

# Safety and Efficacy of Live Retrograde Intrarenal Surgery in Patients with Kidney Stone: Outcomes from a Boutique Course Series Which Complies with the Live Surgery Event Policies

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**Background:** Live surgery events (LSEs) are frequently organized for sharing the surgical experiences with surgeons at the beginning of their learning curves. The aim of this study was to investigate whether the outcomes and complication rates of patients underwent retrograde intrarenal surgery (RIRS) at LSEs are comparable with regular cases.

**Methods:** Ten courses were organized during 2017–2022. Data of 32 patients who operated in the LSEs were 1:3 matched (for stone burden and surgeon) with the data of patients who underwent regular RIRS within the course periods at the same centers ( $n = 96$ ). All courses took place in concordance with the latest LSE policies. The primary outcomes were stone-free and complication rates. Fluoroscopy and operation times were the secondary outcomes.

**Results:** Stone-free rates of the groups were similar (84% in LSE and 79% in control group;  $p = 0.520$ ). Similarly, there were no differences in complication rates ( $p = 0.428$ ) and fluoroscopy time ( $p = 0.477$ ). Duration of the LSE cases ( $82.24 \pm 31.12$  min) was slightly but insignificantly longer than regular cases ( $73.77 \pm 20.89$  min,  $p = 0.092$ ). Moreover, guest surgeons tend to have longer operation time with statistically insignificant prolongation ( $74.92 \pm 30.43$  min for host,  $89.52 \pm 28.34$  min for guest surgeons,  $p = 0.064$ ).

**Conclusions:** RIRS can be performed without jeopardizing operation efficiency and patient safety in LSEs. If surgeon is not familiar with operating room set-up or staff, live surgery must be performed by host surgeon to avoid extended operating time.

**Keywords:** retrograde intrarenal surgery; live surgery events; kidney stone; urolithiasis; ureteroscopy

## Introduction

The high incidence of kidney stones urged the need for more effective and safe methods in the stone disease treatment [1]. Advances in the fiberoptic technologies, intracorporeal laser lithotripters and grasping devices have shaped retrograde intrarenal surgery (RIRS) as an effective and safe minimally invasive option to meet this need. The European Association of Urology (EAU) Guideline recommends RIRS as an alternative approach when percutaneous nephrolithotomy (PNL) and shock wave lithotripsy (SWL) are not an option, even for stones  $>2$  cm [2]. On the other hand, RIRS is a sophisticated surgical procedure that requires the efficient use of aforementioned contemporary technologies simultaneously. Surgical experience is a key

factor influencing the safety and efficiency of RIRS [3].

Live surgery events (LSEs) are frequently organized for sharing the surgical experience with surgeons at the beginning of their learning curves. But live surgery is still a controversial issue in terms of ethics and legal [4]. The EAU published and recently updated its policy on live surgical activities with a review of panel recommendations [5,6]. Retrograde intrarenal surgery has been increasingly the theme of LSEs. But previous studies do not provide a direct data regarding outcomes of live RIRS. The aim of this study was to investigate outcomes and complication rates of patients who underwent RIRS at LSEs and to compare the data of these patients with a matched control group consisting of regular RIRS cases.

## Material and Methods

Ten RIRS courses were organized by Society of Urological Surgery in Turkey (SUST) between February 2017 and June 2022. All courses were held in accordance with EAU panel recommendations for live surgical activities [5]. All procedures were performed in four different centers which have high institutional experience for endourological procedures.

### *Inclusion Criteria*

Following ethical approval, data of 32 patients who underwent live RIRS for kidney stone(s) were consecutively enrolled to the analysis. Control group consisted of patients who had regular RIRS for kidney stone(s) and operated within the course week or previous/upcoming weeks at the same center with LSE cases ( $n = 147$ ). The control cases were operated by the same five surgeons at the hospitals where they work. After 1:3 case-control matching, surgeon- and stone burden-matched 96 control cases were included in analysis. Live surgical event patients were also divided into two subgroups according to surgeon's status (host or guest surgeon).

