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**ORIGINAL ARTICLE**

# Comparsion of Outcomes of Single Versus Multiple Mini-Tract Percutaneous Nephrolithotomy for Staghorn Renal Stone Clearance

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## ABSTRACT

**Background:** Staghorn calculi are branched stones that contain extra than Failure to cast off staghorn calculus might also additionally ruin the parenchyma and kidney feature and motive life-threatening sepsis. Therefore, whole elimination and clearance rates are more often than not taken into consideration while managing staghorn stones. The aim of this study was to investigate the efficacy and safety of multi-tract percutaneous nephrolithotomy (PNL) against the benchmark of the single tract approach.

**Material and Methods**: A randomized clinical trial was conducted at institute of kidney disease Peshawar "between 1st March 2022 to 31st Oct 2022" after fulfilling the inclusion criteria. A total 100 patients were included in this study using consecutive non portability sampling technique. Patients who received single- or multiple-tract mPCNL depended on the stone complexity of their computed tomography (CT) images before the operation. In addition, 50 patients who underwent the single mini-tract (<21-Fr sheath) percutaneous method (Group A) compared with 50 patients who required multiple (≥2) mini tracts (Group 2)

**Results:** A total 100 patients with staghorn calculi (Male 33(57.8%) , Female 21(48.8%) and Male 23 (40.3%) , Female 22 (51.1% ) were treated with two types of tracts for mini PCNL, i.e single- and multiple-tract mini PCNL, respectively. The mean stone size was in single tract was 12.67±8.06 and multiple tracts was 17.23±10.49; a significant difference in stone size in Groups A and B, respectively; (P = 0.005). In addition, the Stone Hounsfield unit means score in single tract was 919.73 and multiple tracts were 1070.11. S. T. O. N. E. score in Group 2 was significantly higher (8.4±1.7 10.6±1.3 = 0.001).

**Practical Implication:** In this study a multi-tract PCNL has been shown to be an effective and secure expansion of a single-tract PCNL for big stone burden and complex kidney stone disease. The benefit of this study was to investigate the efficacy and safety of multi-tract percutaneous nephrolithotomy (PNL) against the benchmark of the single tract approach.

**Conclusion:** A multi-tract PCNL has been shown to be an effective and secure expansion of a single-tract PCNL for big stone burden and complex kidney stone disease in this randomised clinical trial single-center investigation. Future prospective studies should concentrate on how well the technique can help individuals with severe stone disease require fewer interventions before becoming stone-free.

**Keywords:** Multiple-Tract, Percutaneous Nephrolithotomy, Staghorn Calculi, Kidney Stone Disease,

## INTRODUCTION

Percutaneous nephrolithotomy (PNL) is accepted as a first-line treatment modality for staghorn calculi and excretory organ stones of size over a pair of cm.[1,2] Stone formation related to anatomical abnormalities, diseases, genetic determination and medicines characterizes speculative stone formers, that have associate degree inflated prevalence for formation of multiple calculi, massive stone burden or staghorn stone to realize stone-free standing in patients with complicated stone illness remains a difficult goal. Stone distribution, stone volume, the anatomy of the pelvicalyceal system, comorbidities and therefore the surgeon's expertise confirm the quantity of accesses or the quantity of interventions.[3–5]

