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ALBUMIN LEVELS IN NONTRAUMATIC ACUTE ABDOMEN PATIENTS UNDERGOING EMERGENCY LAPAROTOMY: A RETROSPECTIVE STUDY IN THE INTENSIVE OBSERVATION WARD OF DR. SOETOMO GENERAL ACADEMIC HOSPITAL

Fitri Mazia[1] Maulydia[2*] Edwin Danardono[3] Edward Kusuma[2]
[1]Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia
[2]Department of Anesthesiology and Reanimation, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia
[3]Department of Surgery, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia
*Correspondence: Maulydia | maulydia@fk.unair.ac.id

ABSTRACT

Introduction: Acute abdomen is a critical medical emergency characterized by the abrupt onset of severe abdominal pain, often requiring emergency laparotomy. Emergency laparotomy, due to limited preoperative preparation, generally has a higher morbidity and mortality rate than elective surgery. Optimizing perioperative care, particularly by monitoring albumin levels, may improve outcomes, as albumin plays a crucial role in maintaining fluid balance, wound healing, and controlling inflammatory responses. Postoperative emergency patients at Dr. Soetomo General Academic Hospital are closely monitored in a specific ward known as the Intensive Observation Ward (*Ruang Observasi Intensif*/ROI).
Objective: To evaluate albumin levels in nontraumatic acute abdomen patients treated in ROI following emergency laparotomy.
Methods: This study used a retrospective descriptive study design and was conducted from January to June 2022. Patients under 18 with malignancy, trauma, gynecological or obstetrical cases, and incomplete medical records were excluded.
Results: The male and female number of 90 patients was equal, most patients were aged 41-50, and had a normal BMI. Generalized peritonitis was the most common indication, followed by acute appendicitis and bowel obstruction. Appendectomy and exploratory laparotomy were the primary procedures, mostly done in under 3 hours. Most patients had no prior laparotomy history. Most patients had normal albumin levels preoperatively, but these shifted to mild hypoalbuminemia postoperatively. Of 13 deaths, 12 involved preoperative hypoalbuminemia. The predominant PS-ASA scores were 2 and 3. Electrolyte imbalance, especially hypokalemia, was the prevalent preoperative complication. Frequent comorbidities included kidney disorders and hypertension. The average ROI stay was 2.1±1.59 days, with most patients staying for 1 to 3 days. Operation-related complications included intra-abdominal infections and bleeding, while medical complications involved electrolyte imbalances, sepsis, and metabolic acidosis.
Conclusion: Nontraumatic acute abdomen patients with low preoperative albumin levels tend to have higher rates of postoperative complications and mortality.

Keywords*:* Albumin Levels; Emergency Laparotomy; Intensive Observation Ward; Intensive Care Unit; Nontraumatic Acute Abdomen

