Endoscopic Balloon Dilatation for Treatment of Primary Obstructive Megaureter: Experience of a Center

Dilatação Endoscópica de Balão para Tratamento de Megaureter Obstrutivo Primário: Experiência de um Centro

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Abstract

Introduction: Congenital obstructive megaureter may be treated with endoscopic balloon dilatation, particularly in children under one year of age. We report our experience over a six year period.

Methods: All patients with diagnosis of primary obstructive megaureter treated with endoscopic balloon dilatation from 2009 to 2014 (6 years) were included. The diagnosis of primary obstructive megaureter was based on dilatation of the distal ureter greater than 7 mm, obstructive curve on MAG-3 diuretic renogram and absence of vesicoureteral reflux. After diagnosis, conservative management was maintained with antibiotic prophylaxis in all patients. The indications for surgery were a combination of clinical, ultrasonographic and renographic findings. Under general anesthesia and after retrograde ureteropielography, high pressure balloon dilation of the ureterovesical junction was performed under direct and fluoroscopic vision until the disappearance of the narrowed ring. A double-J catheter was positioned. Follow-up was performed with ultrasonography and diuretic renogram. The success of the intervention was defined by improvement of hydroureteronephrosis (at least 2 grades).

Results: A total of nine patients underwent this procedure on a single ureter, two girls and seven boys, with a mean age of 7.6 months (range 1-14) at the intervention. Five were left sided and four were right sided. All patients had prenatal diagnosis of hydroureteronephrosis. No patients were lost to follow-up (average 46.7 months). They all had hydroureteronephrosis greater than grade 3 and preoperative MAG-3 diuretic renogram was obstructive in all cases. Mean differential function of the affected kidney was 46.2% (range 40-53%). The main indication for surgical treatment was progressive hydroureteronephrosis. All patients were treated endoscopically with no intraoperative complications. Ultrasound showed improvement of the hydroureteronephrosis in six patients (66.7%). Three patients were re-implanted (33.3%). The mean differential renal function after the procedure was 47.4% (range 41-53%). At the latest follow-up assessment, all patients remained asymptomatic.
Conclusion: Endoscopic balloon dilatation is a useful option in the management of primary obstructive megaureter requiring surgical intervention and may be considered first line treatment in small children.  

Keywords: Child; Constriction, Pathologic; Dilatation; Endoscopy; Hydro nephrosis; Ureter/abnormalities; Ureteral Obstruction.

Introduction

Megaureter is not a diagnosis but a descriptive term for a dilated ureter. A retrovesical ureteric diameter greater than 7 mm from 30 week’s gestation onwards is abnormal and should be investigated postnatally. Smith classified megaureters into four categories: obstructed, refluxing, refluxing with obstruction and non-refluxing/non-obstructed. These were later subdivided by King into primary and secondary. Primary obstructive megaureter (POM) is most commonly caused by a distal adynamic ureteral segment. A few histopathologic characteristics of the adynamic segment have been described such as abnormal neuromodulation, abnormal collagen deposition and abnormalities in the interstitial cells of Cajal. The timing of smooth muscle differentiation in the distal ureter is unknown but may be the key to explain pathogenesis of primary (or congenital) megaureter. The process whereby the circular muscle pattern, which is typical of the fetal ureter, changes progressively into double muscle layers on the full term infant, may last up to two years, and may explain why this condition resolves spontaneously in approximately 80% of those patients diagnosed prenatally and that is why conservative management is safe initially.

Surgical management is indicated when initial differential renal function (DRF) is less than 40% and when conservative management fails. Traditionally, the surgical management of POM has been via ureteral reimplantation with or without ureteral remodeling. However, in newborns and children under one year of age this technique is very difficult and has a high complication rate. Temporary cutaneous diversion may be beneficial in this cases but it will require two or more procedures for correction.

With advent of minimally invasive surgery, in 1998, Angulo et al published the first report of endoscopic balloon dilatation for POM in children and, since then, several publications have shown that the procedure is feasible, safe and less invasive in very young patients.

This study assesses the long-term effectiveness of endoscopic balloon dilatation in a case-series of six years, in order to evaluate if it can be considered as an alternative to ureteral reimplantation in small children with POM.

Methods

All patients with diagnosis of POM treated with endoscopic balloon dilatation from 2009 to 2014 were included. Data from clinical records was retrieved.

