

# Does the Use of Smaller Amplatz Sheath Size Reduce Complication Rates in Percutaneous Nephrolithotomy?

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**Purpose:** To evaluate the effect of Amplatz sheath size used in percutaneous nephrolithotomy (PCNL) on postoperative outcomes, bleeding and renal impairment rates.

**Materials and Methods:** We retrospectively evaluated the records of 91 patients who had undergone PCNL. We divided the patients into 2 groups according to Amplatz sheath size (22 and 30 French [F]) used in the PCNL procedure. Groups were retrospectively compared in terms of pre- and postoperative hemoglobin and renal function, mean nephrostomy time, mean nephrostomy tube diameter, mean operative time, mean hospitalization time and mean scopy time.

**Results:** Mean operative time, mean preoperative hemoglobin and serum creatinine values were similar in 2 groups. The mean stone diameter of patients in group 1 (22F) and group 2 (30F) were  $38.47 \pm 11.51$  mm and  $37.69 \pm 12.33$  mm, respectively. Pre- and postoperative hemoglobin (Hb) levels were  $14.52 \pm 1.5$  g/dL and  $13.51 \pm 1.4$  g/dL, respectively in group 1. Pre- and postoperative Hb level were  $14.23 \pm 1.6$  g/dL and  $10.73 \pm 1.7$  g/dL, respectively in group 2. There was a significant difference between the two groups in terms of mean scopy time ( $P = .023$ ), postoperative Hb ( $P = .027$ ), postoperative creatinine ( $P = .032$ ), mean nephrostomy duration ( $P = .019$ ), mean nephrostomy diameter ( $P = .028$ ) and hospitalization time ( $P = .034$ ). There was significant difference between the two groups in bleeding requiring blood transfusion ( $P = .023$ ) and residual stone ( $P = .035$ ).

**Conclusion:** The smaller the Amplatz sheath used in PCNL, the lower kidney hemorrhage and renal function impairment happens.

**Keywords:** kidney calculi; surgery; nephrostomy, percutaneous; adverse effects; postoperative complications; treatment outcome; retrospective studies.

## INTRODUCTION

In recent years urolithiasis has become one of the most important disorders affecting the daily life of patients and percutaneous nephrolithotomy (PCNL) has become a standard procedure in the surgical treatment of larger renal or proximal ureteral stones.<sup>(1-3)</sup> Since the procedure was firstly described, several efforts have been made to improve the outcome and decrease the complication rates.<sup>(2,4)</sup> Although the procedure has various advances, some issues associated with PCNL remain matter of debate.<sup>(3)</sup>

Recently there have been several reports in the literature investigating the effect of nephrostomy tube size on the success, bleeding, renal function impairment and postoperative urinary leak rates.<sup>(1-3)</sup> In addition there are many trials comparing the nephrostomy drainage with no nephrostomy (tubeless) drainage following PCNL.<sup>(1-3,5,6)</sup> In most of the previous studies a 26 to 30 French (F) Amplatz sheath was positioned into the renal collecting system.<sup>(1,3)</sup> None of these reports include any data presenting the effect of Amplatz sheath size on surgical outcomes and perioperative findings.

In the recent study we retrospectively evaluated the effect of Amplatz sheath size used in PCNL on postoperative outcomes, bleeding, and renal impairment. Nephrostomy tube size and duration, operative time, hospitalization time, and scopy time were also compared.

## MATERIALS AND METHODS

The records of 91 patients (56 males and 35 females) who have undergone PCNL by two different surgeons between November 2011 and June 2013 were retrospectively evaluated. Previously 30F Amplatz sheath was routinely used in all patients who underwent PCNL in our clinic regardless of the stone size. In our clinical experience we observed that the intraoperative bleeding following serial renal dilatation increased after 24F renal dilatator, although there was no significant bleeding with renal dilators smaller than 24F. Therefore we began to use 22F Amplatz sheath routinely in all patients regardless of stone diameter after October 2012. We divided the patients into 2 groups according to Amplatz sheath size (22F and 30F) used in the PCNL procedure. Patients with abnormal preoperative renal function and pyonephrosis were excluded from the study.

