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Hypercontinence in Women after Orthotopic Neobladder Diversion

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ABSTRACT

INTRODUCTION: There is a great debate about the cause of the higher incidence of hypercontinence in women undergoing orthotopic diversion after cystectomy in relation to men.

METHODS: A total of 39 females with orthotopic diversion were studied: 21 from the Theodore Bilharz Research Institute (TBRI), and 18 from the University of South Florida at Tampa (USF). Nerve preservation was attempted in all cases. Cystectomy was done with a cut across the bladder neck in the TBRI cases, while the urethral cut in the USF cases was done across the proximal urethra.

RESULTS: Hypercontinence was found in 38% (8 of 21) of TBRI patients and in 16% (3 of 18) USF patients. Urodynamic evaluation was done in 10 of the TBRI cases, and it was comparable to other series regarding pouch capacity (mean = 500 ml), pouch pressure (mean = 17 cm H_2O at capacity), maximum urethral pressure (mean = 67 cm H_2O), and maximum urethral closure pressure (mean = 49.2 cm H_2O).

CONCLUSION: The relaxation of the striated sphincter and the contraction of the longitudinal smooth muscle opens the way for micturition. The loss of this normal coordinated reflex leads to the presence of a urethra with a fixed tone that does not open with trials of evacuation. As men and women have an intact striated sphincter, the higher incidence of hypercontinence in females compared to males is due to the presence of the extra tone of the urethral smooth muscles. This study proves that the more urethral length left, the higher the incidence of hypercontinence because more smooth muscle tone is faced during micturition. Nerve preservation has no impact because the coordinated detrusor urethral smooth muscle action is lost.

KEYWORDS: Women, Orthotopic diversion, Hypercontinence

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INTRODUCTION

The first report of a successful neobladder was in 1888 by Guido Tizzoni and Alfonso Poggi of Bologna who performed a 2-stage technique using a small bowel in a female dog [1]. In 1979, Camay [2] proved that urinary continence is possible with a neobladder, but the procedure remained unpopular until the last 2 decades of the last century when orthotopic lower urinary tract reconstruction became the procedure of choice in select male patients undergoing cystectomy.

Different techniques and variations have been developed with the same concept of achieving a urinary diversion that physically, physiologically, and psychologically resembles the

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normal voiding pattern. The excellent clinical and functional results achieved in men stimulated efforts to provide women requiring lower urinary tract reconstruction with a similar form of diversion.

The application of orthotopic urinary diversion in women has been lagging behind because of the fear of compromising radicality by retaining the urethra and the fear of incontinence because of the lack of understanding the physiology and anatomy of female continence.

Many studies have provided the scientific basis and paved the way for orthotopic substitution in selected cases in women. From the oncological viewpoint, there was the general conviction that urethrectomy is a fundamental component of radicality. Reliable data on the development of synchronous or metasynchronous secondary urethral tumors has been collected in recent years and has found that the association of urethral tumor and bladder cancer is around 2% [3]. Regarding the functional viewpoint, an essential finding was that the continuity of the bladder and urethra is not essential for closure of the striated urethral sphincter [4]. Urethral continence in women who underwent cystectomy was attributed to the rhabdosphincter and the distal urethra with its somatic innervation derived from the pudendal nerve [5].

What is puzzling is that there is a 40% incidence of hypercontinence upon application of orthotopic diversion in women. This is much higher than the rate in men, and its cause still a matter of great debate.

MATERIALS AND METHODS

We studied a total of 39 women who underwent orthotopic diversion. Of the cases, 21 were from the Theodore Bliharz Research Institute (TBRI) in Giza, Egypt, and 19 were from the University of South Florida at Tampa (USF) in Florida, USA.

Indications for orthotopic diversion were vesical malignancy in 37 cases, refractory interstitial cystitis in 1 case, and severe vesical trauma in 1 case. Patient selection and inclusion criteria are shown in Table 1, and both preoperative and intraoperative exclusion criteria are shown in Table 2.

