A comparison of extracorporeal shock wave lithotripsy and ureteroscopy under intravenous sedation for the management of distal ureteric calculi

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Introduction: *We have performed a study to compare shock wave lithotripsy (SWL) and ureteroscopy under intravenous sedation for the management of distal ureteric calculi.*

Materials and method*s: Patient tolerance, procedure times and treatment outcomes were prospectively evaluated in 110 patients undergoing 138 SWL treatments, and 172 patients undergoing ureteroscopy under intravenous sedation for the management of distal ureteric calculi.*

Results: *Men tolerated SWL better than ureteroscopy. Over 90% of women tolerated both procedures well. Procedure times were 52 minutes for SWL and 27 minutes for ureteroscopy. Treatment was successful in 72% of patients undergoing SWL, and 95% of patients undergoing ureteroscopy.*

Conclusions: *In women with distal ureteric calculi requiring treatment, we recommend ureteroscopy under intravenous sedation as the treatment of first choice. In men the better tolerance of SWL must be weighed against the higher success rate of ureteroscopy. If both treatment modalities are available, patients with small distal ureteric calculi, in whom ureteroscopy is likely to be successful, should be informed of and offered their choice of either treatment modality.*

Key Words: ureter, calculus, ureteroscopy, lithotripsy, colic, sedation

Remembrance

It is difficult in a few short sentences to pay adequate tribute to a close friend who had such a major impact on my life and career. I first met Ernie Ramsey while a junior resident in general surgery. He gave a presentation on testis cancer. His enthusiasm and control of his topic were an important factor in my decision to pursue a career in urology.

Ernie excelled as an academic urologist. He was knowledgeable and intelligent. He had the ability to take knowledge and apply it logically and appropriately to patient care. He had a passion for teaching and a talent for it. Throughout his career in Manitoba, his leadership in terms of urological knowledge was unquestioned and unchallenged.

I know I speak for all the residents who trained under Ernie, and all the colleagues he worked with

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over the years when I say that training under his guidance and working with him was a special privilege we shall always value.

Denis H. Hosking

Introduction

There is ongoing debate regarding the optimum treatment of distal ureteric calculi.[1-7] Shock wave lithotripsy (SWL) has been reported to be safe and effective, with treatment being possible on an outpatient basis.[8,9] Two recent studies comparing SWL and ureteroscopy for treatment of distal ureteric calculi found SWL to be similar to ureteroscopy in terms of stone free rates, and recommended SWL as the treatment of first choice because it was less invasive, less time consuming, and could be performed on an outpatient basis.[2,3] Conversely, in other studies comparing ureteroscopy and SWL in the treatment of distal ureteric calculi, ureteroscopy was found to be more efficacious,[4,5,6] less time consuming,[7] and recommended as first line treatment for distal ureteric calculi.[7] In all of these studies, ureteroscopy was performed under a general or major regional anaesthetic. With increasing experience and improved quality of ureteroscopes, ureteroscopy can also be successfully performed in many patients without a major regional or general anaesthetic, on an outpatient basis.[10] To date there have been no large series comparing SWL and ureteroscopy with both procedures being performed under intravenous sedation on an outpatient basis. To address this issue, we have compared patient tolerance, analgesia requirements, treatment duration, and success rates in patients undergoing SWL or ureteroscopy under intravenous sedation for the treatment of distal ureteric calculi.

Materials and methods

Our patient groups consisted of 110 patients undergoing 138 SWL treatments, and 172 patients undergoing ureteroscopy under intravenous sedation. The number of men and women, ages and age ranges in each treatment group are indicated in Table 1. Treatment selection was based on the preferences of the patient and treating urologist. There was no randomization.

SWL was performed on a Siemens Lithostar lithotriptor with Type C shock heads using a maximum power of 19KV (maximum setting of 4 of 8 in most patients) and a maximum of 4000 shocks per treatment. SWL was performed by one of 10 urologists sharing the same lithotripsy unit. Ureteroscopy was performed by one urologist with a semi-rigid 6F or 7.5F ureteroscope, balloon dilatation of the ureter to 15F in most patients, and basket removal of the stone. In 19 patients stone disruption was performed, using a Swiss Lithoclast in 16 and a 2.4F electrohydraulic probe in 3. Stents were not placed after ureteroscopic stone removal.

For both patient groups, intravenous analgesia was achieved with fentanyl and sedation with midazolam. In patients undergoing SWL, treatment was started at low power settings without prior administration of any medication. If required, fentanyl was administered with a usual starting dose of 100 ug, followed by 50 ug increments as required to a maximum dose of 250 ug. An initial dose of 1 mg of midazolam was usually administered with the initial dose of fentanyl, and additional increments of 1 mg of midazolam were administered as required to a maximum dose of 4 mg.