ABSTRAK

Pendahuluan: Akut abdomen adalah keadaan darurat medis yang kritis, ditandai dengan timbulnya nyeri perut yang mendadak dan berat, sering kali memerlukan laparotomi darurat. Laparotomi darurat, karena persiapan preoperatif yang terbatas, umumnya memiliki tingkat morbiditas dan mortalitas yang lebih tinggi dibandingkan dengan operasi elektif. Mengoptimalkan perawatan sebelum dan sesudah operasi, terutama dengan memeriksa kadar albumin, dapat memperbaiki hasil, karena albumin penting untuk menjaga keseimbangan cairan, penyembuhan luka, dan mengatur respons peradangan. Pada RSUD Dr. Soetomo, pasien darurat pascaoperasi dipantau secara intensif di ruang khusus, yaitu Ruang Observasi intensif (ROI).
Tujuan: Mengevaluasi kadar albumin pada pasien abdomen akut nontraumatik pascalaparotomi darurat yang dirawat di Ruang Observasi Intensif (ROI).
Metode: Penelitian ini menggunakan desain studi deskriptif retrospektif dan dilakukan dari Januari hingga Juni 2022. Pasien di bawah 18 tahun, dengan keganasan, trauma, kasus ginekologi atau obstetri, dan rekam medis yang tidak lengkap dieksklusi.
Hasil: Jumlah pasien laki-laki dan perempuan dari total 90 pasien adalah sama, sebagian besar berusia 41-50 tahun, dan memiliki BMI normal. Peritonitis generalisata merupakan indikasi paling umum, diikuti oleh apendisitis akut dan obstruksi usus. Apendektomi dan laparotomi eksplorasi adalah prosedur utama, sebagian besar dilakukan kurang dari tiga jam. Sebagian besar pasien tidak memiliki riwayat laparotomi. Sebagian besar pasien memiliki kadar albumin normal sebelum operasi, tetapi berubah menjadi hipoalbuminemia ringan setelah operasi. Dari 13 kematian, 12 nya mengalami hypoalbuminemia sebelum operasi. Skor PS-ASA yang dominan adalah 2 dan 3. Ketidakseimbangan elektrolit, terutama hipokalemia, sebagai komplikasi preoperatif yang paling umum. Komorbiditas yang sering ditemukan meliputi gangguan ginjal dan hipertensi. Rata-rata lama tinggal di ROI adalah 2,1±1,59 hari dengan sebagian besar pasien dirawat selama 1-3 hari. Komplikasi terkait operasi meliputi infeksi intra-abdomen dan perdarahan, sementara komplikasi medis meliputi ketidakseimbangan elektrolit, sepsis, dan asidosis metabolik.

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Kesimpulan: Pasien abdomen akut non-trauma dengan kadar albumin preoperatif rendah cenderung memiliki tingkat komplikasi dan mortalitas pascaoperasi yang lebih tinggi.

Kata kunci: Kadar albumin; Laparotomi Darurat, Ruang Observasi Intensif (ROI), Unit Perawatan Intensif; Akut Abdomen Nontraumatik

INTRODUCTION

Acute abdomen, a critical medical emergency, accounts for a significant proportion of surgical admissions globally, necessitating prompt diagnosis and intervention to prevent life-threatening complications (1). Emergency laparotomy, a common surgical intervention for acute abdominal conditions, is associated with significant postoperative risks despite advancements in surgical techniques and perioperative care (2). Mortality rates range from 13% to 18%, with major complications affecting up to 50% of cases (3). These complications include intra-abdominal infections, bleeding, sepsis, and anastomotic leakage, all of which contribute to prolonged hospital stays (4,5).

Preoperative and postoperative albumin can be a predictor of outcomes of emergency laparotomy (6). Low preoperative and postoperative albumin levels were related to adverse postoperative surgical site infection, delayed wound healing, and death within 30 days. Besides, it is also significantly associated with postoperative complications (7). The other related risk factors include length of surgery, advancing age, high Physical Status-American Society of Anesthesiologists (PS-ASA) score (PS-ASA score ≥3), obesity, anemia, and the presence of comorbidities (8–12). A thorough understanding of risk factors, particularly in the case of hypoalbuminemia, is necessary for prevention. Patients classified as high-risk may benefit from close monitoring and early intervention.

Albumin is the major protein of human plasma. It constitutes approximately 60% of the total plasma protein; its normal serum concentration is 3.5–5.0 g/dl. Because its levels fall during injuries and sepsis, albumin is regarded as a negative acute phase protein (7). The hypoalbuminemia condition is characterized by increases in the acute-phase proteins c-reactive protein (CRP), tumor necrosis factor (TNF)-α, interleukin (IL)-1, and IL-6, which are associated with enhanced morbidity and mortality, as well as prolonged inflammation. Hypoalbuminemia slows down the healing of wounds by reducing the activity of important proteins like epidermal growth factor receptor (EGFR), extracellular signal-regulated kinases (ERK)1 or ERK2, transforming growth factors (TGF)-β, and collagen (13). Thus, preoperative serum albumin is critical in determining a patient's postoperative outcome after major surgery (14). Low serum albumin also indicates postoperative complications and longer hospital stays (6).

