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Prediction of Outcome Using the Mannheim peritonitis Index in Patients with Peritonitis at Kigali University Teaching Hospital.

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Background: Successful management of peritonitis has, for decades, presented a challenge to surgeons despite advancements in medicine. This led to the development of disease severity grading systems that would aid in stratifying patients by individual risk factors and hence appropriately predict possible outcome. The objectives of this study was to evaluate the *Mannheim peritonitis index (MPI)* in determining the outcome in patients operated for peritonitis at KUTH and to determine the MPI sensitivity and specificity in predicting outcome.
Methods: The study population consisted of 100 consecutive patients with peritonitis who underwent surgical treatment at Kigali University Teaching Hospital. Patients were enrolled in the study after signing an informed consent. A pre-established questionnaire was filled for all patients registered during the study period. Socio-demographic, clinical, paraclinical, management and outcome were recorded and analyzed using epidata and SPSS software programs. Pearson's Chi-square was used as a statistical test and considered as showing a significant difference if p was equal or less than 0.05.
Results: The mean MPI was 26.78 ±6.32 points with 10 points as the lowest and 39 points as the highest score. 44% of our patients had an MPI score between 21and 29. No death noted below 21 of MPI score. MPI score groups were influencing mortality, complications, reoperations and hospital stay with p- values ≤ 0.001. The most significant predictive factors for morbidity/mortality in this study were the presence of organ failure, the presence of malignancy, the duration of symptoms of more than 24hours, the source of sepsis, the extent of peritonitis, and the presence of fecal peritoneal fluid. However, gender and age were not significant predictors. The ROC curve for mortality showed a predictive power of 0.903 with a sensitivity of 88.2% and a specificity of 74.8% at an MPI of 29 points. In this study, the predictive power of the MPI for morbidity was 0.896 with a sensitivity of 66.7% and a specificity of 99.04% at a score of 29 points.
Conclusion: The MPI score can provide simple and objective means to predict the outcome of patients with peritonitis at KUTH.

Introduction

Peritonitis, inflammation of the serosal membrane lining the abdominal cavity and contained viscera, is associated with a high mortality rate[1]. The outcome of an abdominal infection depends on the complex interaction of many different factors and the success obtained with the early onset of specific therapeutic procedures[1]**.** It may also depend upon exact recognition of the seriousness of the disease, an accurate assessment and classification of the patient's risks[2]. Despite the surgical treatment, sophisticated intensive care units, last generation antibiotics and a better understanding of peritonitis's pathophysiology, the mortality rates are still high, ranging from 10-20% even in good centers[7]

Early prognostic evaluation of abdominal sepsis is desirable to select high-risk patients for more aggressive therapeutic procedures such as radical debridement, lavage systems, open management, and planned reoperations[3]**.** An accurate risk index classification is the only way to settle a standard of comparison between groups of patients and different treatment methods which would allow further prospective adequate comparative studies. Many scoring systems have been created for assessing patient

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risks of death during an event of peritonitis, nevertheless equal results have been achieved with the Mannheim Peritonitis Index (MPI) which was developed by Wacha and Linder[4] in 1983. The effectiveness of the MPI as a reliable predictor of the peritonitis outcome was also confirmed after investigation exceeding two thousand patients from several European surgical units[5,6]. Generally, there are few reported studies in Africa on this subject and particularly none in Rwanda. This study's main objective was to evaluate the outcome of surgery and to determine the predictive value of Mannheim Peritonitis Index in patients with peritonitis at Kigali University Teaching Hospital.

