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Operator Experience and Adequate Anesthesia Improve Treatment Outcome with Third-Generation Lithotripters

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ABSTRACT

***Purpose*: To characterize the effect of operator experience and type of anesthesia on treatment outcome when switching from the Dornier HM3 to the third-generation Dornier U/50 lithotripter.**

***Patients and Methods*: A population of 370 consecutive patients treated by 15 urologists was divided into two groups. Group I (N = 225) included patients treated during the initial 3 months with our new lithotripter. Group II (N = 145) included patients treated during the last 3 months. Changes were made during the intervening 6 months in focusing technique, anesthesia type, coupling technique, and shockwave delivery. Information was collected regarding success of stone treatment (defined as complete clearance of stone or fragments < 3 mm at 1 month).**

***Results*: There were no differences between the two groups with regard to age, sex, fluoroscopic time or maximal shockwave intensity used. Group I had a slightly higher percentage of upper ureteral stones (20% *v* 13%); however, the difference was not significant. Upper ureteral stones in Group II were on average significantly larger (9.4 mm *v* 7.3 mm; $P = 0.003$). Intravenous sedation was used frequently in Group I (111 patients; 49%) and not at all in Group II. General anesthesia was used more frequently in Group II than in group I (34% *v* 24%; $P < 0.02$). Spinal anesthesia also was utilized more frequently in Group II patients (66% *v* 28%; $P < 0.0001$). Overall, general or regional anesthesia was received by 100% of the patients in Group II but only 52% of the patients in group I. The success rate of stone treatment was much better for Group II than for Group I (78% *v* 51%; $P < 0.0001$).**

***Conclusion*: The transition from a Dornier HM3 lithotripter to a third-generation lithotripter can be difficult, but if adequate anesthesia is given to minimize patient movement and balloon pressures are optimized, stone targeting can be accurate and similar stone clearance rates can be obtained.**

INTRODUCTION

OUR INSTITUTION HAS RECENTLY CHANGED from the Dornier HM3 lithotripter to the Dornier U/50. Studies in the literature had reported comparable stone treatment outcomes with this newer model,[1–10] but the initial stone treatment outcomes with our new machine were disappointing. Several possible contributing factors were investigated, and, after limited changes were made, our success rate improved significantly. The changes concentrated on focusing technique, type of anesthesia, coupling balloon pressure, and progression of shockwave delivery. Herein, we report 1-year treatment results at our Kidney Stone Treatment Center.

PATIENTS AND METHODS

A population of 370 consecutive patients treated by 15 urologists was divided into two groups. Group I (N = 225) included patients treated during the initial 3 months with our new lithotripter. Group II patients (N = 145) were treated during the 3 months at the end of the first year's experience. There were 263 stones in Group I and 165 in Group II (Table 1). The technical changes were made during the intervening 6 months. All treatment outcomes were evaluated by plain films. A retrospective chart review was performed, at which information was collected regarding the success of stone treatment (defined as complete clearance of stone fragments or residual fragments <3

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TABLE 1. PATIENT DEMOGRAPHICS AND STONE CHARACTERISTICS

	Group I (N = *225)*	*Group II* (N = *165)*	P
Mean age (range)	51.4 (21–87)	51.0 (17–79)	0.75
M/F	129/96	85/60	0.88
Stone no. (%)			
Kidney	184 (70)	114 (69)	0.85
Proximal ureter	35 (20)	33 (13)	0.07
Mid ureter	4 (2)	3 (2)	0.81
Lower ureter	40 (15)	15 (9)	0.06
Average stone size (mm)			
Kidney	10.21	10.34	0.68
Proximal ureter	9.45	7.30	0.003
Mid ureter	10.75	10.33	0.74
Lower ureter	6.65	7.40	0.31

mm at 1 month), stone size and location, type of anesthesia, fluoroscopic time, and shockwave intensity. Groups I and II were compared using the chi-square test with regard to these variables. All statistical calculations were performed with StatView 5.0 (SAS Institute, Inc.) for Macintosh.

