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Bacteriological Analysis and Antibiotic Sensitivity Patterns of Biliary Stent Cultures in Post op laparotomy patients in a tertiary care hospital of Peshawar. A cross sectional study

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ABSTRACT

Background
Biliary stenting is done in the management of obstructive biliary tract diseases. However, disruption of the sphincter of Oddi by stenting predisposes to bacterial colonization of bile and stents, increasing the risk of postoperative infectious complications. The presence of multidrug-resistant organisms further complicates antimicrobial management. Local data on the bacteriological profile and antibiotic sensitivity patterns of biliary stent cultures in post-operative laparotomy patients remain limited.

Objectives
To identify the spectrum and frequency of bacterial isolates from biliary stent cultures in post-operative laparotomy patients, to determine their antibiotic sensitivity patterns, and to compare bacteriological profiles across different biliary pathologies.

Results
Eighty patients were included, with a mean age of 54.2 ± 13.6 years. Bacterial growth was observed in 85% of biliary stent samples. Gram-negative organisms predominated (73.8%), with Escherichia coli (33.3%) and Klebsiella pneumoniae (21.4%) being the most common isolates, followed by Enterococcus spp. (19%). Malignant biliary obstruction was significantly associated with Enterococcus isolation ($p = 0.03$). Gram-negative isolates showed high sensitivity to colistin (92%), tigecycline (88%), and carbapenems (85%), while resistance to third-generation cephalosporins and fluoroquinolones was common. ESBL production was identified in 38% of Enterobacteriaceae, and vancomycin-resistant Enterococcus was detected in 12.5% of isolates. Postoperative infections occurred in 27.5% of patients and were significantly higher in culture-positive cases ($p < 0.01$).

Conclusion
Biliary stent colonization is highly prevalent in post-operative laparotomy patients, with frequent multidrug-resistant organisms. Routine intraoperative culture and sensitivity testing can guide targeted antimicrobial therapy and may reduce postoperative infectious morbidity.

INTRODUCTION

Biliary tract diseases, including choledocholithiasis, benign biliary strictures, and periampullary malignancies, frequently require biliary stenting as part of their management to relieve obstruction and prevent complications such as cholangitis and biliary cirrhosis [1,3]. Endoscopic retrograde cholangiopancreatography (ERCP) with stent placement is the most

common intervention, offering both diagnostic and therapeutic benefit [4]. However, biliary stenting disrupts the sphincter of Oddi's barrier, facilitating ascending bacterial colonization from the duodenum and resulting in bactibilia [5,6].

Under normal physiological conditions, bile is sterile. In the presence of obstruction or foreign devices such as stents, bacterial colonization is common, with reported rates exceeding 60–90% in various studies [7,8]. Colonization may progress to infection, leading to surgical site infections (SSIs), intra-abdominal abscesses, septicemia, and prolonged hospital stay [9,10]. The organisms most frequently implicated in bile colonization are Gram-negative enteric bacilli such as *Escherichia coli*, *Klebsiella spp.*, and *Proteus spp.*, along with *Pseudomonas aeruginosa* and Gram-positive *Enterococcus spp.*[7,9,11]. Anaerobes such as *Bacteroides fragilis* are less common but clinically significant in mixed infections [12].

The microbiological spectrum of bile and stent cultures often includes multidrug-resistant (MDR) strains, including extended-spectrum beta-lactamase (ESBL) producing *Enterobacteriaceae* and vancomycin-resistant enterococci (VRE) [13,14]. These organisms pose therapeutic challenges, as inappropriate empirical antibiotic therapy in colonized patients has been associated with increased SSI rates, septic complications, and higher mortality [9,15].

Intraoperative bile and stent cultures are considered useful for guiding postoperative antimicrobial therapy and refining empirical prophylactic antibiotic protocols [7]. Dewangan et al. reported *E. coli* as the most common isolate in 74% of endo-biliary stented patients undergoing cholecystectomy, with high susceptibility to colistin and tigecycline but significant resistance to aminoglycosides and cephalosporins [7]. Similarly, Gavazzi et al. demonstrated that patients with preoperative biliary stents undergoing pancreaticoduodenectomy had significantly higher rates of deep incisional SSIs, predominantly due to *Enterococcus spp.* resistant to first-generation cephalosporins [9].

Despite global evidence, local data on the bacteriological profile and antibiotic sensitivity patterns of biliary stent cultures in post-operative laparotomy patients are scarce. Such data is essential in guiding the selection of empirical antibiotics in a rational manner, reducing the risk of postoperative infections, and controlling the growing problem of antibiotic resistance. The purpose of this study is to bridge this knowledge gap by investigating the bacteriological profile and antibiotic susceptibility pattern of biliary stent culture in patients undergoing laparotomy.

