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Simultaneous Bilateral Endoscopic Surgery (SBES) for Patients with Bilateral Upper Tract Urolithiasis: Technique and Outcomes

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Abstract

Background: The incidence of bilateral and multiple renal stones is not negligible. To date, some sparse data on simultaneous bilateral stone surgery are available in literature showing good outcomes in terms of both effectiveness and safety.
Objective: To describe our series of patients with bilateral renal stones who underwent simultaneous bilateral endoscopic surgery (SBES), reporting its effectiveness and safety.
Design, setting, and participants: A prospective analysis of 27 consecutive patients who underwent simultaneous flexible ureteroscopy (fURS) in one side and percutaneous nephrolithotomy (PCNL) in the other side for bilateral renal stones was performed.
Surgical procedure: SBES, performing fURS in one side and PCNL in the other side contemporaneously.
Measurements: Clinical data were collected in a dedicated database. Intra- and postoperative outcomes were assessed. Comparisons among pre- and postoperative serum creatinine levels and estimated glomerular filtration rate values during the study period were performed using the Kruskal-Wallis test with the Dunn multiple comparison test.
Results and limitations: All the procedures were carried out until the end in both sides without encountering any complications intraoperatively. The mean stone size was 27.1 ± 8.1 and 11.1 ± 3.6 mm for the PCNL and fURS side respectively. The mean operative time was 79.4 ± 25.2 min. There were no differences in patients' creatinine and eGFR when comparing at baseline with 1-mo after SBES. No postoperative major complications were experienced (Clavien-Dindo grade I 3.7%; II 11.1%). Stone-free rate was 74% at 1-mo follow-up. The main limitation of the study is the small size of the group analyzed.
Conclusions: SBES is safe and effective, with minimal morbidity. SBES has the potential advantages of shorter operative time, reduced anesthesia, and reduced hospital time, which can benefit patients, surgeons, and health care systems.
Patient summary: Simultaneous bilateral endoscopic surgery is an effective treatment with low complication rates for bilateral urolithiasis. This innovative and complicated procedure should be performed in high-volume centers by experienced surgeons.

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1. Introduction

Urolithiasis is a common health disorder in the Western World with a lifetime risk of stone formation as high as 10–12% in males and 6–8% in females [1–3], and the prevalence of stone disease is on the rise over the past two decades [1]. Similarly, also the incidence of bilateral renal stones is not negligible—recent studies have shown that up to 15% of patients with urolithiasis will have bilateral renal stones [4]. It has been demonstrated that bilateral same-session endourological procedures for stones are effective in terms of both efficacy (ie, stone-free rate or SFR) and safety [5]. Moreover, same-session bilateral procedures for nephrolithiasis are associated with several advantages, including single anesthetic exposure for the patient, shorter cumulative hospitalization time, fewer days out of work, decreased patient radiation exposure, and greater overall cost effectiveness [6].

Historically, same-session bilateral procedures have been performed by the surgeon first completing the treatment on one side and then completing the treatment on the other side—that is, treating the stones in the right ureter and/or kidney first, and then proceeding with treatment of the left ureter and/or kidney or vice versa. However, a potentially more efficient treatment option is *simultaneous bilateral endoscopic surgery* (SBES), which entails at least two surgeons working simultaneously, each treating one kidney or ureter as opposed to treating one kidney after the other. Potential advantages would include improvements in efficiency—treatment of both renal units with shorter anesthetic time and also a decrease in the total number of procedures that a given patient may require. To date, there are sparse reports in the literature on the safety and efficacy of SBES [7–9]. Herein, we report our experience with SBES for patients with bilateral renal stones.

