

## Study of Risk factors predicting increased morbidity and mortality in perforated peptic Ulcer-Our Institutional Perspective

Ravi S<sup>1\*</sup>, PradeepYM<sup>2</sup>, Shankarlal J<sup>3</sup>, Rajanna B<sup>4</sup>

<sup>1</sup>Associate Professor, Department of General Surgery, Hassan Institute of Medical Sciences, Hassan, Karnataka, India

<sup>2</sup>Assistant Professor, Department of General Surgery, Hassan Institute of Medical Sciences, Hassan, Karnataka, India

<sup>3</sup>Assistant Professor, Department of General Surgery, Hassan Institute of Medical Sciences, Hassan, Karnataka, India

<sup>4</sup>Professor and HOD, Department of General Surgery, Hassan Institute of Medical Sciences, Hassan, Karnataka, India

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### Abstract

**Background :** Perforated Peptic Ulcer [PPU] is a common condition operated as emergency in almost all hospitals across the world. Due to availability of good antiulcer medications elective peptic ulcer operations has significantly reduced. But emergency operations for peptic ulcer perforations is still increasing with substantial health issues resulting in significant postoperative morbidity and mortality. **Objective:** To identify the risk factors Predicting Increased Morbidity and Mortality in perforated Peptic Ulcer. **Methods:** This is a retrospective study of 200 patients operated for peptic ulcer perforations between January 2015 to December 2020 done by the Department of General Surgery at Hassan institute of Medical Sciences. Approval to use medical records and clearance certificate from human ethics committee, Hassan institute of medical sciences, Karnataka, India was obtained prior to the study. Demographic profile of patient, symptoms at presentation, time from onset of symptoms to admission to hospital, associated co-morbidities, laboratory and imaging findings, time delay from admission to surgery; hospital stay duration, postoperative complications and mortality were recorded. **Results:** Mean age of subjects in the study was  $46.34 \pm 15.9$  years. Male: Female ratio was 11.5:1. In the study 42.5% had complications. 13.5% had wound infection, 22.5% had chest infection, 16% had renal failure, 10.5% had septic shock, 18.5% required ventilator and 3.5% required Relaparotomy. In the study there was significant association between Mortality and presence of morbidity, and renal failure, septic shock and needed ventilator. **Conclusion:** The present study concluded that Post Op stay (>2 Weeks), ASA grade (>2), Size of Perforation (>1 cm) were significant factors associated with Morbidity and Factors such as Female Gender, Presence of Comorbidity (COPD), Hypotension (Shock), Raised Serum Creatinine, Post Op stay (>2 Weeks) and presence of morbidities such as Renal failure, Septic Shock, Need for Ventilator were significantly associated with Mortality.

**Keywords:** Peptic Ulcer, Acidity, Mortality, Morbidity, Laparoscopic

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### Introduction

Perforated Peptic Ulcer [PPU] is a common condition operated as emergency in almost all hospitals across the world [1]. Due to availability of good antiulcer medications elective peptic ulcer operations has significantly reduced. But emergency operations for peptic ulcer perforations is still increasing with substantial health issues resulting in significant postoperative morbidity and mortality. [2] Most of the perforations are treated by surgery i.e., simple closure and Graham's Omental patch technique. [3,4] Various Studies report that age >60 yrs, presence of shock at admission, sepsis, co-morbidities, delay in presentation and treatment are risk factors of morbidity and mortality in patients with PPU. [5-7] Though the surgery done after adequate resuscitation, appropriate modern anaesthesia and adequate intensive care, there is still high post operative morbidity [20-50%] and mortality [3-40%]. [7]

\*Correspondence

Dr. Ravi S

Associate Professor, Department of General Surgery, Hassan Institute of Medical Sciences, Hassan, Karnataka, India

E-mail: [dr ravi.s67.rsg@gmail.com](mailto:dr ravi.s67.rsg@gmail.com)

Our study aims to understand the preoperative and intraoperative factors in predicting postoperative morbidity and mortality in patients operated for peptic ulcer perforation in a tertiary care hospital.