Patients and Methods

This was a prospective observational study conducted in the Department of Surgery at Kigali University Teaching and National Referral Hospital (KUTH) in Rwanda over a one year period starting from 1st May 2009 to 30th April 2010. The study population included all patients admitted and operated for peritonitis during the period of the study. Exclusion criteria included patients with TB peritonitis, those with chemical peritonitis due to postoperative bile leakage, those suspected primary peritonitis occurring in the setting of renal or hepatic failure, those admitted after laparotomy done elsewhere for peritonitis or transferred out to continue treatment elsewhere were excluded from the study as were excluded HIV positive patients with CD4 count less than 200/µl. Patients who met the inclusion criteria were consecutively enrolled in the study until the sample size was achieved. The sample size calculated using the following Fischer's formula came to 103 patients

Data collected entailed filling of a coded data sheet of variables under investigation. Prospective candidates for inclusion in the study were recruited within the first 24 hours of the post operative period. At the initial visit, relevant data on risk factors, intraoperative findings and definitive procedure as per case notes were entered into the data collection sheet. The patient's age, sex, duration of symptoms and presence or absence of ileus from the preoperative assessment was recorded in the data sheet. The following data was extracted from the operative notes:

- Appearance of the exudate; whether clear, cloudy/purulent or faecal
- Extent of exudate; single quadrant, or diffuse if two or more quadrants involved
- Source of sepsis, for example perforated duodenal ulcer.

Where tissue biopsies were taken, a follow up was made on such specimen to establish if malignancy was the primary pathology.

Laboratory parameters used to define organ failure were those of blood samples drawn within the first 24 hours of laparotomy. Renal failure was defined by serum levels of creatinine ≥ 177 µmol/L and urea ≥16.7mmol/L measured using COBAS Integra 400 plus machine. However, lung failure was not investigated because partial pressures of carbon dioxide and oxygen in arterial blood gas analysis were not available in the hospital. The blood pressure was measured using both manual sphygmomanometer and Heal Force PC 9000 monitoring machine. Hypotension, defined as systolic BP <90mmHg recorded on admission was used to define shock or circulatory failure. Corroborative pulse and blood pressure recorded at initial visit was used to asses for persisting shock. Presence of ileus, circulatory, or renal failure as defined above was taken as organ failure. The above factors were scored appropriately as per the MPI (Table 1). Total patient MPI score was the sum total of all the positive risk factor scores.

This was conducted regularly every alternate day following the initial visit until patient discharge or death. Morbidity during the follow up period was determined by duration of hospital stay ≥14 days and identification of one or more of the following complications: chest infection, surgical site infection, wound dehiscence, fistula formation, ileus lasting more than 5 days, DVT, pulmonary embolism

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etc. Source control was deemed to have been achieved at initial laparotomy in patients who hence forth showed no continuing peritoneal contamination from the previous site of origin of sepsis. Patients were followed up till their discharge. The study end point was reached at patient's discharge or death.

From the data collection sheets, data were progressively entered in epidata computer program 2.1.0.1009 version. At the end of collection, data were transferred electronically to SPSS for analysis.
The data collected was analyzed both manually and with the aid of the computer programme Statistical Package for the Social Sciences (SPSS) software (version 12, SPSS Inc., Chicago, IL. USA). Descriptive statistics were used for both frequencies and cross tabulations. 97% confidence intervals applied as necessary.

Pearson's Chi-square was used as a statistical test and considered as showing a significant difference if p is equal or less than 0.05. Study group general data were analyzed for frequencies giving the study population socio-demographic characteristics. Individual patient MPI score and respective outcome was determined followed by stratification of the scores into 3 main groups of <21 points, 21-29 points and >29 points. Morbidity and mortality rates for the stratified MPI scores were calculated and the predictive power of the MPI, sensitivity and specificity derived from receiver-operator characteristic (ROC) curve analysis. The study proposal was submitted and approved by the department of surgery of the faculty of medicine of the National University of Rwanda and the hospital's ethical committee. Patients were only enrolled into the study after giving an informed consent. A parent or guardian was required to consent for minors (<18 years). All data collected were treated with confidentiality.

Study limitations

This was an observational study; hence the researchers assumed that all patients entered in the study had been subjected to a fairly standard treatment commensurate with the individual diagnosis. Inadequate treatment may have negatively impacted on outcome yet it was not the subject of this evaluation. Due to technical reasons, lung failure was not investigated because partial pressures of carbon dioxide and oxygen in arterial blood gas analysis were not available in the hospital. In addition, we could not confirm the nature of ileal perforations histologically, but clinically, they looked like typhoid fever perforations.

