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***Original research article***

# SPECTRUM OF BACTERIAL CULTURE AND ANTIBIOGRAM IN PCNL PUNCTURE URINE SAMPLE

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**Abstract:** *Percutaneous nephrolithotripsy (PCNL) is the standard treatment for high-volume renal stones, stones resistant to extracorporeal shockwave lithotripsy (ESWL), and multiple and inferior calyx renal stones.* ***Objective:*** *The study's main objective is to find bacterial culture and antibiogram spectrum in PCNL puncture urine samples.* ***Methods:*** *This retrospective observational study was conducted at CMH, Lahore, from April 2024 to July 2024. Data were collected from 185 patients. Urine samples were collected directly from the renal pelvis through the PCNL puncture site during the surgical procedure. This method ensures that the samples accurately represent the microbial environment of the kidney.* ***Results:*** *Data were collected from 185 patients according to the study's criteria. The gender distribution comprised 110 males (59.5%) and 75 females (40.5%). The age of the patients ranged from 25 to 70 years, with a mean age of 48.23±3.54 years. Among the positive cultures, Escherichia coli was the most prevalent species, found in 46.2% of cases, followed by Klebsiella pneumoniae (23.1%), Pseudomonas aeruginosa (15.4%), Enterococcus faecalis (7.7%), and Proteus mirabilis (3.8%). Additionally, 3.8% of the samples included other bacteria, including mixed infections.* ***Conclusion:*** *It is concluded that the bacterial spectrum in PCNL urine samples is diverse, with significant antibiotic resistance patterns observed among isolated pathogens.*

**Keywords:** Antibiotic Resistance, Bacterial Culture, Nephrolithotripsy, Percutaneous, Renal Calculi, Urine Microbiology.

## Introduction

Percutaneous nephrolithotripsy (PCNL) is considered the standard treatment for high-volume renal stones, stones resistant to extracorporeal shockwave lithotripsy (ESWL), and multiple and inferior calyx renal stones. Under open surgery and usually using a flank incision, the kidney stones are located using a nephroscope and disintegrated mainly by the use of the ultrasonic or pneumatic lithotripter (1). Compared to PCNL, APR is an ideal, less invasive and more economical procedure. It is quicker in terms of total operating time compared to open surgery, postoperative pain and morbidity, and a shorter hospital stay than patients undergoing open surgery (2). The approach of PCNL is still popular in the surgical management of stones with sizes greater than 2 cm. However, some possible postoperative complications may occur after performing percutaneous nephrolithotomy; these are postoperative urosepsis and septic shock, which can be life-threatening to the patients (3). The past research findings indicated that UC+ and SC+ were significant risk factors that depicted an independent risk factor of urosepsis among patients receiving PCNL (4). E. coli, Klebsiella pneumoniae, Proteus mirabilis, and Pseudomonas aeruginosa apparently continue to be the most frequent urine bacteria as seen in urolithiasis patients. Lorenzis E et al. also noted that E. fecalis and E. coli were the most frequently isolated bacteria from stones, while in the other study, S. aureus was the most prevalent bacteria in stones (5). From those results, they conclude that in patients with kidney stones, the culture of mid-stream urine is not sufficiently reliable for assessment of bacteriology inside the stones (6). When both UC and SC are positive, it might mean that the bacterial spectra of the two can be different. At the same time, for the moment, only several investigations have analysed in detail the differences in bacterial consortia of urine and stones, yet the relationship between the bacterial results and SIRS after PCNL needs further investigation (7).

However, it is effective in cases of prostate cancer and prostate enlargement, though it is associated with some complications such as UTIs and bacterial contamination. Knowledge of the distribution of bacterial cultures and antibiograms among the PCNL puncture urine samples becomes a handy tool in patients' management and infection control following the procedure (8). In the case of bacterial infection, culture and antibiotic sensitivity testing, commonly referred to as antibiogram, is a central test to indicate different causative bacteria and their susceptibility profile to antibiotics (9). This knowledge is crucial for orienting treatment for bacterial infection based on patient-specific indicators, minimising adverse outcomes due to the illness, and adequately promoting the best possible recovery results in patients (1). On the other hand, antibiograms give specific information about the susceptibility of the isolated bacteria to the antibiotics. This is especially so given the current global scenario, which sees antimicrobial resistance rising, meaning that conventional therapies are more or less rendered ineffective (10). An antibiogram lets practitioners identify which antibiotics will effectively treat the bacterial strains cultured from the patient's sample. It enhances the likelihood of successful management of the infections rather than a generalised approach. At the same time, it is helpful in adequately using antibiotics, hence delaying the emergence of resistance (11). Thus, the study aimed to find

bacterial culture and antibiogram spectrum in PCNL puncture urine samples.