2. Patients and methods

2.1. Study population and endpoints

Prospective data were collected for all patients who underwent SBES at our institution from June 2017 to January 2018. All SBES procedures were performed as follows: in one kidney, a percutaneous nephrolithotomy (PCNL) was performed by a single surgeon, and at the same time (ie, simultaneously), another surgeon performed flexible ureteroscopy (fURS) in the contralateral kidney. Both surgeons were experienced endourologists (G.G. and S.P.). Prior to surgery, all patients were apprised of the benefits and risks of simultaneous bilateral surgery and possible alternative treatment as staged procedures. The study was approved by the local ethics committee, and patients provided informed consent. Inclusion criteria were age 18–80 yr and bilateral renal stones, one of which was deemed suitable for PCNL and the contralateral was deemed suitable for fURS. Exclusion criteria were as follows: pregnancy, anatomic abnormalities of the upper urinary tract, chronic kidney disease, positive preoperative urine culture, and complete staghorn calculi.

Routine preoperative and 1-mo postoperative work-up included history, physical examination, urinalysis, urine culture, and blood test including the evaluation of estimated glomerular filtration rate (eGFR) using the Cockcroft-Gault equation. Abdominal noncontrast computerized tomography (NCCT) scan was performed in all cases preoperatively and 1-mo postoperatively. Stone diameter was reported as the diameter of a single stone or the sum of the diameters of multiple stones on axial CT images. Patients were reported to be stone free if there were no stones on postoperative NCCT or if there were residual fragments <2 mm in diameter. Operative time was calculated as the time of the first endoscope insertion to the completion of final stent placement. Peri/postoperative complications were reported according Clavien-Dindo classification system [10,11]. The primary endpoint of the study was SFR and the secondary endpoints were Clavien-Dindo complications of grade 1 or higher.

Statistical analysis was performed with SPSS version 20 for Windows (IBM, Armonk, NY, USA). Comparisons among pre- and postoperative serum creatinine levels and eGFR values during the study period were performed using the Kruskal-Wallis test with the Dunn multiple comparison test. Data are expressed as mean $\pm$ standard deviation and as median (interquartile range). Statistical significance was considered at $p < 0.05$.

2.2. Technique

2.2.1. Patient positioning, anesthesia, and organization of the operating room

Prior to the operation, according to European Association of Urology guidelines [12], patients are given single-shot second-generation cephalosporin intravenously. After induction of general anesthesia, the patient is positioned for supine PCNL in the Valdivia position [13]—the patient is placed at the edge of the table on the same side as the largest stone (ie, the side on which PCNL would be performed), and the flank is gently elevated by means of a small jelly bolster to obtain a mild rotation with an angle not exceeding 15–20°. The ipsilateral arm is placed lying over the thorax avoiding any stretch of the brachial plexus. The legs are kept open and accommodated over Allen stirrups [14]. The inferior edge of the 12th rib, the iliac crest, and the posterior axillary line are marked on the patient's skin before the patient's draping.

Ergonomic organization of the operating room (OR) is of utmost importance in this surgical procedure. Both surgeons must have a direct view of their own endoscopic and x-ray monitors, and easy access to the screen of the other surgeon; they share a single scrub nurse whose table is placed in between them so as to be easily accessible to everybody at any time.

Surgeons' position and room setup are shown in Fig. 1.

2.2.2. Simultaneous bilateral endoscopic surgery

The procedure is then started by the ureteroscopic surgeon: through a flexible cystoscope, a guidewire is placed into the renal pelvis of the kidney in which PCNL is performed. A ureteral occlusion balloon is subsequently placed and positioned after retrograde pyelography. At this point, the ureteroscopic surgeon can begin the fURS procedure on the contralateral side, while the PCNL surgeon will begin the PCNL. The surgeons work simultaneously during the procedure and the fluoroscopic c-arm is shared by the two surgeons—each using the c-arm when needed (Fig. 2).

2.2.2.1. PCNL approach during SBES. PCNL is performed using either a 24 Fr or a 17.5 Fr percutaneous tract, a rigid nephroscope and either ultrasonic/pneumatic lithotripsy or holmium laser lithotripsy, and basket extraction. Dilatation of the tract is performed using either a balloon or metallic dilatator. At the end of every PCNL procedure, flexible nephroscopy is performed in addition to fluoroscopic evaluation to ensure that all stones have been removed. A double-J stent is left for drainage at the end of each PCNL.

