

Frequency of Osteomalacia in elderly patients with Hip Fractures

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Abstract

Objective: To determine the frequency of Osteomalacia and biochemical abnormalities in patients with hip fracture who presented at our Institution.

Methods: All patients with operatively treated hip fractures (Aga Khan University Hospital, Karachi from June 1996 to June 2001) were included. The total number of patients was 168 with 59 males and 109 females. Eighty nine patients presented with intracapsular hip fracture and 79 had Intertrochanteric fractures. All fracture types and grade of osteoporosis were determined. Laboratory investigations included Serum Calcium, Phosphorus and Alkaline phosphatase. During surgery, small amount of curetted cancellous bone from fracture site was sent for histopathology. An elaborate questionnaire was completed for every patient.

Results: The average age of patients with hip fractures was 61 years with 94.5% of the female patients being postmenopausal. Most of the patients (94%) had low velocity trauma. Singh's index for most of the fractures was grade II (n=48) and grade III (n=65). About one fourth of the patients showed abnormal values of serum Calcium, Phosphorus and Alkaline Phosphatase. Bone biopsy showed osteomalacia to be present in 13 patients (7.7 %). Among these 13 patients, 6 had abnormal values of Serum Calcium, Phosphorus and Alkaline phosphatase. Out of these 13 patients, 4 were male and eight out of nine females were postmenopausal.

Conclusion: Frequency of osteomalacia in cases of hip fractures was found with no association with known risk factors. Bone histopathology was the gold standard of diagnosis and biochemical markers like serum calcium, phosphorus and alkaline phosphates were not very helpful (JPMA 56:273;2006).

Introduction

Hip fractures are a common and often devastating injury in the geriatric population, with an impact that extends far beyond the obvious orthopaedic injury into the domains of medicine, rehabilitation, psychiatry, social work, and medical economics. Despite improvements in patient care, including advances in surgical technique and implant technology, hip fractures continue to pose a huge economic burden on the medical systems in the developed and the developing world. In 15 European Union (EU) countries the number of hip fractures has been 382,000 in year 1995 with an estimated care cost of 9 billion Euros.¹ About 250,000 hip fractures occur in the United States each year. The number of fractures is projected to double by the year 2050 as the population ages.² The cost of care for Hip fractures annually in the United States is about 14 billion dollars.

At 1 year after a hip fracture, mortality rates in elderly people range from 14% to 36%. The highest risk of mortality occurs in the first 6 months after fracture; after 1 year the mortality rate approaches that of persons who have not sustained a hip fracture.² One year after a hip fracture, approximately 40% of surviving patients regain their previous level of mobility and approximately 25% regain their former functional status.³

Majority of these fractures are due to osteoporosis. The National Osteoporosis Foundation estimated that, in the United States, 1 in 2 white women over the age of 50 years will sustain an osteoporosis-related fracture in their remaining lifetime. At a 12-month follow up of more than 160,000 women, rates of hip fracture were approximately 3-fold higher in osteopenic women and 9-fold higher in osteoporotic women than in women with normal BMD.⁴

Osteoporosis is a bone disease in which the amount of bone is decreased and the structural integrity of trabecular bone is impaired. Cortical bone becomes more porous and thinner. This makes the bone weaker and more likely to fracture. On the other hand osteomalacia is a disorder of mineralization of newly formed organic matrix that occurs in adults. The pediatric counterpart of osteomalacia is known as Rickets. Osteomalacia has also been associated with higher risk of hip fractures⁵ as well. Given the significant impact it has on patients' survival and cost of care some preventable measures would be appreciated. A number of reports have uncovered the increased prevalence of vitamin D deficiency and osteomalacia in the immigrant population from the subcontinent to the United Kingdom and Europe.^{6,7} A retrospective study conducted by Peacey⁶ in UK on Asian immigrants show that routine biochemical laboratory tests like serum calcium, phosphate and alkaline phosphatase if

solely relied upon can lead to miss the diagnosis of osteomalacia in about 20% of cases. Studies have shown that serum vitamin D metabolite concentration can not be used as screening tool for osteomalacia, in patients with hip fractures.⁸ Thompson et al have shown that a significant proportion of elderly fracture patients without osteomalacia and some apparently healthy elderly controls had 1.25(OH)2D values as low as those in patients with Osteomalacia.⁹ The gold standard to determine the presence of osteomalacia is bone histopathology.¹⁰

