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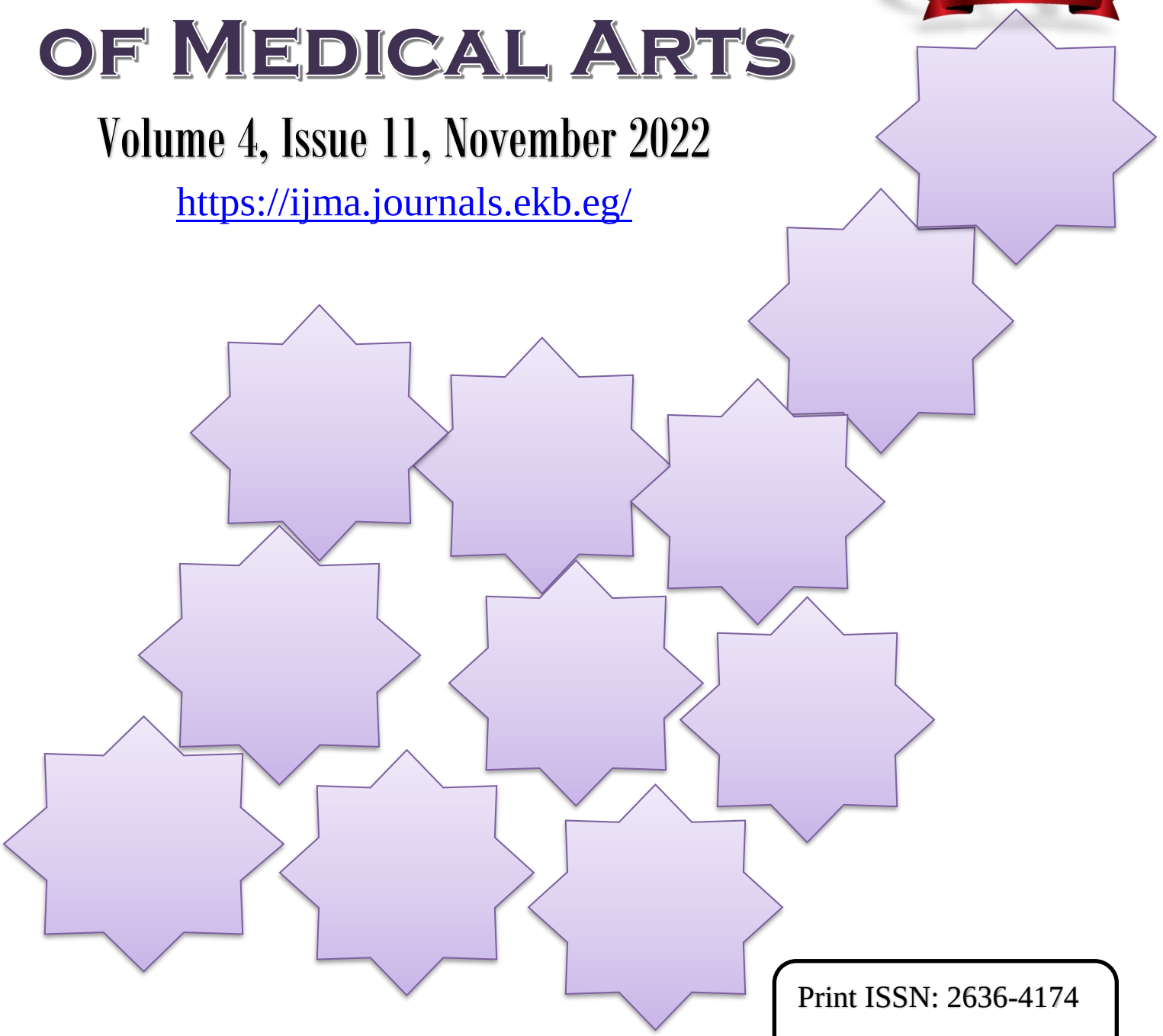

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Original Article

Is A Modified Supine Nephrolithotomy Better Than Prone Percutaneous Nephrolithotomy?

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ABSTRACT

Background: Percutaneous nephrolithotomy [PCNL] is the gold standard surgical procedure for treating large, complex renal stones. The ultimate PCNL positioning is debatable. As a result, research on the influence of patient posture on PCNL outcomes is required.

The aim of the work: This study aimed to compare the surgical outcome of PCNLs performed using modified supine positions [MSP] with the standard prone position [PP].

