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ORIGINAL ARTICLES

Beyond Stone Removal: Modern Challenges and Future Directions in the Management of Urinary Tract Calculi.

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ABSTRACT

Introduction: Urinary tract calculi represent one of the most prevalent benign urological conditions worldwide, with a lifetime risk exceeding 50% in some populations. Despite advances in minimally invasive techniques, management extends beyond stone extraction to encompass residual fragments, infectious complications, recurrence prevention, and longterm patient outcomes.
The Aim is to evaluate the contemporary surgical workload of a regional referral department, describe treatment distribution by stone location, and quantify early postoperative complications.
Methods: A retrospective review was conducted of 168 consecutive patients treated for urinary tract calculi at the Department of Urology, Clinical Hospital of Tetovo, between January 2025 and January 2026. Stones were classified by anatomical site (ureter, kidney, bladder) and managed according to European and American guideline recommendations. Demographic data, treatment modality, and early complications were extracted and graded using a ClavienDindo–compatible system.
Results: The cohort included 126 men (75.0%) and 42 women (25.0%), aged 24–68 years. Ureteral stones (104 cases, 61.9%) were managed exclusively with semirigid ureteroscopy. Renal stones (44 cases, 26.2%) were treated with extracorporeal shockwave lithotripsy (24 cases) or flexible ureterorenoscopy (20 cases). Bladder stones (20 cases, 11.9%) were managed by cystolitholapaxy (16 cases) or open cystolithotomy (4 cases). Early complications were minor: prolonged haematuria (9.5%), urinary tract infection (6.5%), mild urethral stricture (1.8%), and incomplete fragmentation requiring retreatment (2.4%). No complication exceeded ClavienDindo grade III.
Conclusions: Guidelineconcordant, locationbased strategies yielded a safe complication profile dominated by selflimiting events. Modern stone care emphasizes infection control, complete stone clearance, and metabolic prevention, underscoring the shift from purely technical removal toward comprehensive longterm management.
Keywords: urinary tract calculi; ureteroscopy; lithotripsy; cystolitholapaxy; urology

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INTRODUCTION

Urolithiasis is among the oldest documented human diseases and remains one of the most prevalent benign disorders of the urinary tract. A recent meta-analysis pooling more than 1.27 million participants estimated the global prevalence of urinary stone disease at approximately 10.9%, with a consistent male predominance (around 12.9% in men versus 8.9% in women) and marked regional variation, ranging from roughly 8% in North America to more than 20% in parts of Africa (1).

Estimates derived from the Global Burden of Disease programme suggest that the lifetime risk of developing a urinary stone has risen sharply over recent decades and, in several high-risk European populations, now approaches or exceeds two-thirds of the adult population (2-4).

These figures translate into an enormous clinical and economic burden, concentrated heavily in the working-age group between roughly 20 and 54 years (4)

The natural history of the disease compounds its prevalence. Stone disease is not a single acute event but a chronic, recurrent condition: a substantial proportion of patients form a further stone within five years of the first episode unless metabolic risk factors are addressed, with reported recurrence risks of roughly 25% after a first stone and approaching 50% in those with prior stones (5,6).

As a consequence, a patient treated once will frequently return, and the cumulative number of interventions over a lifetime can be considerable. This recurrent pattern is precisely why contemporary thinking has moved away from regarding stone treatment as a discrete mechanical task and toward viewing it as the surgical component of a longer-term medical strategy.

The therapeutic landscape has been transformed over the past four decades. Open surgery, once the mainstay of stone removal, has been almost entirely supplanted by minimally invasive approaches (5).

Extracorporeal shock-wave lithotripsy (ESWL) introduced the possibility of fragmenting stones without any incision; semirigid and flexible ureteroscopy made it possible to reach and treat stones throughout the ureter and the entire pelvicalyceal system; and percutaneous and laparoscopic techniques addressed the largest and most complex burdens (7).

The progressive miniaturization of instruments, the refinement of holmium and thulium-fibre laser lithotripsy, and improvements in flexible scope deflection have steadily expanded the indications for endoscopic management while reducing morbidity (8,9).

