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REVIEW

The Clam Cystoplasty

F. J. BRAMBLE

Department of Urology, Bournemouth General Hospital, Bournemouth

The young adult or teenager with an unstable bladder is a therapeutic challenge. Symptoms of urge incontinence and nocturnal enuresis are degrading, demoralising and disrupt both domestic and social life. A visit to the urologist, delayed by embarrassment, is often provoked by impending marriage, which brings the whole problem into focus.

The first-line treatment is an adequate dose of an anticholinergic agent supported by some kind of bladder drill. For those who fail to respond to anticholinergics some authors recommend bladder transection. Hindmarsh *et al.* (1977) reported a cure or improvement in 53% of patients by transection, but the results were poor if the passive bladder capacity was less than 400 ml. Mundy (1983) reported 65% relieved of symptoms at 2 to 5 years but noted that those patients who failed to respond to anticholinergics also failed to respond to transection (Mundy, 1986). He now offers transection only to those patients who respond to anticholinergics but cannot tolerate their side effects. In my hands, transection has unreliable results and when improvement does occur it seldom lasts for more than a few months. Lucas and Thomas (1987) had equally disappointing results with endoscopic transection.

Transvesical injection of the pelvic plexuses with phenol is another option to be considered. Blackford *et al.* (1984) obtained good results in 69% of women over the age of 55 years, but in younger women, who more commonly present with instability, only 14% had a satisfactory response. Phenol injection is contraindicated in men because it causes impotence. Other complications are few but include the occasional sciatic nerve palsy. Perhaps phenol injection is best reserved for the non-ambulant neuropathic patient with detrusor hyper-reflexia.

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Patients with the most severe symptoms of idiopathic instability often fail to respond to conservative treatment; for these patients the "clam" cystoplasty is a realistic alternative.

Technique

Theoretical considerations and previous experience suggested that a simple patch or cup augmentation enterocystoplasty would result in a diverticulum, since the unstable detrusor muscle tends to evacuate the high pressure vesical element into a separate low pressure compartment (Turner-Warwick and Ashken, 1967). The "clam", which almost completely bisects the bladder, was developed in an attempt to overcome this problem.

The original technique (Bramble, 1982) has stood the test of time. The operation has since been described in some detail elsewhere (Mundy, 1985, 1986) but the crucial elements of the procedure deserve emphasis. The bladder is bivalved almost completely in the coronal plane (Fig.). The incision is carried to within 1.5 cm of the internal urethral meatus, just anterior to the ureteric orifice on each side. The prepared bladder thus has the appearance of an open scallop or clam, from which the operation takes its name. Others have since bivalved the bladder in the sagittal plane with similar results. The bivalving incisions must be carried close to the internal urethral meatus to ensure deactivation of the unstable detrusor muscle.

A length of pre-terminal ileum, equal in length to the bladder defect, is isolated on its own blood supply and detubularised by incising the anti-mesenteric border. The ileal patch is sutured into the bladder defect with a single layer of continuous vicryl. Ileum is used in preference to colon because it has a lesser risk of malignant change. A patch of sigmoid colon can be used if the ileum has a very short mesentery or is unavailable.

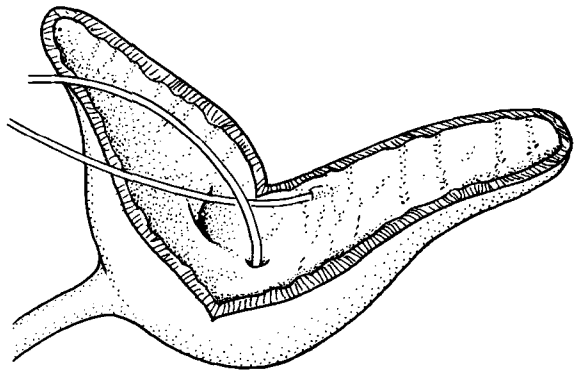

Fig. Bladder preparation for the clam cystoplasty.

