Original Research Article

Role of serum albumin and body mass index in the outcome of major elective abdominal surgery

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ABSTRACT

Background: The prevalence of protein-energy malnutrition in surgical patients is high, ranging from 10% to 54%. The correct assessment of the nutritional studies of such patients is crucial since malnutrition is a risk factor for morbidity and mortality. There is a substantial evidence to show that patients who have signs of malnutrition have a higher risk of complications and an increased risk of death in comparison with patients who have adequate nutritional reserves.

Methods: 150 patients were selected for the study. All the collected data was entered in Microsoft Excel sheet. It was then transferred to SPSS ver. 21 software for statistical analysis. Quantitative data was compared by using student's t-test and chi-square test, qualitative data compared using frequency, standard deviation and percentage. $P<0.05$ considered as significant.

Results: The mean serum albumin was found to be 3.7 gm%±0.3. There was increase rate of complication and duration of hospital stay in those patients with serum albumin <3.5 gm% and BMI>25 kg/m^2 and wound infection was found to be the most common complication among these patients.

Conclusions: Majority of patients had serum albumin >3.5 gm/dl and more complications were seen with serum albumin <3.5 gm/dl which was statistically significant (p=0.01). Serum albumin is a good prognostic indicator because of its ability to detect protein energy malnutrition.

Keywords: Body mass index, Mortality, Post-operative morbidity, Serum albumin

INTRODUCTION

The prevalence of protein-energy malnutrition in surgical patients is high, ranging from 10% to 54%. The correct assessment of the nutritional studies of such patients is crucial since malnutrition is a risk factor for morbidity and mortality. The degree of malnutrition is estimated on the basis of weight loss during the past six months, physical findings and plasma protein assessment. Although variety of nutritional indices have been found to be valuable in predicting the patient outcome by means of risk stratification and objective comparison among

patients, but when used alone there is no consensus on the best method for assessing the nutritional status. The serum albumin is the most readily available and clinically useful parameter.[2] The identification of patients with high surgical risk is essential in the operative indications and decisions, often limited by the potential morbidities and mortality related to the procedure. Serum albumin and body weight are the most commonly measured indices of nutritional assessment. The body mass index [BMI= weight (kg)/height (m^2)] or percentage weight loss are simple and sensitive clinical measures of gross nutritional status. The serum Albumin level is the most readily available and clinically useful parameter.

A serum albumin level greater than 3.5 gm/dl suggest adequate protein scores. A serum albumin level less than 3.5 gm/dl raises concern for potential surgical complications. A body mass index of 19–25 for an average adult suggests a normal nutritional status. A BMI less than 18 suggests potential surgical complications.[3] The poor nutritional status increased postoperative morbidity, wound infection, pneumonia and mortality. Recognition of prognostic factors might lead to interventions and increased postoperative surveillance.[4] Hence, with this background, the need for study of serum albumin and BMI and its relation with postoperative outcomes

Aims and objects

- To assess the level of serum albumin, BMI in patients undergoing major elective abdominal surgeries.
- To determine the association of serum albumin, BMI with postoperative morbidity and mortality in patients undergoing major elective abdominal surgery.

METHODS

Study design

It was a descriptive cross-sectional study.

Set up

The study was conducted in the Department of Surgery and the Department of Biochemistry, Regional Institute of Medical Science Imphal, Manipur.

Study duration

The duration of the study was for 2 years, starting from 1st August 2016 to 31st July 2018.

Study population

Patients admitted in the Department of surgery for elective major abdominal surgery.

Inclusion criteria

All the patients more than >18 years of age indicated for major elective abdominal surgery.

Exclusion criteria

Exclusion criteria were patients with diabetes mellitus; haemoglobin<7 gm/dl; chronic renal/liver diseases; immunosuppressive patients; patient undergoing radiotherapy or chemotherapy; laparoscopic surgeries; patients unwilling to give consent for the study.

Sample size: 150 patients.

Study variables

- Pre-operative serum albumin
- BMI (body mass index) in kg/m^2
- Duration of stay in hospital
- Complications (if any)

Working definitions

Malnutrition is defined as BMI less than 18.5 kg/m^2, serum albumin level less than 3.5 gm/dl and BMI more than 23 kg/m^2 is defined as overweight /obese. Body Mass Index (BMI) is derived from booking weight (kilograms) and height (metres). Using this, the patients will be categorized as underweight (<18.5 kg/m^2), normal or lean BMI (18.5–22.9 kg/m^2), overweight (23.0–24.9 kg/m^2) and obese (≥25 kg/m^2) based on the revised consensus guidelines for India.[12,13]

