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CLINICOPATHOLOGICAL AND MICROBIOLOGICAL PROFILE OF PERFORATION PERITONITIS AND ITS ASSOCIATION WITH POSTOPERATIVE OUTCOMES

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Abstract

Background: Perforation peritonitis is a major surgical emergency associated with substantial morbidity and mortality. Its outcome is influenced by the anatomical and pathological characteristics of perforation, extent of contamination, microbiological profile, antimicrobial resistance, and timing of surgical intervention. The present study evaluated the clinicopathological and microbiological profile of perforation peritonitis and their association with postoperative outcomes.

Materials and Methods: A prospective observational study was conducted among 90 patients with perforation peritonitis undergoing surgical management. Demographic, clinical, laboratory, radiological, operative, pathological, and microbiological characteristics were recorded. Peritoneal fluid or pus obtained intraoperatively was subjected to culture and antimicrobial susceptibility testing. Patients were followed during hospitalization for postoperative complications, intensive care requirement, duration of hospital stay, and mortality.

Results: The mean age of patients was 48.7 ± 16.2 years, with male predominance (70.0%). Duodenal perforation was the commonest anatomical site (32.2%), while perforated peptic ulcer disease was the predominant etiology (42.2%). Generalized peritonitis was present in 67.8% of patients. Peritoneal cultures were positive in 80.0%, with Escherichia coli (38.9%) and Klebsiella pneumoniae (25.0%) being the predominant isolates. Polymicrobial infection occurred in 33.3% of culture-positive cases, while multidrug-resistant organisms were identified in 34.7%. Postoperative complications occurred in 43.3% of patients, with surgical-site infection being the commonest (21.1%). ICU admission was required in 15.6%, and in-hospital mortality was 10.0%. Complications were more frequent with generalized peritonitis, feculent contamination, bowel necrosis, polymicrobial infection, and MDR organisms.

Conclusion: Clinicopathological and microbiological characteristics were important determinants of postoperative outcomes in perforation peritonitis. Early surgical source control, microbiological evaluation, appropriate antimicrobial therapy, and close postoperative monitoring may improve outcomes.

Key Words: Perforation peritonitis; gastrointestinal perforation; microbiological profile; antimicrobial resistance; postoperative complications; Escherichia coli; Klebsiella pneumoniae; mortality.

INTRODUCTION

Perforation peritonitis constitutes a major surgical emergency and remains an important cause of morbidity and mortality worldwide. It results from perforation of a hollow viscus with leakage of gastrointestinal contents, bacteria, and digestive secretions into the peritoneal cavity.[1] Depending on the site, extent of perforation, and degree of contamination, peritonitis may remain localized or progress to generalized peritonitis, intra-abdominal sepsis, septic shock, multiorgan dysfunction, and death. Despite advances in diagnostic imaging, antimicrobial therapy, surgical techniques, anaesthesia, and critical care, perforation peritonitis continues to be associated with considerable postoperative morbidity and mortality. Prompt diagnosis, early resuscitation, timely surgical source control, and appropriate antimicrobial therapy are therefore essential [2]. The clinical course of perforation peritonitis is influenced by several factors, including the anatomical site and cause of perforation, duration of symptoms, extent of peritoneal contamination, associated comorbidities, and physiological status at presentation.[3] Common causes include perforated peptic ulcer disease, ileal and appendicular perforation, intestinal tuberculosis, trauma, diverticular disease, malignancy, and iatrogenic gastrointestinal injury. The distribution of these etiologies varies according to geographical and demographic characteristics.[4] The anatomical site of perforation is particularly important because it influences the nature and quantity of contamination, microbial flora, inflammatory response, operative management, and subsequent postoperative outcome.[5] Gastrointestinal perforation initiates a complex pathological inflammatory response. Local tissue injury and bacterial contamination activate peritoneal macrophages and other immune cells, resulting in the release of inflammatory mediators. Increased vascular permeability, fibrin deposition, neutrophil recruitment, and inflammatory adhesions contribute to peritoneal inflammation.[6] While these mechanisms may localize infection, extensive contamination can result in generalized peritonitis, sepsis, septic shock, and multiple-organ dysfunction. Operative findings such as the site and size of perforation, degree and type of contamination, purulent or feculent collections, bowel necrosis, adhesions, and abscess formation therefore provide important information regarding disease severity. Histopathological examination may further demonstrate acute or chronic inflammation, ulceration, necrosis, granulomatous inflammation, or malignant pathology and may assist in determining the underlying etiology.[7] The microbiological profile is an important component of perforation peritonitis because secondary peritonitis is generally polymicrobial and involves organisms originating from the gastrointestinal tract. Commonly isolated organisms include Escherichia coli, Klebsiella pneumoniae, Enterococcus species, Pseudomonas species, other Enterobacterales, and anaerobic bacteria.[8] The microbial spectrum may vary according to the anatomical site of perforation and clinical circumstances. Increasing antimicrobial resistance, including multidrug-resistant Gram-negative organisms and extended-spectrum β-lactamase-producing bacteria, has further complicated treatment. Peritoneal fluid or pus obtained intraoperatively for culture and antimicrobial susceptibility testing can therefore provide valuable information for modification of empirical therapy and selection of definitive antimicrobial treatment.[9] Postoperative outcome is determined by an interaction of patient-related, disease-related, microbiological, and treatment-related factors. Advanced age, comorbidities, delayed presentation, delayed surgery, hypotension, anaemia, renal dysfunction, hypoalbuminaemia, extensive contamination, feculent peritonitis, and organ dysfunction have been associated with poor outcomes.[10] Important postoperative complications include surgical-site infection, wound dehiscence, intra-abdominal abscess, anastomotic leakage, postoperative ileus, respiratory complications, acute kidney injury, sepsis, and multiorgan dysfunction. Early identification of high-risk patients is therefore essential.[11] Several clinical, laboratory, and prognostic scoring systems have been evaluated for risk stratification in perforation peritonitis.[12] Emphasized the importance of early prognostic assessment to facilitate appropriate triage and intensive management of high-risk patients. Anatomical classifications and physiological scoring systems such as APACHE have also been used to assess disease severity and predict outcomes. Reported that delayed presentation, abnormal laboratory parameters, and delay in operative intervention were associated with increased mortality [13]. However, assessment based solely on physiological parameters may not fully reflect