Results

From July 1, 2009 to June 30, 2010, 114 patients with peritonitis confirmed during surgical intervention were admitted to the Surgical Department of Kigali University Teaching Hospital. Out of these patients, 104 met the inclusion criteria to be admitted to the study. Four were excluded: one had to be transferred to the ICU due to an acute heart failure from a preexisting cardiomyopathy, the second had a low CD4 count and he was on TB treatment and the other two requested for voluntary premature discharge due to familial problems.

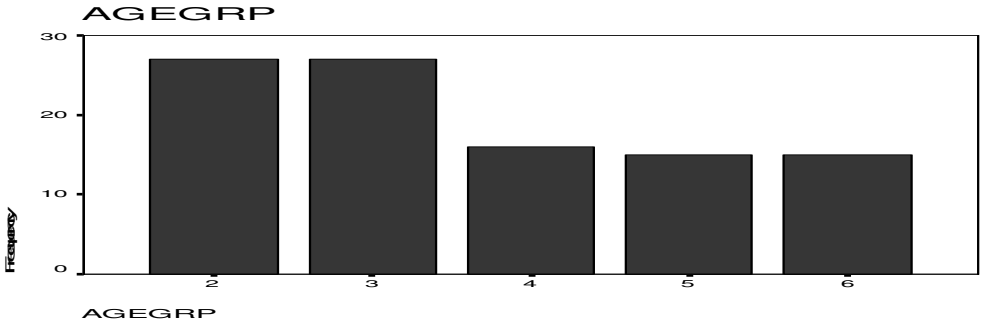

Figure 1. Distribution According to the Age

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Of the 100 patients, 45 were female and 55 were male. Their ages ranged from 10 to 29 years with a mean age was 30.54 and a median of 27 years. The majority of them (54%) were aged between 10 and 29 years of age**.** The mean preoperative duration of symptoms was 6.04 days and ranged from 2-22 days with a peak on the seventh day. The vast majority of patients (81%) presented during the first week after the onset of the symptoms. 71% had one or more organ dysfunction with ileus being the

Table 1. Background Informationof the 100 Patients with Peritonitis.

Item		No (%)	Mean	Median	Minimum	Maximum
Sex	Male	55	-	-	-	-
	Female	45	-	-	-	-
Age	10-19	27	30.54 ±14.9	27	10	63
	20-29	27				
	30-39	16				
	40-49	15				
	≥50	15				
Preoperative duration of symptoms	≤24h	0	6.04±3.3	6	2	22
	2-7 days	81				
	8-15 days	17				
	≥ 15 days	2				
Organ dysfunction	Yes	71	-	-	-	-
	No	29	-	-	-	-
Causes of peritonitis	Ileal perforations	39	-	-	-	-
	Gastric ulcer perforation	24	-	-	-	-
	Appendicular perforation	15	-	-	-	-
	Duodenal ulcer perforation	5	-	-	-	-
	Others	17	-	-	-	-
Types of peritonitis	Generalised	79	-	-	-	-
	2-3 quadrants	15	-	-	-	-
	Focal/single quadrant	6	-	-	-	-
Mortality	Yes	17	-	-	-	-
	No	83	-	-	-	-
Complications* (Morbidity)	Yes	51	-	-	-	-
	No	49	-	-	-	-
Reoperations	Yes	21	-	-	-	-
	No	79	-	-	-	-
Hospital stay in days	1-7	25	15.3± 11.6	11	2	69
	8-14	37				
	15-21	17				
	≥ 22	21				

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Table 2. Causes of Peritonitis

Cause	Frequency (%)
Ileal Perforation	39
Gastric Ulcer Perforation	24
Appendicular Perforation	15
Duodenal Ulcer Perforation	5
Traumatic small bowel perforations	*3*
Transverse colon perforation	*2*
Traumatic sigmoid perforation	*2*
Pyosalpinx	*2*
Others (1 each)	8

Table 3. Distribution according to complications

Complications	Frequency (%)
Superficial surgical site infection	17
Septic shock	7
Intaabdominal abcess	4
Reperforation	4
Chest infection	3
Pulmonary embolism	2
Anastomotic breakdown	2
Denutrition	2
Pneumonia	2
Wound dehiscence	2
DVT	1
Enterocutaneous fistula	1
Gastrocutaneous fistula	1
Lung atelectasis	1
prolonged post operative ileus	1

Table 4. Comparison of behavior of each risk factor of Mannheim peritonitis index in three MPI intervals studied to mortality.

