Pneumatic Lithotripsy: A New Modality for Treatment of Ureteric Stones

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Abstract

Two hundred and twenty ureteric stones in 214 patients were fragmented intracorporeally by pneumatic lithotripsy under general/regional anaesthesia in a day care set-up. Patients were followed-up weekly and retreatment was done at 4 weeks where necessary. Majority (77%) of patients were in the age group 21-40 years with a male to female ratio of 2:1. Stone location was 86% in the lower third, 11% in the middle and 3% in the upper third ureter, Size of stones was less than 6mm in 14%, 7-12mm in 67% and more than 20 mm in 4% cases. All 81% stones of <12 mm were fragmented in one treatment session while single treatment rate for stones 13-18mm was 85% and 44% for more than 20mm size. Overall non-fragmentation rate was 0.9%. Stone free state at four weeks was 95%. Complications were observed in 8.6% cases which included urosepsis, haematuria and perforations. Infrared spectroscopy (IR) in 45 stones showed majority (64%) to be composed of calcium oxalate. Our experience shows that PL is a safe and effective means of performing intracorporeal lithotripsy for both large and hard ureteric stones (JPMA 45:9,1995).

Introduction

The treatment of choice for impacted ureteric stones till the early ‘80s was eitheropen surgery[1] orextractionwithloops or baskets under fluoroscopic control[2]. Today, after the development of in situ extracorporeal shockwave lithotripsy (ESWL) and intracorporeal endoscopic techniques, majority of ureteric stones can be successfully treated by minimally invasive methods[3-5]. Electrohydraulic, ultrasound and laser lithotripsy (LL) have been used in large number of centres[6-8]. Pneumatic lithotripsy (PL) is a relatively new modality of treatment in which stones are fragmented by an osdilary movement ofa 0.8-1 lamda 1mm steel probe against the stone, very much like a jack hammer. Fragmentation is effected mechanically as the device transforms ballistic energy of compressed air into 12-15 shockwaves per minute. This paper describes our experience of treatment of ureteric stones using PL. It highlights its effectiveness and identifies complication encountered in the use of this new modality.

Patients and Methods

Between January, 1993 and April, 1994, two hundred and fourteen patients with 220 ureteric stones were treated by PL. Intravenous urograms were done in all cases fordiagnosis, localization and determination of stone size. Fifty-six cases had either received initial conservative treatment or had failed in situ ESWL. Prior to treatment, complete blood picture, platelets, coagulation profile (PT, APTT), blood urea/creatmine/electrolytes and random blood sugar were performed in all cases. All procedures were carried out under general/regional anaesthesia on a Uroskop urological table (Siemens, Germany) with the facility for fluoroscopic screening. A 0.38mm guide wire was passed prior to insertion of the ureteroscope. A 7 fr ureteroscope (Wolf, Germany) with a straight channel to accommodate the pneumatic probe as well as laser fibre was used in all patients. The ureteric orifice

was dilated by Uretomat (Weist, Germany) which employs hydraulic dilatation of uretenc orifice. Patients were treated by Lithoclast (EMS, Switzerland) with a probe of 1mm. Treatment time and energy varied with the size and location of stones. All treatments were done as a day-care procedure. Post- treatment 4.7 fr uretenc stents were placed whenever the stone burden after fragmentation was large i.e., more than 0.75 mm or when ureteroscopy was difficult causing trauma to the urothelium. Urine collection bags were connected in 54 patients for collection of stone fragments. All patients were followed up routinely at weekly intervals or earlier if indicated. Ultrasound examinations, X-ray KUB and urine culture were repeated as warranted by patients' condition. Patients with inadequately fragmented stones were subjected to subsequent treatment sessions within four weeks of initial treatment. All patients were followed up till stone free. IWU were done at 3 months on selected patients where difficulty during procedures were encountered.
Stone fragments collected from the bags were dried at room temperature and analysed by infrared spectroscopy. About 2-4 mg of fragments were mixed with 200-400 mg of potassiumbromide (KBr) powder andapellet was made under 8 ton pressure and scanned from 4,000-6,000 cm -1 in an infrared spectrophotometer (Shimadzu, Japan). Scans obtained were compared to characteristic spectra of known compounds and compound mixtures.

