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UROLITHIASIS

Influence of pre-stenting on flexible and navigable suction (FANS) access sheath outcomes. Results of a prospective multicentre study by the EAU Section of Endourology and the global FANS collaborative group

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Introduction Pre-stenting remains a subject of debate, and its influence on FANS assisted ureteroscopy is unclear. The global FANS collaborative group aims to address the influence of pre-stenting on FANS-assisted ureterorenoscopy (URS).

Material and methods This prospective multicentre study assesses the outcomes of 394 patients undergoing FANS-assisted ureteroscopy for renal stones. Patients were stratified into a non-pre-stented (group 1, n = 163) and pre-stented group (group 2, n = 231). Data on demographics, stone characteristics, operative parameters, and postoperative 30-day outcomes were analysed. Statistical analyses, including multivariate regression, were performed for stone-free rates (SFR) and complications. SFR was defined by bone window on non-contrast computed tomography (CT).

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Results Pre-stented patients had a higher prevalence of positive urine culture treated with preoperative antibiotics (23.8% vs 12.3%, p = 0.006). Larger stone volumes were noted (1,306 mm^3 vs 1,200 mm^3, p = 0.027) in group 1. Postoperative complications were minor. Sepsis was not reported in either group. Group 1 had a higher incidence of low-grade Traxer grade 1 ureteric injuries (4.3% vs 0.4%, p = 0.021). FANS resulted in high overall SFRs of 97.5% and 97.0% in groups 1 and group 2. Multivariate analysis showed no statistical difference in SFR between the groups (63.2% vs 53.2%, p = 0.063). Only thulium fibre laser (TFL) and stone volume were significant predictors of residual fragments (RF).

Conclusions Pre-stenting for FANS is not mandatory irrespective of stone location and volume. The use of TFL and stone volume significantly influenced SFR, while FANS itself proved highly effective in achieving high SFR.

Key Words: FANS ‹› suction ‹› access sheaths ‹› ureteroscopy ‹› ureterorenoscopy ‹› RIR

INTRODUCTION

Pre-stenting before retrograde intra-renal surgery (RIRS) remains controversial, with studies [1] and guidelines [2, 3] differing in recommendations. It does improve the ability to insert a ureteric access sheath (UAS) in different populations [4] but does not necessarily translate into better stone-free rates (SFR).

Flexible and navigable sheaths (FANS) are effective tools to improve flexible ureteroscopy safety. As FANS crosses the pelviureteric junction (PUJ) and, like a flexible scope, uses active and passive deflection, it must be manoeuvred within the pelvicalyceal system to maximise efficacy [5].

The global FANS collaborative group initiative was established primarily to assess if FANS can be used safely in non-stented patients and if it can achieve a zero residual fragment status, renderi (FURS) outcomes [5]. With miniaturisation, different sheath sizes are available, and further studies need to ascertain if pre-stenting does indeed improve the utility without compromising patients 100% stone-free in a real-world setting, both with and without pre-stenting.

MATERIAL AND METHODS

Twenty-five centres worldwide prospectively contributed data on 394 adult patients undergoing FURS using FANS. A 100 watt pulse-modulated, high-power holmium laser (HpHL) from Lumenis with and without MOSES technology or a 60 watt thulium fibre laser (TFL) from IPG Photonics or Quanta fibre dust or SOLTIVE laser was used for renal stones of any size/number and location in kidneys with a normal pelvicalyceal system (PCS) between 1 April 2023 and 10 January 2024.

All patients had a preoperative and at least one postoperative non-contrast CT scan (NCCT) to assess stone(s) features and residual fragments (RF) within 30 days of the index procedure. Children and patients who had abnormal renal anatomy, ureteral stones, or insufficient data records were excluded. Because most surgeons were new users or had limited exposure to FANS, prior to case enrolment all surgeons were asked to see the step-by-step video on FANS use (9) and perform a trial of at least 2 cases.

The choice of energy source for RIRS, sheath size and brand, perioperative decisions, and postoperative exit strategy was at the respective surgeon's discretion. Data on the reason for pre-stenting (symptomatic relief/obstruction/failure to primary access/staged RIRS or preferred choice) was collected. Only patients in whom FANS was successfully deployed with and without pre-stenting were eligible. The primary outcome was to assess for SFR and complications. RF were classified using the bone window in a NCCT within 30 days of RIRS. Patients were categorised as follows:

- grade A: 100% stone-free, indicating zero RF, no fragments or dust visible on the CT scan,
- grade B: single RF not more than 2 mm,
- grade C: single RF 2.1–4 mm,
- grade D: single RF >4 mm or multiple RF of any size.

