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ORIGINAL ARTICLE

A Clinical Study on Hollow Viscus Perforation and Its Management in a Tertiary Care Hospital

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Abstract

Background: A common emergency of the abdomen with a significant morbidity and fatality rate is gastrointestinal perforation. In the treatment of perforation, surgery is important. Scoring systems are required for prognosis, comparing, and auditing surgical procedures.

Methods: A prospective study conducted at a single center with a sample of 100 individuals who had hollow viscus perforation was carried out. Investigations or a laparotomy were used to confirm the diagnosis. The death rate, anastomotic leak, dehiscence, infection, and respiratory issues, as well as hospital and intensive care unit stays were all followed prospectively over a 30-day period for all patients.

Results: Duodenal perforation was the commonest among hollow viscus perforations. The 20–40 age range was the most severely affected. Males suffer more than females. Complications can be avoided with a correct early diagnosis and suitable treatment. The site, size, age, and number of perforations all affect the surgical method. P-POSSUM and APACHE II scores were strongly correlated with outcomes such as post-operative wound dehiscence, respiratory issues, ICU stay, and hospital stay. When predicting mortality, POSSUM score was found to be superior to MPI.

Conclusions: Gastrointestinal perforations result in substantial morbidity and occasionally fatality. The most frequent reason for an acute abdomen requiring prompt, effective surgical intervention is hollow viscus perforation. Complications can be avoided with an accurate early diagnosis and sufficient treatment. The surgical strategy is determined by the perforation's location, size, age, and quantity.

Keywords: Abdominal emergency, Morbidity, Mortality, Clinical presentation

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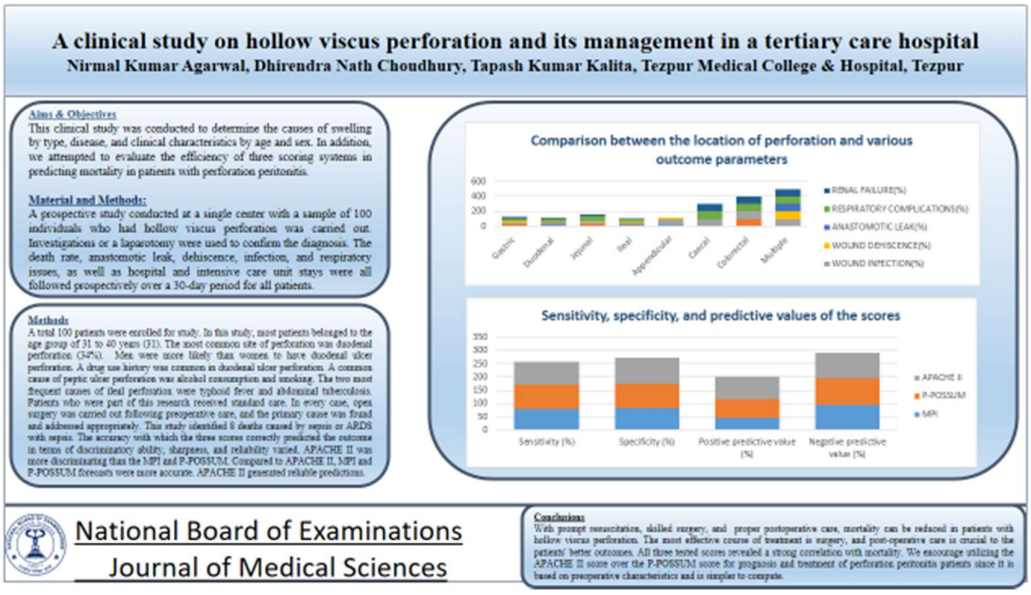
Graphical Abstract



Introduction

A serious abdominal emergency with a high fatality and morbidity rate is a perforation of the digestive tract. [1]. Patients frequently arrive later than expected, which delays intervention and raises morbidity and death [2]. The majority of problems from peptic ulcers result in perforation of the stomach and duodenum. Due to sepsis brought on by peritoneal contamination with mixed microbiology, gastrointestinal perforation has a significant mortality rate [3]. Treatment for peritonitis caused by hollow viscus perforation is complicated and involves critical care, surgery, and resuscitative measures [4]. Understanding prognosis and directing therapeutic response need early diagnosis and risk classification. For this reason, several scoring systems have been developed, including P-POSSUM, APACHE, the Mannheim Peritonitis Index, etc.

