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Surgical treatment of the atonic bladder ("vesical cap")

J. Mráz, J. Michek, M. Sutory, and P. Zerhau

Research Institute for Special Surgery and Traumatology, Brno, Czechoslovakia

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Summary. As demonstrated in animal experiments and in five patients with atonic bladders, "vesical cap" surgery causally solves detrusor impairment by functionally reinforcing it with a vital muscle layer from an ileal seromuscular flap. All other genuine components of the bladder are kept intact, which is very beneficial for bladder function.

Key words: Atonic bladder – Detrusor replacement – Seromuscular intestinal graft

Evacuation of the urinary bladder depends on the expressive component, i.e. primarily on detrusor efficiency and outflow resistance [3]. Outflow resistance can be altered by routine urological surgery [2]. In addition, decreased expressive power can be compensated to some extend by abdominal straining and use of the Credé or Valsalva maneuvers [3]. A large volume of residual urine, however, cannot be managed adequately in this way, mainly because of the high risk of infectious complications [10]. Lapides's clean intermittent self-catheterization [8], while solving the problem, affects the quality of life. Bladder replacement and urinary diversion are accompanied by many complicating factors [1, 4, 11, 13–15]. In an effort to solve the problem more satisfactorily, we had recourse to many years of experimental ureteral replacement with a tapered seromuscular ileal graft. Encouraged by the results of Hirschhorn in 1964, who treated decompensated dilated ureters with his "ureteral sleeves" [5–7] we have been applying the same principle to the urinary bladder since 1987, calling our method construction of a "vesical cap."

Experimental evaluation

Materials and methods

Ten male beagles were operated upon in combined endotracheal anesthesia (thiopental-N_2O-O_2-halothane). A midline low laparotomy was used to gain access to the peritoneal cavity. A segment of 10–15 cm of ileum was isolated and bowel continuity re-established by ileo-ileal end-to-end single-layer anastomosis. The isolated ileum was incised longitudinally along its antimensenteric border and the mucosa stripped off. The ileal loop was divided into two parts. The first one, twice as long as the second, was then transversally folded behind the bladder, and the posterior free intestinal margins were sewn together with a running suture of 4/0 polyglycolic acid. The resulting shallow pocket-like intestinal graft was then placed over the posterior and lateral segments of the bladder wall (Fig. 1a–c). To intensify contact between the two structures, they were successively sewn together with parallel suture lines of chromic catgut placed at distances of 1.5–2.0 cm. Within the suture lines, the fibrin adhesive Tissucol (Immuno) was applied. The anterior bladder wall was covered with the smaller intestinal segment in essentially the same way (Fig. 2). Throughout the procedure, the bladder was maintained semidistended. A urethral catheter, fixed in the preputial fold to prevent the dogs from withdrawing it, was left in place for 5–10 days in seven dogs and for for 14 days in three dogs. The material for histological examination was obtained, 2, 4 and 8 weeks as well as 6 months after the procedure.

Results

All dogs recovered uneventfully. The best results were found in the dogs that had had the catheters in place for 2 weeks: in these animals the adhesion between graft and bladder was most consistent, the bladder wall had the greatest compliance, and the bladder capacity was least reduced. Histological sections revealed loose, highly vascular connective tissue between the two muscle layers as soon as 2 weeks after surgery. After 8 weeks, it had formed to a delicate fibrotic sheet joining the two structures. After 6 months, the two muscular layers were firmly connected (Fig. 3). When the catheter remained in place for a shorter period and vesical function was revived earlier, the intestinal musculature shrank to bundles attached to the anterior and posterior walls of the bladder by hypertrophic fibrous tissue. The bladder capacity was also more markedly reduced.

In essence, the experimental data showed (1) that the chosen technique of intestinal graft application to the bladder was technically acceptable; and (2) that the

