WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.074
Volume 7, Issue 17, 23-33. Research Article ISSN 2277– 7105

CHANGES IN ELECTROLYTE IONS LEVEL IN HEALTHY AND OSTEOPOROSIS WOMEN IN BASRA PROVINCE / IRAQ

Mustafa Abd-Almajeed Hussein*[1] and Sami Jiber AL-Maliki[2]

[1]Department of Physiology- College of Medicine in Basrah University, Basrah –Iraq.
[2]Department of Biology- College of Education for Pure Sciences-Basrah University, Basrah –Iraq.

Article Received on
24 July 2018,
Revised on 14 August 2018,
Accepted on 04 Sept. 2018
DOI: 10.20959/wjpr201817-13333

***Corresponding Author**
Mustafa Abd-Almajeed Hussein
Department of Physiology- College of Medicine in Basrah University, Basrah - Iraq.

ABSTRACT

Osteoporosis is the most common bone disease in humans, it is characterized by low bone mass, deterioration of bone tissue and disruption of bone architecture, compromised bone strength and an increase in the risk of fracture. The osteoporosis is a risk factor for fracture just as hypertension is for stroke, the risk of fractures is highest in those with the lowest BMD, the majority of fractures occur in patients with low bone mass rather than osteoporosis, because of the large number of individuals with bone mass in this range. Ions constitute a key duo for appropriate bone mineral acquisition and maintenance throughout life, outside the skeleton, their essential but distinct physiological functions are controlled by specific transporters and hormonal systems that also serve to secure the appropriate supply of calcium and phosphor for bone health. Eighty two women patients referring from rural and urban housing aging between (55-65) years old was visit a center in private hospital to determine the percentage of bone density using a dual energy x-ray absorptiometry (DEXA) from Lunar Prodigy (version 16) (USA). Blood samples were taken after diagnosis disease, then the electrolyte ions was measured by using OPTILION device cassette are specific for each one of these ions in specialist laboratory. The results shows significant decrease (p<o.o5) in calcium, magnesium, phosphor and potassium ion, while others ions include sodium and chloride have non- significant change in osteoporosis women compared with healthy women in same age and counterpart. In conclusion, electrolytes ions have significant changes in osteoporosis women in Basra province / Iraq.

KEYWORD: Electrolyte, osteoporosis, DEXA, Ions, electrolyte ions.

INTRODUCTION

Osteoporosis is the most common bone disease in humans, representing a major public health problem as outlined in Bone Health and Osteoporosis: A Report of the Surgeon General (2004), it is characterized by low bone mass, deterioration of bone tissue and disruption of bone architecture, compromised bone strength and an increase in the risk of fracture.[1]

According to the WHO diagnostic classification, osteoporosis is defined by bone mineral density at the hip or lumbar spine that is less than or equal to 2.5 standard deviations below the mean BMD of a young-adult reference population, the osteoporosis is a risk factor for fracture just as hypertension is for stroke.[2] The risk of fractures is highest in those with the lowest BMD; however, the majority of fractures occur in patients with low bone mass rather than osteoporosis, because of the large number of individuals with bone mass in this range.[3] Osteoporosis affects an enormous number of people, of both sexes and all races, and its prevalence will increase with ages, based on data from the National Health and Nutrition Examination Survey (NHANES), National Osteoporosis Foundation (NOF) has estimated that more than 9.9 million Americans have osteoporosis and an additional 43.1 million have low bone density.[4] While about one out of two Caucasian women will experience an osteoporosis-related fracture at some point in her lifetime, as will approximately one in five men[5] Over 1 million vertebral compression fractures - mostly caused by osteoporosis - occur worldwide annually, the morbidity and mortality significantly increase in patients who suffered vertebral compression fractures, and the incidence of this type of fracture rises continually.[6]

The worldwide health and economic burden of osteoporosis is likely to increase in the future, as improvements in life expectancy will lead to a growing population of elderly people with a high risk of fracture.[7]

While the leading of fracture in the elderly, has an incidence of 80,000 new cases per year in France and this is a worldwide problem related to the aging of the population, and its incidence to predicted the double if not triple in the coming 40 years.[8]

