

**Review article**

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**Percutaneous Nephrostomy in Obstructive Uropathy: Complications and Feasibility  
Analysis as an Outpatient Surgery**

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## Abstract

This study aimed to examine the efficacy, feasibility, frequency of complications, and outcome of emergency or elective renal unblocking in patients with benign or malignant pathology within outpatient surgical procedure manner.

A prospective study, so far, included 158 patients, of which 94 (59.49%) woman and 64 (40.50%) men, who underwent PCN at the urology department at General Hospital "Aleksa Savić" in Prokuplje from January 2020 to January 2024. All the patients were admitted in an outpatient maner. The cohort included patients with both benign and malignant obstruction.

The operation's success rate was 97.47%. Patients in nearly 40% of PCN placement indications had stones. The frequency of issues in our study is in line with results from earlier investigations. Regarding the hydronephrosis grade, there was a clear statistical significance in the complication rates among the groups with mild, moderate, and severe hydronephrosis. Every problem was categorized using the five modified C-D (Clavien-Dindo Classification System) grades. Most of the problems were low-grade C-D complications.

Percutaneous nephrostomy primarily gives us time in treatment planning and in a certain number of patients or it represents the final urine derivation when there is no definitive surgical procedure. In addition to overcoming the learning curve, it is a sovereign method in prompt intervention on developed obstruction. Performing percutaneous nephrostomy in an outpatient manner represents safe and feasible procedure.

Keywords: kidney, hydronephrosis, nephrostomy, percutaneous

## Pregledni rad

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Perkutana nefrostomija u opstruktivnoj uropatiji: analiza izvodljivosti i komplikacija u  
jednodnevnoj hirurgiji i lokalnoj anesteziji

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Opstruktivna uropatija predstavlja patološko stanje u kome je blokiran prirodni tok urina. Rezultat je povećanje pritiska unutar kolektornog sistema bubrega i moguće trajno oštećenje bubrežne funkcije. Za cilj smo imali da ispitamo efikasnost, izvodljivost, učestalost komplikacija. Ishode hitne ili elektivne deblokade bubrega kod pacijenata sa benignom ili malignom patologijom kao jednodnevne hirurške procedure u lokalnoj anesteziji. Prospektivna studija, je do sada obuhvatila 158 pacijenata, od kojih 94 (59.49%) ženskih i 64 (40.50%) muška pacijenta koji su podvrgnuti proceduri perkutanog plasmana nefrostomskog katetera (PCN) na odeljenju urologije u Opštoj bolnici “Aleksa Savić” u Prokuplju u periodu od Januara 2020. godine do Januara 2024. godine. Uspešnost procedure iznosila je 97.47%. Više od 40% plasmana nefrostomskog katetera bilo je zbog kalkuloze. Incidenca komplikacija u našoj studiji korelira sa literaturom. U kontekstu gradusa hidronefroze, između blage, izražene i teške hidronefroze postojala je jasna statistička razlika između ispitanih grupa u učestalosti pojave komplikacija. Sve komplikacije su klasifikovane prema pet gradusa

modifikovanog C-D (Clavien-Dindo Klasifikacioni sistem). Većina komplikacija bile su niskog C-D gradusa od kojih 19 pacijenata (12.03%) su imali drhtavicu, bol ili prolaznu hematuriju (hematurija koja traje manje od 24h) klasifikovani kao C-D I. Perkutana nefrostomija nam primarno daje vremena u planiranju lečenja dok za određen broj pacijenata predstavlja definitivnu urinarnu derivaciju kada ne postoji dalja mogućnost operativnog lečenja. Savladavanjem krive učenja, predstavlja suverenu metodu brze intervencije kod razvijene opstrukcije. Plasman perkutanog nefrostomskog katetera kao jednodnevna hiruška procedura u lokalnoj anesteziji predstavlja sigurnu i isplativu metodu kod odabranih pacijenata.