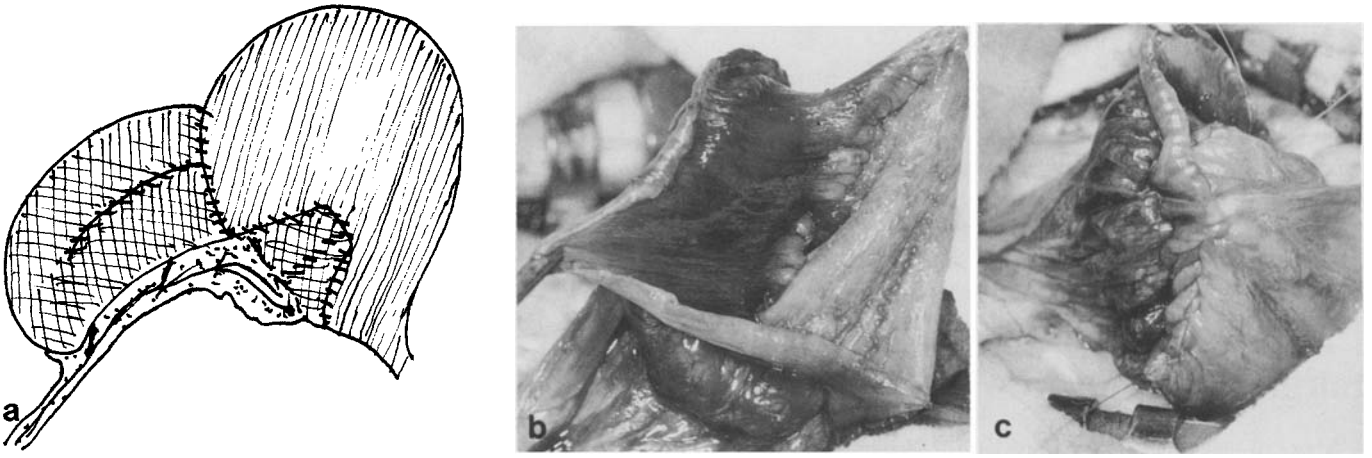

Fig. 1a–c. Application of the seromuscular graft to the posterior and lateral bladder walls

bladder has to be drained by a catheter for at least 2 weeks, since after this period the fibrotic muscle layer connection is compliant enough to permit rearrangement, while resistant enough to withstand the bladder's motor activity.

Clinical evaluation

Materials and methods

The vesical cap technique was employed in five female patients with atonic bladders (residual urine 310–630 ml, bladder capacity 600–1000 ml). Cystometrogram demonstrated outstanding detrusor areflexia (atonia) (Fig. 4). The upper urinary tracts were always normal.

The etiology of bladder disablement was panhysterectomy for endometriosis in two patients; one patient suffered repeated bladder distensions after spinal anesthesia for orthopedic surgery; one patient presumably sustained a spinal contusion and had a Stamey vesicopexy 2 years later to treat urinary incontinence, rendering her unable to pass urine spontaneously (as were in all the other patients); in one patient herpetic infection or disseminated sclerosis was suspected.

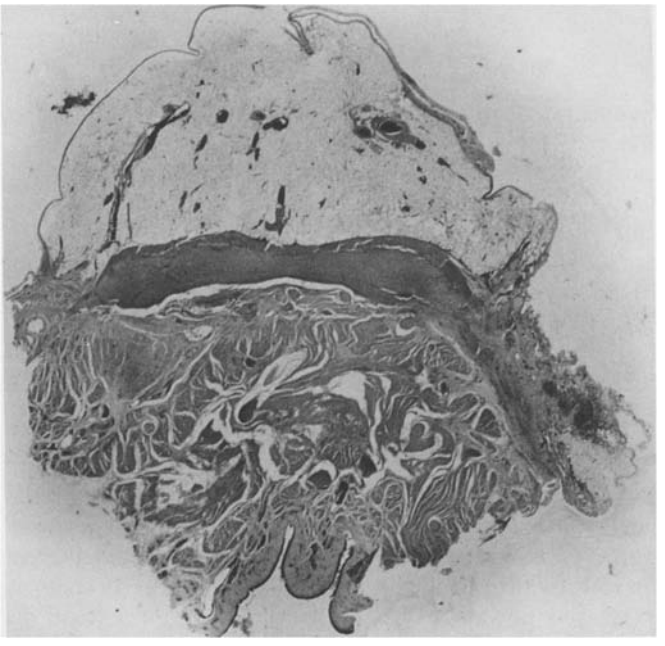

Fig. 3. Cross section of the bladder wall with seromuscular graft. Union of both structures virtually without fibrotic tissue