Therefore, this study investigated the albumin levels in patients with nontraumatic acute abdomen who are treated in the Intensive Observation Ward after emergency laparotomy.

METHOD

This study used a descriptive observational design with a retrospective approach. Ethical clearance was granted by the Ethics Committee of Dr. Soetomo General Academic Hospital on November 30, 2023 under approval number 1534/LOE/301.4.2/XI/2023.

The study included all patients with nontraumatic acute abdomen who were treated in the Intensive Observation Ward (Ruang Observasi Intensif/ROI) of Dr. Soetomo General Academic Hospital in Surabaya, Indonesia, after having emergency laparotomy between January and June 2022, totaling 251 patients.

Patients were excluded based on the following criteria: age under 18 years (n = 55), malignancy (n = 30), trauma (n = 16), obstetric cases (n = 19), gynecological cases (n = 16), and incomplete medical records (n = 25). After exclusions, 90 patients were included in the final sample.

All data were obtained from the patients' medical records and processed using Microsoft Excel and Statistical Product and Service Solutions (SPSS) version 30 to generate descriptive statistics. The statistical measures used included frequency, percentage, mean, and standard deviation.

RESULTS AND DISCUSSION

Gender-wise, the male and female patients were equally distributed, having 1:1 female-to-male ratio. Other studies found that men were slightly more afflicted than women in non-traumatic acute abdomen. Shown in a study conducted by Danish et al. (15), the male-to-female ratio was 1.14:1. Likewise, a study in India found that the male-to-female ratio was 1.22:1 (1). One of the possible reasons behind the higher number of male patients was the exclusion of obstetrical and gynecological cases.

Table 1. Demographic characteristics of the Patients

Variables	N (%)
Sex	
Female	45 (50)
Male	45 (50)
Age (years)	
18-20	8 (8.89)
21-30	15 (16.67)
31-40	10 (11.11)
41-50	20 (22.22)
51-60	8 (8.89)
61-70	17 (18.89)
>70	12 (13.33)
Mean±SD (47±18.94)	
Nutritional Status	
Severely Underweight	2 (2.22)
Underweight	13 (14.44)
Normal Weight	44 (48.89)
Overweight	19 (21.11)
Moderately Obese	9 (10)
Severely Obese	3 (3.33)
Morbidly Obese	0 (0)

As shown in Table 1, the patients were dominated by the age group of 41-50 (22.22%), followed by the 61-70 (17%) age group. Most of the other studies found that acute abdomen in their productive age, especially in the 2nd and 3rd decades. However, those studies also include nonsurgical intervention for acute abdomen (1,16). The age group in this study possibly differs because the surgical intervention was more needed in the older age group, as in this study. The majority of the patients have a normal body mass index (BMI) (48.89%), followed by overweight (21.11%) and underweight groups (14.44%).

Table 2. Indication of laparotomy

Indication	N (%)
Generalized Peritonitis	30 (33.33)
Acute Appendicitis with Perforation	27 (29.99)
Bowel Obstruction	12 (13.33)
Hernia	6 (5.55)
Sigmoid Volvulus	3 (3.33)
GI Perforation	5 (5.55)
Burst Abdomen	3 (3.33)
Intestinal Evisceration	2 (2.22)
Periappendicular Abscess	4 (4.44)
Leakage Anastomosis	1 (1.11)
Complicated Intraabdominal Infection	1 (1.11)

As provided in Table 2, the most common indication in this study was generalized peritonitis (33.33%), followed by acute appendicitis (27.77%) and bowel obstruction (13.33%). Peritonitis mostly results from perforated appendicitis and hollow organ perforation. Peritonitis was also found as the most common indication for laparotomy in the Intensive Care Unit (ICU) of Prof. Dr. Kandou Central General Hospital, Indonesia (17). Similar findings were also found at a tertiary care facility in India (18). Contrary to these findings, cross-sectional studies in Ethiopia and India found that the most common disease was acute appendicitis, followed by peritonitis and intestinal obstruction (15,19). The indicational difference may be due to the time of self-admission or referral from other centers.