### *Exclusion Criteria*

Patients who have missing data, who have renal anomalies or chronic kidney failure, who underwent same session bilateral RIRS or any other simultaneous surgery for any indications were excluded.

Stone-free and complication rates were the primary; Operation time (min), fluoroscopy time (second), length of hospitality (day), and need for additional procedure were the secondary outcomes of the study. Stone-free status was defined as no residual fragments  $>3$  mm in postoperative follow-up imaging (kidney-ureter-bladder graphy, urinary ultrasound or non-contrast computed tomography (CT)).

### *Statistical Analysis*

Demographics (age, gender, BMI); Stone features (burden, side, localization, density), previous history of failed SWL for same stone(s) and pre-operative double j stent; peri-/post-operative findings (operation time, fluoroscopy time, length of hospitality, stone-free status, complications, need for additional procedure, postoperative double j stent) of patients were retrieved. The Chi-Square and Fisher exact tests were used for comparing the categorical variables. Mann-Whitney U test was used for evaluating difference between the continuous variables. The data were analyzed with the Statistical Package for the Social Sciences v. 22 (SPSS Inc., Chicago, IL, USA).  $p < 0.05$  was considered statistically significant.

### *Surgeon Selection for LSE*

All of the surgeons had advanced RIRS experience (each surgeon performs  $>100$  RIRS procedures per year).

All surgeons were native (Turkish) and had previously performed in LSEs. Guest surgeons were assisted by their regular resident/assisting surgeon but not by their regular staff nurse. The same equipment, instruments and devices which had been used by all surgeons previously were moved to the host institutes. Surgeons' familiarity status with all external factors was shown in Table 1. Patients' medical costs were covered by their regular insurance and all surgeons had physician liability insurance. But there was no event-special indemnity insurance arranged. Primary surgeon information was given in the standart operating lists of hospitals and in the course brochures. Patients were aware of the guest surgeons.

### *Patient Selection for LSE*

Patients who underwent surgery in LSEs were selected among those who were previously scheduled for RIRS. Live surgery events did not cause any delay in both regular and LSE cases. Hospitals obtained extra operating rooms for the courses. There were reserve patients for each LSE cases. Reserve cases which were not needed during courses underwent RIRS following LSE cases. These operations were carried out by host surgery teams.

### *Preoperative Planning and Theatre Team Preparation*

All surgeons were familiar with instruments, disposables and devices (Table 1). Live surgery events were national organisations and there was no language barrier. Anesthesiologists involved the courses. Surgical prophylaxis was administered (ceftriaxone, intravenous) before the operations. Urology residents of the host institutions were on duty during courses. Patients were routinely evaluated with hemogram, routine biochemical parameters, urinalysis and urine culture before the procedure. All patients were evaluated by non-contrast low-dose CT before the procedure and the Hounsfield Unit (HU) of stones was measured. All these clinical details were sent to the guest surgeon and a critical discussion was carried out for all LSE patients. Guest surgeon was allowed for selecting patients. They were invited to the host city the day before event if they reside other cities. Most of them were already familiar with the host centers.

All centers check the personnel in the operating room with the WHO surgical checklist. This routine practice was also carried out for LSE patients. Flex-X2® (Karl Storz Endoscope; Tuttlingen, Germany), URF-P5® (Olympus; Hamburg, Germany) flexible URS and URF-V® (Olympus; Hamburg, Germany) were used in the procedures. Lithotripsy was done with Holmium laser lithotripters (Stonelight 30®, Quanta System Litho®). Cook® NGage™ Nitinol and Zero Tip™ Nitinol (Boston Scientific; Marlborough, MA, USA) stone retrieval baskets, Sensor™ PTFE-Nitinol Guidewire with Hydrophilic Tip and Zebra™ Urologic Guidewire (Boston Scien-