Risk factor	**Mortality**						**P value**
MPI group	**< 21**		**21-29**		**>29**		**<0.001**
	No of Pts	**Dead**	**No of Pts**	**Dead**	**No of Pts**	**Dead**	
Age >50 years	21	0	42	2	24	6	
Age <50 years	0	0	2	0	11	9	0.272
Female	6	0	14	0	25	8	0.851
Male	15	0	30	2	10	7	
Presence of organic failure	2	0	34	2	35	15	
Absence of organic failure	19	0	10	0	0	0	0.004
Presence of malignancy	0	0	1	0	6	0	

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Absence of malignancy	21	0	43	2	29	9	<0.001
Time >24 h	21	0	44	2	35	15	
Time <24 h	0	0	0	0	0	0	0.021
Non-colonic origin	10	0	40	1	26	10	0.057
Colonic origin	11	0	5	0	8	6	
Generalized peritonitis	9	0	36	2	34	15	
Localized peritonitis	12	0	8	0	1	0	0.020
Clear peritoneal fluid	5	0	3	0	0	0	0.182
Purulent peritoneal fluid	15	0	39	2	28	10	0.179
Fecal peritoneal fluid	1	0	2	0	9	5	0.015

most frequent at 92%. (Table 1, Figures 1and 2). Table 2 shows the causes of peritonitis. Ileal perforation was the commonest cause (39%) followed by gastric ulcer perforation (24%), appendicular perforation (15%) and duodenal ulcer perforation (5%). Other very rare causes recorded in one case each included caecal perforation, iatrogenic sigmoid perforation post vaginal hysterectomy, infected pancreatic necrosis, small bowel perforation post caesarean, large bowel perforation on colo-colic intussusceptions, perforated caecal volvulus, perforated sigmoid volvulus and perforation on strangulated small `bowel by a band

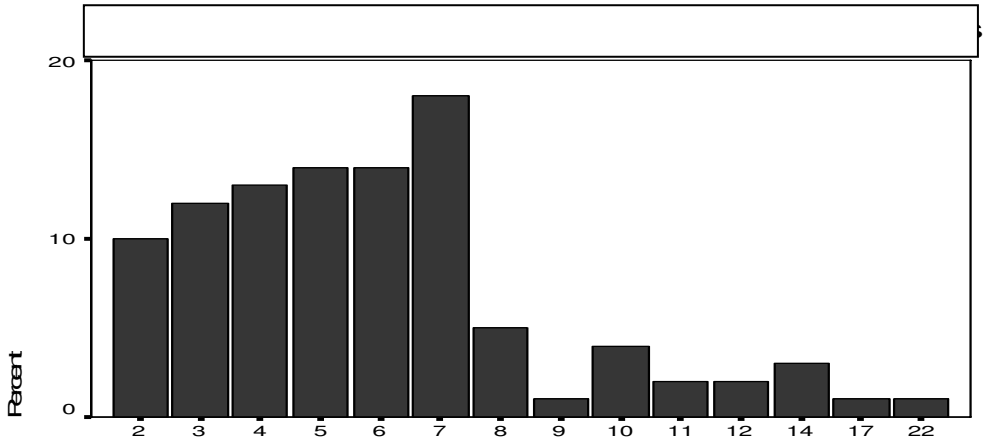

Figure 2. Preoperative Duration of Symptoms

Table 5. Comparison of 3 MPI groups and outcom

OUTCOME		MPI SCORES			P value
		<21	21-29	>29	
		Frequency (%)	Frequency (%)	Frequency (%)	
Mortality	Yes	0	2	15	<0.001
	No	21	42	20	
Complications	Yes	1	17	33	<0.001
	No	20	27	2	
Reoperations	Yes	0	7	14	
	No	21	37	21	0.001
Hospital Stay	≤15 Days	20	30	13	
	>15 Days	1	14	22	<0.001