Patients with grade A were classified as having zero RF, while grade A and B were considered stone-free with no further imaging or follow-up needed. Grade C and D were considered as non-stone-free. These patients, if planned for intervention by a second RIRS, would need a CT scan to reassess the need for the same.

Details about laser type, preferred technique, and lasing mode for laser lithotripsy were recorded. The evaluation was compared between the non-pre-stented (group 1) and pre-stented patients (group 2). Other outcomes of interest included postoperative complications within 24 hours and any readmission within 30 days or future planned re-intervention.

Statistical analysis

Statistical analyses were performed using R Statistical language, version 4.3.0 (R Foundation for Statistical Computing, Vienna, Austria) with $p < 0.05$ indicating statistical significance. Continuous variables were described using median and interquartile range, while categorical variables were described using absolute numbers and percentages. The Shapiro-Wilk test was used to assess for normality. To visualise the similarities and differences between both study arms, patient demographics, peri-operative parameters, and 30-day outcomes were compared between the HpHL and TFL groups using the χ^2 test or Fisher exact test for categorical parameters and the Mann-Whitney U test for continuous variables.

Bioethical standards

Patient consent was obtained to contribute to the IRB-approved anonymised global FANS registry (#AINU 12/2022) maintained by the principal site (Asian Institute of Nephro-Urology, Hyderabad, India).

RESULTS

Baseline characteristics

Of 394 patients, 163 were in group 1 and 231 in group 2. The median age was 50 years (IQR: 36–60) in group 1 and 49 years (IQR: 36–61) in group 2. Both groups had comparable distributions of gender, BMI, and presentation symptoms. A higher percentage of patients in group 2 had positive urine cultures treated with preoperative antibiotics (23.8% vs 12.3%, $p = 0.006$) and received prophylactic preoperative antibiotics more frequently (76.6% vs 92.0%, $p < 0.001$). Stone diameter distribution differed significantly between the groups ($p = 0.044$), with a higher proportion of stones larger than 1 cm in group 1. Stone volume also showed a significant difference ($p = 0.007$), with a higher prevalence of larger stone volumes in group 1 (Table 1).

Operative characteristics

No significant differences were observed in the rates of spinal anaesthesia between the 2 groups.

Table 1. *Baseline characteristics*

	Entire cohort		
	Not pre-stented (n = 163)	Pre-stented (n = 231)	p-value
Age	50 [36, 60]	49 [36, 61]	0.498
Male gender	94 (57.7)	139 (60.2)	0.694
Body mass index (BMI) [kg/m²]	26 [24, 29]	26 [24, 29]	0.96
Presentation			
Haematuria	15 (9.2)	19 (8.2)	0.874
Pain	133 (81.6)	185 (80.1)	0.807
Fever	3 (1.8)	8 (3.5)	0.514
Incidental	17 (10.4)	22 (9.5)	0.9
Urine culture positive (preoperative treated with antibiotics)	20 (12.3)	55 (23.8)	**0.006**
Preoperative antibiotics (prophylactic)	150 (92.0)	177 (76.6)	**<0.001**
Hounsfield units	1,070 [895, 1,213]	1,100 [888, 1,241]	0.923
Right-sided stone	71 (43.6)	95 (41.1)	0.705
Stone diameter			**0.044**
<1 cm	29 (17.8)	66 (28.6)	
1–2 cm	105 (64.4)	126 (54.5)	
>2 cm	29 (17.8)	39 (16.9)	
Stone volume [mm³] (continuous variable)	1,306 [793, 1,943]	1,200 [636, 1,600]	**0.027**
Stone volume [mm³] (categorical variable)			**0.007**
≤1,500	94 (57.7)	159 (68.8)	
1,501–3,000	49 (30.1)	49 (21.2)	
>3,000	20 (12.3)	23 (10.0)	
Stone location			0.177
Multiple locations	12 (7.4)	13 (5.6)	
Upper pole only	32 (19.6)	63 (27.3)	
Middle pole only	59 (36.2)	89 (38.5)	
Lower pole only	60 (36.8)	66 (28.6)	

Differences were noted in sheath size, ureteroscopy time, and total operation time. The distribution of sheath sizes was similar, although more patients in group 2 had larger sheath sizes. Group 1 had longer median ureteroscopy time (39 minutes [IQR: 29–60] vs 32 minutes [IQR: 24–49], p = 0.004) and total operation time (54 minutes [IQR: 39.5–75] vs 45 minutes [IQR: 36–63.5], p = 0.008). Stone fragmentation techniques and laser parameters were similar, although the use of TFL was more common in group 1 (53.4% vs 40.7%, p = 0.017) (Table 2).