Results in Idiopathic Instability

The operation is considered to have a satisfactory result if diurnal and nocturnal incontinence ceases and frequency and urgency are significantly reduced. Thirteen (86%) of an original group of 15 patients were voiding spontaneously and satisfied these criteria at a mean follow-up of 30 months (Bramble, 1982). The 2 remaining patients were also continent but required clean intermittent self-catheterisation (CISC) because of voiding difficulty. Patients measured their own maximum comfortable bladder capacity; the mean value increased from 230 to 554 ml.

Mundy and Stephenson (1985) reported results in 40 cases; 36 (90%) were cured at a mean follow-up of 12 months; 30 of these were voiding spontaneously and 6 by CISC. In post-operative video-urodynamic (VUD) studies they found that the mean bladder capacity increased from 280 to 615 ml, but there was a mean residual volume of 175 ml. The mean *functional* bladder capacity was thus increased from 280 to 440 ml. Low bladder compliance became normal in 14/20 patients (70%). Compliance was improved in 4 others and was worse in 1 patient. In 26 patients with pre-operative instability or hyper-reflexia, the instability was abolished in 15 (57%). The remaining 11 had persistent instability but this was asymptomatic and generated significantly lower pressures than before operation. These results have since been confirmed in other centres. Recurrence of high pressure contractions and relapse of symptoms have not proved to be a problem (McRae *et al.*, 1987; Lewis *et al.*, 1990).

Some young adults with primary nocturnal incontinence have normal urodynamics but still benefit from the clam (Bramble, 1982). Lewis *et al.* (1990) treated 20 such patients with the clam, the age range being 8 to 31 years (average 17); 18 patients became continent (90%), 10 voiding spontaneously and 8 requiring CISC. McInerney *et al.* (unpublished data) studied 24 such patients with overnight cystometry and in 10 cases found prolonged high pressure unstable contractions which were not revealed by conventional cystometry.

How does it Work?

Post-operative VUD studies suggest that a number of factors contribute to the symptomatic improvement. Bivalving the bladder splits the circular continuity of the detrusor fibres and converts a spherical organ into 2 flat plates. This either abolishes unstable activity or makes any residual contractions less effective (Mundy and Stephenson, 1985). Secondly, the interposition of an intestinal segment, which has been detubularised to abolish its own contractile activity, tends to absorb any residual detrusor activity. Finally, the total and functional volume of the bladder is increased. It seems probable that a combination of these factors contributes to the success of the clam.

Problems and Complications

Post-operative complications are those which might be expected from any major operation involving bowel and bladder. If care is taken with the anastomosis between ileum and bladder, post-operative urinary fistula is rare. Bleeding can occur at the angle of the clam if the branches of the inferior vesical vessels are not adequately included in the haemostatic suture.

The object of the clam is to make detrusor contractions ineffective, so it is not surprising that the main post-operative problem is voiding difficulty with relative bladder outflow obstruction. Nearly all patients have to strain to empty the bladder. Because this voiding imbalance is so common, every patient must be followed up closely during the first few months, and success of the operation often depends on the management of this problem.

Residual volume is best monitored by ultrasound as repeated catheterisation can reintroduce infection. If the patient is voiding reasonable volumes without undue discomfort or frequency, a moderate residue can be accepted and the patient allowed home. Most patients take 2 or 3 months to adapt to their new bladder and to learn to void effectively by abdominal straining. Occasional nocturnal incontinence during this period is not unusual. If the

residual volume is high and accompanied by significant frequency, voiding difficulty or persistent urinary infection, a VUD study is performed. About 20% of patients who subsequently void spontaneously will require rebalancing procedures (Bramble, 1982; Mundy and Stephenson, 1985). Rebalancing is accomplished either by bladder neck incision or Otis sphincterotomy, or both, as indicated by serial videos (Turner-Warwick, 1979). Most male patients will require a bladder neck incision; indeed Mundy and Stephenson (1985) do this routinely, either pre-operatively or at the time of operation. Young males, however, may wish to preserve ejaculation and although this cannot be guaranteed it is sometimes possible. I have 2 such patients who have been voiding spontaneously for over 7 years with intact bladder necks.

