Original Article

EVALUATION OF MANNHEIM PERITONITIS INDEX IN SECONDARY PERITONITIS IN HUSM

Mehboob Alam Pasha*[1], Narendran Balasubbiah [2], Sangeta Vadiveloo [3], Nafeesa Banu Sathyamangalam Rahmathulla [1], Zaidi Zakaria [4]

[1] Faculty of Medicine, Universiti Islam Antarabangsa Sultan Abdul Halim Mu'adzam Shah (UniSHAMS), Kuala Ketil, Kedah, Malaysia.
[2] Hospital Sultanah Bahiyah, Alor Setar, Kedah, Malaysia.
[3] Hospital Sultan Abdul Halim Shah, Sungai Petani, Kedah, Malaysia.
[4] School of Medicine, Universiti Sains Malaysia, Kubang Kerian, Malaysia.

ARTICLE INFO

ABSTRACT

Management of peritonitis continues to be a challenge inspite of recent advances in surgical care and technology . Many scoring systems have been developed to study the associated risk factors in order to predict the outcome and develop strategies for improved care. The objective of this study was to evaluate the Mannheim Peritonitis Index (MPI) in determining the outcome of patients operated for secondary peritonitis in Hospital Universiti Sains Malaysia (HUSM). A total of 113 patients with peritonitis undergoing surgical treatment at HUSM between 1 Jan 2013 and 31Oct 2014 were included in the study. Demographic and clinical data, and findings at surgery were documented and analysed using SPSS software . Pearsons Chi-square was used as a statistical test for significance with p value ≤ 0.05. The mean MPI score was 25.22(±8.03) with the lowest score of 10 and highest of 43. The threshold MPI score was 26.5 and there was only 1 death which occurred below this score. The significant predictive factors for mortality were age >50 years, gender, organ failure and diffuse generalised peritonitis. Further, all parameters for MPI affected the scoring except source of sepsis from noncolonic origin. The ROC curve for mortality showed a sensitivity of 94.7% and specificity of 70.2% at a threshold MPI of 26.5. The MPI score is a simple and effective means to predict the outcome of patients with secondary peritonitis in HUSM.

INTRODUCTION

Peritonitis denotes inflammation of the serous membrane lining the peritoneal cavity and abdominal viscera from any cause [1]. It has been further classified into primary, secondary and tertiary. Secondary peritonitis or suppurative peritonitis is due to gastro-intestinal perforation, injury, haemoperitonitis, anastomotic dehiscence, or a gangrenous or infected hollow viscus. or organ. Until the end of the last century, peritonitis was treated medically, with a resultant mortality of over 90%. Since then many interventions have been made to reduce the incidence of mortality due to peritonitis, and is presently reported to be 13-43% [2]. With such high prevalence of mortality, management chiefly depends on early detection of peritonitis. In order to identify the high risk group in these patients, many simple scoring systems have been developed. One of them, which is very simple to apply, is Mannheim Peritonitis Index (MPI). This index

is based on measuring very simple clinical parameters, which are routinely performed during admission to the hospital and findings during surgery available from the operation notes. MPI was developed by Wacha and Linder (1983) based on retrospective analysis of 1253 patients with peritonitis [3]. Twenty possible risk factors were taken into consideration, out of which eight were found to be of prognostic value (Table 1). The maximum possible value was 47 while the minimum was zero. The information is collected during the first laparotomy enabling immediate classification. The aim of this study was to evaluate the Mannheim Peritonitis Index in determining the outcome in patients operated for secondary peritonitis in Hospital Universiti Sains Malaysia, and to assess individual risk factors for their contribution towards mortality.

Table 1: MPI scoring with weightage for each of the eight risk factors

Number	Risk Factors	Weightage when present
1	Age >50 years	5
2	Female Sex	5
3	Organ Failure**	7
4	Malignancy	4
5	Preoperative Duration of Peritonitis >24 Hours	4
6	Origin of Sepsis Non-Colonic	4
7	Diffuse generalised Peritonitis	6
8	Exudate (Intra-operative)	
	• Clear	0
	• Cloudy/Purulent	6
	• Feculent	12

** Definition of Organ Failure

Kidney	Creatinine level >177 umol/L, Urea level >16.7mmol/L, Oliguria <20ml/h
Lung	PO_2 < 50 mmHg , PCO_2 >50 mmHg
Shock	Systolic Blood Pressure < 90 mmHg without inotropes
Intestinal obstruction	Paralysis > 24 Hr or Complete Mechanical Obstruction
Total MPI Score	=