Yet the very success of these technologies has redefined what counts as a good outcome. When the immediate removal of a stone became reliable and reproducible, attention shifted to questions that mechanical extraction does not answer (10).

How often does an apparently successful procedure leave clinically significant residual fragments that seed future stones?

How can the risk of postoperative urinary infection and sepsis, the most feared early complication of endoscopic stone surgery, be minimized?

How can ureteral injury and subsequent stricture be avoided, particularly when treating long-impacted stones (11). And, most importantly, how can the high rate of recurrence be reduced through metabolic evaluation and targeted prevention? It is this constellation of issues that the title of the present study summarizes as the challenges that lie ‘beyond stone removal’.

Against this background, the present work reports the experience of a single regional referral department over a twelve-month period. Rather than focusing on a single technique, it documents the full spectrum of stone presentations encountered in routine practice and the manner in which each was matched to an appropriate, guideline-concordant treatment.

By describing the distribution of cases and the early complications observed, the study offers a transparent snapshot of contemporary stone care in a real-world setting and situates that experience within the wider literature on modern challenges and future directions in urolithiasis management.

A brief note on pathophysiology and why prevention matters

Understanding why the focus of stone care has broadened requires a brief consideration of how stones form. Urinary calculi arise when the urine becomes supersaturated with stone-forming salts, most commonly calcium oxalate but also calcium phosphate, uric acid, struvite and, more rarely, cystine; calcium-containing stones account for roughly 80% of cases in adults (12).

Supersaturation alone is rarely sufficient; the balance between promoters of crystallisation and naturally occurring inhibitors, the volume and concentration of the urine, its pH, and the presence of infection all influence whether crystals nucleate, aggregate, and grow into a clinically significant stone (13). Because these conditions are governed largely by diet, fluid intake, body habitus and metabolic individuality, the tendency to form stones is intrinsic to the patient and persists after any single stone has been removed.

This pathophysiological reality is the root cause of the recurrent nature of the disease and explains why a purely surgical philosophy is incomplete. A laser or a shock wave can shatter the product of an unfavourable metabolic environment, but it cannot alter that environment. Unless the underlying drivers are identified and modified, the same patient remains predisposed to form further stones. It is this insight that links the surgical and medical dimensions of stone care and that underpins the argument, developed throughout this

paper, that successful management must extend beyond the operative event itself.

Aim of the Study

The principal aim of this study was to describe and analyse the contemporary surgical management of urinary tract calculi at a regional referral centre, with particular attention to the alignment between stone location and chosen treatment modality and to the early complication profile that results from such a strategy. Within this overall purpose, the study pursued the following specific objectives:

- To characterise the demographic profile of patients treated for urinary stones over a defined twelve-month period, including the distribution by sex and age.
- To describe the anatomical distribution of stones across the ureter, kidney and urinary bladder, and to report the relative frequency of each presentation.
- To document the treatment modalities employed for each stone location, including semirigid ureteroscopy, flexible ureterorenoscopy, extracorporeal shock-wave lithotripsy, transurethral cystolitholapaxy and open cystolithotomy, and to explain the clinical rationale for each allocation.
- To quantify and classify the early postoperative complications observed in the cohort, with emphasis on haematuria, urinary tract infection, urethral stricture and incomplete fragmentation requiring re-treatment.
- To interpret these findings in the context of current guideline recommendations and the broader shift in stone care from purely mechanical removal toward the prevention of complications and recurrence.

MATERIALS AND METHODS

Study design and setting

This was a retrospective, observational, single-centre study conducted at the Department of Urology of the Clinical Hospital of Tetovo, North Macedonia. The department serves as a regional referral centre for the surrounding population and offers the full range of contemporary endourological and shock-wave treatments for urinary stone disease. All patients treated for urinary tract calculi between January 2025 and January 2026 were considered for inclusion.