Some patients cannot void effectively even after rebalancing. Clean intermittent self-catheterisation is needed in as many as 30%. It is not possible to predict which cases will require CISC, so all patients should be warned of this possibility and trained to self-catheterise before operation. CISC may also be a useful temporary measure during the period of stabilisation in the first few weeks after operation (Mundy, 1986). Although the need for CISC might reasonably be regarded as failure of the clam operation, the previously incontinent but now dry patient is usually pleased with the result.

Minor and moderate degrees of stress incontinence due to sphincter weakness should not be treated at the time of the clam (Mundy and Stephenson, 1985). Stress incontinence is rarely a persistent problem and makes the patient less prone to post-operative voiding difficulties. If stress incontinence persists it can be treated by a cautious endoscopic colposuspension.

Some patients have difficulty in voiding mucus. Mucus production seems to diminish somewhat with time but never stops entirely. In a few patients the mucus aggregates into marble-shaped balls which have to be removed endoscopically. Persistent or recurrent urinary infection is a problem in a significant minority of patients, particularly females, and is best managed by a long-term prophylactic antibiotic. Disordered acid-base balance with hyperchloraemic acidosis does occur (Nurse and Mundy, 1989a) but it is mild and rarely requires bicarbonate replacement.

Late major complications are few but include spontaneous perforation of the neobladder at the site of the suture line, leading to a localised urinoma or generalised peritonitis. The pathogenesis of this complication is not understood and does not appear to be associated with traumatic CISC. Only 1 patient under my care, a young male, has perforated spontaneously on 2 separate occasions after a heavy beer drinking session followed by deep sleep.

Patch diverticulisation may occur if the bladder has been inadequately bisected, since the suture line tends to contract and thus leads to an hour-glass deformity (Mundy, 1988). Patch shrinkage has occurred in 1 of my patients with reduction of bladder compliance. This was successfully managed by a second clam. In the female, the mesentery to the ileal patch lies across the body of the uterus, but there have been a number of successful pregnancies with no reported complications.

After a lifetime of nocturnal incontinence some younger patients are so pleased with the results of their operation that they find it difficult to accept the need for careful follow-up. The altered dynamics of the bladder must be explained to the patient so that the need for continued supervision is appreciated.

There have been few reports of tumours occurring at the ileo-vesical junction in augmentation cystoplasties (Stone *et al.*, 1987), and no tumour has yet been reported in a clam. The use of a colonic patch carries a much higher risk. Nurse and Mundy (1989b) found high levels of urinary N-nitrosamines which correlated with heavy bacterial growth on urine culture in both colonic and ileal cystoplasties. The concentration of these carcinogens was higher when a colonic patch was used but high levels were also found in ileocystoplasties with associated inflammation of the bowel mucosa and squamous metaplasia affecting the urothelium. Ileum has been used to augment the bladder for a very long time and the risk of tumour is known to be small. Reported cases almost always have very large volumes of residual urine with chronic infection. The latent period to presentation is often more than 20 years, but at least 1 case has presented at 7 years. Thus careful follow-up of the clam should include cystoscopy at annual intervals and the effective control of urinary infection.

The Failed Clam

Success or failure of the operation is usually clear within the first few months and late failure is rare (Lewis *et al.*, 1990). Persistent incontinence may require substitution cystoplasty with CISC or even a continent diversion. The choice of further treatment will be dictated by individual circumstance, but if there has been some measure of

improvement the patient may opt for the imperfect results of the clam.