Nerve preservation was attempted in all cases. Cystectomy was done in all TBRI cases with a cut across the bladder neck, while the urethral cut in USF cases was done across the proximal urethra. Diversion was done in the form of Hautmann neobladder in 26 patients, Camey Type II in 4 patients, Y neobladder in 7 patients, and colonic neobladder in 2 patients.

Table 1. Patient inclusion criteria
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1. Cystscopy showed tumour away from the bladder neck and urethra and proved by histopathology
2. Good patient performance status
3. Good renal function with serum creatinine < 2 mg/dl, as good renal function is needed to correct the electrolyte changes that occur after the use of intestinal segments for orthotopic diversion
4. Patient compliance and ability to cooperate, as this helps the patients understand the instructions given about voiding technique and the possibility of self catheterization if needed.
5. Good liver function, as this is needed for ammonia detoxication.
6. History negative for Grade 3 stress incontinence

Omental flap was introduced posterior to the pouch in all cases. Follow-up ranged between 0 and 190 months and was done every 3 months for the first year, every 6 months in the second year, and yearly thereafter.

Urodynamic evaluation was done for 10 cases from TBRI series* and included voiding cystometry, flowmetry, and both pre- and postoperative urethral pressure profile (UPP).

There is a complete breakdown of each case detailed in Appendix 1 and Appendix 2.

RESULTS

Hypercontinence, which is defined as either an inability to void or voiding with more than 150 ml residual urine, was found in 38% (8 of 21) of the TBRI patients and in 16% (3 of 18) of the USF patients. Clean intermittent bladder catheterization (CIC)

**Urodynamics was done for these first 10 patients in TBRI series as a routine during each visit. This was in addition to ascending and voiding pouchogram and other routine lab work but was found to be exhausting to the department's resources. Therefore, we shifted to doing all the radiological and lab workup and only do urodynamics on a selective basis. This was in agreement with the USF policy, and included in this study are only the urodynamics of patients followed up with urodynamics on a regular basis.*

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Table 2. Patient exclusion criteria
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Preoperative exclusion criteria:
1. Tumour or CIS at the bladder neck or urethra shown by cystoscopy or histpathology.
2. Poor patient performance status.
3. Patient noncompliance or inability to cooperate
4 .Serum creatinine > 2 mg/dl. Good liver function
5. Greater than Grade 2 stress incontinence .
Intraoperative exclusion criteria:
1. Presence of liver or other abdominal metastases
2. Presence of lymph node disease > N2.

*Those patients who did not meet the inclusion criteria underwent another form of urinary diversion (e.g. ureterosigmoidostomy or ilael conduit)

was advised for all patients. Our study revealed that there is no correlation between the preoperative continence status and postoperative continence status, taking into consideration that there were no cases of Grade 3 stress incontinence included in our study. This makes sense because the bladder is replaced by an intestinal pouch and the urethra is fixed by fibrosis around the urethro-ileal anastomosis.

Urodynamic evaluation for the first 10 cases of the TBRI series was comparable to other series regarding pouch capacity (mean = 500 ml), pouch pressure (mean = 17 cm H_2O at capacity), maximum urethral pressure (MUP) (mean 67 cm H_2O), maximum urethral closure pressure (MUCP) (mean 49.2 cm H_2O). There was no significant difference between both pre- and postoperative UPP. Complete results of the 10 urodynamic evaluations are shown in Appendix 3.

Urodynamics was done routinely for the first 10 TBRI cases, but thereafter it was not considered a part of the routine evaluation for cost-benefit considerations. It yielded comparable results with other series and there was no significant difference between the 4 hypercontinent patients and the others in this group, apart from pouch capacity.

DISCUSSION

Contrary to the fear of compromising continence in women, hypercontinence is the main problem encountered with the application of orthotopic diversion. Its incidence ranged between 5% and 50% in different series [6-10], and the etiology has always been a point of debate. Different theories proposed include:

1. Urethral angulation with increased urethro-intestinal angle due to lack of the posterior support of the pouch:
This was supported by Ali-el-Dein *et al.* [6] who found the urethral angle to be acute (73° ± 14°) in patients with high residual urine (increasing during voiding), while it was obtuse (122° ± 21° degrees) in others. In later studies, Ali-el-Dein and Ghoneim [11] and Darson *et al.* [12] supported the placement of an omental flap posterior to the pouch for support.

