ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

DOI: 10.5336/urology.2025-108940

Retrograde Intrarenal Surgery Outcomes in the Management of Renal Stones: A Retrospective Analysis of 3,781 Cases Over 11 Years

11 Yıllık Sürede 3.781 Vakanın Retrospektif Analizi: Böbrek Taşlarının Tedavisinde Retrograd İntrarenal Cerrahi Sonuçları

Ali NEBİOĞLU[a], Mert BAŞARANOĞLU[b], Mesut TEK[b], Erdem AKBAY[b]

[a]Mersin City Training and Research Hospital, Clinic of Urology, Mersin, Türkiye
[b]Mersin University Faculty of Medicine Health Application and Research Center, Department of Urology, Mersin, Türkiye

ABSTRACT Objective: To evaluate the efficacy, safety, and clinical outcomes of retrograde intrarenal surgery in a large patient cohort and identify factors affecting treatment success across different demographic groups. **Material and Methods:** This retrospective study analyzed 3,781 patients who underwent retrograde intrarenal surgery between January 2013 and December 2023. Patient demographics, stone characteristics, operative parameters, and complications were evaluated. Stone-free rates, operative times, and complications were assessed according to stone location and size. The primary outcome was stone-free status evaluated by non-contrast computed tomography at 3 months postoperatively. Multivariate analysis was performed to identify predictors of treatment success. **Results:** The overall stone-free rate was 88.7%. Mean stone size was 13.9±5.6 mm, with mean operative time of 52 minutes. Stone distribution was: lower calyx (42.5%), renal pelvis (30.0%), upper calyx (15.2%), and middle calyx (12.3%). Total complication rate was 12.5%, with minor complications (Clavien-Dindo Grade I-II) occurring in 11.4%, moderate complications (Grade III) in 1.0%, and major complications (Grade IV) in 0.05% of cases. Multivariate analysis identified stone size >15mm (odds ratio [OR]: 0.68, p<0.001), lower calyx location (OR: 0.75, p=0.004), and multiple stones (OR: 0.82, p=0.042) as significant predictors of treatment success. Patient satisfaction averaged 8.4 out of 10, showing strong correlation with stone-free status (correlation coefficient: 0.85, p<0.001). **Conclusion:** Retrograde intrarenal surgery demonstrates high efficacy and safety in treating upper urinary tract stones, with favorable outcomes across different patient groups. Stone size, location, and multiplicity significantly influence treatment success, while complication rates remain low with standardized technique. These findings can aid in optimizing patient selection and improving preoperative counseling.

Keywords: Ureteroscopy; urinary calculi; minimally invasive surgical procedures; treatment outcome; postoperative complications

ÖZET Amaç: Geniş hasta kohortunda retrograd intrarenal cerrahinin etkinliğini, güvenliğini ve klinik sonuçlarını değerlendirmek ve farklı demografik gruplarda tedavi başarısını etkileyen faktörleri belirlemek. **Gereç ve Yöntemler:** Bu retrospektif çalışma, Ocak 2013-Aralık 2023 tarihleri arasında retrograd intrarenal cerrahi uygulanan 3.781 hastayı analiz etti. Hasta demografisi, taş özellikleri, operatif parametreler ve komplikasyonlar değerlendirildi. Taş lokasyonu ve boyutuna göre taşsızlık oranları, operasyon süreleri ve komplikasyonlar değerlendirildi. Birincil sonuç, postoperatif 3. ayda kontrastsız bilgisayarlı tomografi ile değerlendirilen taşsızlık durumuydu. Tedavi başarısının öngördürücülerini belirlemek için çok değişkenli analiz yapıldı. **Bulgular:** Genel taşsızlık oranı %88,7 idi. Ortalama taş boyutu 13,9±5,6 mm, ortalama operasyon süresi 52 dakika idi. Taş dağılımı şu şekildeydi: alt kaliks (%42,5), renal pelvis (%30,0), üst kaliks (%15,2) ve orta kaliks (%12,3). Toplam komplikasyon oranı %12,5 olup; minör komplikasyonlar (Clavien-Dindo Grade I-II) %11,4, orta komplikasyonlar (Grade III) %1,0 ve majör komplikasyonlar (Grade IV) %0,05 oranında görüldü. Çok değişkenli analiz, 15 mm'den büyük taş boyutu (odds ratio [OR]: 0,68, p<0,001), alt kaliks lokalizasyonu (OR: 0,75, p=0,004) ve multipl taşları (OR: 0,82, p=0,042) tedavi başarısının anlamlı öngördürücüleri olarak belirledi. Hasta memnuniyeti 10 üzerinden ortalama 8,4 olup, taşsızlık durumu ile güçlü korelasyon gösterdi (korelasyon katsayısı: 0,85, p<0,001). **Sonuç:** Retrograd intrarenal cerrahi, üst üriner sistem taşlarının tedavisinde yüksek etkinlik ve güvenlik göstererek farklı hasta gruplarında olumlu sonuçlar sağlamaktadır. Taş boyutu, lokalizasyonu ve multiplisitesi tedavi başarısını önemli ölçüde etkilemekte, standardize teknik ile komplikasyon oranları düşük kalmaktadır. Bu bulgular hasta seçiminin optimizasyonuna ve preoperatif danışmanlığın iyileştirilmesine yardımcı olabilir.