the anatomical, pathological, and microbiological complexity of perforation peritonitis. Therefore, an integrated evaluation of the clinical, anatomical, pathological, microbiological, and postoperative characteristics may provide a more comprehensive understanding of factors influencing outcome. The present study entitled "Clinicopathological and Microbiological Profile of Perforation Peritonitis and Its Association with Postoperative Outcomes" evaluate the demographic and clinical characteristics, anatomical and pathological findings, microbiological spectrum, and antimicrobial susceptibility pattern of patients with perforation peritonitis and determine their association with postoperative morbidity and mortality..

Materials And Methods

Study Design and Setting

A prospective observational study was conducted in the tertiary care centre.The study included patients presenting with perforation peritonitis who underwent surgical management during the study period. A total of 90 patients fulfilling the predefined eligibility criteria were enrolled.

Study Population

The study population comprised adult patients diagnosed clinically and/or radiologically with gastrointestinal perforation with associated peritonitis and managed surgically at the study centre. Patients were evaluated from admission through the operative period and were followed during the postoperative hospital stay to assess complications and other postoperative outcomes.

Inclusion Criteria

Patients were included if they fulfilled the following criteria:

1. Patients aged ≥18 years.
2. Patients diagnosed with gastrointestinal perforation with clinical, radiological, or operative evidence of peritonitis.
3. Patients undergoing operative management for perforation peritonitis.
4. Patients who provided written informed consent for participation in the study.

Exclusion Criteria

Patients were excluded if they had:

1. Age <18 years.
2. Primary peritonitis without an identifiable gastrointestinal perforation.
3. Pancreatic or biliary peritonitis without gastrointestinal perforation.
4. Patients managed conservatively without surgical intervention.
5. Patients with incomplete clinical, operative, microbiological, or postoperative records.
6. Patients who did not provide consent for participation.

Clinical Evaluation

At admission, all patients underwent detailed clinical evaluation. Demographic characteristics including age and sex were recorded. A detailed history was obtained regarding the onset and duration of symptoms, abdominal pain, vomiting, fever, abdominal distension, altered bowel habits, and other relevant symptoms. The presence of associated comorbidities such as diabetes mellitus, hypertension, chronic kidney disease, chronic respiratory disease, cardiovascular disease, and other significant medical conditions was documented.

General examination included assessment of pulse rate, blood pressure, respiratory rate, temperature, oxygen saturation, hydration status, and level of consciousness. Abdominal examination was performed to assess abdominal distension, tenderness, guarding, rigidity, rebound tenderness, and other clinical signs of peritonitis.

The duration between onset of symptoms and hospital presentation and the interval between admission and surgical intervention were recorded. Patients were categorized according to the duration of symptoms and timing of surgery for assessment of their association with postoperative outcomes.

Laboratory Investigations

Baseline laboratory investigations were performed at admission and included:

- Complete blood count, including haemoglobin, total leukocyte count, and platelet count
- Renal function tests, including serum urea and creatinine
- Serum electrolytes
- Liver function tests
- Blood glucose
- Serum albumin
- Coagulation profile
- Arterial blood gas analysis, where clinically indicated
- Other investigations considered necessary for perioperative assessment

Abnormal laboratory parameters were documented and evaluated for their association with postoperative complications and mortality.

Radiological Evaluation

Radiological investigations were performed according to the clinical condition of the patient. Plain abdominal radiography and/or ultrasonography were performed when indicated. Contrast-enhanced computed tomography (CECT) of the abdomen was performed in hemodynamically stable patients when clinically appropriate.

Radiological findings suggestive of perforation, including pneumoperitoneum, site of perforation, free fluid, localized collection, bowel wall thickening, and other associated abnormalities, were documented.

Operative Evaluation

All patients underwent surgical exploration after appropriate resuscitation and optimization. The operative approach was selected according to the clinical condition, suspected site and cause of perforation, and surgeon's discretion.