Results

Two hundred and fourteen patients were treated for 220 ureteric stones by pneumatic lithotripsy. Majority, i.e., 170 (77.2%) of the patients were inthe age group 21-40 withapeak age of 31-40 years. The male to female ratio was 2:1 (Figure 1).

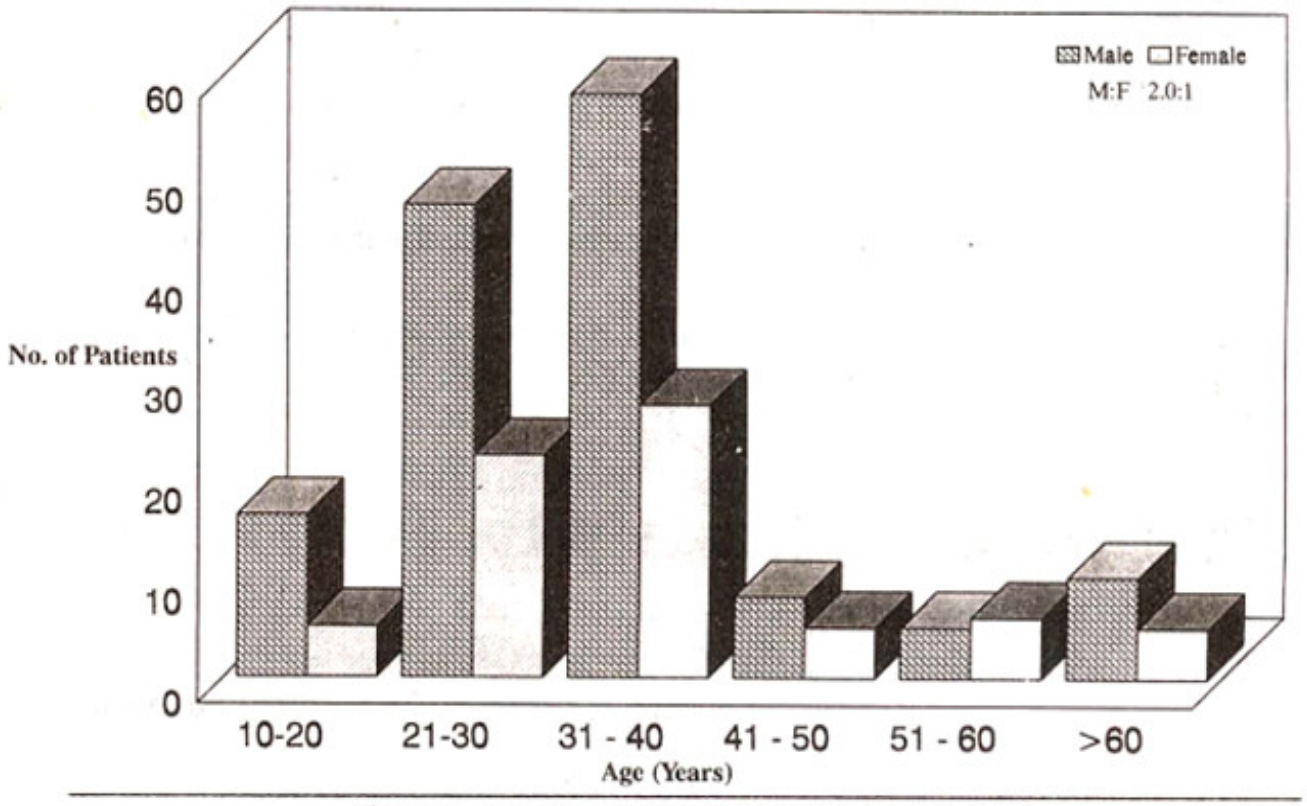

Figure 1. Age and sex distribution of patient population.

One hundred and ninety (86.3%) stones were in the lower third, twenty-four (10.9%) in the middle third and six (2.7%) in the upper third of the ureter.

Of the stones treated, 148 (67.2%) were 7-12mm in size, 30 (13.6%) <6mm and 15% more than 13 mm (Table I).

Table I. Size distribution of ureteric stones.

Size (mm)	Number (n=220)	% of total
≤6	30	13.6
7-12	148	67.3
13-18	33	15

One hundred and seventy-eight (8 1%) stones of <12 mm were successfully treatedinonetreatmentsessionwhile 44%stones of>20 mm required one and 44% two sessions. Eleven percent stones did not fragment.