The most common procedure done was appendectomy (43.33%), followed by exploratory laparotomy (30%). Similar findings were also found in a retrospective study conducted in Afghanistan (15). Most patients did not have a laparotomy history (73.33%). There is only one patient who had undergone laparotomy three times with the indication of recurrent incisional hernia. Among the nontraumatic acute abdomen surgical admissions in Arba Minch General Hospital, Southern Ethiopia,

only 7.1% of patients had a history of abdominal surgery (20). Whereas about 15% of patients in a tertiary care facility in India had a history of abdominal surgery (16).

Table 3. Operative Variables

Variables	N (%)
Procedure	
Appendectomy	39 (43.33)
Exploratory Laparotomy	27 (30)
Stoma Creation	10 (11.11)
Hernia Repair	6 (6.67)
Bowel Resection	6 (6.67)
Perforation Repair	4 (4.44)
Abscess Drainage	3 (3.33)
Burst Abdomen Repair	2 (2.22)
Duodenal stump	1 (1.11)
Number of Previous Surgeries	
0	66 (73.33)
1-2	23 (25.56)
≥3	1 (1.11)
Length of Surgery	
<3 hours	71 (78.89)
≥3 hours	19 (21.11)

Length of surgery was also positively correlated with postoperative complications (21). This study showed that 71 out of 90 cases (78.89%) are done in less than 3 hours, and the rest are done in 3 hours or more (21.11%). However, the length of the surgery can be determined by many factors. One of the possible factors is the preoperative complications of the patients. In this study, patients with ≥4 complications and comorbidities, such as diabetes mellitus and hypertension, generally have longer surgical durations.

As one of the risk factors, the preoperative and postoperative albumin and hemoglobin levels were recorded in Table 4. Out of 90 patients, the level of postoperative albumin was decreased in 81 patients. The rest of the patients had the postoperative albumin increased, and one patient had the same albumin level. The increase in albumin levels is possibly due to the albumin infusion, which is not recorded in this study. A decrease in postoperative serum albumin levels was also found in a study conducted by (6,7).

Table 4. Albumin and Hemoglobin Levels

Variables	N (%)	Mean ± SD
Albumin Levels		
Preoperative		3.39±0.58
Marked Hypoalbuminemia (<2.5 mg/dL)	7 (7.78)	2.18±0.19
Mild Hypoalbuminemia (2.5-3.5 mg/dL)	39 (44.44)	3.08±0.26
Normal albumin (3.5-4.5 mg/dL)	42 (46.67)	3.82±0.21
Hyperalbuminemia (>4.5 mg/dL)	2 (2.22)	4.69±0.07
Postoperative		3.03±0.57
Marked Hypoalbuminemia (<2.5 mg/dL)	17 (18.89)	2.19±0.23
Mild Hypoalbuminemia (2.5-3.5 mg/dL)	51 (56.67)	2.95±0.30
Normal albumin (3.5-4.5 mg/dL)	22 (24.44)	3.74±0.20
Hyperalbuminemia (>4.5 mg/dL)	0 (0)	-
Hemoglobin Levels		
Preoperative		12.17±2.56
Severe Anemia (<8 g/dL)	4 (4.44)	7.08±0.46
Moderate Anemia (8-10 g/dL)	25 (27.78)	9.66±0.86
Mild Anemia (M=11-12.9 g/dL, W=11-11.9 g/dL)	16 (17.58)	11.64±0.60
Normal (M >13 g/dL, W >12 g/dL)	45 (50)	14.19±1.54
Postoperative		11.50±2.00
Severe Anemia (<8 g/dL)	1 (1.11)	6.7±0.00
Moderate Anemia (8-10 g/dL)	33 (36.67)	9.59±0.79
Mild Anemia (M=11-12.9 g/dL, W=11-11.9 g/dL)	29 (32.22)	11.71±0.52
Normal (M >13 g/dL, W >12 g/dL)	27 (30)	14.01±1.22

