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Evaluation of Role of Body Mass Index and Serum Albumin in Major Elective Abdominal Surgeries- A Prospective Study.

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ABSTRACT

Background: Malnutrition is one of the important factors associated with adverse post-operative outcome and is reported to be associated with increased incidence of morbidity and mortality in patients undergoing major surgeries. It is not only associated with increased hospital stay but also may increase the cost of treatment considerably. There is a substantial level of incidence to show that malnutrition and hypoalbuminemia are associated with adverse postoperative outcome in patients undergoing major surgeries therefor it is important to undertake a proper nutritional assessment of patients who are posted for surgeries. In cases of major elective surgeries an attempt must be made to correct nutritional status of the patient so as to reduce morbidity, complication rate and mortality in postoperative period. **Methods:** This was a prospective observational study of 148 patients who underwent major elective abdominal surgery in tertiary care medical college situated in an urban area. All patients admitted to surgical wards who underwent major elective abdominal surgeries , such as laparotomy, thoracotomy, craniotomy or any other surgery involving any major organ putting the patient under considerable stress, were included in this study on the basis of a predefined inclusion criteria. Serum Albumin level and BMI were determined in all cases and postoperative complications and its correlation with serum albumin and BMI was determined. Statistical analysis was done using STATA version 10.1. P value less than 0.05 was taken as statistically significant. **Results:** Out of 148 patients there were 85 (57.43%) males and 63 (42.57%) females with a M:F ratio of 1: 0.74. 52 (35.14%) patients underwent laparoscopic surgeries while 96(64.86%) patients underwent open surgeries. 50% and 42.88% patients develop complications when serum albumin levels are less than 3 and between 3.1 to 3.5 in non-malignant group whereas 85% and 44.44% study subjects develop complications when serum albumin levels are less than 3 and 3.1 to 3.5 respectively in malignant group. Complication rate was 72.73% in patients with BMI < 18.5 and 25.71% in patients with BMI >25 in non-malignant group and this was statistically significant ($p<0.05$). Complication rate was 71.43% in patients with BMI < 18.5 and 60% in those with BMI > 25 in malignant group. The difference was statistically significant ($P<0.05$). **Conclusion:** Decreased Serum Albumin and abnormal BMI (underweight as well as overweight individuals) is associated with increased incidence of postoperative complications in patients undergoing major elective surgeries.

Keywords: Serum Albumin Level, Body Mass Index, Elective surgery, Complications.

INTRODUCTION

Malnutrition is reported to be the leading cause of disease burden in developing countries. Despite great advances in surgical sciences and the diagnostic techniques in last three decades, there is only little change in the nutritional status of patients undergoing surgery. The prevalence of protein energy malnutrition in surgical patients is high, ranging from 10% to 54% and in abdominal surgeries is about 30% to 60%. The postoperative period is a stressful as well as a catabolic condition and proper wound healing following surgery requires a proper nutritional status of the individual undergoing surgical treatment. The poor nutritional status increased postoperative morbidity, wound infection, pneumonia and mortality. Recognition of prognostic factors might lead to interventions and increased postoperative surveillance.[1]

The correct assessment of the nutritional status of such patients is crucial since malnourishment is a risk factor for morbidity and mortality. The identification of patients with a high surgical risk is essential in the operative indications and decisions, often limited by the potential morbidities and mortality related to the procedure. For assessment, dietary history, physical examination and lab investigations are used to evaluate nutritional status of patients. BMI is used to assess individual's body weight apart from what is normal or desirable for his /her weight. BMI is calculated as body weight (kg)

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divided by height (m2) Weight alone is not considered as the useful parameter as it is affected by fluid status of the body. Undernutrition as well as obesity are associated with postoperative morbidity and mortality. BMI has association with postoperative infection and death and length of hospital stay.[2]

