ENDOUROLOGY

Original Article

Evaluation of ureteroscopy outcome in a teaching hospital

Bir eğitim hastanesinde ureteroskopi sonuçlarının değerlendirmesi

Abdulla Al-Naimi, Abdulqadir Alobaidy, Ahmad Majzoub, Tarek Ahmed Amin Ibrahim

ABSTRACT

Objective: To evaluate factors affecting semi-rigid ureteroscopy (URS) results highlighting the influence of teaching on its outcomes.

Material and methods: We reviewed the files of 891 adult patients who had undergone 1182 ureteroscopies at our institute during the period from July 2008 to June 2011. The outcomes of all URSs were evaluated. Outcomes were measured by stone- free rate and presence of complications, which were assessed using the Clavien-Dindo system. Patients were divided into 2 groups; Group 1 (favorable outcome) became stone- free after the first URS and had no documented complications, while Group 2 (unfavorable outcome) had residual stones and/or complications. Group 2 was subdivided according to the skill level of the operating surgeon into two subgroups. Patients belonging to subgroup A had their procedures performed by urology trainees under direct supervision of expert urologists, while those in subgroup B had their procedures performed by the expert urologists themselves. All groups were compared using univariate (chi-square and t tests) and multivariate (logistic regression) statistical tests to identify significant risk factors. All data was analyzed using SPSS.

Results: A total of 1182 URSs were evaluated. 958 patients had a favorable outcome (Group 1) while 224 patients had an unfavorable outcome (Group 2). Factors associated with an unfavorable outcome include location of the presenting stone ($p<0.001$) and presence of stone impaction ($p<0.001$). No statistically significant differences were detected in the overall complication rate between trainees and expert urologists. Trainees stone- free rate was comparable to that of experts; 90.3% vs. 91.1%, respectively, $p=0.6$.

Conclusion: Factors such as stone impaction and proximal location are associated with an unfavorable surgical outcome. In a high- volume teaching hospital, semi-rigid URS done by trainees under direct supervision is safe and their outcome is comparable to literature findings.

Keywords: Complications; outcome; stone- free rate; teaching; ureteroscopy.

ÖZ

Amaç: Eğitimin sonuçlara etkisini vurgulayarak semirijit üreteroskopi (URS) sonuçlarını etkileyen faktörleri değerlendirmek.

Gereç ve yöntemler: Temmuz 2008 ile Haziran 2011 tarihleri arasında kurumumuzda 1182 üreteroskopi uygulanmış 891 yetişkin hastanın dosyalarını gözden geçirdik. Tüm URS'lerin sonuçları değerlendirilmiştir. Sonuç taşsızlık oranı ve komplikasyonların varlığıyla ölçülmüş ve Clavien-Dindo sistemiyle değerlendirilmiştir. Hastalar 2 gruba ayrılmıştır: Grup 1 (olumlu sonuç) ilk URS sonrası taşsızlık sağlanmış ve/veya herhangi bir komplikasyon belgelenmemiştir. Grup 2 (olumsuz sonuç) rezidüel taşlar ve/veya komplikasyonlar mevcuttu. Grup 2 uygulayıcı cerrahın düzeyine göre iki altgruba ayrılmıştır. A altgrubuna dahil hastaların cerrahi işlemleri uzman ürologların doğrudan gözetimi altında üroloji asistanları, B altgrubunda olanlar ise uzman ürologlar tarafından uygulanmıştır. Önemli risk faktörlerini saptamak için tüm gruplar tek (ki-kare ve t-testleri) ve çok değişkenli (lojistik regresyon) istatistiksel testler kullanılarak karşılaştırılmıştır. Tüm veriler SPSS ile analiz edilmiştir.

Bulgular: Toplam 1182 URS değerlendirilmiş, 958 hastada olumlu sonuç (Grup 1) ve 224 hastada bir olumsuz sonuç (Grup 2) elde edilmiştir. Olumsuz sonuçla ilişkili faktörler taşın yerleşimi ($p<0,001$) ve taş sıkışması ($p<0,001$) idi**.** Asistanlarla uzman ürologlar arasında genel komplikasyon oranı açısından istatistiksel açıdan önemli farklılıklar saptanmamıştır. Asistanların taşsızlık oranı uzmanlara benzerdi (sırasıyla %90,3 ve %91,1, $p=0,6$.