All patients were operated in prone position through a percutaneous access following retrograde ureteral catheterization under general anesthesia. Initial percutaneous renal access to either the lower or the middle calyx was performed by the operating surgeon under radiologic assistance using X-ray in combination with retrograde intra-renal contrast injection. Once access was obtained, a Sensor guidewire (Boston Scientific®, Cimed, Inc., Minnesota, USA) was inserted and preferably maneuvered toward the ureter. A 22F or 30F Amplatz sheath was positioned in the renal collecting system following progressive dilation of the tract using serial dilators under fluoroscopic control. The stones were disintegrated with pneumatic lithotripsy and removed using foreign body grasper. The nephrostomy tube was introduced under fluoroscopic control. The nephrostomy tube was closed

following the procedure for hemostasis and re-opened at the postoperative 2nd hour unless the patient experienced pain. Nephrostomy tube was removed if the color of the urine had become clear and all patients were discharged 12 hours following the nephrostomy tube removal if there was no urinary leak. We accepted the patients with residual stones  $\leq 4$  mm as stone free.

Two groups were retrospectively compared in terms of pre- and postoperative hemoglobin and renal function, nephrostomy time, nephrostomy tube diameter, operative time, hospitalization time and scopy time. Clinical and laboratory data were analyzed with Statistical Package for the Social Science (SPSS Inc, Chicago, Illinois, USA) version 18.0 and data were displayed as mean  $\pm$  standard deviation (SD). The two groups were analyzed and compared by using independent t-tests and paired t-tests. A 5% level of significance was used for all statistical testing. A *P* value  $< .05$  was considered significant.

## RESULTS

Mean age of the patients was  $44.35 \pm 13.79$  (range, 24-71) years and mean stone diameter was  $37.56 \pm 9.58$  (range, 10-55) mm. Mean operative and scopy time were  $109.81 \pm 42.43$  (range, 50-202) min and  $14.43 \pm 9.61$  (range, 3-27) min, respectively. The mean stone diameter of patients in group 1 (22F) and group 2 (30F) were  $38.47 \pm 11.51$  mm and  $37.69 \pm 12.33$  mm, respectively. Fifty-eight patients presented with multiple stones (27 and 31 patients in groups 1 and 2, respectively). Thirty-two patients presented with staghorn stone (15 and 17 patients in groups 1 and 2, respectively). **Table 1** includes patients' characteristics and stones' properties. There was no statistical difference between 2 groups in terms of age, male to female ratio, mean maximum stone diameter, number of stones and side.

Preoperative and postoperative hemoglobin (Hb) levels were  $14.52 \pm 1.5$  g/dL and  $13.51 \pm 1.4$  g/dL, respectively in group 1. Preoperative and postoperative Hb levels were  $14.23 \pm 1.6$  g/dL and  $10.73 \pm 1.7$  g/dL, respectively in group 2. There was a significant difference between the two groups in terms of mean scopy time (*P* = .023), postoperative Hb (*P* = .027), postoperative creatinine (*P* = .032), mean nephrostomy duration (*P* = .019), mean nephrostomy diameter (*P* = .028) and hospitalization time (*P* = .034). Postoperative mean Hb level was significantly lower and postoperative mean serum creatinine level was significantly higher in patients who were treated with 30F Amplatz sheath when compared to 22F Amplatz sheath. It was observed that nephrostomy time and nephrostomy tube size significantly increased as the Amplatz sheath size increased. Mean operative time, mean preoperative Hb and serum creatinine values were similar in all 2 groups. Results are summarized in **Table 2 and Figure**.

Eight patients presented with postoperative infection (Clavien grade 1) (3 and 5 patients in 22F and 30F groups, respectively), 11 patients developed bleeding requiring blood transfusion (Clavien grade 2) (3 and 8 patients in 22F and 30F groups, respectively), residual stone was observed in 7 patients (5 and 2 patients in 22F and 30F groups, respectively), and 6 patients had antegrade placement of a 6F double-J

**Table 1.** Demographic and clinical characteristics of study groups.

Variables	Group 1 (22F)	Group 2 (30F)
Patients, no.	47	44
Age, years, mean $\pm$ SD (min-max)	44.3 $\pm$ 13.61 (25-67)	45.17 $\pm$ 12.71 (24-71)
Male:Female, no.	29:18	27:17
Right:Left side, no.	22:25	21:23
Stone diameter, mm, mean $\pm$ SD (min-max)	38.47 $\pm$ 11.51 (10-50)	37.69 $\pm$ 12.33 (15-55)
Multiple stones, no.	27	31
Staghorn stone, no.	15	17

**Abbreviations:** SD, standard deviation; F, French.

ureteral stent (22F and 30F groups, respectively). There was significant difference between the two groups in bleeding requiring blood transfusion ( $P = .023$ ) and residual stone ( $P = .035$ ). None of the patients presented with postoperative prolonged urinary leak and no patient required any ancillary procedures. Postoperative results are summarized in **Table 3**.