**Methodology**

This retrospective observational study was conducted at CMH, Lahore, from April 2024 to July 2024. Data were collected from 185 patients.

*Inclusion criteria:*

- Patients diagnosed with large renal stones requiring PCNL.
- Patients who provided informed consent for participation in the study.
- Patients with no history of antibiotic use in the two weeks preceding the surgery.

*Exclusion criteria:*

- Patients with recent antibiotic therapy, known immunosuppressive conditions and incomplete medical records.

Urine samples were collected directly from the renal pelvis through the PCNL puncture site during the surgical procedure. This method ensures that the samples accurately represent the microbial environment of the kidney. The samples were collected aseptically, put in sterile tubes, and transported to the microbiology laboratory for analysis. While performing the PCNL procedures, urine samples were taken aseptically from the renal pelvis through the puncture site. These samples were put in sterile vials immediately and taken to the microbiology laboratory for testing. Sepsis culture reports were recorded, where records of isolated bacteria were taken and frequency mentioned. The organism was identified, and then the antibiogram was established through the biological assessment of the antimicrobial resistance of the isolated bacteria. The zones of inhibition were determined and described based on the CLSI criteria. All the collected data were also documented and analysed, including the occurrence of the various bacterial species and their antibiotic resistance.

Statistical Analysis

Data were analysed using SPSS v 23. Descriptive statistics were used to summarise the demographic and clinical characteristics of the patients.

**Results**

Data were collected from 185 patients according to the criteria of the study. The gender distribution comprised 110 males (59.5%) and 75 females (40.5%). The age of the patients ranged from 25 to 70 years, with a mean age of 48.23±3.54 years.

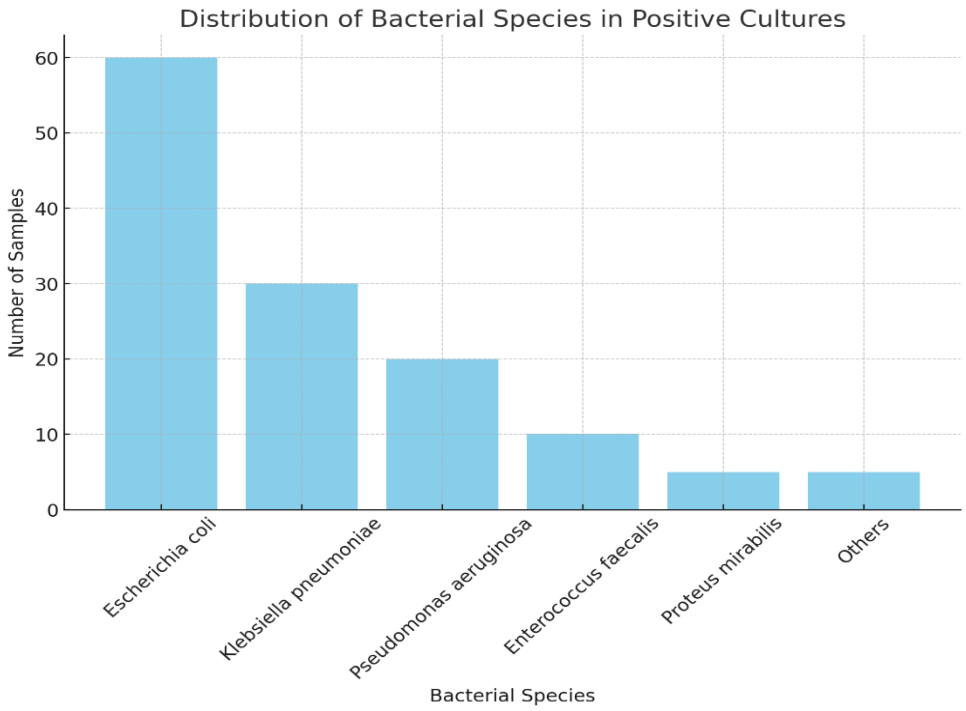
**Table 1: Patient Demographics**

| Parameter | Value |
|---|---|
| Total Patients | 185 |
| Gender Distribution | 110 males (59.5%)<br>75 females (40.5%) |
| Age Range | 25-70 years |
| Mean Age | 48.23±3.54 years |

The study analysed 185 urine samples collected during PCNL procedures, with 70.3% showing positive bacterial cultures and 29.7% negative. Among the positive cultures, Escherichia coli was the most prevalent species, found in 46.2% of cases, followed by Klebsiella pneumoniae (23.1%), Pseudomonas aeruginosa (15.4%), Enterococcus faecalis (7.7%), and Proteus mirabilis (3.8%). Additionally, 3.8% of the samples included other bacteria, including mixed infections.