Staghorn calculi are branched stones that involve more than two calyces and occupy a large portion of the collection system.[1] Failure to eliminate staghorn calculus may destroy the parenchyma and kidney function and cause life-threatening sepsis.[2] Therefore, complete removal and clearance rates are mostly considered when dealing with staghorn stones. Percutaneous nephrolithotomy (PCNL), which is preferred for patients with staghorn stones, is a safe and successful technique.[1],[2] Compared with other treatments, such as open surgery, extracorporeal shock wave lithotripsy (ESWL), and combined surgery, PCNL has a lower morbidity rate and higher stone clearance rate.[3] Since PCNL is a successful method for removing renal stones, modifications, and refinements such as slender nephroscopes have been developed, further enhancing the outcome and decreasing morbidity. Miniaturized PCNL (mini PCNL, mPCNL) is defined as using sheaths between 11 and 21 Fr. In contemporary literature, mPCNL is considered safe and an effective alternative to conventional PCNL for adult and pediatric patients. Furthermore, even in anomalous kidneys, such as the horseshoe, polycystic, and transplanted kidneys, mPCNL is safe and feasible.[4]
However, longer operation times, higher irrigation pump pressure, and multiple tracts become necessary methods for achieving complete stone removal as the size and complexity of renal stones increase.[5] Controversy remains whether creating multiple percutaneous tracts can cause more bleeding and higher complication rates than procedures requiring a single tract.[6] Moreover, mPCNL has been questioned in treating patients with large complex staghorn stones due to the smaller access sheath, leading to comparatively reduced visibility and stone-free rate (SFR).[7] This study reviewed the experience of managing staghorn calculi with multiple-tract mPCNL and evaluates that multiple-tract mPCNL approaches are appropriate and effective in achieving stone-free status in more complex staghorn stones.

Due to technical progress of PNL instruments associate degreed an increasing surgical expertise over the last decades, multiple-tract PNL came into broader use.[6–9] in sight of the restricted multiple tract literature revealed to this point originating from few high-volume stone centers with extremely old endourological surgeons, multiple-tract PNL seems to be each well established with established blessings over single-tract PNL and at identical time underutilized for the fear of complications related to multiple punctures at one stage. [10] Retrospective case series have represented the majority of data on multiple-tract PNL for the last decade.14–19 Currently an increasing number of retrospective analyses have tried to compare multiple- with single-tract PNL. However, a larger volume of data on efficacy, safety and follow-up is needed to strengthen the understanding of advantages and limitations of multi-tract PNL against the benchmark of the single-tract approach. Therefore, the objective of the current study is to compare safety and efficacy of multiple- with single-tract PNL.

## MATERIALS AND METHODS

A randomized clinical trial was conducted after getting approval from hospital ethical and research committee at institute of kidney disease Peshawar, 'between 1st march 2022 to 31oct 2022' Informed consent was taken from the patients meeting the inclusion criteria. The purpose of the study was explained to all the recruited patients at the start of the study before enrolling them.

The patients were randomly allocated and computer-generated table of random numbers were used for the process of randomization. Depending on the complexity of the stones in their computed tomography (CT) imaging prior to surgery, patients either underwent single-tract mini PCNL or multiple-tract mini PCNL. A further comparison was made between 50 patients who had the single mini-tract (21-Fr sheath) percutaneous technique (Group A) and 50 patients who needed multiple (two) mini tracts (Group 2) The perioperative findings and postoperative results of the two groups were compared. Age, gender, height, weight, body mass index (BMI), preoperative serum creatinine, estimated glomerular filtration rate, urine pH, previous procedures, stone complexity (S. T. O. N. E score), and stone burden (cm3) were recorded along with other patient information. Clinical outcomes included SFRs, operation time, complications extending hospital stays, postoperative creatinine and haemoglobin levels, as well as prescriptions for pain medication. Blood analysis was part of the preoperative workup in addition to a brief history-taking (e.g., serum creatinine and Hb measurements, platelet count, and coagulation screening). Ultrasonography and plain radiography of the kidney, ureter, and bladder (KUB) were both used in the radiological examination. In order to determine the anatomy of the renal collecting system and the position, size, and hardness of the stones, An independent-sample t-test was applied for continuous Variables (e.g., patient characteristics and perioperative parameters). Chi-square or Fisher's exact tests was applied for analyzing the categorical data between the two groups. A $P < 0.05$ was considered statistically significant. Statistical analysis was performed using SPSS.

