Extracorporeal Shock Wave Lithotripsy in Prone and Supine Positions for Patients with Upper Ureteral Calculi

Ali Afshar Zomorrodi, Amirreza Elahian, Nematollah Ghorbani, Anahita Tavoosi

Introduction: The aim of this study was to evaluate the treatment of upper ureteral calculi with extracorporeal shock wave lithotripsy (SWL) in the supine and prone positions.

Materials and Methods: A total of 68 patients with upper ureteral calculi underwent SWL. In 35 patients, the procedure was performed in the supine position (group 1), while in the 33 remainders, it was performed in the prone position (group 2). The stone-free rate, the number of SWL sessions required, and the number of shocks per treatment session were compared between the 2 groups.

Results: The mean calculus size was 12.4 ± 3.1 mm and 12.2 ± 2.9 mm in groups 1 and 2, respectively. The stone-free rate was 81.8% in group 1 and 82.9% in group 2 ($P = .91$). The number of sessions for achieving the stone-free status was similar in the patients of the 2 groups (1.9 ± 0.8 in group 1 versus 1.9 ± 0.8 in group 2; $P = .79$). The mean number of shock waves per treatment session was not significantly different between the 2 groups. No major complications were seen and none of the patients required hospitalization, placement of a ureteral catheter, or a double-J stent.

Conclusion: Our study showed that in the prone position, treatment of the upper ureteral calculi by SWL is as safe and effective as the supine position.

Keywords: extracorporeal shock wave lithotripsy, upper ureter, urinary calculi, therapy

Urol J (Tehran). 2006;3:130-3.
www.uj.unrc.ir

INTRODUCTION

Since its initial application in 1980,[1] the indications for extracorporeal shock wave lithotripsy (SWL) have rapidly expanded from the kidney calculi to almost all urinary calculi. However, the overall stone-free rates after SWL vary from 50% to 87% depending on many factors.[2,3] Stone clearance rate after SWL is influenced by the size, location, and chemical composition of the calculus as well as the type of the lithotripter. Coz and coworkers[3] analyzed the outcome of SWL in 2016 urinary tract calculi regarding the site of the calculus. Stone-free rates of the lower caliceal calculi and the middle or upper ureteral calculi are less than the overall stone-free rate. Limitations in each part of the ureter have urged investigation of the best patient position during SWL. Some modifications in patient positioning, such as placement in the prone position proposed by Jenkins and Gillenwater, allow a safe and effective fragmentation of the lower ureteral calculi.[4,5] This approach reduces the negative effect of the pelvic bones on the power transduction of the shock waves to the target.[6]

Department of Urology, Imam Komeini Hospital, Tabriz University of Medical Sciences, Tabriz, Iran

Corresponding Author:
Ali Afshar Zomorrodi, MD
Imam Khomeini Hospital,
Tabriz, Iran
Tel: +98 914 114 7229
E-mail: dr_afshar@hotmail.com

Received March 2006
Accepted July 2006

Concerning the calculi of the upper ureter, guidelines of the American Urological Association (AUA) state that SWL, percutaneous nephrolithotomy, and ureteroscopic lithotripsy are all acceptable choices for the calculi of 1 cm and larger in adults.[7] However, the best position for an optimal SWL is still a controversy. Some authors believe that the supine position, the current preferred approach, is cost-effective and has a low morbidity rate,[8,9] but the transverse processes of the vertebrae adjacent to the upper ureter intervene with transmission of the shock wave.[6] Few studies have been carried out to compare different positions for SWL of the upper ureteral calculi.[10,11] While the prone position may bring about a superior outcome, its potential complications such as perforation of the small intestine must be regarded.[9,12,13] We evaluated the outcome of SWL in the patients with upper ureteral calculi sized 1 cm to 2 cm in the supine and prone positions.

MATERIALS AND METHODS

Between November 2003 and July 2004, a total of 68 patients with solitary upper ureteral calculus were treated by SWL in the supine or prone positions. The location of the calculus was confirmed by intravenous urography or plain abdominal radiography. Upper ureteral calculi were defined as those located between the ureteropelvic junction and the upper border of the sacrum. Patients with calculi in other parts of the urinary tract and the ones with calculi smaller than 10 mm or larger than 20 mm were excluded from the study. Assignment of the patients in either of the groups was done according to the surgeon's decision; if the stone targeting was possible in the supine position, the patient was treated in this position (group 1), and if it was not possible in the supine position, the patient was treated in the prone position (group 2). The patients provided informed consent before the procedure.

Lithotripsy was performed by Lithostar (Siemens, Erlangen, Germany) under fluoroscopic targeting. Two weeks later, a plain abdominal x-ray was taken to assess the fragmentation of the calculus. If no calculus was detected or the residual fragments were 5 mm in diameter or smaller at this stage, the patient would be considered stone free and was asked to return 3 months later for control radiography. If any calculus material larger than 5 mm was revealed, SWL was repeated. This procedure would be performed up to 3 times, if needed.