The studies done on the African¹¹ and Western population show highly variable results (24%, 2%, 0% and 11.25% respectively).¹⁰⁻¹³ No data has been reported from Pakistan regarding the prevalence of osteomalacia in the local population. This is a 5 year study including all patients who presented with hip fractures to our institution. The objectives of this study were to estimate the frequency of osteomalacia in the elderly population with hip fractures and to identify the various biochemical abnormalities present in these patients.

Patients and Methods

This is a cross sectional study performed at the Aga Khan University Hospital, Karachi, Pakistan. All patients with hip fractures (Femoral neck and Intertrochanteric) who presented to our University Hospital between June 1996 and June 2001 were included in this study. Patients who presented with a pathological (metastatic) hip fracture, non-operatively treated patients and patients in whom a biopsy could not be obtained were excluded. All patients were treated by internal fixation. During surgery curetted bone was obtained from the fracture site for histological examination to rule out osteomalacia. Histological examination was performed on a non-decalcified bone specimen by a bone pathologist. On histological examination if average thickness of osteoid was more than 20 micron (normal 15 ± 2.3 micron) and over 20% of the bone surface was covered by osteoid (normal 2.1 ± 1 %) it was declared as Osteomalacia.

We used a standardized questionnaire to collect the data regarding any existing or known bone metabolism disorders, co-morbid conditions, exposure to sunlight, intake of medications, any previous fractures or non-union, ambulation status, any specific dietary habits etc. Extent of osteoporosis was determined using Singh Index.¹⁴ Fractures were classified into Inter-trochanteric or neck fractures which were further classified into there subtypes according to popular classification Schemes. The laboratory data included hemoglobin, erythrocyte sedimentation rate, serum calcium, serum phosphate and alkaline phosphatase levels. We could not perform 24 hour urinary calcium and

vitamin D₃ level due to cost constraints. Data was analyzed using SPSS version 10.0.

Results

The total number of patients was 168, out of which 109 were females and 59 males with a female to male ratio of about 2:1. Mean age of our study subjects was 68.7 ± 16.1 years. Majority of the patients (94%) sustained a low velocity trauma while 9 patients had high velocity injury. Fifty two (31%) patients had an associated history of body aches while arthralgia was present in 55 (33%) patients. A high number of patients had a history of fracture in the past (30%). Neurological disease was present in about 19% of the patients at the time of presentation. Long standing renal disease was present in 17 (10%) of the patients. Hypertension (43%) and Diabetes Mellitus (21%) were amongst the common co-morbid factors. Fourteen patients (8%) were identified to have renal stones. Other co-morbid conditions identified in decreasing order of frequency were: failure of fixation of previous fracture (5.4%), past history of fracture non-union (4%) and alcohol intake (1.2%). Rheumatoid arthritis (8%) and chronic liver disease (4%) were also seen.

More than half of the patients had femur neck fracture ($n = 89$), rest of them ($n = 79$) had an intertrochanteric fracture. Singh index¹⁴ was assessed for every patient. One hundred and twenty eight patients were found to be osteoporotic according to Singh Index. Majority of patients were found to be Singh II (48/168) and Singh III (65/168).

