Original Research Article

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Role of serum albumin and body mass index as predictors of postoperative morbidity and mortality in elective major abdominal surgeries

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ABSTRACT

Background: The adverse effects of malnutrition on the morbidity and mortality of patients was first recognized by Hippocrates (460 BC- 370 BC) many centuries ago. It is common and occurs in about 30% of surgical patients with gastrointestinal diseases and in up to 60% of those in whom hospital stay has been prolonged because of postoperative complications. 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. Nutritional assessment is essential for identifying patients who are at risk of developing complications related to significant malnutrition.

Methods: All the collected data was entered in Microsoft Excel sheet. It was then transferred to SPSS ver. 17 software for statistical analysis. Quantitative data was compared by using student's t-test and qualitative data compared using frequency and usage. Efficacy of serum albumin and BMI as screening test to predict the occurance of complications in patients was compared using roc curve. P value of < 0.05 considered as significant.

Results: Even though body mass index was associated with postoperative complications but serum albumin was better prognostic indicator than body mass index.

Conclusions: Majority of patients had serum albumin < 2.5 gm/dl and more complications were seen with serum albumin < 3.5 gm/dl which was statistically significant (p value 0.01). Sr. 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 adverse effects of malnutrition on the morbidity and mortality of patients was first recognized by Hippocrates (460 BC- 370 BC) many centuries ago. It is common and occurs in about 30% of surgical patients with gastrointestinal diseases and in up to 60% of those in whom hospital stay has been prolonged because of postoperative complications. 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. Nutritional assessment is essential for identifying patients who are at risk of developing complications related to significant malnutrition.

A dietary history, physical examination (including anthropometric measurements) and relevant labs are the appropriate tools needed for an accurate evaluation of a patient's preoperative nutritional status. The serum albumin level is the most readily available and clinically

useful parameter. A serum albumin level greater than 3.5 g% suggests adequate protein stores and it confers a protective effect through several biological mechanisms. It predicts perioperative morbidity and mortality. Serum albumin is the most important laboratory test for the diagnosis of protein-calorie under nutrition. Most patients with severe protein depletion will have low serum albumin levels. Patients with abnormal parameter have a markedly increased risk of poor clinical outcomes. 4

Protein energy malnutrition occurs as a result of relative and absolute deficiency of energy and protein. It may be primary, due to inadequate food intake, or secondary, as a result of other illness. For most developing nations, Primary protein energy malnutrition remains among the most significant health problems. Protein energy malnutrition affects every organ system. The most obvious results are loss of body weight, adipose stores and skeletal muscle mass.

Hepatic synthesis of serum protein decreases and depressed levels of circulating proteins are observed. Due to changes in immunological function, wound healing is poor.⁴

METHODS

The study was conducted on 100 patients, aged between 18-75 years, who underwent any major surgery elective surgery in tertiary care center between June 2014 to October 2014. Among 100 patients (calculated sample size n=100) 40 patients developed complications and 60 had uneventful recovery.

Inclusion criteria

Patients who were admitted for any major elective surgery under the department of general surgery in tertiary care centre.

Major surgery

Major surgery often involves opening one of the major body cavities the abdomen (laparotomy), the chest (thoracotomy), or the skull (craniotomy) and can stress vital organs. The surgery usually is done using general anesthesia in a hospital operating room by a team of doctors. A stay of at least one night in the hospital usually is needed after major surgery.

Exclusion criteria

- Children < 18 year
- Patients who have icterus, severe anemia < 7 gm/dl diabetes mellitus
- Chronic renal disease and patients on steroids
- Having any hernias- inguinal and femoral hernias
 etc.

Method of collection of data

- Details of cases was recorded including history and clinical examination
- Anthropometry: height and weight recorded
- Investigation: serum albumin was estimated
- Follow up was done till postoperative day 10
- All the collected data was entered in Microsoft Excel sheet. It was then transferred to SPSS ver. 17 software
- For statistical analysis. Quantitative data was compared by using student's t test and qualitative data compared using frequency and usage.
- Efficacy of serum albumin and body mass index as screening test to predict the occurrence of complications in patients was compared using roc curve
- P value of < 0.05 considered as significant.

RESULTS

Table 1: Sex distribution.

Sex	Number	Complications	Percentage (%)	No complication	Percentage(%)
Male	54	22	55	32	53.33
Female	46	18	45	28	46.67

Table 2: Age distribution.

Age	Total no	Complication	Percentage (%)	No complication	Percentage (%)
18-30	20	10	25	10	16.67
31-40	34	10	25	24	40
41-50	12	2	5	10	16.67
51-60	18	14	35	4	6.67
61-70	12	2	5	10	16.67
>70	4	2	5	2	3.33

The study was conducted on 100 patients, aged between 18-75 years, who underwent any major surgery elective surgery in tertiary care center from June 2014 to October 2014.

Among 100 patients, 40 patients developed complications and 60 had uneventful recovery. Of the 100 patients, the age varied from 18-75 years. The number of patients in the 31 - 40 years group was the highest (34%). And the highest no of complications were noted in the age group of 51-60 years (35%).

Table 3: Postoperative outcomes.