The diagnosis of POM was based on the following parameters: dilatation of the distal ureter greater than 7 mm, obstructive curve on MAG-3 diuretic renogram and absence of vesicoureteral reflux (VUR). Ultrasound was employed to measure the diameter of renal pelvis, distal ureter and the characteristics of renal parenchyma. The degree of HUN was defined in accordance with guidelines of the Society for Fetal Urology. Voiding cystourethrogram (VCUG) was performed to rule out VUR. On MAG-3 diuretic renogram, obstruction was defined as persistence of more than 50% of the tracer in the renal pelvis 20 minutes after diuretic administration.

After the initial diagnosis, conservative management was maintained with antibiotic prophylaxis (oral trimethoprim 1% 0.1 mL/kg, once a day) in all patients. The indications for surgery were a combination of clinical, ultrasonographic and renographic findings with at least one of the following conditions: initial DRF < 40% with an obstructive excretion pattern on renogram MAG-3, progressive HUN or febrile urinary tract infection (UTI) (Table 1).

Under general anesthesia, cystoscopy was performed with a Wolf® 9Fr pediatric cystoscope (Knittlingen, Germany) with a 5Fr working channel. The ureterovesical junction was passed with a flexible guidewire (0.014 mm Terumo®) introduced up to the renal pelvis which was then filled with radiologic contrast (Fig. 1A), confirming the diagnosis of megaureter and the defining anatomy. A Biosensors Powerline® dilating balloon catheter (4 mm diameter and 30 mm length) was insufflated to 12 or 14 atmospheres until the stenotic ring was no longer present (with 3 to 6 minutes of waiting time). The stenotic ring was always visible before dilatation. Then, distal ureterography was performed, confirming dilatation of the stenotic segment and a 4-4.8Fr 10-14 cm double-J stent was left in place (Fig. 1B). The bladder catheter was withdrawn after 24 hours of surgery and the patient was discharged after 24-48 hours, depending on haematuria. The double-J stent was removed under general anesthesia after a mean period of 5.4 months.
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Follow-up included renal ultrasound at one, three, nine and twelve months and annually thereafter; MAG-3 diuretic renogram at six months, two and five years. VCUG was not performed routinely. Antibiotic prophylaxis was maintained until stent was removed.

The success of the intervention was defined by improvement of HUN (at least 2 grades). Success rate was calculated with 95% confidence interval (95% CI) using openEPI. Data on upper urinary tract infections and further surgical interventions were collected.

**Results**

Out of 110 cases of diagnosed megaureters on that period, a total of nine patients underwent this procedure on a single ureter, two girls and seven boys, with a mean age of 7.6 months (range 1-14) at the intervention. Five were left sided and four were right sided. All patients had prenatal diagnosis of HUN. No patients were lost to follow-up (average 46.7 months; standard deviation 21.2) (Table 1).

They all had HUN greater than grade 3. VCUG showed existence of Hutch’s diverticulum in two patients and none had VUR. Preoperative diuretic renogram was obstructive in all patients in whom it was performed (patients 2, 3, 4, 7 and 9). Mean differential function of the affected kidney was 46.2% (range 40-53%).

The indication for surgical treatment was progressive HUN in eight cases and deterioration of renal function (DRF less than 40%) in one case (Table 1).

All nine patients were treated endoscopically with no intraoperative complications. There was one case of stent migration to the distal ureter that was removed endoscopically.

Ultrasound showed improvement of the HUN in six patients (Fig. 2). The success rate was 66.67% (95% CI) (Table 1).

Three patients were reimplanted (one Cohen and two Poli-tano-Leadbetter neoureterocistostomy). Patients 3 and 6 were reimplanted because of recurrent urinary infections, two and six months after endoscopic dilatation, respectively. One patient was reimplanted twenty-one months after endoscopic balloon dilatation because of worsening of HUN with persistence of the obstructed pattern in a diuretic renogram.

The mean DRF after the procedure was 47.4% (range 41-53%). The mean follow-up was 46.7 months (range 12-72) (Table 1).

At the most recent follow-up assessment, all patients remained asymptomatic. The two patients with shorter follow-up were assessed at about two years of age. Both had great improvement of HUN without obstructive pattern at the postoperative MAG-3 renogram.

**Discussion**

In this case-series, the primary success rate was 66.7%. In three cases (33.3%) the ureter was reimplanted. The secondary success rate (after reimplantation) was 100%. These results are similar to those previously published.

