Section: General Surgery

Original Research Article

TO ASSESS THE DECREASE IN SERUM ALBUMIN LEVELS AFTER SURGERY AS AN INDICATOR OF SURGICAL STRESS AND A PREDICTOR OF CLINICAL OUTCOMES IN PATIENTS UNDERGOING LAPAROTOMY

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Abstract

Background: The aim is to assess the decrease in serum albumin levels after surgery as an indicator of surgical stress and a predictor of clinical outcomes in patients undergoing laparotomy. **Materials and Methods:** The research comprised 100 patients aged 17-68 years who had laparotomies, both in elective and emergency situations. Levels of serum albumin (g/l) were tested throughout the preoperative period at 8 o'clock in the morning, before to breakfast, when the individual was fasting. The first sample was collected 4-6 hours after the surgery. Albumin levels were evaluated at subsequent intervals until post-operative day 5 (POD-5). The Clavien-Dindo approach was used to evaluate and classify the degree of problems that arose as a result of the operation and subsequent difficulties. **Result:** According to Clavein-Dindo classification, 45% patients belonged to grade 1, 25% patients belonged to grade 2, 13% patients belonged to grade 3a, 5% patients belonged to grade 4a, 9% patients belonged to grade 4b and 3% patients belonged to grade 5. Most common post operative complication was blood transfusion (13%) followed by post operative fever (8%), wound gaping and secondary suturing done (7%), MODS (6%), wound gaping (5%), wound infection (5%), acute kidney injury (3%), acute kidney injury + dialysis done (3%), AKI with wound gaping (3%), AKI wound infection (3%), burst abdomen secondary suturing done (3%), elevated renal parameters (3%), elevated renal parameter wound infection (1%), mild fever (1%) and MODS with ventilator (1%). Mean preoperative serum albumin levels were 3.69+0.52 g/dl. Post-operatively, serum albumin levels decreased from 3.61 to 3.41 from day 1 to day 5. **Conclusion:** The quantification of serum albumin is straightforward, uncomplicated, and economical. Furthermore, it may be easily executed in any location, unlike other procedures that need advanced care. The use of serum albumin as a marker enables accurate prognostications about surgical complications, length of hospitalisation, and the intensity of surgical stress.

INTRODUCTION

Surgical interventions elicit varying degrees of metabolic stress responses, which in turn contribute to prolonged recovery, increased complication rates, and extended hospital stays. The term "major abdominal surgery" lacks a clear definition and encompasses various factors related to the procedure, such as the surgical approach (laparoscopy or laparotomy), extent of organ resection, operative time, and blood loss. Additionally, patient factors including underlying disease (benign or malignant), nutritional status, and pre-existing comorbidities are also considered.[1-5] Recent advancements in perioperative care, focused on mitigating a significant stress reaction, have been shown to be effective. The use of enhanced recovery protocols has shown a significant reduction in postoperative stress, leading to decreased hospitalisation duration, fewer problems, and lower expenses after colorectal surgery.[6,7] The implementation of a rigorous perioperative nutritional support regimen, together with the use of immune-modulating formulae, has

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been shown to effectively decrease the occurrence of infectious problems after major surgical procedures, as well as minimise the length of hospitalisation. Moreover, corticosteroids are being used in the perioperative setting, and initial findings indicate that this straightforward approach has great potential in improving postoperative results.[8-10] An uncomplicated and dependable metric that signifies the physiological strain caused by surgery would be of great significance in identifying high-risk patients and customising perioperative treatment. Thorell proposed using insulin resistance as a measure of the stress response. Nevertheless, the measurement of insulin resistance has challenges in terms of both complexity and expense, which has prevented its general use. Interleukins IL-6, IL-10, and other cytokines are exclusively used in clinical trials due to similar justifications.[11-14] Postoperative serum C-reactive protein (CRP) levels are often used in clinical settings to evaluate inflammation after surgery and to anticipate the occurrence of postoperative problems. An important limitation of using CRP as a predictor for stress-related problems is its sluggish kinetics. Peak values are only assessed during postoperative day 2 or 3, which can be beyond the optimal timeframe for early preventative actions. Albumin is the predominant protein found in humans and is often used as a nutritional marker and predictor of outcomes. Furthermore, albumin exhibits a prompt reaction to surgical stress, making it a potential candidate for assessing surgical stress and predicting a difficult postoperative recovery. This specific element has not yet been evaluated for therapeutic use.[14-18]

MATERIALS AND METHODS

A cross-sectional investigation was conducted at a tertiary care hospital. The research population consisted of patients who had laparotomy, both electively and in emergency situations. The research comprised 100 patients aged 17-68 years who had laparotomies, both in elective and emergency situations. The trial excluded patients who were under the age of 16 or above the age of 70, patients with known decompensated liver disease, patients with human immunodeficiency virus (HIV) and a CD count below 200.

