Research Article

Augmentation cystoplasty in neuropathic bladder

Sheilagh Reid¹, Paul Tophill¹, Nadir Osman², Chris Hillary²

¹Princess Royal Spinal Injuries Unit, Northern General Hospital, Sheffield, UK, ²Urology Department, Hallamshire Hospital, Sheffield, UK

Objectives: To look at the changing role of cystoplasty in the neuropathic population.

Design: Retrospective case series.

Setting: Single center over a 10-year period from 2004 to 2014.

Participants and intervention: In 1995, the Princess Royal spinal injuries unit published the outcomes of 78 neuropathic patients who had undergone cystoplasty in the 10-year period from 1982 to 1992. [Singh G, Thomas DG. Enterocystoplasty in the neuropathic bladder. *Neurourol Urodyn* 1995; 14(1): 5–10.]. In this series, we review 51 consecutive patients undergoing the same operation over a 10-year period from 2004 to 2014 in the same single unit.

Outcome measures: Demographic data were collected to include patient age, condition, and previous treatments. Pre- and post-operative details included sphincter insertions, renal function, continence rates, and complications.

Results: Despite an increase in the number of patients seen at the unit, there were considerably fewer cystoplasty procedures performed in the current series (51 vs. 78 in the 1982–1992 series). There were also significantly fewer patients with spina bifida and fewer concomitant sphincter insertions in the latter series (eight patients vs. 52 in the 82/92 series). Nevertheless, similar outcomes are observed between the current and 1982–1992 series, with continence rates of 93.7 and 93.6%, respectively and low numbers of reported adverse events for both retrospective cohorts.

Conclusions: Cystoplasty remains a safe and effective option for the management of neuropathic bladder in a carefully selected group of patients.

Keywords: Augmentation cystoplasty, Spinal injury, Detrusor overactivity

Introduction

Cystoplasty was first described in the late nineteenth century by Von Mikulicz.¹ It has been used as a substitution, where bowel segments are used to replace bladder or as augmentation, where the bladder is enlarged using a bowel segment. With the introduction of intermittent self catheterization (ISC) in the 1970s and following the description of the “Clam” cystoplasty by British urologist Frank Bramble in 1982, its popularity increased.² Ileum is the most commonly utilized bowel segment, but the use of caecum,³ sigmoid,⁴ and stomach⁵ is also described. Although originally cystoplasty was mainly indicated as a treatment for small

contracted tuberculous bladders.⁶ in contemporary practice, it is used for bladders that have poor compliance, low capacity or those that demonstrate detrusor overactivity causing incontinence, unsafe bladder pressures or both.

The spinal injuries unit in Sheffield was opened in the early 1950s and has always accepted patients with congenital spinal conditions including myelomeningocele (including spina bifida) as well as those with acquired spinal injuries. In 1995, the Princess Royal spinal injuries unit published the outcomes of 78 neuropathic patients who had undergone cystoplasty in the 10-year period from 1982 to 1992.⁷ The aim of this paper is to review a contemporary series of patients undergoing the same operation over a 10-year period from 2004 to 2014 in the same unit and to perform a comparative assessment of outcome in light of changes to practice in the treatment of neuropathic bladder.

Correspondence to: Sheilagh Reid, Princess Royal Spinal Injuries Unit, Northern General Hospital, Herries Rd, Sheffield S5 7AU, UK. Email: sheilagh.reid2@sth.nhs.uk
Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/yscm.

Methods

A total of 51 patients who underwent cystoplasty over a 10-year period from 2004 to 2014 were identified retrospectively using a local operative coding database. Follow-up data were available for 48 patients, including 40 male and eight female patients. Mean patient age at the time of surgery was 37 years (range 13–61) and mean follow-up was 69.8 months (range 3–132 months). Acquired spinal cord injury accounted for 36 patients, while congenital anomalies were present in 12 patients, of whom nine had spina bifida and remainder had cerebellar ataxia and cerebral palsy.

