RESEARCH ARTICLE

Frequency of complications in ultrasound-guided percutaneous nephrostomy: An analysis using the modified clavien classification system

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Abstract

Objective: To determine the frequency of complications following percutaneous nephrostomy using the Modified Clavien Classification System in patients with urinary tract obstruction in a tertiary care setting.

Method: The observational study was conducted at the Department of Urology, Sindh Institute of Urology and Transplantation, Karachi, from August 18, 2022, to February 17, 2023, and comprised individuals of either gender aged 16-70 years who were experiencing different types of urinary tract obstructions. The patients were subjected to percutaneous nephrostomy, and they were monitored for 15 days after the surgery. Complications post-procedure were noted using the Modified Clavien Classification System. Data was analysed using SPSS 26.

Results: Of the 90 patients with mean age 50.19±14.70 years, 53(58.9%) were males and 37(41.1%) were females. Grade I complications were observed in 37(41.1%) cases, grade II 8(8.9%), grade IIIa 11(12.2%), and grade IVa in 1 (1.1%) case. No complications were observed in 33(36.7%) cases. Complications were not significantly associated with age, gender, body mass index, site of insertion and comorbidities (p>0.05).

Conclusion: The most common complication observed in patients with urinary tract obstruction was grade I, followed by grade IIIA, while grade IVA had the least common incidence.

Keywords: Clavien classification, Complication, Percutaneous Nephrostomy, Urinary tract obstruction.

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Introduction

Obstruction of the upper urinary tract can result from a range of disorders, encompassing both urological and non-urological conditions. The prompt care of such an obstruction is often necessary to treat a urinary tract infection and safeguard renal function. Urolithiasis is the predominant cause of upper urinary tract blockage from a urological perspective. Urolithiasis is a highly prevalent urological illness, ranking among the top three in terms of significance and commonality.[1,2] Over 50% of individuals diagnosed with urolithiasis encounter a minimum of one instance of recurrence. These episodes deteriorate the patient's quality of life and are potentially life-threatening. If there is an infection and an obstruction present, it can progress into a septic episode.[3] Obstructive uropathy-induced sepsis is a critical condition in urology that necessitates immediate intervention through the insertion of a percutaneous nephrostomy tube (PCN) for decompression.[4] Clavien et al. proposed in 1992 a classification system for surgical complications, based on data from 650 patients who underwent cholecystectomy procedures. The grading system initially employed five distinct categories of complications to categorise them based on the invasiveness of the intervention and the clinical impact of the complication. After conducting additional validation on various surgical procedures, the classification was then revised to provide more detailed categorisation of grade III and IV complications, which were further divided into levels IIIa, IIIb, IVa and IVb.[5] Obstructive nephropathy refers to kidney dysfunction resulting from the blockage of urine flow, leading to increased pressure in the renal pelvic collecting system.[6] Structural abnormalities can lead to a narrowing of urine flow, impacting both the external opening of the urethra and the pelvicalyceal system (PCS). Urologists are skilled in performing the percutaneous nephrostomy (PCN), a commonly used procedure to provide temporary or permanent drainage of a blocked renal PCS.[7,8] PCN is associated with several complications, such as bleeding, sepsis, blockage of the tube, and accidental displacement of the tube.[9]

Dindo et al. in 2004 implemented alterations to these standards with the aim of enhancing their precision and practicality. In recent years, the Modified Clavien Classification System (mCCS) has been used to categorise problems, ensuring a consistent method of reporting complications in many surgical fields.[10]

In a study, mCSS was used to categorise problems resulting from ultrasound-guided PCN, and the occurrence rates of

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grades I, II, IIIa, IIIb, IVa, IVb and V in the patients were 17.1%, 10.1%, 9.2%, 1.1%, 0%, 2.2% and 0%, respectively[11] The corresponding values in another study were 4.5%, 15.2%, 6.4%, 3.1%, 1%, 0.2%, and 0.1%.[12]

Urologists worldwide have been utilising the mCCS to document perioperative complications of different surgical procedures, including laparoscopic donor nephrectomy and laparoscopic radical prostatectomy. The strength of mCCS is determined by the methods used to evaluate problems in relation to the therapy applied to solve them.[13]

The current study was planned to evaluate the frequency of problems associated with ultrasound-guided PCN, using the mCCS.

