



The Role of Serum Protein, Haemoglobin, and BMI as Predictors of Postoperative Morbidity and Mortality in Major Surgeries

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Pre-operative nutritional assessment is necessary for all patients undergoing surgery in order to prevent post-operative complications. This is because wound healing is an anabolic process requiring adequate protein stores in our body. Serum albumin levels has been found to be a reliable tool in assessing the nutrition when used along with two other parameters namely, haemoglobin and body mass index. It is necessary to provide adequate nutritional support prior surgery for better clinical outcome post-operatively.

Objectives: To assess role of pre-operative serum albumin, haemoglobin and BMI as predictors of post-operative morbidity and mortality in major open surgeries.

Materials and Methods: Sixty patients more than 18 years of age posted for elective and emergency laparotomy in the general surgery ward were included in this study based upon the inclusion and exclusion criteria. Detailed history, clinical examination, anthropometry and nutritional assessment with pre-operative serum albumin, haemoglobin and BMI were done. Post-surgery the details of the procedure, anaesthesia, duration of surgery, duration of hospital stay and early post-operative complications were studied. The patients were followed up till they got discharged from the hospital. The data obtained was analysed.

Results: Maximum number of post-operative complications were in the age group of 40-59 years (36.66%). Seroma followed by surgical site infections were the two most common complications seen among the study population. Most of the complications were seen among patients with serum albumin <3.5gm/dl. Patients with hypoalbuminemia and anaemia had a tendency to develop more post-operative complications and this was found to be statistically significant. (p value <0.05) There was no significant relationship between abnormal BMI and complications in the present study.

Conclusion: Pre-operative hypoalbuminemia <3.5gm/dl and anaemia were found to be independent risk factors for post-operative morbidity and mortality in major open surgeries. Although the relationship between BMI and complications was not found to be statistically significant, it is also essential to stabilise BMI prior to surgery for better clinical outcome.

Keywords: Serum albumin; haemoglobin; body mass index; post-operative complications.

1. INTRODUCTION

A variety of preoperative factors and nutritional indices have been found to be useful in predicting a patient's outcome following surgery. When these indicators of postoperative morbidity and mortality are used alone, the accuracy of these indicators become questionable. On the other hand, establishing a correlation between these factors increases their accuracy and helps clinicians predict a patient's outcome in terms of postoperative morbidity and mortality.

Serum albumin is the most readily available and important laboratory test to diagnose protein energy malnutrition. A serum albumin level > 3.5g/dl suggests adequate protein stores and hence patients have a favourable outcome. Whereas a serum albumin level < 3.5g/dl raises a concern for potential postoperative complications [1]. The role of albumin in our body broadly divided into four, namely maintenance of colloidal osmotic pressure, transport function, nutritive function and buffering action. Other functions are that it has antibacterial and antioxidant properties. The following study throws light upon the nutritive functions of albumin. Albumin serves as a source of amino acid for tissue protein synthesis. This plays a major role in acceleration of wound healing. In case of hypalbuminaemic states, there exists poor wound healing and predisposition to wound infections and other remote infections.

Malnutrition is assessed by body mass index and serum protein levels. Wound healing being an anabolic process requires energy and this energy is derived from calories and proteins [2]. Therefore, severe malnutrition can impair wound healing process and increase chances of postoperative infections in an individual.

Body mass index of 18.5 – 24.9 suggests a normal nutritional status for an average adult individual. [3]. Any value below and above the normal range is considered as underweight and overweight/obese respectively. Low BMI reflects on the malnourishment, likewise raised BMI suggests that a person is obese. Obesity like malnutrition is also a risk factor for postoperative morbidity and mortality. Obesity has thought to be significant risk factor for wound infection, more surgical blood loss and a longer operation time [4].

The following study also focusses on the haemoglobin levels. Anaemia is defined as haemoglobin <13gm/dl for males and <12gm/dl for females according to the WHO. Preoperative anaemia has been found to have poor postoperative outcomes such as increased mortality rate, increased duration of hospital stay, ICU admissions and postoperative infections [5].

Another aspect of the study concentrates on the type of surgery undergone, i.e., whether the surgery was elective or emergency. It has been proved in previous studies that emergency surgeries have poor post-operative outcome compared to elective surgeries.

This study tried to determine the correlation between preoperative serum albumin, body mass index and haemoglobin values and assess their relationship with postoperative morbidity and mortality.

2. METHODOLOGY

This is a prospective cross-sectional study conducted at a tertiary health care centre.