Fracture rates are lower in Asian and black population, the number of hip fractures seen in Asian population is rising, it has been estimated that by year 2050, more than half of all hip fractures worldwide will occur in Asia.[9] The incidence of hip fractures has risen considerably, for instance, in Hong Kong Chinese increased by more than 2-fold in the last 2 decades.[10]

PATIENTS AND METHODS

This prospective study was conducted between November 2016 to September 2017 in Basra province to include a 82 women patients referring from rural and urban housing aging between (55-65) years old and weighting between (70-79 kg) while the length of this patient about (160-169 cm). This patients was visit a center in private hospital to determine the percentage of bone density using a dual energy x-ray absorptiometry (DEXA) from Lunar Prodigy (version 16) (USA). The main outcome measure is low bone mineral density (T-score) and according to the WHO criteria the patients are divided into normal, osteopenia and osteoporosis.

Human models

The patients are divided into four groups according to age and residing of housing status:-

1. (22) Patients aged between (55-59) years old residing in rural
2. (15) Patients aged between (55-59) years old residing in urban
3. (25) Patients aged between (60-65) years old residing in rural
4. (20) Patients aged between (60-65) years old residing in urban

Every group of these are divided into two categories:

1. Patients age between (55-59) years old residing in rural

a. (8) Healthy patients aged between (55-59) years old residing in rural

b. (14) Osteoporosis patients aged between (55-59) years old residing in rural.

2. Patients age between (55-59) years old residing in urban

a. (5) Healthy patients aged between (55-59) years old residing in urban

b. (10) Osteoporosis patients aged between (55-59) years old residing in urban

3. Patients age between (60-65) years old residing in rural

a. (11) Healthy patients aged between (60-65) years old residing in rural

b. (14) Osteoporosis patients aged between (60-65) years old residing in rural

4. Patients age between (60-65) years old residing in urban

a. (7) Healthy patients aged between (60-65) years old residing in urban

b. (13) Osteoporosis patients aged between (60-65) years old residing in urban

Information was taken from patients and healthy women according a special forma related to search subject.

Dual Energy X-ray Absorptiometry

The diagnosis of osteoporosis and assessing risk of fracture using DXA screening according to World Health Organization (WHO) has defined criteria for a BMD value that is more than 2.5 *SD*s below the optimal mean for healthy young individuals of the same gender and race defines an individual as having osteoporosis (T- score $\leq$ -2.5).[11]

Sample collection

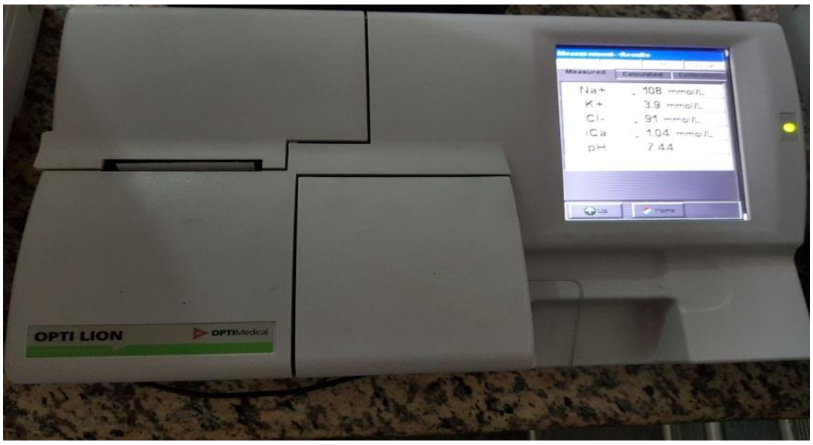
Drawing three milliliters of venous blood sample by 5 ml disposable syringe from each patient and healthy women. The sample was transferred into a clean disposable plain tube, left at room temperature for at least 25 minutes for clotting, centrifuged (3500 r/m for 15 minutes) then the produced serum was removal into special tube and stored at (-17 C^0) unless used directly.

Determination of electrolyte ions level

The principle of measurement these ions according by using the modern OPTILION device cassette are specific for each one of these ions in specialist laboratory.