Patients and Methods

The observational study was conducted at the Department of Urology, Sindh Institute of Urology and Transplantation (SIUT), Karachi, from August 18, 2022, to February 17, 2023. After approval from the ethics review committee of the College of Physicians and Surgeons Pakistan (CPSP), the sample size was determined using the World Health Organisation (WHO) calculator,[11] taking into account the frequency of IIIb complications 9.2%,[11] margin of error 5%, and confidence interval (CI) 95%. The sample was raised using non-probability consecutive sampling technique from among those who were referred to the SIUT Department of Urology through either the emergency room (ER) or the Outpatient Department (OPD), and were recommended to undergo PCN. Those included were individuals of either gender aged 16-70 years who were experiencing different types of urinary tract obstruction, and exhibited thrombocytopenia, characterised by platelet count <80,000 and international normalised ratio (INR) >1.3. Those using anticoagulants were excluded. Data was collected after taking written informed consent from all the patients.

Age, gender, reason for PCN use, serum creatinine level, and any existing medical conditions were initially documented. Proficient professionals conducted measurements of subjects' height (in cm) without shoes, using a stadiometer positioned on a wall. Weight (kg) was measured without shoes, with individuals wearing light clothing, using a scale (SECA 755, Hamburg, Germany). The Body mass index (BMI) was determined as per the standard method.

The patients received a preventive antibiotic that targetted a wide range of bacteria. If the prothrombin time / activated partial thromboplastin time / INR (PT/APTT/INR) tests indicated an INR <1.3 and a platelet count >150,000 per decilitre, the patient underwent PCN. An ultrasound of the afflicted kidney was conducted while the patient was lying face down, following stringent aseptic protocols. The scan was intended to reveal dilatation of the renal calyces. Following the selection of the target calyx, a 2% xylocaine injection was administered into the skin and subcutaneous plane. Using an 11-blade, a 5mm incision was made in the skin. Under real-time ultrasound guidance, an 18G, 20cm puncture needle was inserted into the target calyx. The penetration into the PCS was confirmed by aspirating urine. A J-tipped guide wire was then inserted into the PCS through the puncture needle. The puncture needle was extracted, and the tract was gradually expanded using Teflon dilators until reaching a size of 12-14Fr. Subsequently, a pigtail catheter with a diameter of either 10Fr or 12Fr was inserted. The pigtail catheter was fastened to the skin using non-absorbable suture material. The entire procedure was conducted by primary researcher under the guidance of a specialist with over 5 years of experience. Any complications that occurred during the procedure, such as unintentional penetration into the renal arteries and perforation of the opposite pelvic wall, were documented. After the surgery, the patients were monitored for 15 days to evaluate the complications using the mCCS.[14]

Data was analysed using SPSS 26. Data was expressed as frequencies and percentages or mean±standard deviation, as appropriate. The incidence of complications was evaluated with potential confounders, such as age, gender, insertion side, BMI, diabetes mellitus (DM) and hypertension (HTN) using chi-square test. P<0.05 was considered statistically significant.

Results

Of the 90 individuals approached, none refused, and, as such, the response rate was 100%. Of the total, 53(58.9%) were males and 37(41.1%) were females. The overall mean age was 50.19±14.70 years, mean weight was 77.67±11.46kg, mean height was 1.68±0.08 meters, mean BMI was 27.55±4.49kg/m^2, and mean serum creatinine level was 2.85±1.54kg/m^2 (Table 1). Besides, 33(36.7%) patients had DM, 47(52.2%) had HTN, 42(46.7%) were given a right-side insertion, and 48(53.3%) were given a left-side insertion.

Grade I complications were observed in 37(41.1%) cases, grade II 8(8.9%), grade IIIa 11(12.2%), and grade IVa in

Table-1: Demographic and clinical variables.

Variable	Mean±SD
Age (years)	50.19±14.70
Weight (kg)	77.67±11.46
Height (m)	1.68±0.08
Body mass index (kg/m^2)	27.55±4.49
Serum creatinine (mg/dL)	2.85±1.54

1(1.1%) case. No complications were observed in 33(36.7%) cases (Table 2).

Complications were not significantly associated with age, gender, body mass index, site of insertion and comorbidities (p>0.05) (Table 3).

Table-2: Complications among the participants (n=90).

Complications	n (%)
Grade I	37 (41.1)
Grade II	8 (8.9)
Grade IIIA	11 (12.2)
Grade IVA	1 (1.1)
No Complications	33 (36.7)

Table-3: Stratification of complications by demographic and clinical variables.