The following intraoperative findings were recorded:

- Anatomical site of perforation
- Size of perforation
- Etiological diagnosis
- Number of perforations, where applicable
- Nature and amount of peritoneal contamination
- Localized or generalized peritonitis
- Purulent, bilious, enteric, or feculent contamination
- Presence of bowel necrosis
- Intra-abdominal abscess or collection
- Adhesions
- Associated bowel pathology

The operative procedure performed, including primary repair, omental patch repair, resection and anastomosis, stoma formation, or other appropriate source-control procedures, was recorded.

Peritoneal Fluid Collection and Microbiological Examination

During surgical exploration, an intraoperative sample of peritoneal fluid or pus was collected aseptically from the site of contamination before administration of lavage solution wherever feasible. The specimen was transported promptly to the microbiology laboratory under appropriate conditions.

Samples were subjected to Gram staining, aerobic bacterial culture, identification of isolated organisms, and antimicrobial susceptibility testing according to standard laboratory procedures. Anaerobic culture was performed where facilities and specimen characteristics permitted.
The microbiological profile was recorded as:

- Culture-positive or culture-negative
- Monomicrobial or polymicrobial infection
- Gram-positive organisms
- Gram-negative organisms
- Aerobic organisms
- Anaerobic organisms
- Individual bacterial species isolated

Antimicrobial susceptibility testing was performed according to the laboratory's standard protocol and current applicable Clinical and Laboratory Standards Institute (CLSI) recommendations. The presence of multidrug-resistant organisms and extended-spectrum β-lactamase-producing organisms was documented wherever identified.

Histopathological Examination

Where tissue specimens were obtained during surgery, such as perforated bowel, appendix, gastric or duodenal tissue, or other pathological lesions, the specimens were submitted for histopathological examination.
Histopathological findings were recorded with particular attention to acute or chronic inflammation, ulceration, necrosis, granulomatous inflammation, tissue destruction, perforation-related changes, and malignant pathology, where present. The final histopathological diagnosis was correlated with the clinical and operative findings.

Assessment of Severity

Disease severity was assessed using relevant clinical and physiological parameters recorded at admission. Where applicable, a standardized severity scoring system such as the Acute Physiology and Chronic Health Evaluation II (APACHE II) score was calculated using the appropriate clinical and laboratory variables.
The relationship between disease severity and postoperative complications, length of hospital stay, intensive care requirement, and mortality was assessed.

Postoperative Management and Follow-up

Following surgery, patients received postoperative management according to their clinical condition. This included intravenous fluids, analgesia, antimicrobial therapy, nutritional support, wound care, drain management, and respiratory or organ support when required.
Patients requiring intensive monitoring or organ support were managed in the intensive care unit. Postoperative antimicrobial therapy was initially administered empirically and subsequently modified, where appropriate, according to culture and antimicrobial susceptibility results.
Patients were followed throughout their postoperative hospital stay. The following postoperative outcomes were recorded:

- Surgical-site infection
- Wound dehiscence
- Intra-abdominal collection/abscess
- Anastomotic leak
- Postoperative ileus
- Respiratory complications
- Acute kidney injury
- Sepsis/septic shock
- Multiorgan dysfunction
- Requirement for re-exploration

- Intensive care unit admission
- Duration of hospital stay
- In-hospital mortality

Study Outcomes

Primary Outcome

The primary outcome was the association between the clinicopathological and microbiological characteristics of perforation peritonitis and postoperative morbidity and mortality.

Secondary Outcomes

Secondary outcomes included:

1. Distribution of etiological causes and anatomical sites of perforation.
2. Description of operative and pathological findings.
3. Determination of the microbiological spectrum of peritoneal infection.
4. Assessment of antimicrobial susceptibility and resistance patterns.
5. Association of specific microorganisms and resistance patterns with postoperative complications.
6. Association of clinical and laboratory parameters with postoperative outcomes.
7. Association of disease severity and extent of peritoneal contamination with postoperative morbidity and mortality.
8. Assessment of duration of postoperative hospital stay and intensive care requirement.

Data Collection

All relevant demographic, clinical, laboratory, radiological, operative, pathological, microbiological, treatment, and postoperative outcome data were recorded in a structured study proforma. Each patient was assigned a unique study identification number to maintain confidentiality.

Statistical Analysis

Data obtained from the study were entered into a Microsoft Excel spreadsheet and analyzed using [SPSS version, 16.0]. Continuous variables were expressed as mean ± standard deviation for normally distributed data or as median with interquartile range (IQR) for non-normally distributed data. Categorical variables were expressed as frequency and percentage.

The normality of continuous variables was assessed using the Shapiro–Wilk test. For comparison of continuous variables between two groups, the independent-samples t-test was used for normally distributed variables and the Mann–Whitney U test for non-normally distributed variables. For comparison of categorical variables, the Chi-square test or Fisher's exact test, as appropriate, was used.

Associations between clinical, pathological, microbiological, and operative variables and postoperative outcomes were assessed using appropriate statistical tests. Variables demonstrating clinically relevant or statistically significant associations on univariable analysis were considered for multivariable logistic regression analysis to identify independent predictors of adverse postoperative outcomes. Results of regression analysis were expressed as odds ratios (ORs) with 95% confidence intervals (CIs).