The twelve parameters that make up the Portsmouth - Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (P-POSSUM) score are based on physiological characteristics, past medical history of heart and lung conditions, and age. It was first defined in 1991. Additionally, it has six functional components. Portsmouth changed it since the first score exaggerated mortality [5]. Age, twelve physiological indicators, and points for chronic health make up the Acute Physiological and Chronic Health Evaluation II (APACHE II) score, which was originally published in 1985.

This clinical investigation was conducted to identify the etiological causes, incidence by age and sex, and clinical characteristics of different types of perforations. Additionally, it examines the typical types of perforations, their postoperative consequences, and their appearances. Finally, we attempted to assess how well three distinct scoring systems predicted the risk of death in patients suffering from peritonitis due to a perforation of the hollow viscus.

Methodology

In our investigation, an examination of 100 cases of abdominal hollow viscus perforations was done

prospectively. Cases were chosen at random from patients admitted to the surgery ward. Based on the history and physical examination, a clinical diagnosis of hollow viscus perforation was made, which was later supported by tests or a laparotomy.

Inclusion Criteria:

1. Patients older than 12 years of age.

2. Patients having a laparotomy or an investigation that confirms a clinical diagnosis of hollow viscus perforation.

Exclusion Criteria:

1. Age 12 years or younger.
2. Patients undergoing emergency explorative laparotomy due to other causes like abdominal trauma

A comprehensive clinical history was taken, detailing the symptoms for as long as they persisted, including fever, vomiting, changes in bowel habit, pain in the abdomen, and distension. It was determined if the patient has a history of co-occurring conditions such as diabetes and hypertension. Details about any important cardiac or respiratory history, invasive procedure history, drug use history, and personal history were recorded.

The patient underwent a general examination, which included measuring the patient's temperature, pulse, blood pressure, respiratory rate, and Glasgow Coma Scale (GCS).

The patient underwent a thorough abdominal examination, looking for discomfort, guarding, rigidity, and a palpable mass. The respiratory, cardiovascular, and neurological systems were all examined as part of the remaining systems.

All of the participants underwent routine blood examinations that comprised a complete hemogram, blood grouping and type, viral markers, renal function test, and a urinary albumin and sugar test. An X-ray plain picture abdomen erect was done to identify free gas under the diaphragm (lateral decubitus X-ray in unstable individuals). In suspected cases of intestinal perforations, a Widal test was performed. Additionally, CECT abdomen and Ultrasonography were done. Computed tomography of the abdomen was not performed on patients who had pyoperitoneum or open air under the diaphragm as shown on an erect abdomen x-ray.

Vital signs were carefully monitored in all cases and fluid and electrolyte balance was corrected before surgery. Blood cultures were taken and empiric antibiotics were started, then adjusted according to the culture and sensitivity report.

Exploratory laparotomy was performed in all cases under general anesthesia. A right paramedian, upper midline or lower midline incision was made according to the suspected perforation site. The internal organs were carefully inspected, the puncture site was identified and the corresponding surgical procedure was performed. Intraoperative findings of complete blood loss, perforation site, malignancy, and peritoneal contamination were noted. The peritoneum was washed with normal saline and the abdominal cavity was emptied. Postoperatively, patients were administered continuous nasogastric aspiration of intravenous fluids and antibiotics. Vital signs were observed. Parameters such as wound soakage, presence of bowel sounds, chest infections, postoperative shock, and postoperative stay were noted. Wound swab culture sensitivity was sent when indicated. Intake and output studies were conducted. The patient's recovery was observed and any complications

that occurred during the course were recorded.

Data regarding patient demographics, diagnosis, laboratory tests, surgical procedures, and outcomes were collected on case record forms. All these data were converted into a master chart and an individual assessment was made for each patient using the following scoring system (Figures 1-3). Individual scores were calculated for each patient. The accuracy of the scoring system was evaluated.