M = Man, W = Woman

Half of the patients (50%) in this study presented with a normal preoperative hemoglobin level. Our study also observed a decrease in mean hemoglobin levels postoperatively. A reduction in postoperative hemoglobin levels was also observed in colorectal surgery (22). This condition is likely caused by the worsening of preoperative anemia, blood loss, and reduced erythropoiesis due to surgery-associated inflammation (23).

The distribution of outcomes according to the preoperative albumin levels is also observed, as shown in Table 5.

Table 5. Distribution of Outcomes According to Preoperative Albumin Levels

Preoperative Albumin Levels	Outcomes			
	No complication N (%)	Complication N (%)	Death N (%)	Total N (%)
Marked Hypoalbuminemia (<2.5 mg/dL)	0 (0)	4 (4.44)	3 (3.33)	7 (7.78)
Mild Hypoalbuminemia (2.5-3.5 mg/dL)	9 (10)	21 (23.33)	9 (10)	39 (43.33)
Normal albumin (3.5-4.5 mg/dL)	26 (28.89)	15 (16.67)	1 (1.11)	42 (46.67)
Hyperalbuminemia (>4.5 mg/dL)	2 (2.22)	0 (0)	0 (0)	2 (2.22)
Total	37 (41.11)	40 (44.44)	13 (14.44)	90 (100)

The levels of albumin were significantly correlated with postoperative outcomes (24). More than half of the patients (57.14%) with marked hypoalbuminemia experienced complications, and the rest (42.86%) did not survive during the stay in ROI. The death percentage occurred in marked hypoalbuminemia, also higher than in the mild hypoalbuminemia group (23.08%). The majority of the patients who experienced mild hypoalbuminemia before surgery had postoperative complications. Compared to patients with normal albumin, the majority of the patients were discharged from ROI without complications. Whereas all of the hyperalbuminemic patients were being discharged from ROI without complications. Worse outcomes in hypoalbuminemia patients were also found in a study conducted by (24,25).

As provided in Table 6, the PS-ASA score was measured preoperatively to predict the operative risks. The patients were dominated with PS-ASA scores of II (35.56%) and III (34.44%). PS-ASA score II was considered as low risk, and PS-ASA score III was considered as intermediate risk (26).

Most of the patients had more than one preoperative complication and comorbidity. Pin-on *et al*. also found hypokalemia as the most common electrolyte imbalance before surgery (27). The most common preoperative complication observed was hypokalemia (25.56%), followed by sepsis (24.44%). On the other hand, the most common comorbidity observed was a kidney disorder (22.22%), followed by hypertension (14.44%) and liver disorder (13.33%). Contrary to this finding, a study in Denmark showed heart disorder as the most common comorbidity (28). Another study found hypertension to be the most common comorbidity (3). However, comorbidity can be associated with many factors, including the demographics of the patients and lifestyle factors.

Table 6. PS-ASA Score, Preoperative Complication, and Comorbidity

Variables	N (%)
PS-ASA Score	
I	4 (4.44)
II	32 (35.56)
III	31 (34.44)
IV	23 (25.56)
V	0 (0)
Preoperative Complication (N of patients=90)	
Sepsis	22 (24.44)
Septic shock	5 (5.56)
Electrolyte Imbalance	
Hyponatremia	10 (11.11)
Hypernatremia	8 (8.89)
Hypokalemia	23 (25.56)
Hyperkalemia	2 (2.22)
Hypochloremia	1 (1.11)
Hypocalcemia	1 (1.11)
Acid-Base Disorder	
Metabolic Acidosis	7 (7.78)
Metabolic Alkalosis	3 (3.33)
Respiratory Acidosis	1 (1.11)
Comorbidity	
DM	4 (4.44)
Hypertension	13 (14.44)
DM+HT	2 (2.22)
Cardiovascular Disorder	10 (11.11)
Kidney Disorder	20 (22.22)
Liver Disorder	12 (13.33)
Respiratory Disorder	10 (11.11)
Bleeding Disorder	9 (10)
Thyroid Disorder	3 (3.33)
Allergy	2 (2.22)
HIV	3 (3.33)
Hepatitis B	2 (2.22)
COVID-19	1 (1.11)