The calculus size, number of shock waves per treatment sessions, and number of sessions required for achieving the stone-free status were recorded. Calculus size was registered as the maximum diameter measured on plain abdominal radiography. The patients were followed up for at least 3 months and complications were evaluated. The results were analyzed using the Student *t* test, Mann-Whitney test, and chi-square test, and a *P* value of less than .05 was considered statistically significant.

RESULTS

Of 68 patients who were studied, 47 (69.1%) were men with an age range of 18 to 81 years, and 21 (30.9%) were women aged 24 to 78 years. Size of the calculus was 10 to 15 mm in 55 patients (80.8%) and larger than 15 mm in 12 (19.2%). There were 33 patients in group 1 and 35 in group 2. The mean calculus size was 12.4 ± 3.1 mm and 12.2 ± 2.9 mm in groups 1 and 2, respectively. There were no differences in the age, sex, and calculus size between the 2 groups (Table).

Overall, 56 patients (82.4%) became stone free. The stone-free rate was 81.8% in group 1 and 82.9% in group 2 ($P = .91$). The number of sessions for achieving the stone-free status was similar in the patients of the 2 groups (1.9 ± 0.8 in group 1 versus 1.9 ± 0.8 in group 2; $P = .79$, Mann-Whitney test). The mean number of shock waves applied per treatment session was not significantly different between the 2 groups. The clinical characteristics of the patients are demonstrated in Table.

The patients in both groups had minor complications such as self-limiting hematuria, dysuria, and pain (responding to oral analgesics). None of the patients required hospitalization, placement of a ureteral catheter, or a double-J stent.

DISCUSSION

Treatment of the urinary tract calculi has been changed by SWL during the recent 15 years.[10,14] Today, SWL is widely accepted; while, many urologists criticized it when this innovative technique for extracorporeal fragmentation of the kidney calculi

Clinical and Demographic Characteristics of the Patients Who Underwent SWL in Supine and Prone Positions*

Characteristics	Group 1 (Supine)	Group 2 (Prone)	*P*
Age, y	46.1 ± 16.3	43.6 ± 16.8	.54
Sex			.49
Male	22 (66.7)	26 (74.3)	
Female	11 (33.3)	9 (25.7)	
Calculus size, mm	12.4 ± 3.1	12.2 ± 2.9	.71
In stone-free cases	12.0 ± 3.2	11.4 ± 2.4	.46
In failed cases	14.3 ± 2.3	15.8 ± 2.3	.31
Stone-free patients	27 (81.3)	29 (82.4)	.91
No of SWL Sessions			.90
1	12 (36.3)	13 (37.2)	
2	11 (33.4)	13 (37.2)	
3	10 (30.3)	9 (25.6)	
Shocks per treatment session	6018.2 ± 2857.4	5768.6 ± 3104.2	.73

*Values are shown as means ± standard deviations unless otherwise numbers (percents). SWL indicates shock wave lithotripsy.

was presented in 1983 by Chaussy.[10] Nowadays, there are almost 5500 lithotripters throughout the world.[5] Shock wave lithotripsy is reportedly effective and safe in 98% of patients.[11,15] Nevertheless, long-term complications and its effect on the reduction of the relapses are still a matter of debate.[16,17] Ureteral calculi located above the iliac crest can primarily be candidates for treatment with SWL. According to the Guidelines of the American Urological Association, SWL, percutaneous nephrolithotripsy, and ureteroscopic lithotripsy are all effective for treating adults with upper ureteral calculi larger than 1 cm.[7] Among these techniques, SWL is the least-invasive and most popular one. However, the optimal position for SWL of upper ureteral calculi is still a controversy. The supine position is cost-effective and has a low morbidity rate, while the prone position is accompanied by an increased risk of complications and radiation exposure.[8,9,12,13] Bowel perforation during SWL in the prone position has been reported in a few cases of SWL for calculi in different parts of the urinary tract.[9,12,13] Furthermore, it has been shown that the number of treatment sessions per patient, number of shock waves per treatment sessions, shock voltage per session, and fluoroscopy time per session are significantly lower in the supine position than in the prone.[8,18,19] In a study on 96 patients with upper urinary tract calculi, Goktas and colleagues observed that the patients generally tolerated the supine position better. Discomfort on inspiration and expiration and pain localized to the lumbar vertebrae were seen among patients in the prone position. The mean session number per patients was 1.64 ± 0.75 in the supine group and 1.33 ± 0.59 in the prone group ($P = .22$).[8]

Our study failed to show any differences in the numbers of the shock waves and sessions between the supine and prone positions while SWL. In addition, we found no remarkable complication during or after the procedure. It is speculated that the transverse processes of the vertebrae adjacent to the upper ureter intervene with shock wave transmission when SWL is performed in the conventional supine position.[6] Some authors believe in the effectiveness of the prone position, but they have mostly evaluated calculi of the other parts of the ureter.[4,19-21] Ahlawat and colleagues evaluated ureteral calculi in 107 renal units treated by lithostar lithotripter. The overall satisfactory clearance was unaffected by the position of the patient during treatment.[19] Also, a prone position has been suggested mostly for the distal ureteral and presacral calculi.[20,21]

We found that the stone-free rate is acceptable in the patients of group 2, and there was no difference between the 2 groups in this regard. Goktas and colleagues showed that the stone-free rates 3 months after SWL were 88.3% and 90.6% in the supine and prone groups, respectively ($P > .05$).[8] Thus, it seems that SWL in the prone position is as effective as that in the supine position, but the complications require to be investigated more. We could not provide a randomized study and the number of patients participated was limited. However, our findings are indicative of that the prone position can be a good alternative. Other positions such as semilateral prone and supine have also been studied.[6] A comprehensive large study is suggested to compare

all the possible positions and draw a definite conclusion regarding the efficacy and safety of SWL.