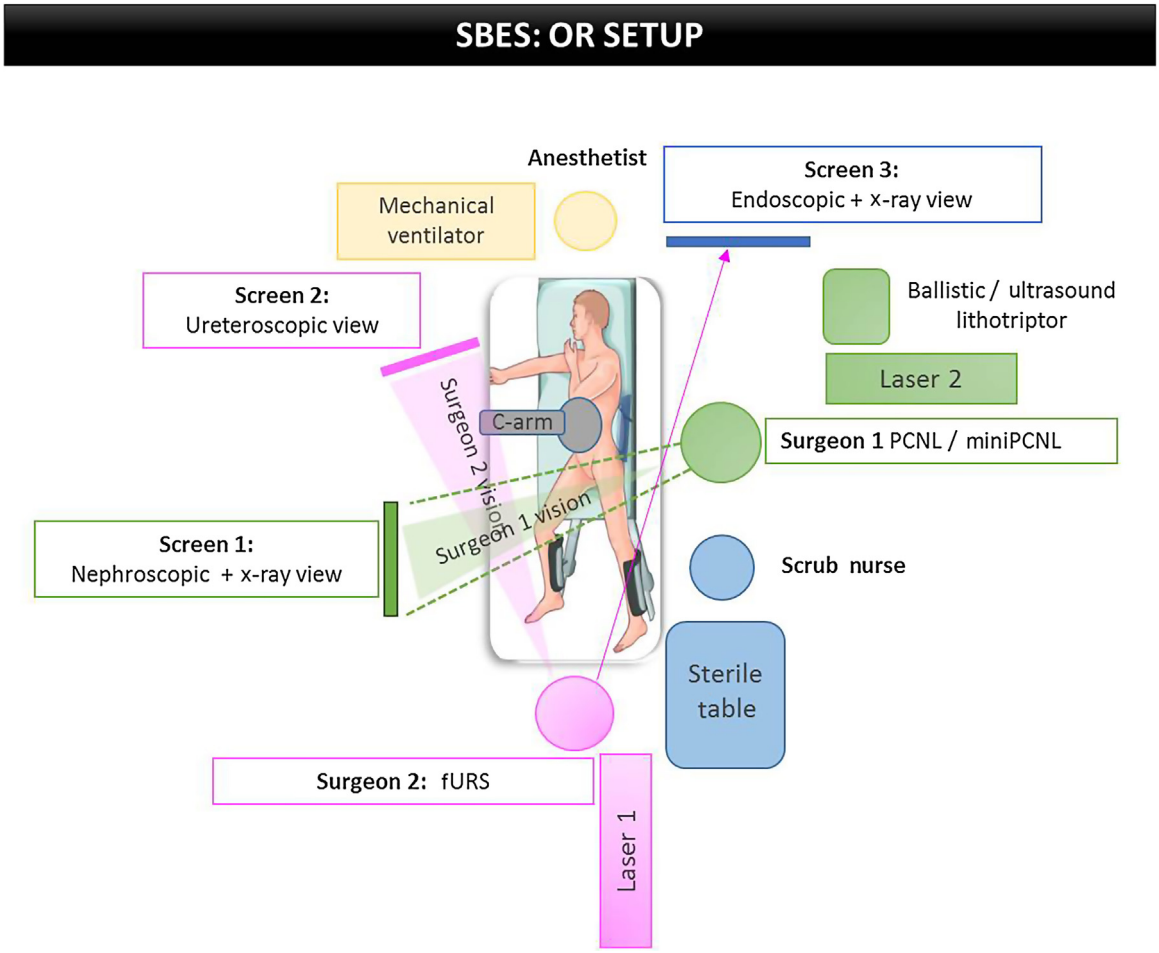

Fig. 1 – Simultaneous bilateral endoscopic surgery (SBES): OR setup.
fURS = flexible ureteroscopy; OR = operating room; PCNL = percutaneous nephrolithotomy.

