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Original Research Article

A clinico-microbiological profile in patients with perforated peptic ulcer with special reference to anaerobic organisms: a descriptive study

Gowda D. B., Kadambari D., Vijayakumar C., Elamurugan T. P.*, Jagdish S.

Department of Surgery, Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry, India

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***Correspondence:**
Dr. Elamurugan T.P.,
E-mail: elamurugantp@gmail.com

ABSTRACT

Background: Gastrointestinal (GI) perforations have been surgical problems since time immemorial. Perforated peptic ulcer (PPU) is associated with aerobes, anaerobes and fungal infection. There is paucity of data regarding anaerobic isolates in perforated peptic ulcer. The purpose of the present study was to determine the clinico-microbiological profile of perforated peptic ulcer with special reference to anaerobes and to assess the impact of anaerobes on morbidity and mortality due to perforated peptic ulcer.
Methods: The present study included consecutive patients admitted and operated for PPU from September 2010 to June 2012. Pre-operative ultrasound guided peritoneal fluid aspirate was analysed for aerobic and anaerobic bacteria. Patients were followed until their discharge from the hospital or death. Correlation between clinical profile and anaerobic infection and morbidity and mortality associated with anaerobic infection were assessed.
Results: The study included 275 consecutive patients with PPU diagnosed intra-operatively. Anaerobic organisms were identified in 9.45% patients. Age > 50 years, lag period $\geq$ 48 hours, peritoneal contamination, length of hospital stay, presence of co-morbidities, shock at presentation, need for ventilator assistance, need for inotropes, chest infection, wound infection, intra-abdominal abscess, wound dehiscence and septicemia were found to be significantly associated with anaerobic infection ($p < 0.05$). Lag period >24 hours ($p = 0.018$) and chest infection ($p = 0.038$) were independent risk factors for mortality.
Conclusions: Anaerobic infection in peritoneal fluid was associated with an increase in morbidity but without a significant increase in mortality.

Keywords: Anaerobic infection, Morbidity, Mortality, Perforated peptic ulcer

INTRODUCTION

Gastrointestinal (GI) perforations have been surgical problems since time immemorial.GI perforation can occur anywhere from the oesophagus to the rectum. The most common cause of GI perforation in our country is peptic perforation.[1] Perforated peptic ulcer (PPU) is one of the most common surgical emergencies in South India.[2,3] Hospital admissions and elective operations for acid peptic disease have decreased in the recent years with the advent of effective medical therapy.[4] However, the incidence of PPU remains high.[5] Age, gender and co-morbid illness are risk factors for morbidity and mortality in PPU. Preoperative shock, lag period more than 24 hours and size of perforation are risk factors for post-operative morbidity. Mixed contamination with both aerobes and anaerobes are usually found in lower digestive tract perforations. Isolates from gastro-duodenal perforations are predominantly aerobes in most cases.[6] However, previous studies have documented presence of anaerobes in PPU.[6,7] There is a paucity of data both from India and abroad, on this topic. Hence this study was conducted to determine the clinico-microbiological profile of PPU with special reference to anaerobic bacteria.

METHODS

This descriptive study was conducted from September 2010 to June 2012 in the Department of General Surgery of a tertiary health care centre in South India. All consecutive patients admitted and operated for peptic ulcer perforation were included in the study and were followed until their discharge from the hospital or death. Hollow visceral perforations other than peptic ulcer perforation, patients who were managed conservatively, patients who died before surgery and those who had received antibiotics before the peritoneal fluid sample was collected were excluded from the study.

A detailed history was taken with respect to the onset of abdominal pain, duration between the onset of symptoms and presentation to hospital, presence of vomiting, abdominal distension, fever, constipation, decreased urine output and dyspnoea. The time delay from the onset of symptoms to surgery was recorded (lag period). The clinical condition of the patient at presentation, pulse rate, blood pressure and temperature were recorded. After recording the abdominal signs, patients were resuscitated with intravenous crystalloids and colloids. Those patients not responding to fluid resuscitation within two hours were started on inotropes. Co-morbidities including diabetes mellitus, hypertension, coronary artery disease, pulmonary tuberculosis, bronchial asthma and renal failure were also noted. Blood investigations (blood urea, serum creatinine, serum electrolytes and haemoglobin) were performed. An erect chest radiograph was done in all patients to look for pneumo-peritoneum.