Various studies have suggested that a serum albumin level less than 3.5 gm/dl may be associated with a poor surgical outcome due to impaired healing as compared to the patients undergoing surgical procedures and have a serum albumin more than 3.5 gm/dl. Serum albumin has been implicated as a strong predictor of outcome, both postoperative morbidity and mortality, in surgical patients. Recent evidence suggests that low serum albumin in elderly patients' correlates with increased rates of readmission, unfavorable disposition and increased overall mortality. Estimation of serum albumin is fairly easy and quick. Moreover it is readily available and clinically significant parameter. Low serum albumin is a sensitive marker of outcome, regardless of whether it is directly related to poor nutritional status or to unidentified complex chronic illness. Patients with abnormal parameter have a markedly increased risk of poor clinical outcome.[3]

A serum albumin level is the most readily available and clinically measured parameter. It is a cost effective test that should be used most frequently as a prognostic tool to detect malnourishment and risk of adverse clinical outcomes.[4] A serum albumin level greater than 3.5g% suggests adequate protection as it confers a protective effect through several biologic mechanisms.[5] Early postoperative albumin drop appeared to reflect the magnitude of surgical trauma and was correlated with adverse clinical outcomes.

We conducted this prospective study to assess the correlation of serum albumin and BMI with postoperative morbidity and mortality in patients undergoing major elective abdominal surgeries.

MATERIALS AND METHODS

This was a prospective observational study of 148 patients who underwent major elective abdominal surgery in tertiary care medical college situated in an urban area. Institutional ethical committee approved the study and an informed written consent was obtained from all the patients. All patients admitted to surgical wards who underwent major elective abdominal surgeries, such as laparotomy, thoracotomy, craniotomy or any other surgery involving any major organ putting the patient under considerable stress, were included in this study on the basis of a predefined inclusion criteria. Any patient having any exclusion criteria was excluded from the study.

A detailed history was noted and thorough clinical examination was done in all the cases. Routine investigations and related investigations for confirmation of diagnosis were done and further plan of operative management was decided after Preanesthetic checkup (PAC). All patients underwent routine pre-surgery investigations including complete blood count, bleeding time, clotting time, prothrombin time, renal function tests, hepatic function tests, HBsAg, HIV and VDRL. Height, weight and BMI were calculated. Serum albumin levels were measured in every patient. In this way, nutritional status in patients undergoing major surgery was noted. The surgery usually was done using general anesthesia by the team of specialist surgeons. The hospital stay of the cases varied from 1 day to 2 weeks depending upon the condition of patient and recovery time. Postoperative observation/follow up was done for 10 days after surgery. Presence of any complications like surgical site infection, burst abdomen, pneumonia, pleural effusion, anastomotic leak was noted. Descriptive statistics like mean and Standard deviation calculated for continuous variable. Frequency and percentage calculated for categorical variables. Association between two categorial variables was analyzed by chi square test.Difference in means of two groups were analyzed by 2 independent sample t test value < 0.05 was considered statistically significant. Data was analyzed in statistical software, STATA, version 10.1. Applying above methodology, observation and results were calculated.

Inclusion criteria

1. Patients who were admitted for major elective surgery under the department of general surgery at tertiary care center.
2. Patients of both sex more than 18 years of age.

Exclusion criteria

1. Patients age < 18 years.
2. Pregnant patients.
3. Patients with severe anemia, diabetes mellitus and jaundice.
4. Chronic renal disease.
5. Chronic liver disease.
6. Immunosuppressive patients (i.e. tuberculosis, HIV, patients on steroids).
7. Patients undergone chemotherapy and radiotherapy.
8. Patients having hypoalbuminemia due to any cause other than malnutrition (for example nephrotic syndrome).

RESULTS

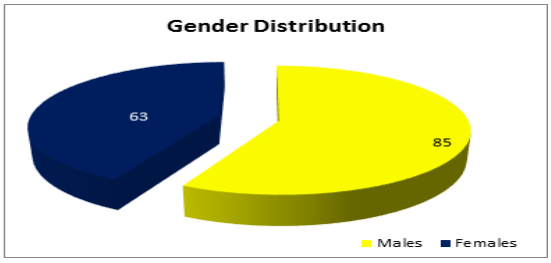

Figure 1: Gender Distribution of the studied cases.