**Table 1. Surgeon's familiarity status with external factors.**

Characteristic	Regular surgeries	LSE with host surgeons	LSE with guest surgeons
Instruments	+	+	+
OR set-up	+	+	-/+
OR staff	+	+	-
Assisting surgeon/resident	+	+	+
Institution	+	+	-/+

**Table 2. Patient baseline characteristics.**

Characteristic	LSE group	Control group	<i>p</i> value
Number	32	96	
Age (year, median, (min–max))	45 (2–72)	44 (5–66)	0.408
Gender			0.539
Male	13/32 (41%)	45/96 (47%)	
Female	19/32 (59%)	51/96 (53%)	
BMI (kg/m <sup>2</sup> )	27.21 ± 3.22	26.97 ± 5.14	0.574
Side			0.535
Right	17/32 (53%)	57/96 (59%)	
Left	15/32 (47%)	39/96 (41%)	
Stone burden (mm)	11.93 ± 3.08	11.14 ± 4.17	0.172
Hounsfield unit (mean)	1100 ± 377	1076 ± 358	0.417
Localization			0.075
Lower calyx	5/32 (16%)	17/96 (18%)	
Other calyces	7/32 (22%)	36/96 (38%)	
Pelvis	18/32 (56%)	30/96 (31%)	
Multiple loc.	2/32 (6%)	13/96 (13%)	
Previous history of failed SWL for same stone(s)	15/32 (47%)	55/96 (57%)	0.305
Preoperative double j stent	14/32 (44%)	32/96 (33%)	0.288

Chi-Square or Fisher exact tests were used for the categorical variables. Mann–Whitney U test was used for the means.  $p < 0.05$  was considered statistically significant. BMI, body mass index, was calculated by dividing weight in kilograms by height in metres (m) squared.

tific; Marlborough, MA, USA) used in the operations. Navigator™ HD Ureteral Access Sheath (Boston Scientific; Marlborough, MA, USA) was used in all patients. Representatives from the companies were ready in course venue. Reserve equipments were provided by the companies.

### LSE Overview

All cases' endoscopic and fluoroscopic views were digitally recorded. Also all operation rooms were recorded during LSE's and archived in the official video database of the SUST, Uropedia ([www.uropedia.com.tr](http://www.uropedia.com.tr)). One or two experienced urologists, acting as the patient's advocate in the theatre, moderated the courses. Moderators were also on duty for recommended tasks which listed on EAU policy paper [5].

### Postoperative Care and Follow-Up

Postoperative care was carried out in the local hospitals under the standart protocols. The regular on-call personnels were on duty for those patients. The guest

surgeons were informed about postoperative courses of patients. Stone-free status and all complications of live surgery cases have been reported to guest surgeons via e-mail. Perioperative and postoperative complications were classified according to the Clavien and Satava Classifications respectively.

### Results

The median age of the patients in LSE and control groups was 45 (interquartile range (IQR): 2–72) and 44 (IQR: 5–66), respectively. There was no statistically significant difference between the groups ( $p = 0.408$ , Table 2). Mean stone diameter was 11.93 ± 3.08 mm in LSE group and 11.14 ± 4.17 mm in control group ( $p = 0.172$ ). Stone density was similar in both groups (1100.42 ± 376.87 and 1076.36 ± 358.14 HU,  $p = 0.417$ ). The LSE group had more pelvis stones, but the distribution of localizations showed no difference ( $p = 0.075$ ). Forty seven percent of the LSE group and 57% of the control group had previous history of failed SWL for the same stone(s) ( $p = 0.305$ ). Preoperative double j stent placement rates were similar ( $p = 0.288$ ).

