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Original Article

Surgery Section

Comparison of Laboratory Parameters and Outcomes in Perforation Peritonitis Patients before and after Peritoneal Drain Placement: A Prospective Cohort Study

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ABSTRACT

Introduction: Patients with perforation peritonitis present in the Emergency Department with various causes, but bowel perforation is the most frequent cause. These patients often arrive late at tertiary centres, resulting in severe peritoneal contamination and septic shock. Therefore, preoperative peritoneal drain placement provides adequate drainage and better outcomes in such cases.

Aim: To compare various clinical and laboratory parameters in patients with perforation peritonitis before and after the placement of a peritoneal drain, prior to any definitive surgical treatment.

Materials and Methods: A prospective cohort study was conducted in the Department of General Surgery at Kalpana Chawla Government Medical College in Karnal, Haryana, India, from October 2022 to June 2023. All cases of perforation peritonitis that were critically-ill or in shock upon presentation in the emergency department were planned for intraperitoneal drain placement before definitive surgery. A total of 140 patients were enrolled in the study, and their clinical parameters (temperature, pulse rate, SpO2, and urine output) and laboratory parameters (such as leucocyte count, electrolytes (Na+, K+, Ca++), pH, base excess, bicarbonate values, lactate, Random Blood Sugar (RBS), and haematocrit) were compared before and 24 hours after drain placement. Statistical analysis was performed using paired t-test.

Results: The mean age of the patients was 46.03±18.06 years, and 116 (82.85%) of the cases were male. The most common co-morbid condition was pulmonary disease {Chronic Obstructive Pulmonary Disese (COPD)/Asthma}, diagnosed in 96 (86.57%) cases. The most common perforation site was duodenal, followed by gastric and ileal, observed in 65 cases (46.42%), 23 (16.34%) cases, and 21 (15%) cases, respectively. There was a significant improvement in clinical parameters such as temperature, pulse rate, Saturation of Peripheral Oxygen (SpO_2), and urine output after drain placement (p-value <0.001). There was also an improvement in laboratory parameters including leucocyte count, electrolytes (Na+, K+, Ca++), pH, base excess, and bicarbonate values (p-value <0.001). The mortality rate was 20%, with 28 cases resulting in death.

Conclusion: Although preoperative intraperitoneal drain placement is not a standard surgical procedure for patients with perforation peritonitis, it resuscitates and stabilises the patient, thereby helping in reducing morbidity and mortality postoperatively.

Keywords: Base excess, Bicarbonate, pH

INTRODUCTION

Perforation peritonitis is the most frequently encountered surgical emergency, with a mortality rate of about 30% [1]. The most commonly reported age range is between 45 and 60 years, with a male-to-female ratio of 3:1 [2,3]. Peritonitis and intra-abdominal infection are not synonymous. Peritonitis denotes inflammation of the peritoneal cavity caused by bacteria or irritation from extravasated secreations [4,5]. Proximal gastric perforation is more common compared to distal perforations. Although laparotomy is the gold standard for perforation peritonitis patients, there are various alternative procedures available, such as primary peritoneal drainage, laparoscopic sanitation, Taylor's conservative method, and laparostomy [6-10].

Drains provide removal of pus, blood, and fluid, which are sources of bacterial proliferation and infection. Preoperative intra-peritoneal drain placement is practiced by surgeons in emergencies to stabilise and resuscitate critically-ill patients who are not suitable for immediate surgery under general anaesthesia. These patients exhibit symptoms such as feeble pulse, unrecordable blood pressure, rapid respiratory rate, low urinary output, low SpO_2, and cold and clammy peripheries. This procedure allows time to stabilise the patient before surgery and can be easily performed at primary health centres under local anaesthesia before transferring them to higher centres for definitive treatment [11-13].

Therefore, present study aimed to compare various clinical and laboratory parameters in patients with perforation peritonitis before and after the placement of a peritoneal drain, prior to any definitive surgical treatment.

MATERIALS AND METHODS

The present prospective cohort study was conducted in the Department of General Surgery at Kalpana Chawla Government Medical College in Karnal, Haryana, India from October 2022 to June 2023. Data collection was done after obtaining approval from the Institute Ethical Committee (IEC no: KCGMC/IEC/2022/134).

Inclusion criteria

- Critically-ill or shock patients presenting with perforation peritonitis in the emergency department.
- Patients who were not fit for surgery under general anaesthesia at the time of presentation.
- Patients with renal profile derangement due to dehydration and sepsis.

- Patients with sepsis-induced coagulopathy.
- Patients aged between 25 and 60 years, including both genders.

Exclusion criteria:

- Haemodynamically stable patients.
- Spontaneous bacterial peritonitis.
- Anastomotic leak peritonitis (postoperative).
- Sealed-off perforation managed conservatively.
- Peritonitis due to other causes such as pancreatitis, ruptured liver abscess, ruptured gall bladder, etc.
- Patients with other systemic illnesses or malignancies.

