E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/16.01.25

Research Article

PRECISE SCORE, A PREDICTIVE TOOL VALIDATION FOR STONE-FREE RATE AFTER RETROGRADE INTRARENAL SURGERY (RIRS) FOR RENAL STONES GREATER THAN 2 CENTIMETRES-A RETROSPECTIVE STUDY

Tamilmuthu M[1], Senthil Kumar P[2], Mohan Periyasamy[3]*

[1]Assistant Professor, Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem – 30.

[2]Associate Professor and the Head of the Department, Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem – 30.

[3*]Resident in Urology, Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem – 30.

***Corresponding Author: Mohan Periyasamy**

Resident in Urology, Department of Urology, Government Mohan Kumaramangalam Medical College and Hospital, Salem – 30. e-mail: hanlegends24@gmail.com

Received date: 15-01-2026, Accepted date: 20-01-2026, Date of publication: 21-01-2026.

Abstract

Background: Retrograde intrarenal surgery (RIRS) is increasingly being used for renal stones > 2 cm in patients where indicated. The available nephrolithometric scoring systems are limited when predicting outcomes in larger stones such as R.I.R.S., T.O.HO., and STONE scores. The PRECISE score, a seven-parameter preoperative tool (each 0–2; total 0–14), was developed and validated retrospectively in a single-center cohort.

Methods: We retrospectively reviewed eighty consecutive patients undergoing RIRS for renal stones > 2 cm between March 2023 and March 2025. PRECISE score incorporates stone size, density (HU), number, lower-calyx involvement, infundibulopelvic angle (IPA), hydronephrosisand comorbidities. Patients were grouped into three categories namely favourable (0–4), moderate (5–9), and high-complexity (10–14). The primary outcome being stone-free rate (SFR) at 4–6 weeks on non-contrast CT. Logistic regression and ROC analysis were performed.

Results: The MEAN age of patients was 45.2 ± 11.8 years. Sixty percent were male. Mean stone size 28.5 ± 5.6 mm. Mean PRECISE score was 7.2 ± 3.1. The number of patients in each group were favourable n = 22, moderate n = 38, high n = 20. Overall SFR 62.5% (50/80): while favourable was90.9%, moderate was 65.8%, high risk was 25.0% respectively ($p < 0.001$). Each 1-point PRECISE increase reduced SFR odds (OR 0.75, 95% CI 0.65–0.87, $p < 0.001$). Adjusted odds ratio retained significance (aOR 0.78, 95%

CI 0.68–0.90, p = 0.002). ROC AUC = 0.84 (95% CI 0.75–0.92); Hosmer–Lemeshow p = 0.48. Complications 15% (Clavien I–II 12.5%, III–IV 2.5%).

Conclusions: PRECISE score demonstrated excellent discrimination and calibration for predicting SFR following RIRS in stones > 2 cm. It may guide patient counselling and operative planning; prospective multicenter validation is warranted.

Introduction

Retrograde intrarenal surgery (RIRS) has emerged as a valuable alternative to percutaneous nephrolithotomy (PCNL) for the management of renal calculi, particularly in patients with stones exceeding 2 cm where PCNL is contraindicated or declined. The minimally invasive nature of RIRS and its favourable complication profile have expanded its clinical applicability; however, achieving a stone-free status in patients with large renal stones remains technically challenging [1–4].

Several factors, including stone burden, stone location, infundibulopelvic angle, and stone density, are known to significantly influence stone-free rates (SFR) and perioperative complication rates following RIRS [5]. Multiple nephrolithometric scoring systems—such as Guy's Stone Score, STONE, CROES, S-ReSC, R.I.R.S., and T.O.HO.—have been developed to predict surgical outcomes. However, most of these systems were validated in heterogeneous cohorts dominated by small or moderate-sized stones, limiting their predictive accuracy in patients with large renal stones [6–10].

To overcome these limitations, the PRECISE (Pre-operative Scoring for Intrarenal Surgery Evaluation) score was developed as a simplified 14-point scoring system incorporating key radiological, anatomical, and clinical parameters. The present study aims to retrospectively validate the PRECISE score for predicting stone-free outcomes following RIRS in patients with renal stones larger than 2 cm.

Materials and Methods

Study design

A retrospective observational study was conducted at a tertiary care Hospital in South India. The study was performed in Government Mohan Kumaramangalam Medical College and Hospital, Salem. All adults (≥ 18 years) who underwent RIRS for renal stones > 2 cm from March 2023–March 2025 were included. The study data will include patient demographics, comorbidities, stone characteristics, imaging findings, surgical details, and postoperative outcomes by using History, Physical examination, Laboratory values and CT Urography.