After the initial resuscitation, patients were subjected to ultrasound (US) guided peritoneal fluid aspiration and two ml was immediately transferred to Robertson Cooked- Meat medium for anaerobic culture. The specimens were transported to the microbiology laboratory only in cases where peptic ulcer perforation was diagnosed intra-operatively. In the laboratory, this peritoneal fluid was incubated at 37°C and sub-cultured at 48 hours, on neomycin blood agar, phenyl ethyl alcohol agar, brain heart infusion medium for anaerobic organisms and plain blood agar and Mac-Conkey medium for aerobic organisms. Finally, growth was assessed by morphology, microscopy and biochemical features.

The preoperative American Society of Anaesthesiologists (ASA) grading was documented. The intra-operative findings noted were site of perforation, size of perforation, nature and amount of peritoneal contamination. The initial choices of antibiotics were according to the hospital antibiotic policy. Relevant changes of antibiotics were carried out according to the culture and sensitivity reports. In the postoperative period, the need and duration of mechanical ventilation and inotropic support were recorded. Haemoglobin, total leukocyte count and the differential count were assessed. The postoperative complications recorded in the patients were surgical site infection (SSI), wound dehiscence, intra-abdominal abscess, chest infections, septicemia, renal failure and re-leak. In patients with SSI, intra-abdominal abscess, ventilator support, the microbiological profile was recorded with culture and sensitivity performed on appropriate specimens (swab, aspirate (US guided), sputum or tracheal aspirate and blood respectively). Septicemia was labelled only after getting the positive blood culture report. The duration of hospital stay was noted.

Patients were classified into four groups based on culture reports - culture negative, aerobes positive, anaerobes positive and mixed culture positive. The clinical parameters were compared between different culture groups. For the purpose of tabulation and analysis, patients with anaerobic infection constituted the “Anaerobes positive” group (n = 26) and the other patients constituted the “anaerobes negative” group (n = 249) (Table 1). The morbidity and mortality as well as the duration of hospital stay were compared between these two groups to assess the effect of anaerobes on the outcome of the patients. Chi-square test or Fisher exact test as appropriate was used to compare the categorical variables (distribution, frequency of different cultures and different anaerobic isolates). Univariate analysis was done to assess the preoperative and operative factors which were associated with an increased incidence of anaerobic infection and also to identify the postoperative complications which were associated with anaerobic infections. Multivariate logistic regression analysis was then performed on the factors significant on univariate analysis after adjusting for confounding variables to identify independent risk factors responsible for morbidity and mortality. SPSS software was used for analysis. Statistical analysis was carried out at 95% confidence interval and a p value < 0.05 was considered significant.

RESULTS

Ultrasound (US) guided aspiration was done in 386 consecutive patients presenting with features of hollow viscus perforation during the study period and intra-operatively 318 patients were diagnosed to have PPU. Since forty three patients had received antibiotics before reaching our institute, they were excluded and the remaining 275 patients were included in the study. Based on the culture reports, the study population was divided into four groups - culture negative (CN) - 108 (108/275; 39.2%); aerobic (A) positive 141 (141/275; 51.2%); anaerobic (AN) positive - 17 (17/275; 6.18%) and mixed culture (MC) positive for both aerobic and anaerobic organisms - 9 (9/275; 3.3%) (Table 1).

The mean age observed in the study population was 46.37±14.59 years (range from 13 to 85 years). The incidence of peptic perforation was highest in the fourth decade of life (71/275; 25.8%). Mortality was highest when patients were aged more than 50 years and the majority of the patients positive for anaerobic organisms were more than 50 years (65.38%) of age. Males predominated with a male: female ratio of 9.18:1. The mean lag period to surgery was associated with an increased incidence of anaerobic infections (p=0.000).We observed a significantly increased incidence of anaerobic organisms in patients with co-morbidities (p = 0.006) and shock (systolic blood pressure < 90 mmHg) at presentation (p = 0.001). There was an increased incidence of anaerobic organisms in patients with ASA III-IV (p = 0.000) (Table 2).