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Of the 100 patients that were operated and included in the study, 17 died (overall mortality of 17%).The overall morbidity rate was of 51%. Our patients develo1ed some complications during their stay in the hospital: Ten patients required reinterventions: two patients had wound dehiscence; four patients had intraabdominal abscesses that were drained; four developed tertiary peritonitis. However, 17 patients had superficial surgical site infection, seven had septic shock; five had chest infection; one had lung thromboembolism; three had deep venous thrombosis, five had prolonged postoperative ileus.

The patients spent a mean of 15.3days in the hospital, a range 2 to 69 days. (Table 1). Origin of peritonitis was due to various causes (Tables 1 and 2). The main being ileal perforations probably due to typhoid fever in 39% of cases, gastric and duodenal ulcers representing 24% and 5% respectively with appendicular perforations in 15% of cases. With regard to spread of peritonitis, 79 patients had generalized peritonitis and 21, localized peritonitis. All patients who died had generalized peritonitis (Table 1).

As shown in Table 6, MPI groups were influencing mortality with a p- value <0.001. The presence of organ failure, the presence of malignancy, duration of symptoms more than 24h, the origin of sepsis, the extent of peritonitis, and the presence of fecal peritoneal fluid were statistically significantly influencing the mortality. Age, sex, clear peritoneal fluid, and purulent peritoneal fluid showed no significant statistical difference. Twenty one had under 21 MPI score, 44 had an MPI score between 21and 29 and the rest (35%) had MPI greater than 29. The mean MPI was 26.78 ±6.32 points with 10 points as the lowest score and 39 points as the highest score. Comparing the 3 MPI intervals studied, MPI scores influence statistically and significantly the outcome as far as mortality, complications, reoperations and hospital stay are concerned (Table **7).** The same tendency is shown when MPI scores are grouped into 2 intervals (Table 8).

Comparing the 2 MPI intervals studied, MPI scores influence statistically and significantly the outcome as far as mortality, complications, reoperations and hospital stay are concerned (Table 8). In this study, the predictive power of the MPI for morbidity was 0.896 with a sensitivity of 66.7% and specificity of 99.04% at a score of 29 points.

Table 6. Comparison of 2 MPI groups and outcome

Outcome		**MPI scores**		**P value**
		≤26	>26	
		Frequency (%)	Frequency (%)	
Mortality	Yes	0	17	
	No	49	44	<0.001
Morbidity (complications)	Yes	4	47	
	No	35	14	<0.001

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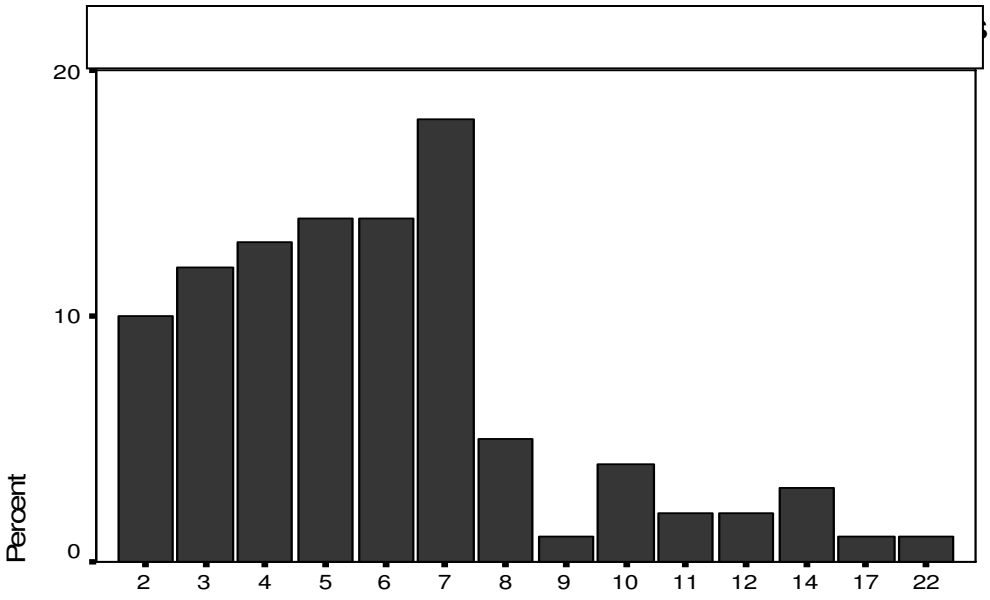

