



Simultaneous Bilateral Endoscopic Surgery (SBES): Is It Ready for Prime Time?

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Abstract

Introduction: To date, some data available in literature on simultaneous bilateral endoscopic surgery (SBES) have shown good outcomes in terms of both effectiveness and safety. The aim of this study was to report the outcomes pertaining to the effectiveness and safety of SBES performed in our series of patients with bilateral renal stones.

Materials and Methods: A prospective analysis of consecutive patients who underwent SBES for bilateral renal stones at our institution between June 2017 and September 2021 was performed. Routine preoperative and 1-month postoperative work-up included history, physical examination, urinalysis, urine culture, and blood tests, including the evaluation of estimated glomerular filtration rate using the Cockcroft-Gault equation. An abdominal noncontrast CT scan was performed in all cases preoperatively and 1 month postoperatively. Peri-/postoperative complications were reported according to the Clavien-Dindo classification system. The primary endpoint of the study was stone-free rate (SFR), and the secondary endpoints were Clavien-Dindo complications grade 1 or higher.

Results: Altogether, 101 patients met the inclusion criteria and were enrolled in the study. SFR for all renal units was achieved in 82 patients (81.1%) at the 1-month follow-up. Twelve patients underwent additional flexible ureteroscopy for residual fragments, and 7 asymptomatic patients with single small residual fragment were observed. Eighteen patients (17.8%) experienced Clavien-Dindo Grade I–II complications, whereas one patient (1%) experienced Clavien-Dindo Grade IIIa complication (renal arteriovenous fistula embolization under local anesthesia).

Conclusions: SBES is a safe and effective procedure for the treatment of bilateral renal stones. Further randomized studies with larger populations are needed to confirm these favorable outcomes of SBES to establish it as an alternative to staged surgeries in patients with bilateral renal stones. Appropriate patient selection is of paramount importance for achieving good outcomes without experiencing severe complications.

Keywords: SBES, simultaneous, bilateral, endourology, urolithiasis, stone

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Introduction

UROLITHIASIS IS A disease with worldwide prevalence and a lifetime risk of stone formation as high as 10–12% in males and 6–8% in females^{1–3}; there has been an impressive increase in the prevalence of urolithiasis over the last 15–20 years,¹ in areas including those that have had historically low rates of stone disease. The current hypothesis explaining this trend indicates lifestyle and dietary changes¹ and global warming.⁴

Concomitantly, the incidence of bilateral and multiple renal stones is rising, being reported in 15% of patients with kidney calculi.⁵ This implies that a significant number of patients with bilateral urinary stones need endourologic management of both upper urinary tract sides. Therefore, the ever-growing burden of stone disease requires highly decisive approaches. Neither the European nor the American Association of Urology Guidelines provide recommendations for the management of bilateral renal stones. Bilateral disease has traditionally been treated in staged procedures and, to a lesser extent, in single-session approaches.

To date, some data available in the literature on simultaneous bilateral endoscopic surgery (SBES) have shown good outcomes in terms of both effectiveness and safety.^{6,7}

The aim of this study is to report the outcomes pertaining to effectiveness and safety of SBES performed in our series of patients with bilateral renal stones.

Materials and Methods

A prospective analysis of consecutive patients who underwent SBES for bilateral renal stones at our institution between June 2017 and September 2021 was performed. Before surgery, all patients were apprised of the benefits and risks of SBES and possible alternative treatment as staged procedures. The study was approved by the local Ethics Committee (Protocol number 2016), and the patients provided informed consent. Inclusion criteria were age 18–80 years and the presence of bilateral renal stones, one of which was deemed suitable for percutaneous nephrolithotomy (PCNL), while the contralateral for flexible ureteroscopy (fURS). The exclusion criteria were as follows: pregnancy, anatomic abnormalities of the upper urinary tract, chronic kidney disease, positive preoperative urine culture, and complete staghorn calculi. Two surgeons performed fURS on one side and PCNL on the other side simultaneously.

The surgical technique has been previously reported.⁶

Routine preoperative and 1-month postoperative workup included history, physical examination, urinalysis, urine culture, and blood tests, including the evaluation of estimated glomerular filtration rate (eGFR) using the Cockcroft-Gault equation. An abdominal noncontrast CT (NCCT) scan was performed in all cases preoperatively and 1 month postoperatively. Stone diameter was reported as the diameter of a single stone or the sum of diameters of multiple stones on axial CT images. Patients were reported to be stone-free if there were no stones on postoperative NCCT or there were residual fragments <2 mm in diameter. Operative time was calculated as the time from the first endoscope insertion to the completion of the final stent placement. Peri-/postoperative complications were reported according to the Clavien-Dindo classification system.^{8,9} The primary endpoint of the study

was stone-free rate (SFR), and the secondary endpoints were Clavien-Dindo complications grade 1 or higher.