The operative characteristics associated with an increased incidence of anaerobic organisms included perforation size more than 5 mm in diameter (p = 0.001), purulent peritoneal fluid (p < 0.000) and peritoneal fluid > 1 litre (p < 0.000). All these factors were associated with higher chances of anaerobic infections (Table 2).

Peritoneal fluid culture was negative in 108 (39.2%) patients. A single micro-organism was isolated in 115 (41.8%) patients and two or more organisms were isolated in 52 (18.9%) patients. Escherichia coli was the most common aerobe isolated in 82 (54.67%) patients. *Bacteroides fragilis* was the most common anaerobe isolated in 17(65.38%) patients.

On univariate analysis need for mechanical ventilator support and inotropes was significantly higher in patients with anaerobic infections (p < 0.000). The incidence of chest (p < 0.000) and wound infections (p = 0.02), wound dehiscence, septicemia and mortality (p < 0.000) were found to be significantly higher when the patients had anaerobic infection (Table 3).

Table1: Patient groups based on microbiological characteristics.

Group	Number of patients N (%)	Combination groups N (%)
Culture negative	108	Anaerobe negative 249 (90.55)
Aerobes	141	
Anaerobes	17	Anaerobe positive 26 (9.45)
Mixed	9	

Table 2: Preoperative and operative factors associated with anaerobic infection univariate analysis.

Parameters		Anaerobes positive (n = 26)	Anaerobes negative (n = 249)	Odds ratio (OR, 95% CI)	P value
Age*		55.73±13.05	45.39±14.42	-	< 0.005
Gender	M	24 (92.3)	224 (90)	-	1.000
	F	2 (8.0)	25 (10)		
Lag period	≤48 hours	4 (15.4)	225 (90.4)	51.6 (16.4-162.1)	<0.005
	>48 hours	22 (84.6)	24 (9.6)		
Co-morbidity		7 (26.9)	19 (7.63)	4.5 (1.7-11.9)	0.006
Shock at presentation		16 (61.5)	70 (28.1)	4.1 (1.8-9.5)	0.001
ASA ≥ III		25 (96.2)	97 (38.9)	38.2 (5.2-294.0)	<0.005
Duodenal perforation		17 (65.4)	214 (85.9)	0.31 (0.1-0.7)	0.02
Perforation size (>5 mm)		4 (76.9)	5 (42.3)	4.5 (1.7-11.7)	0.001
Purulent contamination		26 (100)	152 (61.1)	33.9 (2.0-562.9)	<0.005
Peritoneal fluid (>1000 ml)		18 (69.2)	64 (25.7)	6.5 (2.7-15.7)	<0.005

Numbers in parenthesis are percentages.

Table 3: Comparison of postoperative complications and univariate analysis.

Parameters	Anaerobes positive (n = 26)	Anaerobes negative (n = 249)	Odds ratio (OR, 95% CI)	P-value
Ventilator support	24 (92.3)	52 (20.88)	45.5 (10.4-198.7)	< 0.005
Inotropes support	21 (80.76)	36 (40.46)	24.9 (8.8-70.1)	< 0.005
Chest infection	20 (76.92)	68 (27.30)	8.9 (3.4-23.0)	<0.005
SSI	17 (65.38)	99 (39.76)	2.9 (1.2-6.7)	0.02
Intra-abdominal abscess	4 (15.4)	14 (5.62)	3.1 (1.0-10.1)	0.077
Wound dehiscence	11 (42.31)	25 (10.04)	6.6 (2.7-15.9)	<0.005
Septicemia	26 (100)	18 (7.23)	15.5 (6.3-58.3)	< 0.005
Length of hospital stay (> 10 days)	15 (57.7)	73 (29.3)	3.8 (1.4-7.5)	0.007
Mortality	12 (46.1)	20 (8.03)	9.8 (4.0-24.1)	<0.005

Table 4: Multivariate logistic regression analysis for determining factors contributing to postoperative morbidity.

