

# RETROGRADE PYELOGRAPHY AND URETERIC CATHETERIZATION\*

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## SUMMARY

Instrumentation of the ureters has an incidence of major complications and in a series of 172 patients 3% had a major infection; 1% anuria and 2% perforation of the ureter. That this procedure should be considered selective and not routine is further reflected by a pronounced decrease in its use from 45% to 10% of all activities over an 8-year period in the urological theatre of Johannesburg Hospital. Indications for ureteric catheterization should be definite and contributory.

With the advent of more sophisticated and better techniques of intravenous or secretory pyelography (IVP), the tenet that retrograde pyelography must form part of a routine urological 'work-up' is no longer acceptable.

Ureteric catheterization is not without its dangers; however, catheterization of the ureters remains a valuable tool in the hands of the urologist, and is essential in the correct situation. As a method of investigation, it should be considered as highly selective in specific circumstances. This is borne out by the reduced frequency with which this procedure is employed in this department (Fig. 1).

## MATERIAL

Investigative procedures carried out in the departmental urological theatre from 1963 to the end of October 1970 are reviewed. This shows a steady decline of ureteric catheterization in the 8 years under study. The use of ureteric catheterization compared with all procedures showed a steady decline from 45% in 1964 to 10% in 1970. This decrease was not due to any decrease in the volume of work done in the theatre (Fig. 1).

The incidence of infection, anuria and perforation of the ureter in the 172 cases subjected to ureteric catheterization from January 1970 to the end of October 1970 are reviewed and discussed.

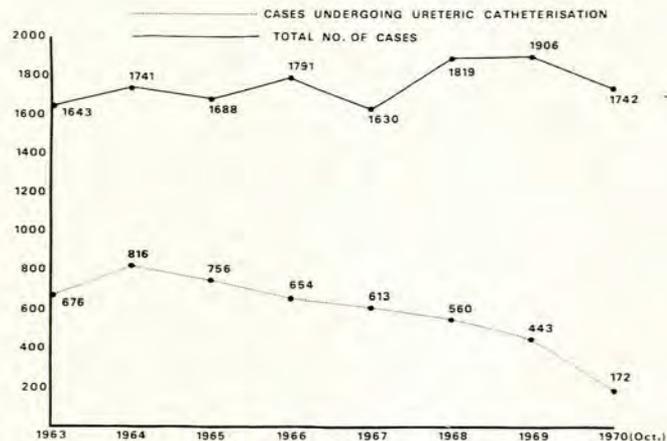


Fig. 1. Cases treated 1963-1970.

## Infection

Five out of 172 cases developed severe and significant postretrograde pyelography infection—an incidence of 3%. All 5 patients developed temperatures of over 101°F and were considered seriously ill.

Cases 1-4 were chronic renal failure patients with a low urinary output, in whom IVP was unsuccessful. *Pseudomonas aeruginosa* was the causative organism, reaffirming the experience that pseudomonas commonly is the causative organism in infections following instrumentation of the urinary tract.<sup>1</sup>

Case 5 was a female in whom the ureters were obstructed due to an extension of cervical carcinoma. The causative organism in this case was *E. coli*.

Vigorous and prolonged antibiotic therapy was required in all these cases to avert a fatal outcome. The incidence of mild infections following this type of instrumentation is not known, as urinary cultures were not

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performed as a routine after retrograde pyelography. Urethral instrumentation, however, is known to be followed by bacteriuria in 4% of patients where the bladder is considered to be normal and in cases of bladder neck obstruction this increases to 30%.<sup>2</sup> Ureteric catheterization compounds the infection of urethral instrumentation by carrying the bacteria into the pelvis of the kidney.

In the 5 patients undergoing retrograde pyelography, the following significant contributory factors were present: (i) a low urinary output (cases 1-4); and (ii) an obstructed upper urinary tract (case 5). Wherever possible, retrograde pyelography should be avoided in these situations. However, if retrograde pyelography is indicated as a diagnostic modality, the operator must be meticulous in its performance, with special care to drain off all radio-opaque material from the upper urinary tract before removing the ureteric catheters, thus removing a stasis factor and a cause of subsequent infection. Passage of ureteric catheters *per se* may cause obstruction (see below) and so predispose to infection.

#### Anuria

Two patients developed postureteric catheterization anuria, giving an incidence of 1%.