**Table 2: Bacterial Culture Results**

| Category | Result | Number of Samples | Percentage |
|---|---|---|---|
| Culture Result | Positive Cultures | 130 | 70.3% |
| | Negative Cultures | 55 | 29.7% |
| Bacterial Species | Escherichia coli | 60 | 46.2% |
| | Klebsiella pneumoniae | 30 | 23.1% |
| | Pseudomonas aeruginosa | 20 | 15.4% |
| | Enterococcus faecalis | 10 | 7.7% |
| | Proteus mirabilis | 5 | 3.8% |
| | Others (including mixed infections) | 5 | 3.8% |




The antibiogram results indicate significant variability in antibiotic susceptibility among different bacterial species. Escherichia coli showed high susceptibility to amikacin (90%) and ceftriaxone (80%) but considerable resistance to ciprofloxacin (30%) and trimethoprim-sulfamethoxazole (40%). Klebsiella pneumoniae demonstrated similar patterns, with the highest susceptibility to amikacin (85%) and notable resistance to trimethoprim-sulfamethoxazole (50%). Pseudomonas aeruginosa was most susceptible to piperacillin-tazobactam (80%) and amikacin (85%), whereas Enterococcus faecalis showed complete susceptibility to linezolid (100%) and high susceptibility to vancomycin (90%). Proteus mirabilis was highly susceptible to amikacin (90%) and ciprofloxacin (80%).

**Table 3: Antibiogram Results for Bacterial species**

| Bacterial Species | Antibiotic | Susceptible | Resistant |
|---|---|---|---|
| Escherichia coli | Ciprofloxacin | 70% | 30% |
| | Trimethoprim-Sulfamethoxazole | 60% | 40% |
| | Amikacin | 90% | 10% |
| | Ceftriaxone | 80% | 20% |
| Klebsiella pneumoniae | Ciprofloxacin | 60% | 40% |
| | Trimethoprim-Sulfamethoxazole | 50% | 50% |
| | Amikacin | 85% | 15% |
| | Ceftriaxone | 75% | 25% |
| Pseudomonas aeruginosa | Ciprofloxacin | 55% | 45% |
| | Piperacillin-Tazobactam | 80% | 20% |
| | Amikacin | 85% | 15% |
| | Ceftazidime | 70% | 30% |
| Enterococcus faecalis | Vancomycin | 90% | 10% |
| | Linezolid | 100% | 0% |
| | Ampicillin | 85% | 15% |
| Proteus mirabilis | Ciprofloxacin | 80% | 20% |
| | Trimethoprim-Sulfamethoxazole | 70% | 30% |
| | Amikacin | 90% | 10% |
| | Ceftriaxone | 85% | 15% |

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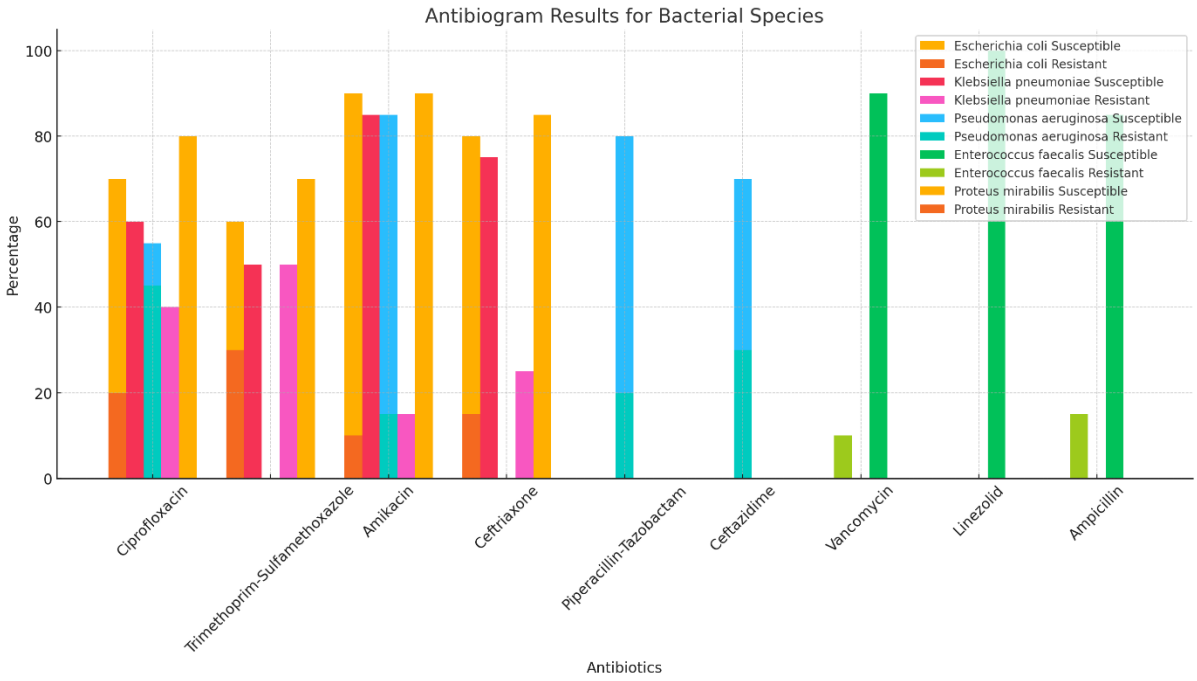


