International Journal of Biomedical and Advance Research
ISSN: 2229-3809 (Online); 2455-0558 (Print)
Journal DOI: https://doi.org/10.7439/ijbar
CODEN: IJBABN **Original Research Article**

American Society of Anaesthesiologists score (ASA) to predict the morbidity and mortality of patients after emergency laparotomy: A prospective analysis

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Abstract

Background: Emergency laparotomy is one of the operations which is done commonly and performed in all age groups. We have conducted this prospective study to evaluate the effectiveness of ASA grading as an outcome predictor in emergency laparotomy.
Methods: We conducted this prospective observational study in the Department of Anaesthesiology, Critical Care, Pain & Palliative Medicine, Dr Sushila Tiwari Government Hospital, Haldwani over one year. Data was collected of patients along with ASA grading and all necessary laboratory investigations. The primary outcome measured was significant complications and mortality within 4 weeks.
Results: Out of 274 total patients, 181(66.4%) were males. Majority of the patients in study 119(43.4%) were of ASA II E, 76(27.7%) were ASA III E, 54(19.7%) were ASA I E and 25(9.1%) were ASA IV E. Postoperative complications were seen in 119(43.4%) out of total 274 patients. Mortality after emergency laparotomy was 23 % (63 died out of 274). ASA IV E had maximum mortality where 20(80%) died out of 25, followed by ASA III E where 32(42.1%) died out of 76. Patients of ASA IV E and ASA III E group developed maximum postoperative complications seen in 23(92%) out of 25, 64 (84.2%) out of 76 respectively.
Conclusion: Maximum mortality and postoperative complications were seen in ASA 1V E followed by ASA III E followed by ASA II E and ASA I E. Thus, ASA classifications have an association with postoperative mortality and complications.
Keywords: Complications, Emergency, Laparotomy, Postoperative.

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***Article History:**
Received: 26/12/2019
Revised: 22/03/2020
Accepted: 28/03/2020
DOI: https://doi.org/10.7439/ijbar.v11i3.5383

QR Code

How to cite: Mamgain N, Bhandari G, Shahi K and Chauhan A. American Society of Anaesthesiologists score (ASA) to predict the morbidity and mortality of patients after emergency laparotomy: A prospective analysis. *International Journal of Biomedical and Advance Research* 2020; 11(03): e5383. Doi: 10.7439/ijbar.v11i3.5383 Available from: https://ssjournals.com/index.php/ijbar/article/view/5383

1. Introduction

Emergency laparotomy is among one of the commonly done operations. Compared with elective surgery, emergency abdominal surgery always has a much higher risk of morbidity and mortality, commonly in patients above the age of 65[2], where around half of these patients have various significant associated comorbidities. Such patients had mortality between 22- 44% [3], and morbidity of 50% [4]. Over 400 different surgical procedures in total were recorded during an emergency laparotomy which reflects the diversity of this surgical cohort [1].

Since a few decades, there have been many advances in the field of medicine and surgical practices; still, the mortality in patients needing emergency

laparotomy remains abnormally high. Early prognostic evaluation of these patients helps in selecting high-risk patients for more aggressive treatment. Hence, a classification system based on clinical and laboratory measures which provide an objective assessment of morbidity and mortality before undertaking surgical management would be beneficial [5]. The scoring system commonly used are ASA classification, APACHE-II, POSSUM, P-POSSUM, CR- POSSUM, Lee index for risk stratification in emergency laparotomies.

In 1941, Saklad introduced The American Society of Anesthesiologists (ASA) classification of physical status for comparison of statistical data in anaesthesia [6]. There have been many prospective and retrospective studies which show a correlation between ASA classification and perioperative mortality [7] and hence its usefulness as a predictor of patient outcome is suggested. We have planned this prospective study to evaluate the ASA scoring as a predictor of mortality or morbidity after emergency laparotomy.