#### Objective

To identify the risk factors Predicting Increased Morbidity and Mortality in perforated Peptic Ulcer

#### Methods

This is a retrospective study of 200 patients operated for peptic ulcer perforations between January 2015 to December 2020 done by the Department of General Surgery at Hassan institute of Medical Sciences. Approval to use medical records and clearance certificate from human ethics committee, Hassan institute of medical sciences, Karnataka, India was obtained prior to the study. Demographic profile of patient, symptoms at presentation, time from onset of symptoms to admission to hospital, associated co-morbidities, laboratory and imaging findings, time delay from admission to surgery; hospital stay duration, postoperative complications and mortality were recorded. Patients who underwent laparotomy for other conditions or malignant ulcer perforations were excluded from the study. All 200 patients were operated after adequate resuscitation and institutional protocol for peptic ulcer perforation management.

Laparotomy was performed in all the patient by a duty surgeon with supervision of unit consultants. All patients underwent simple closure of perforation with omental patch and thorough peritoneal toilet by saline irrigation and abdominal drains were kept. Standard postoperative treatment given as per institutional protocol and intensive care if needed.

Data on relevant preoperative, intraoperative and postoperative variables were recorded.

Age, gender, time delay from symptoms to admission, associated co-morbidities, physical examination findings, investigation reports, time elapsed from admission to surgery, site and size of perforation were taken as study variables. Postoperative mortality was considered as death of patient in hospital during same hospital admission period. Postoperative complications such as surgical site infection, chest infection, renal failure, septic shock or need for mechanical ventilation during postoperative period were analysed.

#### Statistical Analysis

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software [IBM SPSS Statistics, Somers NY, USA]. Analysis was performed on the preoperative and intraoperative variables and its relationship to postoperative complications, need for mechanical ventilation and duration of hospital stay was evaluated. Categorical data was represented in the form of frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Multiple logistic regression was done to determine the independent factors for mortality.

#### Graphical representation of data

MS Excel and MS Word were used to obtain various types of graphs such as bar diagram.

**P value** [Probability that the result is true] of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

#### Results

**Table 1: Profile of subjects in the study**

		Count	%
Age	<30 years	40	20.0%
	30 to 44 years	50	25.0%
	45 to 59 years	52	26.0%
	>60 years	58	29.0%
Gender	Female	16	8.0%
	Male	184	92.0%
Diagnosis	Gastric Perforation	13	6.5%
	Duodenal Ulcer Perforation	187	93.5%
Time to Presentation [hrs]	<12 hrs	102	51.0%
	12 to 24 hrs	75	37.5%
	24 to 36 hrs	21	10.5%
	>36 hrs	2	1.0%
HTN	No	169	84.5%
	Yes	31	15.5%
COPD	No	162	81.0%
	Yes	38	19.0%
DM	No	167	83.5%
	Yes	33	16.5%
CAD	No	196	98.0%
	Yes	4	2.0%
Personnel history	No Habits	116	58.0%
	Smoker	65	32.5%
	Alcoholic	19	9.5%

Mean age of subjects in the study was  $46.34 \pm 15.9$  years. Male: Female ratio was 11.5:1. Majority of subjects were in the age group >60 years (29%), 92% were males, 93.5% had Duodenal Ulcer

Perforation, 87.5% presented before 24 hrs, 15.5% had HTN, 19% had COPD, 16.5% had DM, 2% had CAD, 32.5% were smokers and 9.5% were alcoholics.

**Table 2: Clinical and laboratory profile of subjects in the study**

		Count	%
SBP	>90	159	79.5%
	<90	41	20.5%
S.Creatinine	<1.5	139	69.5%
	>1.5	61	30.5%
Free air under diaphragm	Absent	21	10.5%
	Free air bronchogram	179	89.5%
ASA	<2	166	83.0%
	>2	34	17.0%
Time delay	<36 hrs	177	88.5%
	>36 hrs	23	11.5%
Site of Perforation	Gastric	13	6.5%
	Duodenum	187	93.5%
Size of Perforation	<1 cm	155	77.5%
	>1 cm	45	22.5%
Post Op stay	<2 Weeks	167	83.5%
	>2 Weeks	33	16.5%

In the study 20.5% had hypotension, 30.5% had raised Serum creatinine, 89.5% had free air under diaphragm, 17% had ASA grade >2, 11.5% presented after 36 hrs, 93.5% site of perforation was duodenum, 22.5% had size of perforation >1 cm and 16.5% had post op stay >2 weeks.