The study consisted of 148 patients who underwent major elective abdominal surgeries in the department of surgery in a tertiary care medical college. Out of 148 patients there were 85 (57.43%) males and 63 (42.57%) females with a M:F ratio of 1: 0.74

A total of 148 patients were operated for major surgeries, 52(35.14%) patients underwent laparoscopic surgeries while 96(64.86%) patients underwent open surgeries.

Table 1: Distribution of study subjects by type of surgery

Type Of surgery	No Of Patients	Percentage
Laparoscopic Surgery	52	35.14 %
Open Surgery	96	64.86 %
Total	148	100 %

The analysis of the age groups of the studied cases showed that the most common age group of the patients was 41-50 years (31.76%) followed by 31-40 yrs and 51-60 yrs (20.95%). Least common age group was more than 70 years in which there were only 2 (1.35%) patients.

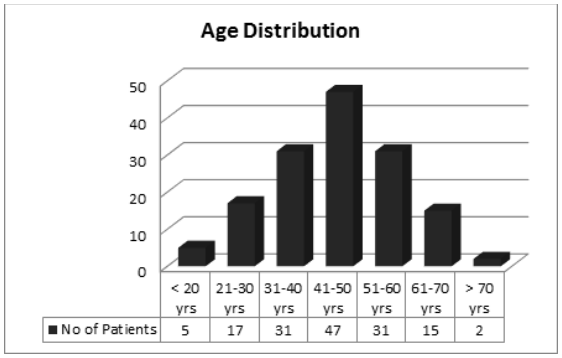

Figure 2: Age distribution of the studied cases.

Mean serum albumin of patients in the study was 3.45g/dl with standard deviation of 0.35g/dl whereas mean BMI of patients in the study was 25.99 +/- 8.25 kg/m2. Mean height and weight of the patients was found to be 1.67 +/- 0.085 and 72.32 +/- 20.66 kg.

Table 2: Descriptive statistics for characteristics of study subjects

Variables	Number Of Patients	Mean	Std Deviation
Age	148	44.8	13
Serum Albumin	148	3.45	0.35
Weight	148	72.32	20.66
Height	148	1.67	0.085
BMI	148	25.99	8.25

The analysis of body mass index of the studied cases showed that majority of the patients (60.81%) had a BMI between 18.6-24.9. BMI above 25 and below 18.5 was seen in 40 (27.03%) and 18 (12.16%) patients respectively.

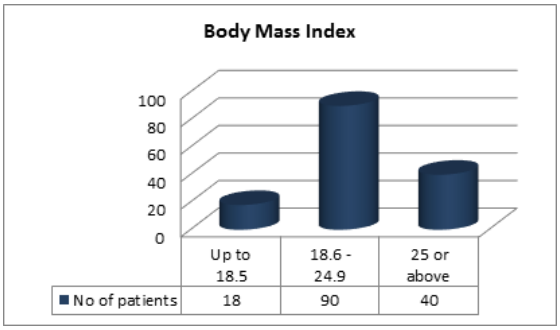

Figure 3: Body mass index of the studied cases.

Maximum no. of patients in the study 76(51.35%) had serum albumin levels above 3.5g/dl. 19 patients(12.84%) had serum albumin levels below 3g/dl.

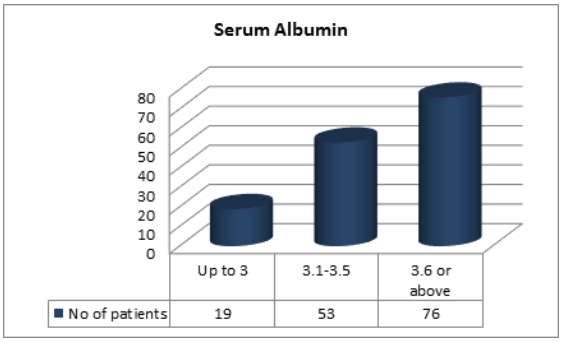

Figure 4: Serum Albumin levels of the studied cases.

Out of the studied cases 57 patients were operated for malignant disease whereas 91 (61.49%) were operated for non-malignant diseases (meckels diverticulum, bariatric surgery, incisional hernia etc.)

Table 3: Distribution of cases on the basis of malignant and non-malignant pathologies.