Anahtar Kelimeler: Üreterorenoskopi; üriner kalkülüsler; minimal invaziv cerrahi işlemler; tedavi sonucu; postoperatif komplikasyonlar

TO CITE THIS ARTICLE:
Nebioğlu A, Başaranoğlu M, Tek M, Akbay E. Retrograde intrarenal surgery outcomes in the management of renal stones: A retrospective analysis of 3,781 cases over 11 years. J Reconstr Urol. 2025;15(2):44-51.

Correspondence: Ali NEBİOĞLU
Mersin City Training and Research Hospital, Clinic of Urology, Mersin, Türkiye
E-mail: alinebioglu90@gmail.com

Peer review under responsibility of Journal of Reconstructive Urology.

Received: 28 Jan 2025 ***Accepted:*** 11 Apr 2025 ***Available online:*** 08 Jul 2025

Urinary system stone disease is emerging as a significant public health problem with increasing prevalence worldwide.[1,2] Changes are being observed in the epidemiology of stone disease, including age and gender distribution, as well as stone location and types.[3] Urinary system stone disease is influenced by a combination of genetic predisposition, lifestyle, diet, and environmental conditions.[4] Genetic studies have shown that nephrolithiasis is more than 45% heritable, and there are many genes and molecular pathways that contribute to the risk of stone formation.[4] Comorbidities such as obesity, as well as dietary habits containing excessive protein, have been associated with increased risk of stone formation.[5] Environmental factors, especially hot climates, play an important role in stone formation.[5] Lifestyle modifications and medical measures requiring individual compliance and continuous motivation can be quite effective in reducing these risks.[5,6]

Minimally invasive urological surgical techniques have significantly advanced and become widespread, especially in the last 3 decades, thanks to technological developments in imaging, instrumentation, and robotics.[7-9] Innovations such as 3-dimensional computer-aided imaging and virtual reality endoscopy have improved diagnostic capabilities and surgical planning.[8] Laparoscopic ultrasound and advanced video cameras have provided better visualization during procedures.[8,9] Moreover, increasingly less invasive approaches are being developed, and these techniques are shown to have positive effects on pain, length of hospital stay, and cosmetic results without compromising therapeutic efficacy.[9]

Retrograde intrarenal surgery (RIRS) and ureterorenoscopy (URS) stand out as effective and safe methods in the treatment of urinary system stone diseases.[10-12] RIRS offers successful results particularly in stones of 1-2 cm size and can be safely applied in patients with special conditions such as bleeding disorders or pregnancy.[12,13] Stone-free rates in the 1st session vary between 87.9-91.1%, and this rate can reach 100% in the 2nd session.[13] However, complication rates in the literature can vary between 0.3% and 31.7%.[12,14] Nevertheless, the minimally invasive nature of RIRS and its satisfactory clinical results increase the reliability of the method, especially when appropriate patient selection is made.[13,15]

In this retrospective study, 3,781 surgical cases performed over an 11-year period were analyzed to evaluate the efficacy, complication profile, and clinical outcomes of the retrograde intrarenal surgery procedure. The study encompasses data from a large patient population and aims to demonstrate what kind of success and safety profile these procedures offer in different demographic groups. Additionally, factors affecting treatment success, anatomical locations of stones, and operation times were examined in detail.