Patients and Methods: This prospective, non-randomized study included 350 PCNL patients, 150 in the PP group and 200 in the MSP group. We included patients with urinary stones who came to the Urology Department, Al-Azhar University, Damietta, Egypt, for PCNL, during the period from January 2017 to December 2020.

Results: The mean operative time of the studied patients was 120.8±32.6 and 91.7±35.4 min in PP and MSP groups, respectively [P=0.001]. The mean hospital stay was significantly [P=0.003] longer in the PP group [3.0±2.5 days] than in the MSP group [2.0±2.1 days]. Both groups have a comparable rate [MPS: 82% vs. PP 80%; P=0.856] in terms of stone-free rate. The mean heart rate was higher [p=0.002] in the PP group [96.8±12.6 bpm] than in the MSP group [72.6±11.9 bpm]. Regarding operative complications, the overall complication rate was higher in the PP [11.33%] than in the MSP group [6%]; however, there is no statistically significant difference [p=0.073].

Conclusion: The current findings demonstrated that MSP had a shorter operative time and shorter hospital stays. Both groups showed a comparable stone-free rate and postoperative complications.

Keywords: Modified Supine Position; Prone Position; Percutaneous Nephrolithotomy; Stone rate

INTRODUCTION

For large or complicated renal stones, percutaneous nephrolithotomy [PCNL] is the primary line of treatment [1]. Compared with other minimally invasive techniques, PCNL is the most effective procedure, despite the frequent morbidities and complications such as bleeding [2]. Therefore, enhanced skills and procedural improvements can reduce the chance of adverse events. Most of the processes in the procedure have improved in the last few years. This includes the steps from establishing access tracts through dilating the urinary system to stone removal [3].

Anesthetic concerns, particularly with high-risk patients, and the need to move the patient throughout the surgery encouraged urologists to explore alternate solutions [4]. For retrograde and percutaneous access, the modified supine position [MSP] offers all of the advantages of prior positions in both surgical and anesthesia-logical terms [5].

A ureteroscope can only be used when both legs are flexed with the ipsilateral leg higher and the contralateral leg lower [6]. Variations in the prone position [PP] and MSP have been observed; however, the PP remains more prevalent, used by more than 80% of centers worldwide [7].

A recent systematic review and meta-analysis demonstrated that PP was associated with a significantly higher stone-free rate than MSP. Nevertheless, the complication rate was much lower in the MSP than PP [8].

THE AIM OF THE WORK

This study aimed to shed light on the two positions and compare between PP and MSP to optimize stone-free rates and reduce side effects for better surgical outcomes.

PATIENTS AND METHODS

Study Design

This is a prospective, non-randomized study that was conducted on patients with renal stones who came to the Urology Department, Al-Azhar Faculty of Medicine, New Damietta, Egypt, for PCNL at the period from January 2017 to December 2020.

The patients were divided into two groups according to the patient's position during the procedure; the PP group [n= 150 patients] and MSP [n= 200 patients].

Written informed consent was given by the patients for their clinical records to be used in this study.

Institutional Review Board [IRB] approval was obtained from our hospital in Al-Azhar University, Egypt, before starting the study.

Inclusion and exclusion criteria

Patients included in the study were adults [more than or equal to 18 years] with stone sizes larger than 2 cm. Patients were only excluded if they had a renal abnormality, renal failure, bladder neck or urethral strictures, urinary tract infection, bleeding tendency disorder, pregnant women.

Methods

Patients of both groups were evaluated with a kidney, ureter, bladder X-ray, and urinary ultrasonography before the procedure. Preoperative demographics of the patients were recorded, including age, gender, body mass index [BMI], stone location, and the laterality of each stone. Computed tomography [CT] was used for the evaluation of stone characters.

Modified supine position

On the operating table, a C-shaped vacuum beanbag was used to conduct the MSP PCNL.

The legs were positioned in the lithotomy position under general anesthesia, with flexed ipsilateral hip and knee, and the contralateral leg was abducted and maintained in an extended position.

The torso was tilted and supported at around 30 degrees by rolling the beanbag under the shoulders and hips.

The ipsilateral arm was supported with a flexed elbow over the chest, while the contralateral arm was tucked next to the torso with an extended elbow.

The beanbag was inflated, which supported the patient in the tilted position. The size and location of the calculus were measured and used

to identify the number and the pole of punctures.

Ureteric catheters were implanted in all patients, about 50 patients in the MSP received DJ stent and 30 in the PP group, and ureteropelvic junction occlusion balloons were not utilized.

