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ASSESSMENT OF NUTRITIONAL STATE AND BONE FUNCTION TESTS IN PATIENTS PRESENTED WITH ACUTE FRACTURES OF PROXIMAL FEMUR

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ABSTRACT

Background: Proximal femoral fractures in elderly patients are common cause of functional disability and mortality. Minor trauma causing fracture in those patients suggests that they are secondary to primary skeletal pathology or diseased bone. **Objective:** The aim of the study to find out the incidence of osteomalacia and malnutrition in elderly patients presented with acute proximal femoral fractures to improve treatment outcome. **Patient and Methods:** This is a case control study. carried out in orthopedic unit in Al-Jumhoori Teaching Hospital from November 2019 to September 2020. The total number of patients were (51) patients. patients with ages over (60) years with acute proximal femoral fractures that occur with simple fall or with simple traumas were included in this study while Patients with history of orthopedic, major trauma, medical or surgical disease that may affect study results. Was excluded from this study Parameters for bone function test were (serum calcium, serum phosphorus, serum alkaline phosphatase and blood urea), for nutritional state (serum albumin and total lymphocyte count). Control group was selected from normal people with the same number, age group and sex. **Statistical Analysis:** .H0 μ 1(control group) = μ 2(test group), H1 μ 1≠ μ2 Sample size=51, z-test and X2 test (chi-squire). **Results:** The study showed that, there is statistically significant low serum calcium and phosphorus, and osteomalacia is statistically significant in patients presented with recent fracture proximal femur, Low serum albumin, total lymphocyte count and malnutrition were also statistically significant in those patients. No statistical correlation between osteomalacia and malnutrition in patients and there is no significant sex differences in malnutrition and osteomalacia. **Conclusion:** Malnutrition and osteomalacia are common in elderly patients recently presented with proximal femoral fractures and need special care to reduce incidence of these conditions, to improve treatment and to reduce their complications.

KEYWORDS: malnutrition, osteomalacia, proximal femoral fractures.

1. INTRODUCTION

The fractures of proximal femur are common and important cause of functional loss and mortality.[1,2,3] The history of minor trauma associated with most femoral neck fractures further suggest that these fractures are secondary to primary skeletal pathology[4], Elderly patients with hip fracture are often malnourished on admission when compared to the age-matched general population.[5] The poor nutritional status is known to be both a common causative factor of proximal femoral fractures and a predictor of excess mortality following surgical intervention, malnutrition adversely affects immunity, healing of fractures, wounds and increases the incidence of post-operative infection[6,7], serum proteins such as albumin and prealbumin (i.e., transthyretin) have been widely used by physicians to determine patients' nutritional status. Other markers that have been studied include retinol-binding protein (RBP), transferrin, total cholesterol and indicators of inflammation such as C-reactive protein (CRP) and total lymphocyte count (TLC).[6] TLC is popular serum marker useful for determining nutritional status. Levels of TLC have been shown to vary with the degree of malnutrition. Levels < 1500/mm^3 correlate well with malnutrition, and those < 900/mm^3 reflect severe malnutrition.[6] Nutritional status assessment by Serum albumin and total lymphocyte count (TLC) are two of the most important blood markers for nutritional status and have been recognized as prognostic factors of hip fractures[6,7], malnutrition was identified by serum albumin of less than 3.4 g/dl or a

