Treatment of Ureteropelvic Junction Obstruction Using a Detachable Inflatable Stent: Initial Experience

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OBJECTIVE. We describe a new method for treating ureteropelvic junction (UPJ) obstruction using a detachable inflatable stent positioned via a cystoscopic transvesicular approach.

CONCLUSION. Eleven patients with UPJ obstruction were treated using a detachable inflatable stent, 64% of whom experienced complete pain relief. In 82% of patients, no obstruction was seen on renograms obtained after the procedure. The initial results achieved in the treatment of UPJ obstruction with a detachable inflatable balloon are promising, but further research in a larger patient population is required.

There are a variety of accepted treatments for primary or secondary ureteropelvic junction (UPJ) obstruction. Although open pyeloplasty remains the gold standard, several endoscopic and laparoscopic techniques are available as alternative treatment options [1]. These techniques include laparoscopic transperitoneal pyeloplasty, cutting balloon retrograde endopyelotomy, antegrade endoscopic endopyelotomy, retrograde endoscopic endopyelotomy, and retrograde balloon dilatation. Open pyeloplasty is an invasive, dismembering treatment with a mean postoperative hospital stay of 6 days [2]. Laparoscopic and endoscopic techniques are less invasive than open pyeloplasty, but they are associated with a long learning curve for the operator [3] and a long operation time (mean, 246 minutes) [4].

In this article, we describe a new method for treating UPJ obstruction using a detachable inflatable stent positioned via a cystoscopic transvesicular approach. The reason for developing a new method to treat UPJ obstruction was to try to help patients using a minimally invasive, straightforward, and fast procedure.

Materials and Methods

Eleven patients (seven women, four men; mean age, 44 years; range, 24–74 years) with UPJ obstruction were treated between 2002 and 2006. Each patient provided written informed consent, and the study was approved by our departmental review board. Before stent placement, a general workup was performed consisting of diuretic renal scintigraphy and urine and blood tests to exclude urinary infection and sonography of the kidneys to rule out pelvic stones. CT was also performed to diagnose crossing lower pole vessels and other nonintrinsic ureter wall factors that can cause obstructions. There are relative contraindications for undergoing this stent placement procedure such as malignancy, infection of the urinary tract, and bleeding disorders. Follow-up was performed using renal sonography and diuretic renal scintigraphy 3 months after the procedure.

The stent placement procedure was performed with the Overtoom Balloon Catheter (OBC) System (T. Th. C. Overtoom Ltd.). The procedure time was measured from the moment the urologist started cystoscopy until the OBC System was positioned and a control radiograph had been obtained in the operating room.

Device Description

The OBC System comprises a catheter with a balloon and a nonreturn valve and a pusher device with a stylet and two ports (Fig. 1). The side port is for injecting contrast agent to inflate the balloon, and the straight port is for the guidewire. The catheter has a relatively large-diameter central lumen and a shaft of 2 mm (6-French). The balloon is in two sections: a long narrow section, or shaft, and a larger cranial bulb (bulb diameter, 10 mm; shaft diameter, 6 mm; length, 73 mm).

The balloon is inflated by injection of nonionic contrast agent via the pusher and remains inflated in situ until the expanded urothelium heals. During the healing process, urine drains through the wide central lumen.

Keywords: interventional radiology, stents, ureteropelvic junction obstruction

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TABLE 1: Characteristics of 11 Patients Who Underwent Placement of a Detachable Inflatable Stent for the Treatment of Ureteropelvic Junction Obstruction

Patient			Symptoms/ Diagnosis Before Procedure	Result of Procedure	Renogram Findings After Procedure	Complications of Procedure	Procedure Time (min)	Follow-Up Time (mo)
No.	Sex	Age (y)						
1	M	69	Fever, pain, and pyelonephritis	No pain	No obstruction	None	90	49
2	F	26	Pain	Pain	No obstruction	None	85	35
3	F	26	Pain	Pain	No obstruction	None	60	33
4	F	63	Pain	Pain	No obstruction	None	50	23
5	M	58	Pain	No pain	No obstruction	None	45	22
6	F	65	Pain	No pain	No obstruction	None	45	21
7	F	47	Pyelonephritis and pain	Pyelonephritis	No obstruction	Nephrectomy	43	20
8	F	31	Pain	No pain	Obstruction	None	47	16
9	M	52	Pain	No pain	Nonfunctioning kidney	Nonfunctioning kidney	41	14
10	F	24	Pain	No pain	No obstruction	None	43	12
11	M	74	Pain	No pain	No obstruction	None	40	3