Sample size calculation: Last month, a total of 97 surgeries were performed. Out of these, 15 were exploratory laparotomies. Therefore, the prevalence of perforation peritonitis was 15/97*100=15.5%. The study utilised convenient sampling, and based on this prevalence, a minimum sample size of 140 patients was required.

Study Procedure

Vital signs of all the patients were recorded, and laboratory investigations were performed, including Complete Blood Count (CBC), Liver Function Test (LFT), Kidney Function Test (KFT), Serum electrolytes, coagulation profile (PT-INR), Arterial Blood Gas (ABG), and viral markers. ECG, RBS, and Chest X-ray (PA view) were also done at the time of admission. Subsequently, an intraperitoneal drain was placed, and the patients were optimised with fluids, blood, blood products, and broad-spectrum antibiotics. Nasogastric decompression and a urinary catheterisation were performed. Clinical parameters such as temperature, pulse rate, SpO2, and urine output, as well as laboratory parameters including leucocyte count, electrolytes (Na+, K+, Ca++), pH, base excess, bicarbonate values, lactate, RBS, and haematocrit, were re-evaluated 24 hours after drain placement. After obtaining informed consent, the patients were shifted to the operation theatre for a definitive surgical procedure.

Operative technique: Percutaneous peritoneal drain placement was performed under local anaesthesia through a 2 cm incision in the left iliac fossa (on the lateral 1/3 and medial 2/3 of a line joining the anterior superior iliac supine and pubic tubercle). The external oblique aponeurosis, internal oblique, and transverse abdominis muscles were split under vision with the help of artery forceps. The index finger was swiped in all directions to protect the bowel and ensure adequate drainage. A wide-bored interabdominal Abdominal Drainage Kit (ADK) drain (size 32 FG) was placed through an incision into the pelvic cavity by the principal investigator. Once the patient was optimised, they underwent a standard laparotomy for a definitive surgical procedure.

STATISTICAL ANALYSIS

The statistical analysis was conducted using IBM Statistical Package for Social Science (SPSS) version 20.0. The analysis utilised paired t-test. Measures of central location (mean and median) and measures of dispersion (Standard Deviation {SD}) were used to estimate all quantitative variables. All statistical tests were considered significant at a two-tailed level of significance ($p<0.01$ and $p<0.05$).

RESULTS

A total of 140 patients were included in present study. The mean age of the patients was 46.03±18.06 years, with 83% of them being males. The most common co-morbid condition was pulmonary disease (COPD/asthma), diagnosed in 68.57% of patients [Table/Fig-1]. The most common site of perforation was the duodenum (46.42%), followed by the stomach (16.34%), and then the ileum (15%). Only a single case of sigmoid perforation was encountered [Table/Fig-2].

Variables		n	%
Age (y)	≤50	45	32.14
	>50	95	67.85
Gender	Male	116	82.85
	Female	24	17.14
co-morbidities	Diabetes	26	18.57
	Hypertension	35	25
	IHD	28	20
	Asthma/COPD	96	68.57

[Table/Fig-1]: Demographic profile and co-morbidities.
IHD: Ischaemic heart disease

Site of perforation	n	%
Duodenal	65	46.42%
Gastric	23	16.42%
Jejunal	9	6.42%
Ileal	21	15.00%
Appendix	12	8.57%
Colonic	2	1.42%
Meckel's diverticulum	5	3.57%
Gall bladder perforation	2	1.42%
Sigmoid	1	0.71%

[Table/Fig-2]: Site of perforation (Intraoperative finding).

There was a significant improvement in the clinical parameters of the patients, including temperature, pulse rate, respiratory rate, SpO_2, and urine output, after drain placement (p-value <0.001) [Table/Fig-3]. There was also improvement in White Blood Cell (WBC) counts, electrolytes (Na+, K+, Ca++), blood urea, serum creatinine, pH, base excess, and bicarbonate levels after drain placement (p-value <0.001). The values of lactate, RBS, and haematocrit were not statistically significant after intraperitoneal drain placement [Table/Fig-4,5]. The mean duration of operative time was 70±3.26 minutes, and the mean duration of Intensive

Parameters	Mean±SD	Std. Error mean	t-test	Two-sided p	95% CI of difference lower	upper
Temp. 1	101.481±1.02055	0.08625	17.736	<0.001	1.749	2.18796
Temp. 2	99.5131±0.87978	0.07436				
PR. 1	112.20±7.252	0.613	11.436	<0.001	12.383	17.560
PR. 2	97.23±13.315	1.125				
RR. 1	28.29±3.725	0.315	15.996	<0.001	5.258	6.742
RR. 2	22.29±2.309	0.195				
SpO_2. 1	93.14±2.190	0.185	-17.528	<0.001	-4.610	-3.676
SpO_2. 2	97.28±1.465	0.124				
Urine O/P1	300.36±58.647	4.957	-8.015	<0.001	-84.774	-51.226
Urine O/P2	368.36±78.196	6.609				

[Table/Fig-3]: Paired sample statistics of vitals and urine output.
Note: Parameter 1 is before Intraperitoneal drain placement and parameter 2 is after drainage of contaminated fluid