*Case 1.* A 78-year-old male had bilateral retrograde pyelography performed, under local anaesthesia, to better delineate the presence of a filling defect which was demonstrated on IVP in the right kidney. Subsequently, the patient developed generalized abdominal pain and was totally anuric for 12 hours. A urethral catheter was introduced into the bladder and the bladder was found to be empty of urine.

Furosemide (Lasix), 40 mg, was given by intravenous injection and 1 litre of 5% dextrose in water was administered intravenously over 1 hour. No response to this therapy was obtained. Five hundred ml of half-normal saline, with 160 mg furosemide, was then administered rapidly with a good response. In the next 24 hours the patient passed 3 500 ml of urine. His subsequent recovery was uneventful.

*Case 2.* A 72-year-old female underwent abdomino-perineal resection for a carcinoma of the rectum. Pre-operatively, both ureters were catheterized in order to facilitate their identification during the operative procedure. The operation was uneventful and without any episodes of hypotension. Postoperatively the catheters were removed, whereupon the patient became totally anuric for 24 hours. A radio-isotope renogram performed at this stage showed only a secretory phase and no excretory phase, this being compatible with obstruction (Fig. 2). After 24 hours of anuria, the patient proceeded to pass blood-stained urine, having received intravenous fluids, mannitol and furosemide. Her blood urea rose from the pre-operative figure of 47 mg/100 ml to 144 mg/100 ml on the fourth postoperative day; subsequently, her urinary output improved and her blood urea level decreased, returning to normal by the twelfth postoperative day.

Twenty-one cases of anuria, following retrograde pyelography, were reported in the literature.<sup>3</sup> This anuria is thought to be due to obstruction following oedema of the ureteral mucosa, after the passage of a ureteric catheter. It has been suggested that the contrast material,<sup>4,5</sup> the catheter sterilizing substance (usually formaldehyde),<sup>4</sup>

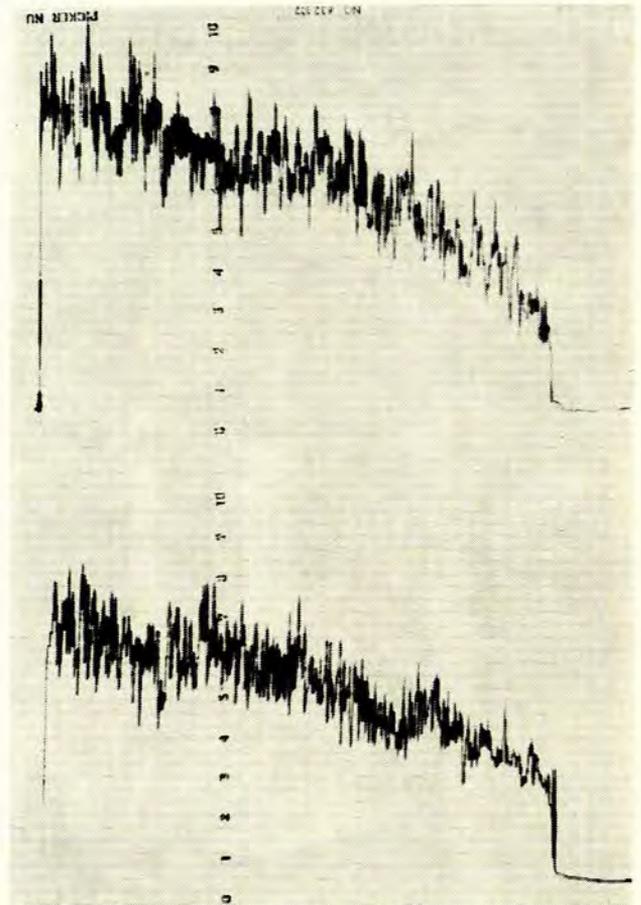


Fig. 2. Radio-isotope renogram showing an obstructive pattern after ureteric catheterization.

or some unknown substance in the catheters could be toxic or allergenic to the ureteral mucosa. Contrast media cannot be invoked as a cause in case 2, as no contrast media was injected. This experience is confirmed by others.<sup>6-9</sup>

Two cases of postretrograde pyelography anuria in which disposable ureteric catheters were used have been brought to our notice.<sup>10</sup> This indicates that factors other than formaldehyde irritation are operative as well.