Sonuç: Taş sıkışması ve proksimal yerleşim gibi faktörler olumsuz cerrahi sonuçla ilişkilidir. Hasta yoğunluğu yüksek olan bir eğitim hastanesinde doğrudan gözetim altında asistanlar tarafından uygulanan semirijit URS olup sonuçları literatürle uyumludur.

Anahtar kelimeler: Komplikasyonlar; sonuç; taşsızlık oranı; öğretim; üreteroskopi.

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Introduction

Ureteroscopy (URS) is an integral procedure of urology practice. In 1912, Hugh Hampton Young was the first to perform this procedure using a rigid cystoscope.[1] Since that time, the technique has evolved dramatically into becoming the minimally invasive procedure of choice for managing ureteric diseases.[2] With introduction of flexible technology, URS gained further potentials, not only related to maneuverability but also to safety and efficacy.[3]

Urolithiasis is by far the most common condition requiring therapeutic URS.[4] Like any other treatment modality, the objective for managing ureteric calculi is complete stone clearance with minimal patient morbidity. Several studies have been performed to investigate factors associated with the best achievable outcome from URS in stone disease.[5-8] In addition to factors related to stone presentation, such as position and size, operator related factors were also found to influence surgical outcomes. Surgeons with an endoscopic training background were generally associated with a more favorable treatment outcome.[6]

With the introduction of structured medical training, a continuous need to assess the value of this training on patient care immerges. After all, providing high quality healthcare that ensures patient safety is an everlasting goal for all. This motivated continuous efforts to set structured medical education standards for modern practice.[9] In this study, we aim to investigate patients undergoing URS by analyzing all factors associated with an unfavorable surgical outcome. Additionally, we intended to highlight the safety of ureteroscopy teaching.

Material and methods

Data collection

This is a retrospective study done between July 2008 and June 2011 at a tertiary medical center recognized by the international accreditation council for graduate medical education (ACGME-i). The hospital's medical registry was reviewed for records of patients undergoing URS. The identified records were evaluated for data collection. Inclusion criteria were male and female patients above 18 years of age who had undergone URS. The collected data included information regarding patients' demographics, characteristics of their stone disease, details of surgery and postoperative period.

In addition to routine preoperative investigations, computed topography (CT) was done for all patients upon presentation, and results were assessed for stone characteristics. Data regarding stone size, location and presence or absence of hydronephrosis or hydroureter were collected. Dilatation of the renal pelvis and ureter was considered when their diameters measured more than 20 mm and 6 mm, respectively.[6] Intraoperative findings were documented including the presence of stone impaction (if any).

Information related to surgery included mean duration, skill level of operating surgeon, use of pneumatic or holmium laser for stone disintegration, use of forceps or basket for retrieval of the fragments and use of an an indwelling ureteral stent (if any). Presence of recognized intraoperative complications such as mucosal injury, contrast extravasation, false ureteric passage and ureteric perforation or avulsion were also noted.

All patients underwent laboratory and radiographic investigations in the form of complete blood count, renal function tests and plain kidney ureter and bladder (KUB) x-ray on the first postoperative day to monitor their medical condition. Three months after surgery, a KUB x-ray or urinary ultrasound and/or CT scan were performed for all patients depending on the stone radiolucency. Data regarding postoperative course were collected which included information regarding presence of residual fragments, location of double J stent (DJS) (if placed), results of laboratory investigations, days of hospital stay, and presence of postoperative complications. Postoperative complications included fever (>38°C), obstruction after removal of ureteral catheter necessitating re-fixation, and ureteral stricture. Intraoperative and postoperative complications were recorded in compliance with the modified Clavien–Dindo classification system.

Operative details

The URS performed at our center followed a standardized technique. After obtaining signed informed consent forms from all patients, URS was performed using general anesthesia in most patients and spinal anesthesia in others. Intravenous antibiotics (third-generation cephalosporin) were routinely given to all patients at the time of anesthesia and maintained for 24 to 48 hours.