MATERIAL AND METHODS

This observational retrospective record review was conducted at the Surgical department of Hospital Universiti Sains Malaysia (HUSM), in the state of Kelantan, Malaysia. Ethical approval was obtained from the HUSM Ethics and Research Committee and permission to review the hospital records from the hospital director. The study included 113 patients aged above 12 years in whom secondary peritonitis was confirmed at laparotomy or laparoscopy. Exclusion criteria were patients below 12 years, those whose records were incomplete, those with primary and tertiary peritonitis, and those who underwent surgery for similar pathology elsewhere within the last six months. Proforma was designed to collect and enter demographic data and findings at surgery. Mannheim Peritonitis Index was then used to calculate prognostic score for each of the eight parameters according to the values set in Table 1. A cut-off score of 26 was set to predict mortality based on Billings (1994) study [4].

Data collected was analysed using SPSS version 21 (IBM, Chicago, IL,USA). Pearson Chi-square and Independent T-test was used to test validity of each of the eight MPI values. Results were summarised using Receiver Operating Characteristic (ROC) analysis and Area Under the Curve (AUC) was calculated. A p-value of <0.05 was considered statistically significant.

RESULTS

From January 1, 2013 to October 31, 2014, the records of 113 patients with secondary peritonitis who were operated were reviewed and included in the study. Of the 113 patients, 64 were males and 49 were females. There were more males than females (ratio 1.3:1). The ages ranged from 15 to 99 years, with a mean of 45 years. Among the causes of secondary peritonitis, appendicular perforation (49.6%) was the most common. Other causes were gastric perforation (14.2%), small bowel perforation (8.8%), colonic perforation of non-cancer origin (8%), perforated colon cancer (3.5%) etc (Table 2).

Out of the 113 patients in this study 19 patients died, with overall mortality of 16.8% (Figure1). In this study there were 66 patients aged 50 years and below, out of whom three patients died , giving a mortality of 4.5% (3/66). There were 47 patients aged ≥ 50 years old. Among this group the mortality rate is 34% (16/47). This suggests that age is a significant contributor to mortality. There were 64 male patients and 49 females. The mortality for males is 15.6% (10/64) and for females it is 18.4% (9/49). Females in this study had higher mortality. 41(36.3%) patients in this study had at least one type of organ failure most commonly shock followed by intestinal failure. The mortality rate of 46.3% is statistically significant (p=0.0001). Three of 10 patients who had malignancy of some organ system

Table 2: Causes of Secondary Peritonitis in HUSM

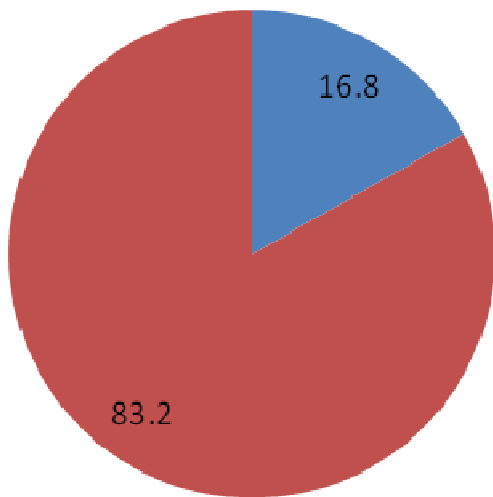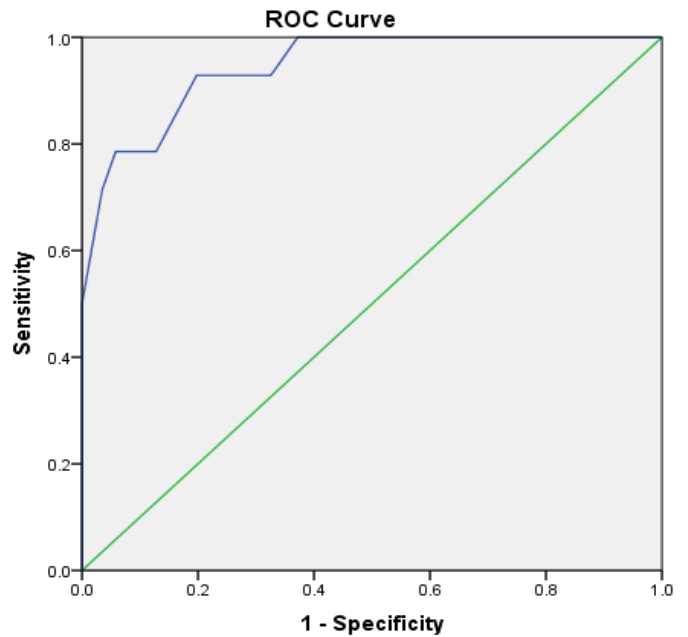| Causes	Frequency	Percentage
Small bowel perforation	10	8.8
Gastric perforation	16	14.2
Duodenal perforation	2	1.8
Appendicular perforation	56	49.6
Colon perforation other than cancer	9	8.0
Perforated colon carcinoma	4	3.5
Pelvic inflammatory disease	1	0.9
Tubo-ovarian abscess	2	1.8
Ruptured liver abscess	3	2.7
Perforated gall bladder	1	0.9
Post –bowel anastomotic leak	4	3.5
Other causes	5	4.4
Total	113	100

