Urol Res (2010) 38:417–420
DOI 10.1007/s00240-010-0285-2

ORIGINAL PAPER

Sciaticum majus foramen and sciaticum minus foramen as the path of SWL in the supine position to treat distal ureteral stone

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Received: 26 February 2009 / Accepted: 11 June 2010 / Published online: 13 July 2010

Abstract The purpose of the study is to evaluate the efficacy and safety of shock wave lithotripsy (SWL) using sciaticum majus foramen and sciaticum minus foramen as the path to treat distal ureteral stone in supine position. Between December 2006 and November 2008, 243 cases of distal urinary calculi were treated in our department using SWL or ureteroscopy. 189 cases for SWL were treated in supine position. The shockwave target on the stone in distal ureter via sciaticum majus foramen and sciaticum minus foramen, avoiding the sacroiliac joint. 54 cases were underwent ureteroscopy combined with holmium:YAG laser lithotripsy. The stone-free rate and the efficacy quotient (EQ) for SWL and ureteroscopy was 81.5%, 0.68; 94.4%, 0.78; respectively ($p = 0.02$). The retreatment rate for SWL and ureteroscopy was 14.6%, 0, respectively. The number of the shocks ranged from 600 to 3,000 (mean 2,566.3 ± 378.8). The energy per pulse of SWL ranged from 8 to 12 kV (mean 10.7). SWL in the supine position using sciaticum majus foramen and sciaticum minus foramen as the path is a choice of the treatment of distal ureteral stones with an excellent success rate and low side effect.

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Keywords Shockwave lithotripsy · Supine position · Distal ureteral stone · Ureteroscopy

Introduction

Although Shockwave lithotripsy (SWL) has revolutionized the treatment of urinary calculi since 1980s and most of urinary tract stones can be treated nowadays with this method [1]. The fast stone-free rate for ureterorenoscopy (URS) and the often needed retreatments after SWL has led to a new discussion about the optimal treatment for distal calculi. The use of ureteroscopy with Ho:YAG laser lithotripsy is quite acceptable for ureteral stones in recent years [3]. However, compared with the invasive treatments, SWL offers many advantages including shorter hospitalization, more rapid recovery, lower complication rate and easier retreatment.

Prone position is widely used for SWL in adult distal ureteral stones [2, 3]. It has been reported that SWL with the patient prone is a safe and effective form of treatment for calculi in the distal ureter [4], the supine position seldom is used for SWL to treat the distal ureteral stone, because the blockage of shock waves by the bony pelvis reduces the efficacy of SWL as performing the supine position. If we can find a path from bony pelvis which the shock wave can enter to the stone, the supine position can be performed for SWL to treat the distal ureteral stone. In fact, the sciaticum majus foramen and sciaticum minus foramen is bone gap of bony pelvis. The section of distal ureteral may be showed in the gap from the posterior position view. We can use the bone gap in the supine position as the path of shock wave and enable shock wave to reach the stone.

In this study, we analyzed the efficacy and safety of SWL using sciaticum majus foramen and sciaticum minus

foramen as the path to treat distal ureteral stone in supine position.

Patients and methods

Study inclusion criteria included radio-opaque calculi in the distal ureter treated with in situ SWL or ureteroscopy combined with holmium:YAG laser lithotripsy as primary therapy between December 2006 and November 2008. A total of 243 patients were entered into the study. We considered the distal ureter as the section of ureter between the distal edge of the sacroiliac joint and ureterovesical junction. Stone size was registered as the maximum diameter measured on a plain abdominal film. Plain roentgenogram for the kidneys, ureters, and bladder, renal ultrasonography, intravenous excretory urogram (IVU), or a combination of these was used to diagnose, locate and define the stone burden.

Patients were preoperatively evaluated with a history, physical examination, image system (including a plain roentgenogram for the kidneys, ureters, and bladder, ultrasound and intravenous excretory urogram). Preoperative laboratory evaluation included urinalysis, urine culture, coagulation profile, serum creatinine level and complete blood count. Patients with a known urinary tract infection received specific antimicrobic culture before SWL until the urine culture turned to negative.