In 1998 Angulo et al and in 2007 Angerri et al described the first POM treatment with endoscopic balloon dilatation, which

### Table 1: Patients characteristics and results

<table>
<thead>
<tr>
<th>Patient number</th>
<th>Age at surgery (months)</th>
<th>Diagnosis</th>
<th>HUN grade</th>
<th>% DRF</th>
<th>Indications for surgery</th>
<th>Postop HUN grade</th>
<th>Postop % DRF</th>
<th>Ureteral reimplantation</th>
<th>Follow-up (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>prenatal</td>
<td>3</td>
<td>–</td>
<td>increasing HUN</td>
<td>0</td>
<td>49</td>
<td>no</td>
<td>72</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>prenatal</td>
<td>3</td>
<td>49</td>
<td>increasing HUN</td>
<td>0</td>
<td>49</td>
<td>no</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>prenatal</td>
<td>3</td>
<td>40</td>
<td>DRF &lt; 40</td>
<td>3</td>
<td>45</td>
<td>yes - recurrent febrile UTI</td>
<td>60</td>
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<tr>
<td>4</td>
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<td>4</td>
<td>44</td>
<td>increasing HUN</td>
<td>1</td>
<td>44</td>
<td>no</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
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<td>3</td>
<td>–</td>
<td>increasing HUN</td>
<td>0</td>
<td>49</td>
<td>no</td>
<td>48</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
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<td>3</td>
<td>–</td>
<td>increasing HUN</td>
<td>3</td>
<td>–</td>
<td>yes - persistent HUN + febrile UTI</td>
<td>48</td>
</tr>
<tr>
<td>7</td>
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<td>4</td>
<td>45</td>
<td>increasing HUN</td>
<td>4</td>
<td>49</td>
<td>yes - increasing HUN</td>
<td>48</td>
</tr>
<tr>
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<td>no</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
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<td>4</td>
<td>53</td>
<td>increasing HUN</td>
<td>2</td>
<td>53</td>
<td>no</td>
<td>12</td>
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</tbody>
</table>
Endoscopic Balloon Dilatation was believed to be a definitive, safe and less invasive treatment that avoids unnecessary open surgery.\textsuperscript{5} A small number of publications have reported short series with good results in the short and medium-term. Garcia-Aparicio \textit{et al}\textsuperscript{11} presented a series of thirteen patients with postoperative improvement of HUN in 84.6\% (eleven cases) and need for reimplantation in 23\% (three cases). Carroll \textit{et al}\textsuperscript{3} presented a series of thirty-one patients with improvement of HUN in 48.4\% (fifteen cases) and reimplantation in 35.4\% (eleven cases).

Historically, the surgical management of POM has been based on ureteral reimplantation with or without ureteric remodeling, with a reported success rate of 90-96\%.\textsuperscript{5} However, ureteric reimplantation in infants less than one-year of age may be challenging due to the discrepancy between the grossly dilated ureter and the small infantile bladder and the concern regarding possible iatrogenic bladder dysfunction, such as VUR.\textsuperscript{2}

Therefore, some authors consider alternative temporizing or permanent interventions avoiding reimplantation in infancy.

In the era of minimally invasive surgery, endoscopic management of POM offers a less invasive option for treatment. Furthermore, should an endoscopic approach fail, reimplantation surgery can still be performed.\textsuperscript{10}

The youngest patient in the series of Angerri \textit{et al} was twelve months, in Garcia-Aparicio \textit{et al} was four months, in Carroll \textit{et al} was two months and in Bujon \textit{et al} was one month. In the present series the youngest patient subject to intervention was one month old.\textsuperscript{3,5,11}

The stents were left for more time than the average mentioned on literature (2 months) because of the need of general anesthesia and lack of operating room availability.

Virtually no morbidity was detected, with only one case of stent migration without clinical implications.
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This study has a small number of cases and short follow-up time which limits conclusions, however the results show that endoscopic balloon dilatation is a useful option in the management of POM requiring surgical intervention, reducing morbidity associated with open surgery without sacrificing efficacy.

Conclusion
This study shows that endoscopic balloon dilatation of POM is a safe, feasible and less invasive procedure with few post-operative complications and may be considered first line treatment in the management of POM in small children.

Ethical Disclosures
Conflicts of interest: The authors report no conflict of interest.

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Protection of Human and Animal Subjects: The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of Data: The authors declare that they have followed the protocols of their work center on the publication of patient data.

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REFERENCES