By comparison, in the 1982–1992 series there were 78 patients, of whom 48 were male and 30 female. Mean age at surgery was 26 years (range 13–61), with a mean patient follow-up of 52 months (range 12–125). Twenty-two patients had acquired spinal injury, while 56 had congenital abnormalities, 49 of whom had spina bifida.

All patients had pre-operative video urodynamics. Video-urodynamic findings in the 2004–2014 series showed reflex bladder (neurogenic detrusor overactivity) in 40 patients (83.3%). The remaining eight (16.7%) had areflexic bladders with reduced compliance. Urodynamic stress incontinence was demonstrated in 14/48 patients (29.2%), while vesicouretric reflux was present either unilaterally or bilaterally in 11 (22.9%).

Pre-operative urodynamic assessment in the 1982–1992 series showed reflex bladder (neurogenic detrusor overactivity) in 52 patients (66.7%) and areflexic bladder with poor compliance in 19 (24.3%). Stress urinary incontinence was demonstrated in 54 (69.2%) (see Table 1).

Where statistical analysis is used, the paired *T*-test is performed.

Table 1 Demographic and outcome data for 1995 and 2014 series.

	1995	2014
Number of cases	78	48
Congenital problem	56	12
Acquired spinal injury	22	36
Mean age	26	37
Bladder substitute	47 ileum, 20 sigmoid, 11 ileocaecal	34 ileum, 10 sigmoid, 3 ileocaecal, 1 caecal
Insertion of AUS cuff	52	8
Dry	65 + 8 (93.6%)	41 + 4 (93.7%)

AUS, artificial urinary sphincter.

Results

Previous treatment

Botulinum toxin was licensed for the treatment of neurogenic detrusor overactivity in 2012. Therefore, none of the 1982–1992 cohort of patients received this treatment, while 15/48 patients (31.3%) in the 2004–2014 received this treatment, all of whom were deemed treatment failures. Furthermore, there is a much greater variation in the oral pharmacotherapeutic agents that were offered in the later cohort of patients, given the recent advent of newer anticholinergics and beta-3 agonists. Therefore, it is difficult to make comparisons between the 1992 series and the 2014 series.

Pre-operative surgical procedural details were not described in the 1982–1992 series; it is likely that the majority had not undergone previous major procedures for incontinence, some of these especially the spina bifida patients may well have been undivertions.

A total of nine patients out of 48 patients (18.8%) in the 2004–2014 series underwent a number of other urological procedures prior to cystoplasty, including four patients who had undergone a previously failed cystoplasty, one detrusor myomectomy, five transurethral sphincterotomies, three artificial urinary sphincter (AUS) insertions, one colposuspension, and one bladder neck closure.

Bladder management

All patients in both series would have been expected to be managing their bladders with ISC post-cystoplasty. We counsel patients that the risk of having to perform ISC in this group is 100%. Even if all patients are not entirely ISC dependent, we believe that they need the ability and the commitment to perform ISC indefinitely. Therefore, we will not offer the operation without this being taught. We have no record of pre-operative bladder management in the 1982–1992 cohort although it is likely that many of them were already performing ISC. In the 2004–2014 group, 30 were already performing ISC (Figure 1).

Operative management

The choice of bowel segment is surgeon dependent at the time of surgery. Ileocystoplasty is the most common procedure. For patients with a small capacity bladder, the decision may be made to use caecum and ascending colon. Sigmoid cystoplasty is now rarely offered and in the 2004–2014 series those offered it were early in the surgeon’s experience. The choice of sigmoid was usually in patients who have a large redundant sigmoid colon and less mobile ileum (as is sometimes found in the spina bifida population). Although there

Figure 1 Bladder management strategies prior to surgery.

is still a place for this substitute in a selected group, anecdotally it has produced fewer good results although we do not have the evidence to back this up.

In the 2004–2014 series, there were 34 ileocystoplasties, 10 sigmoid, and four ileocaecal cystoplasties. In the 1982–1992 series, there were 47 ileocystoplasties, 20 sigmoid and 11 ileocaecal cystoplasties.

