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Predicting the Surgical Outcome in Patients with Peritonitis Using Mannheim Peritonitis Index (MPI): A Prospective Study

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KEYWORDS

Peritonitis, Mannheim Peritonitis Index, exploratory laparotomy, surgical outcomes, risk stratification, prognosis.

ABSTRACT:

Background: Peritonitis constitutes a critical surgical emergency characterized by substantial morbidity and mortality rates. The Mannheim Peritonitis Index (MPI) represents a validated prognostic scoring methodology utilized for outcome prediction in patients requiring surgical intervention for peritonitis.

Objectives: To assess the clinical efficacy of MPI in forecasting postoperative complications and mortality among peritonitis patients in a tertiary hospital in Lucknow..

Methods: This prospective observational investigation was executed at the Integral Institute of Medical Sciences and Research, Lucknow, spanning January 2023 through June 2024. Sixty patients diagnosed with peritonitis requiring exploratory laparotomy were enrolled. MPI scores were determined intraoperatively utilizing eight established risk parameters. Patients were stratified into low (<21), moderate (21–29) and high (>29) risk categories. Postoperative outcomes, encompassing complications and mortality, were evaluated relative to MPI scores employing appropriate statistical methodologies.

Results: The majority of patients (88.3%) were classified within the moderate-risk category. Respiratory and renal complications demonstrated significantly elevated incidence within the high MPI group ($p < 0.05$). Mortality reached 100% in patients with MPI >29, 5.7% in the moderate group and 0% in the low-risk category. Elevated MPI scores correlated with decreased blood pressure, diminished urine output, increased creatinine levels and hypoxemia.

Conclusion: MPI represents a dependable and practical scoring methodology for predicting morbidity and mortality in peritonitis. It facilitates early risk stratification and enhanced clinical decision-making, particularly in resource-constrained environments.

INTRODUCTION

Peritonitis, representing an inflammatory pathology of the peritoneal cavity, remains among the most formidable emergency conditions encountered in general surgical practice, particularly within developing nations. This condition typically arises from gastrointestinal perforations, appendicular rupture, traumatic injuries, or postoperative complications, presenting with substantial morbidity and mortality when management is inadequate or delayed [1,2].

Despite progressive advances in diagnostic modalities and surgical methodologies, predicting clinical

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outcomes in peritonitis patients continues to pose significant clinical challenges. This has prompted the development of multiple scoring systems designed to stratify patients according to disease severity and facilitate clinical decision-making processes. Among these assessment tools, the Mannheim Peritonitis Index (MPI) stands as a straightforward, efficient and well-validated prognostic scoring instrument employed for outcome prediction in peritonitis patients [3,4].

The MPI, first introduced by Wacha and Linder in 1983, incorporates eight clinically and intraoperatively assessable risk parameters, encompassing age, gender, organ dysfunction, peritonitis duration, sepsis origin, peritoneal involvement extent and exudate characteristics [5]. This scoring system facilitates differentiation between patients who may benefit from conservative management approaches and those requiring aggressive surgical intervention with intensive care support [6]. Multiple investigations have established MPI as a dependable instrument for mortality prediction and outcome stratification in peritonitis populations [7,8].

While MPI has demonstrated considerable clinical utility in international healthcare settings, its applicability and predictive precision may fluctuate based on regional variations in peritonitis etiology, healthcare resource availability and timely surgical intervention access [9,10]. Within India, gastrointestinal perforations, particularly those resulting from infectious aetiologies such as typhoid and tuberculosis, represent common peritonitis causes and frequently present with delayed presentation due to socioeconomic constraints and healthcare access barriers [11].

Furthermore, factors including respiratory and renal complications, postoperative wound infections, intensive care unit duration and intraoperative findings substantially influence patient outcomes in peritonitis [12,13]. The need persists to correlate MPI scores with such variables to comprehensively evaluate its predictive value within the Indian clinical environment.