total lymphocyte count of less than 1500 cell/ cubic mm It is widely recognized that patients with low serum albumin levels have difficulty with wound healing, survival rate in elderly patients with hip fractures also well correlated with adequate serum albumin level.[6,7] The hypocalcaemia and hypophosphatemia that accompany vitamin D deficiency result in impaired mineralization of bone matrix proteins, a condition known as osteomalacia. Osteomalacia is also a feature of longstanding hypophosphatemia, which may result from renal phosphate wasting, or chronic use of etidronate or phosphate- binding antacids. This hypomineralized matrix is biomechanically inferior to normal bone; as a result, patients with osteomalacia are prone to bowing of weight-bearing extremities and skeletal fractures. Vitamin D and calcium supplementation have been shown to decrease the incidence of hip fracture among ambulatory nursing home elderly people, suggesting that under mineralization of bone contributes significantly to morbidity in the elderly.[6,7] The'calcium phosphate product' (derived by multiplying calcium and phosphorus levels expressed in mmol/L), normally about 3, is diminished in osteomalacia, and values of less than (2.4) are diagnostic (Ca x P = < 2.4 mmol/L).[7,8,9] Patients with chronic renal failure and lowered glomerular filtration rate are liable to develop diffuse bone changes which resemble those of other conditions that affect bone formation and mineralization. Thus, the dominant picture may be that of secondary hyperparathyroidism [due to phosphate retention, hypocalcaemia and diminished production of 1,25-(OH)2D], osteoporosis, osteomalacia or in advanced cases a combination of these.[7] Renal abnormalities usually precede the bone changes by several years, biochemical features are low serum calcium, high serum phosphate and elevated alkaline phosphatase levels.[7] Anderson and Coworkers reported osteomalacia in 14% of femoral neck fractures of unselected elderly women. Chalmers and associates revealed that 12% of patients with osteomalacia initially presented with fractures proximal femur.[8,9,10] Hofeldt suggest that the decrease in calcium absorption seen in elderly play a major role in the development of osteopenia, in addition, femoral neck fractures are much more common in elderly women.[11,12] Femoral neck fractures or fractures of proximal femur in general are uncommon in young age group with normal bone, also uncommon in older patients of races in which osteoporosis are uncommon. such as black American.[13,14,15] Calcium is the most important nutrient for skeletal health throughout life and 99% of body's calcium is present in the bone. Calcium is required to achieved peak bone mass in the first three decades of life due to minimize the rate of bone mineral loss thereafter.[16,17] The most rapid period of bone loss for women is in the initial post-menopausal years and for men and women bone loss continues from midlife onwards, end result of this period change in bone minerals.[18,19]

PATIENTS AND METHODS

The study is case control study. carried out in orthopedic unit in Al-Jumhoori Teaching Hospital from November 2019 to September 2020. The total number of patients were 51 patients. patients include ages over 60 years with acute proximal femoral fractures that occur with simple fall or with simple traumas. were included in this study. The overall number of elderly patients presented to our department with proximal femoral fractures at that period was 93 patients. 42 Patients were excluded from the study because they had long history of fractures or had medical or surgical disease that may change their bone function tests and nutritional status laboratory results. The blood samples were taken within 48 -72 hours after sustaining the fractures, Parameters for bone function test were included, serum calcium [sample taken without tourniquet], serum phosphorus, serum alkaline phosphatase and blood urea, and for nutritional state, serum albumin and total lymphocyte count. The measurements were carried out in the laboratory of Al-Jumhoori Teaching Hospital. All these investigations were done to take an idea about the nutritional state and the presence or absence of osteomalacia in elderly patients recently presented with proximal femoral fractures. The outcome measures from normal people we selected 51 persons with same sex and age group as control group. The control group had no frank medical or surgical problem and no orthopedic problem. Ethical consideration Approval for the study was taken from Nineveh Directorate of health (DOH). Verbal consent was taken from each patient and from control group before participation in the study. The statistical package for social science (SPSS) version (18) was used to calculate the results. Two sample z-tests to compare between two means and X^2 test (chi-squire) or fisher exact test used for qualitative analysis. The (p value) regarded significant when less than or equal to (0.05). H0 μ 1(control group) = μ 2(test group), H1 μ 1≠ μ2 Sample size=51, z-test and X2 test (chi-squire).

RESULTS

The mean age of the patients that included in this study were (69.405) years, table (1).

Table 1: Age Incidence of patients.

Group	Mean	Number	Std. deviation
Patients	69.405	51	9.21
Control	71.724	51	11.68
Total	70.564	102	10.445

Sex Distribution of patients. There were 29 (56%) females & 22 (43%) males with ratio of (1.3: 1) female to male table (2).

Table 2: Sex Distribution of patients.

Sex	Number	%
Male	22	43.137
Female	29	56.863
Total	51	100

Means of patients and control

The mean of serum calcium, phosphorus, total lymphocytes count, and albumin are statistically Significant lower in patients than control group (P < 0.01) Table (3). The mean of serum alkaline phosphatase is higher in patients but there is no significant statistical reduction (P < 0.05) Table (3). There is no significant statistical difference in mean of blood urea between patients and control (P <.0.05) Table (3).

Table 3: Two sample Z test for means of patient and control.

