

A CROSS SECTIONAL STUDY OF BILE BACTERIOLOGY AND THEIR SENSITIVITY PATTERN IN CALCULOUS DISEASES OF THE GALL BLADDER

General Surgery

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ABSTRACT

Background: Calculous diseases of the gallbladder, characterized by the production of gallstones, can progress into cholecystitis, often exacerbated by bacterial infections. Understanding the microbial landscape and antibiotic resistance patterns in bile samples from patients undergoing cholecystectomy is crucial for effective management of complications which occur due to spilled gall stones or bile leak during Cholecystectomy and also effectively treat post operative complications. **Objectives:** 1. To determine the frequency of potentially infective gram positive, gram negative and anaerobic bacteria in the bile cultures. 2. To determine the antimicrobial susceptibility pattern of the frequently isolated Bacteria. **Materials & Methods:** A total of 123 subjects who were admitted in the Department of General Surgery were enrolled in the study and Intraoperative bile specimens were collected from patients undergoing cholecystectomy due to Calculous diseases of Gall bladder. Microbiological culture and sensitivity testing were performed to identify pathogens and determine antibiotic susceptibility. **Results:** *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa* were the most prevalent pathogens identified. Our study revealed a low prevalence of bacterial colonization in bile samples. Antimicrobial susceptibility testing showed significant resistance, particularly to Penicillin group. However, Carbapenems and Aminoglycosides demonstrated higher rates of effectiveness against the identified organisms. **Conclusion:** This study emphasizes on the importance of judicious antibiotic use and individualized treatment plans based on local resistance patterns. This approach is essential for optimal therapeutic outcomes in patients with gallbladder calculi, reducing morbidity rates, and improving surgical and clinical outcomes.

KEYWORDS

Gallbladder calculi; Cholecystectomy; Bile microbiome

INTRODUCTION

Gallstone disease is a widespread condition that varies by geography and ethnicity.

According to Moynihan aphorism "Gall stones are the tombs erected in the memory of the bacteria". While several factors contribute to its development, bile contamination plays a significant role. In fact, the presence of bacteria in the bile (bactobilia) is a key factor, with higher rates found in patients with gallstones (3%) and common duct stones (30%)^[1,2].

Bacteria can enter the biliary tract from the duodenum or hepatic portal vein through hematogenous route^[3]. Although aerobic and anaerobic bacteria have been linked to gallbladder disease, their exact role is not well understood. Despite its low mortality rate, gallstone disease has a significant impact on health and economics due to its high morbidity.

Laparoscopic cholecystectomy is a common treatment, but interestingly, the type and composition of gallstones, as well as the presence of bacteria, do not significantly impact treatment. However, spilled stones during cholecystectomy can lead to complications, emphasizing the importance of proper stone retrieval and peritoneal lavage^[4].

This study aims to investigate the current bacteriology trends in patients undergoing cholecystectomy, antibiotic sensitivity, and correlations with age and sex. When it comes to refining treatment regimens and improving patient outcomes, it benefits greatly from having access to such information.

AIM

To determine the trend of bacteriology in bile and their antibiotic sensitivity in patients undergoing cholecystectomy.

OBJECTIVES OF STUDY

- To determine the frequency of potentially infective gram positive,

gram negative and anaerobic bacteria in the bile cultures.

- To determine the antimicrobial susceptibility pattern of the frequently isolated bacteria.

MATERIALS AND METHODS

A Cross sectional observational study was carried out for a period of 24 months in the Department of General Surgery, on participants who underwent Cholecystectomy.

Inclusion Criteria

All patients > 18 – 70 years of age, presenting with right hypochondrium pain, confirmed as Cholelithiasis on Ultrasonography or Computed tomography abdomen and underwent Cholecystectomy and who gave consent.

Exclusion Criteria

- Patients who have been admitted by other specialties for other complaints and subsequently developed right hypochondrium pain.
- Patients presenting with Acalculous Cholecystitis.
- Patients who have received antibiotic in last 2 days for other complaints.
- Patients with cholelithiasis in pregnancy.
- Patients with co-morbid factors like HIV or on long term steroids.

