Section: General Surgery

Original Research Article

# MICROBIOLOGICAL PROFILE EVALUATION IN THE CASE OF PERFORATIVE PERITONITIS WITH RESPECT TO THE ANATOMICAL SITE OF PERFORATION

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***Received*** *: 31/04/2025*
***Received in revised form*** *: 22/05/2025*
***Accepted*** *: 06/06/2025*

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**DOI:** 10.70034/ijmedph.2025.2.424

**Source of Support:** Nil,
**Conflict of Interest:** None declared

**Int J Med Pub Health**
2025; 15 (2); 2352-2356

ABSTRACT

**Background:** Peritonitis is a critical and potentially fatal medical condition, with a wide range of causes that can differ based on geographic location. It remains a frequent surgical emergency, with mortality rates reported between 10% and 60%. This study aims to investigate the microbiological characteristics of pathogens in relation to the anatomical site of gastrointestinal perforation. The primary goals of this study are to evaluate the bacterial composition of peritoneal fluid, determine the culture and antibiotic sensitivity patterns in cases of secondary peritonitis, and assess the effectiveness of empirical antibiotic treatment protocols used in such cases.

**Materials and Methods:** A total of 60 patients diagnosed with clinical features of peritonitis were included in this cross-sectional observational study. These patients were admitted to Krishna Rajendra Hospital, Mysore—affiliated with Mysore Medical College and Research Institute—between August 2023 and January 2025. Peritoneal fluid samples were collected before the administration of antibiotics and subjected to microbiological analysis.

**Results:** Peritonitis was found to be more prevalent in males, especially those in the age group of 30 to 49 years. In most cases, perforation of the stomach and duodenum was observed during surgery, followed by appendicular perforations. The most frequently isolated microorganism from the peritoneal fluid was Escherichia coli, followed by Enterococci and Klebsiella. Antibiotic sensitivity testing revealed that the majority of isolates were most responsive to Meropenem and Tigecycline, with notable sensitivity also seen to Piperacillin-Tazobactam and third-generation cephalosporins.

**Conclusion:** This study underscores the critical importance of identifying the microbiological profile in Perforative peritonitis, as pathogen distribution varies with the anatomical site of perforation. Escherichia coli was the predominant organism, often in polymicrobial contexts. Rising resistance to commonly used antibiotics, including third-generation cephalosporins and Meropenem, necessitates revisiting empirical therapy protocols. Tigecycline demonstrated promising efficacy and may serve as a valuable reserve agent. Empirical regimens should ensure broad-spectrum coverage, especially in severe or delayed cases. Timely microbiological assessment and antimicrobial stewardship are essential to combat antimicrobial resistance and improve clinical outcomes in peritonitis management.

**Keywords:** Perforative peritonitis, Anatomical site of perforation, Microbiological profile.

## INTRODUCTION

Perforative peritonitis frequently presents as a surgical emergency, typically requiring an exploratory laparotomy.[1] In countries like India, particularly in tropical regions, the condition is more commonly observed in males aged between 30 and 50 years.[2] Patients generally arrive at emergency services exhibiting signs of established generalized peritonitis,[3] though the clinical presentation can vary significantly. Mortality rates associated with perforative peritonitis range between 6% and 21%,[4] depending largely on the specific anatomical site of the perforation. Therefore, identifying the perforation site in relation to the microbial profile is crucial for selecting the most effective empirical antibiotic therapy.[5]

Typically, patients with perforative peritonitis are initially treated with broad-spectrum empirical antibiotics. However, if the causative organisms are resistant, recovery may be delayed or compromised. There is a lack of sufficient studies correlating anatomical sites of perforation with specific microbial patterns and their antibiotic sensitivities—a gap this study seeks to address.[6,7] Timely administration of the correct antibiotics plays a pivotal role in improving outcomes, especially since culture results are not immediately available. Understanding the microbial landscape and antibiotic susceptibility based on the site of perforation can guide the initiation of appropriate post-operative antibiotic therapy more effectively.[8,9]

Acute peritonitis, often leading to multi-organ dysfunction syndrome, remains a major contributor to emergency-related complications and fatalities. Delays in seeking surgical evaluation can worsen patient outcomes. The symptoms of peritonitis range from mild, persistent abdominal discomfort to severe pain with guarding and systemic manifestations such as fever and respiratory distress.[10]