Figure 2. Preoperative Duration of Symptoms

Mortality ROC curve for sensitivity and specificity

The ROC curve for mortality showed a predictive power of 0.903 with a sensitivity of 88.2% and specificity of 74.8% at an MPI of 29 points. These are shown in Table 7 and Figure 3. In this study, the predictive power of the MPI for morbidity was 0.896 with a sensitivity of 66.7% and specificity of 99.04% at a score of 29 points as shown in table 10 and figure 4 below.

The ROC curve for mortality showed a predictive power of 0.903 with a sensitivity of 88.2% and specificity of 74.8% at an MPI of 29 points. These are shown in table 9 and figure 3. In this study, the predictive power of the MPI for morbidity was 0.896 with a sensitivity of 66.7% and specificity of 99.04% at a score of 29 points as shown in Table 8 and Figure 4.The ROC curve for mortality showed a predictive power of 0.903 with a sensitivity of 88.2% and specificity of 74.8% at an MPI of 29 points. These are shown in table 9 and figure 3.

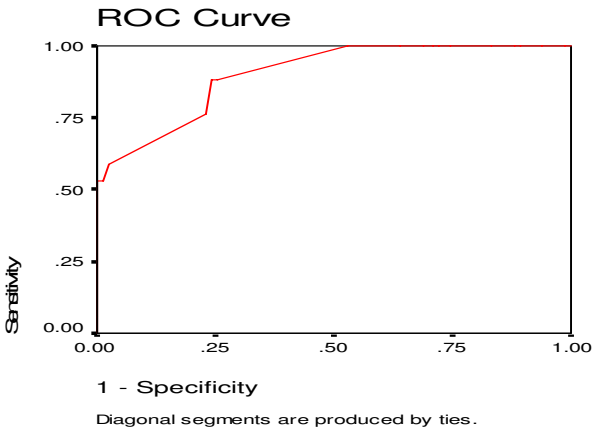

Figure 3. Mortality ROC curve for sensitivity and specificity. Area Under the Curve for mortality: 0.903

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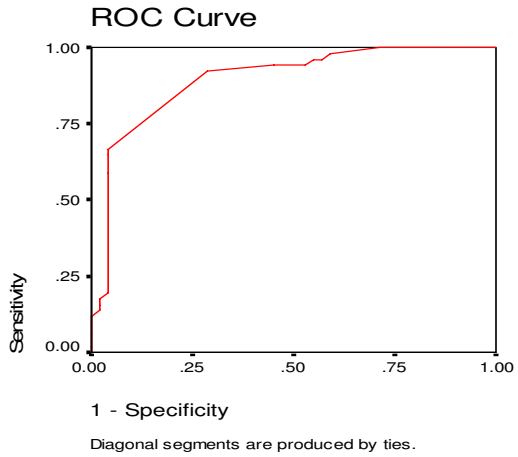

Area Under the Curve: 0.896

Figure 4. Morbidity ROC curve for sensitivity and specificity

Table 7. Coordinates of the Curve for Mortality

MPI	Sensitivity	1 – Specificity
9.00	1.000	1.000
12.00	1.000	.988
14.50	1.000	.940
15.50	1.000	.892
17.50	1.000	.880
19.50	1.000	.831
21.00	1.000	.747
22.50	1.000	.723
23.50	1.000	.711
24.50	1.000	.687
25.50	1.000	.639
26.50	1.000	.530
28.50	.882	.253
30.50	.882	.241
31.50	.765	.229
32.50	.588	.024
33.50	.529	.012
34.50	.529	.000
35.50	.471	.000
36.50	.353	.000
37.50	.176	.000
38.50	.059	.000
40.00	.000	.000