Regarding concomitant procedure in the 2004–2014 series, there were four Mitrofanoff conduits formed and 11 procedures for stress urinary incontinence. Three patients had autologous slings and eight had artificial sphincters inserted. These were all bladder neck cuffs, two of which were cuff only and six had full AUS systems implanted. In the 1982–1992 cohort, there were 54 concomitant stress incontinence procedures performed, 45 sphincters, and nine colposuspensions. We assume that the majority of the sphincter insertions were bladder neck cuffs in male patients only, but we do not have the full details.

Hospital length of stay data and catheter protocol information are not available for the 1982–1992 series. Our present regime is to ensure a urethral catheter and suprapubic catheters are left on free drainage with 2–4 hourly catheter flushed post-operatively. A Robinson drain is placed for a minimum of 48 hours and then removed if there is less than 100 mls in the preceding 24 hours. Once the patient is recovering and the suprapubic is draining well, we remove the urethral catheter, usually between the 4th and 7th post-operative day. Patients are discharged with the suprapubic catheter on free drainage and taught to perform twice daily bladder washouts. They return 3 weeks post-operatively to be taught clip-and-release of the suprapubic catheter and commencement of regular ISC. If patients are able to do this and we feel that they can manage regular ISC including initially during the night, we remove the suprapubic catheter. We do not routinely perform a

cystogram unless there is a surgical or clinical indication to do so. We are careful during the intra-operative suprapubic placement to locate this in an extraperitoneal bladder segment. If surgically this is not possible, we would adjust our post-operative protocol.

In the 2004–2014 series, mean hospital length of stay was 10.5 days (range 4–30 days), while meantime to suprapubic catheter removal was 22.6 days (14–28 days).

Complications

Post-operative complications are not specifically documented for the 1982–1992 series, however in 1997 Singh and Thomas published on their follow-up data, documenting that 30% of patients in their original series demonstrated persistent bowel problems.⁸

In the current series, 7/48 patients (14.6%) developed post-operative complications within 3 months of surgery, including urinary sepsis in two patients, urine leak in one, prolonged ileus in two patients, and mechanical bowel obstruction in two. There were no deaths within 90 post-operative days.

Late (>3months) complications occurred in 8/48 patients (16.7%) and included loose stools in three patients, recurrent urinary tract infection (UTI) in one patient, and incision hernia in three patients. While we appreciate that these figures do not accurately reflect what the actual urinary tract infection rate may be, we stress that patients should not send routine urine cultures and only be managed if symptomatic. Our patients have very stringent pre-operative counseling on good bladder management including optimal catheterization and bladder washouts. We have also not been able to accurately report on the number of bladder stones.

Our present follow-up for patients with cystoplasty once they have recovered and are dry is as follows: annual renal ultrasound, FBC, UE, Chloride, Bicarbonate, Vitamin B12 and review in the clinic. We

do not routinely perform a cystoscopic assessment. However, patients are counseled pre-operatively that there is an increased malignancy risk in patients with cystoplasties although it may not be higher than that in other disabled patients who may have long-term poor bladder emptying or indwelling catheters. They are given a direct line to our nurse specialist and told to report hematuria, recurrent urinary tract infections or a general change in urinary symptoms.

Our data capture has not been sensitive enough to document metabolic disturbances and this strict protocol has only been in place since about 2012; however, it is our experience that metabolic complications are rare. What we do know in the 2004–2014 series is that no patient has required renal replacement therapy for deterioration in renal function from this group. Complete pre- and post-operative data on renal function were found in 35 patients. Mean pre-operative serum creatinine was 69.18, while mean post-operative creatinine was 61.74 ($P < 0.05$, paired t -test).

We also do not have clear documentation of the malignancy outcome. To our knowledge, only one patient in the 2004–2014 group has developed bladder cancer and this was a low-grade non-muscle invasive transitional cell cancer, which has been treated with transurethral resection and surveillance.

To the best of our knowledge, no patient in the current series has had to undergo a further cystoplasty in the study period.

Continence rates

In the 2004–2014 series, 41/48 patients (85.4%) were dry post-cystoplasty. Of the remaining seven patients, three are managed conservatively with sheath devices, botulinum toxin, or SPC, and four patients successfully underwent further surgery, which included AUS insertion in two patients, autologous fascia sling in one, and urethral closure in one patient. In total, 45/48 patients (93.7%), including those undergoing additional anti-incontinence surgery, are dry.