Insertion Technique

A straight catheter is introduced cystoscopically into the ureter, and contrast agent is injected to visualize the renal pelvis. A 0.035-inch guidewire is passed via the straight catheter and the ureter into the renal pelvis; we recommend an angled stiff guidewire (Radiofocus, Terumo; or Roadrunner, Cook).

A high-pressure dilatation balloon catheter is passed over the guidewire. The urologist must select the appropriate length and diameter. Typical sizes for the diameter are between 6 and 9 mm, whereas the length depends on the length of the stenosis.

The high-pressure dilatation balloon catheter is then positioned in the stricture, and the balloon is fully inflated until the "waist" caused by the stricture disappears. The balloon is left inflated for several minutes to prevent possible hemorrhage of the ureter wall.

Inflation pressures of up to 15 bar (15.10^5 Pa) can be applied to the percutaneous transluminal angioplasty (PTA) balloon. If no waist appears on the balloon, it can be assumed that the stenosis is due to external compression on the ureter rather than intrinsic wall factors.

The balloon is left in situ for at least 5 minutes. The PTA balloon is then retracted over the guidewire and the OBC System is then passed over the same guidewire. The catheter is advanced using the pusher device until its radiopaque marker is just above the cranial end of the stenosis (Fig. 2). The side port of the pusher is then connected to the inflation device. The balloon is inflated until it is fully deployed (pressure, 1–2 bar [1.0^5–2.10^5 Pa]). Then the guidewire is withdrawn, and a stylet is inserted in the pusher. The pusher is advanced until the connector is in the bladder, and the stylet is pushed until the stylet cannot be advanced any further in the pusher.

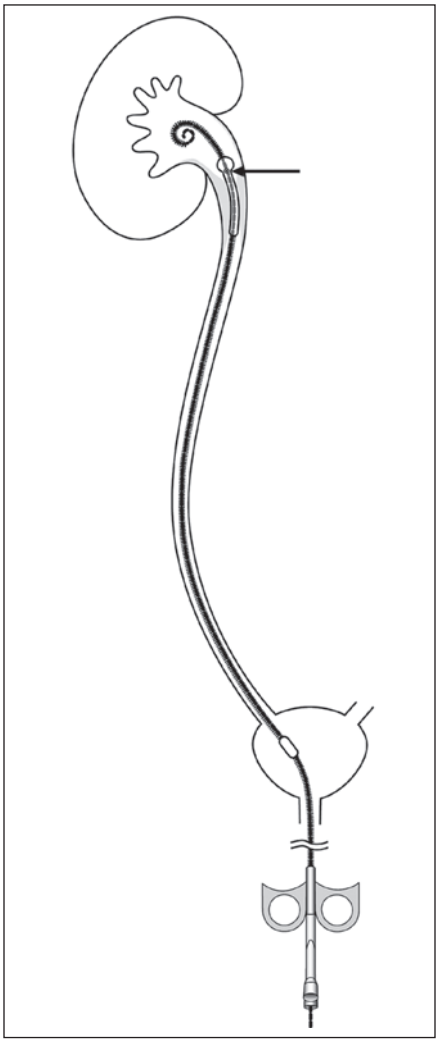

Fig. 1—Drawing shows Overtoom balloon in position before inflation. Arrow indicates radiopaque marker.