One hundred and eighty-nine cases for SWL (Xixin Compact lithotripter; electromagnetic lithotripter, China) were treated in supine, the sciaticum majus foramen and sciaticum minus foramen was used as the path of shock wave (Figs. 1, 2). Fluoroscopic guidance was used for stone location. The table position was adjusted to ensure the stone is in the focal zone. The data were analyzed with respect to stone parameters and treatment characteristics. Stone parameters include location, size, and number of stones; treatment characteristics include energy level, number of shock waves, and number of SWL sessions, and auxiliary procedures.

Fifty-four cases were underwent ureteroscopy. Ureteroscopy combined with holmium:YAG laser lithotripsy was performed by a single urologist using a small caliber 8.5Fr semirigid (Wolf, Knittlingen, Germany). The holmium:YAG laser operates at a wavelength of 2,100 nm and laser frequency was usually set between 5 and 10 Hz at a power of 10–15 W. For lithotripsy, 365-mm laser fibres were used, and the laser generator was a Pulse Select (20 W Dornier Medical Systems, Germany). Continuous irrigation and/or intermittent manual pumping of irrigant were done to maintain a clear ureteroscopic view when appropriate.

Average patient age, the male-to-female ratio and stone size were similar between the 2 groups (Table 1). Also, there was no statistically significant difference between the groups in the time from diagnosis to treatment. The stone-free rates (SFRs), defined as the complete absence of stone fragments were determined using KUB film with or without ultrasonography in 2 weeks and 3-months. Treatment failure was defined as radiologically confirmed persistence of the stone with no fragmentation after three SWL sessions. A complication, which have related to SWL or ureteroscopy during the intraoperative or post operated periods, were recorded.

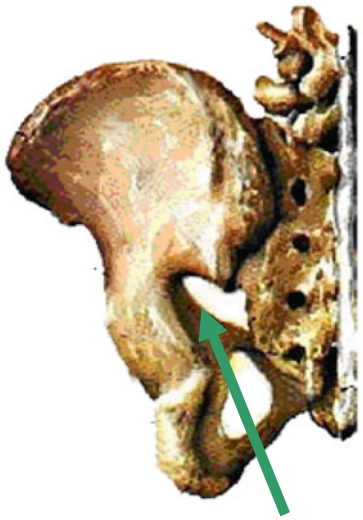

Fig. 1 Sciaticum majus foramen and sciaticum minus foramen

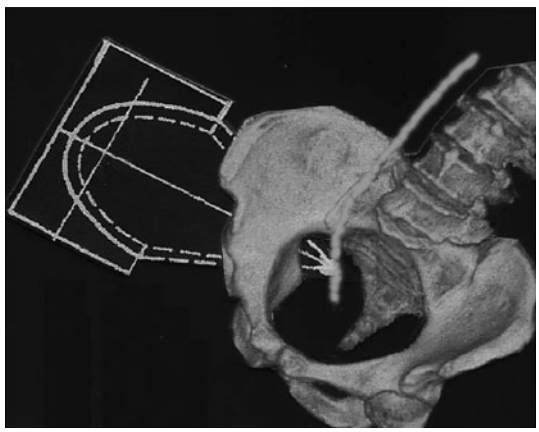

Fig. 2 The path of SWL to treat distal ureteral stone

Table 1 Patient date

Treatment	*n*	Patient age range (mean)	Male:female	Maximum stone size range (mean)
SWL	189	20–65 (37.3)	1:0.81	5–16 (11.3)
URs	54	23–61 (35.7)	1:0.64	5–15 (11.9)

The efficiency quotient (EQ) was calculated using the formula: percentage stone free × 100/(100 + retreatment rate in percentages + auxiliary procedures in percentages).

Results

The stone-free rate and the efficacy quotient (EQ) for SWL and ureteroscopy was 81.5%, 0.68; 94.4%, 0.78, respectively ($p = 0.02$). The retreatment rate for SWL and ureteroscopy was 14.6%, 0, respectively. The number of the shocks ranged from 600 to 3,000 (mean 2,566.3 ± 378.8). The energy per pulse of SWL ranged from 8 to 12 kV (mean 10.7).