Where appropriate, receiver operating characteristic (ROC) curve analysis was performed to evaluate the discriminatory ability of selected clinical or severity parameters for predicting postoperative morbidity or mortality. The area under the curve (AUC) was reported.

A two-sided p-value <0.05 was considered statistically significant.

Results

A total of 90 patients with perforation peritonitis who fulfilled the predefined eligibility criteria were included in the study. The demographic, clinical, operative, pathological, microbiological, and postoperative characteristics of the study population were evaluated.

The mean age of the study population was 48.7 ± 16.2 years, with patients ranging from 18 to 82 years. The majority of patients belonged to the 41–60-year age group (42.2%), followed by those aged >60 years (27.8%). There was a male predominance, with 63 (70.0%) males and 27 (30.0%) females.

Abdominal pain was the most frequent presenting symptom and was reported by all patients, while vomiting and fever were reported by 56.7% and 48.9% of patients, respectively. Clinical evidence of generalized peritonitis was present in 61 (67.8%) patients. Diabetes mellitus and hypertension were the most frequently observed comorbidities.

The mean duration of symptoms before presentation was 2.8 ± 1.7 days. A delay of more than 24 hours between symptom onset and hospital presentation was observed in 58 (64.4%) patients. Baseline clinical and laboratory characteristics are summarized in Table 1.

Table 1. Demographic, clinical and baseline laboratory characteristics of patients with perforation peritonitis (N=90)

Variable	n (%) / Mean ± SD
Age (years)	48.7 ± 16.2
18–30 years	15 (16.7)
31–40 years	12 (13.3)
41–50 years	21 (23.3)
51–60 years	17 (18.9)
>60 years	25 (27.8)
Sex	
Male	63 (70.0)
Female	27 (30.0)
Duration of symptoms >24 h	58 (64.4)
Generalized peritonitis	61 (67.8)
Abdominal pain	90 (100.0)
Vomiting	51 (56.7)
Fever	44 (48.9)
Abdominal distension	39 (43.3)
Diabetes mellitus	18 (20.0)
Hypertension	21 (23.3)
Mean haemoglobin (g/dL)	10.8 ± 2.1
Mean TLC (/mm³)	14,820 ± 5,760
Mean serum creatinine (mg/dL)	1.32 ± 0.74
Mean serum albumin (g/dL)	2.9 ± 0.6
Hypotension at presentation	19 (21.1)

The most common anatomical site of perforation was the duodenum, accounting for 29 (32.2%) cases, followed by ileum in 22 (24.4%) cases and appendix in 14 (15.6%) cases. Gastric perforation was observed in 11 (12.2%) patients, while colonic and jejunal perforations accounted for 8 (8.9%) and 6 (6.7%) cases, respectively.

Perforated peptic ulcer disease was the most common etiology, identified in 38 (42.2%) patients, followed by ileal perforation of infective/indeterminate etiology in 20 (22.2%) patients and appendicular perforation in 14 (15.6%) patients. Tubercular pathology was identified in 7 (7.8%) patients, while traumatic, malignant, and iatrogenic causes accounted for the remaining cases.

Generalized peritonitis was more frequently associated with small-bowel and colonic perforations than with localized perforations. The distribution of anatomical sites and etiologies is shown in Table 2, Figure 1

Table 2. Anatomical and etiological profile of perforation peritonitis (N=90)

Variable	n (%)
Anatomical site of perforation	
Duodenum	29 (32.2)
Ileum	22 (24.4)
Appendix	14 (15.6)
Stomach	11 (12.2)
Colon	8 (8.9)
Jejunum	6 (6.7)
Etiology	
Perforated peptic ulcer disease	38 (42.2)
Ileal perforation, infective/indeterminate	20 (22.2)
Appendicular perforation	14 (15.6)
Intestinal tuberculosis	7 (7.8)
Traumatic perforation	4 (4.4)
Malignancy	4 (4.4)
Iatrogenic perforation	3 (3.3)