This comprehensive analysis aims to contribute both to the evaluation of current clinical practice and to future research.

MATERIAL AND METHODS

This single-center retrospective investigation encompassed clinical data from 3,781 consecutive patients who underwent retrograde intrarenal surgery at our tertiary referral center between January 2013 and December 2023. The institutional review board granted approval for this study (date: January 08, 2025, no: 2025/033), and all procedures adhered to the ethical principles outlined in the Declaration of Helsinki. The investigation incorporated adult patients with documented renal calculi necessitating surgical management. We established specific inclusion parameters comprising complete preoperative assessments, detailed surgical documentation, and comprehensive follow-up records. Exclusion criteria encompassed insufficient medical documentation, absence of research consent, concomitant urological conditions requiring additional interventions, and cases lost to follow-up within the initial trimester.

All procedures were conducted under general anesthesia with patients positioned in modified lithotomy position. Fluoroscopic guidance was employed selectively during access sheath placement and for verification of stone clearance. Our surgical approach incorporated the Karl Storz Flex-X2 (Karl Storz, Tuttlingen, Germany) digital flexible ureteroscope system in conjunction with a 272 µm Holmium:YAG laser apparatus. The laser parameters were cus-

tomized according to stone characteristics, employing 0.8-1.2 J energy and 10-15 Hz frequency settings. We utilized appropriately sized access sheaths, selecting between 9.5/11.5F or 12/14F based on individual anatomical considerations and stone parameters. The stone fragmentation strategy employed a dusting technique for calculi below 15mm, while larger stones underwent a combined dusting and fragmentation approach. Double-J stent placement was performed based on operative time exceeding 90 minutes, presence of residual fragments, ureteral injury, or surgeon preference for anatomical considerations.

Treatment success was defined as complete stone clearance or presence of clinically insignificant residual fragments ≤2mm at 3-month follow-up imaging. Stone-free status was evaluated using non-contrast computed tomography, chosen for its superior sensitivity in detecting residual fragments. The postoperative protocol implemented a standardized pain management regimen consisting of initial intramuscular diclofenac sodium administration followed by oral paracetamol maintenance. Antimicrobial prophylaxis was administered according to institutional protocols based on local resistance patterns and individual culture results.

Our comprehensive follow-up strategy incorporated multiple assessment points. Initial evaluation occurred within the first postoperative week, focusing on catheter-related complications and immediate surgical outcomes. The 1-month follow-up assessed general recovery and early complications. Stone clearance was verified through non-contrast computed tomography at 3 months, with subsequent annual monitoring for recurrence over a 3-year period. Patient satisfaction was evaluated using a validated 10-point visual analog scale addressing pain management, recovery time, and overall treatment experience. We systematically categorized complications into intraoperative, early postoperative, and late postoperative events, utilizing the Clavien-Dindo classification system for standardization. Stone composition analysis revealed predominant calcium oxalate monohydrate formation, with varying distributions of calcium oxalate dihydrate, uric acid, and struvite components. Comprehensive statistical findings are presented in Table 1.

TABLE 1: Demographic characteristics and surgical results

Characteristic	Value	p value
Age (years)	45.80±6.33	0.038
Gender (n, %)		
Male	2,000 (52.9%)	0.042
Female	1,781 (47.1%)	ref
Stone size (mm)	13.9±5.6 (4-19)	<0.001
Stone location (n, %)		
Upper calyx	575 (15.2%)	ref
Middle calyx	465 (12.3%)	0.856
Lower calyx	1,608 (42.5%)	0.034
Renal pelvis	1,133 (30.0%)	0.762
Operation time (min)	52 (15-90)	0.027
Fluoroscopy time (sec)	62 (20-136)	0.033
Stone-free rate	88.7%	<0.001
Complications (n, %)		
Grade I-II	433 (11.4%)	0.012
Grade III	38 (1.0%)	0.004
Grade IV	2 (0.05%)	0.042

Values are presented as number (percentage) or mean±standard deviation where appropriate.

