CURRENT TOPIC

Surgical treatment of urinary incontinence

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Urinary incontinence of the severity encountered in spina bifida and bladder exstrophy can deal a shattering blow to the fragile self esteem of children and young people. Patients stigmatised by incontinence in childhood are often underachievers at school and denied employment opportunities as young adults. Treatment is aimed at creating the degree of continence required to enable them to fulfil an active, independent role in most aspects of normal adult life.

The single most influential contribution to the management of neuropathic bladder has been intermittent clean catheterisation, a concept introduced and popularised by Lapides *et al* in the 1970s.¹ In conjunction with pharmacological manipulation, notably anticholinergic treatment with oxybutinin, intermittent clean catheterisation will produce continence in approximately 50% of patients. Where the bladder is small, poorly compliant, or hyper-reflexic, or in the presence of significant weakness of the striated sphincter, surgical reconstruction represents the only realistic route to total continence. It should be noted, however, that in most instances intermittent catheterisation will still be required to empty the reconstructed bladder. Within the overall framework of treatment the goal of restoring continence must take second place to the overriding priority of safeguarding renal function. Previously chronic renal failure was the single most common cause of late mortality in adolescents and young adults with spina bifida. Before the advent of bladder reconstruction, protection of upper tract function could often only be achieved at the price of continence—for example, bladder outflow obstruction resulting from detrusor-sphincter dyssynergia was generally treated surgically by ablating the bladder neck and striated sphincter complex, which invariably resulted in incontinence. Utilising newer forms of surgical reconstruction, the preservation of renal function and the restoration of continence become mutually compatible goals. Augmenting a small, poorly compliant neuropathic bladder with intestine will enhance continence by increasing the storage capacity, while at the same time protecting renal function by improving compliance and reducing pressure within the bladder and the upper urinary tract.

Viewed simplistically, two essential functions are required of the bladder: (a) to store

adequate volumes of urine at safe, physiological pressures; and (b) to empty to completion under voluntary control. When the bladder is surgically reconstructed, the first requirement—that is, storage—is generally met by incorporating segments of intestine into the bladder (augmentation or substitution), coupled, where necessary, with some technique designed to enhance sphincteric resistance. The second requirement—that is, voluntary emptying—is generally accomplished by intermittent clean catheterisation.

Patient selection

Before considering the technical aspects of bladder reconstruction, its outcome and complications, it is necessary to highlight the crucial importance of careful patient selection. In few areas of surgery is a satisfactory outcome so dependent on the continuing commitment of the patient or, in younger children, the parents. Careful preoperative assessment is required, not only to gauge the motivation and intelligence of the young patient, but also to ensure that he or she possesses the required degree of manual dexterity to perform intermittent self catheterisation and, where appropriate, to manipulate the implanted pump of an artificial urinary sphincter. For girls confined to wheelchairs access to the perineum for urethral self catheterisation may be difficult, and in this situation an easier route of access to the bladder can be created by fashioning a continent catheterisable stoma on the abdominal wall (Mitrofanoff procedure).² A dedicated paediatric urology nurse specialist can fulfil an invaluable role in preoperative assessment and patient selection by assessing needs and family support in the home environment, offering practical advice, and demonstrating the technical aspects of self catheterisation and the management of an artificial urinary sphincter. Ideally, a similar level of expert specialist nursing outreach support should be extended to patients and their families postoperatively.

The timing of continent reconstruction depends on a number of factors, including emotional maturity and motivation, family support, and the extent of the surgery envisaged. Bladder augmentation combined with colposuspension can reasonably be considered for girls of 5 or 6 years (possibly younger), providing there is an appropriate level of parental supervision and support.

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Figure 1 Clam ileocystoplasty: the bladder is opened in a bivalved configuration, likened to a clam.

In boys the timing of surgery is more problematic because, even after bladder augmentation, the degree of outflow resistance required to produce total continence often demands the use of an artificial urinary sphincter. In some US centres acceptable results have been reported after the implantation of artificial urinary sphincters in boys as young as 6 years, but in the UK it is now generally considered that in view of the higher complication rate in this age group, the use of artificial urinary sphincters is best reserved for boys of 10 or 11 years upwards.

Enterocystoplasty

A wide variety of operative techniques has been described, including the use of small intestine (ileocystoplasty), large intestine (colocystoplasty), and stomach (gastrocystoplasty). The intestinal smooth muscle encircling intact tubular segments of intestine is capable of generating high intraluminal pressures and it is now generally accepted that bowel segments should be 'detubularised'—that is, opened and reconfigured as a cup or patch—before being incorporated into the reconstructed bladder. The term 'augmentation' refers to the use of a large intestinal patch intended to increase capacity and improve compliance, whereas 'substitution' describes the more extensive replacement of the bladder by bowel. In the UK the most widely used operation is the clam ileocystoplasty (figs 1, 2, and 3).