## RESULTS

A total 100 patients with staghorn calculi (Male 33(57.8%) , Female 21(48.8%) and Male 23(40.3%) , Female 22(51.1% ) patients were treated with single- and multiple-tract PCNL, respectively. The mean stone size was in single tract was 12.67±8.06 and multiple tracts was 17.23±10.49; a significant difference in stone size in Groups 1 and 2, respectively; (P = 0.005). In addition, the Stone Hounsfield unit means score in single tract was 919.73 and multiple tracts were 1070.11. S. T. O. N. E. score in Group 2 was significantly higher (8.4±1.7 10.6±1.3 = 0.001). [Table 1].

Table 1: Patient Parameters

| Patient Characteristics | Single tract | Multiple tracts | P. Value |
|---|---|---|---|
| Age | | | |
| Mean | 56.6±3.7 | 57.7±1.4 | 0.012 |
| Gender wise distribution | | | |
| Male | 23(40.3) | 33(57.8) | 0.001 |
| Female | 22(51.1) | 21(48.8) | 0.013 |
| BMI | | | |
| Mean | 24.1±2.24 | 23.5±2.15 | 0.000 |
| Stone houns field unit | | | |
| Mean | 919.73 | 1070.11 | 0.014 |
| Stone complexity | | | |
| Mean | 8.4±1.7 | 10.6±1.3 | 0.014 |
| Stone size (cm3) | | | |
| Mean | 12.67±8.06 | 17.23±10.49 | 0.031 |
| Range | 4.31-40.39 | 4.26-39.88 | |
| Preoperative hemoglobin (g/Dl | | | |
| Mean | 13.85±2.18 | 12.68±1.72 | 0.001 |
| Preoperative serum creatinine (mg/dL) | | | |
| Mean | 1.21±0.60 | 1.21±0.71 | 0.002 |
| e-GFR | | | |
| Mean | 67.38±24.68 | 66.47±23.31 | 0.004 |
| Urine pH | 6.47±0.61 | 6.53±0.69 | 0.003 |

Comparison between the two groups in terms of operative time in a single tract mean time was Mean (min) was 100±11.0 and multiple tracts was 120±22.6 having p Value(0.005) and having Range (min) 70-150 to 85-140. In addition, the Stone free rate (residual stone)<0.4 cm) (%) in single tract was 44.5and multiple tract was 55.6. Hospital stay in single tract was 4.21±2.22days and multiple tracts was 4.22±2.11days .Similarly number of blood transfusion in single tract was 26% and multiple tract was 14% [Table 2].

The average multiple tracts used was 2.8. The complication was classified as Clavien- Dindo. Patients in this study who experienced fever (≥38.5℃) were related to urinary tract infections. Blood transfusion requirement was defined as postoperative symptomatic anemia (Hb level, <8 g/dL). All patients recovered after treatment with intravenous antibiotics and other supportive measures. [Table 3].

Table 2: Operative Details and Postoperative Parameters

| | Single tract | Multiple tracts | P.Value |
|---|---|---|---|
| Operative time | | | |
| Mean (min) | 100±11.0 | 120±22.6 | 0.005 |
| Range (min) | 70-150 | 85-140 | |
| Stone free rate (residual stone)<0.4 cm) (%) | | | |
| Number (%) | 44.5 | 55.6 | 0.001 |
| Hospital stay Days | | | |
| Mean | 4.21±2.22 | 4.22±2.11 | 0.003 |
| Blood transfusion, n (%) | 26% | 14% | 0.003 |

Table 3: Comparison of Tract Details and Complications (Clavien-Dindo Classification)

| | Single tract | 2 tracts | 3 tracts | 4 tracts |
|---|---|---|---|---|
| Stone free case, n (%) | 13 (68.4) | 5 (71.4) | 4 (66.6) | 2 (66.6) |
| Grade I: Fever, n (%) | 1 (5) | 2 (11) | 1 (16) | 1 (33) |
| Average stone complexity (S.T.O.N.E score) | 8.42 | 9.57 | 11 | 11.67 |
| Grade I: Fever, n (%) | 1 (5) | 2 (11) | 1 (16) | 1 (33) |