Figure 1:
Percentage of patients who died or survived (N=113)

Diagonal segments are produced by ties.

Figure 2: ROC Curve For Sensitivity and Specificity

died {Mortality30% (3/10)}. On MPI analysis this was found to be a significant risk for mortality. In our study, in patients having duration of peritonitis < 24 hours, the mortality rate is 4.3% (1/23). Meanwhile, in the other group when duration of preoperative peritonitis was >24 hours, the mortality rate is 20% (18/90). Late presentation is a significant risk for mortality. The mortality for diffuse peritonitis in this study is 21% (18/65), compared to localised peritonitis where mortality was only 3.6% (1/28). This is significant. Similarly, the mortality when exudate was

purulent or cloudy was 17% (15/88) and when the exudate was feculent the mortality was 16%(4/25).

Mannheim Peritonitis Index was used to evaluate each of the eight parameters mentioned in Table 1, and assess the statistical significance of each factor to predict mortality (Table 3). When Pearson Chi-square test was applied to test each of the eight MPI parameters, only 4 factors had a significant outcome to the survival of patients (Table 3). The four factors are age more than 50 years, female sex, presence of

organ failure, and diffuse generalised peritonitis (p=0.0001).

The other four factors namely; the presence of malignancy, source of sepsis, preoperative duration of peritonitis more than 24 hours, and nature of peritoneal exudates did not contribute to survival outcome as an independent variable. But when all the eight parameters were studied independently for relationship to mean MPI scores using the Independent T-test, all showed significance except for non-colonic origin of sepsis (p=0.079).

In this study the mean MPI score is 25.22 (SD ±8.03) with a score of 10 as the lowest and 43 as the highest. The minimum possible score is 0 and the maximum is 47. The ROC curve for mortality showed the best sensitivity at 94.7% and specificity of 70.2%, corresponding to the MPI score of 26.5.

The MPI threshold score of 26.5 was analysed to the survival outcome. In this study only 1 death was recorded among the patients with secondary peritonitis having MPI score of 26.5 and below . The remaining 18 deaths were recorded in patients whose MPI score was greater than 26.5. (Figure 3). Higher MPI scores are predictors of mortality (p<0.0001).

DISCUSSIONS

Inspite of recent advances in surgical techniques and postoperative care, the mortality in secondary peritonitis remains unacceptably high. Billings (1994) in a multicenter study reported a mean mortality of 19.5% [4]. Others have reported mortalities reaching up to 60% in their studies[5,6]. In this study the mortality rate was 16.8%, comparing favourably with most other studies [1,4,7]. Surgical and medical management may be favourably influenced by early prediction of mortality. Out of the several scores available, the Mannheim Peritonitis Index and the

Apache II score can independently predict the outcome of sepsis in peritonitis [8]. The MPI however is easier to apply and uses details readily available from the patient records, with accuracy matching the APACHE II scores [9,10].

In previous studies patients with MPI score of less than 21 had mortality rate ranging from 0% - 2.3%, and with MPI more than 29, highest mortality rates even up to 100% was observed [4,11]. However, in a study by Qureshi (2005) at a threshold MPI score of 26 , the mortality was 4.3 % in patients having MPI below 26 , and 28.1% when MPI was above 26 [12].

In the present study, mortality was 1.5% when MPI is less than 26 whereas it was 39.0% with MPI score of >26 comparing favourably with other studies [1,7] (sensitivity 94.7%, specificity 70.2%). An optimal cut off point for MPI is one at which the maximum values of sensitivity and specificity of the score can be obtained and it is identified from the ROC curve. In this study the AUC of 0.947 indicates that MPI is a good indicator of mortality.