Patients undergoing emergency laparotomy have high perioperative risk. 30-day mortality in the UK is one in seven overall, and for the elderly (age ≥ 80 years), almost one in four [1]. Mortality and postoperative complications are higher in elderly patients as elderly patients have less difficulty in recovering from complications when they occur.

Any prognostic system must take into consideration both the premorbid condition and also the metabolic derangement, which has resulted in the acute abdominal pathology. The American Society of Anesthesiologists Physical Status Classification System in routine is used to classify patients before any procedures where an anaesthetic intervention is present, and this system's application has become a standard component of anaesthetic practice all over the world.

The ASA PS scale ranges from 1 through 6 (increasing order of risk) with an additional designation to symbolise an emergency procedure ("E"). Many studies have suggested a significant association between increasing ASA class and increased risk of 48-h mortality in the postoperative period [8].

We have conducted this prospective study to evaluate the effectiveness of ASA grading as an outcome predictor in emergency laparotomy in our institution. A complete analysis was done on patient's preoperative status and postoperative outcome in terms of mortality and various morbidities like wound infection & dehiscence, multiorgan failure and septic shock, ventilatory support, systemic complications, postoperative sepsis. We have seen the association between ASA grading and various comorbidities with postoperative mortality and morbidity.

2. Material and methods

It was an observational study conducted after getting approval from the institutional ethical committee. The study population included patients undergoing emergency laparotomy over one year from November 2017 to October 2018. All patients presenting with acute abdominal pathology requiring midline laparotomy during their hospital admission were included in the study. The exclusion criteria include patients undergoing simple appendicectomy through a right iliac fossa incision and patients undergoing elective laparotomy.

Preoperatively ASA grading was assessed along with all clinical parameters (NIBP, HR, ECG, temperature, spO_2) and necessary laboratory investigations (CBC, kidney function tests, liver function tests, coagulation profile and ABG analysis). We collected Relevant data on associated comorbidities including asthma, chronic obstructive airway disease, cardiovascular disease (which includes hypertension, cardiac failure, stroke), chronic renal disease, liver disease, diabetes mellitus and metastatic cancer.

Other data collected include surgical procedure, finding at laparotomy, final diagnosis, duration of surgery, type of anaesthesia administered, intraoperative blood loss, intensive care admission, in-hospital mortality and complication. The primary outcome measured was significant complications and mortality within 4 weeks.

Follow up of the patients was done at 24 hours, 48 hours and then weekly till the time of discharge. Significant complications include postoperative continued systemic sepsis, problems of respiratory system (pneumonia, aspiration, ARDS), problems of cardiovascular system (such as CHF, cardiac failure), problems of renal system (acute/chronic renal failure, oliguria/anuria), bleeding, patients requiring vasopressor Support, anastomotic leak, need of reexploration.

Data were analysed and statistically evaluated using SPSS-PC-20 version. Quantitative data were expressed in mean, standard deviation, and qualitative data in percentage. We used ANOVA test or Kruskal Wallis 'H' test used to compare quantitative data between more than two groups. Statistical differences between the proportions are tested by chi-square test or Fisher's exact test. 'P' value of less than 0.05 was considered statistically significant.

3. Results

Total 274 patients underwent emergency laparotomy over one year out of which 181(66.1%) were males, and 93(33.9%) were females. Maximum patients in the study were in the 21-50 years of age group 167 (60.9%), 52(18.9%) were <20 years, 38(13.8%) were 51-65 years, 17(6.2%) were >65 years. 36.18±17.53 was the mean age of the study population. Majority of the patients in study

119(43.4%) were of ASA II E, 76(27.7%) were ASA III E, 54(19.7%) were ASA I E and 25(9.1%) was ASA IV E.