Patient population

A total of 168 consecutive patients formed the study cohort. Patients were eligible for inclusion if they had a radiologically confirmed urinary stone and underwent active surgical or shock-wave treatment during the study period. Each patient was assigned to one of three anatomical groups according to the predominant stone location: ureteral, renal, or vesical (urinary bladder). Demographic information, the chosen treatment modality and the early postoperative course were retrieved from operative notes and ward records.

Diagnostic work-up

In accordance with current European Association of Urology recommendations, the diagnostic assessment of each patient combined a focused clinical history, urinalysis and urine culture, serum biochemistry and imaging (6).

Non-contrast computed tomography served as the principal imaging tool for the characterisation of stone size, density and location, supplemented by ultrasonography where appropriate. Sterilisation of the urine before any instrumentation was regarded as a prerequisite for elective intervention, and prophylactic antibiotics were administered according to local protocol and culture sensitivities. Definitive stone removal was deferred in the presence of active, untreated infection until an appropriate antimicrobial course had been completed (6)

Treatment modalities

Ureteral calculi were managed by semirigid ureteroscopy (URS) with intracorporeal laser or pneumatic lithotripsy and fragment retrieval. URS was selected as the first-line approach for ureteral stones on the basis of its high single-session stone-free rate and its favourable balance of efficacy and morbidity compared with shock-wave lithotripsy for this indication (7,14), including in the demanding subgroup of impacted ureteral calculi (11).

Renal calculi were treated either by extracorporeal shock-wave lithotripsy (ESWL) or by flexible ureterorenoscopy (FURS) with laser lithotripsy. The choice between these modalities was individualised according to stone size, density and location within the collecting system, patient preference and anatomical considerations, consistent with guideline algorithms that stratify treatment by cumulative stone diameter (6,7) and with established standardised FURS techniques (15).

Vesical (bladder) calculi were managed predominantly by transurethral cystolitholapaxy. In a small number of patients in whom stone size made an endoscopic approach impractical, open cystolithotomy was performed. The decision to proceed to open surgery was driven principally by stone bulk, where endoscopic fragmentation would have been prohibitively prolonged or hazardous (16).

Outcome measures and complication grading

The primary descriptive outcomes were the distribution of treatment modalities by stone location and the

incidence of early postoperative complications. Complications recorded included prolonged haematuria, urinary tract infection, urethral stricture and incomplete stone fragmentation requiring a further procedure. Complications were considered in a manner compatible with the modified Clavien-Dindo classification, which grades surgical complications according to the intensity of the treatment required to manage them, ranging from grade I (any deviation from the normal course requiring no intervention) through grade II (requiring pharmacological treatment) to grades III to V (requiring procedural, intensive-care or resulting in death) (17).

Statistical analysis

Given the descriptive and observational nature of the study, data are presented as absolute frequencies and percentages for categorical variables and as ranges for continuous variables such as age. No formal hypothesis testing was undertaken, as the principal objective was to characterise the case mix and complication profile rather than to compare interventions directly. This analytical approach is appropriate to a single-centre case series and is presented transparently so that the findings may be interpreted in light of their methodological limitations.

Ethical considerations

The study was conducted as a retrospective analysis of routinely collected clinical data. Patient confidentiality was preserved throughout, and no individually identifying information is reported. The conduct of the analysis was consistent with the principles of good clinical practice and with institutional requirements governing the use of anonymised clinical records for audit and research.

RESULTS

Demographic characteristics

The cohort comprised 168 patients, of whom 126 (75.0%) were men and 42 (25.0%) were women, giving a male-to-female ratio of approximately 3:1. The age of patients ranged from 24 to 68 years, encompassing the working-age population in which urinary stone disease exerts its greatest burden. The marked male predominance observed in this series is consistent with the gender distribution reported in large international epidemiological studies of urolithiasis (3,4).

Table 1. Demographic profile of the study cohort.

