Evolving the Invaginated – One Step Closer to the Perfect Valve? Modified Serosal Lined Tapered Ileum (Kälble's Procedure) as a Continence Mechanism for Catheterizable Pouches

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Key Words

Urinary diversion • Continent pouches • Bladder cancer

Abstract

Introduction: A sufficient and easily catheterizable continence mechanism is essential in continent cutaneous pouches. Kälble embedded a tapered ileum as efferent segment into a serosal lined tunnel formed by an ileal 'U' according to the principle of Abol-Enein and Ghoneim. We report a modified technique applied in a series of 12 patients who had undergone different urinary diversions. **Methods:** All patients received a modified Kälble procedure (first-line urinary diversion, n = 8; revision/undiversion, n = 4) for different forms of continent pouches. To alleviate embedding of the efferent segment, ileal detubularization was performed asymmetrically. Mean follow-up was 9.5 months. **Results:** All patients were continent and performed self-catheterization easily. Of 12 patients, 2 underwent endoscopic incision for stomal stenosis 8 and 12 months postoperatively. **Conclusions:** Subject to our short follow-up, Kälble's technique is a promising alternative in patients undergoing a continent cutaneous urinary diversion but offers an inapplicable or missing appendix.

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Introduction

Urinary diversion is an appreciative topic for operative techniques, in particular the efferent segment (outlet) in continent pouches. Operative evolution started with Mitrofanoff's principle and led to a widespread number of technical alternatives [1]. Today, worldwide, urologists agree on a limited number of reasonable solutions, namely submucosally embedded appendix, intussuscepted ileum, tapered ileum as neoappendix or transversally tubularized ileum (Yang-Monti) [2–6]. However, current available data suggest incorporation of the appendix into the wall of the pouch (flap-valve principle) as the best solution with least complication rates [7]. Unfortunately, a number of patients undergo appendectomy before urinary diversion or offer an unsuitable small-sized or narrow appendix. Furthermore, patients who have failed an appendix nipple procedure ask for a second-line solution and thus considerably enhance the operative challenge. Addressing this common problem, Kälble and Roth [8] recently published a small series of patients undergoing an alternative operating technique – the embedded tapered ileum as an efferent segment into a serosal lined tunnel according to the principle of Abol-Enein and Gho-

Table 1. Patient characteristics

Patient No.	Gender	Age, years	Indication for urinary diversion	Initial urinary diversion	Serosa-lined technique
1	F	46	cervical carcinoma	Mainz pouch 1	first line
2	F	59	urinary incontinence	Mainz pouch 1	revision of appendix
3	M	69	bladder cancer	Mainz pouch 1	first line
4	F	46	neurogenic dysfunction	bladder/continent vesicostomy	first line
5	F	15	neurogenic dysfunction	ileal conduit	conversion into ileal pouch
6	M	54	bladder cancer	ileal neobladder	conversion into ileal pouch
7	F	70	low-compliance bladder	Mainz pouch 1	first line
8	M	73	urinary incontinence	bladder/continent vesicostomy	first line
9	F	72	bladder cancer	Mainz pouch 1	first line
10	F	62	bladder cancer	Mainz pouch 1	first line
11	F	69	bladder cancer	sigma pouch	first line
12	F	65	bladder cancer	Mainz pouch 1	first line

neim [9]. Thus a combination of continence mechanism (valve) and pouch augmentation (cap) was established. Consequently, the procedure was named 'serosa-lined tunnel' by the authors and can be applied to all forms of continent pouches. Encouraged by Kälble's and Roth's short-time results with both 100% continence and successful catheterization, their technique was applied in 12 patients with continent urinary diversion for various indications at the Department of Urology, Bonn University, Bonn, Germany.

Patients and Methods

Patients and Indications

As orthotopic ileal neobladder is generally not performed in female patients at our institution, urinary diversion with a continent catheterizable stoma is offered to women asking for reasonable alternatives to the ileal conduit. Of 12 patients, 7 received the Mainz pouch 1 procedure described by Lampel et al. [10] or a colon sigmoideum pouch similar to the neobladder suggested by Chen et al. [11] (1/12 patients) as initial urinary diversion after radical cystectomy for bladder cancer ($n = 5$), cervical cancer ($n = 1$) or severe non-neurogenic bladder dysfunction ($n = 1$). In 1 of 12 patients an incontinent appendix nipple (Mainz pouch 1, initially performed for severe urinary incontinence) was converted to the serosa-lined tunnel technique. The challenge of a continent catheterizable vesicostomy ($n = 2$) after bladder neck closure for severe non-neurogenic or neurogenic bladder dysfunction perfectly matched with the innovative technique too. In 1 of 12 patients, urethral recurrence of transitional cell carcinoma 2 years after radical cystectomy followed by an ileal neobladder was resected by radical urethrectomy. The neobladder neck was closed and a catheterizable stoma (serosa-lined tunnel technique) was formed. For easy catheterization and cosmetic reasons, the nipple was connected to the umbilicus in all of these patients.