Data from the 1982–1992 series demonstrate that 65/78 patients (83%) were dry day and night with stable upper tracts not needing pads or medication for continence. A further eight patients were socially continent (needing 1–2 pads per day and medication). Therefore, social continence overall was 73/78 (93.6%).

Discussion

Patients

Between 2000 and 2010, the number of bladder augmentation procedures as recorded by the Hospital Episode Statistics database (Department of Health) has dropped from over 200 per year to less than 100. This was accompanied by the exponential rise in the number of intravesical botulinum toxin procedures during that period.⁸ This change is reflected in our findings where there has been a significant decline in the number of patients between these two papers and even within the later series there is a decrease in the number of procedures per year over time (Figure 2).

There has been a significant decrease in the number of babies born with central nervous system anomalies between 1968 and 1999 (Figure 3). The rate for live and stillbirths has dropped from about 25 to less than 5 per 10,000 between 1968 and 1999.⁸ Along with the drop in the birth rate, it is worth noting that the earlier series essentially looked back at the introduction of reconstructive urology, cystoplasty, and AUS. The spina bifida patients were coming through either unreconstructed or with ileal conduits. These days, most of the congenital and childhood neuropaths come through with reconstruction courtesy of our pediatric colleagues.

We feel that these changes explain the lower number of spina bifida patients in the later series and the difference in the number of acquired spinal injury *versus* congenital etiology patients between the two groups; 22 acquired and 56 congenital in 82/92 compared to 35 acquired and 17 congenital in the 2004–2014 series.

Figure 2 Number of cases by year.

Patients with congenital neuropathic bladders are more likely to have intermediate type bladders with poor compliance, detrusor overactivity, and stress incontinence. Patients with spastic spinal cord injuries (those injuries that leave the distal cord intact) tend to have detrusor overactivity with detrusor sphincter dyssynergia and an intact guarding reflex meaning that they do not have stress incontinence. Although both populations benefit from cystoplasty, the former group is more likely to benefit from concomitant artificial sphincter insertion. In the 1982–1992 series, 66.7% (52 patients) had a stress incontinence procedure as well as a cystoplasty. By comparison, in the latter group only 22.9% (11 patients) had a stress incontinence procedure, again reflecting the reduction in congenital etiologies.

Botulinum toxin

Intravesical botulinum toxin was licensed for use in neuropathic detrusor overactivity in 2012 and used off license before then. Therefore, none of the 1982–1992 group had been offered this and only 15/48 (31.3%) in

the 2004–2014 group were offered it. These patients clearly failed their botulinum toxin treatment as they went on to have cystoplasties; however, what we do not know is how many patients who were offered botulinum toxin did not go to have cystoplasties.

Our practice now is to offer botulinum toxin for patients with neurogenic detrusor overactivity, who are either performing ISC or have indwelling suprapubic catheters, who have failed anticholinergics with or without mirabegron and who wish to be dry. The place for cystoplasty in neurogenic detrusor overactivity in our hands is as follows: failed or very frequent need for intravesical botulinum toxin with suboptimal effect, patient choice when botulinum is working well but they will need recurrent lifelong injections, patients with high-pressure bladders and poor compliance.

Outcomes

We believe that augmentation cystoplasty remains an effective management option for patients with neurogenic detrusor overactivity and poor compliance to

Figure 3 Central nervous system anomalies live births, stillbirths, and terminations in England and Wales. Rate per 10,000 live and stillbirths 1968–1999. Taken from Bottling B. Trends in neural tube defects, vol. Summer. Office for National Statistics, 2001.

improve both bladder safety and continence. Contemporary evidence for the comparative safety and efficacy of the two techniques in patients with neurogenic detrusor overactivity was recently published by Anquetil and co-workers.⁹ They treated 31 patients with either botulinum toxin and cystoplasty and included a mean follow-up of 9.94 years (cystoplasty) and 6.63 years (botulinum toxin). Both quality of life and continence rates were found to be significantly better in those undergoing cystoplasty with a similar occurrence of urinary infection and stones in both groups. There was no significant deterioration in the post-operative renal function to date in this current series, a finding that is comparable with other similar series.¹⁰ Furthermore, in the series from Krebs *et al*, continence rates were 69% post-operatively, while their series contained a significantly greater proportion with stress urinary incontinence than ours.