No serious intraoperative complications, including ureteral avulsion, intussusceptions, perforation, false passage, mucosal abrasion, extravasations and thermal injury developed in ureteroscopy group. No intraoperative or postoperative serious complications developed in SWL group. Patients had minor complications, e.g., self-limiting haematuria, dysuria and pain that responded to oral analgesics.

Discussion

Prospective studies have also evaluated the optimal treatment modality for distal stones [1–5]. SWL and URS are regarded as effective modalities with low complication rates for larger or persisting stones [3]. Since the holmium:YAG laser was introduced into practice in the early 1990s. It has now become the most accepted form of ureteroscopic lithotripsy [3]. The holmium:YAG laser has successfully fragmented all types of urinary calculi regardless of composition. The successful fragmentation of ureteral stones is reported in 91–100% of cases, with a mean stone-free rate of 95% [17].

Extracorporeal shock wave is the least invasive and most widely accepted form of treatment for ureteric stones [5–8]. It has been estimated that the success rate of SWL for distal ureteral calculi varies greatly, ranging from 54 to 99% and re-treatment rates ranging from 0 to 46% [3, 18, 19]. Auxiliary procedures are necessary in up to 41% after SWL [20]. American Urological Association Ureteral Stones Clinical Guidelines Panel reported that, for distal ureteral stones, the success rate of SWL has been 85 and 76% for stones 10 mm or less and greater than 10 mm, respectively [5]. Our overall stone-free rate was similar to those reported in the literature. The stone-free rate and the efficacy quotient (EQ) for SWL and ureteroscopy was 81.5%, 0.68; 94.4%, 0.78, respectively.

The position of the patient under SWL treatments generally depended on the approach of the shockwave. Most of shockwave generators of present lithotripters are undertabled and the blockage of shock waves by the bony pelvis can reduces the efficacy of SWL in the supine position, so prone position is widely used in the SWL treatment of distal ureteral stones [9]. It has been reported that SWL with the patient in prone position is a safe and effective form of treatment for calculi in the distal ureter [8–11]. Although the prone position is used in SWL to treat the distal ureteral stone currently, many different body positions for SWL have been attempted to improve efficacy. Some authors [12, 13] believe that supine positioning is cost effective, has low morbidity and prone positioning carries the risk of small intestinal perforation. Meanwhile, the patient who has enough urine in bladder will have stronger feeling of the emiction in the prone position when performing SWL, it will affect the procedure of SWL.

Becht et al. [14] treated 39 cases of distal ureteric stones using SWL with the patient supine and the pelvis nearly horizontal, which allowed X-rays and shock waves to enter through the foramen obturatum or the greater sciatic notch; the authors reported a 95% success rate. Miller et al. [15] reported that the 133 patients with distal ureteral stone were treatment with SWL using the sitting position. Treatment was successful in 125 patients (94%). Ackaert et al. [16] reported that the 'straddle' (horse-riding) position was successful in 89% with distal ureteric stones. SWL of the distal ureteral stones in the prone position seems to have an associated patient morbidity when Guntekin [13] compare the results of treatment performed in prone position and the supine position via the obturaor.

For successful localization of stones, it must adjust the focal zone of the lithotripter in an anatomical window where bony structures did not interfere with the application of shock waves. The sciaticum majus foramen and sciaticum minus foramen is bone gap of anatomical window. The section of distal ureteral may be showed in the gap of bony pelvis; we can use the bone gap as the path of shock wave in supine for avoiding the interference of sacroiliac joint. When distal ureteral stone was treated by SWL in supine position, the stone localization of fluoroscopic guidance can adopts the standard postero-anterior position. The stone seldom lap over skeleton in the standard postero-anterior fluoroscopic guidance, it also accord with the doctor's work habit. Supine position for fluoroscopic guidance seems to be more simple and reasonable.

Conclusion

SWL in the supine position using sciaticum majus foramen and sciaticum minus foramen as the path is a choice of the treatment of distal ureteral stones with an excellent success rate and low side effect.

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