*2.2.2.2. **Flexible ureteroscopic approach during SBES.*** Flexible ureteroscopy is carried out using either a single-use or a reusable digital flexible ureteroscope. It is our practice to place a 10/12 Fr ureteral access sheath whenever possible; however, if it is not possible to place the access sheath, then fURS is performed sheathless. Once the stone is visualized, lithotripsy starts. The aim is always to maximize pulverization of the stone. Provided that pulverization should always be pursued, especially in presence of very hard stones, the surgeon should also be prepared for residual fragment retrieval using baskets. At the end of the procedure, a careful exploration of the ureter should be performed in order to check the ureteral integrity. A double-J stent is left for drainage at the end of each fURS. Foley catheter is placed in all patients at the end of the procedure [15].

*2.2.2.3. **Postoperative management.*** In case of uneventful procedures, the Foley catheter is removed after 1 d and bilateral stents are removed after 7–10 d.

3. Results

A total of 27 patients met the inclusion criteria and were enrolled in the study. Demographic and stone characteristics are reported in Table 1. Intra- and postoperative data are shown in Table 2. For all of the procedures, the target stone(s) were able to be treated and no procedures were ended prior to completion. For the fURS side, ureteral access sheath placement was feasible in all but one patient (96.2%). SFR for all renal units was 74% at 1-mo follow-up. Six patients underwent an additional fURS for residual fragments, and a single patient with a 4 mm residual fragment was observed. Four patients (14.8%) experienced Clavien-Dindo grade I–II complications (urinary tract infection requiring antibiotics in three patients and urinary retention requiring Foley catheterization in one patient). There were no differences in patients' creatinine and eGFR when comparing at baseline with 1-mo after SBES (p = not significant; Table 3).

4. Discussion

In recent years, same-session bilateral endoscopic surgery has been shown to be safe and effective, for both fURS and PCNL procedures [5]. Potential advantages of same-session surgery include less anesthetic exposure for the patient as well as the need for fewer procedures to achieve stone clearance. Historically, same-session bilateral endoscopic procedures have typically been performed by the surgeon

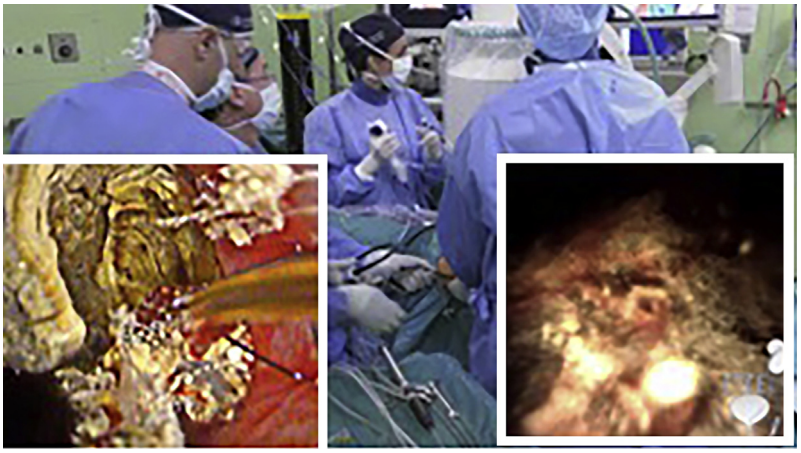

Fig. 2 – Simultaneous bilateral endoscopic surgery: fURS on one side and PCNL on the other side performed simultaneously. fURS = flexible ureteroscopy; PCNL = percutaneous nephrolithotomy.

Table 1 – Demographic and stone characteristics of patients (*n* = 27)

Gender, *n* (%)	
Male	17 (63)
Female	10 (37)
Age (yr), mean ± SD	49.1 ± 12.7
ASA score	1.5 ± 0.6
BMI (kg/m^2), mean ± SD	25.1 ± 2.5
Stone size (mm), mean ± SD	
PCNL side(14 R, 13 L)	27.1 ± 8.1
fURS side (13 R, 14 L)	11.1 ± 3.6
Hounsfield units, mean ± SD	
PCNL side	998.1 ± 342.7
fURS side	1012.6 ± 338.7

ASA = American Society of Anesthesiologists; BMI = body mass index; fURS = flexible ureteroscopy; L = left; PCNL = percutaneous nephrolithotomy; R = right; SD = standard deviation.

