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Original Article

Impact of Body Mass Index on renal outcomes following Percutaneous nephrolithotomy: A cross-sectional study.

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Abstract

Background
Observation, medication, or procedures that are invasive, such as percutaneous nephrolithotomy (PCNL), ureteroscopy, or even laparoscopic surgeries for instances that are severe, are among the management protocols for kidney stones. Body mass index (BMI) has a variable effect on PCNL outcome, despite obesity being linked to higher rates of perioperative complications and all-cause mortality.
Objectives- The study was conducted to evaluate the effect of BMI on renal outcomes following PCNL.

Materials and methods
It was a cross-sectional study. The study was carried out at the Department of Urology, Mahatma Gandhi Medical College and Research Institute, Puducherry, India. The study was conducted for one and a half years, that is, from October 2022 to April 2024. In all, 40 patients were enrolled.

Results
In comparison to the normal BMI group, which had a mean serum creatinine level of 1.13 ± 0.40 mg/dL, the increased BMI group had a slightly higher mean level of 1.22 ± 0.49 mg/dL. Thirty-five (97.2%) patients in the normal BMI group exhibited normal echogenicity, whereas three (75%) of the participants in the increased BMI group did the same.

Conclusion
Patients with elevated BMI had slightly higher serum creatinine levels, higher resistive index values, and a lower incidence of normal renal echogenicity, suggesting early morphological changes, even though overall renal function and vascular resistance stayed within normal limits in both groups.

Recommendation
Patients with elevated BMI undergoing percutaneous nephrolithotomy (PCNL) should be closely monitored for early renal morphological changes and subtle functional alterations to prevent long-term renal complications.

Keywords: *Nephrolithiasis, Percutaneous Nephrolithotomy (PCNL), Body mass index, Renal function, Percutaneous nephrolithotomy*
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Introduction

A common urological condition that significantly affects a patient's health and quality of life is renal stones. In Western

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communities, the disease's prevalence ranges from 0.1% to 14.8%, but in Asian populations, it can reach 10.6% [1, 2]. Abdominal pain, infections, hydronephrosis, and impaired renal function are just a few of the symptoms that kidney stones can cause, and they can cause serious patient morbidity [1].

Among frequent symptoms presented for stones in the kidney, one of them is colicky discomfort, which is known to be caused by kidney stones [3]. Observation, medication, or procedures that are invasive, such as percutaneous nephrolithotomy (PCNL), ureteroscopy, or even laparoscopic surgeries for instances that are severe, are among the management protocols for kidney stones [4].

Additionally, gain in weight and obesity increase the incidence of kidney stones [5]. However, if the stone is larger than 2 cm, PCNL is currently the standard treatment. Also, obesity was considered mainly a predictor for renal stone failure along with extracorporeal shock wave lithotripsy (ESWL) [6, 7].

Body mass index (BMI) has a variable effect on PCNL outcome, despite obesity being linked to higher rates of perioperative complications and all-cause mortality [8]. Unlike the current series with outcomes independent of BMI, the Clinical Research Office of the Endourological Society (CROES) recently released a database of a PCNL that was prospective, showing a longer operational duration and a poorer stone-free rate (SFR) in superobese patients [9]. Zhou et al. previously tried to compare the results of PCNL in patients with normal BMI and those with obesity in their systematic review. It was generally determined by the authors that outcomes of PCNL was not affected by the obesity, having operating times longer in patients that are obese, and stays in the hospital to be shorter, using the World Health Organization's (WHO) definitions of normal, overweight, obese, and morbidly obese [10].

It is uncertain, nevertheless, if PCNL was considered more effective and safer in obese people than it is in patients with normal BMI. The study was conducted to evaluate the effect of BMI on renal outcomes following PCNL.

Methodology

Study design

It was a cross-sectional study. The study was carried out at the Department of Urology, Mahatma Gandhi Medical College and Research Institute, Puducherry, India. The study was conducted for one and a half years, that is, from October 2022 to April 2024.

Study population

In all, 40 patients were enrolled. Participants have to be patients who had undergone PCNL for renal calculus at Mahatma Gandhi Medical College and Research Institute in Puducherry between 2022 and 2024. Individuals who had received PCNL for a single kidney, lost follow-up, or had undergone any operation in the contralateral kidney were excluded.

Sampling Technique- Participants were selected using consecutive sampling, where all eligible patients undergoing PCNL within the study period and meeting inclusion criteria were enrolled until the required sample size was achieved.

Sample size determination

The sample size of 40 was determined based on patient availability during the study period, considering the frequency of PCNL procedures at the institution and the feasibility of follow-up for complete data collection.

Bias- Selection bias was minimized through consecutive sampling of all eligible patients. Measurement bias was reduced by using standardized protocols for Doppler and ultrasonography, and by ensuring all investigations were performed by trained personnel. Data collection forms were structured to ensure uniformity.

Data collection

Every patient got a routine physical examination and had a thorough medical history taken. Routine investigations, vascular Doppler, and ultrasonography (USG) will be carried out. The patient's preferred language of written consent was used.

Statistical analysis

Microsoft Excel and SPSS version 24.0 were used to assemble and analyze the study's data. Continuous variables were shown as mean±standard deviation (SD), whereas categorical variables were shown as percentages or the number of participants (n).

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Ethical clearance

The ethical approval to conduct the study has been obtained by the Institutional Ethics Committee (IEC), Mahatma Gandhi Medical College and Research Institute, Puducherry, India, under letter number MGMCRI/Res/01/2023/4/IHEC/10, dated 16 February 2023.