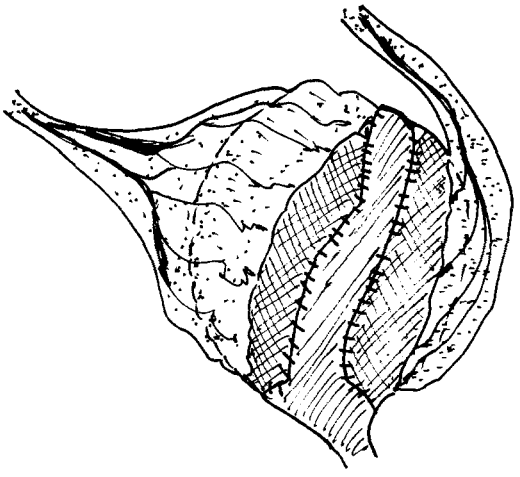

Fig. 2. Final cap formation

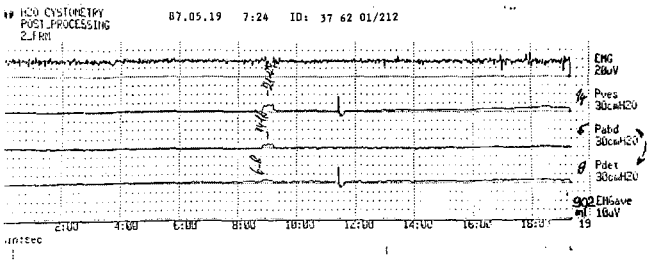

Fig. 4. Preoperative filling cystometrogram of patient no. 376201/212

Table 1. Preoperative functional data

		Patients				
		376201/212	496123/777	545214/801	525209/113	615923/109
First sensation at	$P(cmH_2O)$	5	2	2	3	2
	V(ml)	659	981	450	250	255
Cyst. cap.	$P(cmH_2O)$	9	7	5	5	4
	V(ml)	902	1003	850	605	790
Residual urine	V(ml)	530	630	460	305	300

Table 2. Postoperative functional data

		Patients				
		376201/212	496123/777	545214/801	525209/113	615923/109
First sensation at	$P(cmH_2O)$	14	11	13	10	12
	V(ml)	82	190	160	210	170
Cyst. cap.	$P(cmH_2O)$	24	33	29	29	31
	V(ml)	399	410	290	330	365
Residual urine	V(ml)	0	0	0	0	0

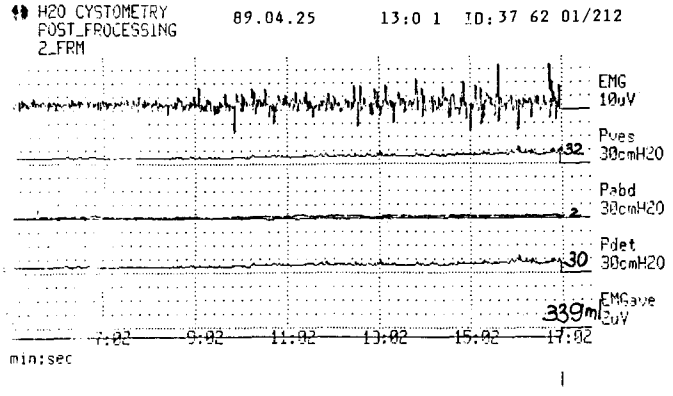

Fig. 5. Postoperative filling cystometrogram of patient no. 376201/212

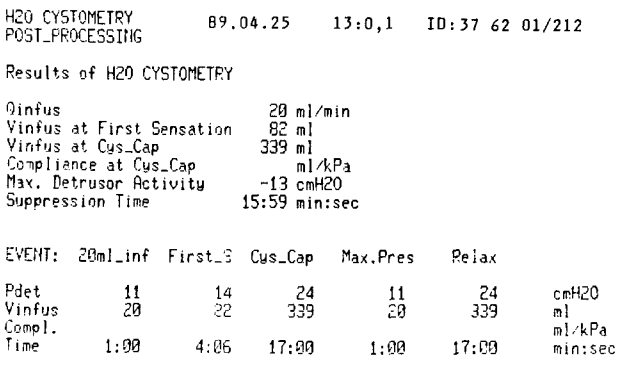

Fig. 6. Postoperative filling cystometrogram of patient no. 376201/212

The operating technique was similar to that used in the dog experiments. The isolated ileal loop was 25–30 cm long. Complete removal of the mucosa was histologically verified in each case and, in addition, the urinary bladder was stripped of its peritoneal covering. Application of the seromuscular intestinal grafts to the very thin vesical wall proved to be rather difficult. After removal of the mucosa the musculature of the intestinal graft was always rather lax, and the bladder had to be distended in keeping with the graft's surface in order to estimate and maintain the suitable bladder capacity and proper healing. Fixation of the graft was basically performed as described in the experimental part, leaving a strip of uncovered vesical wall 3–20 mm wide between anterior and posterior intestinal grafts (Fig. 2). The subperitoneal space anterior and posterior to the bladder, where the vesical cap was placed, was drained with suction drains. These were left in place for 3–5 days and the urethral catheter for 3 weeks.