Postoperative outcomes

The incidence of mild bleeding due to scope/sheath movement was higher in group 2 (7.8% vs 3.7%, p = 0.142), but this difference was not statistically significant. Ureteric injury was more common in group 1 (4.3% vs 0.4%, p = 0.021). Other complications, including postoperative transfusion, fluid extravasation, perinephric stranding, fever, and sepsis, did not differ significantly between the groups. Loin pain scores on the first postoperative day were similar between the groups (p = 0.093) (Table 3).

Stone-free rates

Stone-free parameters, including intraoperative 100% SFR (zero R, grade A) and 30-day outcomes, were comparable between both groups. Intraoperative 100% stone-free rates were 50.3% in group 1 and 51.9% in group 2 (p = 0.203). At the 30-day follow-up, the rates of achieving 100% stone-free status (zero RF) were 63.2% and 53.2% in group 1 and 2, respectively

Table 2. *Operative characteristics*

	Not pre-stented (n = 163)	Pre-stented (n = 231)	p-value
Spinal anaesthesia	29 (17.8)	41 (17.7)	>0.99
Sheath size (Fr)			
12–14	32 (19.6)	51 (22.1)	0.75
11–13	64 (39.3)	83 (35.9)	
10–12	67 (41.1)	97 (42.0)	
Sheath			
Clearpetra	103 (63.2)	141 (61.0)	0.058
Innovex	5 (3.1)	20 (8.7)	
Elephant	45 (27.6)	49 (21.2)	
Others	10 (6.1)	21 (9.1)	
Disposable scope	144 (88.3)	208 (90.0)	0.709
Scope size ≥8 (Fr)	69 (42.3)	104 (45.0)	0.669
Laser time [min]	19 [12, 28.5]	17. [11, 27]	0.177
Ureteroscopy time [min] (actual usage of Flexible scope)	39 [29, 60]	32 [24, 49]	**0.004**
Total operation time [min] (from cystoscopy to exit)	54 [39.5, 75]	45 [36, 63.5]	**0.008**
Stone fragmentation technique			
Dusting with aspiration only	68 (41.7)	87 (37.7)	0.848
Popcorning with aspiration only	7 (4.3)	9 (3.9)	
Fragmentation and basketing only	3 (1.8)	4 (1.7)	
Fragmentation and aspiration only	85 (52.1)	131 (56.7)	
TFL	87 (53.4)	94 (40.7)	**0.017**
Laser parameters			0.688
Dusting energy [J]	0.5 [0.4, 0.8]	0.50 [0.4, 0.8]	**0.01**
Dusting frequency [Hz]	25 [20, 45]	25 [12, 40]	**<0.001**
Popcorning/fragmentation energy [J]	1.0 [0.6, 1.0]	1.0 [0.8, 1.2]	**0.002**
Popcorning/fragmentation frequency [Hz]	18 [10, 35]	15 [10, 33]	
Stone basketing (for relocation and extraction)	26 (16.0)	26 (11.3)	0.228
Sheath able to access all parts of kidney	147 (90.2)	195 (84.4)	0.13
Postoperative strategy (exit strategy)			
DJ stent	135 (82.8)	176 (76.2)	0.282
Overnight ureteric catheter	19 (11.7)	37 (16.0)	
No stent or ureteric catheter	9 (5.5)	18 (7.8)	
Likert scale rating for UAS performance			
Ease of suction	2 [1, 2]	2 [1, 2]	0.229
Manipulation	2 [1.5, 2]	2 [1, 3]	0.384
Visibility	1 [1, 2.5]	1 [1, 3]	0.186

DJ stent – double J stent; TFL – thulium fibre laser; UAS – ureteric access sheath (p = 0.063). Single-stage SFR (grade A + B) was 97.5% in group 1 and 97.0% in group 2 (p = 0.975).