**Table 3: Complications distribution**

	No		Yes	
	Count	%	Count	%
Over all Morbidity	115	57.5%	85	42.5%
Wound Infection	173	86.5%	27	13.5%
Chest Infection	155	77.5%	45	22.5%
Renal Failure	168	84.0%	32	16.0%
Septic Shock	179	89.5%	21	10.5%
Needed Ventilator	163	81.5%	37	18.5%
Relaparotomy	193	96.5%	7	3.5%

In the study 42.5% had complications. 13.5% had wound infection, 22.5% had chest infection, 16% had renal failure, 10.5% had septic shock, 18.5% required ventilator and 3.5% required Relaparotomy.

**Table 4: Reason for reoperation**

		Count (n = 7)	%
Reason for reoperation	Bile Leak	1	14.3%
	Burst Abdomen	5	71.4%
	Pelvic Abscess	1	14.3%

In the study 14.3% had bile leak, 71.4% burst abdomen, 14.3% had pelvic abscess.

**Table 5: Mortality distribution**

		Count	%
Death	No	189	94.5%
	Yes	11	5.5%

In the study 5.5% had mortality.

**Table 6: Factors associated with Morbidity (Complications)**

		Morbidity				P value
		No		Yes		
		Count	%	Count	%	
Age	<60 years	96	60.4%	63	39.6%	0.105
	>60 years	19	46.3%	22	53.7%	
Gender	Male	108	58.7%	76	41.3%	0.246
	Female	7	43.8%	9	56.2%	
Diagnosis	Gastric Perforation	7	53.8%	6	46.2%	0.783
	Duodenal Ulcer Perforation	108	57.8%	79	42.2%	
Time to Presentation [hrs]	<24 hrs	100	56.5%	77	43.5%	0.426
	>24 hrs	15	65.2%	8	34.8%	
Post Op stay	<2 Weeks	113	67.7%	54	32.3%	<0.001*
	>2 Weeks	2	6.1%	31	93.9%	
Comorbidities	No	64	70.3%	27	29.7%	0.001*
	Yes	51	46.8%	58	53.2%	
SBP	>90	95	59.7%	64	40.3%	0.205
	<90	20	48.8%	21	51.2%	
S.Creatinine	<1.5	87	62.6%	52	37.4%	0.028*
	>1.5	28	45.9%	33	54.1%	
Free air under diaphragm	Absent	12	57.1%	9	42.9%	0.972
	Free air bronchogram	103	57.5%	76	42.5%	
ASA	<2	108	65.1%	58	34.9%	<0.001*
	>2	7	20.6%	27	79.4%	
Time delay	<36 hrs	105	59.3%	72	40.7%	0.148
	>36 hrs	10	43.5%	13	56.5%	
Site of Perforation	Gastric	5	38.5%	8	61.5%	0.51
	Duodenum	110	58.8%	77	41.2%	
Size of Perforation	<1 cm	100	64.5%	55	35.5%	<0.001*
	>1 cm	15	33.3%	30	66.7%	

In the study Post Op stay >2 weeks, presence of Comorbidities, Serum Creatinine >1.5, ASA grade >2, size of perforation >1 cm were significantly associated with Morbidity.

**Table 7: Multiple logistic regression to determine independent factor associated with Morbidity among subjects with perforation.**

		B	P value	Exp(B)	95% C.I. for EXP(B)	
					Lower	Upper
Factors for Morbidity	Age (>60 years)	-0.099	0.837	0.905	0.351	2.334
	Gender (Female)	0.115	0.867	1.121	0.293	4.291
	Diagnosis (Duodenal Ulcer Perforation)	-0.149	0.845	0.861	0.193	3.849

Post Op stay (>2 Weeks)	-3.054	<b>&lt;0.001*</b>	<b>0.047</b>	<b>0.010</b>	<b>0.220</b>
Time to Presentation (>24 hrs)	0.695	0.319	2.005	0.510	7.880
Comorbidities (Yes)	-0.751	0.051	0.472	0.222	1.005
SBP (<90 mmhg)	-0.050	0.934	0.951	0.293	3.087
S.Creatinine (>1.5 mg/dl)	-0.624	0.224	0.536	0.196	1.464
X Ray Chest (Free air bronchogram)	0.467	0.445	1.595	0.482	5.278
ASA(>2)	-1.733	<b>0.001*</b>	<b>0.177</b>	<b>0.061</b>	<b>0.508</b>
Time delay(>36 hrs)	-0.639	0.267	0.528	0.171	1.630
Site of perforation (Duodenum)	0.426	0.557	1.531	0.370	6.336
Size of Perforation (>1 cm)	-1.325	<b>0.003*</b>	<b>0.266</b>	<b>0.111</b>	<b>0.638</b>

Post op Stay, ASA status and Size of perforation were independent factors associated with Morbidity.