Major complications are defined as untoward events that threatens life or prolongs the hospital stay which are as follows:[10]

- Postoperative septicaemia is defined as body temperature >37.5℃ with a positive blood culture, leucocytosis or leucopenia.
- Intra-abdominal sepsis as intra-abdominal purulent collection requiring CT guided or open drainage.
- A fistula defined as enterocutaneous or colocutaneous connection confirmed radiologically.
- Pneumonia as chest infection with positive sputum culture with an abnormal chest x-ray requiring anti-biotic treatment.
- Wound infection defined as purulent discharge with positive swab culture.
- Postoperative ileus as abnormal bowel function with or without vomiting requiring nasogastric intubation or cessation of oral fluids.
- Urinary tract infection as significant bacteriuria more than or equal to 10^5/hpf.
- pseudo-membranous colitis as postoperative diarrhea with isolation of clostridium difficile with or without endoscopic confirmation.
- Sinus as connection of skin or any epithelial surface to a deep seated abscess.
- Postoperative mortality as death that occurs following operations in patients who have been hospitalized continually or discharged home since operation until 30 days.

Study tools

- Serum albumin
- Anthropometry: Height and Weight at the time of admission.
- Clinical features/ Complications (postoperative).
- Number of post operative days in hospital.

Procedure

Total number of 150 patients who underwent major elective abdominal surgery were selected for the study. Informed written consents were obtained, after which a proper history, physical examination and anthropometric measurements were done. A preoperative serum albumin levels were noted and the patients were followed up till the time of discharge and all the postoperative details and events were noted.

Data analysis

- Data was done analyzed using SPSS 21 for windows.
- Descriptive statistics like frequency, percentage, standard deviation (SD), mean was used for analysis.
- Chi-square test and t-test was used to see the association between the variables.
- P<0.05 will be taken as statistically significant.

Ethical issues

Prior permission was taken from the Ethics Committee, Regional institute of medical sciences (RIMS), Imphal, before the study was conducted. Informed consent of the participants for the study was taken from all the patients.

RESULTS

A total number of 150 patients were included in the study, all above 18 years of age who underwent major elective abdominal surgery. Among 150 patients 56 developed complications and 96 had uneventful recovery.

The postoperative complication were found to be more in the age group more than 60 with total number of 29 patients out of which 15 (51.7%) developed complications with p value of 0.06.
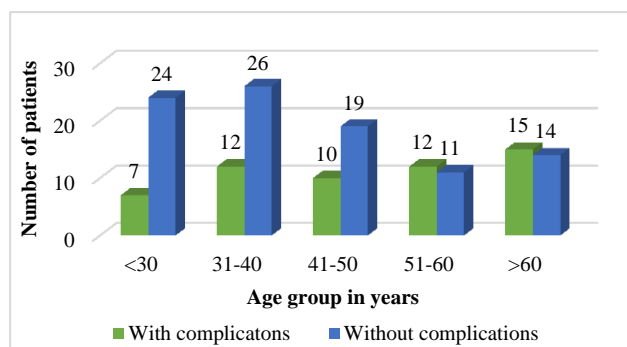

Figure 1: Comparison between age and complication.

Total number of patients with serum albumin less than 3.5 gm/dl was 28 i.e. 15% of the total sample size. Hypoalbuminemia was common in the age group more than 60 years with total number of 8 patients (5.3%) and it was the least among the age group less than 30 years

with only 4 (2.6%) patients out of the total sample size (Table 3) with p value of 0.09 which was not significant.

Table 1: Comparison between age group and serum albumin.

Age group (in years)	S. Albumin group (gm/dl)		Total
	Less than 3.5	Equal or More than 3.5	
Less than 30	4	27	31
31-40	6	32	38
41-50	5	24	29
51-60	5	18	23
More than 60	8	21	29
Total	28	122	150

Of the 150 patients studied 79 (52.7%) patients were female and 71 (47.3%) were males. Postoperative complication rate was almost the same in both the age groups. Out of 71 male patients 24 (33.8%) patients had complications, whereas in females 32 (40.5%) out of 79 had postoperative complications. The p value was found to be 0.8 which is not significant.

Out of 71 male patients 24 patients had complications, whereas in females 32 out of 79 had postoperative complications as shown in the table given below. P value was found to be 0.8 which was not significant.

Table 2: Comparison between sex and complication.

Sex	Complications		Total
	No	Yes	
Male	47	24	71
Female	47	32	79
Total	94	56	150

Out of 150 patients 28 (18.7%) patients who underwent surgery had serum albumin level less than 3.5 gm/dl and the remaining 122 (81.3%) patients had albumin level more or equal to 3.5 gm/dl and mean serum albumin level was found to be 3.7 gm/dl.

