Panacea Journal of Medical Sciences 2024;14(2):486–491

Content available at: https://www.ipinnovative.com/open-access-journals

Panacea Journal of Medical Sciences

Journal homepage: http://www.pjms.in/

Original Research Article

Role of nutrition in orthopedic trauma and surgery-A prospective study

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ARTICLE INFO

Article history:
Received 30-05-2023
Accepted 06-11-2023
Available online 13-08-2024

Keywords:
Malnutrition
Orthopaedics
Body Mass Index
Transferrin

ABSTRACT

Introduction: Nutrition is an age-old issue of human civilization with approximately 40% undernourished hospitalized inpatients. This has effect on surgery as healthy individuals have better tolerance than malnourished patients.

Objective: This study was designed to evaluate the effect of nutrition on patients who had undergone different types of Orthopedics surgeries.

Material and Methods: This prospective research involved 200 participants who received various orthopedic surgeries at a tertiary care facility. The evaluation of nutritional status involved measuring anthropometric (BMI) and biochemical markers (pre-albumin and transferrin) before, after, and three months after surgery for various age groups, genders, comorbidities like diabetes and hypertension, as well as for complications like urinary tract infections and surgical wound dehiscence. Version 16 of the SPSS statistical analysis program was used for the analysis. Chi Square and the repeated variable ANNOVA test were the tests employed.

Results: 113 patients were followed up prospectively with 4.42% under nourishment rate. Nutritional markers were statistically significant values at pre,post and at 3 months of post op. Diabetes and age more than 40 years were two important parameters affecting nutrition of patients undergoing different orthopedic surgeries. Surgical wound infection was not related to nutritional status of the patient in this study. Pre albumin was found to be a better predictor of nutrition than transferrin.

Conclusion: This study clearly showed that nutrition has tremendous impact on the outcome different orthopedics surgeries. But needs more extensive research with huge sample size to prove the same in a more accurate way.

1. Introduction

Trends in orthopedic surgery have been changed in last decades like no other branch in medicine. The approach to orthopedic diseases have evolved from conservative to more of operative procedures.[1] Everything has its pros and cons, so with operation too. Surgery gives better functional outcome as better anatomical reduction is achieved, but many a time it is associated with blood loss, infection and wound dehiscence and like so on.[2]So, surgery is a stress to body and persons with better nutritional status can sustain better than under nourished people.[3] There comes the role of nutrition which is usually under estimated in modern days

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https://doi.org/10.18231/j.pjms.2024.088

of practice in medicine. About 30 – 60 % of hospitalized patients are under nourished.[4] A well-known fact that healthy people have better resistance to surgical pain, better wound healing and early post-operative rehabilitation. In contrary to it malnourished patients have prolonged rehabilitation, increased predisposition to sickness, anemia, and exhaustion and so on.[5] Poorer outcomes are linked to protein energy malnutrition (PEM), which can be corrected by switching to an anabolic condition.[6]

As mentioned, trauma and surgery put the body under stress because they cause the release of APRs including C-reactive protein, haptoglobin, and complements.[7] APR causes significant catabolism and a gradual loss of body cell mass. Therefore, patients who are malnourished have a lower capacity to withstand this kind of stress than healthy ones. The maintenance of an adequate protein reserve in the body to enable the restoration of physical function and prevent death thus appears to be a delicate balance between the normal metabolic responses to injury that promote recovery and.[8] This interaction is further complicated by the effects of aging. Age is linked to diminished muscle mass, an increased risk of chronic illness, and frequently inadequate nutrition.[9] Hence elderly people thus more susceptible for surgical injury than adult.

It is well known that malnutrition reduces the effectiveness of treatment for patients who are undernourished, but it may be prevented and frequently reversed with nutrition rehabilitation, thus it is important to detect malnutrition in hospitalized patients as soon as feasible. About 40% of hospitalized patients have undernutrition. Anthropometric markers and biochemical markers are two categories for the various nutritional indicators used to detect malnutrition. Body Mass Index (BMI), Mid Upper Arm Circumference (MUAC), and Triceps Skin Fold (TSF) thickness are anthropometric measures.[10] These non-invasive techniques for determining nutritional status are frequently employed. Total Leukocyte Count (TLC), Albumin, Prealbumin (PA), and Transferrin (TF) are frequent biochemical indicators. Prealbumin and transferrin are discovered to be more reliable in determining nutritional status among them.[11]

Therefore, it was intended for this study to investigate how major elective orthopedic surgery affects patients' nutritional status. It focuses on how various nutritional markers react prior to surgery, following surgery, and at follow-up, as well as how long it takes for the nutritional parameters to return to normal. It looked at how nutrition affected issues including urinary tract infections (UTI) and wound healing after surgery. The relationship between diet and factors including age, gender, and co-occurring diseases like diabetes mellitus and hypertension was also examined.