The procedure started with cystoscopy using video monitor, followed by the introduction of a guidewire through the ureteral orifice. A semi-rigid 8/9.8Fr (Richard Wolf, Knittingen, Germany) or 9.5Fr (Karl Storz, Tuttlingen, Germany) ureteroscopes were routinely used. A smaller caliber ureteroscope - 8Fr (Karl Storz, Tuttlingen, Germany) was used when encountering a stenotic ureter. Small stones were removed intact with forceps or basket, while large stones were disintegrated with pneumatic or holmium laser lithotripter. Resulting fragments were either removed or left for spontaneous passage depending on their size. At the end of the procedure, a ureteral catheter or a DJS was placed according to patients' condition and surgeon's decision.

The same procedure was done in all cases. Expert urologists are certified urologists who had been practicing endo-urology procedures for at least 2 years post- residency. Trainees were urol-

ogy residents who had received 2 years of postgraduate basic surgical training before practicing endo-urology. All procedures performed by trainees were done under direct supervision of an expert urologist. Direct supervision is the first level of graduate medical education (GME) graded responsibility system in which the Faculty is physically present with the resident and patient.

Statistical analysis

Patients were divided into two groups according to their outcomes. Group 1 included patients with a favorable outcome who became stone-free after a single ureteroscopy procedure without any intraoperative or postoperative complications. Group 2 included patients with an unfavorable outcome, who were not stone free, and needed more than a single procedure and/or showed any complication. The group with unfavourable outcomes (Group 2) was subdivided according to the skill level of operating surgeon into two subgroups. Patients belonging to subgroup A had their procedures performed by trainees under direct supervision of expert urologists, while those in subgroup B had their procedures performed by the expert urologists themselves.

All groups were compared using univariate (chi-square and t tests) and multivariate (logistic regression) statistical tests to identify significant risk factors. A *p* value of <0.05 was considered significant. All data were analyzed using Statistical Package for the Social Sciences® version 20 (IBM SPSS Statistics, Armonk, NY, USA). Results were compared with literature data.

Results

Eight hundred and ninety- one patients had undergone 1182 URSs which were performed on the right (558), left (479), and both ureters (145). The patients' mean age ± SD was 39.7±11.6 years. All URSs were done for the management (94.8%) or diagnosis (5.2%) of urolithiasis. Intra-, and post-operative complications were noted in 10.8%, and 1.4% of the cases, respectively. Other characteristics of the studied population are presented in Table 1.

The overall stone- free, and complication rates were 90.8%, and 12.1% respectively.

Groups 1, and 2 included 958, and 224 atients. Univariate analysis of factors revealed that an unfavorable outcome was significantly related to the presence, size, location, degree of impaction of the stone, mean operative time, and failure of stone retrieval. The mean (± SD) stone size in the groups with favourable, and unfavourable outcomes were 10.5±4.6 x 9.9±4.3 mm, and 8.5±3.4 x 8.1±3.3 mm, respectively (p<0.001). Stone location significantly influenced the outcome of surgery. Unfavorable, and favourable outcomes of URS performed for distal ureteric stones were seen in 50.6, and 65.7 % of the cases, respectively. On the contrary, upper ureteric stones were associated with unfavorable, and favourable outcomes in 49.4, and 34.3% of the cases, respectively (p<0.001). The mean operative time was significantly higher in Group 1 when compared with Group 2 (56.4±35.5 and 49.3±27.7 min, respectively) Nearly half (47.7%) of the stones were impacted in Group 2 versus 26.4% in

Table 1. Characteristics of the study population

Patient characteristics	
Age (year)	39.7±11.6
Sex	
Male	802 (67.9)
Female	89 (7.5)
BMI (kg/m^2)	27.2±5.2
Stone characteristics	
ST length	9.5±4.8
ST width	7.3±3.1
ST location	
Unilateral	1037 (87.7)
Bilateral	145 (12.3)
Hydronephrosis	352 (29.8)
Surgery characteristics	
Indications	
Diagnostic	62 (5.2)
Therapeutic	1120 (94.8)
Mean OR time	50.7±29.4
Stone disintegration	685 (58)
DJS	907 (76.7)
Status of the surgeon	
Expert	689 (58.9)
Trainee	493 (41.7)
Complications	
Intraoperative	128 (10.8)
Postoperative	17 (1.4)
Stone- free at 3 months	1073 (90.8)

BMI: body mass index; OR: operative time; DJS: double J stenting

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Table 2. Univariate analysis of risk factors for the groups with favorable (Group 1) and unfavorable (Group 2) outcomes