Methodology

Prior to data collection, the project obtained approval from the institutional ethics committee. The research obtained informed permission from the individuals in accordance with established protocols. Levels of serum albumin (g/l) were tested throughout the preoperative period at 8 o'clock in the morning, before to breakfast, when the individual was fasting. The first sample was collected 4-6 hours after the surgery. Albumin levels were evaluated at subsequent intervals until post-operative day 5 (POD-5). The surgical duration was calculated based on the interval between the first incision and the subsequent closure of the skin. The task was performed by the anesthesiologist. The choice to assess intraoperative blood loss was made via collaboration between the surgeon and the anesthesiologist. The quantification of blood loss was determined by measuring the volume of aspirated fluids and the saturation of gauze materials. The Dindo-Clavien approach was used to evaluate and classify the degree of problems that arose as a result of the operation and subsequent difficulties.

Clavien-Dindo system

Grades I and II- measured as minor complications, grades III and IV- measured as major complications, and grade V– mortality. The following surgeries were performed: laparoscopic cholecystectomy, extraperitoneal incisional hernia repair, open colectomy, upper gastrointestinal resections, gastrectomy, bowel resection and anastomosis, adhesiolysis, Graham's patch repair, right salphingectomy, and GI resections.

Table 1: Clavien-Dindo system of grading.

Grade	Implications
1	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic and radiological intervention; acceptable therapeutic regimens are: drugs as antiemetics, antipyretics, analgesics, diuretics and electrolytes and physiotherapy
2	Requiring pharmacological treatment with drugs other than such allowed for grade I complications; blood transfusion, antibiotics and total parenteral nutrition are also included
3	Requiring surgical, endoscopic or radiological intervention
3a	Intervention under regional/local anaesthesia
3b	Intervention under general anaesthesia
4	Life threatening complication requiring intensive care/intensive care unit management
4a	Single organ dysfunction
4b	Multi organ dysfunction
5	Patient demise

Statistical analysis

The data input was performed using Microsoft Excel, while the statistical analysis was conducted utilising the Statistical Package for Social Sciences (SPSS) version 25.0 for MS Windows. ANOVA was used to demonstrate the disparity between two or more means or components using significance tests. A P value below 0.05 is deemed statistically significant.

RESULTS

The largest proportion of patients (45%) fell within the age range of 40-50 years, followed by those aged 50-60 years (20%), 20-30 years (13%), beyond 60 years (13%), below 20 years (5%), and 30-40 years (5%). The average age was 45.14 years with a standard deviation of 5.69 years, as shown in [Table 2].

Most common indication of surgery was duodenal perforation (15%) followed by ruptured ectopic

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pregnancy (6%), sigmoid volvulus (7%), acute intestinal obstruction (3%), hollow viscous perforation (3%), obstructed incisional hernia (5%), obstructed left inguinal hernia (5%), obstructed umblical hernia (5%), right ovarian cyst torsion (5%), right blunt injury abdomen (5%), ruptured liver abscess (6%), superior mesentric vein thrombosis (3%), acute abdomen appendicular perforation (3%), acute abdomen ruptured ectopic pregnancy (3%), acute abdomen torsion ovarian (3%), appendicular perforation (3%), assault stab injury (3%), assault stab injury abdomen (illeal perforation) (2%), carcinoma rectum (2%), carcinoma stomach antropyloric growth stage II (2%), fall from height (1%), gastric perforation (1%), ileocecaltb with perforation query (1%), internal hernia with pain abdomen (1%), intestinal obstruction (adhesions) (1%), intususseption (1%), left torsion ovarian cyst (3%), obstructed right inguinal hernia (1%) and stab injury abdomen (1%).

Most common procedure done was grahams omental patch closure (23%) followed by resection and anastamosis (14%), laparotomy + right oophorectomy (10%), laparotomy + adhesinolysis (11%), exploratory laparotomy+ wash given (6%), exploratory laparotomy and proceed (6%), laparotomy left oophorectomy (6%), laparotomy + resection anastomosis (3%), diversion colostomy (3%), exploratory laparotomy (3%), jejunostomy with resection (3%), jejunostomy with resection of 100 cm gangrene bowel (3%), laparotomy and resection of gangrene bowel up to terminal ileum (3%), laparotomy right salphingectomy (3%), laparotomy + appendicectomy (1%), laparotomy + jejunostomy (1%), laparotomy + ltsalphingectomy (1%), laparotomy + packing done (1%), polytrauma transverse colon (1%), right herniorapphy (1%), segmental ileal resection (1%) and subtotal gastrectomy with d2 (1%) [Table 5].