- **Ključne reči:** bubreg, hidronefroza, perkutana nefrostomija

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## **Introduction**

Obstructive uropathy is a pathological condition in which urine flow is blocked, resulting in increased pressure within the renal collecting system and possibly permanent kidney damage. The interruption and inability of urine to flow results in pain, infection, sepsis, and loss of renal function in its terminal stage [1]. This condition is potentially life-threatening especially in a patients with a single functioning kidney due to progressive uremia. The very degree of developed hydronephrosis or the possibility of developing primary renal atrophy is individual patient's response that requires prompt renal decompression [2].

Various modalities allow unblocking the affected organ: retrograde stenting, open drainage, and percutaneous nephrostomy (PCN). Although very widespread as a procedure and favorite among both urologists and radiologists, there are still no European recommendations and guidelines that would include determined rates of complication [3]. Our study included patients who underwent a PCN procedure in a secondary health care facility, in the urology department. All patients included in this study underwent the PCN in an outpatient surgery maner. It is inevitable to mention the epidemiological aspect during the COVID 19 pandemic. Due to a drop in elective surgery rates worldwide, PCN represents an opportunity to delay the final intervention without consequences for patients health effectively [4].

## **Materials and methods**

The prospective study, so far, included 158 patients, of which 94 (59.49%) women and 64 (40.50%) men who were placed percutaneous nephrostomy catheter (PCN) unilaterally or bilaterally at the Department of Urology of General Hospital "Aleksa Savić" in Prokuplje from January 2020. to January 2024. All procedures were performed in our center by a urologist, under local anesthesia, and were entirely done under ultrasound guidance.

Inclusion criteria: renal blockage in the urinary tract with or without infection, patient living close to the hospital.

The study included patients with benign and malignant pathophysiological mechanism of obstruction. Patients were held for 2 to 4 hours for observance and continuously monitored for tension, pulse, body temperature and control blood count. Furthermore, blood count, biochemical analysis and ultrasound follow up within 72 hours postoperatively were also performed. All patients received cefazolin or cefuroxime prophylaxis if there was no positive urine culture. Otherwise, adequate antibiotic was administered.

During the procedure, the posterior calyx of the lower calyx group of the pyelocaliceal system was most commonly used following the avascular line of Brodel for access to avoid vascular injuries. After the incision site is determined, a local anesthetic is administered in the form of 20 ml of 1% lidocaine. After the incision of the skin and fascia, under ultrasound vision, through the channel of the previously fixed guide on the convex probe, and according to modified Seldinger technique described by Pedersen [5].

Postoperative complications were evaluated according to the standardized modified Clavien Dindo classification system which has been employed for grading of complications [6]. Patients were stratified by comorbidity status using the Charlson comorbidity index within investigating feasibility and complications rate among given groups. Comparison between complications arising from benign and malignant etiology was made by using the Chi-square. A univariate analysis was performed in which the relationship between some independent variables and occurrence of complications was analyzed. Data were expressed as mean plus standard deviation and a p value < 0.05 was considered statistically significant. Patients were also categorized according to their BMI groups and investigated through univariate analysis for dependence.

## Results

Percutaneous nephrostomy (PCN) was performed in obstructive uropathy due to various benign or malignant conditions in a total of 158 patients. The age structure of the patients was between 25 and 84 years. In men, the mean age was 54.32 years, while in women patients the mean age was 52.13 years. In 97 (61.39%) patients, PCN was placed due to benign, and 61 (38.61%) PCNs were indicated due to obstruction caused in the field of malignant diseases. **Table 1**

The success rate was 97.47%, noting that after repeated unsuccessful procedures, that percentage was even higher. Placement failure was noted in 4 (2.53%) patients and was caused by intolerance to the pronation position, difficult anatomy or interposed abdominal organs. In 2 (1.27%) patients, PCN catheter blockage occurred within the first 24 hours, and they required re-placement after failed probing attempts. Over 40% of the indications for placement were calculosis. All the patients included in study were admitted in an outpatient manner.