Parameters Means (Nr. Range)	**Patients Number =51**	**Control Number =51**	**P* value**
Serum Ca 2.2- 2.7 mmol/L	2.2 ± 0.2 mmol/L	3.1 ± 0.2 mmol/L	Significant
Serum P 1.12-1.45 mmol/L	0.9 ± 0.3 mmol/L	1.1 ± 0.2 mmol/L	Significant
Serum alkaline phosphatase 20-140 IU/L	89.1 ± 24.8 U/L	76.8 ± 16.5 U/L	Not significant
Blood urea 2.5-7.1 mmol/L	6.2 ± 3.2 mmol/L	6.3 ±3.4 mmol/L	Not significant
Total lymphocyte Count 1-4.8 cell/mm	1.1±0.3 cell/mm	1.8 ±0.2cell/mm	Significant
Serum albumen 35-50 g/L	34.4 ± 4.2 g/L	36.9 ±5.4 g/L	Significant

*Data analyzed by two sample Z test (P<0.05) considered significant.

Comparison of serum Ca between patients and control.

Serum calcium reduced in 16 (31.37%) patients compared with 3 (5.8%) in control group, (P < 0.01), so there is significant statistical reduction, Table (4), Fig (1).

Table 4: Comparison of serum Ca between patients and control.

	Control		**Cases**		**p-value**	**Significant**
	No.	**%**	**No.**	**%**		
Low Ca	3	5.8	16	31.37	<0.01	Significant
Normal Ca	48	94.2	35	68.63		

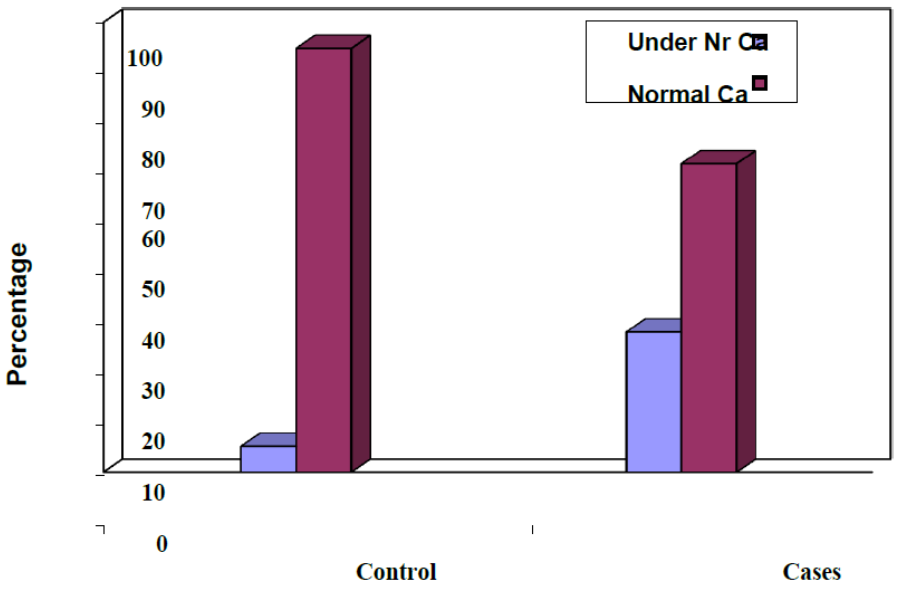

Fig. 1: Comparison of serum Ca in patients with recently fractures proximal femur with control group.

Comparison of serum phosphorus between patients and control.

Serum phosphorus reduced in 11(21.56%) patients compare with 2(3.9%) in control group, (P < 0.01), so there is significant statistical reduction, Table (5), Fig (2).

Table 5: Comparison of serum phosphorus between patients and control.

	Control		Cases		P - value	Significant
	No.	%	No.	%		
Low P	2	3.9	11	21.56	<0.01	Significant
Normal P	49	96.1	40	78.44		