An attempt was made to estimate the degree of sunlight exposure in our patients. Majority of patients (58%) had limited exposure to sunlight either due to living in multistoried closed buildings or limited ambulation. We also divided the patients into four groups

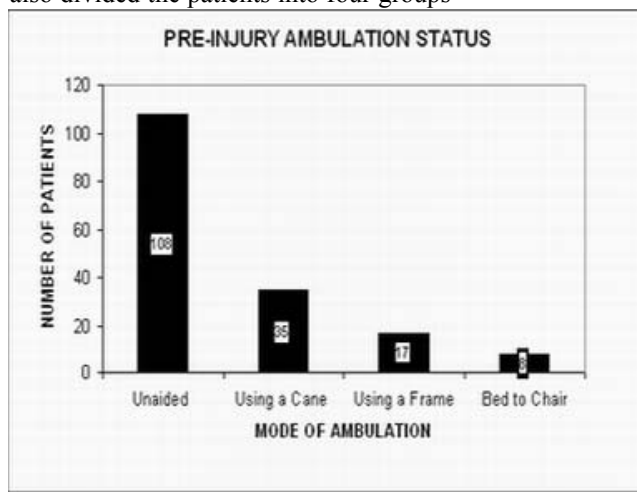


Figure. Pre-injury ambulation status

Table. Biochemical analysis of patients with Hip Fractures (n=168).

	Calcium	Phosphorus	Alkaline Phosphatase
Normal	92	107	127
Elevated	None	10	21
Low	60	29	None
Not Available	16	22	20

depending on their mobility status. The results are shown in the Figure.

Sixty patients (35.7%) were hypocalcaemic, 39 (23.3%) patients had abnormal values of phosphorus. Alkaline phosphatase was raised in 12.5% (n=21) of patients (Table). Almost half of them were anaemic (haemoglobin < 10mg/dl).

Thirteen patients (7.7%) showed evidence of osteomalacia on histopathology. The most common associated diagnosis was osteoporosis. Four (4/59) males and 9 (9/109) females had Osteomalacia. All 13 patients with osteomalacia had low velocity trauma. Seven patients with osteomalacia had subcapital fracture whereas 6 had intertrochanteric fractures. All except one of these 13 patients were operated within 48 hours of injury. One patient, who was treated elsewhere, had a failure of previous fixation and presented about 6 weeks after injury. Almost half (6/13) patients had previous history of fracture and one patient had a history of non-union of a hip fracture that was internally fixed with a dynamic condylar screw. All patients with osteomalacia had good or satisfactory level of pre-injury ambulation. Six of these thirteen patients were mainly restricted to indoors and had limited exposure to sunlight due to living in closed multistoried buildings or community centers. No statistically associated correlation was found between the presence of various variables like neurological disease, renal pathologies, Diabetes Mellitus, Hypertension, Rheumatoid arthritis, Cirrhosis, exposure to sunlight and prior mobility status to the occurrence of osteomalacia. Five patients with osteomalacia had abnormal values of phosphorus whereas four patients had abnormal serum calcium and alkaline phosphatase.

Discussion

Osteomalacia is the failure of the organic matrix (osteoid) to mineralize properly.¹⁵ The major disorders leading to osteomalacia are due to vitamin D deficiency. This may be due to inadequate sunlight exposure, decreased dietary Vitamin D supplementation, G.I disease, impaired synthesis of 1, 25(OH)₂ D₃ hydroxylase by the kidney and target cell resistance. Other causes include dietary or renal induced hypophosphatemia, renal tubular acidosis, drug induced osteomalacia¹⁶, toxin induced osteomalacia and primarily mineralization defects.

Clinical presentation is usually vague in osteomalacia. Radiological evaluation may reveal pseudofractures. Laboratory investigations which may prove helpful in diagnosis of osteomalacia are serum calcium, phosphate, alkaline phosphatase, parathyroid hormone level (PTH) and 25 OHD₃, but this depends on the stage of disease.^{6,15} Peacey⁶ demonstrated that in patients diagnosed of osteomalacia; following percentage of patients had normal investigations: calcium (66%), Phosphate (81%), alkaline phosphatase (29%). Only 6% of the patients had all three biochemical values outside the normal ranges. He recommended using serum calcium and serum PTH levels along with serum creatinine, FBC and endomysial antibodies levels to detect Osteomalacia. Hartmut¹⁷ did not find serum PTH as a very specific marker to see bone turn over in patients on dialysis with renal osteodystrophy and strongly recommended bone biopsy as a powerful tool to assess the lesions and their extent in renal osteodystrophy. Studies have shown that in patients with osteomalacia serum vitamin D metabolite concentration can not be used as screening test.^{8,9} The gold standard to determine the presence of Osteomalacia is bone histopathology.^{10,18} A non decalcified specimen is used for histological evaluation to assess the thickness and surface coverage of unmineralized osteoid and the degree of its mineralization. Characteristically in osteomalacia, the average thickness of osteoid is more than 20 micron (normal 15±2.3 micron) and over 20% of the bone surface is covered by osteoid (normal 2.1±1 %).¹⁵