Quantitative techniques based on probabilities were used to evaluate the APACHE, P-POSSUM, and MPI scores' propensity to predict outcomes. As performance criteria, discriminatory ability, sharpness, and dependability were statistically assessed [6].

I. *Discriminatory ability*

What are the differences, as shown by the area under the receiver-operator characteristic (ROC) curve [7], between the percentage of correct predictions in the group of survivors (specificity) and the percentage of correct predictions in the group of non-survivors (sensitivity)?

2. *Sharpness*

How certain are the predictions?

3. *Reliability*

How well do mortality predictions and actual mortality match up?

Physiologic Variable	Points								
	+4	+3	+2	+1	0	+1	+2	+3	+4
1. Temperature (°C)	≥41	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	≤29.9
2. Mean arterial pressure (mmHg)	≥160	130-159	110-129		70-109		50-69		≤49
3. Heart rate (/min)	≥180	140-179	110-139		70-109		55-69	40-54	≤39
4. Respiratory rate (/min)	≥50	35-49		25-34	12-24	10-11	6-9		≤5
5. Oxygenation (mmHg) a. A-aDO_2 if FiO_2 ≥0.5 b. PaO_2 if FiO_2 <0.5	500	350-499	200-349		<200 >70	61-70		55-60	<55
6. Acid-base balance a. Arterial pH b. Serum HCO_3 (mEq/l) if no arterial blood gas	≥7.7 ≥52	7.6-7.69 41-51.9		7.5-7.59 32-40.9	7.33-7.49 22-31.9		7.25-7.32 18-21.9	7.15-7.24 15-17.9	<7.15 <15
7. Sodium (mEq/l)	≥180	160-179	155-159	150-154	130-149		120-129	111-119	≤110
8. Potassium (mEq/l)	≥7	6-6.9		5.5-5.9	3.5-5.4	3-3.4	2.5-2.9		<2.5
9. Creatinine (mg/dl)	≥3.5	2-3.4	1.5-1.9		0.6-1.4		<0.6		
10. Hematocirt (%)	≥60		50-59.9	46-49.9	30-45.9		20-29.9		<2.5
11. White blood count (×1000/mm^3)	≥40		20-39.9	15.19.9	3-14.9		1-2.9		<1
12. Glasgow Coma Score (GCS)	Score = 15 minus actual GCS								
A. Total Acute Physiology Score (sum of 12 above points)									
B. Age points (years) ≤44=0; 45 to 54=2; 55 to 64=3; 65 to 74=5; ≥75=6									
C. Chronic Health Points*									
Total APACHE II Score (add together the points from A+B+C)									

* Chronic Health Points: If the patient has a history of severe organ system insufficiency or is immune-compromised as defined below, assign points as follows:
5 points for non-operative or emergency post-operative patients
2 points for elective post-operative patinets

Figure 1. APACHE II score [20]

Risk factor	Score
Age > 50 years	5
Female sex	5
Organ failure*	7
Malignancy	4
Preoperative duration of peritonitis > 24 h	4
Origin of sepsis not colonic	4
Diffuse generalized peritonitis	6
Exudates:	
Clear	0
Cloudy, purulent	6
Fecal	12

Figure 2: Showing Mannheim Peritonitis Index.