## Discussion

The analysis of bacterial cultures and antibiograms from urine samples collected during percutaneous nephrolithotomy (PCNL) procedures provides critical insights into the microbiological landscape of the renal pelvis. It informs the appropriate management of postoperative infections. In the Swedish study conducted to assess the effectiveness of the treatment on patients, the authors posed a 70. Three Presumptive Cultures per cent of the urine samples have positive bacterial growth confirming a high prevalence of bacterial colonisation or infection in patients with PCNL (12). These bacteria show that there is a wide variety of bacteria in the renal pelvis, and it points to the fact that there is a need to use specific antimicrobial approaches (13). The antibiogram results show present rather high percentage of antibiotic resistance of the isolated bacteria. For example, according to the results, 30% of the obtained E. coli isolates were resistant to ciprofloxacin, and 40% of the isolates – to trimethoprim-sulfamethoxazole (14). These resistance rates are notable as antibiotics are often employed as first-line drugs for UTIs. A very high percentage, 90% of E. coli organisms, was demonstrated to be sensitive to the antibiotic amikacin and 80% to ceftriaxone, so such antibiotics are still effective in eradicating infections caused by this pathogen. Klebsiella pneumoniae also did not show much difference in the resistance percentages where 40% was resistant to ciprofloxacin and 50% to trimethoprim-sulfamethoxazole (15). The moderate resistance to amikacin within 85% and co-trimoxazole within 75% offers another line of treatments. Some specific types of bacteria showed significant resistance to some antibiotics; for example, Pseudomonas aeruginosa is an MDR bacteria; it has a 45% resistance rate for ciprofloxacin and 30% for ceftazidime, which confirms the importance of research on the changes in the resistance indicators (16). Out of the isolated strain, 80% were sensitive to piperacillin-tazobactam and 85% to amikacin, meaning these may be the best drugs for treating P. aeruginosa infections. Resistant patterns of E. faecalis and Proteus mirabilis were also different; E. faecalis were sensitive to all the tested antimicrobial agents, especially linezolid at 100% and vancomycin at 90%, while Proteus mirabilis was sensitive to the commonly used antibiotics such as ciprofloxacin at 80% and amikacin at 90% (17). Therefore, the results of this study suggest that regular culture and sensitivity should be carried out to prevent infections related to PCNL procedures. Although the implementation of empirical antibiotic therapy is crucial in many cases, decisions should be made based on information regarding the antibiogram to increase therapy effectiveness and minimise resistance formation.

## Conclusion

It is concluded that the bacterial spectrum in PCNL urine samples is diverse, with significant antibiotic resistance patterns observed among isolated pathogens. Regular surveillance and tailored antibiotic strategies are essential to improve patient outcomes and combat antibiotic resistance. Integrating microbiological data into clinical decision-making can enhance the management of postoperative infections in PCNL patients.

## Declarations

**Data Availability statement**
All data generated or analyzed during the study are included in the manuscript.
**Ethics approval and consent to participate.**
It is approved by the department concerned. (IRBEC-THQ-23/23)
**Consent for publication**
Approved

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Not applicable

**Conflict of interest**

The authors declared an absence of conflict of interest.

**Authors Contribution**

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*Concept & Design of Study*

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