Statistical evaluation employed SPSS version 26.0 software (IBM Corporation, Armonk, NY, USA), complemented by G*Power (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) for sample size validation. Our analysis achieved a power of 0.99 (α=0.05) with an effect size of 0.3, substantially exceeding the minimum required sample size. We assessed data normality through Shapiro-Wilk testing and Q-Q plot visualization. The analysis stratified stones into 3 dimensional categories: small (<10mm, n=1,252), medium (10-15mm, n=1,875), and large (>15mm, n=654). Statistical comparisons incorporated one-way analysis of variance with Bonferroni correction for normal distributions and Kruskal-Wallis testing with Dunn's "post hoc" analysis for non-parametric data. Categorical variables underwent chi-square analysis with appropriate Bonferroni adjustments. The investigation employed binary logistic regression for multivariate analysis, assessing model fit through Hosmer-Lemeshow testing. Correlation analyses between satisfaction scores and clinical outcomes utilized Pearson's and Spearman's coefficients as appropriate. Multiple linear regression accounted for potential confounding variables including demographic and clinical parameters.

RESULTS

In this retrospective study, a total of 3,781 patients covering 11 years of clinical experience were evaluated. When examining the demographic characteristics of the patients, 52.9% (n=2,000) were male and 47.1% (n=1,781) were female. The mean age of the study population was calculated as 45.80±6.33 years (Table 1).

When examining surgical procedures, the mean stone size was measured as 13.9±5.6 mm (4-19 mm). The mean operation time was 52 minutes (range: 15-90 minutes), and the mean fluoroscopy time during retrograde intrarenal surgery procedures was recorded as 62 seconds (20-136 seconds), as shown in Table 1.

The anatomical distribution of stones is presented in Table 1, with 15.2% (n=575) located in the upper calyx, 12.3% (n=465) in the middle calyx, 42.5% (n=1,608) in the lower calyx, and 30% (n=1,133) in the renal pelvis. Figure 1 illustrates the relationship between stone size and stone-free rates across different locations, while Figure 2 demonstrates the relationship between these factors and operative times.

Multivariate analysis revealed several factors affecting stone-free rates (Table 2). Stone size >15mm (odds ratio (OR): 0.68, 95% confidence interval (CI): 0.52-0.89, p<0.001) and lower calyx location (OR: 0.75, 95% CI: 0.61-0.92, p=0.004) were identified as significant predictors of treatment success. Figure 2 demonstrates the relationship between stone size and operative time.

Complications were evaluated according to the Clavien-Dindo classification system (Figure 3, horizontal bar chart). The distribution of complications across different stone locations is presented in Table 3. In long-term follow-ups, ureteral stricture developed in 0.6% (n=23) of patients (Grade IIIb), which is consistent with the 0.5-2.5% range reported in the literature. While 65% (n=15) of patients who developed stricture were treated