Early surgical intervention is generally more beneficial than delayed surgery. Prior to performing an exploratory laparotomy, thorough clinical evaluation and diagnostic imaging are essential in formulating a proper surgical plan. A conclusive diagnosis is often rapidly achieved through an erect abdominal X-ray, which commonly reveals signs of perforation. Once the diagnosis is confirmed, the focus must shift to implementing an effective management strategy.[11]

**Objectives**

1. To evaluate the bacterial composition present in peritoneal fluid samples.
2. To assess the culture results and antibiotic sensitivity patterns in cases of secondary peritonitis.
3. To examine the current empirical antibiotic treatment protocols used for managing secondary peritonitis.

## MATERIALS AND METHODS

This cross-sectional observational study was conducted at Krishna Rajendra Hospital, Mysore, affiliated with Mysore Medical College and Research Institute, between August 2023 and January 2025. A total of 60 cases of generalized peritonitis of non-traumatic etiology were randomly selected for inclusion. Eligible participants were adults over 18 years of age who presented with peritonitis secondary to hollow viscus perforation and underwent exploratory laparotomy. Exclusion criteria included individuals under 18 years, immunocompromised patients, those with any break in aseptic protocols, and patients referred from other medical facilities or those who had received prior treatment or surgery elsewhere.

Data collection began with a detailed history, focusing on the characteristics of pain (onset, type, location, progression, and exacerbating or relieving factors), presence of nausea and vomiting, bladder and bowel disturbances, menstrual history, smoking and alcohol use, and prior use of non-steroidal anti-inflammatory drugs (NSAIDs). A thorough clinical examination followed, including assessment of vital signs for tachycardia and hypotension, evaluation of abdominal tenderness, guarding, rigidity, and loss of liver dullness. Provisional diagnoses of hollow viscus perforation were made based on history and clinical findings and were further confirmed by radiological investigations.

Routine laboratory tests included complete blood count, urinalysis with microscopy, serum electrolytes, renal function tests, liver function tests, and serology. Radiological assessments consisted of erect abdominal and chest X-rays, along with abdominal ultrasound. Peritoneal fluid was aspirated under ultrasound guidance before the administration of antibiotics, using strict aseptic precautions, and was sent for culture and sensitivity testing. Statistical analysis of the data was performed using rates, ratios, proportions, and percentages.

## RESULTS

60 patients were studied. Most of the patients in this study were between the age of 40-49 years. The youngest patients in this study were 19 years, one had appendicular perforation and the oldest patient was 70 years, with gastric perforation with median of 45. Peritonitis was found more commonly in males i.e., 38(63.33%) cases as compared to the females i.e., 22(36.67%) cases out of 60 patients. This amounts to a male to female ratio of 1.72:1. The maximum numbers of perforation cases were found to be Gastric in location, which accounted for 35% of the cases. The second most common site was found to be in the appendix accounts to about 28.3% of the cases. Next common sites are duodenum and ileum perforation [Table 1].

**Table 1: Profile of subjects in the study**

| | | Frequency | Percentage |
|---|---|---|---|
| Age (Yrs) | <20 | 1 | 1.67% |
| | 20-29 | 7 | 11.67% |
| | 30-39 | 8 | 13.3% |
| | 40-49 | 21 | 35% |
| | 50-59 | 11 | 18.3% |
| | >60 | 12 | 20% |
| Gender | Male | 38 | 63.33% |
| | Female | 22 | 36.67% |
| Site of Perforation | Gastric | 21 | 35.0% |
| | Duodenum | 10 | 16.7% |
| | Jejunum | 2 | 3.3% |
| | Ileum | 7 | 11.7% |
| | Appendicular | 17 | 28.3% |
| | Colon | 3 | 5% |

**Microbiology profile in perforation patients:** Among the microbiology profile, most of culture sensitive showed no growth(sterile), then the most common organism incubated was Escherichia Coli (12), followed by Enterococci among the peritoneal fluid aspirate [Table 2].