According to Clavein-Dindo classification, 45% patients belonged to grade 1, 25% patients belonged to grade 2, 13% patients belonged to grade 3a, 5% patients belonged to grade 4a, 9% patients belonged to grade 4b and 3% patients belonged to grade 5. [Table 6]

Most common post operative complication was blood transfusion (13%) followed by post operative fever (8%), wound gaping and secondary suturing done (7%), MODS (6%), wound gaping (5%), wound infection (5%), acute kidney injury (3%), acute kidney injury + dialysis done (3%), AKI with wound gaping (3%), AKI wound infection (3%), burst abdomen secondary suturing done (3%), elevated renal parameters (3%), elevated renal parameter wound infection (1%), mild fever (1%) and MODS with ventilator (1%) [Table 7]. Mean preoperative serum albumin levels were 3.69+0.52 g/dl. Post-operatively, serum albumin levels decreased from 3.61 to 3.41 from day 1 to day 5. There is albumin drop of 5% from POD 1 to POD 5 due to surgical stress [Table 7]. Serum albumin levels were compared pre-operatively and postoperatively using ANOVA test. There is statistical significance between pre-operative serum albumin levels and postoperative serum albumin levels from POD 1 to POD 5.

Table 2: Gender and age of the patients

Gender	Number	Percent
Male	65	65
Female	35	35
Age group (years)		
Below 20	3	5
20-30	7	13
30-40	3	5
40-50	22	45
50-60	9	20
Above 60	6	12
Mean Age	45.14+5.69	

Table 3: Indication of surgery

Indication of surgery	Number	Percentage
Acute abdomen appendicular perforation	3	3
Acute abdomen ruptured ectopic pregnancy	3	3
Acute abdomen torsion ovary	3	3
Acute intestinal obstruction	3	3
Appendicular perforation	3	3
Assault stab injury	3	3
Assault stab injury (ileal perforation)	2	2
Carcinoma rectum	2	2
Carinoma stomach antropyloric growth stage II	2	2
Duodenal perforation	15	15
Fall from height	1	1
Gastric perforation	1	1
Hollow viscous perforation	3	3
Ileocecal TB with perforation query	1	1
Internal hernia with pain abdomen	1	1
Intestinal obstruction (adhesions)	1	1
Intususseption	1	1

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Left torsion ovarian cyst	3	3
Obstructed incisional hernia	5	5
Obstructed left inguinal hernia	5	5
Obstructed right inguinal hernia	1	1
Obstructed umbilical hernia	5	5
Right ovarian cyst torsion	5	5
Right blunt injury abdomen	5	5
Ruptured ectopic pregnancy	6	6
Ruptured liver abscess	6	6
Sigmoid volvulus	7	7
Stab injury abdomen	1	1
Superior mesenteric vein thrombosis	3	3

Table 4: Surgery procedure

Surgery procedure done	Number	Percentage
Diversion colostomy	3	3
Exploratory laparotomy	3	3
Exploratory laparotomy + wash given	6	6
Exploratory laparotomy and proceed	6	6
Grahams omental patch closure	23	23
Jejunostomy with resection	3	3
Jejunostomy with resection of gangrene bowel of 100cm	3	3
Jejunostomy with resection of gangrene bowel up to terminal ileum	3	3
Laparotomy left oopherectomy	6	6
Laparotomy right salphingectomy	3	3
Laparotomy right oopherectomy	10	10
Laparotomy + adhesinolysis	11	11
Laparotomy + appendicectomy	1	1
Laparotomy + Jejunostomy	1	1
Laparotomy + left salphingectomy	1	1
Laparotomy + packing done	1	1
Laparotomy + resection anastomosis	3	3
Polytrauma transverse colon	1	1
Resection and anastomosis	14	14
Right herniorraphy	1	1
Segmental ileal resection	1	1
Subtotal gastrectomy with D2	1	1

Table 5: Dindo- Clavein classification

Grading as per Dindo- Clavein classificaton	Number	Percent
Grade 1	45	45
Grade 2	25	25
Grade 3a	13	13
Grade 4a	5	5
Grade 4b	9	9
Grade 5	3	3

Table 6: Post operative complication

Post operative complication	Number	Percent
Acute kidney injury	3	3
Acute kidney injury + dialysis done	3	3
AKI with wound gaping	3	3
AKI wound infection	3	3
Blood transfusion	13	13
Burst abdomen secondary suturing done	3	3
Elevated renal parameters	3	3
Elevated renal parameter wound infection	1	1
Mild fever	1	1
MODS	6	6
MODS with ventilator	1	1
Post op fever	8	8
Wound gaping	5	5
Wound gaping and secondary suturing done	7	7
Wound infection	5	5
No complication	37	37