2. Material and Methods

After receiving Institutional Ethical Committee (IEC) approval, this prospective study was carried out in a tertiary care facility in the eastern region of India between February 2019 and 2021 to ascertain the impact of major orthopedic procedures on patients' nutritional condition. Except for spinal injuries and bone malignancies, all patients who received major elective orthopedic surgery were included in the study. A 200-person sample size was estimated.

Anthropometry (BMI) and biochemical markers (Prealbumin and transferrin) were used to assess nutrition. MUAC and TSF were not employed for analysis since they were extremely observer dependent and therefore erroneous. BMI is equal to (weight in kilograms / height in meters). 2. The most precise anthropometric measurements for evaluating nutrition are BMI. BMI values between 19.99 and 24.99 are regarded to be sufficient, 25 to 29.99 are considered to be overweight, 30 to 39.99 are considered to be obese, and more than 40 are considered to be morbidly obese.[12]

Similarly Prealbumin, Transferrin were better biochemical marker than other nutritional markers like albumin, total lymphocyte counts hence they are not analyzed. The biochemical indicators' normal ranges are TLC (1000-3500), albumin (3.4-5.4 g/dl), PA (>20 mg/dl), and TF (>200-400 mg/dl).[13]

Infection of the urinary tract (UTI) is defined as >100,000 colony forming units (CFU)/ml in females, >1000 CFU in males who are not catheterized, and >1000 CFU in patients who are catheterized.[14] If the deep fascia has not been pierced by the infection, the surgical wound infection is considered superficial, and deep infection is indicated when the deep fascia has been breached.[15]

For comparison, patients who are older than 40 and those who are younger than 40 are split into two groups. The retirement age in Western literature is 60. This results from physiologic variations across the populations of our two species.[16] Pre-op, post-op, and three months after surgery, all patients had their BMI, PA, TF, UTI, and surgical site wound infections assessed. Each patient's pro forma was kept up to date with information on their demographics, diagnoses, surgeries, comorbidities, dietary requirements (such as BMI, PA, and TF), and consequences (such as UTI and surgery site wound infections). Version 16 of the SPSS statistical analysis program was used for the analysis. Chi Square and repeated variable ANNOVA tests were the statistical tests that were used.

3. Results

Total number of patients were 199 of which 113 (56.78%) followed up prospectively and were not lost to follow up. Various surgeries that had been taken to account were osteosynthesis 33, amputations 18, unilateral replacements

Table 1: Demographic data

S.No.	Demographic profile	Value		Percentage
1	Total population	199	113 (Actual follow up)	56.78
2	Osteosynthesis	33		29.20
	Amputation	18		15.92
	U/L Replacement	46		40.70
	B/L Replacement	16		14.15
3	Age	16-67 years	Mean 48.8 [>40=86(47.8%)]	Median 49.5
4	Gender	Male	59	52.2%
		Female	54	47.8%
5	Comorbidities	Diabetes	21	18.6%
		Hypertension	19	16.8%
6	Nutritional markers	BMI<20	5	4.42%
		Pre-Albumin <20	4	3.54
		Transferrin < 200	0	0
7	Complications	Superficial infection	11	9.73%
		Deep infection	4	3.53%
		UTI	10	8.84%

Table 2: Results of nutritional markers analysis ofOsteosynthesis group

Groups	Nutritional markers	Value	Statistical significance
Osteosynthesis (33)	BMI<20 BMI>25	2(7.18%) 13 (38.4%)	No association of BMI with wound related infections
	Pre Albumin	Pre/Post/3month(p 0.000)	Significant
		DM(p 0.000)	Significant
		Age(0.004)	Significant
		Wound infection (p 0.077)	Not significant statistically but values were significant
		HTN/Gender	Not significant
	Transferrin	Pre/Post/3 month(p 0.000)	Significant
		Diabetic (p 0.012)	Significant
		Age (p 0.012)	Significant
		Wound infection (p 0.033)	Significant
		Hypertension & Gender	Not significant

Table 3: Results of nutritional markers analysis of Amputation group

Amputation (18)	**BMI <20**	2(11.1%)	**There is no link between BMI and UTI or wound infection**
	BMI>25	2(11.1%)	
	Pre albumin	Pre/Post/3 months (p 0.000)	Significant
		Age, Gender, Diabetes & Hypertension	Not significant
		Wound infection (p 0.147)	Not statistically significant but values significant
	Transferrin	Pre/Post/3 months (p 0.000)	Significant
		Age, Gender, Diabetes & Hypertension	Not significant

