Dusting versus Basketing during Ureteroscopy—Which Technique is More Efficacious? A Prospective Multicenter Trial from the EDGE Research Consortium

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Abbreviations and Acronyms

ASA® = American Society of Anesthesiologists®

CT = computerized tomography

EDGE = Endourologic Disease Group for Excellence

KUB = plain x-ray of the kidneys, ureters and bladder

RUS = renal ultrasound

UAS = ureteral access sheath

URS = ureteroscopy

Purpose: There is scant evidence in the literature to support dusting vs active basket extraction during ureteroscopy for kidney stones. We prospectively evaluated and followed patients to determine which modality produced a higher stone-free rate with the fewest complications.

Materials and Methods: Members of the Endourologic Disease Group for Excellence research consortium prospectively enrolled patients with a renal stone burden ranging from 5 to 20 mm in this study. A holmium laser was used and all patients were stented postoperatively. Ureteral access sheaths were used in 100% of basketing cases while sheaths were optional when dusting. The primary study outcome was the stone-free rate at 6 weeks as determined by x-ray and ultrasound.

Results: A total of 84 and 75 patients were enrolled in the basketing and dusting arms, respectively. Stones in the dusting group were significantly larger (mean ± SD stone area 96.1 ± 65.3 vs 63.3 ± 46.0 mm^2, $p < 0.001$). The stone-free rate was significantly higher in the basketing group on univariate analysis (74.3% vs 58.2%, $p = 0.04$) but not on multivariate analysis (1.9 OR, 95% CI 0.9–4.3, $p = 0.11$). In patients who underwent a basketing procedure operative time was 37.7 minutes longer than in those treated with a dusting procedure (95% CI 23.8–51.7, $p < 0.001$). There was no statistically significant difference in complication rates, hospital readmissions or additional procedures between the groups.

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Conclusions: The stone-free rate was higher for active basket retrieval of fragments at short-term followup on univariate analysis but not on multivariate analysis. There was no difference in postoperative complications or procedures. The 2 techniques should be in the armamentarium of the urologist.

Key Words: kidney calculi; equipment and supplies; ureteroscopy; lithotripsy, laser; outcome and process assessment (health care)

OPTIONS for ureteroscopic treatment of intrarenal stones consist of using a basket to actively extract fragments or using a laser to disintegrate the fragments into dust, which are allowed to pass spontaneously. Potential advantages of dusting include shorter operative time, decreased cost due to decreased use of a UAS and/or a stone basket and decreased potential trauma associated with repeat basketing attempts. Potential advantages of basketing include an improved stone-free rate and a decreased risk of subsequent colic events from retained stone fragments.

To date a single prospective, randomized study of semirigid ureteroscopy for ureteral stones has evaluated basketing and dusting techniques.[1] There are currently no published prospective studies of dusting and basketing for flexible ureteroscopy with laser lithotripsy of renal stones.

The purpose of the current study was to examine outcomes of dusting stones vs basketing stones in a multi-institutional prospective study.

MATERIALS AND METHODS

The trial, which was performed by members of the EDGE research consortium (www.endoedge.net), adhered to a standardized strict treatment and followup protocol. At each site institutional review board approval was obtained and the trial was registered on ClinicalTrials.gov (NCT01619735). Patients undergoing URS with laser lithotripsy to treat renal stone(s) who met the inclusion criteria were enrolled in the study after providing informed consent. Abdominopelvic CT was performed to calculate stone surface area using a previously described formula.[2]

Patients were treated with a single dose of preoperative antibiotics. Those with a positive urine culture preoperatively were treated appropriately before surgery. In the basketing group URS and holmium laser lithotripsy using 30 to 100 W lasers were performed to break the stone(s) into discrete fragments for active extraction. In the dusting group the stone was dusted into small fragments for passive elimination. Each surgeon only enrolled patients in 1 arm according to the current practice and expertise. If available, a representative fragment was removed for stone analysis as part of the study protocol in dusting cases. The use of a UAS (sizes 10/12Fr, 11/13Fr, 12/14Fr and 14/16Fr) was standard in basketing cases and optional in dusting cases.

All patients received a ureteral stent for 4 to 14 days after the procedure as part of the study protocol. All patients without allergies or contraindications received postoperative α-blocker therapy (tamsulosin 0.4 mg daily) for 30 days following the procedure. Standard pain medications were prescribed at the discretion of the treating physician.