The cause of the oedema is most likely trauma to the ureteral mucosa.<sup>3</sup> Body tissues rapidly become oedematous as a result of trauma and only minimal circumferential oedema within a closed tube would be necessary to create a complete obstruction.<sup>3</sup>

In cases of postretrograde catheterization anuria where catheters have been reinserted, urine has often passed from the catheters, thus confirming the fact that obstruction was the operative factor.

Hope and Michie<sup>11</sup> demonstrated obstruction after retrograde pyelography in 9 out of 14 children. Cohen *et al.*<sup>12</sup> have shown that in only 1 out of 14 patients catheterized with 7F catheters was a postoperative renogram normal; the remaining renograms all showed an obstructive pattern. Further, it must be borne in mind that septicaemia precipitated by instrumentation can present as anuria, probably as a result of tubular necrosis. No such case

occurred in this series.

In the 21 reported cases of anuria following retrograde ureteric catheterization<sup>3</sup> and in the 2 patients described here, both ureters were catheterized. This was necessary in case 2 and only one of the reported cases. Anuria could have been prevented if only one ureter had undergone catheterization, emphasizing the fact that this bilateral manoeuvre should be reserved for selected cases and not used as a routine. In addition, in order to minimize trauma to the mucosa, the calibre of ureteric catheter used must be as fine as possible.<sup>12</sup>

The treatment of this complication consists of the judicious use of intravenous fluids, electrolytes and diuretic drugs, to overcome the obstructive oedema. The complication is usually responsive to this regimen and more active methods are rarely indicated.

#### *Perforation of the Ureter*

A ureter was perforated in 4 of the 172 patients, an incidence of 2%. No. 5 French ureteric catheters without stylets were used in all cases. The perforations all occurred in the lower third of the ureter and were diagnosed by the extravasation of dye on the pyelogram (Figs. 3 and 4). Three of the ureters were considered to be normal before



Fig. 4. Perforation of a normal ureter.

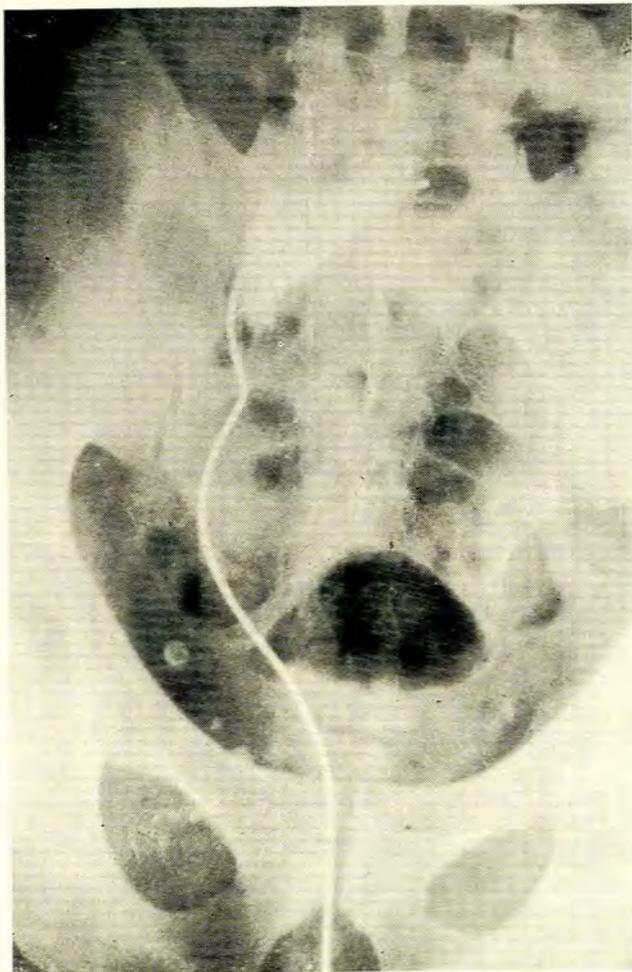


Fig. 3. Perforation of a calculus containing ureter.

perforation and the remaining one perforation occurred in a patient with a ureteric calculus, the site of perforation being just distal to the calculus (Fig. 3). This patient required a ureterolithotomy and the site of perforation was visualized at operation. The remaining three patients were treated conservatively with antibiotics and all made an uneventful recovery.