Complications of enterocystoplasty

Although enterocystoplasty has been a major surgical advance, short and long term problems resulting from the use of intestine continue to become apparent. These problems can mostly be attributed to the fact that intestinal epithelium is poorly adapted to prolonged contact with urine. Whereas transitional epithelium, the normal bladder lining, provides an inert non-mucus producing biological barrier, intestinal epithelium retains its mucus, producing absorptive properties when incorporated into the urinary tract.

Figure 2 Clam ileocystoplasty: a segment of terminal ileum is isolated on its blood supply.

Figure 3 Clam ileocystoplasty: the segment of ileum is opened on the antimesenteric border and the patch thus created is sutured to the margins of the opened bladder.

MUCUS PRODUCTION

Patients may experience episodes of mucus retention or troublesome blockage of catheters, particularly in the early postoperative months. The use of intravesical mucolytic agents has been described, but gentle bladder lavage with water or saline is probably the most effective form of treatment.

STONE FORMATION

This complication has been reported to affect between 30 and 52%^{3,4} of patients after enterocystoplasty. Aetiological factors include the presence of urinary mucus (acting as a nidus for stone formation), low grade bacteriuria, and stasis. Minimally invasive therapeutic modalities are of limited value and open stone removal is often necessary.

SPONTANEOUS PERFORATION

Diagnosis of this uncommon, but potentially lethal, complication may be difficult in patients with spina bifida in whom the neurological deficit may mask the classical signs and symptoms of peritonitis. A number of aetiological factors have been implicated, including catheter perforation, urinary retention, and perforation of the site of adhesions between the augmented bladder and abdominal wall.

METABOLIC COMPLICATIONS

Subclinical hyperchloraemic acidosis is common. Nurse and Mundy documented this pattern of metabolic disturbance in 16 (33%) of 48 patients after small or large bowel enterocystoplasty.⁵ It has been suggested that subclinical acidosis may account for the impaired growth velocity seen in some children after enterocystoplasty.⁶

BACTERIURIA

Urine stored in reconstructed bladders is rarely sterile, but providing the bladder is emptied regularly by intermittent catheterisation, symptomatic urinary infection is uncommon.

MALIGNANT POTENTIAL

Although it is too early to gauge the long term risk of malignancy, this possibility is already generating some anxiety. In 1993, 15 cases of cancer arising in augmented bladders with a mean latency of 17.2 years had been reported.⁷ It has been argued that in these patients the malignancy resulted from the underlying inflammatory disease of the bladder for which the augmentation was originally performed. The presence of *N*-nitrosamines and other carcinogens produced by the interaction of urine and faecal microflora,⁸ however, indicates a more fundamental risk of malignancy associated with enterocystoplasty.

Artificial urinary sphincters

Recent decades have seen the introduction of a number of artificial sphincter devices intended for the treatment of urinary incontinence. Of these, only the artificial sphincter devised and developed by the late Brantley Scott has withstood the test of time. A detailed review of the published results of the artificial sphincter is

beyond the scope of this paper. Mundy and coworkers at Guy's Hospital, however, have reported an overall continence rate of 95% in 250 patients⁹ (a mix of adults and children) followed up for a minimum of five years. In 78% of patients continence was achieved at the first operation. Complications include mechanical failure, tissue erosion, and infection.

Alternative techniques for increasing bladder outlet or sphincteric resistance include colposuspension (hitching the vaginal vault to the pubic rami to angulate the bladder neck) in girls and elongation of the urethra within the bladder to create a flap valve mechanism. The creation of 'hypercontinence' is undesirable and potentially unsafe. Ideally, the surgically created outflow resistance should be sufficient to impart continence while retaining the potential to serve as a 'pop off' valve by leaking when the pressure begins to increase to dangerous levels within the reconstructed bladder.

Catheterisable continent conduit: the Mitrofanoff concept

In addition to its role in wheelchair bound girls, a catheterisable continent conduit may also prove the most acceptable form of access to the bladder in boys with bladder exstrophy, epispadias, and posterior urethral valves for whom self catheterisation is a difficult or uncomfortable manoeuvre. The appendix is ideally suited to this purpose, but when the appendix is not available, alternatives include the distal ureter, Fallopian tube, or tubes fashioned from ileum or stomach.

Conclusions

By dwelling on the complications of continent reconstruction it is too easy to overlook the impressive benefits it has brought to children and young people who would otherwise have been destined to remain wet or suffer the indignity and inconvenience of a stoma and drainage bag. An international research effort is currently directed at devising effective alternatives to conventional enterocystoplasty. These include the development of a totally artificial urinary bladder, the use of intestine from which the epithelium has been removed (seromuscular enterocystoplasty), and 'tissue engineering' techniques being devised experimentally by our group in Leeds¹⁰ and Atala and coworkers¹¹ in Boston.

Even in its current state of development continent reconstruction holds the power to transform the quality of life for young people for whom severe urinary incontinence is a cruel disability. Few patients are more grateful and, for the surgeon, few are more rewarding to treat.

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