Total number of 28 patients had serum albumin level less than 3.5 gm/dl out of which 27 (96%) of them developed postoperative complications which was found to be significant with p value of.000, whereas the total number of 122 patients had serum albumin equal or more than 3.5 out of which 29 (23%) developed postoperative complications which was found to be significant. The mean serum albumin was found to be 3.7 gm/dl±0.32 and the mean among those with postoperative complication was found to be 3.5 gm/dl±0.32.

Among the 28 patients with serum albumin <3.5 gm/dl, 8 (28%) patients had postoperative recovery period of 3 to 6 days, 14 (50%) patients took 7 to 10 days to recover,

and 6 (22%) patients stayed for 11 to 15 days to recover. None of the patients had postoperative recovery period less than 3 days, with p value of 0.000 which was found to be significant. Whereas among the 122 patients with serum albumin more than or equal to 3.5gm/dl, 5 (4.01%) patients recovered in less than 3 days, 92 (75.4%) patients took 7 to 10 days to recover and 9 (7.3%) patients stayed for a longer period for 11 to 15 days, which was found to be statistically significant with p value of <0.00. Hence, it is observed that the rate of delayed recovery (7-10 days) is more in patients with serum albumin <3.5 gm/dl.

Table 3. Comparison between serum albumin and complication.

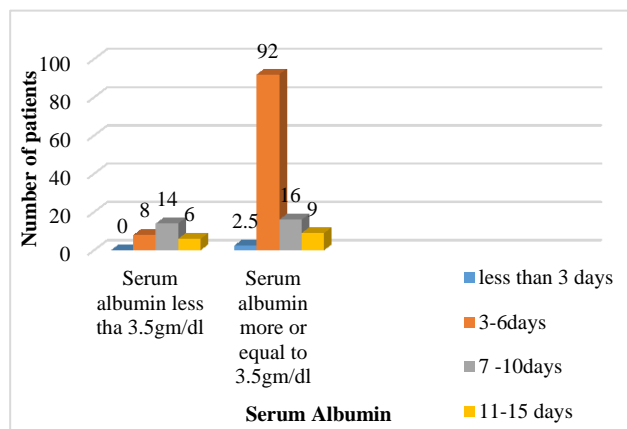| S. Albumin group	Complications		Total
	No	Yes	
Less than 3.5	1	27	28
Equal or More than 3.5	93	29	122
Total	94	56	150

Figure 2: Clustered bar diagram showing relation between serum albumin and number of post-operative days.

Table 4: Distribution of BMI in patients.

BMI (kg/m^2)	Frequency	%	Valid %	Cumulative %
Less than 18.5	1	7	0.7	0.7
18.5-25	136	90.7	90.7	91.3
More than 25	13	8.7	8.7	100.0
Total	150	100.0	100.0	

The anthropometric measurements i.e., height in meters and weight in kilograms were recorded preoperatively and BMI was calculated. Only 1 patient had BMI < 18.5 kg/m^2, and the majority of the patients i.e. 136 patients had BMI 18.25-25 kg/m^2 and the remaining 13 patients had BMI >25 kg/m^2. The mean± SD of the BMI was found to be 22±1.8 and the mean BMI among those with post-operative complication was found to be 22±3.8 kg/m^2.

The rate of postoperative complication was found to be more in the patients with BMI > 25 kg/m^2 i.e., out of 13 patients with BMI >25 kg/m^2, 5 (62%) patients developed post-operative complication. Whereas 47 (36%) out of 136 patients with BMI 18.5-25 kg/m^2 developed complications. There was only one patient with BMI<18.5 kg/m^2 who also developed post-operative complication. The p value was 0.04 after applying exact chi-square test, which was not significant. Therefore it can be concluded that BMI >25 kg/m^2 is associated with increased postoperative complication.

Table 5: Comparison between BMI and complications.

BMI group	Complications		Total
	No	Yes	
Less than 18.5	0	1	1
18.5-25	89	47	136
More than 25	5	8	13
Total	94	56	150

All the patients undergoing major elective abdominal surgery were included in the study out of 150 patients the most common diagnosis was cholelithiasis with total number of 67 (47%) patient's and the least common diagnosis was desmoid tumour and pancreatic

Post-operative duration

Out of 150 patient's it was observed 100 (66.7%) patients had 3-6 days of postoperative period, 15 (10%) patients had a duration of 11-15 days and only 5 (3.3%) patients had minimum postoperative stay for less than 3 days as shown in the table and bar diagram below. The mean postoperative duration was 5.75±3.3 days. Whereas, the mean of postoperative duration in those with serum albumin <3.5 gm/dl and ≥3.5 gm/dl were 8±3.1 and 5.24±3.01 days respectively. P value was found to be significant (0.00). The rate of postoperative complication was increased in BMI >25 kg/m^2 (38.4%) as compared to that of BMI < 25 kg/m^2 (17%) in patients with 7-10 days postoperative period but the p value was not significant. Hence, it can be concluded that there is no association between BMI and postoperative duration.