This investigation aims to assess the clinical effectiveness of the Mannheim Peritonitis Index in predicting surgical outcomes, postoperative complications and in-hospital mortality among patients undergoing exploratory laparotomy for peritonitis in a tertiary hospital. The study additionally examines relationships between MPI scores and various physiological, biochemical and clinical parameters to understand its practical implications in prognosis and patient management.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational investigation was conducted within the General Surgery Department at the Integral Institute of Medical Sciences and Research, Lucknow. The study was executed over an 18-month period, spanning January 2023 through June 2024. Patient recruitment occurred from surgical wards and the emergency department of the institution.

Ethical Considerations

The study protocol underwent review and approval by the Institutional Ethics Committee (IEC) of Integral Institute of Medical Sciences and Research. Written informed consent was secured from all participants or their legally authorized representatives prior to enrollment.

Sample Size

A total of 60 patients meeting inclusion criteria were enrolled consecutively throughout the study period.

Inclusion Criteria

• Patients aged 18 years and above

• Patients with clinical peritonitis diagnosis, established through presenting history, physical examination, and imaging findings (radiography and ultrasonography)

• Patients requiring exploratory laparotomy for peritonitis.

• Patients or their legal representatives providing informed consent for participation.

Exclusion Criteria

• Patients under 18 years of age.

• Patients with mental incapacity, altered consciousness or communication barriers preventing informed consent or accurate clinical assessment.

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Study Procedure

Patient Enrollment

All eligible patients admitted with clinical peritonitis suspicion and scheduled for exploratory laparotomy were approached for participation. Informed consent was obtained before any study-related procedures.

Clinical and Demographic Data Collection

Comprehensive history and physical examination were conducted. Recorded data included:

• Age and gender

• Previous abdominal surgery history

• Vital parameters: temperature, heart rate, blood pressure, oxygen saturation (SpO_2) and mean arterial pressure (MAP).

• Abdominal pain duration and associated symptoms.

Laboratory Investigations

All enrolled patients underwent:

• Complete blood count (CBC)

• Arterial blood gas (ABG) analysis for acid–base and respiratory status evaluation

• Kidney function tests (KFTs) including serum urea and creatinine measurements

• Additional relevant biochemical and haematological parameters as indicated

Radiological Investigations

• Plain erect abdominal radiography for pneumoperitoneum detection (subdiaphragmatic air)

• Abdominal ultrasonography for free fluid detection, bowel wall thickening or air–fluid levels indicating perforation

Surgical Intervention

All patients underwent emergency exploratory laparotomy under general anaesthesia. Intraoperative findings were documented, including:

• Perforation location and dimensions

• Intra-abdominal exudate characteristics (cloudy, fecal, purulent)

• Contamination degree

• Surgical procedure type performed (primary closure, resection and anastomosis, peritoneal lavage)

Surgical management was individualized according to operative findings and patient clinical status.

Mannheim Peritonitis Index (MPI) Score Calculation

MPI scores were calculated intraoperatively for each patient utilizing eight standardized risk factors:

1. Age >50 years
2. Female gender
3. Organ failure at admission
4. Malignancy presence
5. Preoperative peritonitis duration >24 hours
6. Sepsis origin (non-colonic vs colonic)
7. Peritonitis extent (localized vs diffuse)
8. Exudate character (clear, cloudy, purulent, fecal)

Patients were stratified into three MPI categories:

• Low risk: MPI < 21 • Moderate risk: MPI 21–29 • High risk: MPI > 29

Postoperative Follow-up and Outcome Assessment

Patients underwent monitoring throughout hospitalization for postoperative complications, including:

• Surgical site infection • Wound dehiscence (abdominal wall disruption) • Paralytic ileus • Intestinal obstruction • Respiratory complications: ARDS, lower respiratory tract infections (LRI) • Renal complications: Acute kidney injury (AKI), prerenal/renal aetiologies • ICU duration and total hospitalization length

In-hospital mortality was documented. Follow-up continued until discharge or death.

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Statistical Analysis

All data were compiled in Microsoft Excel and analysed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics summarized categorical variables as frequencies and percentages, and continuous variables as means and standard deviations.