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

Results

A total of 101 patients met the inclusion criteria and were enrolled in the study. Demographic and stone characteristics are reported in Table 1. The intraoperative and postoperative data are presented in Table 2. All the procedures were performed until the end in both sides without experiencing any intraoperative noteworthy complications. SFR for all renal units was achieved in 82 patients (81.1%) at the 1-month follow-up. Twelve patients underwent additional fURS for residual fragments, and seven asymptomatic patients with a single small residual fragment were observed.

Eighteen patients (17.8%) experienced Clavien-Dindo Grade I–II complications, whereas one patient (1%) experienced Clavien-Dindo Grade IIIa complication (renal arteriovenous fistula embolization under local anesthesia). No other intraoperative or postoperative complications were observed.

Discussion

Recently, there has been a growing interest in SBES in the urologic community. In fact, considering the sharp increase in urolithiasis prevalence worldwide,¹ bilateral stone disease is no longer an unusual circumstance, and therefore, it requires practical and decisive solutions. For decades, bilateral renal stones and their single-session approach have been considered risk factors for the development of acute renal failure and higher complication rates due to the simultaneous manipulation of both kidneys.

Contrary to these popular claims, some studies have shown that bilateral renal endoscopic procedures are safe not only in a single-session procedure,^{10,11} but also in a simultaneous approach.^{6,7} This concept, however, should not be surprising because it has been shown that both fURS and PCNL can be performed safely in patients with solitary kidneys affected

TABLE 1. DEMOGRAPHIC AND STONE CHARACTERISTICS OF PATIENTS (N = 101)

<i>Demographic and stone characteristics of patients (n = 101)</i>	
Gender, n (%)	
Male	72/101 (71.3)
Female	29/101 (28.7)
Age (years), mean \pm SD	49.6 \pm 12.7
BMI (kg/m ²), mean \pm SD	24 \pm 3.1
Stone size (mm), mean \pm SD	
PCNL side	30.5 \pm 9
fURS side	11.5 \pm 4

fURS = flexible ureteroscopy; PCNL = percutaneous nephrolithotomy.

TABLE 2. INTRAOPERATIVE AND POSTOPERATIVE OUTCOMES

<i>Intraoperative and postoperative outcomes</i>	
Total OR time (minutes), mean \pm SD	72.2 \pm 21.2
24F PCNL sheath use	64/101 (63.4)
17.5F mini-PCNL sheath use	37/101 (36.6)
ECIRS on the PCNL side	14/101 (13.8)
Reusable ureteroscopes	34/101 (33.7)
Single-use ureteroscopes	67/101 (66.3)
Nephrostomy tube on the PCNL side	7/101 (6.9)
Length of hospital stay (days), mean \pm SD	2.9 \pm 1.6
Primary SFR (both sides), <i>n</i> (%)	82 (81.1)
eGFR variation (preop, 1-day postop, 1-month postop)	<i>p</i> > 0.05
Complications by Clavien-Dindo grade	
Grade I	8/101 (7.9)
Grade II	10/101 (9.9)
Grade III	1/101 (1)
Grade IV/V	0/101(0)

ECIRS=endoscopic combined intrarenal surgery; eGFR=estimated glomerular filtration rate; OR=operating room; PCNL=percutaneous nephrolithotomy; SD=standard deviation; SFR=stone-free rate.

with renal stones.^{12,13} In their first series of SBES, Giusti and colleagues demonstrated that this technique is effective and safe, provided that patient selection is appropriate.⁶ They described prospective data of 27 patients with bilateral renal stones reporting an SFR of 74% in both sides without major complications. Notably, no significant changes in eGFR parameters were observed.

Before this first series on SBES, only a few case series reported the simultaneous endoscopic bilateral treatment of renal stones, describing good outcomes in terms of effectiveness and safety, without an increased risk of renal function impairment.^{14–16} In addition, Angerri and coworkers, in their retrospective multicenter study of 47 patients, reported an SFR of 70% with only two cases of complications worthy of mention⁷; one case of candidemia and another of nephrostomy placement due to Double-J stent obstruction. None of the patients experienced acute renal failure.⁷

Our present study, which, to the best of our knowledge, represents the largest series on SBES, parallels what was previously reported in terms of effectiveness and safety. Our outcomes showed an SFR of 81.1% with 7.9%, 9.9%, and 1% complication rates of Grade I, Grade II, and Grade III, respectively. No significant postoperative impairment in renal function was noted (*p* > 0.05).

