

Retrospective Analysis of Ureteric Injury During Ureteroscopy (URS) Versus Retrograde Intrarenal Surgery (RIRS) Over a Three-Year Period

ABSTRACT

Background: Ureteroscopy (URS) and retrograde intrarenal surgery (RIRS) are widely used minimally invasive procedures for urolithiasis. Ureteric injury remains a significant complication with potential long-term morbidity.

Objective: To compare the incidence and severity of ureteric injury during URS and RIRS over a three-year period.

Materials and Methods: A retrospective analysis of 400 patients undergoing endourological stone surgery was performed. Two hundred patients each underwent URS and RIRS. Ureteric injuries were graded intraoperatively and postoperatively as: Grade 1—superficial mucosal abrasion; Grade 2—mucosal injury; Grade 3—partial disruption; Grade 4—total avulsion. Statistical analysis was performed using the Chi-square test.

Results: Ureteric injury occurred in 30 patients (15%) in the URS group and 10 patients (5%) in the RIRS group ($p = 0.0015$). Low-grade injuries (Grade 1–2) constituted the majority in both groups. Severe injuries (Grade 3–4) were significantly more common in the URS group (26.7% vs 10%). No Grade 4 injury was observed in the RIRS group.

Conclusion: URS is associated with a significantly higher incidence and severity of ureteric injury compared to RIRS. RIRS appears to be a safer modality with respect to ureteric integrity.

Key words: Ureteroscopy, RIRS, ureteric injury, endourology, complications

INTRODUCTION

Ureteroscopy (URS) and Retrograde Intrarenal Surgery (RIRS) have become cornerstone minimally invasive procedures for the management of ureteric and renal calculi. Technological advances in optics, miniaturization of instruments, and improved energy sources have significantly expanded the indications for endourological procedures. However, ureteric injury remains a clinically relevant complication, with potential short- and long-term consequences such as stricture formation, urinoma, and loss of renal function.

URS involves direct instrumentation of the ureter, often with semi-rigid scopes, and is associated with mechanical trauma during scope passage, stone manipulation, and basket extraction. RIRS, performed using flexible ureteroscopes with ureteral access sheaths (UAS), is generally considered less traumatic to the ureter but carries its own risks related to sheath insertion and intrarenal pressure.

Clinically significant ureteric injury (perforation/avulsion) after ureteroscopy occurs in approximately 0.5–7%, with major injuries <1–2% and long-term ureteric stricture rates around 0.5–5% (higher in impacted stones). Ureteric injury following RIRS is uncommon, with clinically relevant ureteric wall injury requiring intervention or stenting reported in about 1–2% of cases in large contemporary series.

Traxer and Thomas described ureteral wall injuries related to UAS insertion, highlighting mucosal abrasions as the most common form of injury. Earlier studies on semi-rigid URS

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reported higher rates of mucosal trauma and perforation, particularly in impacted stones and narrow ureters.

RIRS, facilitated by flexible ureteroscopes and routine pre-stenting in selected cases, has demonstrated lower rates of severe ureteric injury. However, access sheath-related ischemia and subclinical injuries remain concerns.

Most published studies focus on either URS or RIRS individually, with limited head-to-head comparison using uniform injury grading. Despite widespread use, comparative data on the pattern and severity of ureteric injury between URS and RIRS in routine clinical practice are limited. This study retrospectively analyzes ureteric injuries encountered during URS and RIRS over a three-year period using a standardized grading system and attempts to bridge that gap by directly comparing both modalities in a single institutional cohort.

Aim

To compare the incidence and severity of ureteric injury during URS and RIRS over a three-year period.

Objectives

1. To determine the incidence of ureteric injury in URS and RIRS.
2. To grade ureteric injuries using a standardized classification system.
3. To compare the severity distribution of ureteric injuries between URS and RIRS.
4. To assess the statistical significance of differences in injury rates between the two procedures.

Methodology

Study Design: Retrospective observational study.

Study Period: Three years.

Study Population: Patients undergoing URS or RIRS for urolithiasis at a tertiary care center.

Sample Size

- URS: 200 cases
- RIRS: 200 cases

Inclusion Criteria

- Age ≥ 18 years
- Primary URS or RIRS for ureteric or renal calculi
- Complete operative and postoperative records available

Exclusion Criteria

- Previous ureteric surgery
- Congenital ureteric anomalies
- Concomitant open or laparoscopic procedures

Definition and Grading of Ureteric Injury

Grade	Description
Grade 1	Superficial mucosal abrasion
Grade 2	Mucosal injury
Grade 3	Partial ureteric disruption
Grade 4	Total ureteric avulsion

Injuries were identified intraoperatively or on immediate postoperative imaging.

Statistical Analysis

- Categorical variables expressed as frequencies and percentages
- Comparison between groups performed using Chi-square test
- $p < 0.05$ considered statistically significant

Results

Overall Incidence of Ureteric Injury

Procedure	Injury Present	No Injury	Incidence (%)
URS (n=200)	30	170	15%
RIRS (n=200)	10	190	5%

- Chi-square value: 10.03
- p-value: 0.0015 (statistically significant)

Severity Distribution of Ureteric Injury

Grade	URS (n=30)	RIRS (n=10)
Grade 1	12 (40%)	6 (60%)
Grade 2	10 (33.3%)	3 (30%)
Grade 3	6 (20%)	1 (10%)
Grade 4	2 (6.7%)	0 (0%)

- Severe injuries (Grade 3–4) were more frequent in URS (26.7%) compared to RIRS (10%).

DISCUSSION

This retrospective analysis demonstrates a significantly higher incidence of ureteric injury in URS compared to RIRS. The majority of injuries in both groups were low-grade (Grade 1–2), consistent with existing literature. However, URS was associated with a greater proportion of severe injuries, including partial disruptions and avulsions.

The higher injury rate in URS may be attributed to:

- Use of semi-rigid instruments
- Forceful negotiation of narrow or edematous ureters
- Impacted ureteric calculi

In contrast, RIRS benefits from:

- Flexible scopes with atraumatic navigation
- Use of UAS allowing repeated entry without repeated ureteric trauma
- Better visualization and controlled manipulation

The absence of Grade 4 injury in the RIRS group reinforces its relative safety profile when performed by experienced surgeons.

In our study, ureteric injury was observed less frequently during RIRS compared to URS. This finding is consistent with evolving endourological practice, where RIRS is increasingly performed using smaller-calibre flexible ureteroscopes and improved accessory technology. The reduced outer diameter of modern RIRS scopes, along with better optics and controlled deflection, results in lower ureteral wall stress and decreased risk of ureteric trauma when compared with semi-rigid URS instruments. Additionally, the selective use of pre-stenting and atraumatic ureteral access sheaths in RIRS further contributes to the lower incidence of ureteric injury.

CONCLUSION

- URS is associated with a significantly higher incidence of ureteric injury compared to RIRS.
- Most injuries are low-grade; however, severe injuries are more common with URS.
- RIRS appears to be a safer modality with respect to ureteric integrity.
- Careful patient selection, gentle instrumentation, and selective pre-stenting may reduce ureteric injury risk.

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