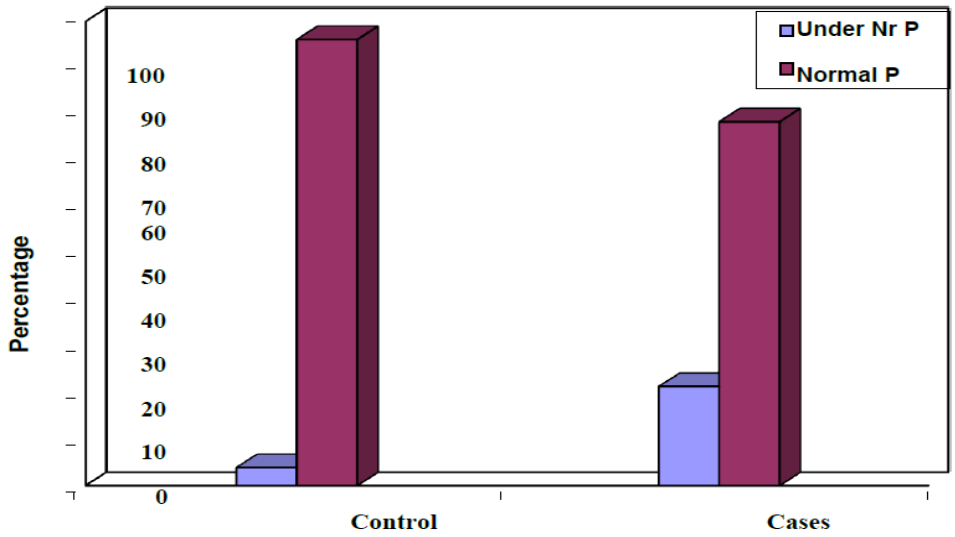

Fig. 2: Comparison of serum Phosphorus in patients with control group.

Comparison of Osteomalacia between patients and control. Osteomalacia (serum calcium x P = < 2.4 mmol/L) found in 17(33.33%) patients 11 female and 6 male compare with 5 (9.8%) in control group. (P < 0.01) So osteomalacia statistically significant in patients in compare with control group, Table (6), Fig (3)

Table 6: Comparison of Osteomalacia between patients and control.

	Control		Cases		p-value	Significant
	No.	%	No.	%		
Osteomalacia (Ca x P <2.4 mmol/L)	5	9.8	17	33.33	<0.01	Significant
Normal	46	90.2	34	66.67		

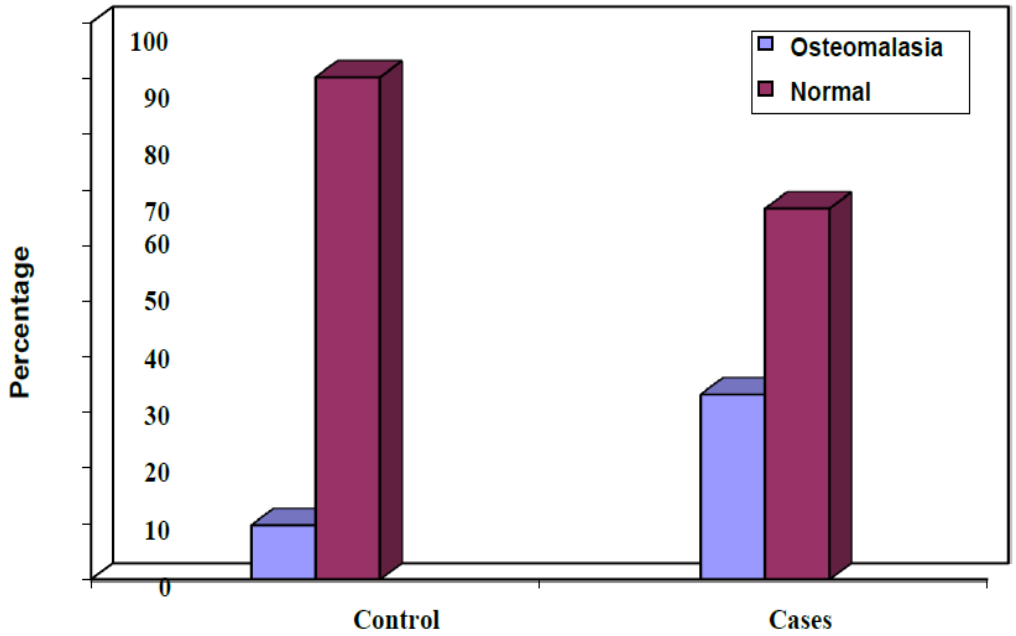

Fig. 3: Comparison of osteomalacia in patients compared with control group.

Comparison of serum Albumin between patients and control. Patients with fractures proximal femur presented recently showed statistically significant reduction in serum albumin 18 (35.3%) patients compare with 6 (11.7%) in control group (P < 0.01) Table (7), Fig (4).