2. Functional obstruction due to denervation of the urethral smooth muscles:
The series by Jarolim *et al.* [13] supported this idea, for which they recommended the use of alpha blockers in addition to CIC. This was debated by Ali-el-Dein *et al.* [6], Ali-el-Dein and Ghoneim [11], and Stein *et al.* [14], who did not recommend nerve sparing cystectomy in women. In an experimental study on female dogs, Ali-el-Dein and Ghoneim [11] reported a reduction of 46% to 48% in the MUP in the proximal urethra after autonomic denervation with no effect on the distal urethra and rhabdosphincter and that the proximal urethra remained patent with no fibrosis after autonomic denervation. Their conclusion was that preservation of 50% of the proximal urethral function and the whole distal urethra and rhabdosphincter function would be sufficient for maintaining continence after orthotopic bladder replacement following non-nerve sparing cystectomy.

3. The level of urethral resection:
Hautmann *et al.* [8,15] concluded that the higher up the urethral resection, the higher the incidence of hypercontinence. He found that in patients with bladder neck preservation, the incidence of hypercontinence was 40%, while it was only 15% in patients where the specimen was cut across the proximal urethra.

4. Ileal valve:
Stenzl *et al.* [16,17] found partially or completely obstructing ileal valve in 3 of 4 patients with hypercontinence. He followed up with TUR valve incision that led to complete resolution.

5. False voiding technique:
Mills *et al.* [18] added that the patient should understand that

relaxing the pelvic floor is more important than abdominal straining during voiding. The pouch capacity is another factor, as he stated that large floppy bags will not empty well and need more straining with the risk of pouchocele formation.

Our experience with 39 patients with a follow-up from 3 to 190 months found that:

1. No case of pouchocele formation was found in our series. We don't agree with the theory of mechanical obstruction.

2. Nerve preservation was attempted in all patients, yet we still got a high incidence of hypercontinence (30%).

3. No ileal valve was found in our cases either radiologicaly (pouchogram) or during follow-up cystoscopy for the hypercontinent patients.

The results of this study are compared to previous studies in Appendix 4.

The only significant factor contributing to hypercontinence in our work was the level of urethral resection. In the TBRI series, the specimen cut was across the bladder neck, and the hypercontinence rate was 38%. This is compared to the USF series where the specimen was cut across the proximal urethra and the hypercontience rate was 25%. A comparison of the 2 groups is shown in Figure 1.

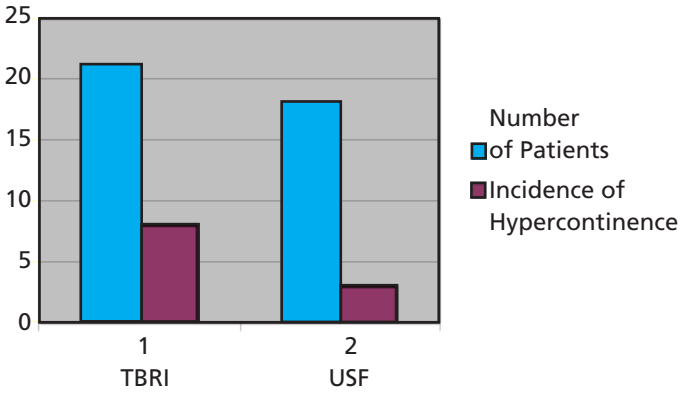

Figure 1. Relation between the level of urethral resection and the incidence of hypercontinence
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Our explanation is that, in these patients, there is no coordination between the relaxation of the striated sphincter and the longitudinal smooth muscle contraction. Typically, this leads to the shortening and widening of the female urethra, and together with detrusor contraction, is the mechanism for micturition. However, the urinary stream of hypercontinent patients faces a urethra with a fixed tone that doesn't open with trials of evacuation.

The significantly higher incidence in females compared to males needs explanation. We believe that, as both have an intact striated sphincter, the difference comes from the extra tone of the urethral smooth muscles left during surgery and that is faced during voiding.