Imaging was performed at 4 to 6 weeks postoperatively. All patients were requested to undergo KUB and RUS. If a patient did not comply with undergoing these 2 imaging studies postoperatively, further imaging was left to surgeon discretion. If there was a discrepancy between the presence, number or size of stones between KUB and RUS, CT was ordered at treating surgeon discretion. If CT was not ordered, the size of fragments were determined by KUB since this modality provides more clinically relevant size information than US. CT was not routinely done due to variation from the standard of care, increased cost and increased radiation exposure to patients. Stone-free status was defined as no residual fragments of any size on KUB or RUS as interpreted by radiologists at each site.

Complications were reported using the Clavien-Dindo classification system.[3,4] The supplementary material (http://jurology.com) describes the statistical analysis.[5–10]

Patients 18 to 80 years old with radiopaque renal stones between 5 and 20 mm which were located at or above the level of the ureteropelvic junction were prospectively enrolled in study. In patients with multiple stones the additive maximal diameter of all stones on axial CT had to be in the same range for inclusion. Patients with an ipsilateral ureteral stone requiring concomitant treatment were included if according to surgeon judgment treating the ureteral stone would not alter the treatment or the plan of the targeted kidney stone. However, treatment specific data on the ureteral stone in terms of laser time or energy were separated and excluded from analysis of treatment of the target stone. Study exclusion criteria were prior ipsilateral upper urinary tract reconstruction, a history of ipsilateral ureteral stricture, a history of abdominopelvic radiation therapy, spinal cord injury and/or neurogenic bladder, and scheduled staged ureteroscopy.

RESULTS

The trial accrued 150 patients, including 68 in the dusting cohort and 82 in the basketing cohort. Mean preoperative stone surface area on CT differed between the groups with statistically significantly larger stones in the dusting group (96.1 vs 63.3 mm^2, $p < 0.001$). There was no difference in the gender distribution or in any other stone characteristics between the 2 cohorts. Supplementary table 1 (http://jurology.com/) lists these results and other patient data.

Table 1 shows the differences between the groups at surgery. Anticoagulation/antiplatelet medication was administered more frequently in the basketing cohort than in the dusting cohort (21.8% vs 7.6% of cases, p <0.02). Mean operative time was longer in the basketing group (67.4 vs 35.9 minutes, p <0.001). However, lasing time (ie the time that the laser was actively discharging) was significantly longer in the dusting group (737.1 vs 608.9 seconds, p = 0.001). A 200 to 270 μ laser fiber was used more often in the basketing group than in the dusting group (93.6% vs 77.5% of cases, p <0.001) No intraoperative complications occurred in either group.

Postoperative imaging in patients in the dusting group included only KUB in 19.2%, only RUS in 14.7% and KUB plus RUS in 66.2%. Postoperative imaging in patients in the basketing group included only KUB in 7.7%, only RUS in 15.4%, KUB plus RUS in 69.2% and CT in 7.7%. There was discordance between KUB and RUS findings in 18.4% of patients.

Supplementary table 2 (http://jurology.com/) lists followup data, including the distribution of residual fragment size. The stone-free rate in the dusting group was 58.2% while it was 74.3% in the basketing group (p = 0.04). There were significantly more residual fragments in the dusting group. However, there was no statistical difference in symptomatic residual fragments or the number of additional procedures between the 2 groups. One patient per group required additional intervention (ureteral stent placement, Clavien-Dindo grade III-B). There were no grade IV or V complications in the study.

Patients who underwent basketing procedures had a significantly higher stone-free rate on univariate analysis but this was not significant on multivariate analysis. After controlling for stone surface area, ASA® score and prior extracorporeal shock wave lithotripsy the odds of being stone-free were 1.9 times higher when stones were basketed than dusted (95% CI 0.9–4.3, p = 0.11). Patients who underwent a basketing procedure had an operative time that was 38.6 minutes longer than in patients treated with a dusting procedure (95% CI 24.0–53.1, p <0.001, table 2). Overall a larger stone area was associated with longer operative time, which was marginally significant. For every 100 mm^2 increase in stone area operative time increased by 11.8 minutes (95% CI −0.4–24.0, p = 0.06). When stratifying stone size by quartiles, there was no statistically significant difference in the stone-free rate for any quartile (table 3). There was also no difference in the distribution of calcium oxalate or other stone compositions between the 2 groups (table 3).

DISCUSSION

We report what is to our knowledge the first prospective, multi-institutional study of dusting vs basketing techniques in patients undergoing URS with laser lithotripsy for renal stones 5 to 20 mm. The study met the accrual requirements to detect a 20% difference in the stone-free rate between the 2 groups based on power calculations. On univariate analysis the stone-free rate 4 to 6 weeks after URS was significantly higher in the basketing group (74.7% vs 58.1%, p = 0.04). However, no difference was found on multivariate analysis. Furthermore, there was no statistically significant difference in patients who reported symptoms or the need for additional procedures between the 2 groups.