Multivariate analysis

Table 4 presents the multivariate analysis (MVA) of 100% SFR in the matched cohort. The analysis revealed no significant effect of presenting on SFR (OR 0.819, 95% CI: 0.430–1.550, p = 0.539). TFL usage was associated with higher SFR compared to HpHL (OR 1.93, 95% CI: 1.044–3.625, p = 0.038). Additionally, larger stone volume (>1,500 mm^3) was associated with lower SFR (OR 0.274, 95% CI: 0.116–0.619, p = 0.002).

Table 3. *Postoperative outcomes*

	Not pre-stented (n = 163)	Pre-stented (n = 231)	p-value
Mild bleeding due to scope/sheath movement not affecting intraoperative surgery	6 (3.7)	18 (7.8)	0.142
Postoperative transfusion (CD1)	0	1 (0.4)	>0.99
Ureteric injury (all cause managed by stenting)	7 (4.3)	1 (0.4)	**0.021**
Level of injury: PUJ/proximal/mid/distal	1/2/2/2	1/0/0/0	
PCS injury (due to scope/sheath or laser managed by stenting only)	3 (1.8)	2 (0.9)	0.693
Fluid extravasation not needing intervention	5 (3.1)	2 (0.9)	0.214
Perinephric stranding reported on first NCCT	14 (8.6)	14 (6.1)	0.446
Fever within 24 hours	7 (4.4)	5 (2.4)	0.458
Sepsis	0	0	NA
Persistent haematuria needing intervention	0	0	NA
Loin pain score (1st postoperative day)	1 [1, 2]	1 [1, 2]	0.093
Stone freedom parameters			
Intraoperative 100% SFR	82 (50.3)	120 (51.9)	0.203
30-day outcomes			
100% SFR (zero residual fragment)	103 (63.2)	123 (53.2)	0.063
Single-stage stone free (grade A + B)	159 (97.5)	224 (97.0)	0.975
Single-stage non-stone free (grade C + D)	4 (2.5)	7 (3.0)	
Reintervention planned after 1st CT: RIRS/ESWL	4 (2.5)/0	7 (3.0)/0	

CT – computed tomography; ESWL – extracorporeal shock-wave lithotripsy; NCCT – postoperative non-contrast CT scan; PCS – pelvicalyceal system; PUJ – pelviureteric junction; RIRS – retrograde intra-renal surgery; SFR – stone-free rates

Table 4. *Multivariate analysis of 100% stone-free rates in the matched cohort*

	Odds ratio (OR)	95% CI	p-value
Pre-stenting	0.819	0.430–1.550	0.539
Laser type (TFL vs HL)	1.93	1.044–3.625	**0.038**
Stone location (vs multiple locations)			
Upper pole	2.328	0.579–9.743	0.236
Middle pole	1.146	0.319–4.231	0.834
Lower pole	1.438	0.389–5.420	0.584
Stone volume (categorical variable, vs ≤1,500)			
1,501–3,000	0.274	0.116–0.619	**0.002**
>3,000	0.696	0.218–2.255	0.538
Hounsfield units	1.001	0.999–1.002	0.436
Laser time	1.01	0.953–1.071	0.725
URS time	0.967	0.928–1.003	0.088
Total operation time	1.007	0.959–1.058	0.786