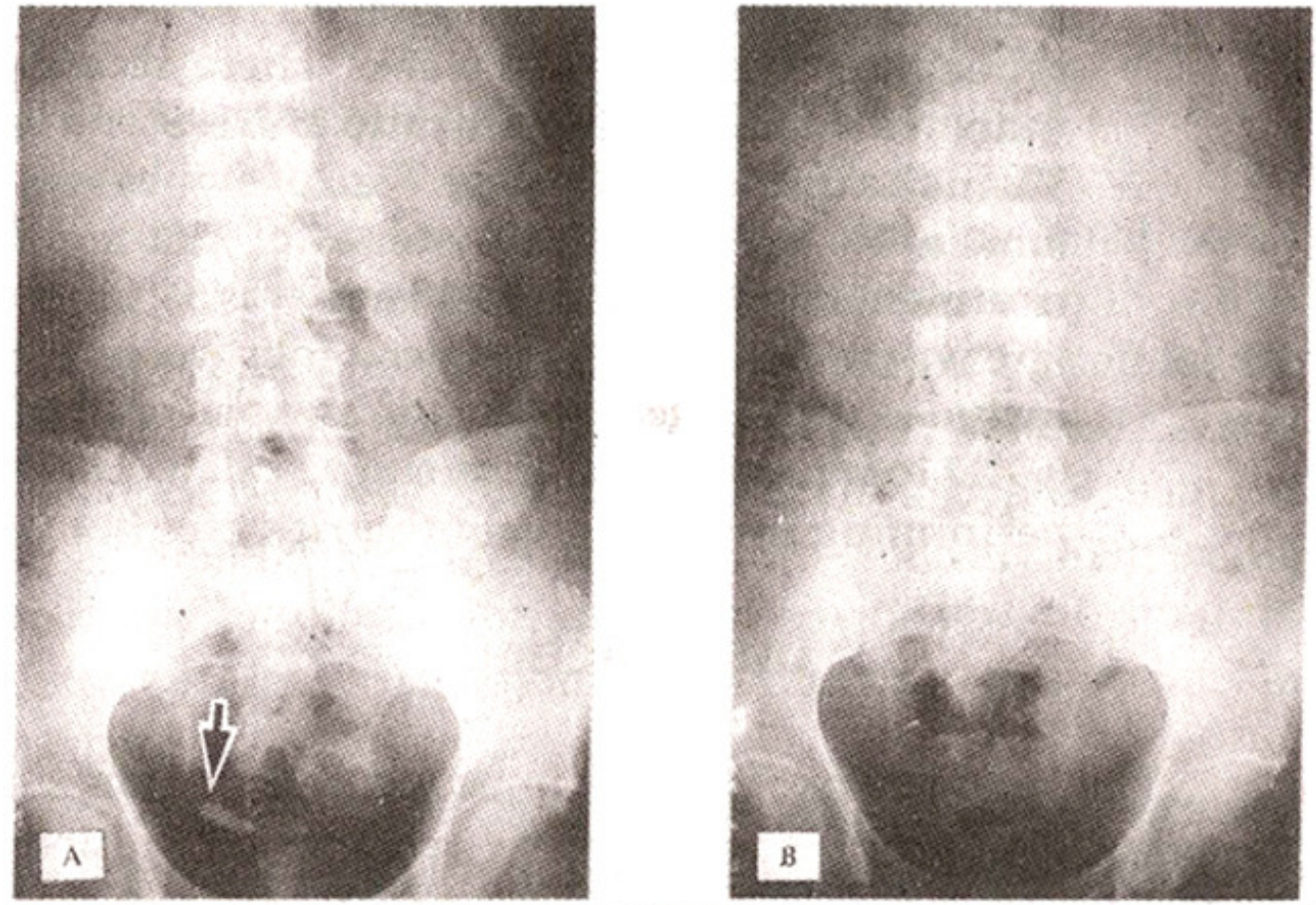

Figure 2 (A). Shows a 2 cm lower ureteric stone. Figure 2 (B). Shows stone free status of the same patient after fragmentation.

Figure 2 shows the fragmentation of lower ureteric stones. Overall non-fragmentation rate was 0.9% (Table II).

