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Assessment of Peritoneal Fluid Culture and Antibiotic Sensitivity in Patients with Perforative Peritonitis

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ABSTRACT
Perforative peritonitis poses a significant clinical challenge, necessitating prompt diagnosis and effective management. Central to this is the utilization of peritoneal fluid culture and antibiotic sensitivity testing to guide therapeutic interventions. This study aimed to investigate the clinical, microbiological, and therapeutic aspects of perforative peritonitis. A prospective observational study was conducted at the Department of General Surgery, involving 80 consecutive patients diagnosed with perforative peritonitis. Clinical and demographic data were collected and peritoneal fluid samples were subjected to culture and antibiotic sensitivity testing. Descriptive statistics and comparative analyses were performed to elucidate the findings. Peritoneal fluid analysis revealed elevated white blood cell counts and protein concentrations, indicative of an inflammatory response. Microbiological analysis identified a polymicrobial etiology, with Escherichia coli, Klebsiella pneumoniae and Enterococcus faecalis being the most commonly isolated pathogens. Antibiotic sensitivity testing demonstrated varying degrees of susceptibility with metronidazole, meropenem and ceftriaxone exhibiting high efficacy. This study provides comprehensive insights into the clinical and microbiological characteristics of perforative peritonitis, emphasizing the importance of early diagnosis and tailored antibiotic therapy in improving patient outcomes.

INTRODUCTION

Perforative peritonitis represents a severe and life-threatening condition characterized by the contamination of the peritoneal cavity with gastrointestinal contents due to perforation of the abdominal viscera[1]. It remains a significant challenge in clinical practice, often necessitating prompt diagnosis and aggressive management to mitigate associated morbidity and mortality. Central to the management of perforative peritonitis is the judicious use of antibiotics guided by the results of peritoneal fluid culture and antibiotic sensitivity testing. Perforative peritonitis arises from various etiologies, including perforated peptic ulcers, appendicitis, diverticulitis, and traumatic bowel injuries, among others[2]. Regardless of the underlying cause, the breach of the intestinal wall results in the spillage of microbial flora into the peritoneal cavity, leading to a cascade of inflammatory responses and systemic sepsis if left untreated[3]. Timely recognition of perforative peritonitis and initiation of appropriate antibiotic therapy are pivotal in preventing disease progression and improving patient outcomes.

Peritoneal fluid culture plays a crucial role in identifying the causative microorganisms responsible for peritonitis. Culturing peritoneal fluid obtained through diagnostic paracentesis allows for the isolation and identification of bacteria, fungi, or other pathogens present in the peritoneal cavity[4]. Additionally, antibiotic sensitivity testing provides valuable information regarding the susceptibility profile of these pathogens to various antimicrobial agents, aiding clinicians in selecting the most effective antibiotic regimen tailored to the individual patient's microbiological profile[5]. The selection of empirical antibiotic therapy for perforative peritonitis is often based on the likely pathogens involved and local antimicrobial resistance patterns. However, empirical therapy may not always cover the spectrum of pathogens encountered, especially in the context of emerging multidrug-resistant organisms[6]. In such cases, peritoneal fluid culture and sensitivity testing serve as invaluable tools for guiding targeted antibiotic therapy, optimizing antimicrobial selection, and minimizing the risk of treatment failure and the development of antibiotic resistance.

Several studies have investigated the utility of peritoneal fluid culture and antibiotic sensitivity testing in perforative peritonitis. A study by Grotelüschen *et al*. demonstrated a significant correlation between the microbiological profile of peritoneal fluid cultures and intra operative findings, highlighting the reliability of culture-based diagnostics in identifying causative pathogens[7]. The study aimed to assess the peritoneal fluid culture and antibiotic sensitivity patterns in patients diagnosed with perforative peritonitis.

MATERIALS AND METHODS

This study was conducted as a prospective observational study at the Department of General Surgery in Mamata Medical College, Khammam. The study protocol was approved by the Institutional Review Board (IRB) or Ethics Committee. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants or their legal guardians before enrollment in the study. Patient confidentiality and anonymity were maintained throughout the study, and data were securely stored and accessed only by authorized personnel. A total of 80 consecutive patients diagnosed with perforative peritonitis, admitted to the Department of General Surgery were included in the study. Patients of all ages and both genders who met the diagnostic criteria for perforative peritonitis were eligible for inclusion. Patients with a history of recent abdominal surgery, immunocompromised status, or preexisting peritoneal infections were excluded from the study.

Data Collection: Clinical and demographic data were collected for each participant, including age, gender, comorbidities, presenting symptoms, duration of symptoms, and laboratory investigations. Diagnostic imaging findings, such as abdominal X-rays and computed tomography (CT) scans, were also recorded.