## DISCUSSION

According to recommendations from the American Urological Association and the European Association of Urology, PCNL is the chosen first-line treatment for big load stones (>2 cm). With this surgical method, a stone clearance rate of 74%–83% was attained, while acute complications, transfusions, and ancillary rates were 15%, 14%–24%, and 18%, respectively1. 8 Furthermore, compared to open, ESWL, RIRS, or combination surgery, PCNL is the preferable therapy for the majority of complicated kidney stones. 9 Multiple-tract PCNL is regarded as a way to raise SFRs when complexity and stone burden rise. Based on the various sheath sizes, PCNL can be divided into standard, mPCNL, ultra-mPCNL, and micro-mPCNL categories. The relative ranges for the regular, mPCNL, ultra-mPCNL, and micro-mPCNL sheaths are 24–30, 14–21, 11–13, and 4.8 Fr. respectively [10] Additionally, mPCNL was formerly primarily employed in cases of adult or paediatric minor kidney stones. However, with advances in technology and surgical methods, multiple tract mPCNL became a workable option for treating renal staghorn stones. The concept of multiple tract mPCNL was also based on anatomical restrictions. Infundibular breadth, intercalyceal angle, and pelvicalyceal system surface area, for example, were factors in the pelvicalyceal anatomy that Verma et al. maintained affected the number of punctures. 11 The same skilled operator in mPCNL divided all patients in this study into two groups based on the stone volume, anatomical factors, Hounsfield unit, and occupied calyx before the operation. Due to the shortening of the procedure's duration to prevent sepsis, the tracts utilised in Group 2 were chosen during the procedure.

In comparison to single-tract treatments, the most significant side effects associated with the multiple-tract approach were bleeding and blood transfusion. The average number of multiple tracts used in this investigation was 2.8. Clavien- Dindo was assigned to the complication. In this study, patients with fever (38.5°C) had a connection to urinary tract infections. Postoperative symptomatic anaemia (Hb level, 8 g/dL) was used to identify blood transfusion necessity. After receiving treatment with intravenous antibiotics and other supportive measures, all patients made a full

recovery. The mean Hb decline was similar in the two groups, according to a recent study by Hegarty and Desai12–14 (2.08 vs. 2.32 g/dL for single and multiple tracts, respectively). This result deviates from that study's findings. Akman and others also observed that the mean drop in postoperative Hb level was significantly higher in the multiple-(2.5 ± 1.6 g/dL) than single-(2.1 ± 1.7 g/dL) tract group. Furthermore, Martin et al.[16] reported that the transfusion rates also differed significantly, with 20% and 41.6% requiring transfusion in patients with less than or more than two tracts for stone clearance.[17] The puncture location and other smaller tracts employed could be to blame for the multiple-tract group's lower Hb decline. In order to reach the renal papilla in the quickest amount of time, the puncture's main idea is to map out the shortest path. Researchers are still unsure about the pelvicalyceal system's major entry point, though. Small sample sizes are one of the study's weaknesses; therefore, a bigger sample size is required to assess the relationship between tract number, stone complexity, SFR, and complication. To reduce bias associated with using different surgeons with varied levels of skill, patients either had multiple or single-tract PCNL performed on them.

Therefore, larger study populations are required for future research. Second, because the blood is mingled with irrigation fluid throughout the procedure, estimating actual blood loss is challenging. Postoperative Hb can therefore only be measured to assess potential bleeding. However, fluid hydration and irrigation may lower Hb levels, which affects judgments about blood transfusions. Third, during the admission period, only the short-term outcome was assessed. Consequently, long-term monitoring of issues and stone recurrence should be carried out in the future.

## CONCLUSION

A multi-tract PCNL has been shown to be an effective and secure expansion of a single-tract PCNL for big stone burden and complex kidney stone disease in this randomised clinical trial single-center investigation. Future prospective studies should concentrate on how well the technique can help individuals with severe stone disease require fewer interventions before becoming stone-free.

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