HL – holmium laser; TFL – thulium fibre laser; URS – ureterorenoscopy

DISCUSSION

Traditionally, UAS was preferably used in pre-stented patients because it allowed for better drainage of irrigation and facilitated multiple scope passages if inserted atraumatically [6]. However, larger sheaths increased ureteric injury risk, leading to a perception that pre-stenting was necessary to prevent ureteric injury and achieve safe RIRS [7].
FANS has emerged as a promising tool in FURS, offering benefits such as improved intraoperative visualisation, enhanced SFR, and reduced intrarenal pressure, temperature, and postoperative complications [5, 8–10]. One notable advantage is its flexible and navigable proximal 10-cm tip, which allows for active and passive deflection, which is particularly beneficial in cases of a dilated system, facilitating navigation into the desired calyx. With the advent of novel FANS designs that can be inserted beyond the PUJ, the role of pre-stenting in these scenarios requires further investigation.
In this study, pre-stenting was conducted for symptomatic relief, obstruction, failure to achieve primary access, or for staged RIRS. The number of patients with asymptomatic incidental renal stones (AIRS) [11] was nearly equal in both groups (10.4% vs 9.5%). Despite FANS being a newer accessory involving sheath movement within the kidney, surgeons did not consider size, volume, and non-pre-stenting as deterrents to perform FANS. In fact, non-pre-stented patients had larger stones compared to pre-stented patients with stone volumes of 1,306 mm^3 (IQR: 793–1,943) and 1,200 mm^3 (IQR 636–1,600), respectively, $p = 0.027$.
Although the stone fragmentation techniques were similar between the groups ($p = 0.848$), TFL was more commonly utilised in group 1 (53.4% vs 40.7%, $p = 0.017$). This could be due to personal preference bias of surgeons or the availability only of TFL at certain centres. Interestingly, group 1 exhibited lower mean laser energy settings, suggesting a more conservative approach to laser energy delivery. This might explain why lasing time, ureteroscopy time, and total operation time were significantly higher in group 1, in addition to larger stone volumes requiring longer total ablation time. This is also reported in traditional RIRS by Chai et al. [1], whereby in the FLEXOR studies the mean operative time for non-pre-stented patients was significantly longer (68.17 min vs 58.92 min, $p < 0.001$).
For our study the ureteroscopy time was recorded specifically representing the surgeon's time spent navigating FANS into different calyces for inspection/lasering and/or aspiration of dust and fragments. One would expect this to prolong operative times, but notably the operative times using FANS are shorter or comparable to most other series (non-pre-stented vs pre-stented: 54 min [39.5, 75] vs 45 min [36, 63.5], respectively, $p < 0.008$) [1, 4]. Noting that dusting or fragmentation with immediate suction was the preferred technique, it might have been more efficacious.
Dusting or fragmentation with suction will depend on the surgeon's preferred choice, but as seen in our study, these methods lead to a lesser need for popcorning or basket extraction of fragments. This might allow surgeons to spend less overall time in the PCS. The trifecta mechanism that enables this is the vacuum effect, which prevents stone debris from migration into other calyces, dust aspiration allowing for clear vision, and active fragment removal via sheath by whirlpool effect of high irrigation flow rates.
Using suction, and lowering lasering time and overall operative times contribute to the well-established benefit of preventing the damage that high intrarenal temperature and pressure may cause during RIRS [12].
Smaller diameter sheaths and scopes have been suggested as preferred choices in multiple studies [5, 13]. In our study, there was a trend towards the utilisation of smaller scopes and sheaths in both groups. Overall, there was no significant difference in sheath sizes between the 2 groups ($p = 0.75$). Interestingly, the sheath reached all parts of the kidney more successfully in group 1 than in group 2, i.e. 90.2% and 84.4%, respectively ($p = 0.13$). This raises questions about potential factors contributing to this difference, such as surgeon skill, sheath design, or the use of smaller scopes in group 1.
Intraoperative bleeding due to scope or sheath movement was slightly higher in group 2 (7.8% vs 3.7%, $p = 0.142$). The larger diameter scopes and sheaths used in pre-stented cases might also have contributed to increased inadvertent mucosal rubbing, leading to mild oozing. This could also be induced by the stones or pre-stenting-induced mucosal inflammation. However, due to effective suction management this did not affect intraoperative surgery significantly. While the incidence of ureteric injuries was low and mostly minor – primarily Traxer grade 1 [7] – they occurred more frequently in group 1 (4.3% vs 0.4%, respectively, $p = 0.021$). Importantly, these injuries predominantly occurred not at the site of the PUJ but rather in the ureter.
This finding is noteworthy, particularly in light of existing concerns regarding the deployment of access sheaths beyond the PUJ. These findings reaffirm that urologists should be mindful while inserting any UAS, especially in non-pre-stented cases, and

more so if a larger diameter is preferred. However, the use of FANS itself is not a reason for PUJ or calyceal injury, unless carelessly inserted.

Group 2 had a higher proportion of patients with positive urine cultures requiring preoperative antibiotic treatment, aligning with the known association between indwelling ureteric stents and increased susceptibility to urinary tract infections, even in patients with initially negative urine cultures [14]. Patients with longer durations of pre-procedural indwelling ureteric stents face a higher risk of postoperative urinary tract infection and sepsis [15]. Despite these considerations, no cases of sepsis were reported in either group, and the incidence of postoperative fever was low, at 4.4% and 2.4% in group 1 vs group 2, respectively. This may be attributed to the lower intrarenal pressures associated with the use of FANS, which can help prevent pyelovenous backflow [16, 17]. This is consistent with prior studies demonstrating either no or minimal infectious complications in FANS-assisted ureteroscopy [5, 17–19].