**Table 2: Microbiological Profile in Peritonitis**

| Microorganism isolated | Frequency | Percentage |
|---|---|---|
| Escherichia coli | 12 | 20.0% |
| Acinetobacter | 4 | 6.7% |
| Citrobacter | 4 | 6.7% |
| Klebsiella | 4 | 6.7% |
| Serratia | 4 | 6.7% |
| Enterococci | 6 | 10.0% |
| Streptococcus | 2 | 3.3% |
| Proteus | 4 | 6.7% |
| Sterile | 20 | 33.3% |

**Table 3: Organisms isolated in different types of perforation**

| | Microorganism Isolated | Number of Cases (n) | Percentage (%) |
|---|---|---|---|
| Gastric Perforation (n =12) | E. coli | 5 | 45% |
| | Klebsiella | 3 | 22% |
| | Citrobacter | 3 | 22% |
| | Acinetobacter | 1 | 11% |
| Duodenal Perforation (n = 4) | E. coli | 3 | 75% |
| | Proteus | 1 | 25% |
| Appendicular Perfoation (n =14) | E. coli | 3 | 22% |
| | Enterococcus | 3 | 22% |
| | Serratia | 2 | 14% |
| | Klebsiella | 2 | 14% |
| | Citrobacter | 1 | 7% |
| | Proteus | 1 | 7% |
| | Streptococcus | 1 | 7% |
| | Acinetobacter | 1 | 7% |

Majority of the peritoneal aspirates in cases of gastric perforation were sterile. 9 out of the 21 cases of gastric perforation were sterile, 12 of the 21 cases showed positive culture. The most common organism isolated was E coli, which occurred in 4 cases out of 21.

Escherichia coli was the most common bacteria isolated in cases of duodenal perforation.

Among 10 cases, 4 showed positive for culture. Among these, E coli was the most common micro-organism isolated (75%) and proteus in 25%.

Out of 2 jejunal perforation, E coli was the most common microorganism isolated. Peritoneal aspirates from cases diagnosed to have a perforation in the ileum showed a predominant growth of Escherichia coli.

The most common organism incubated in Appendicular perforation was Enterococci and E-coli. 3 out of 17 samples should non growth even after incubation for 4 days.

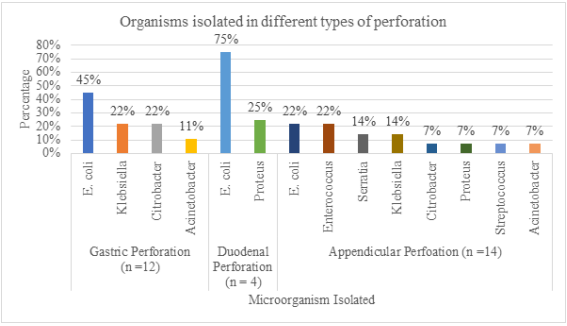


**Figure 1: Bar diagram showing Organisms isolated in different types of perforation**

**Table 4: Antibiotic Sensitivity Pattern**

| Antibiotic | E-Coli | Acinetobacter | Enterobacter | Klebsiella | Proteus |
|---|---|---|---|---|---|
| Amikacin | 8 | 4 | 5 | 3 | 2 |
| Gentamicin | 8 | 4 | 4 | 4 | 3 |
| Cefotaxime | 6 | 2 | 0 | 2 | 3 |
| Ceftriaxone | 7 | 2 | 4 | 3 | 3 |
| Cefoperazone | 8 | 3 | 0 | 0 | 0 |
| Meropenem | 11 | 4 | 5 | 4 | 4 |
| Ciprofloxacin | 6 | 2 | 3 | 3 | 2 |
| Tetracycline | 10 | 3 | 0 | 0 | 0 |
| Tigecycline | 12 | 4 | 0 | 4 | 0 |
| Piperacillin- Tazobactum | 9 | 3 | 5 | 4 | 4 |
| Linezolid | 0 | 0 | 6 | 4 | 2 |
| Vancomycin | 0 | 0 | 4 | 0 | 0 |

E-coli was isolated in 12 cases. Tigecycline was found to be sensitive in all cases. A rise has been seen in cases of multi drug resistant E-coli. Acinetobacter was isolated in 4 cases. Acinetobacter was sensitive to most of the commonly used Antibiotics. Enterococci was isolated in 6 cases. Enterococci was sensitive to most of the commonly used Antibiotics, and was most sensitive to Linezolid. Klebsiella was isolated in 4 cases. Klebsiella was sensitive to most of the commonly used Antibiotics. Proteus was isolated in 4 cases. Proteus was sensitive in most of the antibiotics of 3rd Generation Cephalosporins. We also evaluated the overall antibiotic sensitivity of the microorganisms isolated, which revealed a sensitivity pattern of approximately 80% to Amikacin, 83% to Gentamicin, 68% to Ceftriaxone, 86% to Piperacillin-tazobactum,92% to Meropenem, and 94% to Tigecycline.