Malignancy	No.	%
Yes	57	38.51
No	91	61.49
Total	148	100%

There was increasing trend of laparoscopy in younger age groups and higher rates of open surgery were seen in in older population. However, in the age group 41 – 50 years, about 50% patients go for open surgery and rest 50% for laparoscopic surgery. Similarly the analysis of complications by age showed that Complication rate in the age group 41 – 50 years was 21.28%.

According to study, with increasing age postoperative complication rates increased. But the difference was statistically 'not significant' (p> 0.05)

Of the total 148 subjects studied, 105(70.95%) patients had no complications, whereas 42(28.38%) patients had complications and 1 patient died in postoperative e period.

Complications were found in 21.15% of patients undergoing laparoscopy and in 33.33% of patients undergoing open surgery however this was not

statistically significant (p> 0.05). 27 males out of 85(31.76) and 16 females out of 63 (25.4%) had complications. But this was not found to be statistically significant.

Table 4: Type of surgery and Complications Rate in various age groups

Age Groups (in years)		Type Of Surgery			Complications		
		Laparoscopy	Open	Total	Yes	No	Total
Up to 20 yrs	No	4	1	5	1	4	5
	%	80	20	100	20	80	100
21-30 yrs	No	5	12	17	4	13	17
	%	29.41	70.59	100	23.53	76.47	100
31-40 yrs	No	13	18	31	9	22	31
	%	41.94	58.06	100	29.03	70.97	100
41-50 yrs	No	23	24	47	10	37	47
	%	48.94	51.06	100	21.28	78.72	100
51-60 yrs	No	5	26	31	13	18	31
	%	16.13	83.87	100	41.94	58.06	100
61-70 yrs	No	2	13	15	5	10	15
	%	13.33	86.67	100	33.33	66.67	100
Above 70	No	0	2	2	1	1	2
	%	0	100	100	50	50	100
Pearson chi2 = 18.3427, P = 0.005					P = 0.559 (Not significant)		

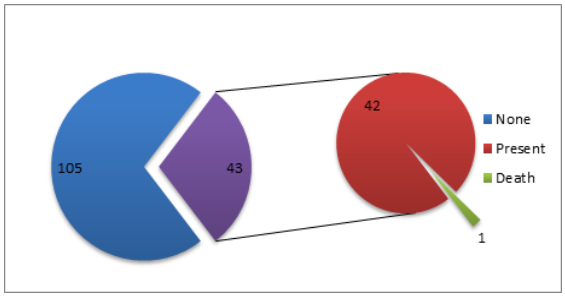

Figure 5: Complications in the studied cases.

The analysis of complication rates in malignant and non-malignant pathologies and serum albumin level showed that 50% and 42.88% patients develop complications when serum albumin levels are less than 3 and between 3.1 to 3.5 in non-malignant group and this is statistically significant(p<0.05). Similarly, 85% and 44.44% study subjects develop complications when serum albumin levels are less than 3 and 3.1 to 3.5 respectively in malignant group and this is statistically significant (p< 0.05).

Table 5: Type of surgery, gender of the patients and complications.

			Complications			Significance
			Yes	No	Total	
Type Of Surgery	Laparoscopy	No	11	41	52	Pearson chi2 = 2.4274, P = 0.119 Not Significant
		%	21.15%	78.85%	100	
	Open	No	32	64	96	
		%	33.33%	66.67%	100	
Gender	Male	No	27	58	85	P=0.399 Not Significant
		%	31.76 %	68.24 %	100	
	Female	No	16	47	63	
		%	25.4%	74.6%	100	

Table 6: Serum Albumin, Malignant and non-malignant etiology and complications rate

Serum Albumin		Non-Malignant Subjects			Malignant Subjects		
		Complications			Complications		
		Yes	No	Total	Yes	No	Total
Level 1 (<=3)	No	6	6	12	6	1	7
	%	50	50	100	85.71	14.29	100
Level 2 (3.1-3.5)	No	15	20	35	8	10	18
	%	42.86	57.14	100	44.44	55.56	100
Level 3 (> 3.5)	No	5	39	44	3	29	32
	%	11.36	88.64	100	9.38	90.63	100
Total	No	26	65	91	17	40	57
	%	28.57	71.43	100	29.82	70.18	100
Pearson chi2 = 28.6665 P= 0.0001					Pearson chi2 = 18.6793 P= 0.001		

