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The effect of Trendelenburg position on outcomes of retrograde intrarenal surgery for medium sized renal pelvis stones

Mehmet Yılmaz Salman[1], Göksel Bayar[2], Orhun Sinanoğlu[1]

[1]Sancaktepe Prof. Dr. İlhan Varank Training and Research Hospital, Department of Urology, İstanbul, Turkey
[2]İskenderun Gelisim Hospital, Department of Urology, Hatay, Turkey

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ABSTRACT

Aim: To compare safety and efficiency between Trendelenburg position retrograde intrarenal surgery (tRIRS) and conventional position retrograde intrarenal surgery (cRIRS) in the management of renal pelvis stones 10-20 mm in size.

Material and Method: From September 2018 to September 2019, the patients undergoing RIRS for single renal stones between 10-20 mm were included in the study prospectively. Patients were divided into two groups randomly. First group of patients were positioned completely parallel to the ground (cRIRS), second group were positioned with Trendelenburg (tRIRS). Success was evaluated at end of 3rd months by non-contrast enhanced tomography. Stones that smaller than 4 mm were accepted as clinical insignificant residual fragment. Complications was classified according to Clavien, class 2 or more complications were recorded.

Results: Totally 100 patients were included to final analyze. Patients' age, gender, stone side and mean stone surface area were similar between groups. Success rate was higher in tRIRS group (90% vs 72% p=0.022). Mean operation time was lower (41.8 vs 58.2 min. p<0.001), and mean session number for each patient was lower in tRIRS group (1.17 vs 1.4 p=0.024). Class 2 or higher complications were occurred in six patients; five was in cRIRS, and one in tRIRS group and rate was similar (p= 0.09).

Conclusions: Inclined Trendelenburg position improves success rate and decrease mean session number and operation time on patients whom performed RIRS for renal pelvis stones. Trendelenburg position has similar complication rate compared to conventional position.

Keywords: Retrograde intrarenal surgery, flexible ureteroscopy, Trendelenburg position, renal pelvis stone

INTRODUCTION

Urinary stone disease is a common world health problem causing significant patient morbidity with serious socioeconomic consequences (1). Over last few decades, progress in biomedical technology have enabled urologists to better treat urolithiasis with few complications. Treatment of renal stones has undergone changes during this period with replacement of open surgery by minimally invasive interventions such as shock wave lithotripsy (SWL), percutaneous nephrolithotomy and retrograde intrarenal surgery (RIRS) which are widely accepted as standard treatment modalities for kidney stones less than 2 cm in diameter (2). The decision among these modalities for 1-2 cm renal stones depends on patient and/or urologist. The definitive treatment is chosen according to patient's compliance and comorbidities, treatment costs, available equipment, complications of the treatment, stone clearance time, and need of auxiliary procedures (3). RIRS, also popular as flexible ureterorenoscopy (FURS), is a less invasive modality with fewer complications. FURS has shown its superiority to SWL in the management of renal stones smaller than 2 cm in kidney and even in patients with complex renal anatomy or using anticoagulants with better stone clearance (4). Stone-free rates (SFRs) up to 90% are provided by RIRS carried out by FURS (5). Investigators tried to increase SFRs in renal and ureteral stones with some auxiliary maneuvers, such as inverted position during SWL session or ureterorenoscopic lithotripsy (6-8). The previous information suggested that, inclining patients in Trendelenburg position could theoretically promote the migration of stone into the

Corresponding Author: Mehmet Yılmaz Salman, mdmehmetyilmazsalman@yahoo.com **Received:** 20.05.2022 **Accepted:** 01.08.2022

upper collecting system, or at least away from the lower pole calices, which provides FURS with convenience to treat the fragments remaining in the upper collecting system (9). Such an approach may potentially decrease the operative time and increase SFRs. To the best of our knowledge, no comparative study between RIRS in Trendelenburg and RIRS in plain lithotomy positions for renal pelvis calculi has been published. Herein, we present a prospective, randomized study comparing the safety and clinical value of cRIRS and tRIRS in the treatment of single 1-2 cm renal pelvis stone.

MATERIAL AND METHOD

The study was carried out with the permission of Sancaktepe Prof. Dr. İlhan Varank Training and Research Hospital Scientific Researches Ethics Committee (Date: 10.02.2021, Decision No: 2021-98-24.02.2021). All patients were informed about the objectives of the study in detail and gave written informed consent. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

From September 2018 to September 2019, patients with a single stone between 10-20 mm in renal pelvis and planned for RIRS at our institution were enrolled in the study. Those with stones other than renal pelvis, undergoing prior stone surgery, or extracorporeal shock-wave lithotripsy (SWL), retrograde intrarenal surgery (RIRS) for significant residual stone, children, patients with comorbidities such as diabetes, hypertension, and ischemic heart disease and patients on anticoagulants, with prior nephrostomy or double-j stent due to infection, serum creatinine level >1.5 mg/ dL or coexisting ipsilateral upper urinary tract pathologies were excluded from the study. The eligible patients were randomized into conventional (cRIRS) group and Trendelenburg (tRIRS) group. Random numbers were generated by computer and assigned to consecutive patients. Age, gender, stone side and surface area, operation time, number of sessions, success and complications were recorded.