The most common diagnosis for which the patients underwent emergency laparotomy was gastric perforation peritonitis (34.3%), others being ileal perforation peritonitis(15.3%), various gynaecological causes comprised (12.4%) of total cases, intestinal obstruction (12%), duodenal perforation peritonitis in (3.6%), appendicular perforation peritonitis (4.3%), jejunal perforation peritonitis (2.5%) trauma (4%), revision surgery (2.9%), ruptured liver abscess (2.9%), obstructed hernia (2.9%).

Comorbidities were present in 181(66.1%) out of a total of 274 patients. The most common was of the respiratory system, seen in 77(28%) of total patients. COPD in 46(16.8%) of cases, asthma in 10(3.6%). Sepsis and electrolyte imbalances being other common seen in 24% and 22.2% of total patients respectively, 26(9.5%) presented with shock. Co-morbidity related to cardiovascular system seen in 38(13.8%) of total cases, hypertension in 32(11.6%), h/o CAD in 5(1.8%) of cases. Diabetes mellitus in 21(7.6%), coagulation abnormality in 24(8.7%), thyroid disorder in 10(3.6%)

Mortality after emergency laparotomy was 23% (63 died out of 274). 119(43.4%) had postoperative complications out of a total of 274 patients. Most common being pulmonary complications which were present in 68(24.8%) of patients, pneumonia 18(6.6%) and respiratory infections 26(9.5%) being most common. Other being ARDS seen in 9(3.3%), pulmonary edema, aspiration pneumonitis, atelectasis in 5(1.8%) each. Postoperative systemic sepsis in 14.2%, cardiovascular complications seen in 12.4% of patients, heart failure 12(4.3%) and arrhythmia 17(6.2%) being most common. 13.5% of cases required Vasopressor support, 23(8.4%) went into septicemic shock. Other complications were wound infection 18(6.6%), wound dehiscence 15(5.5%), anastomotic leak seen in 19(6.9%), out of which 8(2.9%) underwent re-exploration.

After the surgery, 74(27%) of the patients were shifted to ward and 200 patients to ICU; 165(60.2%) to AICU and 35(12.8%) to SICU. The difference in mortality rates and postoperative complications between males and females is not statistically significant. Patients over >65 years of age had maximum mortality where 9(52.9%) patients died out of 17 whereas, in <20 years age group, only 9(17.3%) died out of 52 (Table 1). The difference in mortality with increasing age is statistically significant. Postoperative complications were seen in 15(88.2%) patients out of 17 in >65years age group, and in <20 years age group, only 12(23.1%) out of 52 developed postoperative complications (Table 2). Postoperative complications had an increasing trend with age.

Maximum mortality was in ASA IV E group of patients 20(80%) died out of 25 followed by ASA III E where 32(42.1%) died out of 76, 9(7.6%) out of 119 died among ASA II E patients, and in ASA I E group only 2(3.7%) out of 54 patients died (Table 1.3). Patients of ASA IV E group developed maximum postoperative complications seen in 23(92%) out of 25, 64 (84.2%) out of 76 in ASA III E, 30(25.2%) out of 119 developed postoperative complications among ASA II E patients and only 2(3.7%) out of 54 had postoperative complications among ASA I E group of patients (Table 4).

Out of 274 patients, 113(41.2%) required postoperative mechanical ventilation. Maximum mortality was seen in week 1(42.9%) of emergency laparotomy then in week 2(26.9%), 14.3% at 48 hours, 9.5% in week 3 and 3.2% each in week 4 and 24 hours. Length of stay in ICU was maximum in ASA III E and ASA IV E than in ASA I E and ASA II E. The difference is statistically significant. (p-value 0.02) (Table 5)

Various complications such as pulmonary, cardiovascular, sepsis increase with the increase in ASA grade and this difference is statistically significant. (p value< 0.01) Wound infection was seen independent of ASA grade (Table 6) (figure 1)

Table 1: Association of mortality with age

Age	Died		Survived		P-value
	No.	%	No.	%	
<20 years	9	17.3	43	82.7	<0.01
21-50 years	28	16.8	139	83.2	
51-65 years	17	44.7	21	55.3	
>65 years	9	52.9	8	47.1	