These studies disprove a common dogma without scientific evidence, of avoiding bilateral endoscopic renal surgery due to the potential high risk of renal function impairment. Certainly, it is crucial to drain at least one kidney at the end of the procedure to prevent any risk of obstructive acute renal failure. Indeed, in this study, for the full series of patients undergoing SBES, we always placed bilateral Double-J ureteral stents; in 7 out of 101 cases (6.9%), a nephrostomy tube was placed on the PCNL side.

Moreover, on policy, we refrain from using Double-J ureteral stents with strings, which, in our opinion, is not recommended for bilateral cases owing to the high risk of in-

advertent displacement. In fact, Danilovic and associates in their series of unilateral vs bilateral fURS reported a high rate of displacement of Double-J stent with strings before planned removal (34.8% vs 39.1% respectively).¹⁷ To date, only two cases of acute renal failure have been reported after endoscopic bilateral single-session surgery: one after bilateral tubeless PCNL¹⁸ and the other after bilateral fURS¹⁹; both cases involved totally tubeless procedures and therefore the policy of draining both urinary systems is deemed mandatory in bilateral endoscopic surgery.

In the present study, only one patient experienced a major complication of Grade IIIA (1%); this patient required embolization for renal arteriovenous fistula. The overall complication rate was 18.8% (17.8% minor complications), indicating the safety profile of the procedure. There is a common perception that simultaneous bilateral renal manipulation doubles the risk of complications compared to staged procedures. In truth, the overall risk is substantially equivalent and related to the number of renal units treated. In fact, in staged procedures, the risk of complications is extended over time rather than being dealt with at once as when bilateral procedures are performed. However, appropriate patient selection is of paramount importance for achieving good outcomes without experiencing severe complications.

In addition, careful and meticulous preoperative counseling is also fundamental. As a part of this, the patients should be aware of the potential risk of increased complications rate and are free to decline the possibility of having SBES. Similarly, if they decide for SBES, they are also informed that at any moment the surgeons may decide to quit the surgery on one or even both sides if complications are unexpectedly experienced. For this reason, an accurate consent has to be signed by the patient who wants to be operated on both sides simultaneously.

We believe that patients with small to medium-sized stones are appropriate candidates for effective SBES in terms of avoiding prolonged fURS on one side or prolonged multiaccess PCNL on the other side. Moreover, history of urinary tract infection is of course an exclusion criterion that necessarily implies a staged surgery.

However, Angerri et al. included 22 cases of partial or total staghorn stones in their SBES series; the authors stated that SFR was 70% and the remaining 30% of patients had high-volume staghorn stones preoperatively, with unilateral residual fragments.⁷

Certainly, further larger multicenter randomized studies are needed to standardize the selection criteria and outcome measures of SBES. Several factors, as previously reported, are in favor of SBES. Undoubtedly, SBES has the same advantages of single-session bilateral procedures, including single anesthesia, less surgical stress, less radiation exposure, shorter cumulative hospital stay, overall cost, reduced convalescence, and working day loss, compared to those of staged procedures.¹¹ Moreover, there are several advantages to performing SBES in lieu of single-session and staged procedures.

First, the anesthesia time may be reduced significantly by treating both renal units simultaneously; this could decrease all the complications related to a longer anesthesia duration.²⁰ Second, SBES, which reduces operative time compared to single-session and staged procedures, leads to a decrease in operative room (OR) occupation. Optimization of

surgical slots plays a fundamental role in high-volume centers and, therefore, by taking care of bilateral renal stones simultaneously, the departments are able to free slots, increase the productivity, and shorten the waiting list.²¹ Optimization of surgical slots is generally important, but it becomes essential in difficult times, as observed with the recent COVID-19 pandemic. In the current COVID-19 era wherein the stone procedures are cutback worldwide, SBES should be considered to obtain SFR bilaterally in one single session and make the best use of all the OR slots, which are already few compared to those in the pre-COVID period.²²

In this series, the mean overall operative time was 72.2 ± 21.2 minutes instead of the ~ 140 minutes if the procedure would have been performed in the same session but sequentially instead of simultaneously. The short operative time of the SBES technique may also be attributed to PCNL being performed in the supine position that provides a major advantage in reducing operative time owing to its better ergonomics.²³

Angerri et al. reported a mean operative time of 140 minutes even when all patients were operated in the supine position.⁷ This longer operative time compared to that in our series is probably related to the greater stone size of patients enrolled in the study.⁷

Another advantage of SBES is the possibility to perform endoscopic combined intrarenal surgery (ECIRS) on the PCNL side whenever needed, owing to its versatility, once the fURS ends on one side, the flexible ureteroscope can be inserted retrogradely in the other renal unit to limit multitract access and improve the SFR.²⁴ In this series, ECIRS was performed on the PCNL side in 14 out of 101 cases (13.8%).