Factors*	Adjusted odds ratio (OR, 95% CI)	P-value
SSI		
ASA III or more	3.2 (1.4-7.4)	0.006
Purulent contamination	2.1 (1.1-4.2)	0.034
Chest infection		
ASA III or more	3.7 (1.4-9.7)	0.008
Purulent contamination	4.0 (1.5-10.8)	0.005
IA collections		
Wound dehiscence	9.6 (2.0-46.4)	0.005
Wound dehiscence		
ASA III or more	10.1 (1.0-99.0)	0.047
SSI	5.0 (1.2-20.5)	0.026
Intra-abdominal abscess	6.2 (1.4-26.9)	0.014
Septicemia		
Size of perforation(>5mm)	5.4 (1.4-21.2)	0.015
Chest infection	10.5 (2.3-46.9)	0.002
IA abscess	14.2 (2.2-92.3)	0.006
Anaerobic organisms positive	4.0 (1.0-15.7)	0.044
Length of hospital stay		
SSI	127.4 (26.9-602.7)	0.005
Septicemia	0.004 (0.0-0.03)	0.005
Contamination(>500ml)	6.3 (1.0-38.1)	0.045
Purulent contamination	2.8 (1.1-7.5)	0.036
Chest infection	5.3 (1.7-17.2)	0.005

***** Risk factors for morbidities given under headings.

Table 5: Multivariate logistic regression analysis for determining factors contributing to postoperative mortality.

Parameters	Adjusted odds ratio (OR, 95% CI)	P-value
Age	1.3 (0.3-6.3)	0.746
Lag period	27.6 (1.8-428.4)	0.018
Co-morbidity	1.4 (0.1-31.6)	0.819
ASA	2.9 (0.0)	0.996
Size of perforation	1.0 (0.1-11.5)	0.980
Amount of peritoneal contamination	1.8 (0.0)	0.997
Nature of contamination	2.2 (0.0-145.9)	0.713
Anaerobes positive	0.3 (0.0-29.2)	0.623
Anaerobes negative	1.7 (0.0-139.3)	0.812
Chest infection	14.5 (1.2-180.2)	0.038
Wound infections	0.0 (0.0)	0.996
Wound dehiscence	0.6 (0.1-3.5)	0.578
Septicemia	6.2 (0.0)	0.995
Re-leak	0.3 (0.0-4.0)	0.343

On logistic regression analysis, anaerobic infection contributed significantly only to septicemia. The other significant contributing factors for morbidity in the form of various postoperative complications have been shown in Table 5.

Multivariate analysis for mortality showed lag period ($p = 0.018$) and chest infections ($p = 0.038$) to be significantly associated with an increase in mortality (Tables 4, 5).

DISCUSSION

Peritonitis due to PPU is associated with various microbial agents - aerobic bacteria, anaerobic bacteria and fungi. Isolates from gastro-duodenal perforations are almost always aerobes.[1] Fong et al and Shinagawa et al have isolated anaerobes in PPU.[2,3] In the present series of 275 patients of PPU, anaerobes were isolated from the peritoneal fluid in 9.45% patients. The reported rate of anaerobic infection peritonitis from ranges from 5.5% to

7.1%.[2,6,7] The higher isolation rate in our population may be attributed to the adoption of the following techniques. We aspirated peritoneal fluid before starting antibiotics, used appropriate transport medium for anaerobes (RCM) and incubation at 37°C in all cases.

Various prospective and retrospective studies have shown age and gender to be risk factors for morbidity and mortality in PPU. In our study, we found anaerobes to be commonly prevalent in 60 - 70 years (9/26; 34.62%) followed by 40 - 60 years age groups. In accordance with the trends seen in the previous studies in our institute, our study also documented that nearly 50% of the PPU patients belonged to the 30-50 years age group highlighting the socio-economic impact of this condition.[5-7]

Male to female ratio in this series was 9.2: 1. There is a wide variation in the gender distribution reported in literature in different studies.[3,8-10] Arveen et al reported male to female ratio of 10.3: 1 in their study.[3] A similar ratio was noted in a study from Pakistan.[11] This compares favourably with another study from our country.[10] A delay between the onset of symptoms and presentation to a health care facility was associated with a significantly higher isolation of anaerobes from the peritoneal fluid. Due to this delay, these patients more often presented with shock.