Out of 150 patients 94 (62.7%) patient had uneventful recovery, whereas 56 (37.3%) patient had postoperative complications. The most common postoperative complication was wound infection with 50 (33.3%) patients. 37 (24.7%) patient had fever, 13 (8.7%) patients had respiratory infection, 2 (1.3%) patients developed sepsis, 2 patients developed intra- abdominal collection, 2 (1.3%) patients had ileus, 9 (6%) patients developed anaemia, 3 patients developed anastomotic leakage, entero-cutaneous fistula and diarrhoea respectively. Only 3 (2%) patients expired.
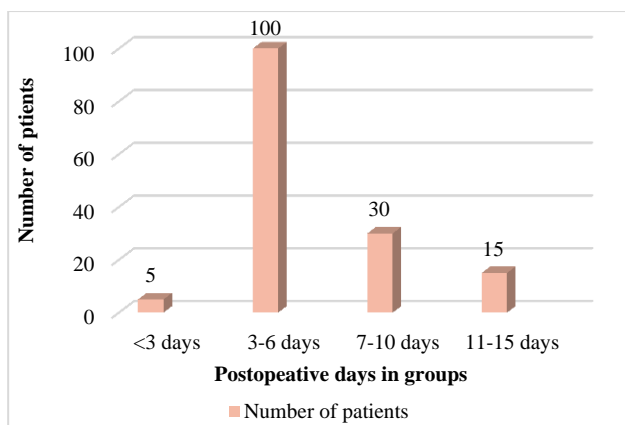
Figure 3: Distribution of patients according to post-operative period.

Wound infection rate was more in patients with albumin less than 3.5 gm/dl. Out of 28 patients with hypoalbuminemia 26 (92.8%) developed postoperative wound infection and only 24 out of 122 patients developed wound infection in the patients with serum albumin more than 3.5 gm/dl and after applying χ^2- test its was found to be statistically significant with p value of 0.00. Hence it may be concluded that post-operative wound infection increases with decrease serum albumin less than 3.5 gm/dl.

Table 6: Comparison between wound infection and BMI.

Complication wound infection	BMI group			Total
	Less than 18.5	18.5-25	More than 25	
No	0	95	5	100
Yes	1	41	8	50
Total	1	136	13	150

Malignancy

The percentage of malignancy in this study group was 14% i.e., 21 patients out of 150 patients. Out of 21 patients with malignancy only 6 patients were found to be having serum albumin less than 3.5gm/dl, and 20 patients had BMI 18.5-25 kg/m^2 and only one patient had BMI more than 25 kg/m^2. The association of malignancy with BMI and serum albumin was not found to be significant with p value of 0.77 and 0.86 after applying chi-square test.

It was observed that out of 21 patients with malignancies 15 (71.42%) developed postoperative complications whereas the remaining six did not developed any complication. After the data was statistically analysed using chi-square test the p value was found to be <0.05, which is considered significant. Therefore, it can be concluded that post-operative complications in case of malignancy is reduced even in patients with normal BMI and serum albumin as mentioned above.

Table 7: Showing association of malignancy with serum albumin and BMI.

	Malignancy		Total
	No	Yes	
Serum albumin			
Less than 3.5	22	6	28
Equal or More than 3.5	107	15	122
Total	129	21	150
BMI			
Less than 18.5	1	0	1
18.5-25	116	20	36
More than 18.5	12	1	13
Total	129	21	150

DISCUSSION

In this study the maximum number of patients belonged to the age group 31 to 40 years. The mean age was found to be 44.13±15. The complication rate was higher in the age group more than 60 years with p value of 0.06. Hypoalbuminemia <3.5 gm/dl and BMI >25 and malignancy were found to be more in age group >60 years.

In a similar study conducted by Bhagvat et al found that number of patients were highest (34%) in the age group 31-40 years, and the highest number of complications was noted in the age group of 51-60 years.[5] However, Kumar et al, found that the highest number of patients belonged to the age group 51-60 years of age and the maximum number of complications were also found in the same group.[6]

Sex distribution

Out of 150 patients, number of females (79) patients were more than that of males. The rate of complication was also found to be higher in females (40.5%) as compared that of males (33.8%) and the p value was 0.8 which is not significant.