If clinically indicated, nephrostomies were inserted. Three months after surgery, all patients underwent X-rays or CT scans to determine stone-free rates. In addition, radiation time, stone-free rate, BMI, stone size, operative time, length of hospital stays, and postoperative complications were measured.

We used a long nephroscope [Karl-Storz 26Fr] and combined pneumatic and ultrasonic lithotripter [SWISS Ultrasonic lithoclast].

Before discharge, patients were examined with abdominopelvic ultrasound and KUP, and then after one month, they were followed after three months by ultrasound KUP and non-contrast spiral CT abdomen and pelvis.

Operative time is defined by the period between the beginnings of cystoscopy until the fixation of the nephrostomy tube. Stone-free rate is defined as stone less than 4 mm [3].

Radiation time is defined as the period from starting putting the ureteric catheter until doing a nephrostogram after finishing the procedure. Amplatz sheath used was 30 Fr. Patients were discharged if their general condition was stable after removing the nephrostomy tube and ureteric catheter.

Statistics

The SPSS software [SPSS, Inc., Chicago, IL, USA, version 22] was used to conduct the data analysis. All statistical tests were two-tailed, and data were presented as means and standard deviations [SDs]. To find differences between groups, Chi-square tests, and student t-tests were utilized. P values less than 0.05 were considered statistically significant.

RESULTS

In the PP group, there were 95 males [63.33%] and 55 females [36.67%], while in the MSP group, 134 males [67%] and 66 females [33%]. The average age of the patients was 55.4 ± 14.1 years and 54.7 ± 15.2 years, in PP and MSP groups, respectively. The BMI of patients was 28.2 ± 8.13 and 29.7 ± 7.61, in PP and MSP groups, respectively. Regarding urinary stone laterality, left-sided stones were more common in both groups [PP: 61.3% vs. MSP 62.5%]. There was no significant difference between both groups regarding the stone burden [PP: 21.9 ± 11.8 vs. MSP 21.8 ± 11.75], p=0.80. In both groups, most stones were renal pelvic stones, followed by multiple calyceal stones [table 1].

The mean operative time of the studied patients was 120.8 ± 32.6 and 91.7 ± 35.4 min in PP and MSP groups, respectively, with a statistically significant difference [p = 0.001]. The mean hospital stay was significantly [p=0.003] longer in the PP group [3.0±2.5 days] than in the MSP group [2.0± 2.1 days]. Radiation time in both groups was comparable [p>0.05]. Both groups have a comparable rate [MPS: 82% vs. PP 80%; p=0.856] in terms of stone-free rate. The mean heart rate was higher in the PP group [96.8 ± 12.6 bpm] than the MSP group [72.6 ± 11.9 bpm], with a statistically significant difference [p = 0.002]. In addition, the mean blood pressure [BP] was significantly elevated [p=0.004] in the PP group [152.8 ± 19.4 mmHg] compared to the MSP [138.1 ± 17.3 mmHg] [table 2].

Regarding operative complications, the overall complication rate was higher in the PP [11.33%] than in the MSP group [6%]; however, there is no statistically significant difference [p=0.073]. Moreover, the blood transfusion rate was higher in the PP group than in the MSP group [2.67% vs. 0.5%; p=0.682], respectively. Postoperative anemia and infection rate were observed in both groups with no statistically significant difference [p>0.050]. Urine leak was observed in only 1.33% of the PP group and 1% of the MSP group [p = 0.100] [table 3].