POSSUM score	1	2	4	8
Physiological parameters				
Age (years)	<60	61–70	≥71	
Cardiac signs	Normal	Cardiac drugs/Steroids	Edema/Warfarin	Raised JVP/cardiomegaly
CXR	Normal		Borderline cardiomegaly	Cardiomegaly
Respiratory signs	Normal	SOB exertion	SOB stairs	SOB rest
CXR	Normal	Mild COPD	Mod COPD	Any other signs
Systolic BP (mmHg)	110–130	131–170	≥171	≤89
		100–109	90–99	
Pulse rate	50–80	81–100	101–120	≥121
		40–49		
GCS	15	12–14	9–11	≤8
Hb (g/dl)	13–16	11.5–12.9	10–11.4	≤9.9
		16.1–17	17.1–18	≥18.1
WBC × 10^{12}/l	4–10	10.1–20	≥20.1	
		3.1–3.9	≤3	
Urea	≤7.5	7.6–10	10.1–15	≥15.1
Na^+	≥136	131–135	126–130	≤125
K^+	3.5–5	3.2–3.4	2.9–3.1	≤2.8
		5.1–5.3	5.4–5.9	≥6
ECG abnormality	Normal		AF (60–90)	Any other change
Operative parameters				
Operative magnitude	Minor	Intermediate	Major	Major+
No. of operations within 30 days	1		2	>2
Blood loss per operation (ml)	<100	101–500	501–999	>1000
Peritoneal contamination	No	Serous	Local pus	Free bowel contents, pus or blood
Presence of malignancy	No	Primary cancer only	Nodal metastases	Distant metastases
Timing of operation	Elective		Emergency resuscitation possible: operation <24 h	Emergency: immediate operation <2 h

Figure 3. P-POSSUM score [21]

Results

In this study, most patients belonged to the age group of 31 to 40 years (31) as shown in Table 1. Seventy seven patients (77%) were male and 23 female patients (23%) as shown in Table 2. The most common site of perforation was duodenal perforation (34%), followed by appendicular perforation (25%) as shown in Table 3. Men were more likely than women to have duodenal ulcer perforation, which happened in the first part of the duodenum (Table 4). A drug use history was common in duodenal ulcer perforation. A common cause of peptic ulcer perforation was alcohol consumption and smoking. The two most frequent causes of ileal perforation were typhoid fever and abdominal tuberculosis.

All of the appendix perforation cases in this study featured symptoms like fever, vomiting, and pain, but there was no gas under the diaphragm. All cases of duodenal ulcer perforation showed all the above signs (Table 5).
Patients who were part of this research received standard care. In every case, open surgery was carried out following preoperative care, and the primary cause was found and addressed appropriately.

This study identified 8 deaths caused by sepsis or ARDS with sepsis (Table 6).

The median duration of symptoms for patients who survived was two days, whereas those who died did so for 4.5 days. Eight of the 24 patients who were in stage three or higher septic shock died. There were 22 patients with multiple organ failure, defined as a creatinine level > 177 umol/L, urea level > 167 mmol/L, or oliguria (urine output <20 ml/hour), intestinal obstruction/paralysis, pulmonary dysfunction, and shock (systolic blood pressure < 90 mmHg, mean arterial pressure < 60 mmHg).

The average hospital stay for survivors was seven days, compared to 3.5 days for patients who did not survive. The fact that patients with severe illnesses and earlier deaths presented later can help to explain this.

The accuracy with which the three scores correctly predicted the outcome in terms of discriminatory ability, sharpness, and reliability varied (Tables 7 and 8).

Table 1. Age distribution of patients

AGE (in YRS)	No. of Patients	Percentage
<20	4	4
21 - 30	14	14
31 - 40	31	31
41 - 50	25	25
51 - 60	15	15
>60	11	11
Total	100	100

Table 2: Sex distribution of patients

SEX	No. of Patients	Percentage
Male	77	77
Female	23	23
Total	100	100

Table 3: Site of perforation

Site of Perforation	No. of Patients	Percentage
Gastric	4	4
Duodenal	34	34
Jejunal	14	14
Ileal	20	20
Appendicular	25	25
Caecal	1	1
Colorectal	1	1
Multiple	1	1
Total	100	100

Table 4. Relation between sex and site of perforation

Sex	Gastric	Duodenal	Jejunal	Ileal	Appendicular	Caecal	Colorectal	Multiple	Total
Male	4	29	11	12	13	1	0	1	71
Female	0	5	3	8	12	0	1	0	29
Total	4	34	14	20	25	1	1	1	100

Table 5: Signs and Symptoms at the time of presentation

Signs & symptoms	No. of Patients
Fever	65
Pain abdomen	98
Vomiting	80
Distension	86
Constipation	40
Diarrhea	5
Tenderness	100
Guarding	95
Obliterated liver dullness	84
Free fluid	54
Absent bowel sound	88
Air under diaphragm	89