2.1 Study Area

Saveetha Medical College and Hospital, Chennai.

2.2 Study Population

Patients admitted in SMCH general surgery wards for any major emergency and elective surgeries.

2.3 Inclusion Criteria

The patients with the following criteria were included in the study:

1. Patients admitted for any major emergency or elective surgery under the department of General surgery.
2. Laparotomies
3. Both males and females >18years of age.
4. Under hernias- Epigastric, Incisional and Umbilical hernias

2.4 Exclusion Criteria

The patients with following criteria were excluded from the study:

1. Individuals <18years of age.
2. Laparoscopic surgeries
3. Patients with co-morbidities such as diabetes mellitus, chronic renal disease, chronic liver disease and patients on steroids or chemotherapy.
4. Patients with prolonged addiction to alcohol and tobacco
5. Under hernias- Inguinal and femoral hernias
6. Minor surgeries

2.5 Study Period

6 Months. From November 2020 – April 2021.

2.6 Sample Size

N=60. All patients eligible by inclusion and exclusion criteria are to be included in the study.

2.7 Study Design

Prospective cross-sectional study.

2.8 Study Procedure

Details of the cases were recorded including demographic details, history, clinical examination, nutritional status, investigations done and surgical procedures undergone. All these data have been recorded using a well-constructed proforma.

Anthropometry- Height and weight were recorded preoperatively. BMI was calculated using the formula $\text{Weight(kg)}/\text{Height(m}^2\text{)}$

Investigations required in this study are routine standardized ones. Complete blood count and Haemoglobin estimation was done. Serum albumin levels were measured preoperatively close to the day of surgery. Only those values taken thirty days prior to the date of surgery were considered valid.

Operative details such as type of surgery (emergency/elective), name of surgical procedure, type of incision, type of anaesthesia (general/regional), duration of surgery, peri-operative complications if any were noted.

The patients were followed up after surgery till the date of discharge from the hospital. Patients were watched out for early postoperative complications (which occur during first 30 days post-operative) such as wound-related complications (surgical site infection, wound gaping, bleeding/hematoma, seroma, non-healing ulcer, fistula), sepsis, myocardial infarction, pleural effusion, pulmonary oedema, pneumonia, acute respiratory distress syndrome, acute renal failure, urinary tract infection, deep vein thrombosis, burst abdomen, death etc. For diagnosis of these complications, relevant laboratory investigations and imaging studies were done and opinion from specialists were obtained for confirmation of diagnosis and management. If complications were present, the postoperative day on which it occurred was recorded. The duration of hospital stay was also noted.

3. RESULTS

The study was conducted on 60 patients aged between 18-65 years, who underwent major open surgeries of the Abdomen, Breast and Thyroid gland. Amongst them forty-two were females and eighteen were males; and the Male to Female ratio (M: F) was 3:7. Maximum number of patients were in the age group of 40-59years (43.33%). (Table 1).

3.1 Distribution of Patients According to BMI

The patients were categorised based on the WHO criteria and it was found that thirty-six subjects had BMI >25 (60.00%), which means that majority of subjects were obese. (Table 2).

3.2 Serum Albumin Level

Most of the patients had a preoperative serum albumin above 3.5gm/dl (56.66%) (Table 3).

3.3 Haemoglobin Levels

According to WHO, anaemia is defined as Hb <13gm/dl in males and <12gm/dl in females. Therefore, from the data it was found that among the forty-two females, thirty females were anaemic and among the eighteen males, twelve males were anaemic. So, in total forty-two out of sixty patients (70%) were anaemic.

3.4 Early Post-Operative Complications

The patients were followed up for complications following surgery. The early post-operative complications, which occurred within the first 30 days of surgery were looked for in this study [6]. Among the sixty patients, forty (66.66%) had early post-operative complications, of which eighteen were males and twenty-two were females. Seroma was the most common early post-operative complication seen in the present study (25%) (Table 4).

It was also noted that there was prolonged hospital stay in 50% of the patients. And most of

early post-op complications occurred between the post-operative days 5-10. (56.66%).

3.5 Relation between Age and Complications

It has been observed that the maximum number of complications were present in between the age group of 40-59years (36.66%) (Table 5).

3.6 Relation between Sex and Complications

Eighteen males participated in the study and all of them developed post-operative complications, which is 30% of the study population. But as a whole, twenty-two females i.e., 52.38% of the study population developed complications, and therefore maximum number of complications were seen among females (Table 6).