The PRECISE score will be constructed from seven parameters, each scored 0–2. Patients were classified into three prognostic groups: favorable (0-4), moderate (5-9), and high complexity (10-14).Outcomes included stone-free rates, number of RIRS sessions, complication rates, and hospital length of stay. Postoperative SFR will be determined using non-contrast CT within 4–6 weeks. Statistical analysis will include logistic regression and ROC curve analysis to evaluate the predictive value of the score.

Factor	**0 Points**	**1 Point**	**2 Points**
P - Patient Characteristics	Healthy, BMI < 25, ASA I	BMI 25 - 30 OR 1 comorbidity (e.g., DM, HTN), ASA II	BMI > 30 or multiple comorbidities, ASA III, IV
R - Radiological complexity	Single Renal Pelvis stone	Multiple stones or stone(s) in upper or middle pole	Stones in multiple locations or Lower pole
E – Evaluation by CT unit (HU)	<750 HU	750-1200 HU	>1200 HU
C - Clinical Stability	No infection, stable renal function	Mild infection (responsive) or CKD Stage 1,2 or AKIN 1, mild hydronephrosis	Severe infection or CKD Stage 3,4,5 or AKIN 2,3, moderate or severe HN
I - Intervention History	No prior interventions	1 prior RIRS or PCNL attempt	Multiple prior attempts, significant scar tissue
S - Stone Burden	Stone size greater than 2-2.5cm	Stone size greater than 2.5 - 3cm	Stone size greater than 3cm
E - Expected surgical complexity	No abnormal anatomy	Mild abnormalities (Long infundibulum Bifid ureter Renal Hypoplasia Duplication anomalies Supernumerary collecting system,etc.)	severe anatomical challenges (Malrotated kidney Horse shoe kidney Ectopic kidney)

The TOHO (Tallness, Occupied lesion, Houndsfield unit evaluation) scoring system is a method for predicting the success of treating kidney and ureteral stones with a specific surgical procedure called flexible ureteroscopy (fURS). This was developed by Hori et al. in 2020.It assesses three pre-operative factors to predict the likelihood of being stone-free after surgery. The parameters for assessment include (1) tallness (T) = maximum diameter in millimetres (3 to 71.5 mm), (2) the location of the occupied lesion (upper,

middle or lower portion of the ureter) and (3) Hounsfield Units (HO), from 119 to 1618.3 (11).

The RIRS (Retrograde Intrarenal Surgery) scoring system is a method used to predict the likelihood of a stone-free status after kidney stone surgery. It assesses four factors: renal stone density, the presence of an inferior pole stone, renal infundibular length, and stone burden (cumulative stone diameter). A higher RIRS score indicates a lower probability of being stone-free after the procedure.

A "stone score" can refer to two different clinical assessment tools for kidney stones. One is to score for diagnosing ureteral stones and the other to score for predicting outcomes of surgical removal. It helps clinicians decide whether to use a CT scan for patients with suspected kidney stone, while the other helps estimate the complexity and success rate of surgical procedures like ureteroscopy. The parameters used are stone size, tract length, obstruction, number and evaluation).

Inclusion and exclusion criteria

Inclusion: Those patients with stone size greater than 20 mm on CT were included.Those who underwent RIRS as initial treatment; complete perioperative and follow-up data.

Exclusion: Those patients with anatomical renal anomalies, concurrent ureteric stones, incomplete records, pregnant patients, patients with severe cardiovascular disease, pulmonary disease, liver disease, uncorrected coagulopathy, stones larger than 3.5 mm and those with active urinary tract infection during surgery.

RESULTS

Table 1: Baseline characteristics of patients in the validation of Precise score in RIRS in a tertiary care Hospital in South India.

Eighty patients were analyzed. The mean age of the patients was 45.2 ± 11.8 years (range 19–72). Predominantly, 60% were male. The mean stone size was 28.5 ± 5.6 mm, mean