Complications	Age Group [years]		*p*-value
	16 – 50	>50	
Grade I	16 (43.2)	21 (56.8)	0.662
Grade II	2 (25.0)	6 (75.0)	
Grade IIIA	6 (54.5)	5 (45.5)	
Grade IVA	0 (0.0)	1 (100.0)	
No Complications	14 (42.4)	19 (57.8)	
Complications	**Gender**		***p*-value**
	Male	**Female**	
Grade I	26 (70.3)	11 (29.7)	0.136
Grade II	4 (50.0)	4 (50.0)	
Grade IIIA	8 (72.7)	3 (27.3)	
Grade IVA	0 (0.0)	1 (100.0)	
No Complications	15 (45.5)	18 (54.5)	
Complications	**Side of Insertion**		***p*-value**
	Right	**Left**	
Grade I	18 (48.6)	19 (51.4)	0.085
Grade II	7 (87.5)	1 (12.5)	
Grade IIIA	3 (27.3)	8 (72.7)	
Grade IVA	0 (0.0)	1 (100.0)	
No Complications	14 (42.4)	19 (57.6)	
Complications	**BMI Group [kg/m^2]**		***p*-value**
	19 – 27	**>27**	
Grade I	16 (43.2)	21 (56.8)	0.345
Grade II	6 (75.0)	2 (25.0)	
Grade IIIA	5 (45.5)	6 (54.5)	
Grade IVA	0 (0.0)	1 (100.0)	
No Complications	19 (57.6)	14 (42.4)	
Complications	**Diabetes Mellitus**		***p*-value**
	Diabetic	**Non-Diabetic**	
Grade I	12 (32.4)	25 (67.6)	0.666
Grade II	3 (37.5)	5 (62.5)	
Grade IIIA	5 (45.5)	6 (54.5)	
Grade IVA	1 (100.0)	0 (0.0)	
No Complications	12 (36.4)	21 (63.6)	
Complications	**Hypertension**		***p*-value**
	Hypertensive	**Non-Hypertensive**	
Grade I	20 (54.1)	17 (45.9)	0.793
Grade II	5 (62.5)	3 (37.5)	
Grade IIIA	5 (45.5)	6 (54.5)	
Grade IVA	1 (100.0)	0 (0.0)	
No Complications	16 (48.5)	17 (51.5)	

Discussion

Ultrasound-guided percutaneous nephrostomy is a safe, minimally invasive, and effective method for upper urinary tract diversion, with a low morbidity rate.[15]

The Society of Interventional Radiology (SIR) standards have traditionally been employed for documenting PCN complications.[16] The mCCS has lately been utilised to assess the severity of complications across many surgical fields, enabling consistent and uniform reporting.[17] Utilising the mCCS to compare morbidity and death rates among healthcare providers might enhance the quality of service.[18] Degirmenci et al. conducted a retrospective study comparing the outcomes of mCCS-assisted ultrasound-guided PCN insertion to the generally used SIR practice recommendations.[19]

The mean age in the current study was 50.19±14.70 years. Others have reported 51.1±13.4 years11, and 42.7±14.5 years.[12] The current gender distribution was 41.1% females and 58.9% males. The corresponding data reported by Kumar S. et al. was 54.6% and 45.4%,[11] while Singh AK. et al. reported 43.64% and 56.36%.[12]

The distribution of complications in the current recent study was grade I 41.1%, grade II 8.9%, grade IIIA 12.2%, grade IVA 1.1%, and no complications 36.7%. In a study, mCSS was used to categorise problems resulting from ultrasound-guided PCN, and the occurrence rates of grades I, II, IIIa, IIIb, IVa, IVb and V in the patients were 17.1%, 10.1%, 9.2%, 1.1%, 0%, 2.2% and 0%, respectively.[11] The corresponding values in another study were 4.5%, 15.2%, 6.4%, 3.1%, 1%, 0.2%, and 0.1%.[12]

In the current study, there was no significant variation in complications observed in relation to age, gender, side of insertion, BMI, DM and HTN.

In a patient's clinical progression, the significance of a complication sometimes depends more on its severity rather than the mere presence or quantity of issues. Hence, to accurately convey the issues related to a certain surgery, it is necessary to implement a grading system that categorises complications based on their severity.

The current study has limitations as it was conducted with a limited sample size from a single hospital. As such, the results may not accurately represent the situation across the country. Further evaluation is required using a larger group of patients from different hospitals in order to validate the current findings.

Conclusion

Grade I mCCS was the most common complication, followed by grade IIIa, while grade IVa was the least

common complication among patients presenting with urinary tract obstructions.

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Author Contribution:
MDI: Concept and design.
MA: Data analysis.
AW: Concept, design and data analysis.
TURG, SR & HMS: Critical review.