Once OPTILION cassettes are refrigerated, they may be used directly out of the refrigerator without a temperature equilibration time. Once cassette are taken out of the refrigerator they must be left at room temperature (18-30^0c) and can be used for up to 2 weeks following refrigeration.

At the end of the assay, results are automatically calculated by the instrument in relation to the calibration curve stored in memory, and then printed out.



Statistical analysis

One way ANOVA test was used to study association of electrolyte ions and development of osteoporosis. P-value was considered statistically significant if <0.05. These data has been analyzed by the use of a statistical SPSS ver. 16.

RESULTS AND DISCUSSION

Electrolyte ions level in healthy and osteoporosis women aged between (55-59) years old and habitant of the (rural)

The changes in electrolyte ions values (magnesium, calcium, phosphor and potassium) show in table (1) was significantly decrease (p<o.o5) in women with osteoporosis aged between (55-59) years old, while other parameters shows non-significant changes compared to their counterparts of healthy women living in the same rural areas.

Table 1: Electrolyte ions level in healthy and osteoporosis women at age (55-59) years in (rural) habitant (mean ± SD).

Ions	Healthy women (n=8)	Osteoporosis women (n=14)
Magnesium (mg/dl)	2.50 ± 0.41	*1.10 ± 0.53
Calcium (mg/dl)	8.63 ± 1.09	*3.44 ± 1.15
Phosphor (mg/dl)	3.86 ± 0.80	*1.19 ± 0.60
Sodium (mEg/L)	139.92 ± 3.21	140.52 ± 1.89
Chloride (mEg/L)	100.86 ± 7.15	102.34 ± 8.31
Potassium (mEg/L)	4.69 ± 0.34	*2.20 ± 0.64

Electrolyte ions level in healthy and osteoporosis women aged between (55- 59) years old and habitant of the (urban)

The results represented in the table (2) showed a significant decrease (p<o.o5) in magnesium, calcium, phosphor and potassium ions in women with osteoporosis while, sodium and

chloride appeared no significant changes compared to values of urbanization healthy women aged between (55-59) years old in the same area.

Table 2: Electrolyte ions level in healthy and osteoporosis women at age (55-59) years in (urban) habitant (mean ± SD).

Ions	Healthy women (n=5)	Osteoporosis women (n=10)
Magnesium (mg/dl)	2.45 ± 0.34	*1.08 ± 0.43
Calcium (mg/dl)	8.58 ± 0.70	*3.16 ± 1.15
Phosphor (mg/dl)	3.38 ± 0.52	*1.16 ± 0.39
Sodium (mEg/L)	133.94 ± 34.43	137.48 ± 9.92
Chloride (mEg/L)	97.90 ± 8.50	95.81 ± 5.81
Potassium (mEg/L)	4.50 ± 0.39	*2.18 ± 0.43

Electrolyte ions level in healthy and osteoporosis women aged between (60- 65) years old and habitant of the (rural)

A significant decrease (p<o.o5) was observed in table (3) of the ions values in women with osteoporosis disease who are live in a rural area compared to healthy women living in the same area with the same age. However no changes occur in sodium and chloride ions.

Table 3: Electrolyte ions level in healthy and osteoporosis women at age (60-65) years old in (rural) habitant (mean ± SD).

Ions	Healthy women (n=11)	Osteoporosis women (n=14)
Magnesium (mg/dl)	1.72 ± 0.48	*0.35 ± 0.56
Calcium (mg/dl)	5.60 ± 1.63	*1.44 ± 1.04
Phosphor (mg/dl)	1.80 ± 1.07	*0.64 ± 0.60
Sodium (mEg/L)	131.05 ± 2.93	134.22 ± 2.18
Chloride (mEg/L)	98.13 ± 7.11	92.02 ± 9.45
Potassium (mEg/L)	3.47 ± 0.73	*1.14 ± 0.63

Electrolyte ions level in healthy and osteoporosis women aged between (60- 65) years old and habitant of the (urban)

Data in table (4) show that women aged between (60-65) years old with osteoporosis disease have a significant decreased (p<o.o5) in magnesium, calcium phosphor and potassium compared with healthy women of the same age who live in the urban area. Also no significant changes occur in sodium and chloride ions.