Table 7: BMI, Malignant and non-malignant etiology and complications rate

BMI		Non-Malignant Subjects			Malignant Subjects		
		Complications			Complications		
		Yes	No	Total	Yes	No	Total
BMI <= 18.5	No	8	3	11	5	2	7
	%	72.73	27.27	100	71.43	28.57	100
BMI= 18.6-24.9	No	9	36	45	9	36	45
	%	20	80	100	20	80	100

BMI 25 or above	No	9	26	35	3	2	5
	%	25.71	74.29	100	60	40	100
Total	No	26	65	91	17	40	57
	%	28.57	71.43	100	29.82	70.18	100
Pearson chi2 = 12.26 P= 0.002					Pearson chi2 = 10.03 P= 0.007		

Complication rate was 72.73% in patients with BMI < 18.5 and 25.71% in patients with BMI >25 in non-malignant group and this was statistically significant ($p<0.05$). Complication rate was 71.43% in patients with BMI < 18.5 and 60% in those with BMI > 25 in malignant group and this was statistically significant ($p<0.05$).

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. Preoperative serum albumin level has been well documented to have significant association with postoperative infectious and wound healing complications for a wide variety of surgical settings.

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.[6]

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.[7] 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. Even when patients are segregated by type of surgery or stress, albumin remains a strong predictor of outcome. Rady et al.[8] 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 albumin8. Similar complications were reported by et al Bhagvat et al.[9]

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.[10]

Lis CG et al. reported low levels of serum albumin adversely affected survival of patients with breast cancer for all stages.[11] 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. Serum albumin level less than 3 g/dl was associated with increased postoperative morbidity and mortality according to studies done by Leite et al,[12] Golub et al,[13] Brown et al.[14]

In present study Patients with serum albumin less than 3.0 g/dl have more postoperative complications and patients with serum albumin >3.0 g/dl have less postoperative complications which was statistically significant.($p<0.05$). The study concludes that as the serum albumin increases complication rate decreases and this is similar to other studies mentioned above.

Present study showed increased rate of complications was found in patients with BMI< 18kg/m2 and it was found to be statistically significant for both malignant and non-malignant disease. Mullen et all studied impact of Body mass index on perioperative outcomes in patients undergoing major intraabdominal cancer surgeries and concluded that underweight patients have a fivefold increased risk of postoperative mortality, perhaps a consequence of their underlying nutritional status. The authors found that in the post-operative period being underweight was associated with increased mortality and obese individuals had more wound complication.[15] Azodi concluded that a BMI of 27.5 kg/m2 or more was associated with more post-operative complication after open appendicectomy in patients with non-perforated appendicitis ($p <0.001$).[16] According to study done by Thomas et al, overweight patients who underwent abdominal or gynecologic procedures had higher wound infection rates, and patients with the highest and lowest BMIs had significantly higher adjusted total costs.[17] According to study done by Turrentine

FE et al18, the data included 189 533 cases of general and vascular surgical procedures reported in 2005 and 2006 for patients with known overall probabilities of death. Among these, 3245 patients died within 30 days of their surgery (1.7%). Patients with a BMI of less than 23.1 demonstrated a significant increased risk of death, with 40% higher odds compared with patients in the middle range for BMI (26.3 to <29.7). Important differences in the association between BMI and mortality risk occur by type of primary procedure. Similar outcomes were reported by the authors such as Engelman DT et al and Revees BC et al.[19,20]

CONCLUSION

Our study shows that serum albumin is a good indicator of postoperative morbidity and mortality. Decreasing serum albumin level was associated with increased rate of postoperative complications for both malignant and non-malignant disease. Similarly abnormal BMI (underweight and obese individuals) was found to be associated with post-operative complications and this association is found to be statistically significant. Consideration should be given for nutritional supplementation in this group of patients before proceeding for elective surgery to reduce postoperative morbidity and mortality.

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