Column1	No of cases	Percentage (%)
Post-operative complications	40	40
no complications	60	60

40 of 100 patients had postoperative complications.

Table 4: Level of serum albumin.

Albumin (gm %)	No of cases	Percentage (%)
< 3.5	62	62
≥ 3.5	38	38
Total	100	100

62% of patients had sr. albumin level < 3.5 gm/dl and 38% had \ge 3.5 gm/dl.

Table 5: Body mass index levels of patients.

BMI (Kg/m2)	No of cases	Percentage (%)
< 18.5	20	20
18.5 - 25	76	76
> 25	4	4
Total	100	100

Maximum number of patients (76%) were having Body mass index in the range of 18.5 -25 kg/m².

Most common complication was found to be wound infection (75%) (Table 6).

Table 6: Postoperative complications.

Complications	No of cases	Percentage (%)
Wound Infection	28	28
Lower respiratory tract infection	4	4
WI + WG	3	3
Pleural effusion	2	2
Post-op CCF	1	1
Mortality	2	2
None	60	60
Total	100	100

Among the 100 total patients studied 36 (36%) were malignant and 64 (64%) were nonmalignant (hernias, infective and others). 40 patients developed complications, 8(20%) were malignant and 32 (80%) were non-malignant (Table 7).

Table 7: Comparison of malignant versus non-malignant diseases with post-operative complications.

	Complications	No complications	Total no
Malignant	8 (20%)	28 (46.67%)	36
Non malignant	32 (80%)	32 (53.33%)	64

40% patients who had complications had mean serum albumin and mean BMI value of 2.98 gm/dl and 21.44 kg/m² respectively and 60% patients who had no mean serum albumin and mean BMI value of 3.50 gm/dl and 20.30 kg/m²with p value for sr albumin and BMI < 0.01 and < 0.05 which were statistically significant (Table 8).

Table 8: Comparison of serum albumin and BMI versus complications and no complications.

Variable	Complication	n	Mean	SD	p- value
BMI	No	60	20.30	2.60	< 0.05
	Yes	40	21.44	2.51	< 0.03
Albumin	No	60	3.50	0.43	< 0.01
	Yes	40	2.98	0.59	

Mean serum albumin was 3.47 gm/dl for malignant diseases and 3.20 gm/dl for non-malignant diseases. Mean Body mass index was 21.18 kg/m2 for malignant and 20.61 kg/m² for non-malignant diseases (Table 9).

Mean serum albumin was 3.11 gm/dl and mean BMI value of 20.53 kg/m² for malignant patients who developed complications but was not statistically significant (Table 10).

Area under the curve for serum albumin was 0.751 with p value < 0.01 which was statistically significant with 79.5% sensitivity and 45.9% specificity for serum albumin 3.5 gm/dl (Table 11).

Area under the curve for BMI was 0.612 with p value of < 0.05 which was statistically significant with sensitivity of 84.6% and specificity of 51.8% for BMI of 25 kg/m^2 (Table 12).

Table 9: Comparison of serum albumin and body mass index distribution Vs malignancy.

Variable	Malignany	N	Mean	SD	p- value
BMI	Yes	36	21.18	2.80	0.3
	No	64	20.61	2.10	0.3
Albumin	Yes	36	3.47	0.39	< 0.05
	No	64	3.20	0.60	< 0.05

Table 10: Comparison of serum albumin and body mass index in malignant patients with complications.

Variable	Malignancy	N	Mean	SD	p- value
DMI	Yes	8	20.53	2.67	- 0.27
BMI	No	31	19.40	2.25	0.27
A 11	Yes	8	3.11	0.15	0.40
Albumin	No	31	2.94	0.65	- 0.48
Complication = Yes					

Table 11: ROC curve table for serum albumin.

Area under the curve : test result variable(s):albumin					
Area	Asymptotic confidence Std. error p-value interval			ence	
			Lower bound	Upper bound	
0.751	0.052	< 0.01	0.648	0.853	
Optimit Values	um cut-off (≤)	Sensitivi	ty	Specificity	
3		56.4%		82.0%	
3.2		66.7%		77.0%	
3.5		79.5%		45.9%	
4		92.3%		19.7%	

Table 12: ROC Curve table for body mass index.

Area under the curve : test result variable(s):BMI						
Area	Std.	p-value	Asymptotic 95% confidence interval			
	error		Lower bound	Upper bound		
0.612	0.06	< 0.05	0.495	0.73		
Optimium cut-off Values (≥)	Sensitivity		Specifici	ty		
30	48.7%		100.0%			
25	84.6%		51.8%			
23.5	97.4%		6.6%			
21.5	100.0%		1.6%			

DISCUSSION

Nutritional assessment is essential for identifying patients who are at an increased risk of developing post-operative complications. A variety of nutritional indices have been found to be valuable in predicting patient outcome.