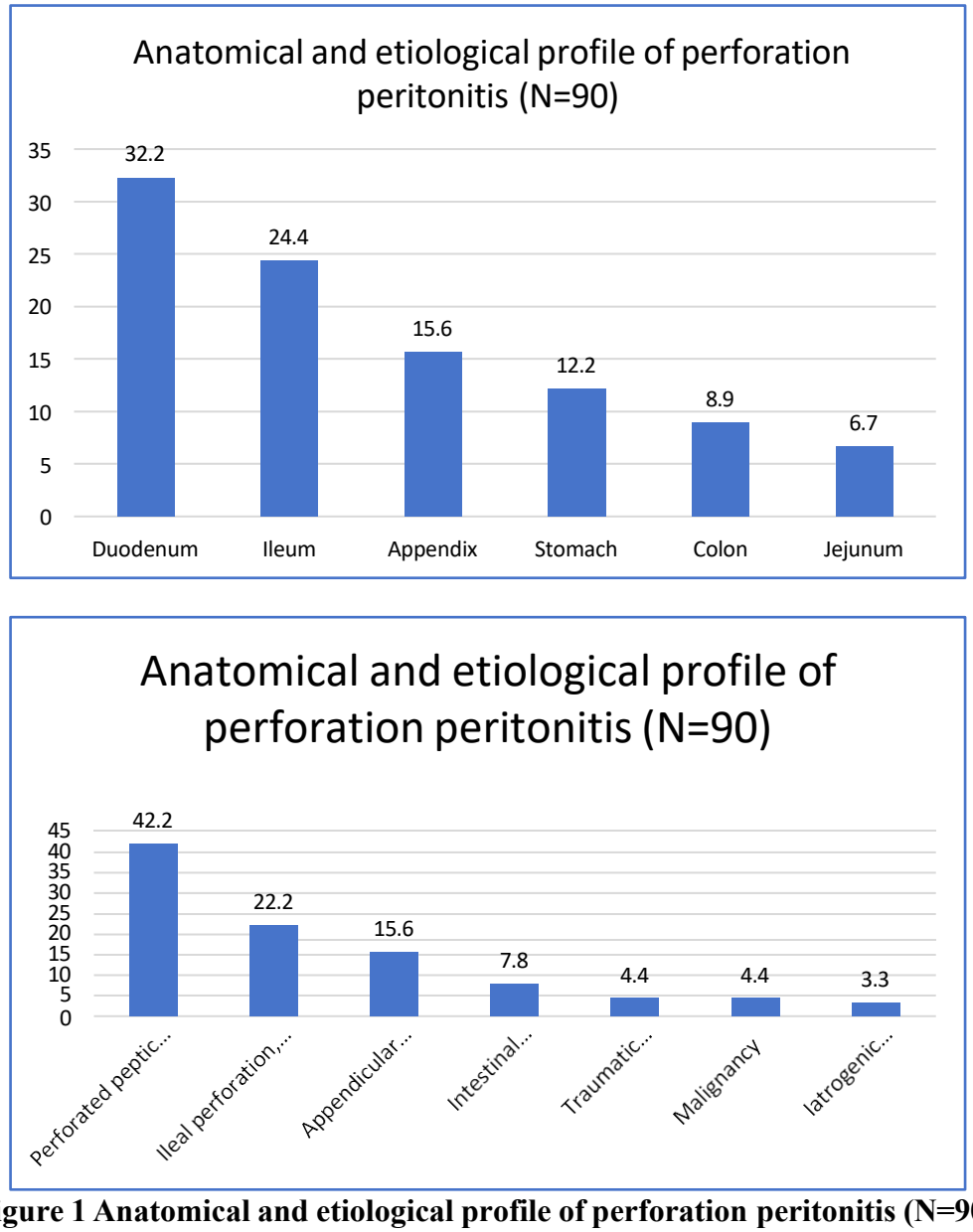


Figure 1 Anatomical and etiological profile of perforation peritonitis (N=90)

Generalized peritonitis was observed in 61 (67.8%) patients, whereas 29 (32.2%) had localized peritonitis. Purulent contamination was the most common type of contamination, occurring in 43 (47.8%) patients, followed by bilious contamination in 19 (21.1%), enteric contamination in 17 (18.9%), and feculent contamination in 11 (12.2%).

Bowel-wall necrosis was identified in 18 (20.0%) patients and intra-abdominal abscess or localized collection in 16 (17.8%). Histopathological examination was performed in patients in whom tissue specimens were obtained. Acute inflammatory changes were the predominant finding, while granulomatous inflammation and malignant pathology were identified in selected cases.

Primary repair with or without omental patch was the most frequently performed procedure, followed by resection with anastomosis and stoma formation. The operative and pathological findings are presented in Table 3.

Table 3. Operative and pathological findings (N=90)

Variable	n (%)
Extent of peritonitis	
Localized	29 (32.2)
Generalized	61 (67.8)
Type of contamination	
Purulent	43 (47.8)
Bilious	19 (21.1)
Enteric	17 (18.9)
Feculent	11 (12.2)
Bowel-wall necrosis	18 (20.0)
Intra-abdominal collection/abscess	16 (17.8)
Adhesions	24 (26.7)
Operative procedure	
Primary repair ± omental patch	46 (51.1)
Resection and anastomosis	21 (23.3)
Stoma formation	17 (18.9)
Other procedures	6 (6.7)
Histopathological findings	
Acute inflammatory changes	49 (54.4)
Chronic/active inflammation	17 (18.9)
Granulomatous inflammation	7 (7.8)
Necrosis/ulceration	11 (12.2)
Malignant pathology	4 (4.4)
Other/nonspecific findings	2 (2.2)

Peritoneal fluid or pus was submitted for microbiological examination in all patients. Culture positivity was observed in 72 (80.0%) patients, whereas 18 (20.0%) had no bacterial growth. Among culture-positive patients, 48 (66.7%) had monomicrobial infection and 24 (33.3%) had polymicrobial infection.

Gram-negative organisms predominated. Escherichia coli was the most frequently isolated organism, accounting for 28 isolates, followed by Klebsiella pneumoniae (18 isolates), Pseudomonas aeruginosa (9 isolates), and Enterococcus species (8 isolates). Other organisms included Staphylococcus aureus, Acinetobacter species, and anaerobic organisms.

Overall, multidrug-resistant organisms were identified in 25 (34.7%) of culture-positive patients, with ESBL-producing Enterobacterales representing an important proportion of resistant isolates. The microbiological profile is detailed in Table 4.