Results

All patients recovered uneventfully. After removal of the catheter all were able to pass urine spontaneously without residual urine. Pertinent cystometric parameters are given in Tables 1 and 2, and typical cystometrograms are shown in Figs. 5 and 6.

Urinary tract infection was effectively eliminated by appropriate antibiotics. Subjectively, all patients were highly pleased with the outcome. None of them had previously thought that they would again be able to void spontaneously. They reported bladder sensations rather different after the operation from those before surgery

Fig. 7. Postoperative voiding CUGr showing good emptying of the bladder

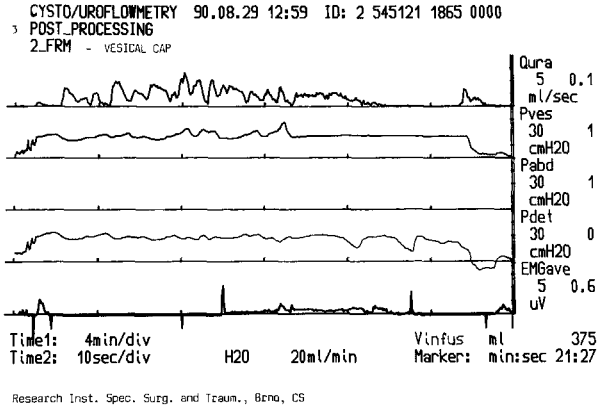

Fig. 8. Postoperative uroflowmetrogram showing a good neodetrusor function

and even before the disease. Bladder capacity ranged between 290 and 410 ml. Upper urinary tracts remained stable, as did urinary continence. Owing to the meticulous removal of the mucosal layer, there were no complications whatsoever due to mucosal secretion.

Discussion

Earlier attempts to solve the problem of impaired expressive power of the detrusor were not directed at the real cause of the problem, i.e. the impaired detrusor. The

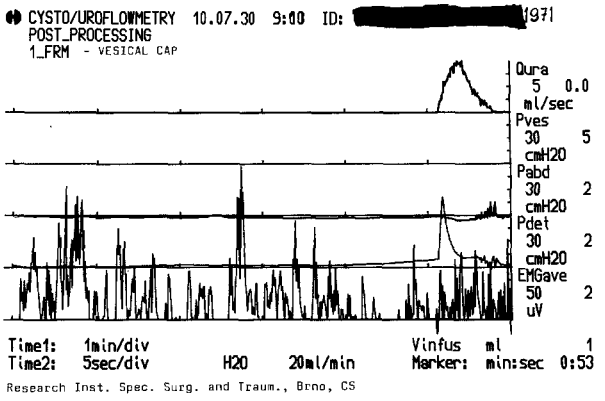

Fig. 9. Second type of postoperative uroflowmetrogram

vesical cap replaces the impaired detrusor, while leaving the other components of the urinary bladder intact. The transitional cell lining of the bladder has various advantages over intestinal mucosa covering grafts used for bladder replacement; it resists hypertonic urine and infection, does not produce mucus and has no absorptive capacity, for example [1, 5, 9–11]. The impaired detrusor is replaced by sound, vital muscular tissue, which is controlled by undamaged neurogenic structures (vagus, splanchnic nerves) [12].

The motility of seroumuscular flaps used in ureteral replacement remains unchanged after removal of the mucosa [9]. This is why the good results with ileal bladder replacement promised adequate bladder function after vesical cap surgery. This was confirmed by both experimental and clinical experience.

An ileal seromuscular flap only 5–10 cm long was recently used by a Japanese group [12] as a vesical patch to improve voiding and defecation in myelodysplastic patients. The mechanism of their technique was not univocally explained in their report, but the results were excellent. Although the contractilitly of the patch did not increase vesical voiding pressure, voiding dysfunction was substantially improved.

The cinefluoroscopic patterns of vesical emptying after vesical cap surgery and after ileal bladder replacement are identical. Emptying is complete, with no residual urine. There were two types of uroflowmetrograms in our patients (Figs. 8, 9). Particularly interesting was the complete absence of abdominal muscle participation in two patients (Fig. 9).

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J. Mráz, MD
Research Institute for Special Surgery and Traumatology
Ponavlea 6
CSFR-66250 Brno
Czechoslovakia