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Table 8. Coordinates of the Curve for morbidity

MPI	Sensitivity	Specificity
26	93.2%	63.4%
29	66.7%	99.04%

Discussion

In this study, the mean MPI was 26.78 ±6.32 points with 10 points as the lowest score and 39 points as the highest score. 44% of our patients had an MPI score between 21and 29. No death noted below 21 of MPI score. These results compare well with previous studies. Wabwire et al, in Kenya, found a mean MPI of 24.7±7.4 points. Sailer et al[9] analyzed 258 patients with an exclusive diagnosis of generalized peritonitis and reported so far the highest mean of 27.1 points. Bielecki et al[10] found a mean of 24.2 points among patients with large bowel perforation. In a meta-analysis of results from 7 centres involving 2003 patients, Billing et al[5] reported an average group mortality rate of 2.3% for MPI <21 points, 22.5% at MPI of 21-29 points and 59% with MPI of >29 points. In this study, the group mortality rate albeit lower appear to follow this pattern as no mortality occurred at MPI <21 points, was 2% with MPI 21-29 points and was 15% with MPI >29points. Differences in patient demographics and sepsis source between our study population and international reports may be responsible for the lower mortality rates observed in this study.

The most significant predictive factors for morbidity/mortality in this study were the presence of organ failure, the presence of malignancy, duration of symptoms more than 24h, the origin of sepsis, the extent of peritonitis, and the presence of fecal peritoneal fluid. However, gender and age were not significant predictors.Wabwire et al[8] found as predictive factors the female gender, age above 50 years, presence and number of organ dysfunction, character of exudate extent. Melero[11] reported a similar pattern but noted that gender was not a significant factor. Sailer et al[1,9] whose studies focused on generalized peritonitis reported similar findings only that he found preoperative duration to significantly influence eventual mean MPI from 23.2 to 29 points.

The ROC curve for mortality showed a predictive power of 0.903 with a sensitivity of 88.2% and specificity of 74.8% at an MPI of 29 points. In this study, the predictive power of the MPI for morbidity was 0.896 with a sensitivity of 66.7% and specificity of 99.04% at a score of 29 points. Reports on ROC curve analysis for morbidity were few in our references. Wabwire et al[8], in Kenya reported a morbidity predictive power of 0.663 by ROC curve analysis. Although low, it did attain statistical significance albeit with a low sensitivity of 33% but good specificity of 83.3% at a score of 29 points. This may be due to the fact that 60% of all his patients with morbidity had an MPI ≤29 points. In analysis of ROC curve for mortality, Biondo et al[13] reported a predictive power of 0.725 at an MPI score of 26 points, while Billing et al[5] in a meta analysis of 2003 patients reported a mean sensitivity of 86% (54%-98%) and specificity of 74% (58%-97%) at a score of 26 points. In his study, Wabwire[8] attained a mortality predictive power of 0.916 with a sensitivity of 88.9% and specificity of 85.2% at an MPI of 29 points. This result compares favourably with ours and what has already been reported in literature.

In our study, 100 patients were recruited, 45 and 55 being females and males respectively. This pattern, is similar to studies from the developed countries which show an even gender distribution or a slight preponderance of either sex[1,2,5]. However, Wabwire et al[8] found a male predominance with a sex ratio of 4 :1. The majority of our patients were young with a mean age of 30.54±14.9 years and 54% of the study group falling in the 10-29 years age category. Melero[11] in Mexico reported a similar distribution with a

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mean of 34.6 years but studies from Europe show a much older age group with a range of 44-64.8 years even in centres where source spectrum closely resembles our findings[1,2,3,4,5].