Patient characteristics	Group 1 (n=958)	Group 2 (n=224)	p
Age (year)	39.5±11.7	40.3±11.3	0.39
BMI (kg/m^2)	27.4±5.3	26.5±5.0	0.02
Male	689 (89.8)	113 (91.1)	0.39
Female	78 (10.2)	11 (8.9)	
Stone characteristics			
Stone Length	8.5±3.4	10.5±4.6	<0.001
Stone Width	8.1±3.3	9.9±4.3	<0.001
Stone location			0.25
Unilateral	837 (87.4)	200 (89.3)	
Bilateral	121 (12.6)	24 (10.7)	
Stone level			<0.001
Distal	473 (65.7)	81 (50.6)	
Upper	247 (34.3)	79 (49.4)	
Hydronephrosis	275 (28.8)	77 (34.5)	0.055
Surgery characteristics			
Indication			0.52
Diagnostic	50 (5.2)	12 (5.4)	
Therapeutic	908 (94.8)	212 (94.6)	
OR time	49.3±27.7	56.4±35.5	<0.001
Orifice dilatation	20 (2.3)	12 (3.7)	0.37
Stone presence	831 (86.7	198 (88.4)	0.29
Stone Impaction	253 (26.4)	106 (47.7)	<0.001
Stone disintegration	341 (39.8)	156 (47.9)	0.008
Stone retrieval	520 (54.3)	57 (25.4)	<0.001
The status of the Surgeon			0.33
Expert	555 (57.9)	134 (59.8)	
Trainee	403 (42.1)	90 (40.2)	

BMI: body mass index; ST: stone; OR: operative time

Group 1 (p<0.001). Other results of univariate analysis are presented in Table 2. Factors with statistical significance were compared using multivariate analysis and the results are presented in Table 3. Stone location and impaction were the only factors that maintained statistical significance.

Table 3. Multivariate analysis of significant univariable variables

	OR	p	95% CI
Stone length	1.1	0.37	0.9-1.3
Stone width	1.0	0.8	0.8-1.2
Operative time	1	0.8	0.9-1
Stone Impaction	2.9	<0.001	1.6-5.3
Stone Level	2.9	<0.001	1.6-5.4

OR: odds ratio

Five trainees performed 493 URSs under direct supervision and contributed to 90 cases (18%) of Group 2 in comparison with expert urologists who had 134 cases (19%) of the same group. The trainees' stone- free rate (SFR) was 90.3% and complication rate (CR) 10.5% compared to SFR 91.1% and CR 13% for URSs done by expert urologists. Four cases operated by expert urologists were converted to open surgery. One case had a large impacted 3 cm ureteric stone proximal to the stricture developed after ureteric re-implantation and 3 had large impacted stones that completely obstructed their ureters and failed ureteroscopy. Comparative results between supervised trainees and expert urologists are presented in Table 4.

Discussion

Advancements in URS technology have greatly improved management of urolithiasis. In very few circumstances URS cannot handle a ureteric stone.[10] This progress in the efficacy of URS was additionally associated with a remarkable safety profile. Although an overall complication rate of up to 12% has been reported[11], major intraoperative complications requiring surgical intervention occur in no more than 1% of the cases.[12] Recently, there has been a notion to utilize standardized methods for reporting complications; as such, the modified Clavien–Dindo classification system was proven to be a reliable tool for this purpose.[13] The European Association of Urology guideline panel adopted this system since 2012.[14] An ad hoc committee concluded that uniform reporting of complications after urologic procedures will contribute to improvements in scientific quality of papers published in the field of urologic surgery.[14] Our reported results fall in the accepted range with an overall intraoperative complication rate of 10.8% in a total of 1182 procedures.