CONCLUSION

Our findings showed that the treatment of upper ureteral calculi by SWL in the prone position is as safe and effective as the supine position. However, concerns about the complications and costs warrant further studies. Moreover, the patient's preference can influence the decision made by the surgeon. Overall, where required, we can attempt the prone position in the SWL of the upper ureteral calculi.

CONFLICT OF INTEREST

None declared.

REFERENCES

1. Chaussy C, Brendel W, Schmiedt E. Extracorporeally induced destruction of kidney stones by shock waves. Lancet. 1980;2:1265-8.
2. Rüffer JH, Prikler L, Ackermann DK. Factors of fragment retention after extracorporeal shockwave lithotripsy (eswl). Braz J Urol. 2002;28: 3-9.
3. Coz F, Orvieto M, Bustos M, et al. Extracorporeal shockwave lithotripsy of 2000 urinary calculi with the modulith SL-20: success and failure according to size and location of stones. J Endourol. 2000;14:239-46.
4. Jenkins AD, Gillenwater JY. Extracorporeal shock wave lithotripsy in the prone position: treatment of stones in the distal ureter or anomalous kidney. J Urol. 1988;139:911-5.
5. Tombolini P, Ruoppolo M, Bellorofonte C, Zaatar C, Follini M. Lithotripsy in the treatment of urinary lithiasis. J Nephrol. 2000;13:71-82.
6. Hara N, Koike H, Bilim V, Takahashi K, Nishiyama T. Efficacy of extracorporeal shockwave lithotripsy with patients rotated supine or rotated prone for treating ureteral stones: a case-control study. J Endourol. 2006;20:170-4.
7. Segura JW, Preminger GM, Assimos DG, et al. Ureteral Stones Clinical Guidelines Panel summary report on the management of ureteral calculi. The American Urological Association. J Urol. 1997;158: 1915-21.
8. Goktas S, Peskircioglu L, Tahmaz L, Kibar Y, Erduran D, Harmankaya C. Is there significance of the choice of prone versus supine position in the treatment of proximal ureter stones with extracorporeal shock wave lithotripsy? Eur Urol. 2000;38:618-20.
9. Kurtz V, Muller-Sorg M, Federmann G. Perforation of the small intestine after nephro-uretero-lithotripsy by ESWL—a rare complication. Chirurg. 1999;70:306-7.
10. Chaussy C, Schmiedt E, Jocham D, Brendel W, Forssmann B, Walther V. First clinical experience with extracorporeally induced destruction of kidney stones by shock waves. J Urol. 1982;127:417-20.
11. Lingeman JE, Woods J, Toth PD, Evan AP, McAteer JA. The role of lithotripsy and its side effects. J Urol. 1989;141:793-7.
12. Kajikawa T, Nozawa T, Owari Y, et al. [Bowel perforation after extracorporeal shock wave lithotripsy: a case report]. Nippon Hinyokika Gakkai Zasshi. 2001;92:586-8. Japanese.
13. Rodrigues Netto N Jr, Ikonomidis JA, Longo JA, Rodrigues Netto M. Small-bowel perforation after shockwave lithotripsy. J Endourol. 2003;17:719-20.
14. Drach GW, Dretler S, Fair W, et al. Report of the United States cooperative study of extracorporeal shock wave lithotripsy. J Urol. 1986;135:1127-33.
15. Wilson WT, Preminger GM. Extracorporeal shock wave lithotripsy. An update. Urol Clin North Am. 1990;17:231-42.
16. Chaussy CG, Fuchs GJ. Side effects and complications of extracorporeal shock-wave lithotripsy. Curr Opin Urol. 1993;3:323.
17. Tolley DA, Downey P. Current advances in shock wave lithotripsy. Curr Opin Urol. 1999;9:319-23.
18. Guntekin E, Kukul E, Kayacan Z, Baykara M, Sevuk M. Morbidity associated with patient positioning in extracorporeal shock wave lithotripsy of distal ureteral calculi. Int Urol Nephrol. 1994;26:13-6.
19. Ahlawat RK, Bhandari M, Kumar A, Kapoor R. Treatment of ureteral calculi with extracorporeal shock wave lithotripsy using the Lithostar device. J Urol. 1991;146:737-41.
20. Amiel J, Touabi K, Peyrottes A, Toubol J. [Extracorporeal piezoelectric lithotripsy in the treatment of calculi of the ureter. Apropos of a series of 143 cases]. Ann Urol. 1990;24:135-9. French.
21. Jenkins AD. Dornier extracorporeal shock-wave lithotripsy for ureteral stones. Urol Clin North Am. 1988;15:377-84.