Average duration of the procedure in the observed series was 27 minutes with an SD of 7.24. Patients were divided into 8 groups for investigating the learning curve timeline. Within groups there is statistical significance between mean operative time of procedure in “group I” compared to means of other given groups ( $p < 0.5$ ). This gives us the proof of relatively short learning curve of ultrasound guided percutaneous nephrostomy procedure.

### Figure 1

Charlson comorbidity index (CCI) score was calculated as “0” for 42 patients (26.6%, called group I), “1” for 55 patients (34.8%, called group II) and “ $\geq 2$ ” for 61 patients (38.6%, called group III). High CCI score was not significantly related to higher medical complication

rates after PCN in our study enabling feasibility of the procedure in widest possible pathological states.

In order to achieve data standardization, all complications were classified according to the five grades of modified C-D (Clavien-Dindo Classification system). Majority of complications were low grade C-D complications out of which 19 patients (12.03%) had fever, pain or transient hematuria (hematuria lasting <24 h) classified as C-D I. In 2 patients (1.27%), subcapsular hematoma (C-D IIa) was recorded, verified and monitored by ultrasound. Urine leaks and urinoma formation (C-D IIb) were not noted as complications in our series. PCN tube dislodgment/blockage/failure was recorded in 10 patients (6.33%) as C-D III. One patient (0.63%) developed sepsis (C-D IVb) after PCN placement, while 1 patient (0.63%) was referred to the ICU of a tertiary reference center after placement of a nephrostomy catheter (in a single kidney), where he was successfully treated, with previously diagnosed preprocedural septic shock. There were no complications with a fatal outcome or other major complications (C-D V). **Table 2**

Patients included in the study had mild 24 (15.19%), moderate 75 (47.47%) or severe 59 (37.34%) grade of hydronephrosis. In relation to the hydronephrosis grade, incidence of complications was also observed. Out of the total number of procedures, among mild, moderate and severe hydronephrosis groups there was clear statistical significance in complication rates. ( $p=.00017420$ ), ( $p<.05$ ) **Figure 2**

The difference in the complication rates between the benign and malignant disease groups of patients was not statistically significant. In the group of patients with benign obstruction, a total of 21 complications occurred in our series, while 11 complications occurred in the group with obstruction based on malignant pathology. The  $\chi^2$  test was used to compare the rates of complications that occurred in the observed groups, which showed that



there was no statistical significance of the occurrence of complications between the examined groups ( $\chi^2 = 0.3033$ ), ( $p < .05$ ).

As mentioned, Charlson comorbidity (CCI) score was used to compare “weight” of comorbidity score and incidence of complications and feasibility of procedure among weighted groups. Group calculated as “0” for 42 patients (26.6%, called group I), “1” for 55 patients (34.8%, called group II) and “ $\geq 2$ ” for 61 patients (38.6%, called group III). There was no statistical significance between groups when observing incidence of complication. Also, there was no significance in feasibility of percutaneous nephrostomy procedure within differed comorbidity groups.  $X^2 (2, N = 158) = 0.0546, p = .973082$ . **Figure 3**

Complications within BMI groups showed no statistical significance. BMI  $< 18.5$  kg/m<sup>2</sup> underweight group (N=10 6.3%) had 3 (1.9%), 18.5 - 24.9 kg/m<sup>2</sup> normal group (N=74, 46.8%) had 14 (8.86%), 25 - 29.9 kg/m<sup>2</sup> overweight group (N=51 32.3%) had 10 (6.30%) and  $> 30$  kg/m<sup>2</sup> obese group (N=23 14.6%) had 5 (3.16%) complications.  $X^2 (2, N = 158) = 0.4449, p = .930823$

Percutaneous nephrostomy catheter placement was performed under local anesthesia in 142 (89.87%) patients and analgesic sedation in 16 (10.13%) patients. We believe that it is important to note that in patients who had no problems or contraindications for the PCN procedure under local anesthesia, a better and more precise placement was achieved in our series. This was achieved thanks to better communication with the patient suggesting rhythm of respiration and reduction of respiration-caused changes in the position of the targeted calyx (respiratory amplitude of the kidney).