Table 4: Comparison of Results of nutritional markers analysis ofOsteosynthesis and amputation group

Osteosynthesis vs. Amputation	Pre albumin	P 0.032	Significant
	Transferrin	P 0.2	Not significant

Table 5: Results of nutritional markers analysis of unilateral replacement group

Unilateral replacement (46)	**BMI<20**	**1(2.1%)**	**There is no link between BMI and UTI or wound infection**
	BMI >25	18(39.13%)	Significant
	Pre albumin	Pre/Post/3 months (p 0.000)	Significant
		Age (p 0.000)	Significant
		Gender, Diabetes & Hypertension	Not significant
	Transferrin	Pre/Post/ 3 months (p 0.000)	Significant
		Age (p 0.000)	Significant
		Gender, Diabetes & Hypertension	Not significant

Table 6: Results of nutritional markers analysis of bilateral replacement group

Bilateral replacement (16)	**BMI <20**	**Nil**	**There is no link between BMI and UTIs or wound infections**
	BMI > 25	5(31.25%)	Significant
	Pre albumin	Pre/Post/ 3 months (p 0.000)	Significant
		Diabetes (p 0.006)	Significant
		Gender, Age & Hypertension	Not significant
	Transferrin	Pre/Post/ 3 months (p 0.000)	Significant
		Gender, Age, DM, & HT	Not significant

Table 7: Comparison of results of nutritional markers analysis of unilateral vs. Bilateral replacement group

Unilateral Vs. Bilateral replacement groups	**Pre albumin**	**P 0.016**	**Significant**
	Transferrin	P 0.077	Not significant

46 [THR 31, TKR 15], bilateral replacement 16 [TKR 11, THR 5]. As bilateral cases were small in numbers hence analyzedcombined under heading of bilateral replacement. Demographic data of 113 patients at 3 months of follow up were, age group was between 16 to 67 years with average age of 48.8 years and median age of 49.5 years with 86 (76.1%) patients over 40 years. Males 59 (52.2%) were slightly more affected than female 54 (47.8 %). 21 (18.6%) were Diabetic and 19 (16.8%) were Hypertensive. There were only 5 (4.42%) individuals with BMI 20 or undernutrition. In 4 of these 5 patients, the prealbumin level was less than 20, and none of the patients had a transferrin level below 200. 38 (33.62%) individuals had a BMI over 25 or were overweight. Separate analyses of PA and TF were conducted for each surgery group. Surgery-related wound complications affected 15 patients (13.3%), of which 11 were superficial and 4 were deep. 10 patents (8.8%) have UTI. [Table 1]

Analysis of each surgery group revealed 33 patients in the osteosynthesis group, of whom 2 (7.1%) had inadequate nutrition. There was no link between BMI and infection associated to wounds. Pre albumin levels during preoperative, postoperative, and 3-month follow-up indicated a significant difference between all three values (p 0.000). The pattern of values in diabetics and for age groups differed significantly (0.001 and 0.004, respectively). Although the difference in the pattern of values among the patients with wound infection was significant (p 0.077), the difference was not statistically significant. Gender and hypertension did not indicate any appreciable differences in the pattern of values. In the osteosynthesis group, the transferrin value at baseline, one month after surgery, and three months later revealed a significant change between all three values (p 0.000). The pattern of values for TF in diabetics differed significantly (p 0.000), but not for age groups (p 0.012), wound infections (p 0.033), or hypertension. [Table 2]

Only 2 (11.1%) and 2 (11.15) of the 18 amputation patients who had follow-up had malnutrition, and there was no correlation between BMI and the frequency of UTI and wound infection. Pre-albumin values for the amputation group revealed a significant difference (p 0.000) before surgery, after surgery, and at the 3-month follow-up. The pattern of pre albumin levels between the variables for comparison for age group, gender, diabetes, and hypertension did not show any statistically significant differences. [Table 3]

Although there was a noticeable change in the pattern of values in patients with wound infections, this difference was not statistically significant (p 0.147). The TF values showed a significant difference between all three values at pre-op, post-op, and follow-up (p 0.000). The pattern of TF value differences amongst the comparative factors (age, gender, DM, and HT) did not show any statistically significant differences. Prealbumin value was statistically significant (0.032) when comparing the osteosynthesis

group to the amputation group, however transferrin value was not statistically significant (p = 0.2). [Table 4]