Unless medically contraindicated, patients undergoing ureteroscopy received a bolus of 100 ug fentanyl and 2 mg midazolam immediately prior to the start of the procedure. Additional increments of either or both agents were administered as required to a maximum dose of 250 ug fentanyl and 4 mg midazolam. Monitoring of the pulse rate, blood pressure, electrocardiograph, and oxygen saturation was performed in all patients, and oxygen was administered to all patients who received intravenous analgesia or sedation.

Patient tolerance was assessed by the nursing staff in attendance, and recorded at the end of the procedure. Tolerance was assessed as "good", "fair" or "poor". Tolerance was "good" if there were no complaints of discomfort during the procedure, or few

TABLE 1. **Treatment of distal ureteric calculi - study groups**

	Men		Women	
	#	**Age (range)**	**#**	**Age (range)**
SWL	68	55 (22-82)	42	43 (14-84)
Ureteroscopy	86	51 (20–82)	86	42 (16-78)

TABLE 2. **Treatment of distal ureteric calculi - patient tolerance of the procedure**

Treatment	Tolerance	Male	Female	Total
SWL (138 treatments)	Good	88 (97%)	44 (94%)	132 (96%)
	Fair	3 (3%)	3 (6%)	6 (4%)
Ureteroscopy (172 patients)	Good	59 (69%)	77 (90%)	136 (79%)
	Fair	27 (31%)	9 (10%)	36 (21%)

complaints, easily addressed with the administration of additional fentanyl or midazolam. Tolerance was "fair" if there were frequent complaints of discomfort, even if they were satisfactorily controlled with additional analgesia or sedation. Tolerance would be considered "poor" if discomfort was poorly controlled, or resulted in premature termination of the treatment.

Treatment duration for SWL was measured from the time the patient was placed on the lithotriptor, until the end of the procedure, including targeting of the stone, and the performance of a radiograph at the end of the treatment. The duration of ureteroscopy was measured from the time the patient was placed on the cystoscopy table, until removal of all endoscopes from the patient.

Follow up of patients undergoing SWL was either personal, or by telephone 1 week and 3 months following their treatment. Follow up details if available were also obtained from the offices of the treating urologists. Treatment was considered a failure if the patient required further SWL for the same stone, or another procedure such as ureteroscopy for stone removal, or a persisting stone was confirmed at follow up. Unless a persisting stone was confirmed, SWL was considered successful if the patient was asymptomatic 3 months after treatment, and had not undergone additional treatment for the same stone. Ureteroscopy was successful if the stone was removed.

Results

Patient tolerance of both procedures is summarized in Table 2. Of the patients undergoing SWL, tolerance was "good" in 132 of 138 (96%) treatments, compared to 136 of 172 (79%) patients undergoing ureteroscopy. Tolerance was "good" in 94% of women undergoing SWL, compared with 90% of women undergoing ureteroscopy, and "good" in 97% of men undergoing SWL compared with 69% undergoing ureteroscopy. No patient was considered to have tolerated either treatment poorly, and no treatments were prematurely terminated.

Analgesia requirements were similar in both patients groups and are summarized in Figure 1. The mean duration of treatment for patients undergoing SWL were 52 minutes, and 27 minutes for patients undergoing ureteroscopy under intravenous sedation. In women the ureteroscopy procedure times were 20 ± 9 (mean ± SD) and 23 ± 11 minutes for patients whose tolerance was "good" and "fair" respectively. In men the ureteroscopy procedure times were 28 ± 13 and 38 ± 18 minutes for patients whose tolerance was "good" and "fair" respectively.

The success rates for the treatments are summarized in Table 3. The success rate for the first SWL treatment in 110 patients was 62%, dropping to

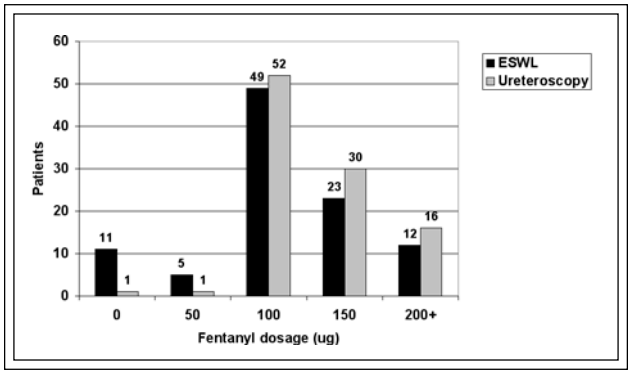

Figure 1. Treatment of distal ureteric calculi. Fentanyl requirements for each treatment group.

TABLE 3. **Treatment of distal ureteric calculi – success rates**

	1st treatment	2nd treatment	Overall success
SWL (110 patients)	62%	39%	72%
Ureteroscopy (172 patients)	95%		

39% for the second or subsequent treatments. Stone removal was successful in 95% of patients undergoing ureteroscopy under intravenous sedation. Of eight failures, six were in men in whom the stone was too large to engage in a basket, and a suitable stone disrupting device was not readily available. All were subsequently removed successfully by ureteroscopy under general anaesthesia. In one male patient, excessive tortuosity of the lower ureter prevented successful passage of the ureteroscope up to the stone, and in one female patient the stone migrated into the renal pelvis where it was successfully treated with SWL.