Table 7: Comparison of serum Albumin between patients and control.

	Control		Cases		p-value	Significant
	No.	%	No.	%		
Low Albumin	6	11.7	18	35.3	<0.01	Significant
Normal	45	88.3	33	64.7		

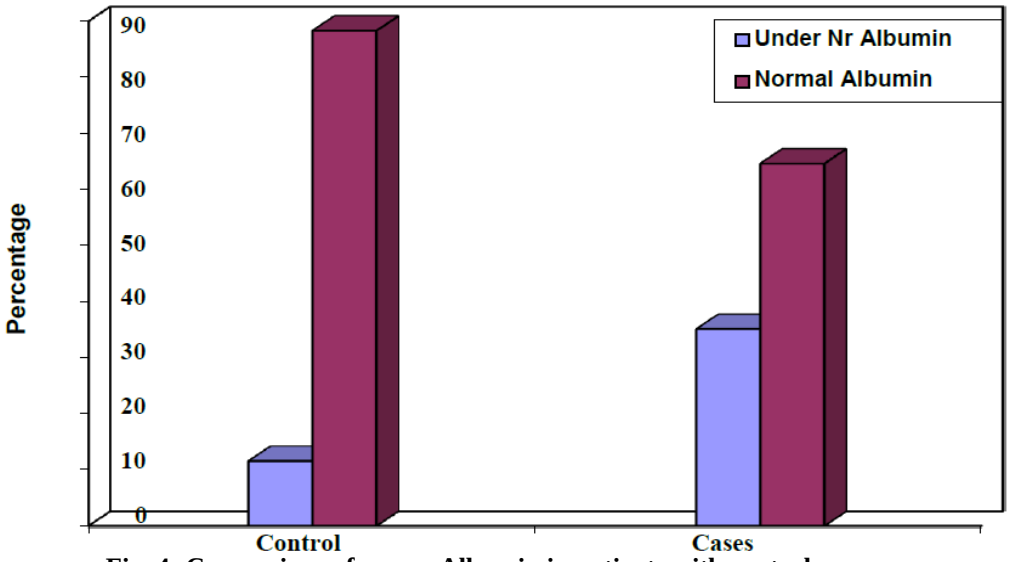

Fig. 4: Comparison of serum Albumin in patients with control group.

Comparison of TLC between patients and control.
Total lymphocyte count reduced in 15(29.4%) patients compared with 3(5.8%) control group, (P > 0.01) so reduction in total lymphocyte count statistically significant, Table (8), Fig (5).

Table 8: Comparison of TLC between patients and control.

	Control		Cases		p-value	Significant
	No.	%	No.	%		
Low TLC	3	5.8	15	29.4	> 0.01	Significant
Normal	48	94.2	36	70.6		

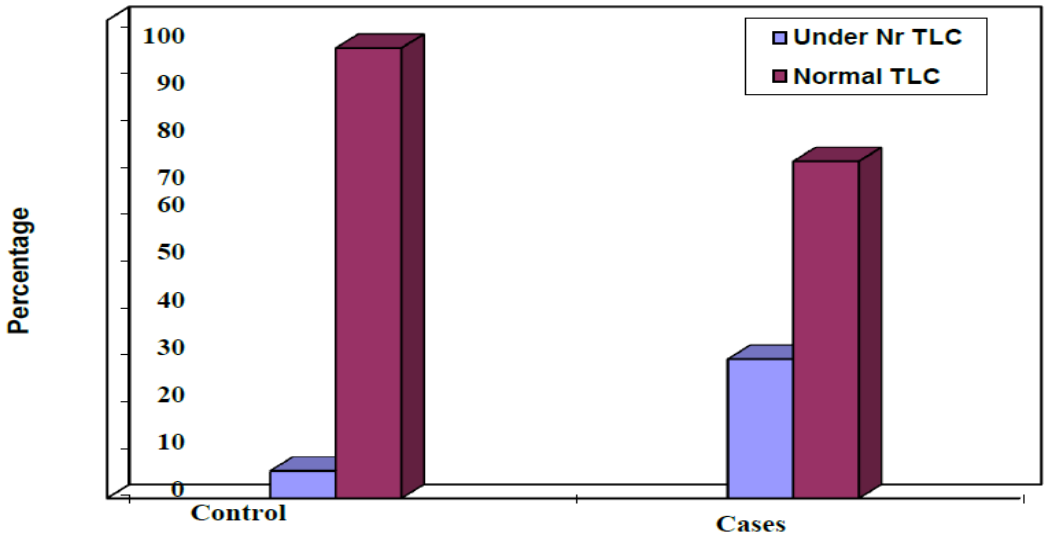

Fig. 5: Comparison of TLC in patients with control group.