Inferential statistical tests included:

• Chi-square test/Fisher's exact test for categorical data analysis • One-way ANOVA for inter-group mean comparisons across MPI categories • p-value < 0.05 was considered statistically significant

RESULT AND OBSERVATIONS;

Table 1: Descriptive Statistics of MPI Scores Among Study Participants (N=60)

	Mean	SD	Median	Min	Max	Valid N
MPI score	23.92	4.09	22.00	16.00	34.00	60

Table 2: Descriptive Statistics of Clinical Parameters and Lab Values

	Mean	SD	Median	Min	Max	Valid N
Age	42.30	16.54	42.50	10.00	75.00	60
Pain duration in days	3.18	2.21	2.00	1.00	10.00	60
Systolic BP (mm/Hg)	114.63	19.20	118.00	70.00	160.00	60
Diastolic BP (mm/Hg)	68.30	11.22	70.00	36.00	92.00	60
Mean arterial BP (mm/Hg)	82.33	11.63	85.50	47.00	98.00	60
Urea (mg/dl)	36.17	24.24	27.00	18.00	120.00	60
Creatinine(mg/dl)	1.30	.78	.90	.60	3.50	60
pO2(mmHg)	88.90	9.17	89.00	42.00	98.00	60
pCO2(mmHg)	41.52	4.94	41.00	34.00	54.00	60
Urine output (ml/hr)	54.67	19.72	60.00	5.00	85.00	60
Durationbetween symptoms & Signs	71.08	59.30	53.50	9.00	250.00	60
MPI score	23.92	4.09	22.00	16.00	34.00	60

Table 3: Association Between MPI Score and Age/Sex Distribution

		MPI score						
		<21		21-29		>29		p value
		N	%	N	%	N	%	
Age intervals	<18 years	2	66.7%	3	5.7%	1	25.0%	0.048
	18-35 years	0	.0%	15	28.3%	1	25.0%	
	36-50 years	1	33.3%	18	34.0%	0	.0%	
	51-65 years	0	.0%	12	22.6%	1	25.0%	
	>65 years	0	.0%	5	9.4%	1	25.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Sex	Female	0	.0%	12	22.6%	3	75.0%	0.039
	Male	3	100.0%	41	77.4%	1	25.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	