We do not specifically investigate patient satisfaction with cystoplasty; however, this has been demonstrated to be equivocal to repeated botulinum toxin injections in non-neurogenic patients with refractory detrusor overactivity.¹¹

Limitations

This current series is limited by the retrospective nature of data collection which has limited some of the details we have been able to compare, particularly in the older cases. Furthermore, a variation in follow-up duration exists as a result of many patients traveling long distances to attend follow-up appointments, many of whom ultimately undergo follow-up at their local institution.

Conclusions

Augmentation cystoplasty remains a safe and effective management option for a carefully selected and motivated group of patients with neuropathic bladder dysfunction. The continence rates in our series are comparable to those in the literature, while there were relatively few significant early or late complications. We believe that appropriate patient counseling is imperative to ensure good outcomes for patients and long-term follow-up

should be conducted to monitor for and avoid the potential metabolic, infective, and renal complications.

Acknowledgements

David Thomas was the original urologist in the spinal injuries unit in Sheffield and his contribution to neurourology is profound. He authored the original cystoplasty paper from this unit. He sadly passed away September 2018.

Disclaimer statements

Contributors None.

Funding This work received no financial support.

Declaration of interest None.

Conflicts of interest There are no conflicts of interest to declare.

References

- 1 Von Mikulicz J. Zur operation der angeborenen blaben-Spalte. *Zentralbl Chir* 1889; 20: 641–3.
- 2 Bramble FJ. The treatment of adult enuresis and urge incontinence by enterocystoplasty. *Br J Urol* 1982; 54(6): 693–6.
- 3 Vajda P, Pinter AB, Harangi F, Farkas A, Vastyan AM, Oberitter Z. Metabolic findings after colocolocystoplasty in children. *Urology* 2003; 62(3): 542–6; discussion 546.
- 4 Yuan L, Xu Q, Liao LM, Ma LL, Wang L, Wang Y *et al*. Comparison of bowel function pre and post-sigmoid augmentation cystoplasty in spinal cord injury patients. *Zhonghua Yi Xue Za Zhi* 2012; 92(12): 842–4.
- 5 Castellan M, Gosalbez R, Bar-Yosef Y, Labbie A. Complications after use of gastric segments for lower urinary tract reconstruction. *J Urol* 2012; 187(5): 1823–7.
- 6 Couvelaire R. The “little bladder” of genito-urinary tuberculosis; classification, site and variants of bladder-intestine transplants. *J Urol Medica Chir* 1950; 56(6): 381–434.
- 7 Singh G, Thomas DG. Enterocystoplasty in the neuropathic bladder. *Neurourol Urodyn* 1995; 14(1): 5–10.
- 8 Bottling B. Trends in neural tube defects, vol. Summer. Office for National Statistics, 2001. Available from <https://www.ons.gov.uk/ons/rel/hsq/health-statistics-quarterly/no--10--summer-2001/trends-in-neural-tube-defects.pdf>.
- 9 Anquetil C, Abdelhamid S, Gelis A, Fattal C. Botulinum toxin therapy for neurogenic detrusor hyperactivity versus augmentation enterocystoplasty: impact on the quality of life of patients with SCI. *Spinal Cord* 2016; 54(11): 1031–5.
- 10 Krebs J, Bartel P, Pannek J. Functional outcome of supratrigonal cystectomy and augmentation ileocystoplasty in adult patients with refractory neurogenic lower urinary tract dysfunction. *Neurourol Urodyn* 2016; 35(2): 260–6.
- 11 El-Azab AS, Moeen AM. The satisfaction of patients with refractory idiopathic overactive bladder with onabotulinumtoxinA and augmentation cystoplasty. *Arab J Urol* 2013; 11(4): 344–9.