In an attempt to reduce complication rate, several studies were made to evaluate risk factors for unfavorable outcome with URS.[5-8,15,16] Factors found to be associated with higher complication rate were stone size, proximal stone location, stone impaction and operating surgeon experience. In this study, stone impaction

Table 4. Some demographic characteristics of the urology trainees and urologists in the unfavorable group (n=224)

	Trainees (n=90) (18.3%)	Experts (n=134) (19.4%)	p 0.6
Patient characteristics			
Age (years)	39.7±11.7	38.9±11.5	0.54
BMI (kg/m^2)	26.9±5.7	26.7±4.9	0.81
Stone characteristics			
Stone size	9.57±4.1 x 7±1.4	10.7±4.6 x 9±4.4	0.21
Stone location			
Distal	33 (36.7)	48 (35.8)	0.97
Upper	27 (14.4)	52 (38.8)	
Multiple stones	17 (18.9)	21 (15.7)	
Hydronephrosis	33 (24.3)	67 (35.4)	0.02
Operative time (min)	53.7±27.8	58.2±37.05	0.24
Stone impaction	43 (48.3)	63 (47.4)	0.43
Complications according to modified Clavien-Dindo classification system			
Grade 1			
Mucosal injury	8(8.9)	11 (8.2)	0.52
Contrast extravasation	7 (7.8)	11 (8.2)	0.49
Grade 2			
Perforation	1 (1.1)	4 (3)	0.21
Fever	7 (7.8)	2 (1.5)	0.17
Grade 3a			
Failure to pass URS	22 (24.4)	33 (24.6)	0.55
Stone migration	4 (4.4)	23 (17.2)	0.01
Obstruction post DJS removal	2 (2.2)	1 (0.7)	0.48
Grade 3b			
Conversion to open surgery	0 (0)	4 (3)	
Grade 4a			
Sepsis	1 (1.1)	1 (0.7)	0.50
Total complications	52	90	0.1
Stone-free rate	42 (46.7)	73(54.5)	0.15

BMI: body mass index; DJS: double J stenting

and proximal location were the only factors that maintained statistical significance with multivariate analysis, with odds ratio of 2.9 (95% CI 1.6-5.3) and 2.9 (95% CI 1.6-5.4), respectively.

The relation of stone size to the ureteroscopy outcome is controversial. Some studies revealed unfavorable outcome with larger stone size[6,7,16], while others didn't show significant effect on outcome.[8,17] In this study, a mean stone width ± SD of 9.9±4.3 mm and length 10.5±4.6 were found to be the only significant factors in the univariate analysis but they didn't maintain their significance in the multivariate analysis.

As is the case with previous studies[6,7], we found that stone impaction is strongly related to an unfavorable outcome. Considerable ureteral edema occurring as a result of stone impaction leads to submucosal false passage early in the surgery during the insertion of the guide wire. As a consequence, extravasation can occur and more seriously ureteral perforation, which may result from URS manipulation through the false passage or forceful pushing of the stone through the fragile ureteral lumen during lithotripsy.

Location of the stone is also found to be a significant factor associated with unfavorable outcomes.[6,7] The ureter is a smooth

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muscular tube with a thinner proximal wall that renders it prone to injury during upper URS.[18] Actions such as excessive handling, lithotripsy or use of forceps or basket in this part of the ureter are more likely to cause injury than the distal part. As such, leaders in the field of endo-urology recommend that basketing of stones in the mid and proximal ureter be tried only with extreme caution, and–unless the stones are exceptionally small–never be retrieved intact.[19] In this study, unfavorable and favorable outcomes related to proximal ureteric stones were detected in 45.4 and 33.8% of the cases, respectively (p=0.001).

The experience of the operating surgeon affects the outcome of ureteroscopy; the more experienced endo-urologists have better outcome than the less experienced certified urologists.[6] In the meantime, there is evidence to suggest equivalent outcomes for trainees under direct supervision when compared to expert staff. In a study by Leijte et al.[20] comparing surgical outcomes between experts and trainees, the surgical outcome in terms of stone- free rate and complication rate was superior in the supervised trainees group than in the least experienced expert group. In another series, Netsch et al.[21] evaluated the impact of surgical experience on the outcome of ureteroscopy done for a single upper ureteric stone and found that the supervised trainees had a similar overall outcome to their mentor consultants. In this study, we compared the outcomes of all ureteroscopies that were done by supervised trainees and their mentors for a period of 3 years. There was no significant difference in the incidence of outcomes. This finding prompted further analysis aiming for an explanation. All surgeries performed by trainees at this center are done under the direct supervision of an expert experienced urologist. This means that the expert is physically active in the operating theatre, monitoring the procedure and giving instant and continuous feedback to the trainee. The expert urologist takes over the procedure whenever a complication occurs. One good example that can be given to a similar circumstance in operation is the commercial airline industry. It is not uncommon to compare medical and aviation fields, as both tend to deal with people's safety. One study evaluated perceptions of fatigue, stress and error as targets for improvement necessary in both aviation and medicine.[22] In commercial aviation, the first officer is the junior or co-pilot who performs duties similar to the captain. The captain, on the other hand, is the commanding officer who is responsible for the overall flight operation and is physically active in the cockpit at all times. This hierarchy system is adopted by almost all airline carriers and is proven to be most effective in reducing human errors. This model of operation can explain our study results. The expert urologist is present monitoring every step of surgery but is not involved physically in the procedure, which makes him more focused on feedback to ensure a safe procedure. Additionally, to warrant proper teaching, he insists on performing an evidence-based step ward approach to surgery, an aspect that he might overcome in certain situations based on his expertise.