The age range of patients in this study is 15-99 years , similar to a study in Srinagar, India where the age range was 15-90 years [13]. The mean age was 45 years similar to the Iranian study by Notash [14] where the mean age was 44 years . However studies from Western populations show relatively higher age ranges from 46-64.8 [1-3,15]. This is probably due to higher life expectancy and higher prevalence of colon related pathology [15]. Most studies reported age >50 years to be a significant risk factor for mortality. This can be explained on the basis of poorer physiological and immunological responses to the stress caused by sepsis in older patients[16]. In our study, the mortality rate for patients over 50 years was 34%, which is strongly significant (p=0.0001). Boey (1982) did not find age to be a significant risk factor for mortality [17]. Majority of the patients included in his study had

Table 3:Distribution of MPI variables and outcome of patients

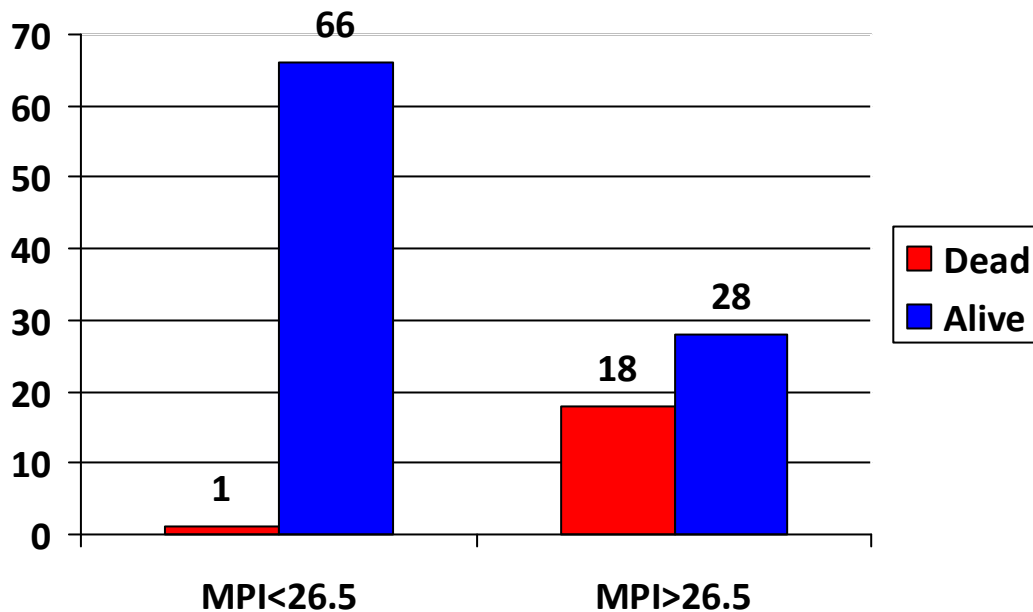| Variable	Outcome		Chi-square	Mean MPI	T-test
	Survived n(%)	Dead n(%)			
Age>50yrs	31 (66)	16 (34)	0.0001	31	0.0001
Female Sex	40 (82)	9 (18)	0.0001	28	0.0001
Organ failure	22 (53.7)	19 (46.3)	0.0001	32	0.0001
Duration>24 hrs	72 (80)	18 (20)	0.115	27	0.0001
Malignancy	7 (70)	3 (30)	0.368	35	0.0001
Diffuse peritonitis	67 (78.9)	18 (21.1)	0.039	28	0.0001
Peritoneal Exudate					
- Cloudy	73 (83)	15 (17)	1.000	24	0.0001
- Fecal	21 (84)	4 (16)	1.000	31	0.0001
- Noncolonic origin	78 (84.8)	14 (15.2)	0.343	25	0.0079

Figure 3: MPI threshold score related to the survival outcome

duodenal perforation, where risk for sepsis is less than other types of peritonitis.

In the Linder scoring scale for MPI 5 points have been added to the MPI if the patient is female [3]. Most studies have reported a higher mortality among females with peritonitis [18-22]. The mortality rate for females in this study was 18.4% (8/49). The mean MPI score of 28 was strongly significant (P=0.0001). It is possible that in females with their smaller peritoneal cavity, infections tend to spread faster leading to higher mortality. Nevertheless, other studies have not found female gender to be a significant risk factor for mortality [12,23-25]. This may be due to possible differences in demographic pattern and cut-off values for MPI in those studies.