METHODOLOGY:

After obtaining the ethical clearance, 123 participants meeting the above mentioned inclusion criteria were recruited for the study.

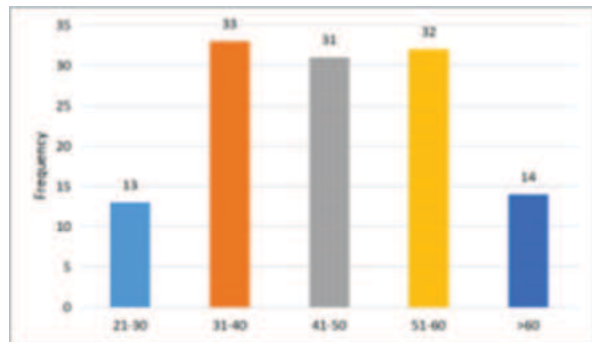
Ultrasound of the abdomen and pelvis or Computed Tomography (CT) Abdomen was used in order to verify the existence of gallstones and determine the status of Gall bladder (infective or non infective).

Intraoperatively bile samples were collected in a sterile syringe from the Gall bladder and sent for (Microbiological analysis) Culture and Antibiotic Sensitivity.

A version 22 of the International Business Machines Statistical Package for the Social Sciences (IBM SPSS) was employed in order to carry out the statistical study.

The microbiological evaluation of bile samples was the major outcome variable that was considered for the statistical analysis.

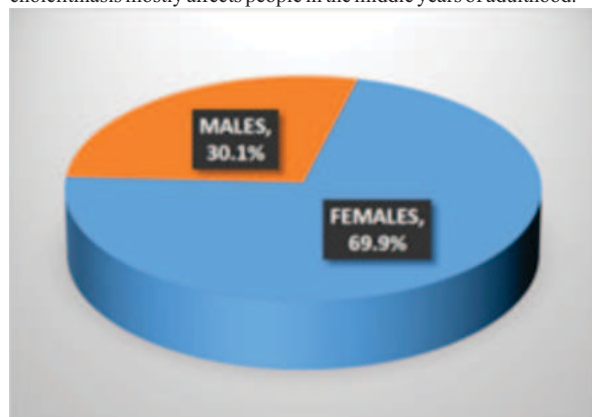
OBSERVATION AND RESULTS



Graph 1: Age distribution of study participants

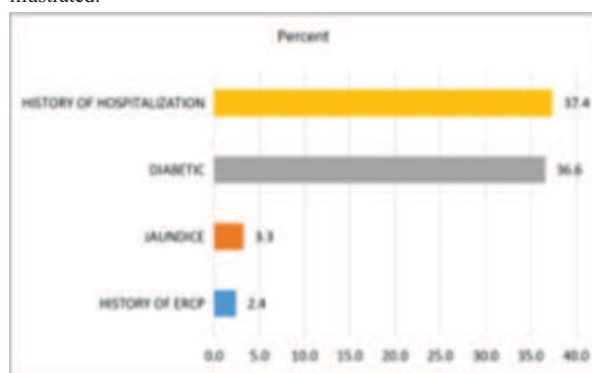
Participants were categorized into 5 groups. Participants who were in their thirties made up the biggest section, accounting for 26.8% of the overall sample. That was closely followed by participants who were in their forties (25.2%) and those who were in their fifties (26.0%). The mean age is 45.08yrs.

This distribution is consistent with the widely held belief that cholelithiasis mostly affects people in the middle years of adulthood.