**Table 6: Association between various factors and mortality**

		Death				P value
		Yes		No		
		Count	%	Count	%	
Age	<60 years	149	93.7%	10	6.3%	0.335
	>60 years	40	97.6%	1	2.4%	
Gender	Female	3	18.8%	13	81.2%	0.015*
	Male	8	4.3%	176	95.7%	
Diagnosis	Gastric Perforation	0	0.0%	13	100.0%	0.368
	Duodenal Ulcer Perforation	11	5.9%	176	94.1%	
Time to Presentation [hrs]	<24 hrs	169	95.5%	8	4.5%	0.092
	>24 hrs	20	87.0%	3	13.0%	
Comorbidity	No	1	9.1%	90	47.6%	0.013*
	Yes	10	90.9%	99	52.4%	
HTN	No	9	5.3%	160	94.7%	0.800
	Yes	2	6.5%	29	93.5%	
COPD	No	6	3.7%	156	96.3%	0.021*
	Yes	5	13.2%	33	86.8%	
DM	No	9	5.4%	158	94.6%	0.877
	Yes	2	6.1%	31	93.9%	
CAD	No	11	5.6%	185	94.4%	0.626
	Yes	0	0.0%	4	100.0%	
Personnel history	No Habits	6	5.2%	110	94.8%	0.421
	Smoker	5	7.7%	60	92.3%	
	Alcoholic	0	0.0%	19	100.0%	
SBP	>90	4	2.5%	155	97.5%	<0.001*
	<90	7	17.1%	34	82.9%	
S.Creatinine	<1.5	3	2.2%	136	97.8%	0.002*
	>1.5	8	13.1%	53	86.9%	
Free air under diaphragm	Absent	0	0.0%	21	100.0%	0.243
	Free air bronchogram	11	6.1%	168	93.9%	
ASA	<2	161	96.4%	6	3.6%	0.351
	>2	28	84.8%	5	15.2%	
Time delay	<36 hrs	166	93.8%	11	6.2%	0.219
	>36 hrs	23	100.0%	0	0.0%	
Site of Perforation	Gastric	1	7.7%	12	92.3%	0.720
	Duodenum	10	5.3%	177	94.7%	
Size of Perforation	<1 cm	149	96.1%	6	3.9%	0.061
	>1 cm	40	88.9%	5	11.1%	
Post Op Stay	<2 Weeks	161	96.4%	6	3.6%	0.008*
	>2 Weeks	28	84.8%	5	15.2%	

Factors such as Gender, Comorbidity, COPD, SBP, Serum creatinine and post op stay were significantly associated with Mortality.

**Table 7: Association between Complications and mortality**

		Death				P value
		Yes		No		
		Count	%	Count	%	
Morbidity	No	112	59.3%	3	27.3%	0.037*
	Yes	77	40.7%	8	72.7%	
Wound Infection	No	10	5.8%	163	94.2%	0.660
	Yes	1	3.7%	26	96.3%	
Chest Infection	No	7	4.5%	148	95.5%	0.257
	Yes	4	8.9%	41	91.1%	

Renal Failure	No	6	3.6%	162	96.4%	<b>0.006*</b>
	Yes	5	15.6%	27	84.4%	
Septic Shock	No	5	2.8%	174	97.2%	<b>&lt;0.001*</b>
	Yes	6	28.6%	15	71.4%	
Needed Ventilator	No	4	2.5%	159	97.5%	<b>&lt;0.001*</b>
	Yes	7	18.9%	30	81.1%	
Relaparotomy	No	11	5.7%	182	94.3%	0.516
	Yes	0	0.0%	7	100.0%	

In the study there was significant association between Mortality and presence of morbidity, and renal failure, septic shock and needed ventilator.