Comparison of malnutrition between patients and control.

When both parameters of malnutrition are taken (serum albumin and total lymphocyte count), it is reduced in 20(39.2%) patients compared with 7 (13.7%) in a control group (P < 0.01) so malnutrition is statistically significant in patients, Table (9), Fig (6).

Table (9). Comparison of malnutrition between patients and control.

	Control		Cases		p-value	Significant
	No.	%	No.	%		
TLC and albumin (Malnutrition)	7	13.7	20	39.2	<0.001	Significant
Normal	44	86.3	31	60.8		

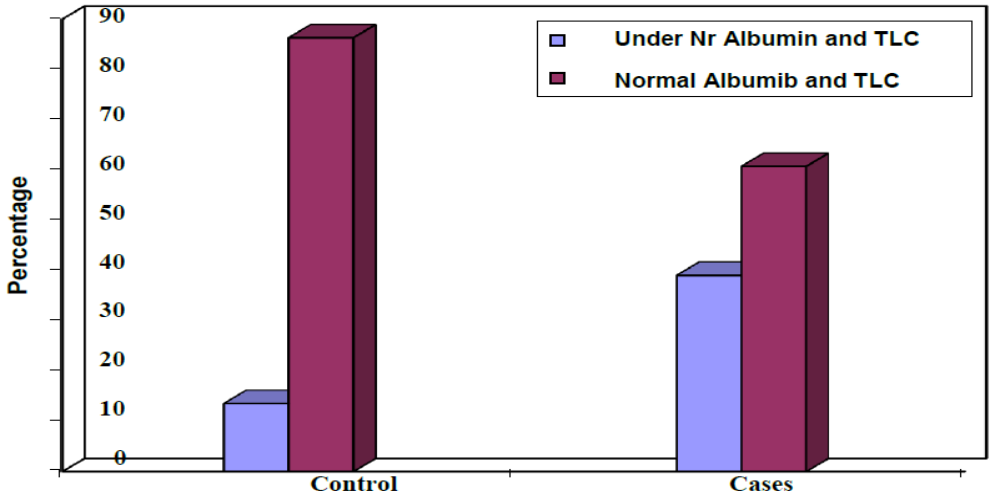

Fig. 6: Comparison of malnutrition in patients with control group.

Correlation between osteomalacia and malnutrition in patients. 9(52.9%) patients with osteomalacia have also malnutrition state, 8(47.1%) with Osteomalacia but no malnutrition, 11(32.35%) with no osteomalacia but with malnutrition and 23(67.65%) with on osteomalacia nor malnutrition (P > 0.05), so there is no statistically significant correlation between osteomalacia and malnutrition in patients, Table (10), Fig (7).

Table 10: Correlation between osteomalacia and malnutrition in patients.

	Osteomalacia (n=17)		Non-osteomalacia (n=34)		p-value	Significant
	No.	%	No.	%		
TLC and albumin (Malnutrition)	9	52.9	11	32.35	>0.05	Not Significant
Normal	8	47.1	23	67.65		