In group 1 there was a higher rate of postoperative stent placement (82.8% vs 76.2%, respectively). Conversely, the confidence to leave only an overnight ureteric catheter was lower in group 1 (11.7% vs 16.0%, respectively). Furthermore, fewer cases in group 1 opted for neither stent nor ureteric catheter placement. The difference in postoperative strategies between the 2 groups was not statistically significant ($p = 0.282$). This does raise a paradoxical situation wherein should we therefore pre-stent to avoid postoperative stenting? Further studies are warranted to determine the optimal approach.

No statistically significant difference was seen between both groups regarding postoperative loin pain, with very low scores. This suggests a favourable outcome for patients undergoing FANS-assisted retrograde intrarenal surgery (RIRS), regardless of pre-stenting status. Probably the low IRP prevents retro- and intrarenal extravasation that contributes to lower pain [19–21].

SFR between the 2 groups were comparable. Intraoperatively, both groups exhibited similar rates of achieving 100% SFR, with 50.3% in group 1 and 51.9% in group 2 ($p = 0.203$). At the 30-day follow-up, the differences in SFR remained non-significant. The proportion of patients achieving 100% SFR (zero residual fragments) was 63.2% in group 1 and 53.2% in group 2 ($p = 0.063$). Furthermore, the single-stage SFR (grades A and B) were notably high and comparable between both groups, with 97.5% in group 1 and 97.0% in group 2 ($p = 0.975$). Reintervention rates after the first CT scan were similar between the groups, with 2.5% in group 1 and 3.0% in group 2 requiring further intervention, either by RIRS or extracorporeal shock-wave lithotripsy (ESWL). Overall, these findings suggest that pre-stenting does not significantly impact stone-free outcomes.

MVA demonstrated that pre-stenting had no significant effect on SFR. This suggests that pre-stenting does not independently contribute to higher SFR. Interestingly, only TFL usage was associated with higher SFR compared to HpHL, with an OR of 1.93 and a p-value of 0.038. Indeed, TFL has been shown to be a better ablative laser for RIRS due to its ability to produce finer dust, perhaps allowing for easier aspiration. However, the use of TFL itself is not responsible for a better SFR compared to other lasers [22]. We believe that the combination of FANS and TFL, allowing for targeted access to all parts of the calyces, may have contributed to more effective removal of finer dust. However, this warrants corroboration with studies that specifically look at ablation efficiency with FANS.

Furthermore, stone volume was a significant predictor of SFR. Stones with volumes ranging from 1,501 to 3,000 mm^3 were associated with a significantly lower likelihood of achieving 100% SFR compared to stones with volumes of 1,500 mm^3 or less, with an OR of 0.274 and a p-value of 0.002. Stones larger than 3,000 mm^3 showed lower odds of SFR, but our study had very high overall SFR at 30 days. Indeed, stone volume should be used instead of stone diameter as a predictor for RIRS efficacy.

Overall, the findings suggest that pre-stenting does not independently influence stone-free outcomes. Instead, factors such as the type of laser used and stone volume play more significant roles in determining the success of the procedure. Perhaps FANS technology itself may be the primary driver of improved SFR, rather than pre-stenting.

While this study provides valuable insights into the outcomes of FANS-assisted RIRS and the role of pre-stenting, several limitations should be considered:

- Although this study benefits from its prospective and multicentric design, it was not randomised, and its sample size may not be sufficient to draw definitive conclusions.
- The study's multicentre design with use of different UAS and instrumentation manufacturers introduces variability in surgical techniques, which may affect generalisability. However, to minimise variability in outcome reporting, a uniform methodology of NCCT in bone window and strict follow-up protocol were applied in a real-world practice.

Further prospective, randomised controlled trials with larger sample sizes and longer follow-up periods are warranted to validate the findings of this study.

CONCLUSIONS

Our findings suggest that pre-stenting for FANS procedures is not mandatory regardless of stone location and volume. However, the preference for smaller sheaths and disposable scopes to minimise incidental low-grade injuries emphasises the importance of meticulous instrumentation selection.

TFL and stone volume were critical variables influencing stone-free rates. Nonetheless, the efficacy of FANS itself in achieving a high SFR highlights its utility in RIRS as a useful accessory.

We speculate from our study findings that pre-stenting may minimise postoperative stent requirements; however, the trade-off between pre-stenting and postoperative stenting warrants further investigation to optimise patient outcomes and resource utilisation.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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ETHICS APPROVAL STATEMENT

The ethical approval was not required.

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