## DISCUSSION

Morbidity associated with the open surgery for larger renal and proximal ureteral calculi has significantly decreased by the use of PCNL.

<sup>(1)</sup> Although PCNL is a well-defined procedure, surgical technique is still changing since most of the clinicians are trying to optimize the outcomes and minimize the complications and patients' discomfort related with the procedure.<sup>(2,3)</sup> Previous studies mainly discussed PCNL exit strategy including nephrostomy drainage versus no nephrostomy drainage (tubeless) and nephrostomy tube type and size if used.<sup>(1,3,7-10)</sup>

There has been increasing evidence that the drainage method used in PCNL may significantly affect the outcomes and complications including hospital stay, patients' discomfort, bleeding, prolonged urinary leak and renal impairment.<sup>(1,2)</sup>

Previous studies mainly discussed PCNL postoperative outcomes, complications, bleeding, and renal impairment. Recently tubeless PCNL has been advocated by various trials in short and uncomplicated cases with minimal bleeding, fewer complications and reduced hospital stay.<sup>(1,3,9-18)</sup> Desai and colleagues prospectively compared postoperative outcomes among tubeless, conventional large bore and small bore nephrostomy drainage.<sup>(1)</sup> They concluded that tubeless PCNL is associated with the least postoperative pain, urinary leakage and hospital stay. In contrast several studies demonstrated that nephrostomy tube placement is mandatory providing hemostatic tamponade for the percutaneous renal tract, continuing access to the renal collecting system if a second look procedure is required and avoiding urinary extravasation.<sup>(2,3)</sup> There are conflicting findings associated with the type and size of the nephrostomy tube used to drain the renal collecting

system following PCNL.<sup>(2)</sup>

In a previous study 3 different nephrostomy tube types including 24F re-entry tube, 8F pigtail catheter and double J stent plus 18F Councill-tip catheter were compared.<sup>(19)</sup> The authors noted no statistical difference in terms of pain scores, hematocrit change and hospital stay. In a recent study, the effect of nephrostomy tube size (22F versus 12F) on perioperative outcomes of PCNL was investigated.<sup>(3)</sup> This study showed that a small bore nephrostomy tube can safely be used instead of a larger size tube following uncomplicated PCNL procedure since the size of the nephrostomy tube does not affect blood loss and hospital stay. In a similar study the authors explored the relationship between nephrostomy tube size and results of PCNL.<sup>(2)</sup> The authors concluded that large bore nephrostomy tube reduce bleeding and overall complication rate.

Previous studies have not discussed the potential impact of Amplatz sheath size on surgical outcomes of PCNL procedure. To the best of our knowledge the recent study represents the first trial investigating the effect of Amplatz sheath size on surgical outcomes and perioperative findings of PCNL. We tried to evaluate the effect of Amplatz sheath size used in PCNL on postoperative outcomes, bleeding, and renal impairment. We also compared nephrostomy tube size and duration, operative time, and scopy time.

Postoperative mean Hb level was significantly lower and postoperative mean creatinine level was significantly higher in the patients who were treated with larger Amplatz sheath when compared to smaller size. We think that although PCNL is a minimally invasive procedure to the skin, the technique is still invasive for the kidney. The findings of the recent study proved that the use of small size Amplatz sheath is less harmful for the kidney resulting in less bleeding and less renal impairment. Although we have not objectively evaluated the postoperative pain status of the patients, we observed that the use of small size Amplatz sheath decreased the postoperative patient discomfort. However further studies investigating postoperative pain with valid pain scoring systems are needed.