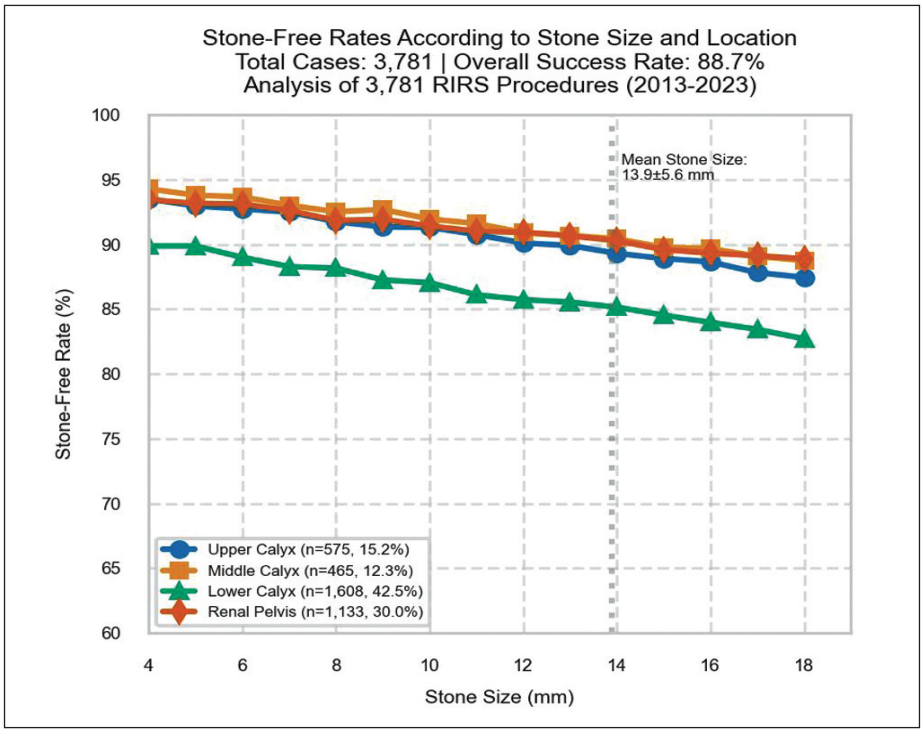

FIGURE 1: Relationship between stone size and stone-free rates across different anatomical locations

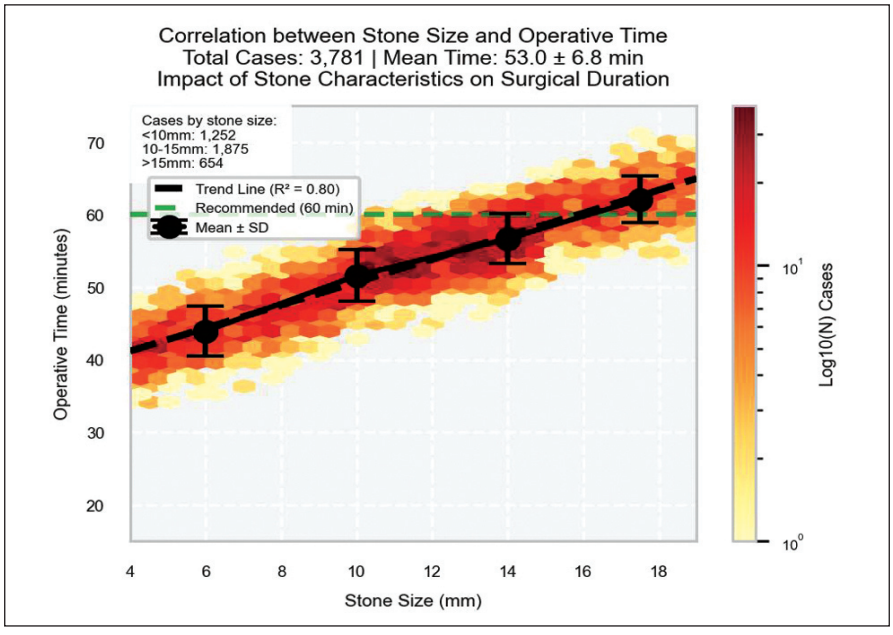

FIGURE 2: Correlation between stone size, location and operative times

endoscopically, 35% (n=8) underwent open surgery. In postoperative follow-up, 6.0% (n=226) of patients developed urinary tract infection (Grade II) and these patients were successfully treated with appropriate antibiotic therapy following infectious diseases consultation.

Stone composition analysis revealed calcium oxalate monohydrate as the predominant type (65%), followed by calcium oxalate dihydrate (20%), uric acid (10%), and struvite (5%). Analysis across age groups (<30, 30-50, 50-70, >70 years) showed similar distributions of calcium oxalate monohydrate and dihydrate stones (p=0.342). However, a significant increase in uric acid stones was observed in patients >70 years (15% vs. 8% in younger groups, p=0.012), while struvite stones showed no age-dependent variation (p=0.876).

Patient satisfaction analysis revealed strong correlations with various factors. Stone-free status showed the strongest positive correlation (r=0.85, p<0.001), while negative correlations were observed with complications (r=-0.65, p<0.001), operative time (r=-0.45, p=0.002), and postoperative pain (r=-0.35, p=0.008). These correlations remained significant after adjusting for age and gender.