**Table 8: Multiple logistic regression to determine independent factor associated with Mortality among subjects with perforation**

	B	P value	Adjusted OR	95% C.I.for EXP(B)	
				Lower	Upper
Factors associated with Mortality	Age (>60 years)	3.693	0.082	40.158	0.628 2569.178
	Gender (Female)	<b>2.898</b>	<b>0.040</b>	<b>18.141</b>	<b>1.146 287.249</b>
	Diagnosis (Duodenal Ulcer Perforation)	-19.471	0.998	0.000	0.000 .
	Post Op stay (>2 Weeks)	0.262	0.891	1.300	0.031 54.555
	Time to Presentation (>24 hrs)	-1.858	0.206	0.156	0.009 2.779
	Comorbidities (Yes)	-1.907	0.194	0.149	0.008 2.634
	SBP (<90 mmhg)	-1.065	0.627	0.345	0.005 25.308
	S.Creatinine (>1.5 mg/dl)	-0.054	0.980	0.947	0.014 62.151
	X Ray Chest (Free air bronchogram)	-23.541	0.997	0.000	0.000 .
	ASA(>2)	-2.711	0.061	0.066	0.004 1.128
	Site of perforation (Duodenum)	3.523	0.164	33.892	0.239 4816.292
	Size of Perforation (>1 cm)	0.855	0.606	2.351	0.092 60.354
	Morbidity (yes)	0.399	0.871	1.491	0.012 182.462
	Wound Infection (Yes)	1.759	0.498	5.804	0.036 935.592
	Chest Infection (Yes)	1.215	0.545	3.370	0.066 172.487
	Renal Failure (Yes)	-0.127	0.937	0.880	0.038 20.657
	Septic Shock (Yes)	-1.494	0.428	0.224	0.006 9.012
	Need for Ventilator (Yes)	-3.675	0.092	0.025	0.000 1.824

In the study Gender was the only independent factor associated with Mortality.

## Discussion

Incidence and prevalence of Peptic ulcer disease [PUD] varies from different regions and places, its frequency is estimated to be 1500-3000 per 100000 population.[8] Postoperative morbidity rate in PPU ranges between 21-42 %.[7,8] Postoperative mortality rate in PPU ranges between 4-30%.[7-11,20-25] The lifetime possibility for an individual to develop PUD is approximately 5%.[12] Though NSAID'S and H.Pylori are blamed as etiologies for PUD, wide spread use of proton pump inhibitors in recent years for PUD has resulted in decrease in elective peptic ulcer surgeries.[12] In spite of all these medications, PUD patients develop perforations at a rate of 7% and bleeding at rate of 15-20% per year.[13] Peptic ulcer perforations are common in 4th and 5th decade of life and male:female ratio is in the range of 2-8:1.[7] In our series mean age of patients was 46.34 ± 15.98 years in a way similar to the literature, male :female ratio was 11.5 /1. It was reported that free air under diaphragm was identified in the chest x-ray images including diaphragm in 72-80 % patients with PPU.[7] Corresponding to these data 89.5 % of our patients in our study were identified to have free air in their x-ray images. CT Scan abdomen was used to confirm the diagnosis when no free gas seen in x-ray. Almost all patients presented with severe abdominal pain with or without vomiting. Time lag between initial symptom of abdominal pain to presentation at hospital has been mentioned as an important determinant of the outcome in perforated peptic ulcer in various studies.[5,6,7] In the present study, however presentation >24hrs was not a significant factor in terms of morbidity and mortality. Shock at presentation i.e., BP<90/60 increased the incidence of inotropic support as well as postoperative mechanical ventilation. [7,28] There are few studies suggest non operative management for such high risk cases in PPU[17]. These factors were found to influence the outcome. In the present study Hypotension (Shock) at admission was a significant factor associated with Mortality. Mean duration of hospital stay was 11.34 days with a standard deviation of ± 5.41 days. The maximum