The duration of patients' stay in the ICU was recorded. Patients were categorized based on the length of stay. To assess the potential of preoperative

albumin levels, the mean ± SD of albumin values was compared across the different length-of-stay groups, as detailed in Table 7.

Table 7. Length of ROI Stay

Length of ROI Stay	N (%)	Mean±SD of Pre-op Albumin Levels
Mean±SD (2.1±1.59)		
1-3 days	75 (83.33)	3.48±0.55
4-6 days	14 (15.55)	2.87±0.50
≥7 days	1 (1.11)	3.63

The patients stayed in the ROI on average for 2.1±1.59 days before either being discharged or passing away during the stay. Patients who stayed for 4-6 days had lower average pre-op albumin levels than patients who stayed for 1-3 days. Patients who stayed for ≥7 days had the highest mean value of pre-op albumin levels. This is more likely because there is only one patient who stayed for ≥7 days. Although that patient had a normal preoperative serum albumin level, the level dropped to <3 mg/dL postoperatively.

Table 8. Patients' Outcome

Outcome	N (%)	Preoperative Albumin Levels (Mean±SD)
Death	13 (14.44)	2.83±0.48
Survival		
With postoperative complications	40 (44.44)	3.28±0.57
Without postoperative complications	37 (41.11)	3.70±0.43

During the stay in ROI, 13 (14.44%) patients passed away with a mean preoperative albumin level value of 2.83±0.48 mg/dL. Among 13 dead patients, 12 patients were in a hypoalbuminemic state, and only one patient was in a normal albumin state. Of the 77 survived patients, 40 (44.44%) patients experienced postoperative complications with a mean preoperative albumin level value of 2.83±0.46. On the other hand, 37 (41.11%) patients survived without complications with a mean preoperative albumin level value of 3.39±0.46. As we can see, the highest mean preoperative albumin level was found in the group of patients without complications.

One patient can experience more than one complication. Ylimartimo et al. (29) found that medical complications appear earlier than operation-related complications. This condition is relevant to this study since the complications were only observed during the stay in the ICU, the complications that occurred later are not recorded. The majority of the patients in this study experienced medical complications, which aligned with a study conducted in Finland (29). The most common medical complication observed was metabolic acidosis, followed by hypocalcemia. Similar findings were also found in postoperative traumatic brain injury patients (27). The high incidence of metabolic acidosis can be induced by hyperchloremia from excessive 0.9% saline or Ringer's lactate solution administered intraoperatively. Tissue hypoperfusion during the surgical procedures can also induce metabolic acidosis (30).

There are still limited studies that investigate the role of serum albumin as a predictor of morbidity and mortality in patients who underwent emergency laparotomy with a nontraumatic cause of acute abdomen, especially in Dr. Soetomo General Academic Hospital. Hence, I conducted this study to provide an advanced understanding regarding this case.

CONCLUSION

This study revealed that patients with low preoperative albumin levels tend to have higher rates of postoperative complications and mortality. These findings also provide valuable data on the profile of nontraumatic acute abdomen patients and the associated risk factors. Identifying high-risk patients based on albumin levels and providing targeted interventions may improve surgical outcomes.

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Conflict of Interest

The authors declared that there is no conflict of interest.

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Author's Contribution

All authors contributed to all aspects of the research process.

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