The degree of training required to master endo-urology procedures such as URS has not been explored thoroughly. A literature review by Skolarikos et al. certifies the presence of obstacles in defining the learning curve in URS.[17] In a study done by Botoca et al.[23] it was found that URSs performed by trainees were associated with lower stone- free rates and higher complication rates. However, after approximately 50 procedures, URSs done by trainees showed a tendency to plateau at a level similar to the results mentioned in the EAU guidelines. This finding indicates that URS is suitable for trainees provided that they receive adequate supervision by expert urologists.

The ACGME[17] assigned a minimum number of procedures as part of the accreditation process for urology residency programs. Three categories exist and include surgeon, teaching assistant, and the first assistant. For all these categories a minimum requirement of 40 URSs during the entire residency are needed for achieving competence. In this study, 5 trainees performed 493 URSs over two years. This exposure, by far, explains the favorable surgical outcomes of URSs performed by trainees. This study was evaluating the outcomes of semi-rigid ureteroscopy in a high- volume teaching hospital. High- volume hospitals where more than 200 ureteroscopy procedures are performed per year were found to obtain better outcomes.[24]

This study is limited by its retrospective design, which is generally considered to have a lower level of evidence. However, it can also serve as an audit for a given practice. We were able to retrieve valuable information and withdraw conclusions regarding the education of future urologists. However, some valuable information that may have influenced the outcome couldn't be assessed; in reality, suspected difficult cases are usually done by expert staff rather than trainees and easier cases that were pre-stented are usually done by trainees. This can't be ruled out except in a prospective randomized controlled trial.

Finally, this study is not comparing trainees with expert urologists, as surgeries done by trainees were under direct supervision by the same expert urologists who were directing them and interfering at any crucial step. On the contrary, it values a teaching atmosphere in medicine and may suggest that a high- volume teaching hospital is a safer place for patients to seek treatment for different ailments.

In conclusion, advancements in ureteroscopy greatly improved the efficacy of management of urolithiasis and reduced complication rates. Factors such as stone impaction and proximal location are associated with unfavorable surgical outcomes.

In the modern era of medical practice, teaching in the surgical field is a valued principle; it can improve surgical outcome and patient safety.

