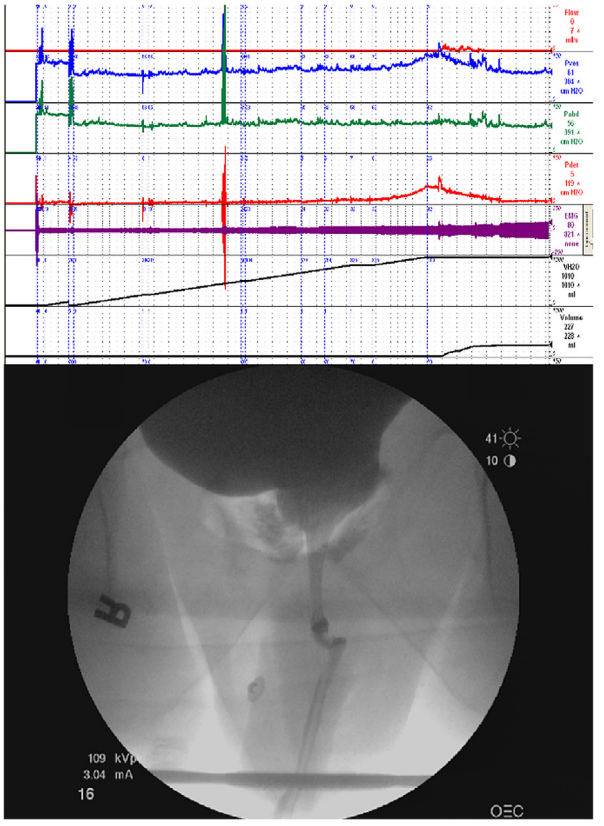

Figure 3. Postoperative videourodynamic study of the same 43-year-old man after he underwent a synchronous suprapubic prostatectomy and reduction cystoplasty. He had a postoperative bladder capacity of 891 mL and a postvoid residual volume of 242 mL. (Color version available online.)

The selection process that we employed, though, is difficult to quantitate and there were a number of confounding factors that made the analysis difficult. The sine qua non for considering reduction cystoplasty was a demonstrable detrusor contraction during urodynamics that fulfilled our criteria for IDC, a large bladder capacity and a large postvoid residual urine volume. However, there are many men who fulfill these criteria who were thought to be too frail for this surgery or were offered the surgery but declined because of the unknown results of the surgery. Unfortunately, we had no way to capture these data. Furthermore, in the absence of proven prostatic obstruction, one must still consider the possibility that outlet reducing surgery might be of benefit even without reduction cystoplasty; by lowering urethral resistance, a weakened bladder may be sufficient to overcome a lowered urethral resistance. However, in this series, both patients who had urethral obstruction had already failed 1 attempt at outlet reducing surgery.

Other studies have shown bladder outlet reduction surgery not to be of benefit in improving IDC.[21,24] However, due to the retrospective nature of these studies, they are prone to a selection bias where the patients have more severe disease leading to results that are worse than that would be expected in the general population. We believe that the favorable results in our study are due to a rigorous selection process; all patients exhibited at least some detrusor contraction during videourodynamic studies.

The patients in our study had large capacity bladders (mean, 2555 mL) that when evaluated with videourodynamics resulted in a BCI <100 or a detrusor contraction of insufficient duration to empty the bladder. The entire cohort overall responded well to reduction cystoplasty. Most patients (88%) had excellent results based on PGII. There was also substantial improvement in Q_{max} and PVR, and only 1 patient remained on CIC postoperatively.

This was a retrospective observational study because of the scarcity of patients who met criteria for IDC and underwent reduction cystoplasty. Subsequently, the present study suffers from all limitations of a small, retrospective case series. Firstly, we used the available data, some of which was recorded for clinical rather than research purposes. Moreover, since there were many other patients who fulfilled the criteria for reduction cystoplasty but had declined the operation, selection bias may be a significant factor in the outcome. Further, 3 patients

underwent synchronous suprapubic prostatectomy, and 3 others had concomitant bladder diverticulectomy, all major confounding factors as previously discussed. These patients may have experienced better outcomes compared with reduction cystoplasty alone, although the patients with urethral obstruction had previously undergone 1 or more attempts at bladder outlet reducing procedures. Although the urodynamic studies and surgeries were all performed by the same surgeon, the extended period of time from which these patients were recruited is another limitation of this study because of the intrinsic non-homogenous nature of urodynamic assessments and surgical technique. The relatively short follow-up time for some patients is also attributable to the extended recruitment time required for the study. More recent surgeries were included to improve the number of recruited patients with the risk of underestimating failure of therapy in patients with shorter follow-up periods taken into consideration. Finally, not all patients had videourodynamics postoperatively, resulting in lack of information regarding improvements in detrusor contractility and/or obstruction.