## DISCUSSION

In our study, in a period of 4 years, 158 procedures were performed by placing percutaneous nephrostomy (PCN) catheters under complete ultrasound guidance as an outpatient surgical procedure. The study is of prospective design. All relevant parameters were evaluated to obtain clear statistical factors on the frequency of complications after this procedure. In order to standardize our cohort we used Charlson comorbidity index, Clavien Dindo classification of complications, BMI observance and “shredded” timeline groups for learning curve observation.

Most of the papers previously published, have shown successful PCN placement without complications in more than 90 percent of cases. However, most of them haven't shown the results within outpatient procedure cohorts. Nephrostomy catheters placement under exclusive ultrasonic guidance success range from 83.1% to 92% [3,7].

Pedersen was the first to perform a percutaneous nephrostomy completely under ultrasound guidance with a placement success rate of 70%. Today, it is one of the most common interventions performed by urologists in the centers world wide performing this procedure [5]. The AUA guidelines suggests an upper limit of 4% of PCN complications. Guidelines in Europe are still under preparation. Even studies with CT enhanced PCN procedures are showing relatively similar complications incidence, although designed for more complex cases [8].

There were no patients in our study that required the need for transfusion resulting from bleeding after PCN. Also, there were no injuries of intra-abdominal organs (spleen, liver, colon, and pleura) which are described in the literature as major complications [9,10]. Modified Clavien Dindo classification of complications that Kumar used in their study showed similar results compared to our cohort [11]. As noted in the study results, 1 (0.63%)

patient developed a septic condition after PCN placement, which brings the rate of major complications to levels below 1% (0.63%) and correlates with data from the literature. The criteria for defining a specific condition during consideration were set on the basis of the Third International Consensus on the definition of sepsis and septic shock [12].

Comparatively, in the literature, with respect to this definition, the incidence of sepsis as a complication is up to 3.6% [13,14].

In terms of considering minor complications, it is challenging to classify and standardize some of them concerning primarily technical problems such as "slippage" of the catheter outside the pyelocalyceal (PC) system due to large respiratory amplitude and renal movement within its physiological limits [15]. There were 4 (2.53%) slips in our series, while 2 (1.27%) patients had a catheter blockage that required replacement within 24 hours of initial placement, which correlates with data from the literature [15,10,11]. Transient hematuria after the procedure is a common condition that is difficult to quantify. However, all patients who had hematuria in the urine after PCN placement were classified into minor complications 19 (12.03%) for the purpose of clearer statistical processing. It should be noted that these patients did not require therapeutic protocol adjustment except for the extension of hospitalization to a maximum of 48 hours. In all of the patients, haematuria was lost spontaneously or after mild nephrostomy catheter rinsing with saline (<24hrs).

Percutaneous nephrostomy primarily gives us time in treatment planning, multidisciplinary consideration of pathological conditions arising in the field of kidney and ureter blockage, diagnosis and preparation for their definitive surgical solutions. Also, in a certain number of patients, it represents the final urine derivation when there is no alternative surgery to be performed in terms of derivation or unblocking of the natural urine pathway.

## CONCLUSION

Ultrasound-guided percutaneous nephrostomy as an outpatient procedure is safe and effective procedure in terms of both therapeutic and diagnostic treatment. Studies have highlighted the importance of patient selection criteria to ensure the safety and effectiveness nephrostomy as one day surgery. Epidemiological aspect should be emphasized during the pandemic of COVID-19 as PCN isn't aerosol-generating procedure. It enables the functioning and preservation of renal function in the case when the definitive solution should be waited in a limited timeframe.

Performing percutaneous nephrostomy in an outpatient manner represents safe and feasible procedure.

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