## DISCUSSION

This study analyzed the bacterial isolates and antibiotic sensitivities from peritoneal fluid samples of 60 patients diagnosed with perforative peritonitis. The male-to-female ratio was 1.72:1, with the highest number of patients (35%) in the 40–49 age group.

The stomach emerged as the most commonly affected organ, with gastric perforations observed in 35% of cases, followed by appendicular perforations in 28%. Escherichia coli was the most frequently detected organism, appearing in 20% of all samples. Notably, 33% of the cultures yielded no bacterial growth. Among the positive cultures, E. coli accounted for approximately 30%.

These findings are in line with data from a tertiary care facility in New Caledonia, where E. coli was identified in 44% of peritoneal samples. Enterococci were the second most prevalent, found in 10% of cases, although their exact role in peritonitis remains less clearly defined. D.H. Wittmann's work emphasizes that such infections are often polymicrobial in nature, suggesting that single-drug therapy is typically inadequate. His recommendations include using broad-spectrum agents, with β-lactam antibiotics as first-line options and Imipenem as a secondary choice.[12]

The Infectious Diseases Society of America (IDSA) recommends treating intra-abdominal infections with a combination of a third-generation cephalosporin and metronidazole, optionally supplemented with an aminoglycoside. Our study supports this guidance, noting that most organisms were susceptible to third-generation cephalosporins. However, due to increasing resistance—especially in delayed presentations or cases involving significant contamination—adding gentamicin is advised.

Over time, there has been a noticeable surge in antibiotic resistance. In our cohort, 21 cases showed multidrug-resistant (MDR) organisms. These bacteria develop resistance through spontaneous genetic mutations or by acquiring resistance genes, making standard treatment regimens less effective.

A related study found MDR organisms in 35.4% of male and 22.1% of female patients, with E. coli and Proteus vulgaris being particularly resistant. Our results are consistent, with 25.2% of isolates being multidrug-resistant and E. coli accounting for 48% of these.

This underscores the urgent need for routine culture and sensitivity testing in all surgical peritonitis cases. E. coli remains the most common pathogen in such infections. While resistance to third-generation cephalosporins and Piperacillin-Tazobactam is growing, Meropenem and Tigecycline continue to be highly effective against gram-negative bacteria, particularly members of the Enterobacteriaceae family.[13]

## CONCLUSION

Escherichia coli emerged as the most commonly detected pathogen in patients with gastrointestinal perforations. These cases frequently involve multiple types of gram- negative bacilli, indicating polymicrobial infections.

The Surgical Infection Society advises that due to the varied microbial environment of the gastrointestinal tract, effective antibiotic regimens must cover both aerobic and facultative anaerobic Enterobacteriaceae, as well as anaerobes like Bacteroides fragilis. As a result, using a single antibiotic is often inadequate, particularly because of rising resistance and the frequent isolation of multiple organisms from peritoneal samples.

Our findings revealed a concerning increase in resistance to third-generation cephalosporins and

Meropenem. However, most organisms retained sensitivity to Tigecycline, which could serve as a valuable last-line option. An ideal empirical regimen should start with a third-generation cephalosporin plus metronidazole. For patients with extensive contamination or symptoms persisting beyond three days, incorporating an aminoglycoside offers broader antimicrobial coverage.

The rise in resistance to standard antibiotics highlights a pressing need for prompt and strategic action. Antimicrobial resistance (AMR) threatens the successful treatment of an expanding range of bacterial, viral, parasitic, and fungal infections. As resistance mechanisms continue to evolve and spread globally, our ability to manage common infections is at serious risk—potentially leading to increased mortality, long-term disability, and the failure of otherwise routine medical interventions.

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