Characteristic	Value	Proportion
Total patients	168	100%
Male	126	75.0%
Female	42	25.0%
Age range (years)	24 – 68	—

Anatomical distribution of stones and treatment allocation

Ureteral calculi were the most common presentation, accounting for 104 of 168 cases (61.9%), all of which were treated with semirigid ureteroscopy. Renal calculi were the second most frequent group, comprising 44 cases (26.2%); of these, 24 were treated with extracorporeal shock-wave lithotripsy and 20 with flexible ureterorenoscopy. Bladder stones accounted for the remaining 20 cases (11.9%); 16 of these were managed endoscopically by cystolitholapaxy, while 4 cases involving very large stones measuring between 6 and 9 cm required open cystolithotomy. The distribution of cases and treatments is summarised in Table 2.

Table 2. Anatomical distribution of urinary stones and corresponding treatment modalities

Stone location	Treatment modality	Cases (n)	% of total
Ureter	Semirigid ureteroscopy (URS)	104	61.9%
Kidney	Extracorporeal shock-wave lithotripsy (ESWL)	24	14.3%
Kidney	Flexible ureterorenoscopy (FURS)	20	11.9%
Bladder	Transurethral cystolitholapaxy	16	9.5%
Bladder	Open cystolithotomy (stones 6–9 cm)	4	2.4%
Total	—	168	100%

Several features of this distribution merit attention. First, the predominance of ureteral stones treated exclusively by ureteroscopy reflects both the referral pattern of the centre and the contemporary preference for endoscopic management of ureteral calculi. Second, renal stones were managed by a roughly balanced split between shock-wave and flexible endoscopic treatment, illustrating the individualized, stone-specific decision-making that characterizes modern renal stone care. Third, the very small proportion of cases requiring open surgery, confined to bladder stones of exceptional size, underscores the extent to which minimally invasive techniques now dominate practice.

Early postoperative complications

Early complications were observed in a minority of patients and were, in the overwhelming majority, minor and self-limiting. Prolonged haematuria was the most frequently recorded event, occurring in 16 patients (9.5%). Urinary tract infection was diagnosed in 11 patients (6.5%).

Mild urethral stricture developed in 3 patients (1.8%), and incomplete stone fragmentation that necessitated a further procedure occurred in 4 patients (2.4%). No life-threatening complications, conversions to emergency open surgery for haemorrhage, or deaths were recorded. The complication profile is detailed in Table 3.

Table 3. Early postoperative complications observed in the cohort. Clavien-Dindo grades are indicative of the management each event typically required.

Complication	Cases (n)	Incidence	Typical Clavien grade
Prolonged haematuria	16	9.5%	I–II
Urinary tract infection	11	6.5%	II
Mild urethral stricture	3	1.8%	II–III
Incomplete fragmentation / re-treatment	4	2.4%	III

Taken together, these results describe a treatment programme that achieved its primary mechanical objective across all stone locations while maintaining a low and predominantly minor complication burden. The most common adverse event, transient haematuria, is an expected consequence of intracorporeal lithotripsy and resolved without intervention in essentially all affected patients.

The infection rate fell within the range reported for endoscopic stone surgery in the international literature, and the small number of strictures and re-treatments reflects the irreducible residue of difficulty inherent in stone surgery rather than any systematic shortcoming.

Relationship between treatment modality and complications

When the complications are considered against the modalities that produced them, a coherent pattern emerges. Prolonged haematuria and urinary infection were distributed across the endoscopic procedures, in keeping with their origin in intracorporeal lithotripsy and ureteral instrumentation.

The three cases of mild urethral stricture were associated with transurethral procedures, where the passage of instruments through the urethra carries an inherent, if small, risk of late narrowing. The four cases of incomplete fragmentation requiring re-treatment were concentrated, as expected, among the larger and harder stones, where a single session does not invariably achieve complete clearance and a planned second-look or staged approach is sometimes necessary.

None of the four open cystolithotomy cases for very large bladder stones was associated with a major complication, supporting the appropriateness of reserving open surgery for that specific indication rather than attempting prolonged endoscopic fragmentation.

It is also notable that no complication in the series exceeded Clavien-Dindo grade III, and the majority were grade I or II, that is, events managed by observation alone or by simple pharmacological treatment such as antibiotics.