TABLE 2: Multivariate analysis of factors affecting stone-free rates

Variable	OR	95% CI	p value
Stone size >15 mm	0.68	0.52-0.89	<0.001
Lower calyx location	0.75	0.61-0.92	0.004
Multiple stones	0.82	0.67-0.99	0.042
Operation Time >90 min	0.88	0.71-1.09	0.238
Age >65 years	0.93	0.76-1.14	0.476
BMI >30 kg/m^2	0.85	0.69-1.05	0.128

Logistic regression analysis identifying independent predictors of stone-free status. Stone size >15mm (OR: 0.68, p<0.001), lower calyx location (OR: 0.75, p=0.004), and multiple stones (OR: 0.82, p=0.042) were significant predictors of treatment success. Multivariate logistic regression analysis of factors affecting stone-free rates.
OR: Odds Ratio; CI: Confidence interval; ref: reference; BMI: Body mass index

DISCUSSION

The results obtained in this study emphasize the efficacy and safety of retrograde intrarenal surgery in urolithiasis treatment. Our overall stone-free rate of 88.7% aligns with recent large-scale studies (85.9-89.3%).[16] This success rate is particularly noteworthy given our large sample size and long follow-up period. Retrograde intrarenal surgery demonstrates lower morbidity and shorter recovery time compared to percutaneous nephrolithotomy, especially

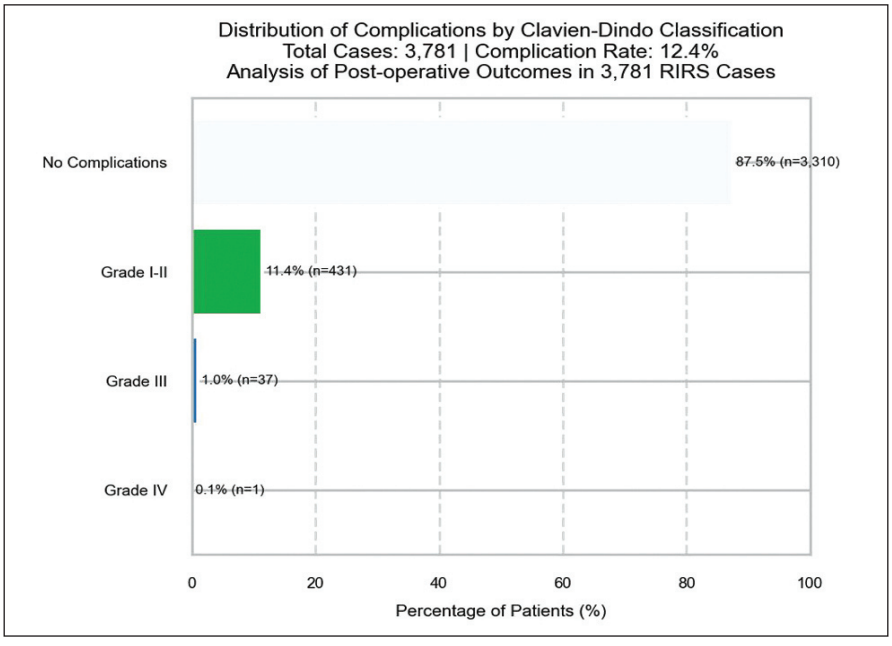

FIGURE 3: Values are presented as number (percentage) or mean±standard deviation where appropriate.

TABLE 3: Comparison of complications according to stone location

Complication type	Upper calyx (n=575)	Middle calyx (n=465)	Lower calyx (n=1,608)	Renal pelvis (n=1,133)	Total (n=3,781)
Mucosal injury	12 (2.1%)	9 (1.9%)	45 (2.8%)	28 (2.5%)	94 (2.5%)
Ureteral perforation	1 (0.2%)	1 (0.2%)	6 (0.4%)	3 (0.3%)	11 (0.3%)
Bleeding	2 (0.3%)	1 (0.2%)	8 (0.5%)	5 (0.4%)	16 (0.4%)
Fever	7 (1.2%)	5 (1.1%)	28 (1.7%)	16 (1.4%)	56 (1.5%)
UTI	32 (5.6%)	25 (5.4%)	102 (6.3%)	67 (5.9%)	226 (6.0%)
Ureteral stricture	3 (0.5%)	2 (0.4%)	12 (0.7%)	6 (0.5%)	23 (0.6%)