The mean preoperative duration of symptoms was 6.04 days and ranged from 2-22 days with a peak on the seventh day. The vast majority of patients (81%) presented during the first week of symptoms. None presented during the first 24hours after onset of symptoms. This late presentation of patients can be explained by local health system organization and referral system making patients to pass through district hospitals which have generally no surgical competences before being sent to one of the 3 main referral hospitals of the country. However, in Kenya, Wabwire et al[8] found that only 5 of the 70 patients in his study presented to hospital and were treated within 24 hours of onset of symptoms. Sixty percent of the patients presented to hospital and were operated at least 5 days after onset of symptoms. The two peaks of presentation observed on the 2nd and 7th days is a pattern that had previously been noted by Ndonga[12] in his study on jejunoileal perforations. In this study, the main etiologies of peritonitis were ileal perforations probably due to typhoid fever in 39% of cases, gastric and duonenal ulcers representing 24% and 5% respectively with appendicular perforations in 15% of cases.

In a previous study at KNH, Ndonga[12] found that perforated duodenal ulcer was the commonest cause of generalized peritonitis at 28% followed by jejunoileal perforations (19.5%) and perforated appendicitis (14.6%). Wabwire et al[8], who included patients with focal peritonitis shows that perforated appendicitis (31.4%) is the commonest source of peritoneal sepsis at KNH. However, considering that most patients with focal peritonitis had a diagnosis of appendicitis, perforated gastro-duodenal peptic ulcers (30%) remain the commonest cause of generalized peritonitis at KNH followed by ileal perforation at 18.6% in keeping with the above findings. Studies from Europe show a different picture with colonic perforation due to diverticular disease and cancer (16-70%) the leading causes followed by gastro duodenal peptic ulcer perforation (16%) and perforated appendicitis (8%)[1,5,6,14,15]

The overall morbidity rate was 51%. The commonest complications was infection with.17 patients having superficial wound infection, two of these had wound dehiscence; four patients had intraabdominal abscesses that were drained; seven had septic shock; five had chest infection and four required reintervention for reperforation or anastomotic breakdown. However, one had pulmonary emboli; three had deep venous thrombosis, five had prolonged postoperative ileus. The patients spent a mean of 15.3 days in the hospital, ranging from 2 to 69 days. Worldwide, morbidity rates in surgery for peritonitis vary widely with reports ranging from 18% to 67%[1,4,5,6,9]. In Kenya, Ndonga[12] found a rate of 61.1% in jejuno-ileal perforations while Wabwire et al[8] reported rates of 47.1%, with wound sepsis the most common complication. Although localized complications replicate patterns observed in other studies, it is noteworthy that systemic complications were less observed in this study than one would have expected. The overall mortality rate of 17% is in keeping with rates from referenced studies. Rates from European studies range from 6% to 42%[1,4,5,7,9,14,15,16]. In Kenya, a rate of 22% in patients with generalized peritonitis due to jejuno-ileal perforations has been reported by Ndonga[12], and Wabwire[8], who considered localized and generalized peritonitis, reported a rate of 12.9%.

This study had its own limitations. Being an observational study, we assumed that all patients received standard and adequate therapy commensurate with the diagnosis. However, given our poor working environnement, system related drawbacks, serious shortages both in personnel and resources, inadequate therapy can have contributed to either morbidity or mortality, but this was not subject of this study. The absence of children less than 10 years of age in the sample also renders the results inapplicable to this group of patients.

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Conclusion

The results of this study are in keeping with previous studies done elsewhere and show that the MPI score is predictive of outcome. We can conclude that MPI is a useful method to determine outcome in patients with peritonitis, surgically evaluated, at the KUTH. All MPI adverse factors, except age and sex behaved as expected, and the following were especially useful in predicting outcome: presence of the organic failure; time elapsed >24 hours; presence of malignity; the origin of sepsis; the presence of fecal peritonitis, and generalized extension of peritonitis. The increase of MPI scores is proportional to that of morbidity and mortality.

Recommendations

From the findings of this study, it is recommended that:

1. The MPI score should be used by surgeons as a tool which allow them to predict outcome in patients with secondary peritonitis at KUTH with the aim of identifying and aggressively managing high risk patients so as to improve outcome
2. Similar study be carried out in children <10 years since this study did not include this age category.
3. Study to be carried out in order to investigate the exact cause of the many ileal perforations in our hospital, which are believed to be typhoid fever complications based only on clinical judgement.

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