Table 4. Microbiological profile of peritoneal fluid/pus cultures

Microbiological finding	n (%)
Culture-positive patients	72 (80.0)
Culture-negative patients	18 (20.0)
Among culture-positive patients (n=72)	
Monomicrobial infection	48 (66.7)
Polymicrobial infection	24 (33.3)
Organisms isolated	
Escherichia coli	28 (38.9)
Klebsiella pneumoniae	18 (25.0)
Pseudomonas aeruginosa	9 (12.5)
Enterococcus spp.	8 (11.1)
Staphylococcus aureus	4 (5.6)
Acinetobacter spp.	3 (4.2)
Anaerobic organisms	2 (2.8)
Multidrug-resistant organisms	25 (34.7)
ESBL-producing organisms	18 (25.0)

Postoperative complications occurred in 39 (43.3%) patients. Surgical-site infection was the most common complication, followed by postoperative respiratory complications, wound dehiscence, intra-abdominal collection, and acute kidney injury. Re-exploration was required in 7 (7.8%) patients.

Patients with culture-positive peritonitis had a higher frequency of postoperative complications than culture-negative patients. Similarly, polymicrobial infection and isolation of multidrug-resistant organisms were associated with a greater proportion of postoperative complications.

Generalized peritonitis and feculent contamination were also associated with poorer postoperative outcomes. Patients with generalized peritonitis had a higher frequency of ICU admission, postoperative sepsis, and mortality compared with patients with localized peritonitis. These associations are presented in Table 5, Figure 2

Table 5. Association of clinical, operative and microbiological factors with postoperative complications

Variable	Complications present n/N (%)	Complications absent n/N (%)	p-value
Age >60 years	15/25 (60.0)	10/25 (40.0)	0.048
Symptoms >24 h	30/58 (51.7)	28/58 (48.3)	0.032
Generalized peritonitis	33/61 (54.1)	28/61 (45.9)	0.006
Feculent contamination	9/11 (81.8)	2/11 (18.2)	0.009
Bowel necrosis	12/18 (66.7)	6/18 (33.3)	0.028
Culture-positive	36/72 (50.0)	36/72 (50.0)	0.021
Polymicrobial infection	16/24 (66.7)	8/24 (33.3)	0.018
MDR organism	17/25 (68.0)	8/25 (32.0)	0.011

Hypoalbuminaemia	25/39 (64.1)	14/39 (35.9)	0.004
Hypotension at presentation	13/19 (68.4)	6/19 (31.6)	0.006

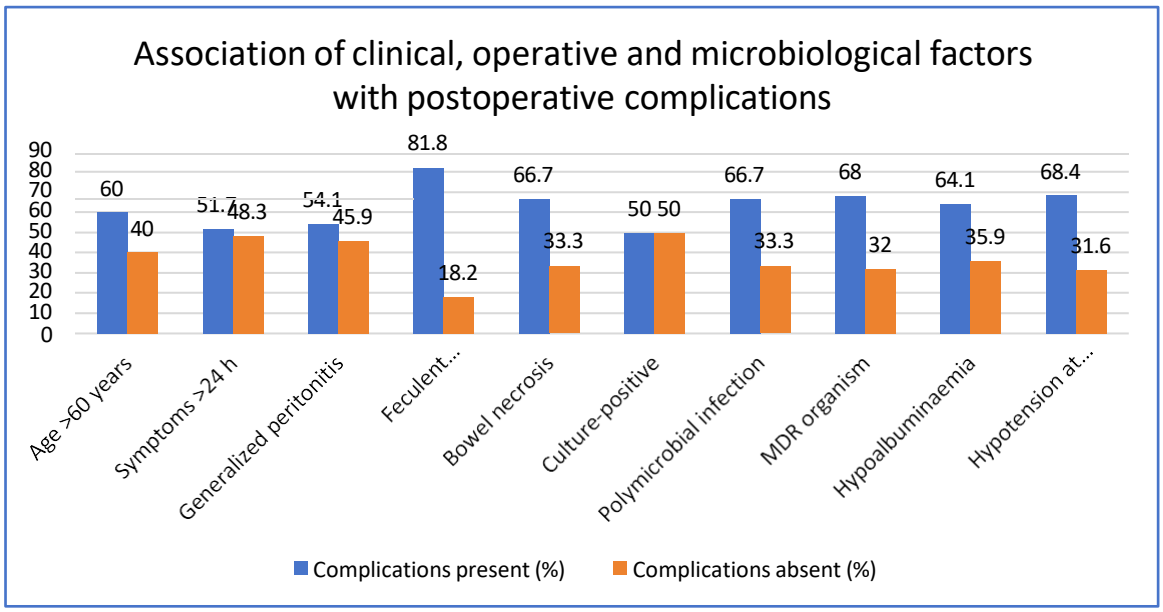


Figure 2 Association of clinical, operative and microbiological factors with postoperative complications

Of the 90 patients, 51 (56.7%) had an uncomplicated postoperative course, while 39 (43.3%) developed one or more postoperative complications. Surgical-site infection was observed in 19 (21.1%) patients, followed by respiratory complications in 13 (14.4%), wound dehiscence in 10 (11.1%), intra-abdominal collection in 9 (10.0%), and acute kidney injury in 8 (8.9%).