Table 6. Comparison between the location of perforation and various outcome parameters

LOCATION OF PERFORATION	FREQUENCY	MORTALITY (%)	WOUND INFECTION (%)	WOUND DEHISCENCE (%)	ANASTOMOTIC LEAK (%)	RESPIRATORY COMPLICATIONS (%)	RENAL FAILURE (%)
Gastric	4	25	25	25	0	25	25
Duodenal	34	11	17.6	0	0	41.1	11
Jejunal	14	14	35.7	7.1	0	71.4	14
Ileal	20	10	25	5	0	40	10
Appendicular	25	0	72	16	0	0	0
Caecal	1	0	100	0	0	100	100
Colorectal	1	100	100	0	0	100	100
Multiple	1	0	100	100	100	100	100

Table 7. Showing median scores and area under ROC curves of the three scores

Scores	Survived	Died	p-value	AUC
MPI	23.5	32.5	0.0000	0.95
POSSUM	39	57.5	0.0000	0.99
APACHE II	10	24	0.0000	0.96

Table 8. Showing sensitivity, specificity, and predictive values of the scores.

Score	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
MPI	80	82	46	96
P-POSSUM	91.5	94	70.5	98.75
APACHE II	85.8	98.5	86.67	97.5

Discriminatory ability

Figures 4-6 display the ROC curves that correlated sensitivity to specificity for various cut-off settings. According to the APACHE II curve, it was more discriminating than the MPI and P-POSSUM. For instance, the sensitivity of P-POSSUM was 91% with a fixed specificity (for instance, 80%), which was higher than MPI (80%) and APACHE II (85%). Throughout the whole range of values, this distinction remained constant.

Sharpness

In the majority of cases, APACHE II provided modest predictions of mortality. Compared to APACHE II, MPI and P-POSSUM forecasts were more accurate.

Reliability

Comparing observed and predicted death rates allowed authors to examine the reliability. APACHE II generated reliable predictions.