duration of hospital stay was 36 days. In a study by Arveen et al[18] from south india, the mean hospital stay was 10.9 ± 6.8 days.[range: 1-59 days]. Tas et al[19] reported a mean hospital stay of 8.7 ± 4.6 days [0-44] days with a maximum duration of 44 days which was similar to our study. The postoperative stay >2 weeks, presence of Comorbidities, raised creatinine, ASA grade>2 and size of perforation >1cm were significant factors associated with morbidity in the present study. Factors such as old age, female gender, perforation to surgery interval >36hrs and size of perforation>1cm<sup>2</sup> affected both morbidity and mortality.[20-23] In the present study, female gender, presence of Comorbidity, past history of COPD, Hypotension, raised serum creatinine, post op stay >2 weeks and complications such as renal failure, septic shock and need for ventilator were significantly associated with mortality. Female gender did not correlate with previous studies. Though the different authors mention duodenum to gastric perforation ratio of 5.5: 1.[23] In our series laparotomy showed the site of perforation was located in duodenum in 93.5% of patients and only 6.5% were gastric in location. Though large perforation>1cm reported from Guptha et al from Chandigarh of 25%, [24] in our study 22.5% of patients had perforation greater than 1cm in diameter. The co-morbid illness in patients with PPU influencing poor outcome has been mentioned in various studies.[25,26] In the present study, most common co-morbidity was COPD, followed by DM, Hypertension and CAD. The ASA classification is an assessment of the patients preoperative physical status. ASA Score of 3 or more was identified as a significant risk factor associated with worst outcome. [13-15] In the present study 17% of subjects had ASA Score >2 and it was significantly associated with morbidity. Postoperative morbidity rate increases depending on associated co-morbidities like COPD and diabetes.[25] Abnormal renal function on presentation, presence of preoperative shock, high ASA score, open surgery, long operative time > 150 minutes was identified as additional risk factors for postoperative morbidity and longer hospital stay.[26,27] These factors could be

used as a guide by surgeons to monitor patients with PUP for a better outcome after surgical intervention. In the present study morbidity rate [complications] ranged from 3.5% to 22.5% which is parallel with literature.[27] Need for postoperative requirement of mechanical ventilation was taken as indicator of morbidity. In the present study 18.5% required mechanical ventilation during immediate postoperative period. Surgical site Infection including wound dehiscence was found in 13.5% of cases. Laparoscopic closure of perforation has been shown to be a better option for patients with perforated peptic ulcer. [28-30] Relaparotomy was required in 3.5% of subjects in the present study. For logistic reasons, we did not provide laparoscopic surgery for our patients. When the facilities and expertise improve in our center, laparoscopy will be a viable option in managing such cases.

### Conclusion

The present study concluded that Post Op stay (>2 Weeks), ASA grade(>2), Size of Perforation(>1 cm) were significant factors associated with Morbidity and Factors such as Female Gender, Presence of Comorbidity(COPD), Hypotension (Shock), Raised Serum Creatinine, Post Op stay (>2 Weeks) and presence of morbidities such as Renal failure, Septic Shock, Need for Ventilator were significantly associated with Mortality.