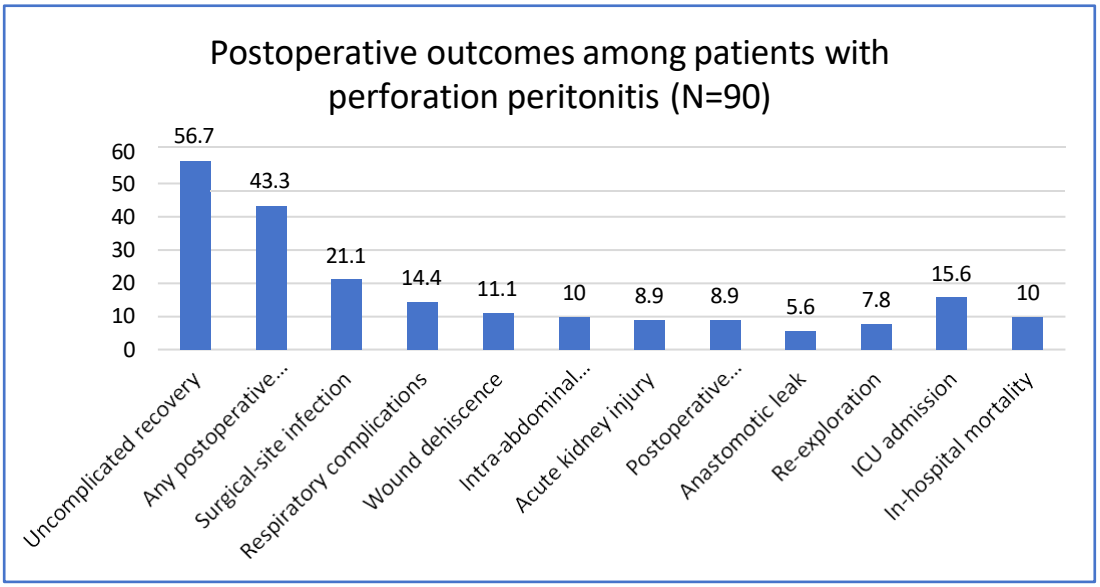
A total of 14 (15.6%) patients required intensive care admission, and 7 (7.8%) required re-exploration. The mean postoperative hospital stay was 10.6 ± 6.4 days. Overall in-hospital mortality was 9 (10.0%).

Mortality was higher among patients with generalized peritonitis, feculent contamination, hypotension, bowel necrosis, culture-positive infection, and multidrug-resistant organisms. The overall postoperative outcome profile is shown in Table 6, Figure 3

Table 6. Postoperative outcomes among patients with perforation peritonitis (N=90)

Postoperative outcome	n (%)
Uncomplicated recovery	51 (56.7)
Any postoperative complication	39 (43.3)
Surgical-site infection	19 (21.1)
Respiratory complications	13 (14.4)
Wound dehiscence	10 (11.1)
Intra-abdominal collection/abscess	9 (10.0)
Acute kidney injury	8 (8.9)
Postoperative sepsis/septic shock	8 (8.9)
Anastomotic leak	5 (5.6)
Re-exploration	7 (7.8)
ICU admission	14 (15.6)
Mean postoperative hospital stay (days)	10.6 ± 6.4

In-hospital mortality	9 (10.0)