CONCLUSION

All but 1 patient who met specific criteria for reduction cystoplasty had excellent outcomes after surgery based on the PGII, improvements in Q_{max} and PVR, and need for CIC. Reduction cystoplasty is a viable option for properly selected patients with IDC.

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EDITORIAL COMMENT

From the outset, I am confused by this article. The authors have taken 8 men with large capacity bladders and incomplete emptying secondary to a multitude of factors and credited reduction cystoplasty as the cure for their impaired detrusor contractility. They prefer the term impaired detrusor contractility over detrusor underactivity to characterize the poorly performing detrusor muscle, although that alone implies a myopathic condition, whereas detrusor underactivity could represent a smooth muscle problem or neural control dysfunction, both leading to "underactivity". Seven men had concurrent pathology in addition to large capacity bladders with high postvoid residual urine volumes, including 2 men with bladder outlet obstruction index >40, 3 with large diverticula, and 3 undergoing a simultaneous suprapubic prostatectomy. This is hardly a homogenous population being reported, where reduction cystoplasty can be credited with their more efficient voiding function. Bladder diverticulectomy alone has significant benefits in the right patient suffering from recurrent infection and stones. However, I would not include that surgical procedure with reduction cystoplasty when you define your population as

having impaired detrusor contractility. By definition, tics are devoid of muscle! The surgical technique of reduction cystoplasty was curious as well, where the dome of the bladder was opened and "sharply excised being careful to remove all thinned-out areas of the bladder." The goal was to excise redundant bladder and leave a capacity of 500-600 mL. I have concerns about how reproducible that could possibly be with different surgeons removing "thinned-out bladder" and deciding when enough was removed, so that closure would give you a 500-mL bladder capacity. Only a cohort of men with detrusor underactivity and large postvoid residual urine volumes, devoid of obstruction or diverticula, who undergo reduction cystoplasty and are followed in all cases for more than a year will show the benefits of reduction cystoplasty, if any.

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REPLY

The authors thank the reviewer for his carefully considered comments and for his time and effort in reading and critiquing this study. We greatly appreciate this free and open forum provided by the publisher.

This was an observational study of a small number of patients with an uncommon condition mired by "a multitude of factors" that rendered the manuscript "confusing" to the reviewer. So, let us clarify—the message is simple. Some patients with very high residual urine and documented impaired detrusor contractility derive long-term benefit from reduction cystoplasty. Based on the urodynamic studies and the authors' extensive clinical experience, only 2 patients were thought to have urethral obstruction, and none had bladder diverticula that held enough urine to contribute any more than a small fraction to residual urine. When outlet reducing surgery or bladder diverticulectomy was done synchronous with the reduction cystoplasty, it was done empirically except for the 2 with prostatic obstruction. We agree with the reviewer's comments about the beneficial effects of bladder diverticulectomy when the bladder diverticulum is the main cause of the residual urine, but this was not the situation in any of these patients.

He also had concerns about the reproducibility of surgeons using their judgment about how much "thinned out" bladder to remove. Yes, that is why medicine is part art, part science. How tight to make a midurethral sling?

He concluded with a statement that reduction cystoplasty should only be considered in men with large residual urine and "detrusor underactivity" without urethral obstruction or bladder diverticula, but we disagree with the last 2 criteria for the reasons previously stated. We do agree that "only a highly selective cohort" of men will benefit… "if any." That is why we selected 8 of thousands of men who underwent urodynamic studies because of large residual urines. Seven of 8 derived sustained benefit with a mean follow-up of 6.4 years.

The reviewer also takes issue with our use of the phrase "impaired detrusor contractility"; he prefers the term detrusor underactivity, which, of course, is his prerogative. But we also have ours. The detrusor is a muscle, and when it does not contract strongly enough, it is weak; its contractility is impaired, but it is not underactive. Of course, as he points out, impaired contractility can be myogenic or neurologic in origin. In fact, if measured by the duration of the detrusor contraction, it might be considered overactive because it contracts for a much longer time than if its contractility was normal. So there!

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