Perforation of a normal ureter occurs most commonly near the ureterovesical junction and rarely at the ureteropelvic junction. The occurrence of perforation in these areas is probably related to the angulation of the ureter at these points.<sup>13</sup>

A diseased ureter, however, is more prone to perforation than the normal ureter.<sup>13</sup> Other factors which may predispose to ureteral perforation are the use of stylets and bougies, forceful and careless instrumentation, and the exertion of too much pressure on injecting the contrast material.

The majority of cases clear up uneventfully with conservative therapy. However, several deaths from sepsis following perforation of the ureter during attempts at retrograde pyelography have occurred.<sup>14,15</sup> All patients with perforations of the ureter must be admitted to hospital and observed for complications which may develop.

## DISCUSSION

Retrograde pyelography and ureteric catheterization must be considered as a highly selective procedure with definite indications and not used as a common routine procedure. Sophisticated intravenous secretory pyelography has replaced retrograde pyelography as a diagnostic tool in the majority of instances. In addition to demonstrating the anatomy of the collecting system, intravenous pyelography (IVP) has the advantage of reflecting, to some extent, renal function, and also renal parenchymal morphology, which retrograde pyelography cannot do. The whole ureter can be demonstrated on IVP by taking X-ray films with the patient in the prone and supine positions and using lower abdominal compression.

The indications for retrograde pyelography and ureteric catheterization are:

1. The demonstration of renal collecting system morphology.
2. As a preliminary to ureteric calculus extraction with a stone basket.
3. Differential renal function studies.
4. To provide drainage to the obstructed ureter.
5. To provide localization to the ureters in difficult abdominal and pelvic surgery.
6. In patients with iodine sensitivity where IVP is contraindicated.

#### 1. The Demonstration of Renal Collecting System Morphology.

The decision as to when to perform retrograde pyelography should only be made after the performance of preliminary and thorough IVP and a consideration whether retrograde pyelography will be contributory to the diagnosis and management.

Poor renal function is no indication *per se* for omitting intravenous secretory pyelography and performing retrograde pyelography *ab initio*. With large dose contrast material and tomography, it has even been possible to demonstrate renal tract morphology adequately in patients with a serum creatinine level as high as 11.6 mg/100 ml and a creatinine clearance of 8 ml/min.

In this department, retrograde pyelography is thus only reserved for those cases to demonstrate morphology which is not adequately delineated on secretory pyelography. In these circumstances, only unilateral retrograde pyelography may be required.

#### 2. Ureteric Catheterization as a Preliminary to Stone Basket Extraction of a Ureteric Calculus.

Extractions of a ureteric calculus necessitates ureteric instrumentation and as a preliminary manoeuvre it has been found beneficial to pass a Fogarty catheter up to the calculus, inflating the bulb and then dilating the ureter distal to the ureteric calculus by extracting the inflated bulb catheter.<sup>16</sup>

#### 3. Differential Renal Function Studies

In renovascular hypertension, the minute sequence intravenous secretory pyelogram is a good screening and diagnostic test. This and angiography will usually confirm the diagnosis. Differential renal function studies and thus ureteric catheterization are only indicated in these and other cases of renal hypertension in which the diagnosis

is doubtful. Where unilateral nephrectomy is contemplated, split renal function studies will indicate the functional status of the unaffected kidney.

#### 4. Drainage of an Obstructed Ureter

Ureteric catheterization is a useful temporary measure to relieve obstruction in an obstructed ureter or ureters. A ureteric catheter is introduced beyond the site of obstruction and left *in situ* to allow drainage of the affected kidney until more definitive measures can be undertaken.

#### 5. Localization of Ureters in Pelvic and Abdominal Surgery

Where difficulty in localizing the ureters during pelvic or abdominal surgery is anticipated, preliminary ureteric catheterization will aid the surgeon in localizing the ureters. This enables the surgeon to avoid injuring the ureter and will reduce the morbidity associated with such a complication.

#### 6. Iodine Sensitivity

If intravenous secretory pyelography is contraindicated because of iodine sensitivity, retrograde pyelography may be used, in selected cases, to demonstrate renal morphology. A serious systematic reaction to iodine is unlikely during retrograde pyelography.

Lytton *et al.*<sup>17</sup> have shown that, under normal conditions, less than 1% of the contrast material injected during retrograde pyelography appears in the systemic circulation. However, if pyelorenal backflow is present from excessive force used while injecting the contrast material, this increases 12-fold;<sup>17</sup> also, if obstruction is present, there is a substantial increase in the systemic absorption of the contrast material. This can result in a systemic reaction.

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