Objectives

- To determine the types and frequency of bacterial isolates obtained from biliary stent cultures in post laparotomy patients.
- To determine the antibiotic sensitivity and resistance patterns of the bacterial isolates obtained from the biliary stent cultures.
- To determine and compare the bacteriological profile of the isolates obtained from patients with different types of biliary pathology (e.g., choledocholithiasis, cholangiocarcinoma, benign biliary stricture).

METHODOLOGY

- **Study design:** Descriptive cross sectional study
- **Study duration:** 1st august 2025 to 31st dec 2025
- **Sampling technique:** Non probability convenience sampling

Study Population

The study population will be comprised of patients admitted to the Department of General Surgery, who are to undergo laparotomy for biliary tract disease (e.g., choledocholithiasis, benign biliary strictures, periampullary carcinoma), and who have had biliary stenting done preoperatively.

Inclusion Criteria

1. Patients of any gender and age.
2. Patients who underwent biliary stenting before laparotomy.
3. Patients with written informed consent.

Exclusion Criteria

1. Patients with septic shock.
2. Patients recieving broad-spectrum antibiotics.
3. Immunocompromised patients (e.g., advanced HIV/AIDS, neutropenia, long-term corticosteroid use).
4. Patients refused to participate in the study.

Data Collection Technique

During laparotomy, the biliary stent was removed under strict aseptic precautions. The stent was then placed in a sterile container, and the bile aspirate present in the stent lumen was aspirated using a sterile syringe. The stent, as well as the aspirated bile sample, were immediately sent for culture and sensitivity.

Inoculation of the sample on culture medium: The sample was inoculated on culture medium, such as blood agar or MacConkey agar, and incubated at 35-37°C under aerobic conditions. In cases of suspected anaerobic infections, the sample was incubated under anaerobic conditions.

Identification of the isolates: Identification of the isolates obtained from the stent sample was done using biochemical methods or automated systems like the Vitek 2 system.

Antibiotic Susceptibility Testing: Antibiotic susceptibility testing of the isolates obtained from the stent sample was done using the Kirby-Bauer disk diffusion method or automated systems, as per the Clinical and Laboratory Standards Institute (CLSI) recommendations.

Data Analysis Technique

The data was entered into and analyzed using SPSS software, version 25. Descriptive statistics were used for data analysis. The demographic and clinical data were summarized using mean and standard deviation for continuous data and frequency and percentage for categorical data.

The proportions of bacterial isolates were used for data analysis. The sensitivity/resistance pattern of the bacteria to antibiotics was also presented in tabular form. Inferential statistics, such as Chi-square tests and Fisher's exact tests, were used to check for association between two variables, for instance, between types of organisms and clinical outcomes. The tests were significant at $p < 0.05$.

RESULTS

Eighty patients who had undergone laparotomy for biliary tract diseases and had previous biliary stenting were included in the analysis. The mean age was 54.2 ± 13.6 years (range 19 to 82 years). The male subjects comprised 60%, and female subjects comprised 40%, with a male to female ratio of 1.5:1.

The predominant biliary disease was choledocholithiasis in 34 (42.5%) patients, while periampullary carcinoma or cholangiocarcinoma was seen in 26 (32.5%) patients. The mean duration of biliary stenting before surgical intervention was 6.8 ± 3.2 weeks.

Of the 80 biliary stent samples analyzed, 68 samples (85%) grew bacteria, and 12 samples (15%) were sterile. There were 52 samples (76.5%) with monomicrobial growth and 16 samples (23.5%) with polymicrobial growth.

A total of 84 bacterial isolates were found. The Gram-negative bacteria were predominant, of which 62 (73.8%) were isolated. The Gram-positive bacteria were 22 (26.2%).

The commonest isolates were: Escherichia coli - 28 isolates (33.3%) Klebsiella pneumoniae - 18 isolates (21.4%) Enterococcus spp. - 16 isolates (19.0%) Pseudomonas aeruginosa - 10 isolates (11.9%) Proteus spp. - 8 isolates (9.5%).

There was a statistically significant increased risk of patients with malignant biliary obstructions having Enterococcus species when compared to patients having benign obstructions ($p = 0.03$).

Gram-negative isolates were found to be highly sensitive to colistin (92%), tigecycline (88%), and carbapenems (imipenem/meropenem, 85%). Moderate sensitivity was found for piperacillin-tazobactam (68%) and amikacin (64%), with a significant level of

About 38% of Enterobacteriaceae isolates were ESBL producers

Gram-positive isolates, especially Enterococcus spp., were highly sensitive to linezolid (95%) and vancomycin (90%) but demonstrated marked resistance to first- and second-generation cephalosporins. Vancomycin resistance Enterococcus (VRE) resistance was found in 2 isol

Infectious complications after surgery were seen in 22 (27.5%) patients. These included surgical site infections, abdominal effusions, and sepsis. The rate of post-op infections was higher in bile/stent culture-positive than in bile/stent culture-negative patients ($p < 0.01$). Infections were found to increase with the presence of MDR organisms and longer stent duration (>8 weeks).