Graph 2: Gender distribution

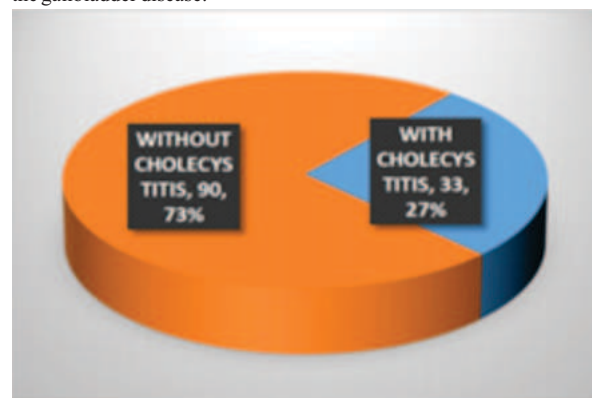
Females outnumbered men with the gender distribution among those who participated in the survey was divided between the sexes, as illustrated.



Graph 3: Past History

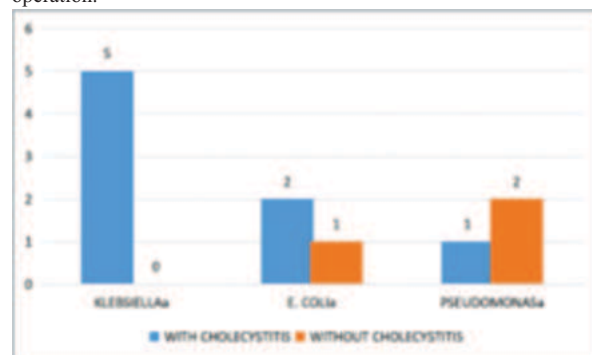
A sizeable proportion (36.6% of the total) had a history of diabetes, which highlights the common occurrence of diabetes mellitus and gallstone disease together. Having diabetes is known to have an effect

on the metabolism of cholesterol and to increase the likelihood of gallstone development. In addition, a significant proportion of the individuals (37.4%) had a previous hospitalization for similar complaints, which highlights the severity of symptoms associated to the gallbladder disease.



Graph 4: Cholecystitis

Cholecystitis was detected in 33 out of 123 individuals, which accounts for 26.8% of the entire sample. A sizeable percentage of patients who had cholecystectomy had experienced acute inflammation of the gallbladder as a consequence of gallstone disease. On the other hand, most of the patients, who accounted for 73.2% of the total, did not display any symptoms of cholecystitis at the time of operation.

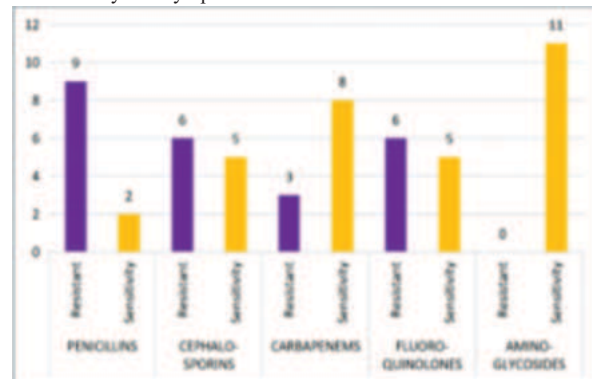


Graph 5: Bacteriology Of Bile

Klebsiella spp., *Escherichia coli*, and *Pseudomonas aeruginosa* were the three species of bacteria that were found in our study, and the table provides a breakdown of their frequencies and percentages within each category.

These samples are classified according to whether or not they contain cholecystitis.

It is noteworthy that *Klebsiella spp.* was found in bile samples taken from patients who had cholecystitis, with a frequency of 15.2%. On the other hand, it was not found in samples taken from patients who did not have cholecystitis symptoms.



Graph 6: Antibiogram

The antibiogram data that is shown in Graph 6 provides a complete overview of the antimicrobial resistance patterns that are present among bacterial isolates that are resistant to various classes of antibiotics.

A significant resistance rate of 81.8% was seen with Penicillins. Carbapenems and Aminoglycosides, on the other hand, have shown encouraging outcomes, with resistance rates of 27.3% and 0.0%, respectively, indicating that they continue to be viable alternatives for empirical treatment. The fact that Cephalosporins and Fluoroquinolones exhibit moderate resistance levels of 54.5% and sensitivity rates of 45.5% highlights the need of using these antibiotics with caution and taking into account alternate therapies when dealing with resistant bacteria.