Dusting was associated with a 44% reduction in operative time (mean ± SD 35.9 ± 17.8 vs 67.4 ± 53.3 minutes, p <0.001), which should translate to less operative cost in the dusting group. Litwin et al estimated that for ureteroscopic lithotripsy 74% of procedure resources depend on operative time,

Table 1. *Operative data on basketing and dusting cohorts*

	Basketing	Dusting	p Value
No. pts	82	68	—
No. intraop anticoagulation/antiplatelet medication (%)	17 (21.8)	5 (7.6)	0.02
No. digital URS (%)	26 (35.1)	10 (15.6)	0.009
No. Fr ureteral access sheath size (%):	79 (100)	10 (15.6)	<0.001
10/12	1 (1.3)	3 (30)	
11/13	11 (13.9)	0	
12/14	61 (77.5)	7 (70)	
14/16	6 (7.6)	0	
Mean ± SD operative time (mins)	67.4 ± 53.3	35.9 ± 17.8	<0.001
Mean ± SD laser:			
Time (secs)	608.9 ± 1,127.3	737.1 ± 654.1	0.001
Energy (kJ)	20.2 ± 140.8	49.5 ± 215.4	<0.001
No. intentional stone displacement during case	24 (31.2)	24 (36.4)	0.51
No. intraop stone clearance (%):			
Visual	73 (92.4)	49 (73.1)	0.003
Radiographic	72 (92.3)	56 (82.4)	0.18
Mean ± SD hospital stay (hrs)	5.9 ± 6.6	3.0 ± 3.1	<0.001
No. discharged with α-blocker (%)	72 (94.7)	56 (87.5)	0.13

There were no intraoperative complications.

Table 2. *Stone-free rate and operative time in dusting and basketing cohorts*

	Stone-Free Rate		Operative Time	
	OR (95% CI)	p Value	Estimate (95% CI)	p Value
Basketing (vs dusting)	1.9 (0.9—4.3)	0.11	38.6 (24.0—53.1)	<0.001
Stone surface area/ 100 mm^2 increase	1.1 (0.6—2.2)	0.73	11.8 (−0.4—24.0)	0.06
ASA score (3 or greater vs less than 3)	0.9 (0.4—2.1)	0.86	−8.4 (−22.7—5.9)	0.25
Prior extracorporeal shock wave lithotripsy (yes vs no)	0.8 (0.4—1.9)	0.63	12.4 (−3.1—28.0)	0.12

highlighting the potential financial impact of each technique.[11] In addition to reducing costs by shorter operative time, dusting also can decrease cost by not requiring a basket retrieval device unless one is used to obtain a fragment for analysis, which was standardized in our study protocol when thought to be feasible. A UAS is also optional. Dusting clearly appears to be a faster technique even for larger stones but at the cost of increased short-term residual fragments. At 4 to 6 weeks of followup 41.9% of dusting cases showed residual fragments but this caused symptoms in only 16.7% and required a readmission rate similar to that of basketing cases. In our study it proved to have rates statistically equivalent to those of basket extraction on multivariate analysis.

Patients who underwent dusting had a statistically larger mean stone surface area and as expected more laser energy was required as well as longer laser time. Dusting requires a low pulse energy of 0.2 to 0.5 J and a higher frequency of 20 to 80 Hz to produce small fragments and minimize stone retropulsion but at the expense of longer lasing time and decreased efficiency for harder or denser stone types.[12,13] Sea et al found that fragment size increased as pulse energy increased, as did crater volume and the speed at which fragments were produced.[13] However, due to the mobility of stones or fragments in the renal collecting system the increased retropulsion associated with high pulse energy may actually be less efficient by decreasing the contact time of the laser with the stone. In contrast, increasing the frequency reduces retropulsion and produces the smallest fragments. This allows surgeons to paint the stone surface to ablate the stone slowly. The small particles produced by such a technique may impair the visualization of residual fragments. This was supported in our study since stone fragments greater than 1 mm were visually cleared at surgery in only 75.7% of the patients.