Almost all studies done worldwide quote organ failure as a major risk factor for death in peritonitis [12,14,16,18,24-25]. The systemic inflammatory response (SIRS) induced by the peritoneal infection usually leads to septic shock and multiorgan failure. In our study 19 out of 51 patients had at least one failed organ at the time of death , The high MPI score of 33 with a mortality rate of 46.3% is strongly significant (p=0.0001), conforming to most other studies. Probable reasons could be late presentation of the patient and time taken to stabilise the patient before laparotomy.

Presence of malignancy in any system produces destruction of anatomical barriers and probable alterations of immune systems by decreased phagocytic activity, humoral and cellular responses.

Hence peritonitis in oncologic patients presents with higher mortality as reported by various studies [12,15,24,26]. However other studies were inconclusive probably due to the small number of patients in their studies [21,25]. In this study, three of 10 peritonitis patients who had malignancy died (30% mortality). The MPI scores for those with and without malignancy were 35 and 21 respectively. This was strongly significant (p=0.0001). Hence malignancy in our study is a useful prognostic indicator.

The majority of patients in this study presented to the hospital after 24 hours from the onset of symptoms . 20% of them died as a result of late presentation. With a MPI score of 27 on Independent T-test, this was significant (p=0.0001). Probable causes are tendency of the local population to neglect their symptoms, belief in traditional medicinal systems, or lack of proper referral systems. Some authors have noted zero mortality when duration of peritonitis is less than 24 hours[16]. On the other hand Notash (2005) found mortality to be 11.4% when patients presented within 24 hours[14] . Differences in demographics and types of pathology could be the reason.

14 (15.2%) of our patients in this study died when their perforation was not from the colon. With a MPI score of 25 this was not found to be statistically significant (0.079). This correlates with findings in other studies [12,15]. Our local population unlike their Western counterparts are

probably less prone for colonic pathology and hence less risk for mortality.

Diffuse generalised peritonitis denotes the spread of the inflammatory process within the peritoneal cavity. This is identified at laparotomy by the finding of cloudy, purulent or faecal exudates in two or more quadrants. In this study, 75% of patients had diffuse generalised peritonitis, with a MPI score of 28 and a mortality of 21.1%. This was a significant MPI predicator (p=0.0001), comparing favourably with previous studies [1,10,21,25].

Peritoneal exudates can be clear, and considered to be probably sterile in the early stages, purulent or cloudy, and frankly feculent. Faecal exudates are generally of colonic origin with a high microbial content mainly due to gram negative organisms. In this study there were no clear exudates. 15 out of 88 patients with purulent exudates died (mortality 17% and MPI of 24). Of the 25 who had faecal exudates, four patients died (mortality 16% and MPI of 31). Pearsons Chi-square showed no significance (p=1.000) but between groups analysis showed presence of faecal exudates to be a significant risk factor (p=0.0001) .Our finding compares favourably with previous studies [9,12,18,25].

This retrospective study is limited by the small population in Kelantan, which may not be representative . There are limited or scarce reports available to compare our results within the Malaysian population. Sepsis of noncolonic origin was not a significant risk factor in this study. Hence, the MPI can be widened to include colonic perforation as a risk factor for sepsis to increase its validity.

CONCLUSION

The results of our study conform favourably with previous studies done elsewhere. All the MPI adverse factors except origin of sepsis being noncolonic, behaved as expected, with age ,gender, organ failure and diffuse peritonitis showing strong significance. High MPI scores were found to be associated with higher mortality. We can conclude that MPI score is a safe and reliable predictor for mortality in patients with secondary peritonitis.