Table [1]: Demographic characteristics of the studied groups

Parameters		PP	MSP	Total	P-value
Age, years		55.4 ± 14.1	54.7 ± 15.2	55.05 ± 14.65	0.822
BMI, Kg/m^2		28.2 ± 8.13	29.7 ± 7.61	28.95 ± 7.87	0.142
Stone Size, mm		21.9 ± 11.8	21.8 ± 11.75	21.85 ± 11.78	0.801
Gender	Male	95 [63.33%]	134 [.670%]	229 [65.4%]	0.509
	Female	55 [36.67%]	66 [33.0%]	121 [37.6%]	
Laterality	Right	57 [38%]	70 [35%]	127 [36.3%]	0.043
	Left	92 [61.3%]	125 [62.5%]	217 [62%]	
	Both	1 [0.67%]	5 [2.5%]	6 [1.71%]	
Stone location	Lower pole calculous	23 [15.3%]	36 [18%]	59 [16.85%]	0.989
	Upper pole calculous	9 [6%]	15 [7.5%]	24 [6.85%]	
	Renal pelvic stone	75 [50%]	91 [45.5%]	166 [47.42%]	
	Multiple calyceal stones	16 [10.67%]	20 [10%]	36 [10.28%]	
	Partial staghorn	8 [5.33%]	12 [6%]	20 [5.71%]	
	Complete staghorn	14 [9.33%]	18 [9%]	32 [9.14%]	
	Diverticular stones	4 [2.67%]	6 [3%]	10 [2.85%]	
	Encrusted stents	1 [0.67%]	2 [1%]	3 [0.85%]	
Stone composition	Calcium oxalate	96 [64%]	112 [56%]	208 [59.42%]	0.629
	Mixed: oxalate/urate	17 [11.3%]	28 [14%]	45 [12.85%]	
	Cysteine	5 [3.33%]	6 [3%]	11 [3.142%]	
	Struvite	28 [18.7%]	48 [24%]	76 [21.71%]	
	Urate	4 [2.67%]	6 [3%]	10 [2.857%]	
Puncture site	Upper pole	10 [6.67%]	18 [9%]	28 [8%]	0.732
	Middle	33 [22%]	42 [21%]	75 [21.4%]	
	Lower pole	105 [70%]	135 [67.5%]	240 [68.6%]	
	Diverticular	2 [1.33%]	5 [2.5%]	7 [2%]	
Number of punctures	One Puncture	130 [86.67%]	165 [82.5%]	295 [84.29%]	0.551
	Two Puncture	16 [10.67%]	29 [14.5%]	45 [12.85%]	
	Three Puncture	4 [2.66%]	6 [3.0%]	10 [2.86%]	

Table [2]: Intraoperative and postoperative data of the two studied groups

Outcomes	PP	MSP	P-value
Operation time [min]	120.8 ± 32.6	91.7 ± 35.4	0.001*
Hospital stay [days]	3.0 ± 2.5	2.0 ± 2.1	0.003*
Radiation time [min]	8.2 ± 4.7	8.1 ± 5.2	0.446
Radiation dose [mSv]	85.3 ± 52.7	88.8 ± 53.6	0.096
Stone free rates	80%	82%	0.856
Heart rate [bpm]	96.8 ± 12.6	72.6 ± 11.9	0.002*
Blood pressure [mmHg]	152.8 ± 19.4	138.1 ± 17.3	0.004*

* Significant

Table [3]: Postoperative complications of the two studied groups

Complication	PP	MSP	P-value
Blood transfusion	4 [2.67%]	1 [0.50%]	0.682
Postoperative anemia	6 [4%]	4 [2%]	0.124
Infection	5 [3.33%]	5 [2.50%]	0.699
Urine leak	2 [1.33%]	2 [1.0%]	0.100
Total	17 [11.33%]	12 [6.0%]	0.073

DISCUSSION

PCNL in the PP is the predominant technique for treating complicated renal stones [10]. There is a common belief that PP prevents abdominal visceral injuries, provides a large field for a renal puncture, and simplifies the execution of numerous access tracts with no restrictions on instrument manipulation [11]. Nevertheless, individuals with poor lung and heart function, morbidly obese patients, and severe kyphosis cases do not tolerate PP well [12]. Anterior and posterior axillary lines defined the flank renal puncture zone in MSP. Site and angle of puncture may also be limited [13]. As a result, either tilt the table to the contralateral side or alter the supine position, such as lateral decubitus, Galdakao modified Valdivia position,

Barts flank-free-MSP, or supine oblique position, to overcome the original supine restriction. Both simultaneous surgery and the ability and simplicity of creating and dilating numerous tracts can benefit from these improvements. A wider space area for nephroscope manipulation is feasible [14].

The MSP offers several advantages, including the reduced pressure placed on the patients' lungs during the operation, which reduces patients' difficulties maintaining stable ventilation [15]. As a result of airway access, reintubation may be performed more quickly and easily [16]. Precise measurements and extra precautions were needed when doing PCNL in a conventional PP because the patient was transferred mid-procedure from lying on his back to lying on his belly [17].

In the present study, the mean operative time of the studied patients was longer in the PP compared to the MSP group [p = 0.001]. The mean hospital stay was significantly longer in the PP group than in the MSP group. In terms of the stone-free rate, both groups have a comparable rate [p=0.856]. The mean heart rate was higher [p=0.002] in the PP group than in the MSP group. In addition, the mean blood pressure [BP] was significantly elevated [p=0.004] in the PP group compared to the MSP. Regarding operative complications, the overall complication rate was higher in the PP than in the MSP group; however, there is no statistically significant difference [p=0.073].