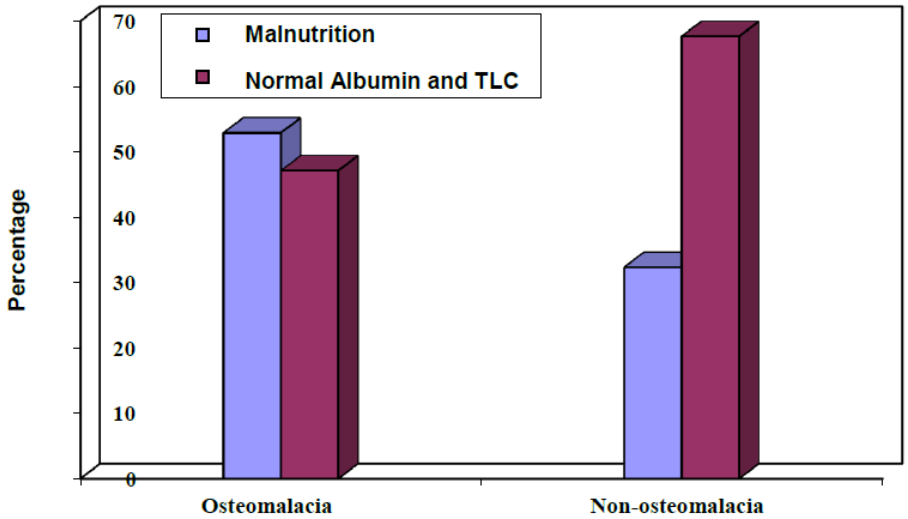

Fig. 7: Correlation between osteomalacia and malnutrition.

Sex distribution of osteomalacia

Osteomalacia presented in 17 (33.33%) patients presented with recently fractures proximal femur 11 (64.7%) of them female and 6 (35.3%) males, (p>0.05) so there is no statistically significant sex distribution in osteomalacia, Fig (8).

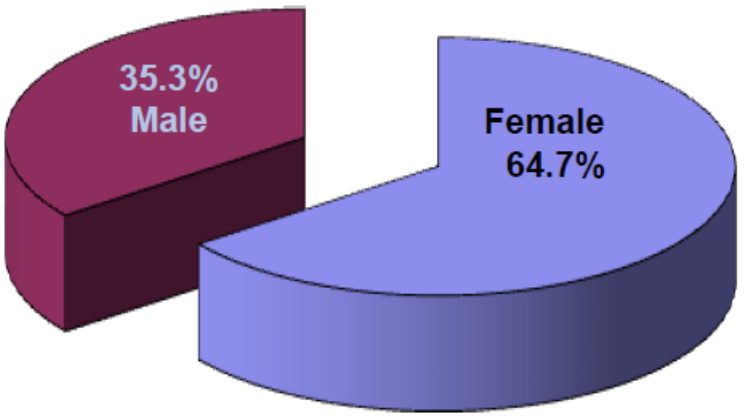

Fig. 8: Sex distribution of osteomalacia.

Sex distribution of malnutrition presented in 20 (39.2%) patients, 12 (60%) of them female, 8 (40%) males, (p>0.05) so there is no statistically significant sex distribution in malnutrition, Fig (9).

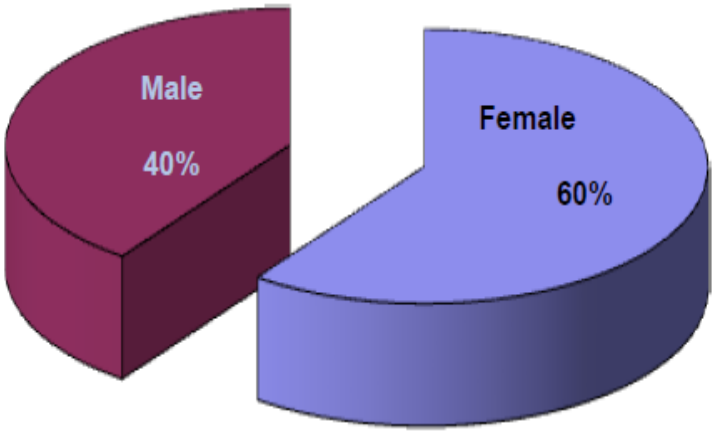

Fig. 9: Sex distribution of malnutrition.

DISCUSSION

Fractures of the proximal femur can be elapse from traumas due to low energy such as fall. The greatest increase in the incidence of these fractures in the age group about 65 years of age is due mainly to the installation of the osteomalacia and malnutrition as well as to the largest incidence of fall in this age group.[20]

Serum calcium reduced in 16(31.37%) patients compare with 3(5.8%) in control group. Serum phosphorus reduced in 11(21.56%) patients compare with 2(3.9%) in control group. So, there is significant statistical reduction (P < 0.01) in both serum calcium and phosphorus. Osteomalacia (serum calcium x P = < 2.4 m□/L) found in 17 (33.33%) patients 11 female and 6 male compare with 5 (9.8%) in control group. So osteomalacia statistically significant in patients with recently fractures proximal femur compare with control group (P < 0.01). So, bone function tests showed low serum calcium, low serum phosphorus and the osteomalacia were common in patients presented recently with fracture proximal femur. This may be due to vitamin $_D$ deficiency due to lack of sun exposure or low socioeconomic reason or vitamin $_D$ malabsorption, liver disease, renal disease or due to phosphate depletion due to any cause.