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References

1. Tefekli A, Cezayirli F. The history of urinary stones: in parallel with civilization. Scientific World J 2013;2013:423964 [CrossRef]
2. Puppo P, Ricciotti G, Bozzo W, Introini C. Primary endoscopic treatment of ureteric calculi. A review of 378 cases. Eur Urol 1999;36:48-52. [CrossRef]
3. Vorreuther R, Franzen W, Engelking R. Ultrathin flexible endoscopes for ureteroscopy. A preliminary experimental and clinical study. Surg Endosc 1989;3:212-5. [CrossRef]
4. Mursi K, Elsheemy MS, Morsi HA, Ali Ghaleb AK, Abdel-Razzak OM. Semi-rigid ureteroscopy for ureteric and renal pelvic calculi: Predictive factors for complications and success. Arab J Urol 2013;11:136-41. [CrossRef]
5. Perez Castro E, Osther PJ, Jinga V, Razvi H, Stravodimos KG, Parikh K, et al. Differences in ureteroscopic stone treatment and outcomes for distal, mid-, proximal, or multiple ureteral locations: the Clinical Research Office of the Endourological Society ureteroscopy global study. Eur Urol 2014;66:102-9. [CrossRef]
6. El-Nahas AR, El-Tabey NA, Eraky I, Shoma AM, El-Hefnawy AS, El-Assmy AM, et al. Semirigid ureteroscopy for ureteral stones: a multivariate analysis of unfavorable results. J Urol 2009;181:1158-62. [CrossRef]
7. Ciftci H, Savas M, Altunkol A, Yeni E, Verit A, Celepkolu B. Influence of stone size, location and impaction on the success of ureteroscopic pneumolithotripsy. Georgian Med News 2010;183:7-12.
8. Cheung MC, Lee F, Yip SK, Tam PC. Outpatient holmium laser lithotripsy using semirigid ureteroscope. Is the treatment outcome affected by stone load? Eur Urol 2001;39:702-8.
9. Van Zanten M, Boulet JR, Greaves I. The importance of medical education accreditation standards. Med Teach 2012;34:136-45. [CrossRef]
10. Honeck P, Wendt-Nordahl G, Krombach P, Bach T, Häcker A, Alken P, et al. Does open stone surgery still play a role in the treatment of urolithiasis? Data of a primary urolithiasis center. J Endourol 2009;23:1209-12. [CrossRef]
11. Harmon WJ, Sershon PD, Blute ML, Patterson DE, Segura JW. Ureteroscopy: current practice and long-term complications. J Urol 1997;157:28-32. [CrossRef]
12. Johnson DB, Pearle MS. Complications of ureteroscopy. Urol Clin North Am 2004;31:157-71. [CrossRef]
13. Ibrahim AK. Reporting ureteroscopy complications using the modified clavien classification system. Urol Ann 2015;7:53-7. [CrossRef]
14. Mitropoulos D, Artibani W, Graefen M, Remzi M, Rouprêt M, Truss M, et al. Reporting and grading of complications after urologic surgical procedures: an ad hoc EAU guidelines panel assessment and recommendations. Eur Urol 2012;61:341-9. [CrossRef]
15. Geavlete P, Georgescu D, Niţă G, Mirciulescu V, Cauni V. Complications of 2735 retrograde semirigid ureteroscopy procedures: a single-center experience. J Endourol 2006;20:179-85. [CrossRef]
16. Abdelrahim AF, Abdelmaguid A, Abuzeid H, Amin M, Mousa el-S, Abdelrahim F. Rigid ureteroscopy for ureteral stones: factors associated with intraoperative adverse events. J Endourol 2008;22:277-80. [CrossRef]
17. Skolarikos A, Gravas S, Laguna MP, Traxer O, Preminger GM, de la Rosette J. Training in ureteroscopy: a critical appraisal of the literature. BJU Int 2011;108:798-805. [CrossRef]
18. Huffman JL. Ureteroscopic injuries to the upper urinary tract. Urol Clin North Am 1989;16:249-54.
19. De la Rosette J, Skrekas T, Segura JW. Handeling and prevention of complications in stone basketing. Eur Urol 2006;50:991-9. [CrossRef]
20. Leijte JA, Oddens JR, Lock TM. Holmium laser lithotripsy for ureteral calculi: predictive factors for complications and success. J Endourol 2008;22:257-60. [CrossRef]
21. Netsch C, Knipper AS, Orywal AK, Tiburtius C, Gross AJ. Impact of surgical experience on stone-free rates of ureteroscopy for single urinary calculi of the upper urinary tract: a matched-paired analysis of 600 patients. J Endourol 2015;29:78-83. [CrossRef]
22. Sexton JB, Thomas E, Helmreich RL, Error, stress, and teamwork in medicine and aviation: cross sectional surveys. BMJ 2000;320:745-9. [CrossRef]
23. Botoca M, Bucuras V, Boiborean P, Herman I, Cumpanas A, Miclea F. The learning curve in ureteroscopy for the treatment of ureteric stones. How many procedures are needed to achieve satisfactory skills? Eur Urol Suppl 2004;3:138.
24. Kandasami SV, Mamoulakis C, El-Nahas AR, Averch T, Tuncay OL, Rawandale-Patil A, et al. Impact of case volume on outcomes of ureteroscopy for ureteral stones: the clinical research office of the endourological society ureteroscopy global study. Eur Urol 2014;66:1046-51. [CrossRef]