Only 1 (2.1%) and 18 (39.13%) of the 46 patients with unilateral knee or hip replacements had a BMI 20, and neither UTI nor surgical site wound infection were associated with BMI. Pre-albumin levels during pre-op, post-op, and follow-up all differed significantly from one another (p 0.000). Except for when comparing age groups (p 0.000), there was no statistically significant difference in the pattern of pre albumin levels between the factors for comparison groups (gender, DM, and HT). With the exception of the age group (p 0.000), no other variables (gender, DM, or HTN) exhibited a statistically significant difference. The TF value shown a significant difference between all three values. [Table 5]

There was no correlation between BMI and UTI or wound healing in the 16 bilateral replacement group patients with BMI 20 and >25 in 5 (31.25%). Pre-op, post-op, and follow-up prealbumin values differed statistically significantly (p 0.000). Except for DM (p 0.006), no statistically significant difference was seen for age groups, HT, or gender. The differences in the serum TF values from baseline to follow-up were statistically significant (p 0.000). However, there was no statistically significant difference found in the distribution of TF values for the comparison variables (age, gender, DM, and HT). [Table 6]

When pre albumin values were compared between the unilateral replacement group and the bilateral groups, there was a significant difference (p 0.016) between the two groups. The difference in transferrin values was not statistically significant (p = 0.077). [Table 7]

4. Discussion

The preoperative, postoperative, and 3-month follow-up values for the biochemical markers prealbumin and transferrin in all patient groups differed significantly according to the study's findings. This suggests that, as stated in numerous other research, the trauma of hospitalization, surgery, and anesthesia does impair the nutritional condition of the patients.

among this study, the incidence of malnutrition was determined to be 4.42%, however other literature quotes place the rate at almost 40% among patients with orthopedic conditions. This can be as a result of the study's patient selection criteria. Patients who underwent major orthopedic procedures on an elective basis were included, while patients with spinal injuries, tumors, and emergency trauma surgeries were excluded from the study. Furthermore, 33.62% of these obese people had a BMI over 25. The majority of the orthopedic research on malnutrition focuses on trauma, particularly hip trauma in senior patients, which could account for the stark disparity in the incidence of malnutrition between this study and the literature.[17]

Even while the biochemical markers are significantly better at follow-up than at post-op levels, they still have not returned to pre-op levels at three months. This suggests that more monitoring of these individuals is necessary to determine when the parameters genuinely return to their pre-operative levels.

The two main variables that significantly impacted the nutritional recovery of patients undergoing major orthopedic surgery in this study were diabetes and age greater than 40.[18] Patients who underwent osteosynthesis behaved very differently from those who underwent amputations, which may be related to the impact of infections, frequently chronic diseases like tuberculosis, on the nutritional condition and metrics that were linked to the amputation group.[19]The behavior of the unilateral replacement group as a whole differs from that of their biochemical counterparts. Between patients with unilateral and bilateral TKR, as well as between the unilateral THR and TKR groups, there was no variation in the behavior of the nutritional indicators. Overweight patients undergoing bilateral TKR were at risk for post-operative infections. Hypertension became significant in the unilateral THR group as a factor impacting the level of nutritional indicators, which may be the cause of the associated blood loss during these operations.

Although the literature suggests a positive link between nutrition and wound infection, our study's low rate of undernutrition—4.42%—may be to blame for this finding.[20] Even though studies have established the efficiency of transferrin as a nutritional marker, pre albumin was shown to be a better nutritional marker in our study than transferrin. This suggests that pre albumin may be a better marker for the nutritional assessment.[21]

5. Conclusion

The results of this study conclusively demonstrated that diabetes mellitus and age greater than 40 years are the two key patient-related factors that influence the nutritional health of patients undergoing major orthopedic surgery. The pre albumin and transferrin values at pre op, post op, and at three months of follow up were compared in this study, which also established pre albumin as a better biochemical marker than transferrin to assess the nutritional status of the hospitalized patients undergoing major orthopedic surgery. The study's main limitation was its small sample size, which led to a 40% dropout rate in follow-up cases. As a result, the incidence of malnutrition was lower in this study—4.42% as opposed to 40% in the literature. Longer follow-up was required to predict the time needed for biochemical parameters to normalize following surgery since the short follow-up period of three months prevented the biochemical parameters from returning to their pre-surgery levels. Only elective cases, whose nutritional state was roughly normal, were taken into consideration; trauma and tumor patients

were excluded since they were more likely to suffer from malnutrition.

6. Source of Funding

None.

7. Conflict of Interest

None.

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Cite this article: Pradhan CS, Sethi GC, Ray S, Samal BP, Nanda DP, Purty VK. Role of nutrition in orthopedic trauma and surgery-A prospective study. *Panacea J Med Sci* 2024;14(2):486-491.