Surgical Technique

Urine culture was taken in addition to routine laboratory examinations, the operation was performed when urine culture became negative. Preoperative 1 g ceftriaxone was administered intravenously. Patients in tRIRS arm were inclined to Trendelenburg lithotomy position with head down 300 under general anesthesia. All patients were attempted to insert access sheath. Access was attempted through the guide wire with reusable FURS (Flex X2™,Karl Storz®,Germany) even if the access sheath could not be placed. Zebra guide wire™ (Boston Scientific®, USA) was inserted into ureter with FURS, and intramural ureter was dilated with FURS up to the mid ureter, then the access sheath was tried over the guide wire. Access sheath of Flexor-Regular (R; 9.5/11.5F, Cook Medical, USA) were used in reusable FURS. The Quanta LithoTM holmium laser was applied as an energy source set at 0.8–1.0 J and a rate of 6–10 Hz. DJ stent was inserted to all patients at the end of first procedure. All operations were carried out by a single urologist experienced in flexible ureteroscopy.

Evaluation of Outcomes and Complications

Each RIRS operation for same patient was considered as a separate session; removal of DJ stents was not counted as a session. Operation time involved the duration from insertion of FURS through urethral meatus up to DJ stent placement. All operations were carried out by a single urologist experienced in flexible ureteroscopy. Complications were classified according to Clavien-Dindo system, grade 2 and above were recorded. Complete SFR status or clinically insignificant stones (≤ 4 mm) in non-contrast computed tomography three months after the last operation was considered successful.

Statistical Analysis

Chi-square and Mann Whitney U tests were used for statistical analysis and p value< 0.05 was considered significant. Continuous variables with normal distribution were expressed as the mean±SD and compared with Student's t test. All analyses were performed using the Statistical Package for the Social Sciences (SPSS for Windows, version 17.0., IBM Inc., Chicago, USA).

RESULTS

One hundred and ten patients complied with the inclusion criteria of this study, 55 cases were assigned to cRIRS group, whereas 55 cases were assigned to tRIRS group. In 10 patients (5 in cRIRS group and 5 in tRIRS group), a primary insertion of FURS was failed. Thus, hundred patients (50 in cRIRS group and 50 in tRIRS group) were finally analyzed in this study. The demographic data and the clinical features of the patients were listed in **Table 1**.

Table 1. Patients' characteristics in cRIRS(conventional retrograde intrarenal surgery) group and tRIRS (Trendelenburg position retrograde intrarenal surgery) group.

	cRIRS	tRIRS	P value
Patient number (n)	50	50	
Mean age (year)±sd	49.1±13.3	48.3±12.6	0.764
Gender (m/f)	31/19	20/20	0.838
Side (R/L)	26/24	27/23	0.841
Mean stone surface area (mm2)±sd	134±65.3	130±59	0.739

No statistical difference was found in the patient's characteristics between the two groups, in terms of age, gender, as well as stone side and stone surface area (**Table 1**). The clinical outcomes of the two groups were compared in **Table 2**.

Table 2. Operative and clinical outcomes in cRIRS group and tRIRS group

	cRIRS	tRIRS	P value
Access sheath inserted (%)	41 (82%)	39 (78%)	0.617
Mean session number±sd	1.4±0.64	1.17±0.37	0.024
Mean operation time (min)±sd	58.2±15.6	41.8±11.9	<0.001
SFR (%)	36 (72%)	45 (90%)	0.022
Complication (%)	5 (10%)	1 (2%)	0.090

The mean operative time was significantly prolonged in cRIRS group than in tRIRS group (58.2±15.6 min., 41.8±11.9 min., p<0.001), while the SFR at 4 weeks was significantly higher in tRIRS group than in cRIRS group (93.2 vs. 98.3%, p< 0.001). The mean operative session number was significantly higher in cRIRS group than in tRIRS group (1.4±0.64 vs1.17±0.37, p=0.024) SFRs in cRIRS and tRIRS were 36 (72%) and 45 (90%) respectively (p=0.022). Class 2 or higher complications occurred in 5 patients in cRIRS, and one in tRIRS group requiring termination of the operation which were ureteral injury in four patients, and bleeding in two. Two groups are similar in terms of complication seen rate (p= 0.09). These six patients had no additional intervention except for DJ stent placement and the stones were removed in the second session.