Analysis of complications stratified by stone location. Most common complications were UTI (6.0%, n=226), mucosal injury (2.5%, n=94), and fever (1.5%, n=56). Serious complications (Grade III-IV) occurred in 1.05% of cases. UTI: Urinary tract infection

for stones <20mm, as confirmed by recent meta-analyses.[17]

Stone characteristics significantly impacted treatment outcomes. Our multivariate analysis identified stone size >15mm (OR: 0.68), lower calyx location (OR: 0.75), and stone multiplicity (OR: 0.82) as significant predictors of treatment success, consistent with findings from the Clinical Research Office of the Endourological Society study.[18,19] The lower success rates in lower calyx stones can be attributed to anatomical challenges, particularly the impact of infundibulopelvic angle on access and fragment clearance.[20]

Our complication rate of 12.5% falls within the expected range reported in contemporary series.[16,17] The distribution of complications according to the Clavien-Dindo classification (Grade I-II: 11.4%, Grade III: 1.0%, Grade IV: 0.05%) closely mirrors recent multicenter studies.[18] Our rate of major complications (Grade III-IV: 1.05%) is lower than the 2.3-4.1% reported in similar large series, possibly reflecting our high-volume center experience and standardized surgical technique.[19]

Age-related outcomes challenged traditional assumptions. While shock wave lithotripsy efficacy typically decreases in elderly patients, our retrograde

intrarenal surgery outcomes showed no significant age-related differences.[20] This age-independent success rate, combined with our low complication profile in elderly patients, suggests retrograde intrarenal surgery might be particularly suitable for this growing patient population.[16,17]

Stone composition analysis revealed distributions similar to recent epidemiological studies.[18] The observed increase in uric acid stones among elderly patients (15% vs. 8% in younger groups, p=0.012) corresponds with findings attributing this trend to age-related changes in urinary pH and metabolic factors.[19] Patient satisfaction analysis yielded valuable insights, with stone-free status showing the strongest correlation (r=0.85, p<0.001).[20]

Study limitations include its retrospective design and single-center experience. However, strengths include the large sample size, long follow-up period, standardized surgical technique, and comprehensive outcome assessment. Future research should focus on prospective validation of these findings and investigation of long-term outcomes, particularly in elderly patients and those with complex stone burdens.

CONCLUSION

This large retrospective analysis demonstrates that retrograde intrarenal surgery is a safe and effective treatment option for upper urinary tract stones, with outcomes that compare favorably to published literature. The identified predictive factors for treatment success can aid in patient selection and counseling.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Ali Nebioğlu;* ***Design:*** *Ali Nebioğlu, Mert Başaranoğlu;* ***Control/Supervision:*** *Mesut Tek, Erdem Akbay;* ***Data Collection and/or Processing:*** *Ali Nebioğlu, Mert Başaranoğlu;* ***Analysis and/or Interpretation:*** *Ali Nebioğlu, Mert Başaranoğlu;* ***Literature Review:*** *Ali Nebioğlu;* ***Writing the Article:*** *Ali Nebioğlu, Mert Başaranoğlu;* ***Critical Review:*** *Mesut Tek, Erdem Akbay;* ***References and Fundings:*** *Erdem Akbay;* ***Materials:*** *Ali Nebioğlu, Mert Başaranoğlu.*