CONCLUSIONS

The normal coordinated micturition reflex is the relaxation of the striated sphincter and contraction of the longitudinal smooth muscle. The loss of this reflex leads to the presence of a urethra with a fixed tone that doesn't open with trials of evacuation. Because both have an intact striated sphincter, the higher incidence of hypercontinence in females compared to males is due to the presence of the extra tone of the urethral smooth muscles. This study proves that the more urethral length left, the higher the incidence of hypercontinence because more smooth muscle tone is faced during micturition. Nerve preservation has no impact, as the coordinated detrusor urethral smooth muscle action is lost.

No correlation was found in our study between the preoperative continence status and the postoperative continence condition. However, there were no cases of Grade 3 stress incontinence included in our study.

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Appendix 1. Patient and surgery data in TBRI cases

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No.	Code	Age (years)	History*	Diversion	Continence status	Follow-up (months)
1	FM	55	Normal continence status; recurrent superficial BC†	Hautmann	Hypercontinent on CIC	51
2	IAM	60	Mild cystocele, no incontinence; invasive BC	Camey II	Hypercontinent on CIC	47
3	AH	41	Normal continence status	Camey II	Day / Night continence	46
4	AAZ	50	Mild cystocele, mild stress incontinence; invasive BC	Camey II	Day / Night continence	13
5	FHA	32	Mild cystocele, dysuria, urgency, and urge incontinence; invasive BC	Hautmann	Hypercontinent on CIC	4
6	AZA	53	Normal continence status, urgency, dysuria; invasive BC	Hautmann	Hypercontinent on CIC	35
7	SH	55	Mild cystocele, mild stress and urge incontinence; no evidence of ISD‡; invasive BC	Camey II	Day continence, Night incontinence	13
8	GHM	65	Mild cystocele, mild stress incontinence; no evidence of ISD, invasive BC	Hautmann	Day / Night continence	12
9	FH	35	Normal continence status; invasive BC	Hautmann	Day / Night continence	9
10	SSA	45	Mild cystocele, mild stress incontinence; no evidence of ISD; invasive BC	Hautmann	Day continence, Night incontinence	23
11	SM	41	Normal continence status; recurrent superficial BC	Hautmann	No follow-up; died of acute myocardial infection in the IPOP§	-
12	FR	34	Mild cystocele, continent, LUTS = dysuria and hematuria; invasive BC	Hautmann	Hypercontinent on CIC	21
13	MW	43	Normal continence status; invasive BC	Hautmann	Day / Night continence	21
14	RM	37	Normal continence status; invasive BC	Hautmann	Hypercontinent on CIC	19
15	HAS	52	Mild cystocele, mild stress and urge incontinence; no evidence of ISD; invasive BC	Hautmann	Day / Night continence	17
16	SAM	48	Mild cystocele, mild stress incontinence; no evidenc of ISD; invasive BC	Hautmann	Hypercontinent on CIC	10
17	ZEZ	40	Normal continence status; invasive BC	Hautmann	Day / Night continence	18
18	IFM	44	Urge incontinence; invasive BC	Hautmann	Day / Night continence	7
19	FMM	56	Mild cystocele, mild stress incontinence; no evidence of ISD; invasive BC	Hautmann	Day continence, Night incontinence	11
20	RAS	33	Mild cystocele, mild stress incontinence; no evidence of ISD; invasive BC	Hautmann	Hypercontinent on CIC	9
21	WAF	37	Normal continence status; invasive BC	Hautmann	Day / Night continence	8

*All patients included in TBRI series were operated upon because of bladder cancer; †Bladder cancer;

‡Intrinsic sphincter deficiency; §Immediate postoperative period

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Appendix 2. Patient and surgery data in USF cases