Table 2: Association of postoperative complication with age

Age	Present		Absent		P-value
	No.	%	No.	%	
<20 years	12	23.1	40	76.9	<0.01
21-50 years	60	35.9	107	64.1	
51-65 years	32	84.2	6	15.8	
>65 years	15	88.2	2	11.8	

Table 3: Association of mortality with ASA classification

ASA grade	Died		Survived		P-value
	No.	%	No.	%	
I E	2	3.7	52	96.3	<0.01
II E	9	7.6	110	92.4	
III E	32	42.1	44	57.9	
IV E	20	80.0	5	20.0	

Table 4: Association of postoperative complications with ASA classification

ASA grade	Present		Absent		P-value
	No.	%	No.	%	
I	2	3.7	52	96.3	<0.01
II	30	25.2	89	74.8	
III	64	84.2	12	15.8	
IV	23	92.0	2	8.0	

Table 5: Association of number of days in ICU with ASA classification

	ASA I E	ASA II E	ASA III E	ASA IV E	P value
ICU stay (days)	3.47±1.67	4.79±4.35	5.49±3.62	6.46±5.31	0.02

Table 6: Association of different postoperative complications with ASA classification

Post-operative complications	Grade I N (%)	Grade II N (%)	Grade III N (%)	Grade IV N (%)	P-value
Pulmonary	0 (0.0)	10 (8.4)	37 (48.7)	21 (84.0)	<0.01
CVS	0 (0.0)	1 (0.8)	15 (19.7)	18 (72.0)	<0.01
Need of vasopressor	1 (1.8)	7 (5.9)	17 (22.4)	12 (48.0)	<0.01
Renal system	0 (0.0)	4 (3.4)	17 (22.4)	11 (44.0)	<0.01
Septicemic shock	0 (0.0)	6 (5.0)	12 (15.8)	5 (20.0)	0.01
Sepsis	1 (1.8)	8 (6.7)	21 (27.6)	9 (36.0)	<0.01
Wound infection	1 (1.9)	8 (6.7)	8 (10.5)	1 (4.0)	0.24

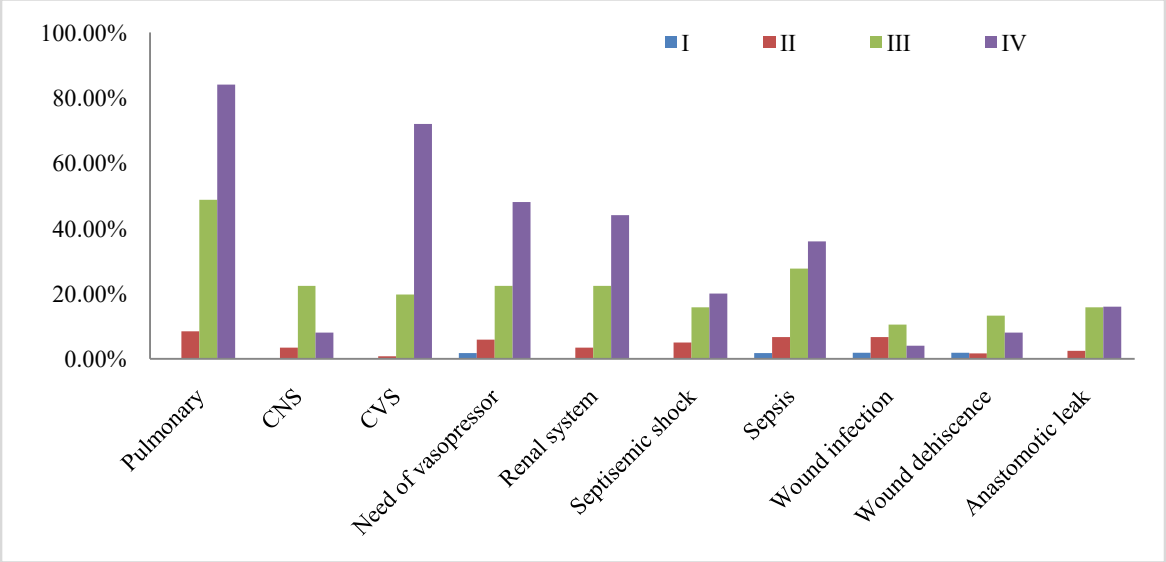

Figure 1: Association of different post-operative complications with ASA classification