Table 2 – Intra- and postoperative outcomes

Use of UAS, *n* (%)	26/27 (96.2)
24 Fr PCNL sheath use	18/27 (66.7)
17.5 Fr PCNL sheath use	9/27 (33.3)
Reusable ureteroscopes, *n*/*N* (%)	17/27 (63)
Single-use ureteroscopes *n*/*N* (%)	10/27 (37)
Total OR time (min), mean ± SD	79.4 ± 25.2
Length of hospital stay (d), mean ± SD	2.7 ± 1.3
Primary SFR (both sides), *n*/*N* (%)	20/27 (74)
Complications by Clavien-Dindo grade, *n*/*N* (%)	
Grade 0	23/27 (85.2)
Grade I	1/27 (3.7)
Grade II	3/27 (11.1)
Grade III/IV/V	0

OR = operating room; PCNL = percutaneous nephrolithotomy; SD = standard deviation; SFR = stone-free rate; UAS = ureteral access sheath.

operating on one kidney until that procedure was completed, and then proceeding to operate on the contralateral kidney [16–18]. In this report, we describe our experience with a prospective study of SBES. Unlike the more commonly reported same-session bilateral surgery, SBES involves two surgeons operating on separate kidneys at the same time. Successful performance of SBES should in theory magnify the advantages of same-session bilateral surgery, as both procedures can be accomplished at the same time (ie, one kidney does not have to wait until the other is stone free),further shortening operative and anesthetic times. Recently, two reports have described the SBES approach to both kidneys for the treatment of renal calculi, showing favorable outcomes in terms of SFR and complication rates without an increased risk of the development of acute renal failure or other complications [8,9].

The current study describes the first prospective series of simultaneous bilateral endoscopic procedures for renal stones combining supine PCNL and fURS in tandem fashion—that is, one surgeon performing PCNL while at the same time another surgeon performs a contralateral fURS. Given the novelty of this practice, we have named this procedure “SBES” in order to differentiate this procedure from traditional same-session bilateral procedures where one kidney is treated to completion followed by treatment of the contralateral kidney. To summarize our results, SFR were consistent with previously published reports in the literature and there were no major complications. Notably, despite simultaneous manipulation of both kidneys, no patients experienced renal complications, and there was no change in serum creatinine and eGFR from baseline to 1-mo follow-up after surgery. We also note that no patients in our study required blood transfusion during the perioperative period—this is likely due to the exclusion of complex staghorn stones both from the study and potentially from the small sample size.

This is a key point: as emerges from the average diameter of small stones of our series, ideal candidates to SBES are patients bearing bilateral small- to medium-size stones who have a high chance to become stone free and, as a consequence, are unlikely to undergo a second surgery.

It is noteworthy that SBES requires a special OR setup, a complete endourological armamentarium, and dedicated nurses in order to allow both surgeons to work simultaneously and efficiently. Specialized equipment includes two

Table 3 – Comparison between serum creatinine and eGFR during the study period

	Preoperative	Postoperative day 1	1-mo follow-up	*p* value [a]
Serum creatinine (mg/dl)	0.95 ± 0.29	0.97 ± 0.24	0.92 ± 0.23	0.779
	(0.9 [0.7–1.2])	(0.9 [0.8–1.2])	(0.9 [0.7–1.1])	
eGFR (ml/min)	109.7 ± 46.4	104.3 ± 41.4	110.2 ± 45.7	0.926
	(95 [73–136])	(92 [79–138])	(95 [79–133])	

eGFR = estimated glomerular filtration rate.
Data are expressed as mean ± standard deviation (median [interquartile range]).
[a] Kruskal-Wallis test with Dunn multiple comparison test.