Chalmers and Hodkinson were unable to demonstrate an increased incidence of osteomalacia in patients with fractures femoral neck. However, they did show a high incidence of low serum calcium and phosphorus in their analysis.[21,22,23] Wilton reported a 2% incidence of iliac crest biopsy proven osteomalacia in patients with femoral neck fractures.[24] In our study patients with acute fractures of proximal femur showed significant reduction in serum albumin 18(35.3%) patients compare with 6(11.7%) in control group (P < 0.01). Total lymphocyte count reduced in 15(29.4%) patients compared with 3(5.8%) control group, so reduction in total lymphocyte count statistically significant (P > 0.01). When both parameters of malnutrition are taken (serum

albumin and total lymphocyte count) in 20(39.2%) patients compare with 7(13.7%) in a control group found to be statistically significant (P < 0.01). So, malnutrition statistically significant in patients with recently fractures proximal femur compare with control group. Patients for poor outcome after hip fractures can be identified using relatively inexpensive laboratory test such as serum albumin and total lymphocyte count.[25,26] So, in addition to calcium and phosphorus, protein, malnutrition state play an important role in bone health at least in elderly frail patients.[27] Fractures of proximal femur should be considered fractures through pathologic bone secondary to either osteomalacia or malnutrition state and fracture of proximal femur related to other factor in addition to degree of osteoporosis.[28,29,30,31,32] In severe malnutrition state bone are extremely fragile the force required to produce a fracture may be minimal not much more than normal daily living activity.[33,34] With age there is decrease in the muscle strength, balance and other factors that increase the risk of fractures.[35,36,37] In our study there is 9 (52.9%) patients with osteomalacia have also malnutrition state, 8 (47.1%) with Osteomalacia but no malnutrition, 11(32.35%) with no osteomalacia but with malnutrition and 23(67.65%) with on osteomalacia nor malnutrition (P > 0.05), so There is no statistically significant correlation between osteomalacia and malnutrition in elderly patients with recent proximal femoral fractures .Although osteomalacia may be underlying cause in some cause the more commonly held concept is that femoral neck fractures are preceeded by the development of osteoporosis related malnutrition (38.39.40.). Osteomalacia presented in 17 (33.33%) patients presented with recently fractures proximal femur 11 (64.7%) of them female and 6 (35.3%) male, (p>0.05) so there is no statistically significant sex distribution in osteomalacia.Malnutrition presented in 20 (39.2%) patients, 12 (60%) of them female, 8 (40%) male, (p>0.05) so there is no statistically significant sex distribution in malnutrition.

Hilton and Smith reported that the rate of occurrence of hip fractures is high in white women followed by white men, black women and finally black men.[41,42]

Calcium intake can be increased by increasing dairy food intake and nondairy calcium supplements bearing in mind the cofactors which affect calcium absorption, metabolism and excretion.[43,44] Appropriate level for age should be encouraged and nutritional information should be balance.[45] Active calcium absorption regulated by vitamin D is decreased in older people so both calcium and vitamin D intake need to increase in older population.[46] Using of exercise program in the prevention of hip fracture combined with other intervention Such as home assessment dietary change, use of hip protectors, education, and medication change.[47] Green studed preoperative nutritional status in total joint arthroplasty, he found relationship between malnutrition and post-operative wound complication. The records of (217) elderly patients who underwent hip surgery were reviewed for preoperative and post-operative nutritional status. (57) Patients had a lymphocyte count of less than1.500 cell/mm^3, (4) patients of an albumin level of less than 3.5 g/dl and (2) patients had both, giving a 26.3% incidence of pre-operative nutritional depletion.[48]

CONCLUSIONS AND RECOMMENDATIONS

We conclude that malnutrition and osteomalacia are statistically significant in patients presented with recently fractures of proximal femur. The use of biochemical markers such as (serum calcium, serum phosphorus, serum albumin, total lymphocyte count) in monitoring and adjusting the treatment being given to elderly patients presented with acute fractures of proximal femur. The need for programs that prevent malnutrition and osteomalacia in old age group through dietary and pharmacological agents to reduce the risk of proximal femoral fractures and its complications.

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