Why is the detection and treatment of osteomalacia important? Two reports show that intake of calcium and 800 IU or more of vitamin D lead to a 32 to 50% reduction in fractures.^{19,20} In a randomized, controlled trial of 268 British women and men between the ages of 65 and 85 years, 100,000 U of oral vitamin D₃ every 4 months led to a reduction of fractures and restoration of vitamin D levels to approximately 30 ng/mL. The use of 100,000 U of oral vitamin D three times per year is safe and effective in decreasing fractures in the elderly.²¹ In contrast, 300,000 U of vitamin D₂ injected yearly did not fully restore vitamin D levels at 1 year, although both 800 IU vitamin D daily and the injectable vitamin D resulted in decreased fractures.²² Recent data from a randomized clinical trial in elderly women show that in 3 months, calcium (1200 mg) and vitamin D (800 IU) compared with calcium alone led to a 49% reduction in falls and improved musculoskeletal function.²³ In another randomized study, alfacalcidol (1[alpha]OHD₃) reduced the risk of falls among 368 elderly women and men who had a daily calcium intake greater than 500 mg.²⁴

The prevalence of osteomalacia in different populations has been assessed from different parts of the

world and have shown variable results.^{10,12,25} Only one study with 26 patients was conducted from Indo-Pak Subcontinent. This study from India showed extremely high percentage (65%) of osteomalacia among patients with hip fractures diagnosed by bone biopsies.¹⁸ Another study conducted in Japan⁵ showed that stroke patients with Osteomalacia (diagnosed on decreased level of Vitamin D) are more likely to have hip fractures than patients without Osteomalacia. The present study showed a lower rate of Osteomalacia (7.7%) compared with the above mentioned study done in India, no significant cause to explain this difference could be found in our study.

As in previous studies, no significant association between serum calcium, phosphorus, alkaline phosphatase levels and osteomalacia could be identified in this study. In the absence of any reliable biochemical marker to detect osteomalacia we would recommend a more liberal use of trans-iliac bone biopsy in patients (without hip fractures) who are clinically suspected to have osteomalacia. This biopsy can be done in an orthopaedic surgeon's office/clinic as an out patient procedure under local anaesthesia with minimal morbidity associated to the procedure. Patients with hip fractures suspected of Osteomalacia should undergo bone biopsy from the fracture site during surgery. One weakness of the study is the inability to get serum Vitamin D, 24 hour urinary calcium and parathyroid hormone levels of patients with hip fractures which would have been interesting to correlate in patients with and without osteomalacia. The original study design did contain the Vitamin D and Parathyroid hormone levels but it could not materialize due to the high expenses of these tests and the non-availability of funding.

The availability of adequate sunlight all round the year in our part of the world prevents the theoretical risk of osteomalacia. People living in closed apartments with decreased mobility in populous cities like Karachi can be predisposed to osteomalacia. On the contrary in our study, most of the patients with osteomalacia were reasonably ambulant and had good exposure to sunlight.

On review of the operative notes, almost all patients with osteomalacia were noted to have a poor bone quality at the time of surgery. Two of these patients with intertrochanteric fracture had to be cemented at the time of sliding hip screw fixation. Cementing the lag screw of DHS (Dynamic Hip screw) improves the purchase of the screw in the head. We suggest that in suspicious cases where quality of bone of Femur head is in doubt one should consider cementation of the DHS implant.

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