4. Discussion

Preoperative risk assessment is quite essential as it allows for appropriate preemptive resource allocation, and aid in decision-making for the patient in light of their best interests [19]. Several perioperative scores have developed until now to aid in this process for the risk assessment of the postoperative morbidity and mortality.

In our study out of 274, maximum patients 119(43.4%) were of ASA II E, and ASA III E 76(27.7%). Wolters *et al* [9], Shaheed Mirani *et al* [20] and Saunders *et*

al [1] also observed in their study that majority of patients belonged to ASA II E and ASA III E. Patients presenting for emergency laparotomy are generally associated with one or other comorbidity thus resulting in higher ASA grade.

We have seen that out of 274 patients, 181(66%) of patients had medical comorbidities (one or more), maximum being of respiratory system 77(28 %) next being of cardiovascular system, i.e. 38(13.8%), diabetes in 21(7.6%) of patients, 66(24%) patients presented with sepsis, 26(9.4%) presented in shock, electrolyte abnormalities present in 61(22.2%) of patients. Vivekanand *et al* [11] in their study found that out of 100 patients, 50 patients had at least one medical comorbidity. COPD, hypertension, diabetes being the common ones. Endale *et al* [13] observed that 33 out of 260 (12.7%) patients had preoperative associated comorbidities. In a study done by Wolters *et al* [9], 22% of patients were having severe bronchopulmonary disease, hypertension in 28%, diabetes in 11%, renal failure in 11%. Maximum studies have not taken into account the number of patients having electrolyte imbalances despite being a common finding. Increased number of patients with electrolyte imbalance is because patients coming to our hospital usually belong to difficult hilly terrains; they come to the hospital after travelling for several hours, resulting in worsening of their condition. ABG analysis for electrolyte imbalances and metabolic disturbances should be done in every patient undergoing emergency laparotomy that is to be followed by proper optimisation.

The mortality rate in patients undergoing emergency surgeries is usually high when compared with elective surgeries. In our study, 63 people died out of 274; the 30-day mortality rate is 23%. Out of 63, 28 belong to 21-50 years of age. We have observed that mortality after emergency laparotomy is having an increasing trend with age which was analysed by chi-square test, p-value being < 0.01. Mortality in 21-50 years of age group is 16.8%, 44.7% in patients of age group 51-65 years and 52.9% in patients >65 years of age. The increased mortality rate is consistent with other studies. Arenal *et al* [3] observed it is 22%, whereas Howes *et al* [12] found it to be 14.6 % and elderly patients had increased mortality, i.e. 33.3. Chandrasekhar *et al* [14] found that the overall 30-day mortality rate was 23.84%. Of this, 50% were belonged to 30–50 years' age group.

Out of 274, 119(43.4%) developed one or other postoperative complications. The pulmonary complication was most commonly seen in 68 cases pneumonia, and respiratory infections were common ones, cardiovascular complications in 34 patients, CNS complications in 23 patients, 37 patients required vasopressor support, the septicemic shock is seen in 23 of patients, sepsis in 39 patients. Other studies also had the same observation where pulmonary complications, cardiac complications, sepsis, wound infection were the most common ones seen after emergency laparotomy. Postoperative complications increased with advancing age, p-value being < 0.01. Vivekanand *et al* [11] observed that out of 100 patients undergoing emergency laparotomy, postoperative complications were found in 67 patients, wound dehiscence, pneumonia, and cardiac complications being the common ones. Bansal *et al* [18] in his study found that postoperative complications occurred in 68% of patients and Abbas *et al* [10] observed it in 33% of patients. Poor optimisation of patient's preoperative status, non-availability of equipment, emergency drugs, investigation facilities and poor operating conditions are all contributory factors in the development of various postoperative complications in an emergency in developing countries.