Results

A total of 48 patients who underwent percutaneous nephrolithotomy (PCNL) during the study period were initially screened for eligibility. Among them, 5 patients were excluded due to having single kidneys or prior surgeries on the contralateral kidney, and another 3 patients were excluded due to loss to follow-up or incomplete data. Ultimately, 40 patients were confirmed eligible and included in the study for final analysis.

The left side has 22 stones (55%), whereas the right side has 18 stones (45%). Seven patients (17.5%) had positive urine cultures, while thirty-three patients (82.5%) had sterile urine cultures. Table 1 displays the baseline demographics of the study participants.

Table 1. Patients demographics

Parameters	Number of Participants	Percentages
Age (in years)		
< 30	06	15.0
31–45	16	40.0
46–60	13	32.5
> 60	05	12.5
Sex		
Male	29	72.5
Female	11	27.5
Laterality of Stone		
Left	22	55
Right	18	45
Urine Culture		
Sterile	33	82.5
Positive	07	17.5

In 36 (90%) of patients, BMI was observed to be normal, while in 04 (10%) of patients, BMI tended to be elevated. Table 2 depicts the distribution of BMI among participants.

Table 2. Distribution of BMI among Participants

BMI	Frequency	Percentages
Normal	36	90%
Elevated	04	10%

In comparison to the normal BMI group, which had a mean serum creatinine level of 1.13 ± 0.40 mg/dL, the increased BMI group had a slightly higher mean level of 1.22 ± 0.49 mg/dL. Thirty-five (97.2%) patients in the normal BMI group exhibited normal echogenicity, whereas three (75%) participants in the increased BMI group did the same. Table 3 indicates the effect of BMI on renal outcomes.

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Table 3. Effect of BMI on renal outcomes

Parameter	Normal BMI (n = 36)	Elevated BMI (n = 04)
Mean Serum Creatinine (mg/dL)	1.13 ± 0.40	1.22 ± 0.49
Mean RI of Operated Kidney	0.624 ± 0.041	0.635 ± 0.038
Mean RI of Contralateral Kidney	0.610 ± 0.039	0.618 ± 0.036
Renal Echogenicity (normal)	35 (97.2%)	3 (75.0%)

Discussion

The present study evaluated the impact of body mass index (BMI) on renal outcomes following percutaneous nephrolithotomy (PCNL). Findings revealed that patients with elevated BMI had slightly higher mean serum creatinine levels (1.22 ± 0.49 mg/dL) compared to those with normal BMI (1.13 ± 0.40 mg/dL), although both groups remained within normal renal function limits. Additionally, the resistive index (RI) values were marginally higher in the elevated BMI group, suggesting subtle increases in renal vascular resistance. A lower proportion of patients with elevated BMI (75%) exhibited normal renal echogenicity compared to those with normal BMI (97.2%), indicating early morphological changes in the renal parenchyma.

These results suggest that elevated BMI may be associated with early structural and vascular alterations in the kidneys post-PCNL, even in the absence of overt renal dysfunction. Similar findings were reported by Zhang et al. [11], where changes in renal morphology and vascular resistance were observed through color Doppler ultrasonography, despite preserved renal function. The increase in resistive indices observed in both studies points towards possible long-term risks such as renal scarring and microvascular changes.

Technical challenges during PCNL were also more pronounced in obese patients. Excess adipose tissue complicates ultrasonographic visualization of anatomical landmarks and stone localization, potentially prolonging operative time and increasing procedural difficulty. The findings align with those reported by Fuller et al. [12], who noted longer operative durations and a higher prevalence of staghorn stones in patients with morbid obesity. These factors contribute to greater surgical complexity and may affect outcomes.

Obesity is frequently associated with comorbid conditions such as diabetes mellitus and hypertension, both of which are established risk factors for nephrolithiasis and can influence renal outcomes [12, 13]. Baseline differences in metabolic profiles between patients with normal and elevated BMI should therefore be considered when interpreting outcomes.

In conclusion, elevated BMI appears to be linked with subtle renal morphological and vascular changes following PCNL, despite preserved renal function. These findings highlight the importance of monitoring renal parameters in obese patients after PCNL and indicate a need for further comparative research to assess long-term renal effects in this population.

Generalizability

The findings may apply to similar tertiary care settings but require caution when extrapolating to broader populations.

Conclusion

PCNL was considered to be a safe and efficient method for renal calculi in patients with normal or increased BMI, according to this study. Patients with elevated BMI had slightly higher serum creatinine levels, higher resistive index values, and a lower incidence of normal renal echogenicity, suggesting early morphological changes, even though overall renal function and vascular resistance stayed within normal limits in both groups.

Limitations

The study included many restrictions, like firstly, due to limited sample size, the results cannot be applicable to a broad population. Second, long-term changes in renal function could not be well captured by short-term postoperative biomarker tests. Long-term renal function follow-up and imaging-based functional outcomes were also not evaluated in this study.

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Recommendations

To further validate these findings, larger, multicenter trials with longer follow-up and a wider range of BMI classifications are advised.

List of abbreviations

IEC- Institutional Ethics Committee
ESWL- Extracorporeal shock wave lithotripsy
PCNL- Percutaneous nephrolithotomy
CROES- Clinical Research Office of the Endourological Society
SFR- Stone-free rate
WHO- World Health Organization
BMI- Body mass index
SD- Standard Deviation
USG- Ultrasonography

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Source of funding

No external funding was received for this study.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

All authors contributed to the study design, data collection, analysis, and manuscript preparation.

Author biography

All authors are affiliated with the Department of Urology, Mahatma Gandhi Medical College and Research Institute, with expertise in urology and kidney stone management.

Data availability

Data supporting the study findings are available from the corresponding author upon reasonable request and subject to institutional policies.

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