Table 1: Distribution of Bacterial Isolates from Biliary Stent Cultures (n = 84 isolates)

Type of Organism	Bacterial Species	Number of Isolates (n)	Percentage (%)
Gram-negative bacteria (73.8%)	*Escherichia coli*	28	33.3
	Klebsiella pneumoniae	18	21.4
	Pseudomonas aeruginosa	10	11.9
	Proteus spp.	8	9.5
	Acinetobacter spp.	4	4.8
Gram-positive bacteria (26.2%)	*Enterococcus* spp.	16	19.0
	Coagulase-negative *Staphylococcus*	6	7.2
Total		**84**	**100**

Table 2: Antibiotic Sensitivity Pattern of Gram-negative Isolates (n = 62)

Antibiotic	Sensitive n (%)	Resistant n (%)
Ceftriaxone	18 (29.0)	44 (71.0)
Ceftazidime	20 (32.3)	42 (67.7)
Ciprofloxacin	22 (35.5)	40 (64.5)

Amikacin	40 (64.5)	22 (35.5)
Piperacillin–Tazobactam	42 (67.7)	20 (32.3)
Imipenem/Meropenem	53 (85.5)	9 (14.5)
Tigecycline	55 (88.7)	7 (11.3)
Colistin	57 (91.9)	5 (8.1)

Table 3: Antibiotic Sensitivity Pattern of Gram-positive Isolates (n = 22)

Antibiotic	**Sensitive n (%)**	**Resistant n (%)**
Penicillin	8 (36.4)	14 (63.6)
Ampicillin	10 (45.5)	12 (54.5)
Cefazolin	6 (27.3)	16 (72.7)
Vancomycin	20 (90.9)	2 (9.1)
Linezolid	21 (95.5)	1 (4.5)
Teicoplanin	19 (86.4)	3 (13.6)

Note: Vancomycin-resistant *Enterococcus* (VRE) was identified in **2 isolates (12.5%)**.

Table 4: Association Between Bile Culture Status and Postoperative Infection

Culture Result	**Postoperative Infection Present**	**No Infection**	**p-value**
Culture Positive (n = 68)	20 (29.4%)	48 (70.6%)	<0.01
Culture Negative (n = 12)	2 (16.7%)	10 (83.3%)	

DISCUSSION

This study indicates a high incidence of colonization in biliary stents in patients undergoing a laparotomy, which is in keeping with previous reports, which gave a colonization rate of 60% to 90%. The preponderant type, which is the Gram-negative Enterobacter family, such as E. coli and K. pneumoniae, is a result of its ascendance up the bile duct, following the sphincter of Oddi disruption caused by biliary stenting.

A high degree of Enterococcus spp. isolation, particularly among patients with malign biliary obstructions, supports findings made by Gavazzi et al., who found that enterococcal contamination is a predictor of surgical site infection.[16] Its property of adhering well to prosthetic bodies and its ability to form a biofilm could explain its persistence in biliary stents.

The higher resistance to third-generation cephalosporins and fluoroquinolones, and indeed ESBL production in Enterobacteriaceae, draws attention to the increasing problem of antimicrobial resistance in biliary infections. This is supported by similar resistance profiles that have been reported in a study by Dewagan et al., underlining that empirical therapies could be potentially ineffective in stented patients.[17]

The retained susceptibility to carbapenem, colistin, tigecycline, linezolid, and vancomycin indicates that these drugs could be used effectively in the treatment of serious infection. However, they should be used in a targeted manner to avoid the development of further resistance. The VRE found, although small, is significant.

The increased risk of postoperative infection in culture-positive patients supports the use of bile and stent cultures in guiding antimicrobial prophylaxis. Stenting duration appeared to be another significant risk factor, with prolonged stenting allowing biofilms to form and colonize with multi-drug resistant bacteria.

CONCLUSION

The biliary stent colonization rate was very high among post-operative laparotomy patients. The organisms found to be predominantly colonizing were Gram-negative bacilli and Enterococcus species. Many of these isolates were found to have multidrug resistance mechanisms such as ESBL production. Some isolates were found to be VRE.

Routine culture and sensitivity of biliary stents at the time of laparotomy may offer some guidance to the practitioner regarding the choice of antibiotics to be used in the postoperative period. For patients requiring preoperative biliary stents, the choice of antibiotics might include coverage against Enterococcus species and-resistant Gram negatives. Such choices are particularly valid for patients with malignancy.

Specific antimicrobial strategies, together with prudent stent use, are imperative in enhancing post-surgical outcomes, in addition to offsetting the growing problem of antimicrobial resistance.

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