ASA physical status classification has an essential role in the prediction of mortality after emergency laparotomy. In our study mortality in ASA IV E being highest that is 80 %, followed by 84.2 % in ASA III E, 35.9 % seen in ASA II E, and 3.7 % in ASA I E. Howes *et al* [12], Clarke *et al* [17] and Wolters *et al* [9] also found in their study that ASA score was significantly higher among non-survivors (3-4) than survivors (2-3). Thus it is observed that increasing grade in ASA classification is associated with an increase in mortality in patients of emergency laparotomy which was analysed by chi-square test, p-value being <0.01.

Post-op complications increase significantly with the increase in ASA grading. Among ASA I E patients post-op complications were seen in only 3.7% cases, 25.2 % in ASA II E, 84.2 % in ASA III E and 92 % in ASA IV E. We have seen that ASA grading is having an association with various postoperative complications. Pulmonary, cardiac, renal complications increased through ASA I-IV ($p < 0.01$) via a chi-square test, sepsis and septicemic shock are also increasing with each ASA class p=0.01.Wound infection is independent of ASA class. In study done by Akoh *et al* [16] and Barlow *et al* [15], the postoperative morbidity after emergency laparotomy was 40%, 63% and 100% in ASA 2, 3 and 4 patients respectively, which is same as it was observed in our study, suggesting the increase in post-op complications with the increase in ASA grading. Wolters *et al* [9] in their study found a significant association between ASA and various postoperative variables like bronchopulmonary complications, cardiac complications.

Saunders *et al* [1] in their study has seen that after emergency laparotomy, out of 1789 patients 700(39.1%) were shifted toward, 523(29.2%) to HDU, 527(29.5%) to ICU and 39(2.2%) to PACU. In our study out of 274, 193 patients were shifted to ICU (including both surgical ICU

and Anaesthesia ICU), and 81 patients to ward. Duration of stay in ICU increase with the increase in age. Duration of ICU stay(days) in ASA I E being 3.47 ± 1.67, 4.79 ± 4.35 in ASA II E, 5.49 ± 3.62 in ASA III E, 6.46 ± 5.31in ASA IV E. It was analysed using ANOVA or Kruskal Wallis H test, the p-value is 0.02.

5. Conclusion

Various factors like preoperative optimisation, meticulous surgical technique, age, any co-morbid condition (coronary artery disease, diabetes mellitus, hypertension, any chronic illness), anaesthesia technique and postoperative care contribute to the outcome of the patient. Postoperative complications and mortality are seen more in patients who undergo emergency laparotomy in comparison with elective laparotomy.0. We have seen that ASA classification is having an essential role in the prediction of mortality and morbidity after emergency laparotomy. Mortality and morbidity increased proportionally to the ASA grading. It is easy to calculate and is of significant use in determining perioperative variables in patients undergoing emergency laparotomy.

References

[1]. Saunders DI, Murray D, Pichel AC, Varley S, Peden CJ. UK Emergency Laparotomy Network. Variations in mortality after emergency laparotomy: the first report of the UK Emergency Laparotomy Network. *Br J Anaesth*. 2012 Sep; 109(3): 368-75.

[2]. Cook TM, Day CJ. Hospital mortality after urgent and emergency laparotomy in patients aged 65 yrs and over. Risk and prediction of risk using multiple logistic regression analysis. *Br J Anaesth* 1998; 80: 776-81.