endoscopic towers (one for each surgeon to view the kidney that each is operating on). We feel that for the patients in our study in whom a single-use ureteroscope was used, the smaller mobile screen associated with this ureteroscope may yield some ergonomic advantages in terms of room setup and space optimization [19,20]. In this series, we used Lithovue ® scope (Boston Scientific, Natick, MA, USA), in 10 cases (37%) for the ureteroscopic sides, and it clearly eased the organization of the entire procedure reducing significantly OR time and the labor of OR personnel. In addition, for the procedures in which we utilized laser fragmentation for PCNL (ie, 17.5 Fr mini PCNL procedures) [21], two laser consoles were required so that simultaneous laser lithotripsy could be performed—depending on the electricity capabilities of a given OR, it is possible that the usage of high-power (ie, 120 W) lasers may be limited, and the procedure will require one high-power and one low-power laser.

There are several potential advantages to performing SBES in lieu of staged procedures or even same-session bilateral procedures. Most importantly, anesthesia time may be decreased significantly by having both renal units operated on at the same time. Several prior studies have demonstrated that the duration of surgery and anesthesia is one of the strongest predictors of postoperative pulmonary complications, including respiratory complications [22–24]. In fact, the incidence of postoperative pulmonary complications is very similar to the incidence of cardiovascular complications in patients undergoing noncardiac surgery and heavily contributes to an increase in postoperative length of hospital stay and costs [25].

In addition, shorter operative time may limit the decrease in core body temperature that is seen during endourological surgery when abundant irrigation is used [26]. This may, in turn, decrease the risk of postoperative shivering and prolong recovery time due to hypothermia. Moreover, SBES reduces the overall operative time compared with a single-session bilateral procedure and/or staged surgeries. In our series, the overall operative time was 79.4 ± 25.2 min. By comparison, prior studies have reported the mean operative time for bilateral single-session PCNL to be 101.6 min and for bilateral fURS 149 min [5]. This short operative time was possible because PCNL was performed in supine position, which is associated with shorter operative time than prone PCNL due to improved ergonomics [27]. Of note, indeed the combination of fURS and PCNL in the prone position was previously described, but that implementation has been limited because prone fURS can be challenging from the ergonomic perspective [28]. SBES also has the same advantages as those of single-session bilateral procedures, including a single anesthetic, reduced cumulative hospital stay, fewer days out of work, less radiation exposure, greater overall cost effectiveness regarding room and anesthesia time, pre- and postoperative laboratory analysis, use of equipment and disposable instruments, drug administration, and postoperative imaging [6,16]. Another potential advantage of SBES is in the area of reimbursement and economic efficiency of the health care system. By reducing overall operative time and accomplishing two procedures at once, reimbursement opportunities for the surgeon and hospital are optimized.

There are several limitations to our study. First is the sample size—this was a pilot study of only 27 patients and was not randomized. There were no major complications, but a larger study in the future is necessary to confirm the safety and efficacy of SBES. However, our data were collected prospectively, which strengthens our findings. In addition, the procedure requires two surgeons to operate simultaneously with specialized equipment, and not all urology departments have the equipment, personnel, or bandwidth to accomplish this. Nonetheless, we feel our results are encouraging and that SBES has the potential to be an effective and more commonly used procedure in the future for patients with bilateral nephrolithiasis.

5. Conclusions

SBES is safe and effective, with minimal morbidity. SBES has the potential advantages of shorter operative time, reduced anesthesia, and reduced hospital time, which can benefit patients, surgeons, and health care systems.

Author contributions: Guido Giusti has full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Giusti, Proietti.
Acquisition of data: Proietti, Rodríguez-Socarrás, Saitta, Mantica.
Analysis and interpretation of data: Giusti, Proietti.
Drafting of the manuscript: Giusti, Proietti, Rodríguez-Socarrás.
Critical revision of the manuscript for important intellectual content: Giusti, Proietti, Rodríguez-Socarrás, Eisner, Villa, Salonia, Montorsi, Gaboardi.
Statistical analysis: Proietti, Rodríguez-Socarrás, Mantica.
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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.eururo.2018.06.034.

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