DISCUSSION

The reported SFRs of RIRS in the literature varies between 54%-96% for renal stones smaller than 2 cm after one session regardless of their location (10). Our overall stone-free rate was %81 and was similar to literature. Location of the stone in renal collecting has been reported to be have impact on RIRS outcomes. Lower pole stones were reported to be a predictive factor for SFR at RIRS (11). In the series of Lim et al. (12) SFRs of RIRS in stones in the lower calyx was 73.3% which was lower than SFR of stones in upper and middle calyx or renal pelvis (94.4%) . Even with the most up-to-date flexible ureteroscope, the initial SFR was found to be 64.9 %, the retreatment rate was 16.2 % and the auxiliary procedure rate 21.6 % for the lower calyceal stones (13). Hence, before considering RIRS for renal pelvis stones, it is important to prevent the calculus or fragments from migrating to the lower calices than other part of the renal collecting system. During RIRS, gravity force tends to drive stone fragments in the lower calyx having a reverse infundibulopelvic angle. Previous studies investigating inclined positioning of patients during treatment with SWL and semirigid ureterorenoscopy suggested better outcomes for renal stones. Leong et al. (14) reported that simultaneous Trendelenburg position in SWL assured 1.28 times improvement in SFR with no or minimal additional costs. In the study of Pan et al. (7) authors claimed that semirigid URS in Trendelenburg position (tURS) rendered higher SFR and less operative time compared to conventional position URS (cURS) in upper ureteral stones. In case of retropulsion, surgeons were able to follow the stones or fragments by semirigid URS up to the renal collecting system, and then, a lithotripsy was performed in renal pelvis, middle calices or even in upper calices (7). Moreover, the requirement of FURS was mostly for lower calyceal stones which could potentially reduce the medical cost. Based on these results, we placed the patients in a Trendelenburg position during RIRS in order to promote stone fragments proximally, away from the lower calices, which might decrease the total operative time and improve the SFRs. Stone fragments migrating in the upper calices or remaining in renal pelvis would be certainly easier to treat by a FURS. In our study, we found that mean operation time (58.2±15.6 min., 41.8±11.9 min., p<0.001), and mean session number (1.4±0.64 vs1.17±0.37, p=0.024) were lower in tRIRS group compared to cRIRS group. This might be related to more fragments migration into lower calices. We postulate that fragments escaping to lower calyces create unfavorable conditions on SFR outcomes in three ways; First, limited maneuverability of FURS with laser fiber or basket catheter in its working channel at downward hyperflexion, second, poor visibility caused both by blurred fluid by stone dust and hemorrhage hardly circulated through infundibulum of lower calyx and obliterated FURS working channel and thirdly, fragments and debris remaining in the upper calyces, middle calyces and renal pelvis after any lithotripsy method may spontaneously pass down through ureter, which is improbable for those in lower calyces. In our study, SFR status was defined as absence of stone or clinically insignificant stones (≤ 4 mm) in non-contrast computed tomography (NCCT) three months after the last operation in contrast to most studies where imaging is performed to define clearance at postoperative 4-6 weeks (15, 16). Only a few studies suggested the timing of control imaging at 60-90 days. However, the precise timing of postoperative imaging for SFR status control is not established yet, according to recent data, early control imaging is useful for assessment of complications such as hydronephrosis, hematoma or pyelonephritis but may show some residual fragments that could be cleared spontaneously within three months following RIRS (17,18). Therefore, early control imaging risks to display lower SFR and mislead physicians to overtreatment. In our study, we performed control scans three months after of the procedure.

Our study has also some limitations. First, it is based on a limited number of patients, secondly, it is an unblinded study, the surgeons were aware of patients' position at operation theater. Thirdly, factors like hydronephrosis, infundibular angle, the stone composition or density which might influence the duration of RIRS and SFRs were not evaluated.

CONCLUSION

As suggested in various upper urinary lithotripsy series, the Trendelenburg position can improve the SFRs and may be considered as an auxiliary method in the treatment of renal stones with RIRS as well. The present comparative study showed that tRIRS was safe and efficient for the management of medium sized renal pelvis stones, with lower complication rates, it rendered higher SFRs and less operative time compared with cRIRS. Moreover, avoiding secondary RIRS and/or SWL in tRIRS could potentially reduce the patient burden and medical cost.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Sancaktepe Prof. Dr. İlhan Varank Training and Research Hospital Scientific Researches Ethics Committee (Date: 10.02.2021, Decision No: 2021-98-24.02.2021).

Informed Consent: All patients signed the free and informed consent form.

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