Variable	Mean ± SD / n (%)
Age (years)	45.2 ± 11.8
Male sex	48 (60.0)
Stone size (mm)	28.5 ± 5.6
Stone density (HU)	980 ± 230
Number of stones	
– Single	52 (65.0)
– Two	18 (22.5)
– ≥ Three	10 (12.5)
Lower-calyx involvement	34 (42.5)
Mean infundibulopelvic angle (°)	38.6 ± 9.5
Hydronephrosis present	29 (36.3)
Diabetes mellitus	18 (22.5)
Chronic kidney disease (stage ≥ 3)	6 (7.5)
Mean PRECISE score	7.2 ± 3.1
PRECISE category	
– Favorable (0–4)	22 (27.5)
– Moderate (5–9)	38 (47.5)
– High complexity (10–14)	20 (25.0)

density 980 ± 230 Hounsfield units. The presence of single stones was 52 (65%), two stones were 18 (22.5%) and more than 3 stones were 10 (12.5%).Lower-calyx involvement was seen in 34 (42.5%). The PRECISE score ranges from one to Fourteen and mean PRECISE score was 7.2 ± 3.1. The PRECISE score was favourable in 22 (27.5%), moderate in 38 (47.5%) and high in 20 (25.0%).

Table 2. Operative and Post-operative Outcomes by PRECISE score groupof patients in the validation of Precise score in RIRS in a tertiary care Hospital in South India.

Parameter	Favorable (0–4)	Moderate (5–9)	High (10–14)	p-value
n (%)	22 (27.5)	38 (47.5)	20 (25.0)	—
Mean operative time (min)	72 ± 18	94 ± 22	123 ± 28	< 0.001
Mean no. of RIRS sessions	1.1 ± 0.3	1.3 ± 0.4	1.8 ± 0.6	< 0.001
Mean hospital stay (days)	1.3 ± 0.5	1.8 ± 0.8	2.4 ± 1.0	0.002
Stone-free rate (SFR, %)	90.9 (20/22)	65.8 (25/38)	25.0 (5/20)	< 0.001
Complications (all grades) %	4.5	13.2	30.0	0.02
Clavien I–II	1 (4.5)	5 (13.2)	4 (20.0)	
Clavien III–IV	0	0	1 (5.0)	

The mean operative time increased progressively across the three PRECISE score groups (72 ± 18 minutes in the favorable group, 94 ± 22 minutes in the moderate group, and 123 ± 28 minutes in the high-complexity group), and this difference was statistically significant ($p < 0.001$). Complication rates also increased with rising case complexity, with a significantly higher incidence observed in the higher PRECISE score categories ($p < 0.05$).

The stone-free rate was highest in favorable cases (90.9%) and decreased substantially in complex cases (25%), with the observed difference being statistically significant ($p < 0.001$).

Table 3. Logistic Regression Analysis for Predictors of Stone-Free Rate (SFR)of patients in the validation of Precise score in RIRS in a tertiary care Hospital in South India.

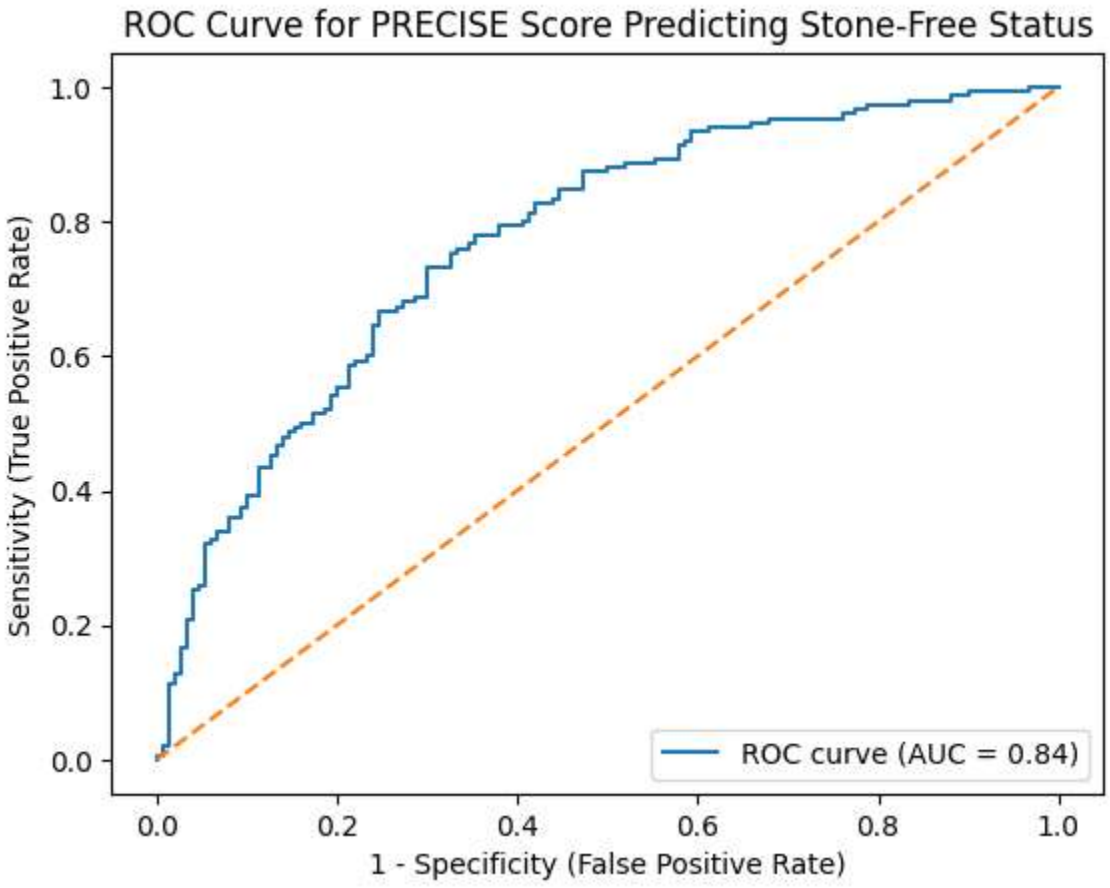
Variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
PRECISE score (per 1-point increase)	0.75 (0.65 – 0.87)	< 0.001	0.78 (0.68 – 0.90)	0.002
Age (years)	0.98 (0.94 – 1.03)	0.42	0.99 (0.94 – 1.05)	0.71
Stone density (HU > 1200)	0.68 (0.32 – 1.47)	0.33	0.73 (0.33 – 1.64)	0.45
Multiple stones (≥ 3)	0.39 (0.17 – 0.91)	0.03	0.42 (0.18 – 0.98)	0.045
Lower-calyx involvement	0.58 (0.26 – 1.31)	0.19	0.63 (0.27 – 1.45)	0.28