**Table 3. Perioperative and postoperative outcomes.**

Characteristic	LSE group	Control group	<i>p</i> value	Host surgeons	Guest surgeons	<i>p</i> value
Number	32	96		16	16	
Operation time (min)	82.24 ± 31.12	73.77 ± 20.89	0.092	74.92 ± 30.43	89.52 ± 28.34	0.064
Floroscopy time (s)	23.64 ± 21.37	15.68 ± 9.19	0.477	26.42 ± 28.39	20.83 ± 14.16	0.524
Length of hospitality (d)	1.80 ± 1.14	1.93 ± 1.97	0.736	1.53 ± 0.84	1.98 ± 1.23	0.162
Stone-free rate	27/32 (84%)	76/96 (79%)	0.520 <sup>α</sup>	88% (14/16)	81% (13/16)	1*
Complication rate	5/32 (16%)	10/96 (11%)	0.428 <sup>α</sup>	19% (3/16)	13% (2/16)	1*
Need for additional procedure	3/32 (9%)	5/96 (5%)	0.412*	13% (2/16)	6% (1/16)	1*
Postoperative double j stent	30/32 (94%)	89/96 (93%)	1*	14/16 (88%)	15/16 (94%)	1*

<sup>α</sup>Chi square test, \*Fisher exact test, Mann–Whitney U test for other *p* values. *p* < 0.05 was considered statistically significant.

**Table 4. Complication characteristics of LSE cases.**

Variable	Grade	LSE group	Details
Postoperative complications according to the modified Clavien Classification	1	2 (66%)	Fewer requiring antipyretics
	2	0 (0%)	
	3	1 (33%)	Renal colic for ureteral residual stone fragment treated with ureterorenoscopy
	4	0 (0%)	
Postoperative complications		3 (9.38%)	
Perioperative complications according to modified Satava Classification	1	2 (66%)	Mild bleeding and minimal mucosal injury
	2A	1 (33%)	Ureteral access failure
	2B	0 (0%)	
	3	0 (0%)	
Perioperative complications		3 (9.38%)	
Overall complications (patients)		5 (16%)	

Stone-free rates of the groups were similar (84% in LSE and 79% in control group; *p* = 0.520, Table 3). Similarly, there was no difference in complication rates between two groups (*p* = 0.428). In LSE group, two patients had fewer as Grade 1 complication and one patient developed renal colic for ureteral residual stone fragments required ureterorenoscopy (Grade 3). During the procedures, two cases had mild bleeding accompanying minimal mucosal injuries (Grade 1). Ureteral access sheath insertion was failed in one case (Grade 2A). The procedure was proceeded without sheath.

Mean fluoroscopy times were not statistically different between the groups (*p* = 0.477). There was slightly longer duration of the LSE cases (82.24 ± 31.12 min) compared to regular cases (73.77 ± 20.89 min) but the difference was not statistically significant (*p* = 0.092). Fifty percent (16/32) of LSE cases were performed by the guest surgeons. Perioperative and postoperative outcomes of LSE group according to surgeons status were shown in Table 3. No significant difference was found between the two subgroups in any outcome. Guest surgeons tend to have long operation time with statistically insignificant prolongation (74.92 ± 30.43 min for host 89.52 ± 28.34 min for guest surgeons, *p* = 0.064). The duration of any operation did not exceed 120 min except for a case that had a stone in the cal-

iceal diverticulum and an ipsilateral open ureterolithotomy history. Complication characteristics of the live surgery cases were shown in Table 4. Vast majority of peri- and postoperative complications were mild. No patient had high grade severe complications.

## Discussion

Live surgical events create unique learning opportunities for participants. SUST RIRS courses took place in four different clinics during 2017–2022. Throughout the course series period, more than 100 urologists had the chance to learn the tips and tricks of RIRS by closely watching experienced endourologists. In this study, we report that all sessions were performed with satisfaction in all aspects and no major complications has occurred during and after the live surgeries.