Table 3. *Stone-free rate by stone size on multivariable analysis and by stone composition*

Stone Size (mm^2)	No. Stone-Free/Total No. (%) Basketing	Dusting	p Value
Size (mm^2)			
Quartiles:*			
Less than 35.5	13/22 (59.1)	5/9 (55.6)	0.86
35.5—less than 68.5	17/21 (81.0)	8/14 (57.1)	0.15
68.5—less than 94.3	11/16 (68.8)	12/19 (63.2)	0.73
94.3 or Greater	13/14 (92.9)	12/20 (60)	0.05
Median:			
Less than 70	33/46 (71.7)	14/24 (58.3)	0.26
70 or Greater	21/27 (77.8)	23/38 (60.5)	0.14
Composition†			
Calcium oxalate monohydrate/ calcium oxalate dihydrate	32/39 (82.1)	22/35 (62.9)	0.06
Uric acid	4/5 (80)	1/2 (50)	>0.99
Magnesium ammonium phosphate	0	2/2 (100)	
Calcium phosphate apatite	8/9 (88.9)	4/5 (80)	>0.99
Mixed	8/15 (53.3)	4/8 (50)	>0.99
Other	3/5 (60)	2/5 (40)	>0.99

* Stone-free rates were similar in first (less than 35.5 mm^2) and third (68.5 to less than 94.3 mm^2) quartiles while rates were higher in basketing group in second and fourth quartiles but did not reach statistical significance.
† There was no difference in stone-free rate by stone composition and technique.

A recent study demonstrated a stone-free rate similar to that in our dusting group when using the new 120 W Lumenis® Ho:YAG laser.[14] Those investigators reported a 62.3% stone-free rate with the laser set at low energy and high frequency to dust stones. Altering the pulse width of the laser can change the effects of laser fragmentation. Longer pulse widths produce less retropulsion and smaller fragments, and are well suited to a dusting technique. Shorter pulse widths produce larger fragment sizes and are better suited to basketing. The supplementary material (http://jurology.com/) provides further information on the meaning of stone-free status as well as the imaging modality and the laser lithotripsy technique.[5–10]

In the basketing group patients in our study had smaller stones but more patients had positive preoperative urine cultures, were on concomitant anticoagulation therapy and had higher ASA scores, implying a more ill patient cohort. Despite this the stone-free rate was higher on univariate analysis and equivalent on multivariate analysis with a complication rate similar to the patients treated with dusting. This is significant, considering the increased use of UAS in basketing cases and the report by Traxer and Thomas showing a 46.5% risk of ureteral wall injury.[15] The risk of injury should be theoretically higher in patients who underwent basketing, in whom a UAS was used in 100%. However, this was not observed in our study, maybe because ureteral stents were used postoperatively in 100% of our patients.

Several limitations should be pointed out. This was a prospective, multi-institutional study with multiple surgeons who used different equipment and it was vulnerable to the inherent biases. However, we believe that due to the broad geographic representation the results may be more generalizable. It is notable that the participating centers were high volume kidney stone centers, which may limit application of the findings to lower volume centers. Also, this study was not randomized, which at first may be perceived as a weakness but it was intentional by design. Each participating surgeon was already firmly entrenched as a dusting or a basketing surgeon so that randomizing surgeons to perform a technique with which they may not have the same level of expertise or belief in could have impacted the results. Further, the fact that these patients were not consecutive may also help explain the differences in stone size between the 2 groups.

As stated, followup imaging included KUB and RUS rather than CT, which may overestimate or underestimate stone-free status. In addition, CT was not done due to the overwhelming understanding that it is over performed and it over exposes patients to excessive amounts of radiation.[16] The requested postoperative KUB and RUS was not performed in all patients, which could have resulted in some detection bias in fragment size. The fact that investigators at all centers agreed to a uniform protocol and followup limited potential deviations in an attempt to minimize the confounding variables.

The dusting group had significantly larger stones at the outset of surgery. Despite this the stone-free rates did not differ on multivariate analysis. In this study stones were fragmented and retrieved by baskets or were dusted into fragments. There was no hybrid approach involving dusting the stone into fine bits and then retrieving the final fragments with a basket. Basketing those last few fragments which can be hard to dust may have improved the stone-free rate. It could also be argued that followup at 6 weeks was too early for all fragments to pass in the dusting group. There was only followup in the first 6 weeks. It is planned for patients to undergo followup 1 year after the operation. Perhaps if imaging was performed at an intermediate time such as 3 or 6 months, the stone-free rate would be different.

CONCLUSIONS

For stones between 5 and 20 mm fragmenting and actively basketing every fragment or dusting the stone produced equivalent stone-free rates on multivariate analysis. It is clear that each technique has relative merits and the true answer to which is better depends on patient and stone specific factors. The answer likely lies somewhere between with a combination of techniques to realize maximum efficiency, lowest cost and the least risk of repeat intervention in the patient. The number of patients with fragments who became symptomatic did not differ between the techniques. However, in the long term larger residual fragments have the potential to predispose patients to future stone events. Longer term followup may reveal differences between the groups. Future studies will include a cost-benefit analysis between these groups as well as longer followup.

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