3.7 Relation between BMI and Complications

In this study, majority of complications were seen among individuals with normal BMI range 18.5-24.9kg/m² i.e., Twenty individuals comprising 33.33% of the study population. This suggests a negative correlation between BMI and complications in this present study (Table 7).

Table 1. Distribution of patients according to age

Age group(years)	Frequency	Percentage
<20	2	3.33
20-39	24	40.00
40-59	26	43.33
60-70	8	13.33
Total	60	100.00

Table 2. Distribution of patients according to BMI

BMI (kg/m ²)	Frequency	Percentage
<18.5(Underweight)	2	3.33
18.5-24.9 (Normal)	22	36.66
>25(Overweight/Obese)	36	60.00
Total	60	100.00

Table 3. Distribution of patients according to Serum Albumin

Pre-operative Serum albumin (g/dl)	Frequency	Percentage
<2.1	6	10.00
2.1-3.5	20	33.33
>3.5	34	56.66
Total	60	100.00

Table 4. Distribution of complications

Complications	Frequency	Percentage
Seroma	10	25.00
Surgicalsite infection	6	15.00
Wound gaping	6	15.00
Fistula	6	15.00
Urinary tract infection	2	05.00
Myocardialinfarction	2	05.00
Basalatelectasis	2	05.00
Acuterespiratory distress syndrome	2	05.00
Sepsis	2	05.00
Deep vein thrombosis	2	05.00
Total=	40	100.00

Table 5. Correlation of age and complications

Age (years)	Complications		Total
	Present	Absent	
<20	2(3.33%)	0(0%)	2(3.33%)
20-39	8(13.33%)	16(26.66%)	24(40%)
40-59	22(36.66)	4(6.66%)	26(43.33%)
60-70	8(13.33%)	0(0%)	8(13.33%)
Total	40(66.66%)	20(33.33%)	60(100%)

Table 6. Correlation of sex and complications

Sex	Complications		Total
	Present	Absent	
Male	18(30%)	0(0%)	18(30%)
Female	22(52.38%)	20(33.33%)	42(70%)
Total	40(66.66%)	20(33.33%)	60(100%)

Table 7. Correlation of BMI and complications

BMI (kg/m ²)	Complications		Total
	Present	Absent	
<18. 5	2(3.33%)	0(0%)	2(3.33%)
18.5-24.9	20(33.33%)	2(3.33%)	22(36.66%)
>25	18(30%)	18(30%)	36(60%)
Total	40(66.66%)	20(33.33%)	60(100%)

Table 8. Correlation of Serum albumin and complications

Pre-operative Serum Albumin Complications (gm/dl)	Present	Absent	Total
<2.1	4(6.66%)	2(3.33%)	6(10%)
2.1-3.5	18(30%)	16(2.66%)	34(56.66%)
>3.5	18(30%)	2(3.33%)	20(33.33%)
Total	40(66.66%)	20(33.33%)	60(100%)
Chi squarevalue			7.7824 (p value 0.020421)*

Table 9. Correlation of anaemia and complications

Anaemic	Complications		Total
	Present	Absent	
Present	38(63.33%)	8(6.66%)	42(70%)
Absent	2(3.33%)	16(26.66%)	18(30%)
Total	40(66.66%)	20(33.33%)	60(100%)
Chi square value	28.2177 (p value <0.0001)*		

Table 10. Correlation of Type of operation and complications

Type of operation	Complications		Total
	Present	Absent	
Elective	26(43.33%)	18(30%)	44(73.33%)
Emergency	14(23.33%)	2(3.33%)	16(26.66%)
Total	40(66.66%)	20(33.33%)	60(100%)

3.8 Relation between Pre-Operative Serum Albumin and Complications

It has been proved in the following study that individuals with serum albumin ranging between 2.-3.5gm/dl developed more complications compared to those with albumin levels greater than >3.5gm/dl. About 36.66% (22 individuals) had serum albumin levels less than 3.5g/dl, suggesting that hypoalbuminemia may be a possible reason for post-operative complications. This correlation is found to be statically significant. (p value <0.05) (Table 8).

3.9 Relation between Haemoglobin Level and Complications

It was observed in the following study that thirty-eight anaemic individuals which comprised 63.33% of the study population, developed maximum number of post-operative complications compared to that of non-anaemic individuals. And this relation has been found to be statistically significant (p valve <0.05) (Table 9).