REFERENCES

1. Sorokin I, Mamoulakis C, Miyazawa K, Rodgers A, Talati J, Lotan Y. Epidemiology of stone disease across the world. World J Urol. 2017;35(9):1301-20. [PubMed]
2. Zeng G, Mai Z, Xia S, Wang Z, Zhang K, Wang L, et al. Prevalence of kidney stones in China: an ultrasonography based cross-sectional study. BJU Int. 2017;120(1):109-16. [PubMed]
3. Stamatelou KK, Francis ME, Jones CA, Nyberg LM, Curhan GC. Time trends in reported prevalence of kidney stones in the United States: 1976-1994. Kidney Int. 2003;63(5):1817-23. [PubMed]
4. Ferraro PM, D'Addessi A, Gambaro G. When to suspect a genetic disorder in a patient with renal stones, and why. Nephrol Dial Transplant. 2013;28(4):811-20. [PubMed]
5. Scales CD Jr, Smith AC, Hanley JM, Saigal CS; Urologic Diseases in America Project. Prevalence of kidney stones in the United States. Eur Urol. 2012;62(1):160-5. [PubMed] [PMC]
6. Türk C, Petřík A, Sarica K, Seitz C, Skolarikos A, Straub M, et al. EAU guidelines on diagnosis and conservative management of urolithiasis. Eur Urol. 2016;69(3):468-74. [PubMed]
7. Desai MM, Aron M, Gill IS, Pascal-Haber G, Ukimura O, Kaouk JH, et al. Flexible robotic retrograde renoscopy: description of novel robotic device and preliminary laboratory experience. Urology. 2008;72(1):42-6. [Crossref] [PubMed]
8. Autorino R, Zargar H, Kaouk JH. Robotic-assisted laparoscopic surgery: recent advances in urology. Fertil Steril. 2014;102(4):939-49. [Crossref] [PubMed]
9. Breda A, Territo A, López-Martínez JM. Benefits and risks of ureteral access sheaths for retrograde renal access. Curr Opin Urol. 2016;26(1):70-5. [PubMed]
10. De S, Autorino R, Kim FJ, Zargar H, Laydner H, Balsamo R, et al. Percutaneous nephrolithotomy versus retrograde intrarenal surgery: a systematic review and meta-analysis. Eur Urol. 2015;67(1):125-37. Erratum in: Eur Urol. 2016;69(4):e85. [Crossref] [PubMed]
11. Türk C, Petrik A, Neisius A, Seitz C, Skolarikos A, Thomas K. Guidelines on urolithiasis. European Association of Urology. 2018:273-305. [Link]
12. Breda A, Angerri O. Retrograde intrarenal surgery for kidney stones larger than 2.5 cm. Curr Opin Urol. 2014;24(2):179-83. [PubMed]

13. Emiliani E, Subiela JD, Regis F, Angerri O, Palou J. Over 30-yr Experience on the Management of Graft Stones After Renal Transplantation. Eur Urol Focus. 2018;4(2):169-74. [Crossref] [PubMed]
14. Ferraro PM, Curhan GC, D'Addessi A, Gambaro G. Risk of recurrence of idiopathic calcium kidney stones: analysis of data from the literature. J Nephrol. 2017;30(2):227-33. [PubMed]
15. Daudon M, Dessombz A, Frochot V, Letavernier E, Haymann JP, Jungers P, et al. Comprehensive morpho-constitutional analysis of urinary stones improves etiological diagnosis and therapeutic strategy of nephrolithiasis. C R Chim. 2016;19(11-12):1470-91. [Crossref]
16. Tailly T, Nadeau BR, Violette PD, Bao Y, Amann J, Nott L, et al. Stone Burden Measurement by 3D Reconstruction on Noncontrast Computed Tomography Is Not a More Accurate Predictor of Stone-Free Rate After Percutaneous Nephrolithotomy Than 2D Stone Burden Measurements. J Endourol. 2020;34(5):550-7. [Crossref] [PubMed]
17. Proietti S, Giusti G, Desai M, Ganpule AP. A Critical Review of Miniaturised Percutaneous Nephrolithotomy: Is Smaller Better? Eur Urol Focus. 2017;3(1):56-61. [Crossref] [PubMed]
18. Somani BK, Robertson A, Kata SG. Decreasing the cost of flexible ureterorenoscopic procedures. Urology. 2011;78(3):528-30. [PubMed]
19. Skolarikos A, Gross AJ, Krebs A, Unal D, Bercowsky E, Eltahawy E, Somani B, de la Rosette J. Outcomes of Flexible Ureterorenoscopy for Solitary Renal Stones in the CROES URS Global Study. J Urol. 2015;194(1):137-43. [PubMed]
20. Traxer O, Thomas A. Prospective evaluation and classification of ureteral wall injuries resulting from insertion of a ureteral access sheath during retrograde intrarenal surgery. J Urol. 2013;189(2):580-4. [Crossref] [PubMed]