[3]. Arenal JJ, Bengoechea-Beeby M. Mortality associated with emergency abdominal surgery in the elderly. *Can J Surg* 2003; 46: 11-116

[4]. Kettunen J, Paajanen H, Kostiainen S. Emergency abdominal surgery in the elderly. *Hepatogastroenterology* 1995; 42: 106-8.

[5]. Jones HJS, de Cossart L. Risk scoring in surgical patients. *Br J Surg* 1998; 86: 149-157.

[6]. Saklad M: Grading of patients for surgical procedures. *Anaesthesiology* 1941; 2: 281-284.

[7]. Thorsen K, Søreide JA, Søreide K. Scoring systems for outcome prediction in patients with perforated peptic ulcer. *Scand J Trauma Resusc Emerg Med* 2013; 21: 25.

[8]. Makela JT, Kiviniemi H, Laitinen S: Prognostic factors of perforated sigmoid diverticulitis in the elderly. *Dig Surg* 2005, 22:100-106

[9]. Wolters U, Wolf T, Stutzer H, Schroder T. ASA classification and Perioperative variables as predictors of postoperative outcome. *Br J Anaesth.* 1996; 77: 217-22.

[10]. Abbas, S., Kahokher, A., Mahmoud, M., & Hill, A. Physiologic Modification of the American Society of Anaesthesiology Score (ASA) for Prediction of Morbidity and Mortality after Emergency Laparotomy. *The Internet Journal of Surgery*, 2012; 20(2): 1–9.

[11]. Vivekanand, K. H *et al*. Clinical Outcome of Emergency Laparotomy: Our Experience at tertiary care centre (A case series). *International Journal of Biomedical and Advance Research* 2015; 6(10): 709-714

[12]. Howes, T. E. , Cook, T. M. , Corrigan, L. J. , Dalton, S. J. , Richards, S. K. , & Peden, C. J. Postoperative morbidity survey, mortality and length of stay following emergency laparotomy. *Anaesthesia,* 201; 70(9): 1020–1027.

[13]. Gebremedhn, Endale Gebreegziabher *et al*. Outcome assessment of emergency laparotomies and associated factors in low resource setting. A case series. *Annals of medicine and surgery* 2012; 36: 178-184. Doi: 10. 1016/ j. amsu. 2018. 09. 029

[14]. Chandrashekar N *et al*. , Prabhakar GN, Gurukiran CS, Shivakumarappa GM, Naveen H M. "Study of prognostic factors in perforative peritonitis". *Journal of Evolution of Medical and Dental Sciences* 2013; 2(30): 5568-5574.

[15]. Barlow AP, Zarifa Z, Shillito RG, Crumplin MKH, Edwards E, McCarthy JM: Surgery in a geriatric population. *Ann R Coll Surg Engl* 1989, 71:110-4.

[16]. Akoh JA, Mathew AM, Chalmers JWT, Finlayson A, Auld GD: Audit of major gastrointestinal surgery in patients aged 80 years or over. *J R Coll Surg Edin* 1994; 39: 208-213

[17]. Clarke, Adrian; Murdoch, Henry; Thomas, Matthew J; Cook, Tim M; Peden, Carol J. Mortality and postoperative care after emergency laparotomy. *European Journal of Anaesthesiology* 2011; 28(1): 16–19 doi: 10. 1097/ EJA. 0b013e32833f5389

[18]. Bansal AR, Mallick MR, Jena S. A study of post-operative complications of all emergency laparotomy in a tertiary care hospital within 90 days. *Arch Clin Gastroenterol* 2019; 5(2): 015-018.

[19]. Sharrock AE, McLachlan J, Chambers R, Bailey IS, Kirkby-Bott J. Emergency Abdominal Surgery in the Elderly: Can We Predict Mortality? *World J Surg.* 2017; 41(2):402–9.

[20]. Merani, Shaheed *et al*. Predictors of in-hospital mortality and complications in very elderly patients undergoing emergency surgery. *World journal of emergency surgery* 2014; 9 (43). doi: 10. 1186/1749-7922-9-43