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No.	Code	Age (years)	History*	Type of Diversion	Continence status	Follow-up (months)
1	HD	29	Trauma; vesico-urethral disruption; Normal continence status	Y ileal neobladder	Day / Night continence	190
2	AG	77	Recurrent superficial BC†; continence status not available	Hautmann	Hypercontinent, low compliance bladder, noncompliant for CIC, +ve LNs for malignancy; refused chemotherapy	24
3	ND	64	Microhematuria; mild stress and urge incontinence; invasive BC	Hautmann	Hypercontinent on CIC	62
4	CE	72	Resistant interstitial cystitis; stress and urge incontinence	Hautmann	Day continence, Night minimal leakage; no residual urine	36
5	LR	60	Cystocele, gross hematuria, urgency; invasive BC	Hautmann	Hypercontinent on CIC	58
6	WA	75	Normal continence status; recurrent superficial BC	Colonic neobladder	Night continence, Day occasional N.E.	24
7	GO	50	Normal continence status; microhematuria; invasive BC	Hautmann	Day / Night continence	48
8	PE	72	Mild stress and urge incontinence; recurrent superficial BC	Colonic neobladder	Continence; Day N.E. pouchocele	42
9	ME	57	Normal continence status; recurrent superficial BC	Hautmann	Day / Night continence; no residual urine	34
10	MR	70	Cystocele, mild stress incontinence, gross hematuria; invasive BC	Y ileal neobladder	Day / Night continence; no residual urine	30
11	CR	79	Normal continence status; gross hematuria; invasive BC	Y ileal neobladder	Day / Night continence; mild leakage	29
12	GS	63	Cystocele, mild stress incontinence, gross hematuria; invasive BC	Y ileal neobladder	Day continence NE	24
13	CM	61	Normal continence status; recurrent superficial BC	Y ileal neobladder	Postoperative ileus; multisystem faliure; died	2
14	WC	52	Mild stress incontinence, gross hematuria, urgency; invasive BC	Y ileal neobladder	Enterovesicovaginal fistula with marked right hydronephrosis → ileal conduit pelvic mass invading rectum and pelvic side wall → CT biopsy → TCC G3 radiotherapy	9
15	GE	44	Normal continence status, suprapubic discomfort; invasive BC	Hautmann	Received chemotherapy for metatstatic disease; otherwise OK	3
16	PM	70	Hematuria; stress and urge incontinence; invasive BC	Hautmann	Stress incontinence	5
17	EP	42	Hematuria TCC exploration +ve LNs MVAC, normal continence status	Y Ileal neobladder	Day / Night continence	14
18	WC	46	Normal continence status; gross hematuria; invasive BC	Hautmann	Day / Night continence	10

*All patients but 2 in the USF series were operated upon because of bladder cancer, †Bladder Cancer

Appendix 3. Urodynamic details of 10 patients of the TBRI series

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No.	Code	Age (years)	Follow-up (months)	Pouch capacity (ml)	Intraluminal (cm 200 ml)	Pressure (H_2O) Full capacity	Static MUP	UPP MUCP P	Maximum flow rate (ml/sec)	Residual urine (cc)
1	FM	55	46	1200	4	7	69	49	13.8	1000
2	IAM	60	43	656	6	22	75	57	34.7	300
3	AH	41	43	450	20	50	73	67	35.6	-
4	AAZ	50	13	500	8	13	47	30	30.6	-
5	FHA	32	4	580	3	11	55	24	45	300
6	AZA	53	31	450	3	7	72	56	11.2	240
7	SH	55	13	340	7	10	81	64	17	60
8	GHM	65	12	240	20	24	54	38	8.3	-
9	FHM	35	8	325	10	13	71	55	5.8	-
10	SA	45	19	270	10	19	72	52	24.8	30

Appendix 4. Incidence of continence and hyper continence in different series

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Reference	Number of Patients	Follow-up (months)	Continence Day / Night	Hypercontinence
TBRI + USF study	39	3-190	89 / 74%	30%
Ali El-Dein *et al.* (1999)	43	6-36	88 / 74.5%	14%
Hautmann *et al.* (1997)	18	3-109	83 /	50%
Stein *et al.* (1997)	34	17-70	88 / 82%	15%
Stenzl *et al.* (1997)	24	2-41	87.5 / 79%	4%
Darson *et al.* (2000)	15	4-41	87 / 60%	40%