One patient presented with neurogenic bladder dysfunction related to meningomyelocele and a preexisting and massive elongated ileal conduit. The conduit was converted to an ileal pouch with catheterizable stoma. As the umbilicus had been resected in a former operation, an extraumbilical cutaneous stoma was formed. The history in 9 of 11 patients gave evidence of an appendectomy; in 2 of 11 patients the appendix was not suitable because of its insufficient diameter (for detailed patient characteristics, see table 1).

Follow-Up

Mean duration of follow-up was 9.5 (2–10) months. All patients underwent clinical examination, ultrasound imaging of the urinary tract, and blood analysis for creatinine and base excess.

Operative Technique

In case of preexisting urinary diversion, 25–30 cm of ileum are excluded for the continence mechanism. Additional segments were included on an individual basis in patients undergoing initial urinary diversion. Bowel passage is reconstructed by ileoileostomy. The most oral ileal part (8–10 cm) is separated and tapered around an 18-Fr catheter (monofile absorbable suture; fig. 1). To form the basis for the nipple, the remaining ileum is prepared in a U-shape. The ileum is opened asymmetrically allowing more ileal wall in favor of the inside edges of the U which are adapted by a non-resorbable running suture as close to the mesentery as possible (fig. 2). The tapered ileum is positioned between the U's edges and anastomized circularly at the U's base. The ileal edges are then closed over the tapered ileum with single-stitch sutures (resorbable). The wider the remaining ileal edges are, the easier even a thick nipple mesentery can be integrated into the tunnel. Here, the technique of a sensible asymmetrical ileal detubularization is beneficial. Once completed, the nipple-bearing cap can be attached to any continent urinary diversion (fig. 3). The 18-Fr catheter is kept in place for 21 days. Pouchography is advisable before starting clean intermittent self-catheterization via the umbilicus or extraumbilical stoma.

Fig. 1. Ileal nipple with an 18-Fr catheter, reducing the diameter by tapering with a running suture.

Fig. 2. U-shaped ileum, the later position of the nipple is marked by an arrow. The ileal edges are dotted.

Results

No complications related to the urinary diversion occurred within 30 days after operation. All patients started intermittent self-catheterization 21 days after operation without any technical problems. No incontinence occurred during our mean follow-up of 9.5 (2–20) months. Two patients, who presented with scary stoma stenosis located at the abdominal fascia 8 and 12 months respectively, were treated successfully by incision using an endoscopic urethrotomy device. No complications like dilation of the upper urinary tract, severe urinary tract infections or urolithiasis were observed. One patient died 10 months postoperatively due to tumor progression.

Discussion

Common problems of catheterizable cutaneous pouches are stoma stenosis or incontinence. In a large series with ileocecal reservoirs containing 800 patients and an impressive mean follow-up of 7.6 years, stomal stenosis is reported in 15.3% for intussuscepted ileum and 23.5% for submucosally embedded appendix. Overall, continence rates were detectable in 92.8% [12]. Catheterization problems are even met more frequently (60%) in Yang-Monti ileovesicostomy, so generally this procedure is rarely advocated in cases with a missing or unsuitable appendix [13]. Incontinence due to the nipple-gliding phenomenon or ischemia with a reoperation rate of 12.3% in pouches following the hydrostatic nipple valve prin-

Fig. 3. Nipple embedding is completed, the nipple-bearing cap (dotted) is sutured to the pouch (line).

ciple of intussuscepted ileum are for example likely to banish this ambitious technique slowly from the widespread spectrum of urinary diversion [7]. Urologists would be well advised not to get lost in space and focus their skills on two techniques, namely establishing a continent cutaneous pouch in patients with an appendix and in those without.

Incontinence is mostly related to insufficient length or secondary (mostly ischemic) shrinkage of the segment. Here, the surgeon is challenged, as blood vessel-sparing thinning of the mesentery is mostly required for submucosal embedding. Causatively, gentle preparation is the key to sufficient perfusion and therefore to the appen-

dix success story as efferent segment – the mesappendix can easily be prepared in most patients. In this point the serosa-lined tunnel technique offers a great advantage, namely embedding of the nipple can easily be performed even with a thick mesenterium, and therefore the risk of ischemic shrinkage is minimized. According to our experience, asymmetric preparation of the U-shaped bed (in favor of the inner U's limbs) adds even more diameter to the tunnel and solves an intermittent problem of Kälble's original technique in patients with a massive mesenterium.

As a limitation of our technique, the required length of small intestine (20–25 cm) in cases of nipple revision

only is remarkable. Thus, it considerably exceeds an ileal segment for a tapered ileum procedure known as the classical first-choice solution for a failed appendix stoma. This problem should be taken into account with the patient preoperatively when discussing possibilities or urinary diversion.

At present the mean follow-up of 9.5 months is not comparable to published data but early results can undoubtedly be considered to be promising for the future. To conclude, in our experience the modified serosa-lined tunnel is likely to become the standard second-choice technique in cutaneous continent urinary diversion.

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