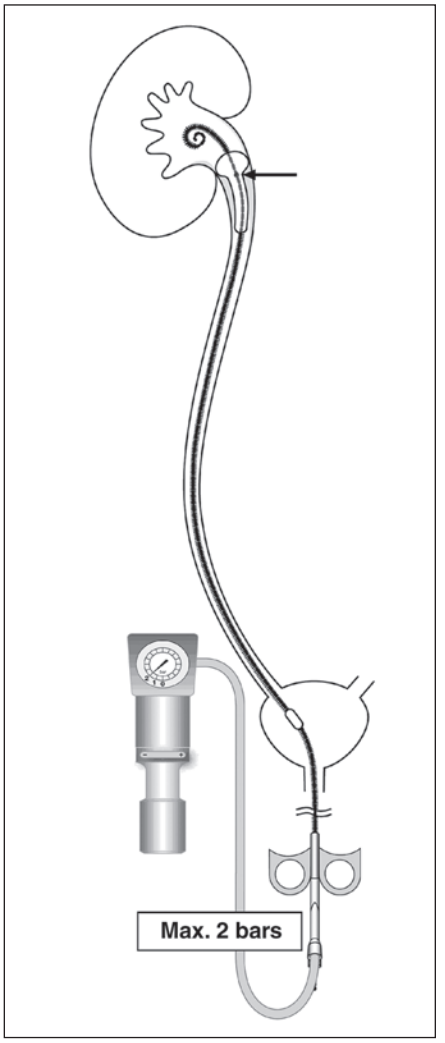

Fig. 2—Drawing shows Overtoom balloon in position after inflation. Arrow indicates radiopaque marker. Max. 2 bars indicates inflation pressure not higher than 2 bars (2.10^5 Pa).

This step detaches the catheter, leaving the balloon fully inflated (Fig. 3). The pusher and the inflation device can now be withdrawn.

The inflated balloon should be left in situ for 4–6 weeks to allow time for the expanded urothelium to heal (Figs. 4 and 5).

The OBC System can be used alone or in conjunction with a double-J stent. The double-J stent provides additional drainage space, reducing the chance of renal colic due to blockage by debris or sludge.

Removal

We removed the balloon catheter in all patients 6 weeks after the procedure.

In female patients, the catheter tail is withdrawn through the urethra during cystoscopy and cut 1 cm or more from the distal tip; this will deflate the balloon. After the balloon is fully deflated, the catheter can be slowly and gently withdrawn.

In male patients, the catheter tip can be cut within the bladder during cystoscopy and withdrawn using biopsy forceps during an outpatient session.

Results

The results of our study are summarized in Table 1. In 64% of the patients (seven of 11), there was complete pain relief. In 82% of the patients (nine of 11), no obstruction was seen on the renogram obtained after the procedure.

Patient 1 presented with fever, pain, and pyelonephritis (Table 1). Pyelonephritis and a UPJ obstruction were diagnosed. A renogram obtained after the procedure showed normal findings and the patient no longer felt pain.

Patient 9 had persistent dilatation of the pyelum after placement of the OBC System. We therefore inserted a double-J stent 2 weeks after balloon placement. After removing both the OBC System and the double-J stent, diuretic renal scintigraphy performed 2 months after the intervention showed a nonfunctioning kidney. Before the procedure, renal function of the affected kidney was 50%.

The follow-up time for the 11 patients was between 3 and 49 months (Table 1).

Discussion

Pyeloplasty can be performed as an open procedure or laparoscopically [1]. The advantages of open pyeloplasty are mucosa-to-mucosa anastomosis, excision of redundant renal pelvis and diseased ureter, and the opportunity to treat associated findings such as concomitant stones and lower pole arteries. The disadvantages of open pyeloplasty are higher morbidity and longer hospital and recovery times than endourologic techniques.

Endopyeloplasty is a nondismembering alternative. Endourologic techniques have now