The Clam for the Neuropathic Bladder

Because the clam proved to be the most effective treatment for idiopathic instability resistant to conservative treatment, it was not long before the operation was tried in patients with neuropathic bladders who would previously have been treated by substitution cystoplasty (Stephenson and Mundy, 1985).

McRae *et al.* (1987) treated 59 patients. The majority were ambulatory cases of myelodysplasia but the group included cases of spinal tumour, multiple sclerosis, spinal injury and transverse myelitis. The indication for operation in most of these cases was incontinence due to hyper-reflexia or severely reduced compliance. Impaired renal function was a factor in 17 cases. In 7 cases the clam was performed as part of undiversion and 22 patients also required insertion of an artificial urinary sphincter (AUS). There was a significant complication rate in this complex group but satisfactory results were obtained in 42 patients (72%) who were continent with stable upper tracts; 13 of these patients were managed by CISC.

Because the clam technique is quicker and easier to perform than a substitution cystoplasty it considerably reduces the magnitude of the surgery. McRae *et al.* (1987) concluded that the clam cystoplasty is the procedure of choice when the bladder is not too severely diseased and fibrotic. Parry *et al.* (1990) further defined the role of the clam in the treatment of the neuropathic bladder and in particular its use in conjunction with the AUS.

American urologists have concentrated more attention on the source and configuration of the bowel segment in augmentation cystoplasty and less attention has been paid to the shape of the residual detrusor component (Goldwasser and Webster, 1986). Sidi *et al.* (1990) used a colonic cup patch with a clam reconfiguration of the bladder in 12 spinal cord injury patients. At 15 months all patients were continent on CISC with stable upper tracts. Strawbridge *et al.* (1989) used a clam augmentation cystoplasty with the AUS in 18 neuropathic cases of incontinence due to poor bladder compliance with sphincteric incompetence. All 18 patients attained continence, 15 with the help of CISC. All but 2 of these patients had refashioning of the bowel segment into a cup shape. The UK experience would suggest that reconfiguration of the bowel is unnecessary unless the detrusor is very thickened and fibrotic.

Conclusions

Experience with the clam since 1982 has further defined the scope and indications for this operation. The clam cystoplasty is not the answer to the occasional episode of urge incontinence. It is a major operation with significant complications and should be reserved for patients with severe symptoms who have not responded to conservative treatment.

Idiopathic instability

The treatment of idiopathic instability by the clam is well within the capability of the urologist with a general surgical background who has access to adequate urodynamic facilities. Good results can be expected in idiopathic instability, particularly in the younger patient, providing the urologist is prepared to give time to post-operative reassessment and careful rebalancing.

Nothing is gained by delaying treatment beyond the late teens if symptoms are severe.

Those cases of post-prostatectomy incontinence where instability is the underlying cause respond well to the clam providing there is no co-existing brain failure.

The neuropathic bladder

The use of the clam in the reconstruction of the neuropathic bladder may benefit even more patients, but the treatment of this complex group of cases is not within the scope of the general urologist. It often involves the use of an AUS and should be confined to specialised centres.

The clam plays a major role in:

(1) Patients with drug-resistant hyper-reflexia where the detrusor is not too severely fibrotic and diseased.
(2) Bladders with poor compliance, with or without sphincter incompetence, which are unaffected by tuberculosis, interstitial cystitis or radiation.
(3) Undiversion, providing the bladder capacity on cycling reaches at least 150 ml.

The Future

For the present, the clam is the most reliable treatment available for severe instability and hyper-reflexia. Unlike transection and subtrigonal injection of phenol, late relapse of symptoms does not

occur. Future research needs to concentrate on the underlying pathophysiological abnormality affecting the detrusor and its innervation. We must hope that this will lead to a pharmacological cure which will render the clam obsolete before some of these patients develop long-term complications. Because no detrusor muscle is excised, a pharmacological cure might permit reversal of the clam with excision of the potentially hazardous bowel segment.