Parameters	Mean±SD	Std. Error mean	t-test	Two-sided p	95% CI of difference lower	upper
TLC. 1	14.9453±4.71938	0.39886	10.003	<0.001	3.61861	5.40148
TLC. 2	10.4353±2.31676	0.19580				
Na+. 1	122.56±4.585	0.388	-14.438	<0.001	-8.194	-6.220
Na+. 2	129.76±3.383	0.286				

K+. 1	3.4187±0.84294	0.07124	-6.321	<0.001	-0.72063	-0.37724
K+. 2	3.9676±0.56663	0.04789				
Ca2+. 1	7.0133±0.59709	0.05046	-15.536	<0.001	-1.98499	-1.53678
Ca2+. 2	8.7742±1.09290	0.09237				
Urea. 1	75.07±16.626	1.405	11.029	<0.001	15.518	22.297
Urea. 2	56.16±11.717	0.990				
Creat. 1	1.7798±0.76930	0.06502	7.469	<0.001	0.40850	0.70263
Creat. 2	1.2242±0.45011	0.03804				
RBS. 1	116.83±38.408	3.246	0.381	0.704	-6.695	9.895
RBS. 2	115.23±35.365	2.989				

[Table/Fig-4]: Paired sample statistics of biochemical parameters.
Creat: Creatinine: TLC: Total leucocyte count

Parameters	Mean±SD	Std. Error mean	t-test	Two sided p	95% CI of difference lower	upper
Lactate. 1	6.3834±2.02204	0.17089	-1.961	0.052	-0.99705	0.00418
Lactate. 2	6.8798±2.02400	0.17106				
pH. 1	7.0878±0.11541	0.00975	7.0878	<0.001	0.11541	0.00975
pH. 2	7.2065±0.05727	0.00484				
Base excess 1	-7.64±5.133	0.434	-15.101	<0.001	-7.852	-6.034
Base excess 2	-0.69±1.937	0.164				
HCO^{3-}. 1	17.84±2.651	0.224	-12.474	<0.001	-4.328	-3.144
HCO^{3-}. 2	21.58±2.545	0.215				
Hct. 1	34.21±4.308	0.364	0.402	0.688	-0.756	1.141
Hct. 2	34.02±3.553	0.300				

[Table/Fig-5]: Paired sample statistics of ABG analysis.
Hct: Haematocrit

Care Unit (ICU) stay was six days. A total of 36 patients (25.71%) had postoperative fever, 31 patients (22.14%) had wound infection in the postoperative period, and 28 patients expired, resulting in a mortality rate of 20%.

DISCUSSION

In present study, the mean age of the patients was 46.03±18.06 years, with 82.85% (116/140) being male. This is consistent with the findings of Baloch I et al., and Afridi SP et al., who also reported a male preponderance [14,15]. A total of 43.57% (61 patients) presented in the emergency department with a duration of symptoms exceeding 72 hours, indicating delayed presentation. This could be attributed to seeking treatment from nearby centres or local practitioners before reaching a tertiary center. Kocer B et al., reported that delayed presentation after 24 hours is associated with increased morbidity [16].

The most common site of perforation in in present study was the duodenum (46.42%), followed by the stomach (16.34%), and then the ileum (15%). Appendicular perforation was found in 8.57% of cases. This is consistent with the findings of Chakma SM et al., who reported similar rates of duodenal and appendicular perforation [17]. Smith I et al., considered base deficit and bicarbonate levels as prognostic markers in ICU patients, with lower base deficit and higher bicarbonate levels associated with increased mortality [18]. In present study, pH, base excess, and bicarbonate values significantly improved after intraperitoneal drain placement (p-value <0.001), indicating reduced morbidity and mortality in these patients. The mortality rate in present study was 20% (28 out of 140 patients), which is comparable to the study conducted by Baloch I et al., (16% mortality) [14]. Among these 28 patients, 23 had associated asthma/COPD.

A study by Kareem T et al., in 2021 during the Coronavirus Disease-2019 (COVID-19) pandemic reported that intraperitoneal drainage early in the management of perforation peritonitis decreased morbidity and mortality in COVID-19 infected patients [19]. Intraperitoneal drainage significantly improved the physiological status of the patients and aided in their resuscitation [20]. Stable patients with bowel perforation without signs of peritonitis and radiological evidence of sealed perforation can be managed conservatively [21]. Delayed presentation, old age, and co-morbidities such as pulmonary disease, coronary arterial disease, and diabetes mellitus are poor prognostic factors associated with higher mortality rates. Early diagnosis and control of septicaemia may lead to more favourable outcomes [19].

Limitation(s)

The present study had certain potential limitations. It was a unicentric, prospective observational study with a limited sample size. Additionally, authors did not compare the outcomes between the drain and no-drain groups.

CONCLUSION(S)

Preoperative drain placement resulted in significant improvement in vitals and biochemical parameters, leading to reduced mortality and morbidity in patients with perforation peritonitis. This procedure can be performed even at primary health centres under local anaesthesia using the described technique. After drain placement, patients can be safely transferred to a higher centres for further management, such as definitive surgery.

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