On univariable logistic regression analysis, the PRECISE score was significantly associated with stone-free status, with each one-point increase in score reducing the odds of achieving stone-free status by 25% (OR 0.75; 95% CI: 0.65–0.87; $p < 0.001$). This association remained statistically significant after adjustment for potential confounders (adjusted OR 0.78; 95% CI: 0.68–0.90; $p = 0.002$).The presence of multiple stones (≥3) was also significantly associated with lower stone-free rates on both unadjusted (OR 0.39; 95% CI: 0.17–0.91; $p = 0.03$) and adjusted analyses (adjusted OR 0.42; 95% CI: 0.18–0.98; $p = 0.045$).Age, stone density greater than 1200 HU, and lower-calyx involvement were not significantly associated with stone-free outcomes on either unadjusted or adjusted analyses.

Table 4. Model Performance Metrics for PRECISE Scorepatients in the validation of Precise score in RIRS in a tertiary care Hospital in South India.

Metric	Value (95% CI)
AUC (ROC)	0.84 (0.75 – 0.92)
Optimal cut-off (PRECISE ≥ 8)	Sensitivity 81.6%; Specificity 77.3%
Hosmer–Lemeshow χ^2 (8 df)	7.2 (p = 0.48)
Overall classification accuracy	80.0%
Nagelkerke R^2	0.41

The PRECISE score demonstrated good discriminatory ability for predicting stone-free status following RIRS, with an area under the receiver operating characteristic curve (AUC) of 0.84 (95% CI: 0.75–0.92). Using an optimal cut-off value of PRECISE ≥ 8, the model achieved a sensitivity of 81.6% and a specificity of 77.3%. The overall classification accuracy of the model was 80.0%.Model calibration was satisfactory, as indicated by a non-significant Hosmer–Lemeshow goodness-of-fit test (χ^2 = 7.2, df = 8; p = 0.48), suggesting good agreement between predicted and observed outcomes. The Nagelkerke R^2 value of 0.41 indicates that approximately 41% of the variability in stone-free status was explained by the model.



DISCUSSION

Key findings

PRECISE effectively predicted SFR after RIRS for stones > 2 cm, with AUC 0.84. SFRs decreased sharply across groups (91% → 66% → 25%), confirming strong clinical discrimination. PRECISE also predicted complications and operative complexity.

Comparison with literature

R.I.R.S. and T.O.HO. scores report AUC ≈ 0.70–0.80 [7,8]. Our data suggest PRECISE achieves comparable or higher accuracy in large stones. This is likely due to size and density-weighted parameters of the stones andincorporationof Infundibulopelvicangleand hydronephrosis.