Table II. Overall results of pneumatic lithotripsy of ureter stones.

Results	Number	% of total (n=220)
Non-fragmentation	2	0.9
Fragmentation one session	209	95
Fragmentation two sessions	8	3.6
Fragmentation three sessions	1	0.4
Stones free status <4 weeks	209	95
>4 weeks	9	4.1

Stone free states at four weeks or less was 95%. Two stones not fragmented by PL were subjected to ureterolithotomy. These stones could not be fragmented because of trauma to the ureter on ureteroscopy causing poor visualization of calculi. Therefore, the procedure was abandoned. Infrared spectroscopic analysis of stone fragments was done in52 stones. Thirty-three (63.4%)stoneswere composed of calcium oxalate monohydrate. The frequency of other stone types, either pure or in combination with other compounds, were struvite 23%, uric acid 21.1% and apatite 15.3%. Average treatment time was 12 minutes with a range of 10-15 minutes. Average energy for small to medium stones was 85 MJ while that for large was 95 MJ. Overall complications were observed in ninteen (8.6%) patients (Table III).

Table III. Complications following pneumatic lithotripsy.

Complications	Number	% of total (n=220)
Urosepsis	8	3.6
Haematuria	7	3.2
Perforations	4	1.8
Total	19	8.6

Discussion

In the last decade, electrohydraulic, ultrasound and more recently laser lithotripsy have been used in increasing large numbers of patients for treatment of ureteric stones with better results[9]. Pneumatic lithotripsy is the most recent modality in the armamentarium for treatment of ureteric stones[10]. The laser and pneumatic lithotripsy, two of the most promising methods in West, have followed the use of electrohydraulic and ultrasound lithotripsy. Both laser and pneumatic lithotripsy have become available

in our centre recently and this report is the first experience of the PL in the clinical settings of a developing country situated in the Afro-Asian stone belt. Age and sex distribution of the patients in the present study is a representative of our stone former population[11]. This is generally in agreement with other workers from the West, who found a mean age of 40-45 years[12]. PL was used in the treatment of uretenc stones predominantly in the middle and lower ureter. The main indication for treatment of uretenc stones was failure of conservative management in the presence of symptoms or patients with a failed in situ ESWL. Sometimes, failure of ancillary procedures to dislodge the stone were considered an indication for intracorporeal iithotripsy. There is broad consensus amongst workers in the use of in situ ESWL for upper ureter stones where results are rewarding[3,9] and our own experience has been similar. In the middle ureter, we have treated 24 patients and here too, the first option was in situ ESWL. More than three fourths of the patients had stone lodged in the lower third of the ureter. PL offered good results with complete fragmentation rate of 95% in one session in this series making it a very suitable option. It has been observed that smaller stones are likely to impact in the pelvic ureter resulting in obstruction to the affected renal unit. It is here that uretemscopic methods, particularly with the use of PL, holds great promise as a day care procedure. Not only does this save costs of hospitalizationbut the patient can resume work in two to three days time. Under direct vision PL has shown good results at fragmenting ureteric stones and was able to fragment virtually all stones (99%) ma single treatment session. It has, therefore, become the treatment of choice in our setting for larger and harder ureteric stones due to increased success of fragmentation in the first session. However, the fragments post-PL are large and tend to advance upwards due to the irrigants' pressure and this requires turning down the flow orchasing the fragments in the proximal ureter before disintegrating them further to facilitate their downward course.

The use of stents in our series has shown several advantages. They have made intracorporeal lithotripsy as a day care pmcedure. They were used in patients with larger stone burden or in those who had a difficult procedure and also employed in patients coming from long distances especially from rural areas where access to medical care is not satisfactory. They prevented obstruction in the post-treatment period permitting the patient to go home early. This is corroboratedby our study of the use of ureteric stents in relation to ESWL[13]. In the present series the complications are marginally higher than what has been observed by other[10]. This may be reflection of a higher pmportion of larger stones as well as a greater percentage of calcium oxalate monohydrate stones in our series. The advantages of this device include its simplicity, reliability and ease of use. The generating medium-compressed air is readily available in hospitals and the lack of disposable components make it attractive in terms of costs. In conclusion, PL offers safe and effective stone clearance rendering majority of the patients stone free in one sitting.Discussion

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