Table 1: Bacteriology Of Bile And Antibiogram With And Without Cholecystitis

		WITH CHOLECYSTITIS			WITHOUT CHOLECYSTITIS		
		KLEBSI	E.	PSEUDO	KLEBSI		PSEUDO
		ELLA	COLI	MONAS	ELLA	E. COLI	MONAS
PENICILLINS	Resistant	4	1	1	-	1	2
		80.0%	50.0%	100%	-	100%	100%
	Sensitivity	1	1	0	-	0	0
		20.0%	50.0%	0.0%	-	0.0%	0.0%
CEPHALO-SPORINS	Resistant	2	0	1	-	1	2
		40.0%	0.0%	100%	-	100%	100%
	Sensitivity	3	2	0	-	0	0
		60.0%	100%	0.0%	-	0.0%	0.0%
CARBAPENE MS	Resistant	1	0	1	-	0	1
		20.0%	0.0%	100%	-	0.0%	50.0%
	Sensitivity	4	2	0	-	1	1
		80.0%	100%	0.0%	-	100%	50.0%
FLUORO-QUINOLONES	Resistant	2	0	1	-	1	2
		40.0%		100%	-	100%	100%
	Sensitivity	3	2	-	-	-	-
		60.0%	100%	-	-	-	-
AMINO-GLYCOSIDES	Resistant	0	0	0	0	0	0
		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Sensitivity	5	2	1	1	1	2
		100%	100%	100%	100%	100%	100%

A full review of the bacteriology of bile samples and the antibiogram profiles that correlate to them is shown.

Among the bacterial isolates that were found in bile samples taken from individuals who were diagnosed with cholecystitis, the data reveals many remarkable resistance patterns to different classes of antibiotics. Klebsiella, for example, has a high resistance rate to penicillins (80 percent), cephalosporins (40 percent), carbapenems (20 percent), and fluoroquinolones (40 percent). In a similar manner, Pseudomonas exhibits full resistance to penicillins and a significant level of resistance to other kinds of antibiotics. When opposed to Klebsiella and Pseudomonas, E. coli exhibits a relatively lower level of resistance to antibiotics, although displaying a variety of resistance patterns across various drugs.

On the other hand, bile samples taken from individuals who do not

have cholecystitis consistently demonstrate lower rates of antibiotic resistance across the majority of antibiotic classes.

The sensitivity findings demonstrate that aminoglycosides continuously retain good effectiveness, and there is no evidence of resistance across all samples. This demonstrates the dependability of aminoglycosides as potential treatment choices for bacterial infections in the bile.

DISCUSSION

Patients who underwent cholecystectomy as a result of cholelithiasis were the subjects of this research, and the purpose of this study was to identify the bacteriological trends by cultivating bacteria from bile samples. Identifying the number of potentially infectious bacteria inside the gallbladder and determining the antibiotic susceptibility patterns of these bacteria were the major goals of this study. In order to improve clinical knowledge of the microbial landscape associated with gallbladder illness and to advise suitable treatment approaches, the data are intended to be presented.

AGE -

A wide variety of ages were represented among the participants in this research, with the majority of them falling between the ages of 31 and 60. To be more specific, 26.8% of the participants were between the ages of 31 and 40, 25.2% were between the ages of 41 and 50, and 26.0% were between the ages of 51 and 60 and The mean age is 45.08yrs. The documented epidemiology of cholelithiasis, which usually occurs in adults of middle age, is compatible with this demographic distribution, which is consistent with the existing epidemiology. This was in correlation with the other studies **Himank Gandhi, et al. (2021)^[5]**.

GENDER -

The participants were split between males and females, with 30.1% of them being males and 69.9% being females in the ratio of 1 : 2.3 (males : females). The study indicated that women are more prone to developing this illness, consistent with the existing epidemiology which was similar to study conducted by **Kaval, Sunil and Tewari, Swati (2022).^[6]**

COMORBIDITIES -

It was discovered via the analysis of the data that a sizeable percentage of the participants had a history of diabetes (36.6%), as well as previous hospitalizations with similar complaints (37.4%). This hints to the possibility of a connection between chronic illnesses and the formation of gallstones, stressing the need of addressing underlying health concerns.