References

Blackford, H. N., Murray, K., Stephenson, T. P. *et al.* (1984). Results of transvesical infiltration of the pelvic plexuses with phenol in 116 patients. *Br. J. Urol.*, **56**, 647–649.

Bramble, F. J. (1982). The treatment of adult enuresis and urge incontinence by enterocystoplasty. *Br. J. Urol.*, **54**, 693–696.

Goldwasser, B. and Webster, G. D. (1986). Augmentation and substitution enterocystoplasty. *J. Urol.*, **135**, 215–224.

Hindmarsh, J. R., Essenhigh, D. M. and Yeates, W. K. (1977). Bladder transection for adult enuresis. *Br. J. Urol.*, **49**, 515–521.

Lewis, D. K., Morgan, J. R., Weston, P. M. T. *et al.* (1990). The "clam": indications and complications. *Br. J. Urol.*, **65**, 488–491.

Lucas, M. G. and Thomas, D. M. (1987). Endoscopic bladder transection for detrusor instability. *Br. J. Urol.*, **59**, 526–528.

McRae, P., Murray, K. H. A., Nurse, D. E. *et al.* (1987). Clam enterocystoplasty in the neuropathic bladder. *Br. J. Urol.*, **60**, 523–525.

Mundy, A. R. (1983). Long-term results of bladder transection for urge incontinence. *Br. J. Urol.*, **55**, 642–644.

Mundy, A. R. (1985). Cystoplasty. In *Current Operative Surgery-Urology*, ed. Mundy, A. R. Pp. 140–149. Eastbourne: Baillière Tindall.

Mundy, A. R. (1986). The surgical approach to the treatment of incontinence due to drug resistant detrusor instability with particular reference to "clam" ileocystoplasty. *World J. Urol.*, **4**, 45–51.

Mundy, A. R. (1988). Detrusor instability. *Br. J. Urol.*, **62**, 393–397.

Mundy, A. R. and Stephenson, T. P. (1985). "Clam" ileocystoplasty for the treatment of refractory urge incontinence. *Br. J. Urol.*, **57**, 641–646.

Nurse, D. E. and Mundy, A. R. (1989a). Metabolic complications of cystoplasty. *Br. J. Urol.*, **63**, 165–170.

Nurse, D. E. and Mundy, A. R. (1989b). Assessment of the malignant potential for cystoplasty. *Br. J. Urol.*, **64**, 489–492.

Parry, J. R. W., Nurse, D. E., Boucaut, H. A. P. *et al.* (1990). Surgical management of the congenital neuropathic bladder. *Br. J. Urol.*, **65**, 165–167.

Sidi, A. A., Becher, E. F., Reddy, P. K. *et al.* (1990). Augmentation enterocystoplasty for the management of voiding dysfunction in spinal cord injury patients. *Urology*, **143**, 83–85.

Stephenson, T. P. and Mundy, A. R. (1985). Treatment of the neuropathic bladder by enterocystoplasty and selective sphincterotomy or sphincter ablation and replacement. *Br. J. Urol.*, **57**, 27–31.

Stone, A. R., Davies, N. and Stephenson, T. P. (1987). Carcinoma associated with augmentation cystoplasty. *Br. J. Urol.*, **60**, 236–238.

Strawbridge, L. R., Kramer, S. A., Castillo, O. A. *et al.* (1989). Augmentation cystoplasty and the artificial genitourinary sphincter. *J. Urol.*, **142**, 297–301.

Turner-Warwick, R. T. (1979). Cystoplasty. *Urol. Clin. North Am.*, **6**, 259–264.

Turner-Warwick, R. T. and Ashken, M. H. (1967). The functional results of partial, subtotal and total cystoplasty with special reference to ureterocaecocystoplasty, selective sphincterotomy and cystocystoplasty. *Br. J. Urol.*, **39**, 3–12.

The Author

F. J. Bramble, MS, FRCS, Consultant Urologist, The Royal Victoria Hospital, Shelley Road, Bournemouth BH1 4JG.