**Table 2.** Perioperative findings in study groups.\*

Variables	Group 1 (22F)	Group 2 (30F)	P Value
Operative time, min (min-max)	101.31 ± 32.1 (50-115)	118.36 ± 48.5 (62-202)	.082
Scopy time, min (min-max)	18.72 ± 3.2 (5-25)	12.13 ± 5.9 (3-27)	.023
Preoperative Hb, g/dL (min-max)	14.52 ± 1.5 (11.3-16.2)	14.23 ± 1.6 (10.9-16.5)	.092
Postoperative Hb, g/dL (min-max)	13.51 ± 1.4 (10.3-15.2)	10.73 ± 1.7 (8.5-12.7)	.027
Preoperative creatinine, mg/dL (min-max)	0.9 ± 0.53 (0.4-1.66)	0.85 ± 0.42 (0.4-1.39)	.079
Postoperative creatinine, mg/dL (min-max)	0.9 ± 0.31 (0.5-1.4)	1.62 ± 0.43 (0.9-2.1)	.032
Nephrostomy duration, day (min-max)	1 ± 0.53 (1-4)	3.95 ± 1.23 (3-7)	.019
Nephrostomy diameter, mm (min-max)	12.52 ± 1.41 (10-14)	16.64 ± 2.56 (12-20)	.028
Hospitalization stay, days	1.7 ± 0.43	2.7 ± 0.72	.034

**Abbreviations:** Hb, hemoglobin; F, French.

\* Data are presented as mean ± standard deviation.

In contrast to the results of the study reported by Cormio and colleagues, our findings showed that nephrostomy tube size and bleeding significantly increased as the Amplatz sheath size increased.<sup>(2)</sup> We think that the Amplatz sheath size is more crucial than the size of nephrostomy tube used to drain the renal collecting system in terms of bleeding and renal impairment. Although the impact of percutaneous tract dilatation in terms of intraoperative bleeding was not prospectively evaluated in the recent study, in our clinical experience we observed more intraoperative bleeding following 24F or larger dilators. In a recent study the authors advocated that the size of nephrostomy tube does not affect blood loss and hospital stay.<sup>(3)</sup> In contrast our findings showed that the use of small size Amplatz sheath significantly decreased the nephrostomy tube size, bleeding, nephrostomy time hospital stay.

The recent study has some limitations including the retrospective design which might introduce some selection bias. Our findings demonstrated that stone free rate is negatively related with the Amplatz sheath size. This might possibly because we have only used pneumatic lithotripsy device for fragmentation of stones. We suppose that our stone free rates would potentially be better if we could use both pneumatic and ultrasonic lithotripsy devices. We compared two (22F, 30F) Amplatz sheath size and inserted nephrostomy tube to all patients. Further prospective and randomized studies including different sized nephrostomy tube drainage and no nephrostomy drainage (tubeless) groups would probably demonstrate the effect of Amplatz sheath size on perioperative outcomes more objectively.

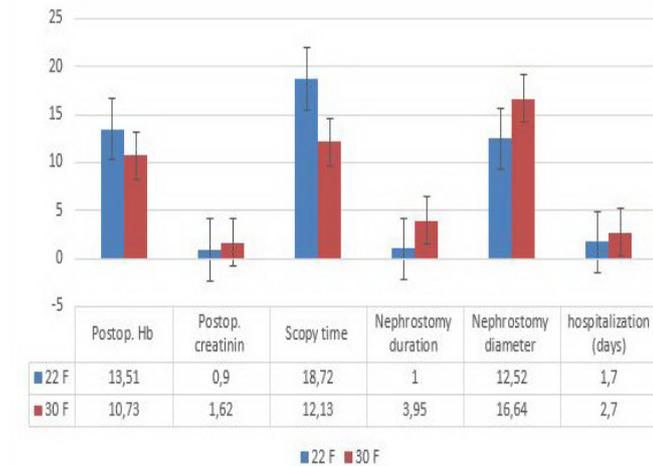
**Table 3.** Postoperative findings in study groups.\*

Variables	Group 1 (22F)	Group 2 (30F)	P Value
Postoperative infection	3 (6.38)	5 (11.36)	.061
Bleeding requiring blood transfusion	3 (6.38)	8 (18.18)	.023
Residual stone	5 (10.63)	2 (4.54)	.035
6 Fr double-J stent	2 (4.25)	4 (9.09)	.053

\* Data are presented as number percent.

## CONCLUSION

The use of small bore Amplatz sheath in PCNL procedure seems to reduce bleeding, renal impairment rates, and patients' postoperative



**Figure.** Mean scopy time, nephrostomy duration, nephrostomy tube diameter, postoperative hemoglobin, hospitalization time and serum creatinine values were significantly different among groups.

discomfort. Further prospective, high numbered and randomized studies are needed to support our findings.

## CONFLICT OF INTEREST

None declared.

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