This may, in part, explain the fallacious association of complications in patients with anaerobic infection as compared to the anaerobe negative group. Pramod et al observed a higher incidence of Candida and mortality rate in patients presenting with mean delay of 44.3±18.3 hours.[12] This delay in presentation to the hospital has been earlier reported to be associated with increase in mortality.[3] We observed mortality to be >50% in patients undergoing surgery after 72 hours of lag period while only 0.6% (1/153) died when lag period was ≤24 hours. This could be due to long duration of decreased small bowel motility, increasing the rate of retrograde colonization of anaerobic organisms in the gastro-duodenum.

Medical illness is considered as a risk factor for the mortality in PPU.[13-19] Kim et al found no association between postoperative morbidity and co-morbid disease in PPU patients.[20] Sharma et al observed an associated medical co-morbidity in 31%.[21] Arveen et al reported co-morbid illness in 24 (7.3%) patients, one-third of whom died.[3] We observed a higher incidence of anaerobic organisms in patients with co-morbidity. Higher ASA grade has been reported to carry poor prognosis.[3,22,23] Kim et al observed higher ASA to be an independent risk factor for post-operative morbidity.[20] Larkin et al found no mortality in ASA I-III irrespective of treatment.[24]

In patients with ASA IV/V, the mortality was 54.5% with operative management and 52.9% with conservative management.[25] Arveen et al also reported higher grade ASA to be associated with an increase in mortality.[3] We noted a significantly higher incidence of anaerobic infection in patients with ≥ASA III which could explain the higher morbidity in anaerobe positive group. Boey et al and others reported that preoperative shock was an important risk factor for postoperative morbidity and mortality following a PPU.[14,16,18,20,22] Arveen et al found 17.7% of the patients with shock at presentation to have increased morbidity and mortality.[3] We also observed a higher incidence of shock at presentation in patients with anaerobic bacteria positive as compared to patients with anaerobic bacteria negative.

A study from Italy reported duodenal: gastric perforation ratio of 5.5: 1.[26] A ratio of 4.38: 1 was observed in Saudi Arabia during the years 1997-2006.[11] We recorded a ratio of 4.29:1 as compared to 3:1 by Arveen et al, Barut et al observed that site of perforation did not influence post-operative morbidity and mortality, but a perforation size of >5 mm was associated with increased post-operative morbidity and mortality.[3,22] A similar observation was made in the present study. Gupta et al reported 25% of all duodenal perforation to be > 1cm and that these patients had a significantly higher incidence of leak, morbidity and mortality.[10]

In a western study, intra-abdominal fluid greater than 200 cc has been reported to affect morbidity.[27] On the other hand, Eastern countries reported that when amount of peritoneal fluid was >500 cc, it had a significant increase in mortality, but its effect on morbidity was insignificant.[19] A mean volume of peritoneal fluid >1000 ml and purulent contamination have been associated with an increased rate of infection.[3] We noticed a higher incidence of anaerobic infections in patients with peritoneal fluid >1000ml and purulent contamination. We also noted that peritoneal fluid >500ml and purulent contamination were increased the morbidity.

In the present study, we noted patients presenting with shock at admission required postoperative mechanical ventilation and inotropes more often than those who were hemodynamically stable at admission, similar to Arveen et al and Pramod et al.[3,12] A study from our institute showed 25.9% patients had post-operative morbidity.[3] The most common complication was chest infection. The mean hospital stay in patients developing post-operative complications was 20±10.1 days. They also found age >60 years, female gender and lag period >24 hours, shock at presentation and co-morbid illness to be significantly associated with morbidity. Pramod et al noted a higher incidence of SSI, wound dehiscence, respiratory complications and septicemia in patients with positive fungal culture.[12] Study noted morbidity in the form of respiratory complications, SSI, wound dehiscence, intra-abdominal abscess and septicemia in the post-operative period. The presence of anaerobic infection was significantly associated only with a higher incidence of septicemia whereas lag period and chest infections emerged to be significant determinants of mortality.

CONCLUSION

Anaerobes were isolated from the peritoneal fluid in 9.45% patients. Age >50 years, lag period >48 hours, co-morbidity, perforation diameter >5 mm, peritoneal fluid >1000 ml and with purulent contamination were associated with increased anaerobic infection. Patients with anaerobic infection had higher incidence of chest infections, septicemia and need for life support with ventilator and inotropes in the post-operative period. Anaerobic infection in peritoneal fluid was associated with a significant increase in septicemia without a significant increase in mortality.

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