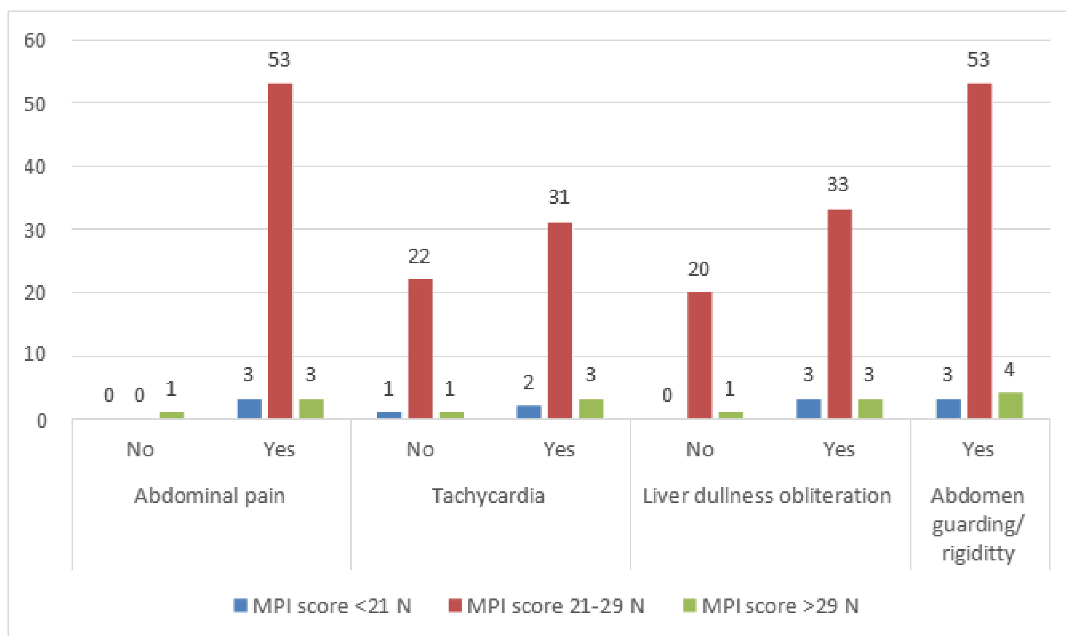

Figure 1: Association Between MPI Score and Clinical Features

Table 4: Association Between MPI Score and Clinical Findings Related to the Abdomen

		MPI score						
		<21		21-29		>29		p value
		N	%	N	%	N	%	
Bowel sounds	H	2	66.7%	43	81.1%	3	75.0%	0.803
	NH	1	33.3%	10	18.9%	1	25.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Air under the diaphragm	No	0	.0%	20	37.7%	1	25.0%	0.374
	Yes	3	100.0%	33	62.3%	3	75.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Nature of exudate	Cloudy	3	100.0%	24	45.3%	2	50.0%	0.481
	Fecal	0	.0%	28	52.8%	2	50.0%	
	Purulent	0	.0%	1	1.9%	0	.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Nature of pathology	B	3	100.0%	51	96.2%	4	100.0%	0.872
	M	0	.0%	2	3.8%	0	.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	

Table :5 Association Between MPI Score and Peritonitis/Pathology Site

		MPI score						
		<21		21-29		>29		p value
		N	%	N	%	N	%	
Peritonitis	Generalized	3	100.0%	49	92.5%	4	100.0%	0.754
	Localized	0	.0%	4	7.5%	0	.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Site of pathology	Appendix	0	.0%	15	28.3%	0	.0%	0.801

	Duodenum	3	100.0%	31	58.5%	4	100.0%	
	Gastric	0	.0%	3	5.7%	0	.0%	
	ileum	0	.0%	3	5.7%	0	.0%	
	jejunum	0	.0%	1	1.9%	0	.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	

Table 6: Association Between MPI Score and Surgical Procedure							
	MPI score						
Procedure done	<21		21-29		>29		p value
	N	%	N	%	N	%	
MG	3	100.0%	30	56.6%	4	100.0%	0.553
PC	0	.0%	4	7.5%	0	.0%	
PL & AP	0	.0%	16	30.2%	0	.0%	
R & A	0	.0%	3	5.7%	0	.0%	
Total	3	100.0%	53	100.0%	4	100.0%	

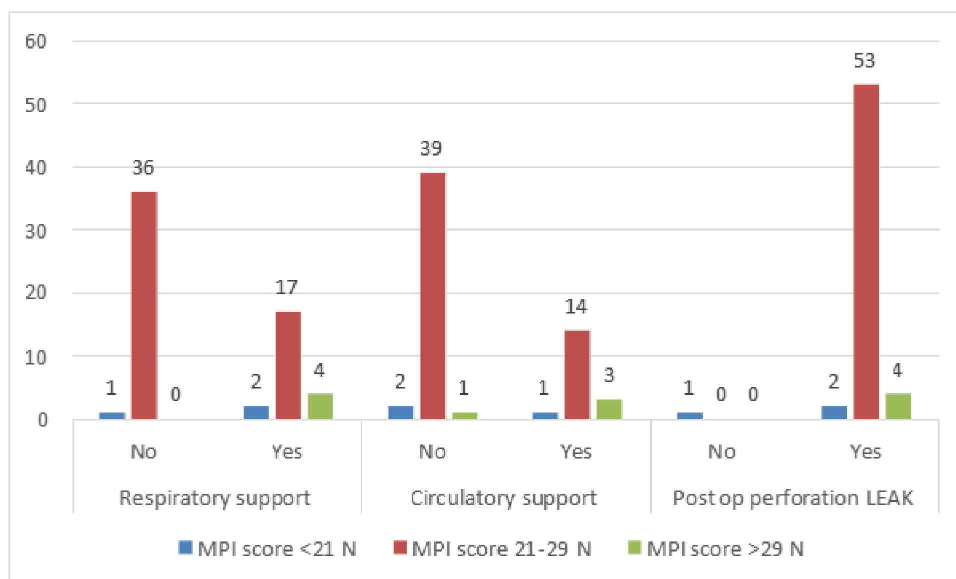

Figure 2 Association Between MPI Score and Postoperative Support and Complications