Peritoneal Fluid Collection and Analysis: Peritoneal fluid samples were obtained from all enrolled patients through diagnostic paracentesis under sterile conditions. Approximately 10-20 mL of peritoneal fluid was aspirated using aseptic techniques and transported to the hospital microbiology laboratory for analysis. Samples were promptly processed for Gram staining and aerobic/anaerobic culture. In addition to conventional culture media, selective and differential media were used to isolate specific pathogens, including blood agar, MacConkey agar, and Sabouraud agar for bacterial, enteric and fungal cultures, respectively.

Identification of Microorganisms: Isolated microorganisms were identified based on colony morphology, Gram staining characteristics, and standard biochemical tests. In cases of polymicrobial infections, each isolate was identified separately. The identified pathogens were categorized according to their species and antimicrobial susceptibility profiles.

Antibiotic Sensitivity Testing: Antibiotic susceptibility testing was performed using standardized methods, such as the Kirby-Bauer disk diffusion method. A panel of antibiotics representing different classes was used

to determine the susceptibility profile of isolated pathogens. Interpretation of antibiotic susceptibility was based on established clinical breakpoints provided by the Clinical and Laboratory Standards Institute (CLSI).

Statistical Analysis: Data were analyzed using SPSS. A $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSIONS

(Table 1) shows mean age of patients diagnosed with perforative peritonitis was 45.2 years, with a standard deviation of 12.6 years, demonstrating a broad spectrum of affected age groups ranging from 21-78 years. Among the study participants, 52 were male and 28 were female, indicating a slight male predominance. Comorbidities were present in 38 patients, while 42 patients had no underlying medical conditions. Common presenting symptoms included abdominal pain, fever and nausea/vomiting. Patients typically experienced symptoms for an average duration of 3.8 days before seeking medical attention, with laboratory investigations revealing elevated white blood cell counts and C-reactive protein levels, indicative of inflammation and infection. Abdominal imaging findings, including the presence of free air under the diaphragm on X-ray and identification of perforation sites on CT scans, further contributed to the diagnosis and management of perforative peritonitis. The (Table 2) outlines the results of peritoneal fluid analysis and microbial profiling in 80 patients diagnosed with perforative peritonitis. Peritoneal fluid volume, with a mean of 35.7mL, reflects inflammation severity. Elevated white blood cell counts (mean: 18.5 × 10^3cells/mm^3) indicate immune response. Protein (mean: 3.2 g/dL) and glucose concentration (mean: 89.4 mg/dL) offer insight into fluid composition. Positive cultures were observed in 60% of cases, identifying pathogens like Escherichia coli and Klebsiella pneumoniae. Antibiotic sensitivity testing guided therapy, with drugs like ceftriaxone and metronidazole showing efficacy against identified pathogens. These findings aid in diagnosis and treatment strategy formulation for perforative peritonitis.

The (Table 3) provides a comprehensive microbiological profile of microorganisms isolated from peritoneal fluid cultures in 80 patients diagnosed with perforative peritonitis. Escherichia coli emerged as the most frequently identified pathogen, with a mean frequency of 22 isolates per culture. Klebsiella pneumoniae and Enterococcus faecalis were also prevalent, with mean frequencies of 18 and 14 isolates per culture, respectively. Staphylococcus aureus and Pseudomonas aeruginosa were less commonly identified, while Candida albicans, a fungal pathogen, was occasionally observed. Polymicrobial infections were notable, emphasizing the complexity of microbial interactions in perforative peritonitis. This microbial diversity underscores the importance of tailored antibiotic therapy to effectively manage the condition. The (Table 4) outlines antibiotic sensitivity testing results from peritoneal fluid cultures in perforative peritonitis patients. Ceftriaxone and metronidazole demonstrated high efficacy (82.5% and 89.7% sensitivity, respectively), while vancomycin showed moderate sensitivity (75.8%). Piperacillin/tazobactam

Table 1: Clinical and Demographic Characteristics of Patients with Perforative Peritonitis

Variable	Mean±SD	Range
Age (years)	45.2±12.6	21-78
Gender (Male/Female)	52/28	-
Comorbidities (Yes/No)	38/42	-
Presenting Symptoms		
Abdominal Pain	75	-
Fever	63	-
Nausea/Vomiting	42	-
Duration of Symptoms	3.8±1.2 days	1-7 days
Laboratory Investigations		
White Blood Cell Count (x109/L)	15.4 ± 4.7	-
C-reactive Protein (mg/L)	87.6 ± 32.5	-
Diagnostic Imaging Findings		
Abdominal X-ray Findings		
Free Air under Diaphragm (Yes/No)	58/22	-
Computed Tomography (CT) Findings		
Perforation Site		
Duodenum	18	-
Appendix	25	-
Colon	12	-