Certainly, SBES demands a dedicated OR setup, a complete endourologic equipment, and dedicated OR staff to allow both surgeons to operate simultaneously and efficiently. Two endoscopic towers are required to perform SBES. A fully integrated OR may be helpful in reducing the occupancy of the theater by using the video equipment to make the environment more ergonomic for both surgeons and nurses with all endoscopic and radiologic monitors under direct vision. Notably, with the advent of single-use flexible ureteroscopes with their dedicated small and mobile screens has considerably improved the ergonomics of the OR setup, especially when the OR space is limited.

In our SBES series, single-use ureteroscopes were utilized in 67 out of 101 procedures (66.3%), which eased the organization of the entire procedure, reducing the labor of OR and sterilization personnel. Of note, when the percutaneous approach is carried out by means of miniaturized PCNL,²⁵ two laser machines should be available in the OR to work simultaneously. This may be problematic in that at least one of the two laser generators should be of low power and not need a dedicated high amperage plugging system that cannot be doubled in a single OR.

The advent of Thulium Fiber laser (TFL) machines has improved the OR ergonomics; indeed, the TFL generator console is small and lightweight, making it compact, portable, and space-efficient, particularly in a cumbersome OR.^{26,27} In addition, its portability is further emphasized by its use of a standard power outlet (220–240 V), which is useful in the case of a mini-SBES. Another drawback of SBES is the reimbursement for the second side procedure,

which is only 50% as for all other synchronous bilateral surgeries; nevertheless, the loss incurred from this halved reimbursement is balanced by the reduction in cost for OR occupancy owing to the simultaneity of the procedure.

Therefore, despite SBES not being fully remunerative for the hospital due to limitations in the coding system for bilateral surgeries,²⁸ given the favorable outcomes, it is reasonable to think that simultaneous bilateral endoscopic manipulation may benefit this subset of patients and should be offered considering strict indications.

A final economical balance indicates that SBES, against significant costs related to manpower and complex armamentarium, is cost effective enough because of the optimization of OR occupancy that allows for performing two surgeries in the time usually necessary for only one with significant tools sharing (guidewires, baskets...) throughout the procedure and reduction in overall postoperative administration of medicaments, blood and urine samples, radiologic follow-up, and absence from work activities. With that said, the most rewarding aspect of SBES is the priceless satisfaction that we always perceive on the faces of our patients when they realize to be stone free with only one single hospitalization. Another potential disadvantage could be the simultaneous requirement of two surgeons in the OR for performing the SBES procedure; in some hospitals, this may not be feasible owing to a busy department schedule.

Moreover, a particular mention of quality of life (QoL) of patients affected by kidney stones deserves attention. As a matter of fact, it has been demonstrated that patients with urolithiasis can have increased levels of bodily pain, depression, anxiety, loss of days at work, and financial distress, leading to overall lower QoL scores compared to controls.²⁹ No studies reported the impact on QoL of patients with bilateral renal stones and the influence of simultaneous or single-session procedures on QoL domains compared to staged procedures. Further studies on QoL of patients with bilateral renal stones are needed to evaluate also this meaningful aspect.

In conclusion, contrary to convention, SBES for the management of bilateral upper tract stones has been proven effective, safe, and advantageous for both the patient and the health care system. Therefore, SBES may become a feasible standard of care for patients with bilateral nonbulky urinary stones when the treatment requires fURS on one side and a percutaneous approach contralaterally. SBES should be offered by experienced endourologists who may rely on a complete set of modern, highly technologic endourologic armamentarium.

However, further randomized studies with larger populations are required to confirm these favorable results of SBES as an alternative to staged surgeries or single-session procedures in patients with bilateral renal stones.

Conclusions

SBES is a safe and effective procedure for the treatment of bilateral renal stones. Further randomized studies with larger populations are needed to confirm these favorable outcomes of SBES to establish it as an alternative to single-session and staged surgeries.

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Abbreviations Used

ECIRS = endoscopic combined intrarenal surgery

eGFR = estimated glomerular filtration rate

fURS = flexible ureteroscopy

OR = operating room

PCNL = percutaneous nephrolithotomy

NCCT = noncontrast computed tomography

QoL = quality of life

SBES = simultaneous bilateral endoscopic surgery

SFR = stone-free rate

TFL = Thulium Fiber laser