Our findings were similar to those of **Melo *et al.*** [18], who found a mean operative time of 123.48 min in the PP group and 90.5 min in the MSP [P = 0.001]. Another study by **Jones *et al.*** [7] showed that the longer operative time in the PP group [123 ± 49.5 min] compared to 93 ± 45.5 min in the MSP group. A recent meta-analysis of PCNL by **Liu *et al.*** [19] revealed that the MSP resulted in a mean decrease of 25 minutes in terms of operating times when compared to the PP, which is consistent with our findings. **Melo *et al.*** [18] stated that the reduced operative time in the MSP group could be attributed to the staff's experience in performing surgeries in that position. The lack of saline bags below the flank or leg, as in the VALD and GALD locations, contributed to a faster PCNL in MSP [20]. Fluoroscopy and overall operative time may be prolonged because of these bags. Saline bags may also make using a rigid nephroscope more difficult when placed under the flank. During MSP, the renal and spinal column overlap is avoided [18]. In addition, the kidney appears to be more stable [fixed] in MSP, which contributes to the difference in operating time between the two procedures. To conduct the PCNL with PP, patients must be positioned and draped twice. This might result in a prolonged surgical time [21].

Regarding the mean hospital stay, a study by **Jones *et al.*** [7] found that hospital stay was 3.0±2.8 days and 2.0±2.1 in PP and MSP, respectively, with significant difference [p= 0.005]. However, the study of **Melo *et al.*** [18] found a comparable hospital study between the two groups [57.23 hours in the PP and 53.12 hours in the MSP group]. Nephrostomies are a major factor in determining the length of hospital stay. Supine PCNL procedures were often performed without nephrostomies, but conventional PP PCNL procedures required nephrostomies, which delays hospital discharge [22]. However, our experience demonstrates that there is no difference between both groups in terms of nephrostomies use and hospital stay length.

Similar to our findings, **Melo *et al.*** [18] found a stone-free rate of 37.4% in the PP and 43% in the MSP group [p= 0.565]. Another study by **Jones *et al.*** [7] demonstrated a stone-free rate of 70% in MSP compared to 50% in the PP group. Likewise, **De Sio *et al.*** [23] found the MSP to have higher stone-free rates. On the other hand, two meta-analyses disagreed with these findings. **Yuan *et al.*** [24] observed that PCNL in the PP was linked with a better stone clearance rate than in the MSP. **Falahatkar *et al.*** [25] showed a similar stone-free rate in both groups. As a result of the supine posture being changed, simultaneous antegrade and retrograde access to large staghorn calculi and ureteric calculi allow for improved stone removal in one procedure. **Melo *et al.*** [18] found that the success and stone-free rates were lower than those reported in the literature. However, they set strict criteria for the measurement of success, including CT.

Regarding the heart rate and blood pressure, **Patel *et al.*** [26] found a decrease in heart rate in MSP than PP, but they found a decrease in BP in the PP than MSP. Additionally, the PP can result in decreased venous return, decreased mean BP, and increased heart rate and lead to a limitation of respiratory movement and increased peak airway pressure.

In terms of operative complications, **Melo *et al.*** [18] found a blood transfusion rate of 8.1% in the PP group and 8% in the MSP group [p = 0.118]. They found a drop of hemoglobin level by 2.34 ± 1.39 g/dL in the PP compared to 2.22 ± 1.46 g/dL in the MSP group. Also, **Jones *et al.*** [7] found postoperative anemia not requiring transfusion of 0.6% in the MSP position compared to the 4% PP group. They also found a urine leak of 0.6% in the MSP position compared to the 1% PP group. No significant differences in complications rate were detected between the MSP and PP groups, according to **Liu *et al.*** [19]. Compared with other trials like **Scoffone *et al.*** [27] and **De Sio *et al.*** [23], our study demonstrated substantially lower rates of complications.

Cases were not randomized in this study, which might lead to selection bias. Most surgeons were previously experienced with the PP for PCNL but may not have had the same experience with the MSP; therefore, a surgeon's experience or skill level and inter-surgeon variability may impact the outcomes. Postoperative hemoglobin was not routinely measured and only examined if clinically required, which might have impacted the incidence of transfusion.

We acknowledge that this study has some limitations including the small sample size and single-center setting, which may hinder the generalizability of our findings. In addition, the randomization and blinding were not applicable; however, we made sure that the baseline characteristics of both groups were comparable to reduce the risk of bias.

In conclusion, MSP has favorable outcomes in terms of the operative time and length of hospital stay compared to PP. Both groups showed comparable stone-free-rate and post-operative complications.

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