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Table 7: Association Between MPI Score and Postoperative Complications								
		MPI score						
		<21		21-29		>29		p value
		N	%	N	%	N	%	
Fluid collection	No	3	100.0%	50	94.3%	4	100.0%	0.812
	Yes	0	.0%	3	5.7%	0	.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Paralytic ileus	No	3	100.0%	48	90.6%	4	100.0%	0.698
	Yes	0	.0%	5	9.4%	0	.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Intestinal obstruction	No	3	100.0%	53	100.0%	4	100.0%	NA
	Yes	0	.0%	0	.0%	0	.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Wound infection	No	3	100.0%	38	71.7%	3	75.0%	0.557
	Yes	0	.0%	15	28.3%	1	25.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	
Wound dehiscence	No	3	100.0%	45	84.9%	3	75.0%	0.656
	Yes	0	.0%	8	15.1%	1	25.0%	
	Total	3	100.0%	53	100.0%	4	100.0%	

Table:8 Association Between MPI Score and Respiratory, Renal Complications, and Final Outcome (N = 60)

Category	Variable	MPI Score <21	%	MPI Score 21–29	%	MPI Score >29	%	p-value
Respiratory Complication	ARDS	0	0.0%	2	3.8%	2	50.0%	0.010
	LRI	0	0.0%	17	32.1%	2	50.0%	
	None	3	100%	33	62.3%	0	0.0%	

	Unspecified (Y)	0	0.0%	1	1.9%	0	0.0%	
Renal Complication	AKI	1	33.3%	7	13.2%	4	100%	0.006
	Normal (N)	2	66.7%	39	73.6%	0	0.0%	
	Prerenal (prer)	0	0.0%	4	7.5%	0	0.0%	
	Renal (REN)	0	0.0%	3	5.7%	0	0.0%	
Final Outcome	Death	0	0.0%	3	5.7%	4	100%	<0.001
	Discharged	3	100%	50	94.3%	0	0.0%	
Total in each group		3	100%	53	100%	4	100%	

Table: 9 Association Between MPI Score and Pain Duration & Blood Pressure Parameters (N = 60)

Clinical Parameter	MPI Score <21	SD	MPI Score 21–29	SD	MPI Score >29	SD	p-value
Pain Duration (days)	5.00	4.36	3.11	2.13	2.75	0.96	0.663
Systolic BP (mm Hg)	103.33	11.55	117.40	18.32	86.50	4.73	0.005
Diastolic BP (mm Hg)	62.67	11.02	70.26	9.72	46.50	4.73	0.003
Mean Arterial Pressure (mm Hg)	80.67	16.62	84.15	9.93	59.50	3.32	0.008

Table 10: Association Between MPI Score and Renal, Respiratory, and Urine Parameters

	MPI score						p value
	<21		21-29		>29		
	Mean	SD	Mean	SD	Mean	SD	
Urea (mg/dl)	26.33	4.04	33.91	20.75	73.50	45.12	0.289
Creatinine(mg/dl)	.77	.15	1.23	.72	2.62	.46	0.014
pO2(mmHg)	95.00	2.65	89.70	6.88	73.75	21.73	0.013
pCO2(mmHg)	38.33	2.08	41.55	4.89	43.50	6.95	0.419
Urine output (ml/hr)	65.00	17.32	57.17	16.91	13.75	6.29	0.008
Duration between symptoms & Signs	115.00	119.06	69.11	57.22	64.25	30.17	0.754

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DISCUSSION

This investigation was undertaken to evaluate the prognostic utility of the Mannheim Peritonitis Index (MPI) in patients requiring surgical intervention for peritonitis. Analysis of 60 patients demonstrated that MPI scores exhibited significant correlation with critical clinical outcomes including respiratory and renal complications, along with in-hospital mortality.