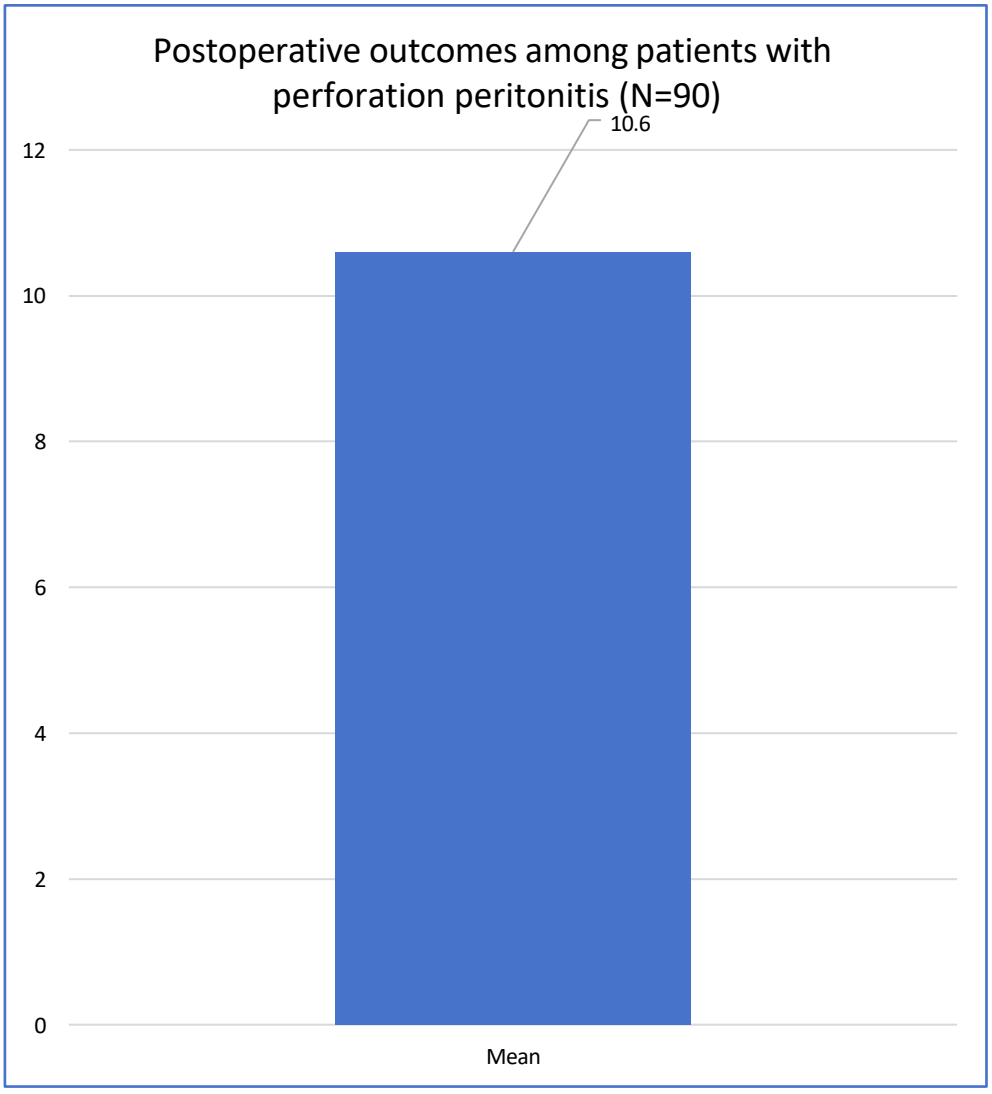


Figure 3 Postoperative outcomes among patients with perforation peritonitis (N=90)

Discussion

Perforation peritonitis is a major surgical emergency in which postoperative outcome is influenced by the patient's physiological status, anatomical site of perforation, extent of contamination, pathological changes, causative organisms, antimicrobial resistance, and timing of surgical intervention. The present study evaluated 90 patients and examined these clinicopathological and microbiological factors in relation to postoperative outcomes. In the present study, the mean age was 48.7 ± 16.2 years, with a male predominance (70.0%). Abdominal pain was present in all patients, while vomiting, fever, and abdominal distension were reported in 56.7%, 48.9%, and 43.3%, respectively. Generalized peritonitis was observed in 67.8%, and 64.4% presented more than 24 hours after symptom onset. Singh et al.,[14] in 84 patients, reported 17.8% mortality and identified age, duration of symptoms, biochemical abnormalities, Mannheim Peritonitis Index, and delay in surgery as important predictors of mortality. These findings support the importance of early presentation and timely intervention observed in the present study. Duodenal perforation was the commonest anatomical site in our study (32.2%), followed by ileal (24.4%) and appendicular (15.6%) perforation. Perforated peptic ulcer disease constituted the largest etiological group (42.2%).

organisms in perforation peritonitis. Their study found E. coli in 87.1% of culture-positive cases and reported sensitivity to amikacin in 85.18% of E. coli and 84.6% of Klebsiella isolates.

A larger recent study of 134 culture-confirmed peritonitis patients also found E. coli to be the predominant organism in secondary peritonitis (27.3%), followed by Enterococcus (15.4%), K. pneumoniae (13.6%) and Pseudomonas spp. (10.9%). The predominance of enteric Gram-negative organisms in both studies supports the importance of appropriate empirical coverage followed by culture-directed therapy. Antimicrobial resistance was an important finding in the present study. MDR organisms were identified in 34.7% of culture-positive patients and ESBL-producing organisms in 25.0%. Postoperative complications occurred in 68.0% of patients with MDR organisms (p=0.011) and 66.7% of those with polymicrobial infection (p=0.018). In comparison, the recent 134-patient study reported ESBL production in 63% of secondary-peritonitis-associated E. coli isolates and an overall 30-day mortality of 36.5%. The lower ESBL proportion in our study may reflect differences in patient population and institutional antimicrobial exposure.

Conclusion

Perforation peritonitis was associated with considerable postoperative morbidity and mortality, with outcomes influenced by delayed presentation, generalized peritonitis, extensive contamination, and pathological tissue damage. Escherichia coli and Klebsiella pneumoniae were the predominant organisms, with a substantial proportion of multidrug-resistant and ESBL-producing isolates. Postoperative complications were more frequent among patients with polymicrobial infection and antimicrobial-resistant organisms. An integrated clinicopathological and microbiological assessment, combined with early surgical source control and culture-directed antimicrobial therapy, may improve risk stratification and postoperative outcomes.

Limitations

The study was conducted at a single centre with a relatively small sample size of 90 patients, which may limit the generalizability of the findings. The observational design allowed identification of associations but could not establish causal relationships between clinicopathological or microbiological factors and postoperative outcomes. Variations in prior antibiotic exposure and timing of presentation may also have influenced culture positivity and antimicrobial susceptibility patterns. Longer-term outcomes after hospital discharge were not assessed.

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