This grading distribution is the single most reassuring feature of the dataset, because it indicates that the adverse events encountered, although not negligible in number, were almost uniformly of low clinical severity and did not translate into lasting harm, intensive-care admission or mortality.

DISCUSSION

The findings of this single-centre series illustrate, in microcosm, the state of contemporary urinary stone management and the reasons why the conceptual focus of the field has moved beyond the simple removal of a stone. Three observations from the data are worth examining in detail: the demographic and anatomical pattern of disease, the rational matching of technique to stone, and the nature and frequency of the complications encountered.

Demographic and epidemiological context

The strong male predominance (3:1) and the age span of 24 to 68 years observed in this cohort align closely with the established epidemiology of urolithiasis. Large pooled analyses report a global prevalence of roughly 11%, consistently higher in men than in women, and concentrate the disease burden in the working-age population (Vera-Ponce et al., 2025; Yao et al., 2025). (1,4)

The lifetime risk of stone formation has been estimated to be very high in several European populations, and the disease is recognised as a growing public-health concern driven by metabolic and lifestyle factors (Global Burden of Disease Urolithiasis Collaborators, 2025). (3)

The present cohort, drawn from a regional referral population, reproduces this pattern faithfully and confirms that the local burden of disease mirrors international trends. This congruence matters because it suggests that lessons drawn from the wider literature, particularly regarding recurrence and prevention, are directly applicable to this population.

Matching technique to stone: a guideline-concordant strategy

The treatment allocation observed in this series reflects a deliberate, location-specific strategy that is consistent with current European and American guideline recommendations (Skolarikos et al., 2024; Assimos et al., 2025). (6,7)

Ureteral stones were managed uniformly by

ureteroscopy, an approach supported by evidence that ureteroscopic lithotripsy achieves higher single-session stone-free rates and lower re-treatment rates than shock-wave lithotripsy for ureteral calculi (Assimos et al., 2025) (7).

Reported stone-free rates for ureteroscopy vary by stone position but are generally high, rising from the proximal to the distal ureter (around 81% proximally to 94% distally), and the technique is widely regarded as the workhorse of ureteral stone surgery (Sönmez et al., 2025) (14).

For renal stones, the cohort was divided between shock-wave lithotripsy and flexible ureterorenoscopy. This split embodies the individualised decision-making advocated by modern guidelines, which stratify renal stone treatment by cumulative stone diameter and take into account stone density, location within the collecting system and patient-specific factors (Skolarikos et al., 2024) (5).

Shock-wave lithotripsy remains an attractive, entirely non-invasive option for suitable stones, whereas flexible ureterorenoscopy offers higher stone-free rates for larger or harder stones and for those in unfavourable locations, at the cost of a more invasive procedure; contemporary laser-assisted retrograde intrarenal surgery achieves pooled stone-free rates approaching 88–89% (Almasoud et al., 2023) (18).

The roughly balanced distribution seen here is therefore not arbitrary but reflects the careful weighing of these trade-offs. The management of bladder stones similarly followed an evidence-based logic. The large majority were treated endoscopically by cystolitholapaxy, the preferred minimally invasive approach, with open surgery reserved for the few stones whose exceptional size, between 6 and 9 cm, rendered endoscopic fragmentation impractical (Tzortzis et al., 2024; El-Tabey et al., 2016) (16,19).

The persistence of a small open-surgery caseload for very large stones is a reminder that, even in an era of advanced endourology, open surgery retains a narrow but genuine indication (Tzortzis et al., 2024) (16).

The complication profile in perspective

The early complications recorded in this series were predominantly minor and align well with published benchmarks. Transient haematuria, the most common event in the cohort at 9.5%, is an anticipated consequence of intracorporeal lithotripsy; the literature describes mild, self-limiting haematuria after retrograde ureteroscopy in approximately 10% to 20% of cases, with significant bleeding being rare (Zhang et al., 2025) (20).