Despite positive impact thereof on educators and participants, live surgical activities bring about some ethical and legal debates from patients' point of view. According to a survey of the American Association of Genitourinary Surgeons, participants consider live surgical activities ethical. But only 28% stated that they would allow themselves or their relatives to undergo surgery in such an event [7]. It is argued that LSE surgeons who working under greater stress compared to regular surgery may lead potential hazards to

patients [8]. In a study reporting personal experience of surgeons regarding LSE, 6.5% of respondents noted significant anxiety. This rate increased to 19.4% when performing as a guest surgeon [9]. Furthermore over-crowded operating room (OR) during LSEs may increase the risk of surgical site infection [10]. Size of the event can also affect the surgeon's anxiety level. Probably LSE with a few course participants in the theater does not cause the same level of stress/anxiety as a large online or live conference with a huge audience watching the procedure [11]. Boutique live surgeries can eliminate ethical concerns in this area. Because, this type of practice is common in medical faculty clinics for teaching/training medical students and residents. Live surgeries are a requirement for effective medical education and postgraduate training. Our courses have been conducted in large centers with experienced staff who can manage the stress and the risks of event in such trainings and there were no more people in OR than in regular education/training activity. Endourology centers in question were showed earlier to be safe surgical training environments [12,13]. We believe that organizing the similar courses with the same surgical team has also a positive effect on live surgical courses.

Surgeons tend to stay away from extremes and choose standard cases in live surgical events. The EAU also recommends the selection of standard cases as much as possible so that the educational objectives are not overlooked. The preoperative characteristics of the cases in our series were summarized in Table 2 and it was similar to those of regular surgery performed. All surgeons who involved in the courses as trainer adopt RIRS with ureteral access sheath and their data showed that UAS use is preventative of unfavourable outcomes [14]. All LSE cases were intended to be initiated by inserting UAS, accordingly. Some patients who have double j stent and unsuccessful SWL history were selected for the educational purpose of the courses. SWL-resistant kidney stones are one of the common indications of RIRS [15]. It is also easier to access kidney in patients with ureteral double j stent prior to RIRS [16]. The cases with the above features were especially preferred to achieve the educational goals. The slightly longer duration of the LSE cases can be attributed to the explanation of each step during the operations. Another reason could be the guest surgeons unfamiliarity with OR set-up or staff (except assisting surgeon).

After first establishing LSE guidelines in 2014, EAU updated its policies and reported outcomes of EAU-affiliated LSEs [6]. The committee concluded that live surgeries performed by local surgeons in their hospital with their regular staff are the best way to have a balance between patients safety and trainee's education goals. Guest surgeons tended to have long operation time in our series and even there was no statistically significant difference we deemed necessary to consider this finding clinically important for our future course plans.

Our study was not devoid of limitations of retrospective design. In addition, changing primary outcome measures among patients caused heterogeneity and lacking long-term stone-free status data contributed it. Furthermore, matching provided stone burden-balanced surgeon-adjusted study groups, but the findings might have been affected by other confounders that could not be taken into account as matching variables for the sake of preventing sample size from shrinking.

## Conclusions

Retrograde intrarenal surgery can be performed in LSEs, with low complication and comparable stone-free rates without jeopardizing patient safety. If surgeon is not familiar with operating room set-up or staff, live surgery must be performed by host surgeon to avoid extended operating time. Compliance with existing policies on live surgical activities in every part of courses is crucial.

## Availability of Data and Materials

Data of this study are available on request from the corresponding author.

## Author Contributions

OÖ, SÇ and CB—contributed to the concept and designed the research study, and provided help and advice on the experiments; OÖ, HMA and GK—performed the research, and contributed to the analysis and interpretation of the data; CMY, YT, HA and BÖ—contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

## Ethics Approval and Consent to Participate

This study conformed to the Declaration of Helsinki (2013) and was approved by the ethical committee of Cerrahpaşa Medical Faculty (approval no.: 21263603-604.02.01-18512). The informed consent was obtained from patients and their families who were aware of the purpose and significance of this study.

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## Conflict of Interest

Given his role as Guest Editor, Oktay Özman had no involvement in the peer-review of this article and has no access to information regarding its peer-review.

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