3.10 Relation between Type of Surgery and Complications

In fourteen out of sixteen emergency surgeries, the subjects developed complications. This shows that 87.5% of individuals undergoing emergency surgeries developed complications. On the contrary, twenty-six out of forty-four individuals who had undergone elective surgeries developed complications, which shows that 61.9% of patients undergoing elective surgeries developed complications. This shows that maximum number of complications are seen post

emergency surgeries. (Table 10) It has also been observed that thyroid surgeries had lesser complication rates compared to breast and abdominal surgeries. Maximum number of complications were seen following abdominal surgeries i.e., thirty-two cases (53.33%).

4. DISCUSSION

From the present study, it has been observed that maximum number of complications were noted in the age group of 40-59 years which was 36.66% followed by age group 60-70 years which was 13.33%. In a study conducted by Samuel et al, similar results were found, wherein maximum cases were seen in the age group of 60-70 years followed by the age group of 40-59 years [6]. Therefore, on comparing with previous studies, it can be suggested that post-operative morbidity and mortality is common between 40-70 years of age.

On considering the pre-operative serum albumin levels, it was found that patients with albumin levels <3.5gm/dl had more complications compared to those with albumin levels >3.5gm/dl. The relation between hypoalbuminemia and complications was found to be statistically significant. (p value <0.05) To support this data, a number of authors have derived at the same conclusion in their respective studies. Davenport et al., [7] in his study on “accuracy of nutritional assessment tools for predicting adverse hospital outcomes” and Beghetto et al., [8] in his study on “multivariable predictors of postoperative adverse events after general and vascular surgery”, both arrived at the same conclusion that post-operative complications were higher among patients with serum albumin levels <3.5gm/dl.

Although different studies have taken different levels of serum albumin for predicting post-operative outcomes, it is safer to take a cut-off value of 3.5gm/dl for serum albumin in order to manage greater number of patients and improve their nutritional status pre-operatively [9,10,11].

In the present study, majority of complications were seen in individuals within normal BMI range. This might be due to the limited number of participants in the study. However previous studies have demonstrated statistically significant relation between BMI and post-operative complications. Samuel et al concluded in his study that patients with BMI <18.5kg/m² developed higher rate of complications [6]. On the contrary, in the current study higher complication rates (30%) were seen in individuals who had BMI >25kg/m². Therefore, it is understood that both undernutrition and overnutrition significantly increase the rate of post-operative complications. Malnutrition and obesity are predisposing factors for poor wound healing.

From the data, it has been found that anaemia is an important predisposing factor for post-operative morbidity. 63.33% of the patients were anaemic and developed postoperative complications. It has been established that an anaemic individual has a higher chance of developing post-operative complications compared to a non-anaemic individual. The relation between anaemia and post-operative complications is found to be statistically significant. (*p* value <0.05) This is further supported by a study conducted by Fowler et al [12].

Seroma is the most common complication in the present study, followed by surgical site infection, wound gaping and fistula. Gibbs et al demonstrated that pneumonia and surgical site infection were the two most common complications in patients with hypoalbuminemia [13]. Similarly surgical site infection is the most common early post-operative complications in a study conducted by Samuel et al. [6] Therefore it is understood that surgical site infection is common in individuals having low pre-operative serum albumin levels. This further substantiates the statement that hypoalbuminemia is associated with poor wound healing.

Pre-operative nutritional status is most commonly assessed by serum albumin levels, haemoglobin and body mass index [14]. These parameters are

readily available to be interpreted and assessed for clinical malnutrition. Hence, they can be used as tools to predict post-operative morbidity and mortality.

5. CONCLUSION

In conclusion, the study establishes that pre-operative hypoalbuminemia and anaemia increased the risk of adverse events post-operatively and this led to increased hospital stay and created a financial burden for the patients. Serum albumin and haemoglobin can be used as potential predictors and prognostic indicators of post-operative complications because of their ability to detect protein energy malnutrition and anaemia respectively in patients undergoing surgeries [15]. Hence proper nutritional assessment prior to surgery is absolutely necessary for better post-operative outcome. Early detection and treatment of hypoproteinaemia and anaemia correction can prevent and decrease post-operative complications.

6. LIMITATIONS

This study was conducted in a single institution. The study was conducted for a short period of six months with limited time to follow-up. Patients were monitored only for early post-operative complications. Due to limitation in time and owing to the covid pandemic situation, delayed post-operative complications could not be assessed and few patients were lost to follow up.

CONSENT

A written informed consent was taken from all the study participants.

ETHICAL APPROVAL

The Institutional Review Board approved the study. IRB approval number: SMC/IEC/2021/03/068.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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