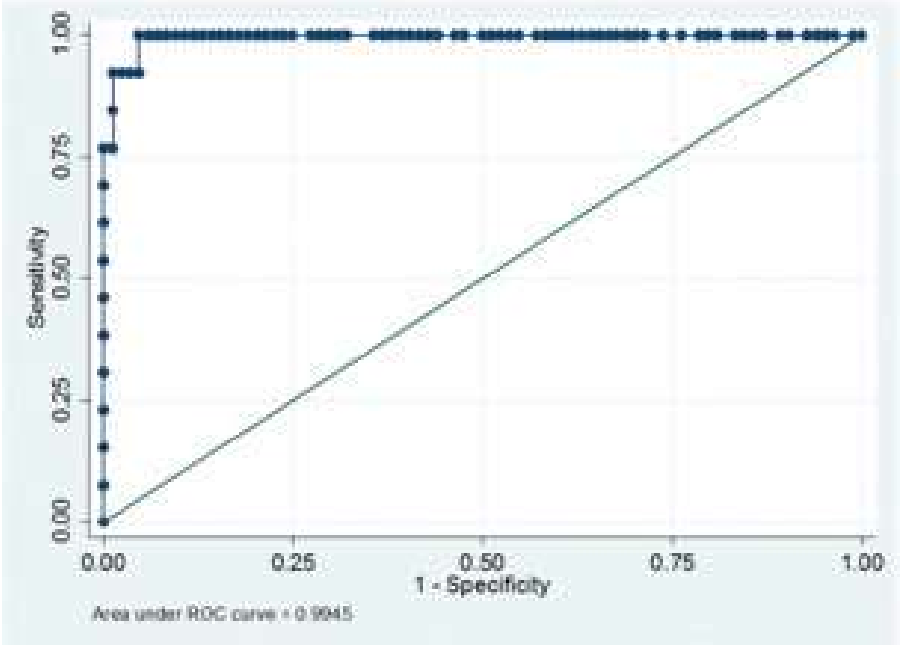


Figure 4. ROC curve for P-POSSUM score

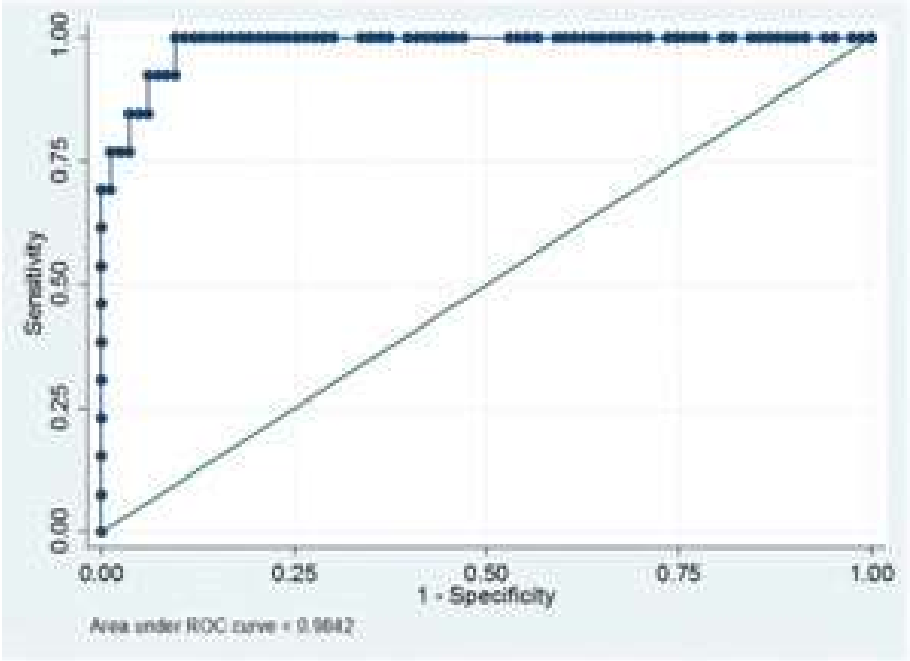


Figure 5. ROC curve for APACHE II score

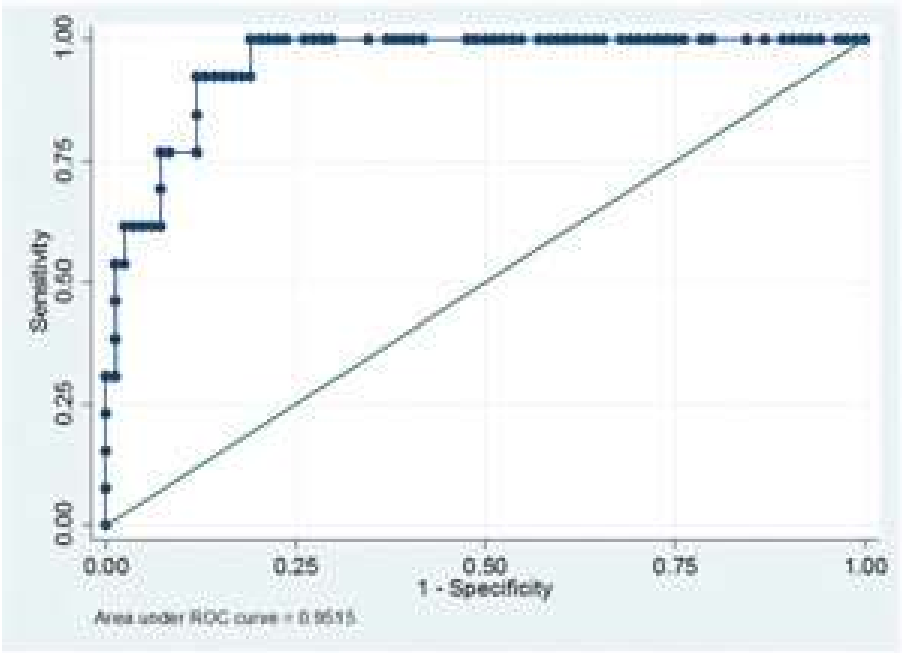


Figure 6. ROC curve for MPI score

Discussion

Perforation of the gastrointestinal tract is one of the main causes of abdominal pain in adults. Most patients with appendicular perforation have a history of constipation. Men are more likely to develop perforated duodenal ulcers, which typically happen in the first part. Additional reasons for gastrointestinal perforation included malignancy, iatrogenic injuries, acid reflux disease, enteric fever, amoebic colitis, and abdominal tuberculosis. Early diagnosis and urgent exploratory laparotomy improve outcomes. It has been found that smoking, alcoholism, and inadequate H. pylori treatment are major risk factors for duodenal ulcer perforation [8]. Abuse of NSAIDs is also a significant factor. Regardless of the pathology, the highest incidence was in men from 30 to 40 years of age. Treatment for ileocecal junction tuberculous perforation involved right hemicolectomy. An emergency appendicectomy combined with peritoneal lavage is sufficient in cases of appendicular perforation [9]. Today, iatrogenic perforations with minimally invasive or endoscopic procedures are common.

The majority of the deceased patients had severe illness. The median MPI value was 23.5 in survivors and 32.5 in deaths. A receiver operating characteristic (ROC) curve was used, and the results showed that the Mannheim Peritonitis Index is a useful scoring system for estimating death with the area under the curve being 0.95 [10 -15] [Figure 6]. The mean P-POSSUM score of survivors was 39 and the mean P-POSSUM score of deceased was 57.5. With an area under the ROC curve of 0.99, P-POSSUM score is good for predicting mortality (Figure 4) [16-19]. The area under the curve for the APACHE score was 0.96 (Figure 5). APACHE score is a good predictor of mortality. The ROC curve is used to determine the ideal cutoff value, which is the value that results in the highest level of score sensitivity and specificity. Plotting ROC curves involves the use of specificity and sensitivity. The Y- and X-axes are used