There was a presence of cholecystitis in 26.8% of the patients. Due to the fact that this inflammation might make gallstone disease more difficult to treat, early medical intervention is required.

In this series, the positive bile culture in cases of cholecystectomy was found in 9%, which is comparable to that reported by **Md Khalid anjum, et al, (2020)^[7]** which was 17.4%.

Bacteriology Of Bile -

Pseudomonas aeruginosa, *Klebsiella spp*, and *Escherichia coli* were found to be the three predominant bacterial species that were found in the bile samples in this study when compared to **Thomas CC, et al. (2019)^[8]**. The presence of *Klebsiella spp* was significantly higher in people who had cholecystitis (15.2%) and was not present in those who did not have cholecystitis, indicating that there is a clear connection between this bacteria and inflammation of the gallbladder similar to **Ambica, R., Bhavesh Rathod Bhavana, C. (2019)^[9]**.

It was discovered that *Escherichia coli* and *Pseudomonas aeruginosa* were present in both groups, but they were more prevalent in the individuals who had cholecystitis. This suggests that these bacteria may have a role in making gallbladder infections worse. More specifically, *Escherichia coli* was detected in 6.1% of cholecystitis cases and 1.1% of non-cholecystitis cases, while *Pseudomonas aeruginosa* was discovered in 3.0% of cholecystitis cases and 2.2% of non-cholecystitis cases at the same time.

Specifically, the identification of specific bacterial species in bile samples is essential for the customization of antibiotic treatment. *Klebsiella spp* is found in a significant number of instances of

cholecystitis, which underscores the need of developing tailored antibiotic regimens that are capable of efficiently combating this virus.

Antibiogram -

Our study was in correlation with studies of **Hang Zhang, et al. (2024)^[10]**, **Komal Prasad Dewangan, et al. (2022)^[11]**, **Nitin Kumar Chavan, G. Sathish Kumar (2017)^[12]** . with majority showing sensitivity to Aminoglycosides and Carbapenems group (80% and 100%) for *Klebsiella spp* i.e., the most isolated bacteria. For the purpose of choosing suitable antibiotics, it is essential to have a solid understanding of the antimicrobial susceptibility patterns of the bacteria that have been identified. This information is helpful in developing efficient treatment regimens, reducing the likelihood of patients developing resistance to antibiotics.

CONCLUSION

The purpose of this research was to offer a comprehensive analysis of the bacteriological landscape in patients who were undergoing cholecystectomy as a result of cholelithiasis.

The study focused specifically on the prevalence of bacteria that were isolated from bile samples as well as their reaction to antimicrobial agents. In order to get a better understanding of the treatment of gallbladder infections, the major objective was to obtain information on the prevalence of potentially infectious bacteria and to identify the patterns of resistance shown by these bacteria.

From our study it is confirmed that gallstone disease has a widespread influence on the population by the fact that this demographic information is consistent with the known epidemiology of the illness.

This study highlights the need of comprehensive care that tackles the underlying health conditions like Diabetes in order to avoid complications associated with gallbladder illness.

The most common bacterial species found in bile samples were *Klebsiella spp*, *Escherichia coli*, and *Pseudomonas aeruginosa*, according to the results of the bacteriological examination. *Klebsiella spp* was found to be more abundant in individuals who were diagnosed with cholecystitis which shows higher incidence of Bactobilia in inflammatory conditions emphasizing on the need for appropriate antibiotic use in treatment of Cholecystitis.

In conclusion, the findings of this research highlight the significance of accurate microbiological identification and individualized antibiotic treatment in the treatment of gallbladder infections. It is recommended that future studies concentrate on broadening the breadth of microbial analysis in order to unveil the whole range of microbial diversity that is present in bile samples.

Since drug resistance is an upcoming concern in recent days, increased incidence of resistance among the isolates of bactibilia demands appropriate use of antibiotics in clinical practice.

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