Where a ureteral stent is placed after the procedure, additional stent-related morbidity such as irritative voiding symptoms, flank pain and haematuria is common but predominantly low-grade (Bostancı et al., 2022) (21).

The infection rate of 6.5% sits comfortably within reported ranges; series of retrograde flexible ureteroscopy describe urinary tract infection rates of around 8% (Zhang et al., 2025),(20) and overall complication rates for ureteroscopy are generally cited as falling between roughly 9% and 25%, with the great majority of events being Clavien grade II or lower (Sönmez et al., 2025; De Coninck et al., 2020)(14,17).

Urethral and ureteral stricture, although among the most consequential late complications of endoscopic stone surgery, occurred in only 1.8% of this cohort (Johnson & Pearle, 2004) (22). Published stricture rates after ureteroscopy span a wide range, typically from below 1% up to around 5% in routine practice, rising substantially in the context of impacted stones and intraoperative perforation (Legemate et al., 2017; Tonyali et al., 2023) (11,23).

The low rate observed here is therefore reassuring and consistent with careful technique. The need for re-treatment because of incomplete fragmentation in 2.4% of patients reflects the reality that complete clearance is not always achieved in a single session, a recognised limitation that modern guidelines address through structured follow-up imaging and clearly defined criteria for further intervention (Skolarikos et al., 2024) (6).

Beyond stone removal: residual fragments, infection and recurrence

The deeper significance of these results lies in what they imply about the unresolved challenges of stone care. The first is the problem of residual fragments. A procedure that removes the dominant stone but leaves small fragments may appear successful in the short term yet sow the seeds of future symptomatic episodes; the modern definition of a stone-free state, and the structured follow-up imaging recommended to confirm it, exist precisely because mechanical removal and durable cure are not synonymous (Skolarikos et al., 2024) (6).

The single most important determinant of long-term success is therefore not the immediate clearance of the dominant stone but the completeness and durability of that clearance.

The second challenge is infection. Urinary tract infection and, in its severe form, urosepsis remain the most dangerous early complications of endoscopic stone surgery. The emphasis in contemporary practice on sterilising the urine before intervention, deferring elective treatment in the face of active infection, administering appropriate prophylaxis, and limiting intrarenal pressure and operative time during ureteroscopy all reflect a sustained effort to control this risk (Skolarikos et al., 2024; Zhang et al., 2025). (6,20). The relatively modest infection rate in the present series is encouraging, but the literature is unanimous that vigilance in this domain cannot be relaxed.

The third and arguably most important challenge is recurrence. Because urolithiasis is a chronic, recurrent

metabolic disease, the surgical episode is only one chapter in a longer story. Guidelines increasingly stress the value of metabolic evaluation, analysis of stone composition, dietary and fluid counselling, and, where indicated, targeted pharmacological prophylaxis, together with risk-stratified, sometimes lifelong, follow-up (Skolarikos et al., 2024; Pearle et al., 2014) (6,24).

High fluid intake sufficient to produce at least 2 to 2.5 litres of urine per day has the strongest evidence base, and a diet with normal calcium but reduced sodium and animal protein has been shown to roughly halve recurrence in hypercalciuric calcium-oxalate stone formers compared with a low-calcium diet (Pearle et al., 2014; Wang et al., 2021)(24,25).

A department that excels in stone removal but neglects this medical dimension will see the same patients return. The present study, by documenting a high-volume surgical workload, implicitly highlights the opportunity that such a caseload represents for systematic metabolic prevention.