Table 7: Mean serum albumin levels- preoperatively and postoperatively

Parameters	Mean±SD
Preop – albumin levels	3.69±0.52
POD1 – albumin levels	3.61±0.53
POD2 – albumin levels	3.58±0.51

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POD3 – albumin levels	3.51±0.54
POD4 – albumin levels	3.45±0.55
POD5 – albumin levels	3.41±0.51

DISCUSSION

After undergoing major surgery, there is a notable metabolic stress response that is associated with an increased likelihood of negative consequences in the future. Various perioperative therapies are accessible to assist patients in controlling an exaggerated stress response, and some interventions have a notable beneficial effect on clinical outcome. Accurately predicting the surgical stress response is very significant.[18] The marker should possess user-friendly functionality, be cost-effective, and have extensive accessibility throughout the first stages of the postoperative period. It should exhibit a high correlation with surgical trauma and serve as a reliable and accurate indication of postoperative problems and an extended duration of hospitalisation. Currently, there is no parameter that exists at this time.[19] The stress response, which has been widely researched after surgery or trauma, is known to induce major changes in electrolyte levels, hormone secretion, and metabolism, as well as the release of cytokines. Elevated levels of the proinflammatory cytokine IL-6 have been associated with the development of insulin resistance after surgery and the extent of the surgical damage. This rise in IL-6 seems to start shortly after the occurrence of a physical injury. Indeed, the use of this method in everyday situations is not feasible owing to the need of costly and advanced measurement apparatus.[19] The study found that the most frequent postoperative complication was blood transfusion, occurring in 13% of cases. This was followed by postoperative fever (8%), wound gaping requiring secondary suturing (7%), multiple organ dysfunction syndrome (6%), wound gaping without secondary suturing (5%), wound infection (5%), acute kidney injury (3%), acute kidney injury requiring dialysis (3%), acute kidney injury with wound gaping (3%), acute kidney injury with wound infection (3%), burst abdomen requiring secondary suturing (3%), elevated renal parameters (3%), elevated renal parameters with wound infection (1%), mild fever (1%), and multiple organ dysfunction syndrome requiring ventilator support (1%). The presence of hypoalbuminemia was the primary risk factor that caused a delay in the healing process of wounds, hence increasing the likelihood of wound dehiscence. Fleck et al and Hoye et al,[20,21] conducted investigations that found a statistically significant positive connection between hypoalbuminemia and wound dehiscence. The research found that the average length of hospital stay was 8.01+1.58 days. Hubner et al performed a research that demonstrated a statistically significant relationship between a decrease in albumin levels and the duration of hospital stay.[19] The study conducted by Arun et al. revealed that the average duration of hospitalisation for patients with hypoalbuminemia was 10.8 days, with a standard deviation of 4.245. In comparison, patients with normal albumin levels had an average hospital stay of 9.03 days, with a standard deviation of 3.765.[15] Among patients with hypoalbuminemia, 50% were released within a period of 10 days, while the remaining 50% were discharged beyond 10 days. Truong et al stated that hypoalbuminemia has a substantial impact on the duration of hospitalization.[6] The research found that the average preoperative serum albumin levels were 3.69+0.52 g/dl. Following the operation, the levels of serum albumin fell from 3.61 to 3.41 between day 1 and day 5. There is a 5% decrease in albumin levels from postoperative day 1 to postoperative day 5, which is attributed to the stress caused by surgery. There is a statistically significant relationship between the levels of serum albumin before surgery and the levels of serum albumin after surgery from postoperative day 1 to postoperative day 5. Lohsiriwat et al reported that individuals with right-sided colon cancer had a mean albumin level of 2.6 g/dl.[22] Gibbs et al. proposed that the preoperative blood albumin level may serve as a credible hypothesis for predicting surgical mortality and morbidity.[23] The amount of serum albumin exhibited the most robust and consistent correlation with the stress response and clinical outcome. Right after the operation, there was a sudden and significant decrease in albumin levels, which thereafter remained stable until postoperative day 3. Furthermore, this research had significant limitations, since it only assessed a solitary set of surgical operations. Excluded from this research were any additional surgical procedures.

CONCLUSION

The quantification of serum albumin is straightforward, uncomplicated, and economical. Furthermore, it may be easily executed in any location, unlike other procedures that need advanced care. The use of serum albumin as a marker enables accurate prognostications about surgical complications, length of hospitalisation, and the intensity of surgical stress.

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