However, in another study conducted shows males (54) were the majority and the number of females (46) were and the rate of complications were almost the same in both the groups. Hence there is no relation between the sex and post-operative complication.

Serum albumin and BMI

In this present study 28 (18.7%) patients had serum albumin less than 3.5 gm/dl and 122 (81.3%) patients had serum albumin ≥3.5 gm/dl. The mean serum albumin was found to be 3.7 gm/dl±0.32 and the mean among those with complication was found to be 3.5 gm/dl±0.32. We found that complication rate was higher among the patients with serum albumin<3.5 gm/dl i.e, 27 (96%) patient out of 28 had postoperative complications with p value 0.00. The mean duration of postoperative hospital

stay was 5.75±3.2 days for all the patients. However, the mean for the duration of hospital stay postoperatively was higher (8±3.1 days) in group with serum albumin <3.5 gm/dl than that of patients with serum albumin≥3.5 gm/dl (5.24±3.01 days). The mean± SD of the BMI was found to be 22±1.8 and the mean BMI among those with post-operative complication was found to be 22±3.8. The rate of post- operative complication was found to be more in the patients with BMI>25 i.e., out of 13 patients with BMI>25, 5 (62%) patients developed post-operative complication. Whereas, 47 (36%) out of 136 patients with BMI 18.5-25 developed complications. There was only one patient with BMI<18.5 who also developed post-operative complication. The p value was 0.06 which was not significant.

Kumar et al observed that the rate of complication was more when serum albumin level was less than 3 gm/dl.[6] They also found that the complication rate was higher (85%) among those patients with BMI 18.6 to 24.9 kg/m^2 and the rate of complication among those patients with BMI more than 25 was less.

They also compared between the malignant and non-malignant diseases with serum albumin. It was found that among the 37 malignant patients 8.1% (3) were malignant with albumin <3.0 g/dl, and albumin between 3.1-3.5 g/dl 32.4%. Among the 60 patients with non-malignant diseases (23), which 5 (22%) were <3.0 g/dl; 7 (30%) patients between 3.1-3.5 g/dl and 11 (43%) patients >3.5 g/dl.

Gibbs et al observed that low serum albumin was associated with exponential increase in morbidity and mortality and that it was a good prognostic indicator, whereas anthropometric markers could not predict postoperative outcome.[7]

In another study, Ejaz et al investigated 755 patients using a multi-institutional data set of US population and found that underweight patients with BMI <18.5 kg/m^2 had overall survival after gastrectomy while overall survival did not differ among the normal BMI and high BMI patients.[8]

Azodi et al concluded that a BMI of 27.5 kg/m^2 or more was associated with more post operative complications after open appendicectomy in patients with non perforated appendicitis (p<0.001).[9]

In a large multi-center study by Hennessy et al the authors determined hypoalbuminemia to be an independent predictor of surgical site wound infection in patients undergoing colorectal surgery.[10]

Thieme et al recently found a significant association between low serum albumin and noninfectious complications.[11]

Seungjin et al in their study found that patients at nutritional risk have higher complication rates after surgery for colorectal cancer, especially, malnutrition increases the rate of anastomotic leakage and wound infection.[12] Malnutrition was also a significant risk factor for the length of hospital stay.

Hussein et al conducted a study in 40 patients undergoing elective major cancer surgery.[13] Patients were divided according to their serum albumin levels into two groups. Group 1: with serum albumin more than 3.5 g/dl and Group 2 less than or equal to 3.5 g/dl. Postoperative complications were higher in number and percentage in group 2 compared to group 1.

The percentage of malignancy in this study group was 14% i.e. 21 patients out of 150 patients. Out of 21 patients with malignancy only 6 patients were found to be having serum albumin less than 3.5 gm/dl, and 20 patients had BMI 18.5-25 and only one patient had BMI more than 25. The association of malignancy with BMI and serum albumin was not found to be significant.

CONCLUSION

The study shows that serum albumin is a good indicator and predictor of postoperative complications. The maximum number of patients was noted with serum albumin ≥3.5 gm/dl. Serum albumin<3.5 gm/dl was associated with more complications and longer duration of hospital stay.

The rate of postoperative complication is increased with BMI>25 kg/m^2. BMI is not associated with duration of postoperative hospital stay.

Wound infection is found to be the most common complication associated with serum albumin<3.5gm/dl and BMI >25 kg/m^2. Malignancy was not found to be associated with either serum albumin or BMI. However it was found to be associated with the age group more than 60 years. The mortality rate was found to be 2% (3 patients) in this present study. There was no association between serum albumin and BMI with the mortality in this study.

ACKNOWLEDGEMENTS

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