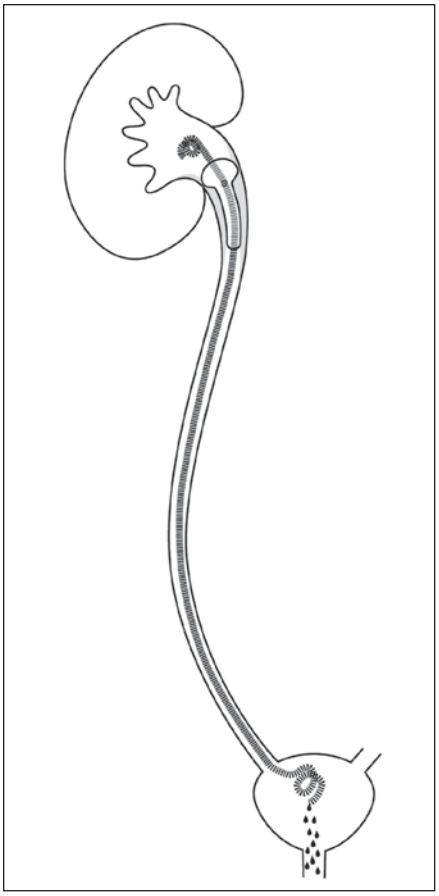

Fig. 3—Drawing shows Overtoom balloon after detachment.

Fig. 4—Photograph shows Overtoom balloon after inflation with contrast medium.

Fig. 5—Radiograph of 24-year-old woman with Overtoom balloon in situ. Patient (patient 10 in Table 1) was symptom free after procedure.

largely replaced open pyeloplasty and become the method of first choice for the treatment of UPJ obstruction. This technique can be performed using an antegrade or a retrograde approach [5].

Antegrade endopyelotomy is performed with the patient under general anesthesia using a percutaneous endoscopic approach. The advantages are a small skin incision, visual control of the incision at the stenosis, and lower morbidity than open pyeloplasty and laparoscopic pyeloplasty. The disadvantages are that surgical remodeling of the dilated pyelum cannot be performed, there is a bleeding risk, and the lower pole arteries cannot be corrected.

Retrograde ureteroscopic endopyelotomy provides adequate treatment in patients with a UPJ obstruction [6, 7]. With the advent of smaller ureteroscopes and ancillary devices, this technique has evolved into a safe and effective treatment modality. No general anesthesia is required. However, the disadvantages of this approach are that it allows only a tone-dependent reduction rather than a surgical reduction in pyelum volume and that visualization is poorer than with the antegrade approach. Furthermore, concomitant pyelum stones cannot be removed during the same session [8]. A possible complication is that the stent can migrate into the retroperitoneum through the incision.

The most widely accepted retrograde techniques are cutting balloon catheter endopyelotomy and ureteroscopic endopyelotomy using a holmium laser [9]. Our initial experience suggests that the OBC System is a useful addition to these techniques, particularly in patients with a history of failed UPJ intervention. However, a larger number of patients is needed to confirm this statement. The learning curve for operators suggests that the procedure time will be approximately 45 minutes and that the mean inpatient stay can be short (1 or 2 days).

In one of our patients (patient 9 in Table 1), renal failure occurred, with a nonfunctioning kidney after the procedure. The mechanism of this outcome is unclear. The procedure was technically successful, but a balloon stent and a double-J stent could be the reason for further obstruction of the UPJ. Another possibility is that we failed to alter the natural progression of UPJ obstruction to renal failure.

The success rate of the OBC System should be compared with that of other endopyelotomy techniques. The success rate of those techniques has been shown to decrease with the length of follow-up [10]. Our success rate in this first small group of patients was lower than that of patients treated with the endopyelotomy method using an Acucise (Applied Medical Resources Corp.) cutting balloon catheter (85%) [9].

The technique of inserting the OBC System is straightforward. We believe that the fact that the technique is straightforward, together with a short hospital stay and the possibility of performing a second intervention, will help to establish this new method as a treatment for UPJ obstruction. The OBC System is removed 6 weeks after the procedure because we judge that 6 weeks is enough time for remodeling of the UPJ. The system keeps ureter strictures dilated while they heal, in a way similar to the use of an indwelling large-diameter bladder catheter for urethral strictures.

Conclusion

Our initial results achieved in the treatment of UPJ obstruction using a detachable inflatable balloon are promising, and the procedure is straightforward and minimally invasive. However, in our small patient group, the success rate was not better than that of existing endopyelotomy techniques. Further research to evaluate the efficiency and safety of this new device for the treatment of UPJ obstruction in a larger patient population is required.

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