### References

- Jhobta RS, Attri AK, Kaushik R et al. Spectrum of perforation peritonitis in India-review of 504 consecutive cases. *World J Emerg Surg.* 2006;1:26
- Post PN, Kuipers EJ, Meijer GA. Declining incidence of peptic ulcer but not of its complications: a nationwide study in the Netherlands. *Aliment Pharmacol Ther.* 2006; 23:1387-1593
- Juan C, Roberto Fernandez Santiago, Garcia et al. Perforated Peptic Ulcer Treated by Simple Closure and Helicobacter pylori Eradication : *World J. Surg.* 2005; 29:849-852
- Jani K, Saxena AK, Vaghasia R. Omental plugging for large sized duodenal peptic perforations: a prospective randomized study of 100 patients. *South. Med. J.* 2006; 99(5):467-471.
- Nogueira C, Silva AS, Santos JN et al. Perforated peptic ulcer: Main factors of morbidity and mortality. *World J Surg.* 2003; 27 (7):782-7
- Kujath P, Schwandner O, Bruch HP. Morbidity and mortality of perforated peptic gastroduodenal ulcer following emergency surgery. *Langenbecks arch surg.* 2002; 387:298-302
- Kocer B, Surmeli S, Solac C et al. Factors affecting mortality and morbidity in patients with peptic ulcer perforation. *J Gastroenterol Hepatol.* 2007;22:565-70.
- Zittel TT, Becker HD. Surgical management of peptic ulcer disease today indication, technique and outcome. *Langenbecks Arch Surg.* 2000; 385:84-96.
- Imhof M, Epstein S, Roher HD. Duration of survival after peptic ulcer perforation. *World J Surg.* 2008;32:408-412
- Moller MH, Thomsen RW et al. Multicentre trial of a perioperative protocol to reduce mortality in patients with peptic ulcer perforation. *Br J Surg.* 2011; 98(6):802-10.
- Anbalakan K, Shelat VG. Five year experience in management of perforated peptic ulcer and validation of common mortality risk prediction models-Are existing models sufficient? A retrospective cohort study. *Int J Surg.* 2015;14:38-44.
- Vaira D, Miglioli M. What is the role of Helicobacter pylori in complicated ulcer disease? *Gastroenterology.* 1997;113:78-84.
- Casali JJ, Franzon O, Krue NF, Neves BD. Epidemiological analysis and use of rapid urease test in patients with perforated peptic ulcers. *Rev Col Bras Cir.* 2012; 39:93-98.
- Wolters U, Schroder ASA. classification and perioperative variables as predictors of postoperative outcome . *Br J Anaesth.* 1996; 77:217-222
- Boey J, Wong J, Ong GB. A prospective study of operative risk factors in perforated duodenal ulcers. *Ann Surg.* 1982; 195(3): 265-9
- Boey J, Choi SK, Poon A et al. Risk stratification in perforated duodenal ulcers. A prospective validation of predictive factors. *Ann Surg.* 1987; 205(1):22-6.
- Crofts TJ, Park KG, Steele RJ et al. A randomized trial of non-operative management of perforated peptic ulcer. *New Eng J Med.* 1989; 320:970-3
- Arveen S, Jagadish S, Kadambari D. Perforated peptic ulcer in South India : an institutional perspective. *World J Surg.* 2009; 33(8):1600-4.
- Tas, Ulger BV, Onder A et al. Risk factors influencing morbidity and mortality in perforated peptic ulcer disease. *Ulus Cerrahi Derg.* 2014; 31(1):20-5.
- Chou NH, Mok KT, Chang HT, Liu SI, Tsai CC, Wang BW et al. Risk factors of mortality in perforated peptic ulcer. *Eur J Surg.* 2000;166:149-153
- Patel S, Kalra D, Kacheriwalla S, Shah M et al. Validation of prognostic scoring systems for predicting 30-day mortality in perforated ulcer disease. *Turk J Surg.* 2019; 35(4):252-258.
- Sivaram P, Sreekumar A. Preoperative factors influencing mortality and morbidity in peptic ulcer perforation. *Eur J Trauma Emerg Surg.* 2018; 44:251-257.
- Testini M, Portincasa P, Peccinni G et al. Significant factors associated with fatal outcome in emergency open surgery for perforated peptic ulcer. *World J Gastroenterol.* 9:2338-2340
- Guptha S, Kaushik R, Sharma R et al. The management of large perforation of duodenal ulcers. *BMC Surg.* 2005; 5:15
- Thorsen K, Soreide K. What is the Best Predictor of Mortality in Perforated Peptic Ulcer Disease? A Population based, Multivariable Regression Analysis Including Three Clinical Scoring Systems. *J Gastrointest. Surg.* 2014; 18:1261-1268.
- Kim JM, Jeong SH, Lee YJ, Park ST, Choi SK, Hong SC et al. Analysis of risk factors for postoperative morbidity in perforated peptic ulcer. *J Gastric Cancer.* 2012; 12:26-35.
- Sharma SS, Mamtani MR, Sharma MS, Kulkarni H. A prospective cohort study of postoperative complication in the management of perforated peptic ulcer. *BMC Surg.* 2006; 6:8-16.
- WT Siu, HT Leong, BK Law, CH Chau, AC Li, KH Fung et al. Laparoscopic repair of perforated peptic ulcer: a randomized controlled trial. *Ann. Surg.* 2002; 235:313-319.
- Wadaani HA. Emergent laparoscopy in treatment of perforated peptic ulcer: a local experience from a tertiary centre in Saudi Arabia. *World J Emerg Surg.* 2013; 8(10):1749-7922.
- Abdellatif ME, El-Morsy G, Salama AF et al. Laparoscopic repair of perforated peptic ulcer: Patch versus simple closure. *Internal J. Surg.* 2013; 11(9):948-95.

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