Discussion

It is difficult to assess patient tolerance of procedures performed under intravenous sedation. Because of the retrograde amnesia frequently induced by midazolam, many of our patients are unable to provide accurate information after the procedure. Of the two procedures, SWL was better tolerated by men than ureteroscopy, while over 90 percent of women tolerated both procedures well. In men, most of the discomfort appeared to be related to the cystoscopy component of the procedure rather than balloon dilatation of the ureter or the ureteroscopy procedure itself. To address this issue, in most men we have increased the initial bolus of medication for ureteroscopy to 150 ug of fentanyl and 3 mg of midazolam. This adjustment appears to have successfully addressed the issue of discomfort for most men.

It is not possible to make recommendations regarding treatment of individual patients based on our findings. Patients undergoing ureteroscopy for distal ureteric calculi were given the choice of SWL or ureteroscopy, and those who elected to proceed with ureteroscopy usually did so based on the greater likelihood of successful stone removal. These patients were not deterred by the invasive nature of ureteroscopy, and would perhaps tolerate the procedure better than individuals coerced into undergoing ureteroscopy as opposed to SWL. Our data with regard to tolerance of ureteroscopy, particularly in men, is potentially biased in that a greater percentage of our patients may have tolerated the procedure well, than a randomly selected population. Furthermore, stone size was not recorded in our ureteroscopy patients, and as patients were not randomized to one or other treatment, direct comparison of treatments and outcomes is not possible.

The potential success rate of an individual procedure is an important consideration for many patients, particularly if they have already needed to take leave from work as a result of renal colic, or there will be any delay in scheduling further treatment if the initial treatment is unsuccessful. Our higher success rates with ureteroscopy were an important factor in the patient's decision making. We were not able to personally evaluate all patients following SWL, and assumed that their treatment was successful if they were asymptomatic 3 months following SWL and had not undergone any other treatments. It is possible that patients with persistent ureteric calculi could have been included in this group, potentially enhancing our observed results of SWL.

Our success rates with shock wave lithotripsy are similar to those in some reports[5,6] but lower than others.[2,3,9] One potential explanation is that most of our patients were anxious to have their ureteric calculus removed, so that repeat SWL or other treatments such as ureteroscopy were offered at an early stage, rather than waiting for a prolonged interval to determine if their SWL treatment had been effective. Our SWL treatments are usually limited to 4000 shocks to facilitate treatment scheduling. This is lower than the 7466 shocks reported by Mobley who reported an 83 percent success rate for lower ureteric stones using the same type of lithotriptor.[9] Peschel and associates stress the importance of the time until the outcome of treatment is achieved.[7] Bierkens and associates reported that in their study patients undergoing ureteroscopy were stone free within 2 days, compared to up to 4 months for patients undergoing SWL.[4] Our observations are in agreement with Peschel and associates in that an early stone-free status is important to most of our patients.

There is considerable variation in reported procedure times for ureteroscopy in the literature. Our mean ureteroscopy procedure time of 27 minutes is comparable to other reports.[4,6,7] It should be noted however that we do not consider patients with large distal ureteric calculi well suited to ureteroscopy under IV sedation, and recommend general or regional anaesthesia for such patients. Indeed, ureteroscopy under IV sedation is only offered to patients in whom a relatively short procedure is anticipated. Our technique of balloon dilatation of the ureter in order to facilitate intact stone removal is used to try and minimize the procedure time.

Currently it is our practice for all patients with small distal ureteric calculi requiring treatment to offer them of the choice of SWL or ureteroscopy under intravenous sedation. Based on our observations of

patient tolerance, treatment efficacy, and procedural times, we recommend ureteroscopy under intravenous sedation as the treatment of first choice for women with small, distal ureteric calculi requiring treatment. For men with small distal ureteric calculi requiring treatment, we advise them of our success rates with each procedure and recommend ureteroscopy under intravenous sedation if definitive resolution of their renal colic is important to them. In all patients, if appropriate, the possibility of observation in the hope of spontaneous stone passage is raised. In our experience however, the inability to determine the necessary duration of observation sways the overwhelming majority of patients towards some form of early intervention.

Conclusions

Based on our experience, we believe ureteroscopy under intravenous sedation is preferable to SWL in women with small distal ureteric calculi requiring treatment. In men, the better tolerance of SWL must be weighed against the higher success rate of ureteroscopy. Men with small distal ureteric calculi requiring treatment should be offered ureteroscopy under intravenous sedation as an alternative to SWL, particularly if stone free status after a single treatment is important. If both treatment modalities are available, patients with small distal ureteric calculi, in whom ureteroscopy is likely to be successful, should be informed of and offered their choice of either treatment modality. □

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