to plot sensitivity and specificity, respectively. Due to their inverse proportionality, the test's sensitivity and specificity vary at different points on the curve. APACHE II and P-POSSUM scores showed a strong correlation with death, however this study did not demonstrate the superiority of one score over the other. P-POSSUM overestimated mortality and had a marginally lower positive predictive value. In comparison to the previous two, MPI was less accurate in predicting the outcome (accuracy 82.8%), despite having a sensitivity and specificity of over 80%. MPI over predicted mortality as well, with a positive predictive value of 46%. Optimizing the cut-off point does not achieve an acceptably low false-positive prediction rate that would justify using the score for individual patient care [Table 8]. These findings indicate that the MPI (0.95) was not as good at predicting mortality as the P-POSSUM score, which had an area under the curve of 0.99 in patients with perforation peritonitis who underwent surgical treatment of the underlying disease. [Figure 4-6]. However, all three scores are good for predicting mortality. Considering the ease of calculating the score, the APACHE II score and Mannheim Peritonitis Index appear to be easier to calculate than P-POSSUM score.

Conclusion

With better preoperative resuscitation, more skilled surgery, and superior postoperative care, mortality can be reduced in patients with delayed presentation, older age groups, and related comorbidities. The most effective course of treatment for patients with perforation peritonitis is surgery, and post-operative care is crucial to the patients' better outcomes. All three tested scores revealed a strong correlation with mortality. The P-POSSUM and APACHE II did not significantly differ from each other in their ability to predict the aforementioned outcomes. We encourage utilizing the APACHE II score over the P-POSSUM score for prognosis and treatment of perforation peritonitis patients since it is based on preoperative characteristics and is simpler to compute.

Statements and Declarations

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Conflict of interest: None

Ethical approval
The Institutional Ethics Committee gave its clearance to the study.

Authors' contributions
The primary author, Nirmal Kumar Agarwal, has significantly influenced the concept and design. The manuscript was drafted with input from Dhirendra Nath Choudhury, Nirmal Kumar Agarwal and Tapash Kumar Kalita, who also critically evaluated it for significant intellectual value. Every author has committed to taking responsibility for every part of the work. Tapash Kumar Kalita is the corresponding author. The final manuscript was read and approved by all writers.

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