Within this study, the mean MPI score was 23.92, with the majority of patients categorized within the moderate-risk group (88.3%), succeeded by high-risk (6.7%) and low-risk (5.0%) classifications. These observations align with previous investigations where most patients presenting with perforation peritonitis were stratified into the moderate-risk category utilizing MPI scoring [14,15].

The correlation between elevated MPI scores and increased age, respiratory failure, renal dysfunction and mortality demonstrated statistical significance. Particularly, patients presenting with MPI scores >29 exhibited 100% mortality rates, while those within the moderate-risk category (21–29) demonstrated mortality of 5.7%. No fatalities occurred within the low-risk group (<21). These findings parallel observations by Mohil et al. and Sharma et al., who established that MPI scores >29 correlated with substantially elevated postoperative mortality risk [4,16].

Respiratory complications, particularly ARDS and lower respiratory infections, occurred with significantly greater frequency in patients presenting with elevated MPI scores. These observations correspond with findings by Ghosh et al. [13], who highlighted the relationship between systemic inflammatory response and pulmonary compromise in peritonitis patients with higher MPI scores. Similarly, renal complications, especially acute kidney injury, were documented in all patients within the >29 MPI group, supporting the concept that systemic organ dysfunction characterizes high MPI scores [17].

Notably, no significant correlation was established between MPI score and symptom duration or peritonitis distribution (generalized vs. localized). This aligns with findings reported by Biondo et al. [7], who indicated that peritonitis extent may not consistently influence outcomes when organ failure is present.

Nevertheless, a strong inverse correlation was documented between MPI score and blood pressure parameters, specifically systolic, diastolic, and mean arterial pressure. Patients within the high MPI group demonstrated significantly reduced blood pressures, indicating hemodynamic instability, which represents a recognized predictor of adverse outcomes in sepsis and peritonitis [18].

Exudate characteristics also demonstrated clinical significance. Fecal contamination occurred more frequently within moderate- and high-risk groups, consistent with existing literature emphasizing fecal contamination as an independent predictor of unfavourable outcomes [3,5]. Conversely, patients presenting with clear or cloudy exudate experienced superior outcomes.

When comparing our findings to investigations from other geographic regions, such as those conducted by Wacha and Linder [5] in Germany, and Bali et al. [9] in India, it becomes evident that MPI maintains validity and reproducibility across diverse healthcare environments, although regional variations in etiology (e.g., duodenal vs appendicular perforation) may influence baseline patient characteristics.

Additionally, postoperative complications including wound infection (26.7%) and wound dehiscence (15.0%) occurred with relative frequency, particularly in patients presenting with moderate and high MPI scores. These findings correspond with previous research, indicating that elevated MPI scores predict not only mortality but also morbidity [12,19].

Despite the relatively limited sample size, this study confirms that MPI represents a valuable instrument for early risk stratification. Its simplicity, reproducibility, and incorporation of readily obtainable clinical and intraoperative parameters establish it as a practical bedside scoring system, particularly in resource-limited environments.

However, certain limitations require acknowledgment. The sample size was modest (n=60), restricting generalizability. Furthermore, the study did not evaluate long-term post-discharge outcomes. Future research

incorporating larger multicentric cohorts with extended follow-up would facilitate further validation of these findings.

CONCLUSION

The Mannheim Peritonitis Index (MPI) represents a straightforward and effective instrument for predicting surgical outcomes in peritonitis. Elevated MPI scores demonstrated significant association with increased morbidity and mortality, encompassing respiratory and renal complications. Its user-friendly nature and robust prognostic capability establish MPI as a valuable resource for early risk stratification and clinical management guidance in patients with peritonitis.

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