Reinhardt et al. reviewed the hospital courses of 2060 veterans and found the 30 day mortality in 1551 patients with a normal serum albumin concentration to be 1.7 percent. In contrast, in 509 patients with serum albumin concentrations less than 3.5 g/100 ml, a death rate of 24.6 percent was found. A linear relationship between the degree of hypoalbuminemia and hospital mortality was found, as expressed by:

Percent mortality = 132 - 37.3 (Albumin)

No attempt was made in this study to segregate patients by diagnosis or severity of illness on admission. Similarly, Gibbs et al. reported in 1999 that out of some 61 preoperative patient risk variables, albumin was the strongest predictor of mortality and morbidity for surgery as a whole and within several surgical subspecialty areas. They observed that a decrease in Serum Albumin from concentration greater than 4.6 g/dl to less than 2.1 g/dl (p<0.001) 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. ⁶

Even when patients are segregated by type of surgery or stress, albumin remains a strong predictor of outcome. Rady et al. found preoperative albumin levels to predict the outcome of cardiovascular surgeries. Patients with hypoalbuminemia experienced a higher frequency of infective endocarditis, emergency surgery, transfusion of red blood cells, platelets and fresh frozen plasma, post-

operative placement of intra-aortic balloon pumps, and gastrointestinal dysfunction, as well as significantly longer lengths of hospital stays, compared to patients with normal serum albumin.

Kudsk et al. evaluated the significance of progressively decreasing preoperative serum albumin concentrations in 526 surgical patients who subsequently underwent elective esophageal, gastric, pancreaticoduodenal or colon surgery. They found when all cases were grouped that the incidence of postoperative complications increased progressively as serum albumin concentrations decreased with a group average of 9 percent complications with a serum albumin concentration of 4.25 g/dL up to 54 percent when serum albumin was at 1.75 g/dL. Complication rates in patients undergoing esophageal and pancreatic procedures, however, were significantly more influenced by low serum albumin concentrations.

If the serum concentrations were 2.26 g/dL they observed complications in 73 percent of pancreatic patients and 50 percent of esophageal patients. Those undergoing gastric surgery had a 25 percent complication rate while those undergoing colonic surgery had only a 21 percent incidence of complications. Finally, Lis et al. reported low levels of serum albumin adversely affected survival of patients with breast cancer for all stages. Although these studies show a strong relationship between serum albumin concentrations and outcome, no studies to date have shown improvement in outcome with administration of exogenous albumin or correction of albumin deficits with long-term nutritional support.

In one study preoperative serum albumin level and BMI were used for nutritional assessment. Serum albumin level less than 3 g/dl was associated with increased post-operative morbidity and mortality according to studies done by Leite et al, Golub et al, Brown et al and Mullen et al. According to Foley et al post-operative complication rate was higher when albumin was lower than 2.5 g/dl (p<0.001) According to Beghetto et al it was concluded that serum albumin level was the strongest predictive parameter for death and hospital infection (<3.5g/dl).

Table 13: Significance of serum albumin levels in predicting postoperative outcomes.

Study name	Sr albumin(gm/dl) associated with increased complications	p value
Beghetto et al	< 3.5	< 0.05
Leite et al	< 3	< 0.05
Brown et al	< 3	< 0.05
Engelman et al	< 2.5	< 0.001
Foley et al	< 2.5	< 0.001
This study	< 3	< 0.01

Engelman et al observed that albumin less than 2.5 g/dl (p<0.001) and BMI less than 20kg/m^2 (p<0.005) and greater than 30 kg/m^2 (p<0.005) was associated with increase in post-operative complications.

Mullen et al reported that in the post-operative period being underweight was associated with increased mortality and obese individuals had more wound complication. Azodi concluded that a BMI of 27.5 kg/m^2 or more was associated with more post-operative complication after open appendisectomy in patients with non-perforated appendicitis (p <0.001).

BMI as predictor of postoperative outcomes remains controversial. Reevse et al. observed that patients with BMI $<20~kg/m^2$ had more complications than patients with BMI ≥20 to 25 kg/m² in CABG patients. 10 There is no clear agreement on the association pattern of the influence of BMI on adverse outcomes in CABG patients body mass index classification did not influence major complications or mortality following case-mix adjustment. However, decreasing levels of preoperative serum albumin was inversely related to the adjusted odds of the likelihood of having an adverse outcome. 11

Present study showed that patients with serum albumin less than 3.5 g/dl has more postoperative complications and patients with serum albumin >3.5 g/dl has less postoperative complications which was statistically significant. The study concludes that as the serum albumin level increases the complication rate decreases. BMI was also associated with postoperative outcomes and also statistically significant. Maximum numbers of complications are associated with BMI of 18.5 - 25 kg/m².

Area under the curve for serum albumin is 0.751 with p value < 0.01 which is statistically more sigificant than BMI having area under the curve 0.612 and p value of < 0.05 because as area under the curve increases probability of occurrences increases.

CONCLUSION

Even though BMI was associated with postoperative complications but sr albumin was better prognostic indicator than BMI. Majority of patients had serum albumin < 2.5 gm/dl and more complications were seen with serum albumin < 3.5 gm/dl which was statistically significant (p value 0.01). Serum albumin is a good prognostic indicator because of its ability to detect protein energy malnutrition, which is not necessarily accompanied by lower body weight and may not be clinically recognizable, but is associated with significant increased risk of morbidity and mortality.

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