ACKNOWLEDGEMENT

CONFLICTS OF INTEREST : Nil

REFERENCES

1. Seiler CA, Brügger L, Forssmann U, Baer HU, Büchler MW. Conservative surgical treatment of diffuse peritonitis. Surgery 2000;127:178-84.
2. Wittman DH. Intra-abdominal Infections: Patho-physiology and Treatment. New York: Marcel Dekker; 1991. p. 48-51.
3. Wacha H, Linder MM, Feldman U, WeschG, Gundlach E, Steifensand RA. Mannheim peritonitis index – prediction of risk of death from peritonitis: construction of a statistical and validation of an empirically based index. Theoretical Surg. 1987;1:169-77.
4. Billing A, Fröhlich D, Schildberg FW. Prediction of outcome using the Mannheim peritonitis index in 2003 patients. Peritonitis Study Group. Br J Surg. 1994 Feb;81(2):209-13.
5. Bohnen J, Boulanger M, Meakins JL, Mclean APH. Prognosis in generalized peritonitis: relation to cause and risk factors. Arch Surg. 1983;118:285-90.
6. Schein M, Saadia R, Freinkel Z and Decker GAG (1983). Aggressive treatment of severe diffuse peritonitis from intestinal origin. *World Journal of Surgery* **7** 762-6.
7. Bielecki K, Kaminski P, Klukowski M. Large bowel perforation: morbidity and mortality. Tech Coloproctol 2002; **6**: 177-82.
8. Malik AA, Wani KA, Dar LA, Wani MA, Wani RA, Parray FQ, et al. Mannheim Peritonitis Index and APACHE II - prediction of outcome in patients with peritonitis. *Ulus Travma Acil Cer-rahi Derg.* 2010;16(1):27-32.
9. Ohmann C, Wittmann DH, Wacha H. Prospec-tive evaluation of prognostic scoring systems in peritonitis. Peritonitis Study Group. *The European journal of surgery = Actachirurgica.* 1993;159(5):267-74.
10. Pacelli F, Doglietto GB, Alfieri S, Piccioni E, Sgadari A, Gui D, et al. Prognosis in intra-abdominal infections. Multivariate analysis on 604 patients. Arch Surg 1996; 131(6): 641-5.
11. Fugger R, Rogy M et al Validation study of the Mannheim peritonitis index. Chirurg. 1988; 59:598-601.
12. Qureshi AM, Zafar A, Saeed K, Quddus A. Predictive power of Mannheim peritonitis index. J Coll Physicians Surg Pak. 2005;15(11):693-6.
13. Khan SP, Dar LA, Hayat H. Predictors of mortality and morbidity in peritonitis in a developing country. *Turkish Journal of Surgery.* 2013;29(3):124-130.
14. Notash AY, Salimi J, Rahimian H, Fesharaki Ms, Abbasi A. Evaluation of Mannheim peritonitis index and multiple organ failure score in patients with peritonitis. Indian J Gastroenter-ol. 2005 Sep-Oct;24(5):197-200.
15. Correia MM, Thuler LCS, Velasco E and Vidal EMSA (2001). Prediction of Death using the Mannheim Peritonitis Index in Oncologic Patients. *Revista Brasileira de Cancerolo-gia* .2001:47(1) 63-68

16. Tushar D, Ramachandra L , Rajesh N, Digvijoy S. Evaluation of prognosis in patients with perforation peritonitis using Mannheim's peritonitis index International Journal of Scientific and Research Publications.2015:5(5):1-35

17. Boey J, Wong J, Ong GB. A prospective study of operative risk factors in perforated duodenal ulcers. *Ann Surg* 1982; 195(3): 265-269.

18. Chaudhari ND, Nakum A, Mahida H. Mannheim's peritonitis index validation study in the Indian set-up. Int J Sci Res 2014;3:1808-11.

19. Sharma S, Singh S, Makkar N, Kumar A, Sandhu MS. Assessment of severity of peritonitis using Mannheim peritonitis index. Niger J Surg 2016;22:118-22.

20. Wabwire B, Saidi H. Stratified outcome evaluation in peritonitis. Ann Afr Surg. 2014;11 (2):29-34.

21. Jain S, Jain M, Jain R. Validation of Mannheim peritonitis index in a tertiary care center in Rajasthan. Int J Med Sci Public Health 2015;4:664-668.

22. Kusumoto Yoshiko, Neyagawa Masayuki, et al. Study of Mannheim Peritonitis Index to Predict Outcome of Patients with Peritonitis. *Japanese Journal of Gastroenterological Surgery.* 2004;37(1):7-13.

23. Yilmazlar T, Toker S, Zorluoglu A. Non-traumatic colorectal perforations. Int Surg 1999; 84: 155- 8.

24. Ntirenganya F, Ntakiyiruta G, Kakande I. Prediction of outcome using the Mannheim peritonitis index in patients with peritonitis at Kigali University Teaching Hospital. East Cent Afr J Surg. 2012;17(2):52-64.

25. Rudofo L, Bracho-Riquelme, Armando Melero-Vela M C , Aidee Torres-Ramirez M C . Mannheim Peritonitis Index validation study at the Hospital General de Durango (Mexico) Cirugia y Cirujanos.2002: 70(4) , 217-225.

26. Koppad SN, Vandakudri AB, Desai M, Kodliwadmath H. Analysis of Mannheim peritonitis index scoring in predicting outcome in patients with peritonitis secondary to hollow viscous perforation. Int Surg J 2016;3:1116-20