Future Directions

Several developments are likely to shape the next phase of stone care. Advances in laser technology, particularly the thulium-fibre laser, promise more efficient and potentially safer lithotripsy, with systematic reviews reporting stone-free rates comparable or marginally superior to the holmium laser and a low rate of high-grade complications (Kwok et al., 2025; Katsimperis et al., 2026). (8,26)

Suction-integrated access sheaths and improved intrarenal pressure monitoring aim to reduce infectious complications by limiting pyelovenous backflow (Skolarikos et al., 2024) (6). Refinements in imaging and in the definition and detection of residual fragments may sharpen the assessment of true stone-free status. Above all, the integration of metabolic prevention into routine pathways, supported by patient counselling and, increasingly, by digital tools for adherence and follow-up, offers the greatest prospect for reducing the lifetime burden of a disease that is, by its nature, recurrent (Pearle et al., 2014; Wang et al., 2021). (24,25)

Clinical implications for a regional referral centre

For a regional referral department such as the one studied here, these findings carry several practical implications. A caseload of this volume and composition confirms that the centre possesses the technical capacity to manage the full anatomical spectrum of stone disease without routine recourse to open surgery or to referral elsewhere, which has clear benefits for patient access and for the efficient use of regional health resources. At the same time, the predominance of working-age men in the cohort identifies a population in which recurrence will impose a substantial future workload unless prevention is addressed.

The same surgical episodes that generate the present caseload therefore represent recurring opportunities to capture stone composition, to perform a basic metabolic screen, and to initiate fluid and dietary counselling. Embedding such steps into the standard perioperative pathway would require modest additional resource yet could meaningfully reduce the rate at which these patients return for further intervention, converting a high-throughput surgical service into a more complete model of chronic disease management.

Limitations

This study has several limitations that should temper the interpretation of its findings. It is a retrospective, single-centre case series without a comparison group, and as such it describes practice rather than testing hypotheses. Outcomes were limited to early complications; no long-term data on stone-free status, recurrence or metabolic evaluation were available within the study window, which is precisely the dimension that the discussion identifies as most important.

The classification of complications was compatible with, but not formally adjudicated against, the Clavien-Dindo system by independent reviewers. Finally, treatment allocation was not randomised but reflected clinical judgement, so the relative effectiveness of the various modalities cannot be inferred from these data. These limitations do not undermine the descriptive value of the series but do define the boundaries within which its conclusions should be read.

CONCLUSION

This twelve-month, single-centre analysis of 168 patients treated for urinary tract calculi demonstrates that a guideline-concordant, location-specific strategy can deliver safe and effective stone management in a real-world regional setting. Ureteral stones were treated uniformly and successfully by ureteroscopy; renal stones were managed by an individualised choice between shock-wave lithotripsy and flexible ureterorenoscopy; and bladder stones were addressed endoscopically wherever feasible, with open surgery reserved for stones of exceptional size.

The early complication profile was dominated by minor, self-limiting events, principally transient haematuria and urinary infection, with low rates of stricture and re-treatment and no serious adverse outcomes.

Beyond these encouraging operative results, the study reinforces the central theme that gives it its title. In an era when the mechanical removal of stones has become reliable, the decisive challenges of stone care now lie elsewhere: in achieving a truly stone-free state rather than a merely improved one, in preventing the infectious complications that remain the principal

early danger of endoscopic surgery, and, above all, in confronting the chronic, recurrent nature of the disease through systematic metabolic evaluation and prevention.

The surgical episode should be regarded not as the end of treatment but as the beginning of a longer-term strategy aimed at preventing the patient's return. Future efforts at this and similar centres should therefore couple their evident surgical competence with structured follow-up and metabolic prophylaxis, so that excellence in stone removal is matched by excellence in keeping patients stone-free.

Editorial Statements

Ethics Approval and Consent to Participate

This study involved the analysis of data from human participants. The research protocol was reviewed and approved by the Institutional Ethics Committee and was conducted in accordance with institutional regulations, the principles of the Declaration of Helsinki, and internationally accepted standards for biomedical research ethics.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author Contributions (CRediT): Conceptualization & Methodology: FD, EE; Data Curation, Investigation and Writing – Original Draft: HD: Formal Analysis: FD, HD: Writing – Review & Editing: EE, AD: Supervision: EE. All authors have read and approved the final version of the manuscript.

Artificial Intelligence (AI) Statement

The authors used a generative artificial intelligence tool solely for language editing and grammar improvement. All scientific content, data analysis, interpretation, and conclusions were independently developed, verified, and approved by the authors.

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