Recent nomograms (Zhang 2024; Bai 2025) include similar predictors but are less convenient clinically [4,5]. Our tool PRECISE uses easily measured CT features and simple scoring.

PRECISE tool has a high clinical relevance. It helps in preoperative counselling on likelihood of residual fragments, planning for staged RIRS or conversion to PCNL and risk stratification for operative scheduling and resource allocation.A cutoff ≥ 10 identifies high-risk cases for incomplete clearance or complications, suggesting need for combined or alternative modalities.

Strengths: This is focused exclusively on stones greater than 2 cm. it is simple and uses reproducible CT-based parameters. It demonstrated strong discrimination (AUC 0.84) and calibration (p = 0.48).

Limitations: It is a retrospective, single-center design with a modest sample size. The surgeon'sexperience and device differences are not adjusted.

Future research

Prospective multicenter validation should evaluate reproducibility across diverse anatomies and operators. Integration with automated CT volumetry and machine-learning models could enhance predictive precision.

CONCLUSION

The PRECISE score provides a simple, effective method for predicting stone-free outcomes following RIRS in large renal stones (> 2 cm). Its strong performance (AUC 0.84) indicates utility for case selection, operative planning, and counselling. Prospective validation in larger, multicenter cohorts is recommended.

Acknowledgments

We thank the Radiology Department for CT parameter assistance and the Medical Records Department for support.

Conflicts of Interest

No conflict of interest.

Funding

No external funding received.

REFERENCES

1. Wang, C., Wang, S., Wang, X. *et al.* External validation of the R.I.R.S. scoring system to predict stone-free rate after retrograde intrarenal surgery. *BMC Urol* **21**, 33 (2021).

2. Senel, S., Kasap, Y., Kizilkan, Y. *et al.* External validation of the T.O.HO. score as predictor of success after retrograde intrarenal surgery. *BMC Urol* **22**, 68 (2022).
3. Karsiyakali N, Karabay E, Erkan E, Kadihasanoglu M. Evaluation of Nephrolithometric Scoring Systems to Predict Outcomes of Retrograde Intrarenal Surgery. Urol J. 2020 Jun 23;17(4):352-357. doi: 10.22037/uj.v0i0.5256. PMID: 31912473.
4. Zhang, Z., Chen, L., Niu, K. *et al.* A novel nomogram for predicting stone-free status after retrograde intrarenal surgery in patients with kidney stones. *BMC Urol* (2025). https://doi.org/10.1186/s12894-025-02022-z
5. Bai T, Zhou J, Li Y, Sun K, Wang D, Chen H, et al. Predictive nomogram for outcomes following retrograde intrarenal surgery: a single-center retrospective analysis. Journal of Endourology. 2025.
6. Thomas K, Smith NC, Hegarty N, Glass JM, Hennessey DB, McNeill A, et al. The S.T.O.N.E. nephrolithometry scoring system: validation and comparison with other nephrolithometric tools. Journal of Endourology. 2016;30.
7. Moisello C, Avanzino L, Tacchino A, Ruggeri P, Ghilardi MF, Bove M. Motor sequence learning: acquisition of explicit knowledge is concomitant to changes in motor strategy of finger opposition movements. Brain Res Bull. 2011 May 30;85(3-4):104-8. doi: 10.1016/j.brainresbull.2011.03.023. Epub 2011 Apr 1. PMID: 21459132
8. Leighton J, Dingwall A, Whitehead S, Luk A, Gauhar V, Somani B, Geraghty R. Effect of infundibulopelvic angle on outcomes of ureteroscopy: a systematic review and meta-analysis. World J Urol. 2024 Jul 16;42(1):413. doi: 10.1007/s00345-024-05104-z. PMID: 39012390; PMCID: PMC11252207.
9. Michel MS, Trojan L, Rassweiler JJ, Knoll T, Alken P, de la Rosette J, **et al.** Complications in retrograde intrarenal surgery and strategies to reduce morbidity. *Current Opinion in Urology*. 2020;30.
10. EAU Guidelines. Edn. presented at the EAU Annual Congress Madrid 2025. ISBN 978-94-92671-29-5.https://uroweb.org/guidelines/urolithiasis/chapter/citation-information
11. Hori S, Otsuki H, Fujio K, Kobayashi H, Nagao K, Nakajima K, Mitsui Y. Novel prediction scoring system for simple assessment of stone-free status after flexible ureteroscopy lithotripsy: T.O.HO. score. Int J Urol. 2020 Sep;27(9):742-747. doi: 10.1111/iju.14289. Epub 2020 Jun 27. PMID: 32594597