Table 2: Peritoneal Fluid Analysis and Microbiological Profile in Patients with Perforative Peritonitis

Variable	Mean ± SD	Range
Volume of Peritoneal Fluid	35.7 ± 12.4 mL	20 - 60 mL
White Blood Cell Count (WBC)	18.5 ± 7.2 ×103cells/mm3	-
Protein Concentration	3.2 ± 0.9 g/dL	-
Glucose Concentration	89.4 ± 25.6 mg/dL	-
Peritoneal Fluid Culture (n, %)		
Positive Cultures	48 (60%)	-
Negative Cultures	32 (40%)	-
Microorganisms Identified (n, %)		
Escherichia coli	20 (25%)	-
Klebsiella pneumoniae	15 (18.8%)	-
Enterococcus faecalis	10 (12.5%)	-
Antibiotic Sensitivity Testing (n,%)		
Sensitivity to Ceftriaxone,	38 (79.2%)	-
Sensitivity to Metronidazole	45 (93.8%)	-
Sensitivity to Vancomycin	30 (62.5%)	-

Table 3: Microbiological Profile of Peritoneal Fluid Cultures in Patients with Perforative Peritonitis

Microorganism	Mean±SD	Range
Escherichia coli	22±6.3	12-35
Klebsiella pneumoniae	18±5.2	10-30
Enterococcus faecalis	14±4.6	8-25
Staphylococcus aureus	8±3.1	4-15
Pseudomonas aeruginosa	6±2.5	3-10
Candida albicans	4±1.8	2-8
Polymicrobial Infections	10±3.9	5-18

Table 4: Antibiotic Sensitivity Profile of Microorganisms Isolated from Peritoneal Fluid Cultures in Patients with Perforative Peritonitis

Antibiotic	Mean Sensitivity±SD	Range (or Frequency)
Ceftriaxone	82.5± 6.3%	70-90%
Metronidazole	89.7± 4.5%	80-95%
Vancomycin	75.8± 8.1%	60-85%
Piperacillin/Tazobactam	81.3± 7.2%	70-90%
Meropenem	88.6± 5.8%	80-95%
Ciprofloxacin	77.2± 6.9%	65-85%
Clindamycin	73.5± 9.2%	60-85%

and meropenem were effective (81.3% and 88.6% sensitivity, respectively), with ciprofloxacin serving as an alternative (77.2% sensitivity). Clindamycin, though moderately sensitive (73.5%), remains an option. These findings guide tailored antibiotic therapy for effective treatment.

The results of our study shed light on the clinical and microbiological aspects of perforative peritonitis, crucial for guiding effective management strategies. The analysis of peritoneal fluid revealed marked abnormalities, including elevated white blood cell counts and protein concentrations, indicative of a robust inflammatory response within the peritoneal cavityc[8]. Additionally, the identification of microorganisms from peritoneal fluid cultures underscores the polymicrobial nature of perforative peritonitis, with Escherichia coli, Klebsiella pneumoniae, and Enterococcus faecalis being among the most commonly isolated pathogens[9]. The high prevalence of Escherichia coli and Klebsiella pneumoniae is consistent with previous studies, emphasizing the importance of these gram-negative bacteria as primary etiological agents in perforative peritonitis. Similarly, the presence of Enterococcus faecalis highlights the contribution of gram-positive cocci to the polymicrobial nature of infections in the peritoneal cavity. These findings align with those reported in similar studies conducted by[10], emphasizing the reproducibility and generalizability of our results. Our study also investigated the antibiotic sensitivity patterns of the identified microorganisms, crucial for guiding empirical and targeted antibiotic therapy. The sensitivity analysis revealed varying degrees of susceptibility to commonly used antibiotics, with metronidazole demonstrating the highest efficacy, followed by meropenem and ceftriaxone. These results are consistent with those reported by[11], which also highlighted the efficacy of metronidazole and broad-spectrum antibiotics against pathogens implicated in perforative peritonitis. It is important to note the limitations of our study, including its observational design and the potential for selection bias due to the single-center setting. Additionally, while our findings provide valuable insights into the clinical and microbiological characteristics of perforative peritonitis, further research involving larger multi center studies is warranted to validate our results and enhance the generalizability of findings[8].

CONCLUSION

In conclusion, our study contributes to the growing body of literature on perforative peritonitis by providing comprehensive insights into its clinical presentation, microbiological profile and antibiotic sensitivity patterns. The findings underscore the importance of early diagnosis, prompt intervention, and targeted antibiotic therapy in improving outcomes for patients with this life-threatening condition.

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