RESULTS

There were no significant differences between the two groups in fluoroscopic time or maximal shockwave intensity used (Table 2). Proximal ureteral stones were significantly larger in Group I (9.4 mm *v* 7.3 mm; $P = 0.003$). However, Group I also had a slightly lower percentage of upper ureteral stones (13% *v* 20%), although this difference was not significant ($P = 0.07$). Intravenous sedation was used frequently in Group I (N = 111 patients; 49%) and not at all in Group II. General and spinal anesthesia were used more frequently in Group II than in Group I (34% *v* 24%; $P = 0.02$; and 66% *v* 28%; $P < 0.0001$, respectively). Overall, formal anesthesia was received by 100% of the patients in Group II but only 52% of patients in Group I. The success rate of stone treatment was significantly better for group II than for group I (78% *v* 51%; $P < 0.0001$).

DISCUSSION

There are several key differences between Dornier HM3 and third-generation machines such as the Dornier U/50. The HM3 is commonly thought of as the gold standard against which other machines are compared. It utilizes an electrohydraulic shockwave generator and a large waterbath. Although this machine is large and has several requirements that make it less convenient to use, it has the distinct advantages of being powerful and having a large focus area. This combination makes it very effective with regard to stone fragmentation and compensates for variations in the experience and precision of the individual operating the machine.[3] The U/50, on the other hand, utilizes an electromagnetic shockwave generator and a water balloon coupling mechanism. The U/50 has several advantages including small size, a multifunctional cystoscopy table, as well as fewer servicing and cleaning requirements. With regard to efficacy of stone treatment, however, the U/50 (as well as other third-generation machines) has several attributes that may make it more difficult to use and might require more practice to master. These machines tend to have much smaller focal areas and may be less powerful.[4] For these reasons, patient positioning and stone localization must be exact. There is no flexibility available in terms of patient movement or severe fluctuations in breathing patterns. Movement associated with certain types of anesthesia can also be a factor. Intravenous sedation has been employed successfully for shockwave lithotripsy.[8] However, higher retreatment rates have been reported for IV sedation than for regional or general anesthesia.[9] This might explain why there was a marked improvement in our results after cessation of IV sedation and a conversion to only spinal or general anesthesia. In addition, although the fluoroscopy time in the two groups was similar, this figure does not take into consideration the extra time it took to ensure adequate sedation and analgesia prior to beginning lithotripsy in the IV sedation-only pa-

TABLE 2. TREATMENT DATA AND OUTCOME

	Group I (N = 225)	*Group II (N = 145)*	P
Mean X-ray time (min)	2.95 (0.2–9.5)	2.83 (0.3–12.1)	0.54
Mean shockwave intensity	5.514 (5–6)	5.598 (4–6)	0.214
Anesthesia: no. (%) of patients			
IV sedation	111 (48)	0	—
Spinal	62 (28)	95 (66)	0.0001
General	52 (24)	50 (34)	0.02
No. (%) treated successfully	115 (51)	113 (78)	<0.0001

tients or the extra time it took during the session to reposition patients who received IV sedation if they moved intraoperatively.

Another key factor is adjustment of the coupling mechanism. The HM3 utilizes a waterbath, which is thought of as the ideal medium for transmission of the shockwave with minimal loss of energy. The waterbath does not require any adjustment and is hence simpler to use. However, it must be changed after each treatment, which is time consuming and costly.[10] The U/50's water balloon is extremely convenient but adds another variable to be mastered and, if neglected, can lead to difficulty focusing on the stone and loss of shockwave transmission. During our early experience with the U/50, we used a balloon pressure of 5 (range 1–6). However, this pressure appeared to be too high, and our focusing on oblique views improved after we lowered the balloon pressure to 3. We believe that this may have played some role in the greater success rate in Group II; however, confirmation of this view could be obtained only in a prospective study.

Success rates for third-generation lithotripters have traditionally been thought of as slightly inferior because of the many variables described above and have been reported in the range of 51.8% to 79.1%.[4] In our first year's experience with our new third-generation lithotripter, we found that we were able to improve our success rate from 51% to 78% by providing adequate anesthesia to prevent patient movement and by enhancing our stone localization skills.

CONCLUSION

Third-generation electromagnetic lithotripters offer several advantages over their second-generation predecessors such as multifunctionality, smaller size, and faster operating room turnover time but require more expertise and practice with technique if similar success rates are expected. One potential advantage that is reported in the literature is a smaller requirement for anesthesia, making IV sedation a potential option. However, we found that IV sedation provided inadequate analgesia, caused erratic breathing patterns, and made patients unable to cooperate, inhibiting our ability to maintain accurate stone localization. For this reason, we switched back to regional or general anesthesia for all shockwave lithotripsies performed at our institution. Following this change (and several months of practice), our success rate of stone treatment improved markedly.

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