Table 4: Electrolyte ions level in healthy and osteoporosis women at age (60-65) years old in (urban) habitant (mean ± SD).

Ions	Healthy women (n=7)	Osteoporosis women (n=13)
Magnesium (mg/dl)	1.58 ± 0.46	*0.11 ± 0.41
Calcium (mg/dl)	5.31 ± 1.26	*1.21 ± 1.18
Phosphor (mg/dl)	1.67 ± 0.96	*0.31 ± 0.39
Sodium (mEg/L)	129.68 ± 8.52	130.51 ± 9.68
Chloride (mEg/L)	94.15 ± 5.95	89.96 ± 5.71
Potassium (mEg/L)	3.21 ± 0.37	*1.02 ± 0.38

Data from our study indicated a significant decreased in calcium, magnesium, phosphor and potassium, while others ions include sodium and chloride showed non-significance changes in osteoporosis women compared with healthy women in same age. The data otherwise, showed not differences between groups with different ages and area compared with healthy women at the same ages and housing status.

The calcium is the major caution of bone from osteoporosis with skeletal calcium being indirectly affected by dietary calcium intake as bone is continuously broken down and reformed and thus has on-going requirement for calcium, but also for energy and for other nutrients including phosphorus, copper, manganese, zinc, magnesium, vitamin C and vitamin D.[12] Also calcium is a major constituent of the bone and vitamin D helps maintain calcium homeostasis and vitamin D supplements have long been recognized as the cornerstones for prevention and management of osteoporosis and fractures.[13]

In addition, calcium, magnesium and phosphor deficiency causes mobilization of bone and leads sooner or later to osteoporosis by reduction amount of bone in the bone or apparent bone density.[14] However, menopausal changes in ions metabolism are the cause or the result of osteoporosis which have a positive action of estrogen on the gastrointestinal absorption and renal tubular reabsorption of calcium.[15] Phosphorus is necessary for proper mineralization of bone as well as vitamin D, vitamin D and fibroblast growth factor 23 regulate serum phosphorus by modulating intestinal phosphorus absorption, renal phosphorus reabsorption and bone metabolism, the decrease in vitamin D effect on fibroblast growth factor 23 and lead to decrease phosphorus absorption causes loss in bone density.[16] Furthermore, serum phosphorus level is regulated by intestinal phosphorus absorption, malabsorption from gastrointestinal tract may be cause low phosphorus due to lack of vitamin D.[17] On the other side, tight control of magnesium homeostasis seems to be crucial for bone health, magnesium deficiency contributes to osteoporosis directly by acting crystal formation on bone cells and indirectly by impacting the secretion and activity of parathyroid hormone.[18] Mg intake was positively associated with bone mass density in pre and post-menopausal women, Mg supplementation is beneficial in osteoporotic women for building healthy bone throughout life by increased activity of osteoblast and reduce osteoclast cell.[19]

The decreased in potassium ions in osteoporosis women probably due to reduce level of estrogen, potassium (K+) channel activation contributes in part to estrogen-mediated vasorelaxation, estrogen may be increases K(+) currents via membrane-associated, interaction and that steroid hormones have differential effects on different types of K(+) channels.[20]

Also, estrogen have effect on the movement of ions in the body and regulate the passage through the membranes specially potassium, any imbalance in the mechanism action of this hormone can cause a noticeable disorder in the regulation of ions in the body.[21] Moreover, dietary potassium can offset the excretion of absorbed calcium as low potassium diets increase net urinary calcium loss, whereas diets high in potassium reduce it.[22]

On the other hand, the low level of calcium in blood can affect the permeability of potassium within the membranes and cause disorder in action, also the channels of potassium are activated by calcium and any decrease in the level of calcium negatively affects the level of potassium in blood plasma.[23,24] The 15% of skeletal calcium can be lost over a decade to buffer a mild metabolic acidosis as a result of dietary practices and shown that small downward deflections of potassium lead to increased osteoclastic activity, an indicator of bone resorption.[25]

In addition, clarified that a higher alkaline state manipulated by potassium diet agents have positive effects on calcium balance and increased bone mineral density.[26,27] The reduce potassium in osteoporosis women may be due to decreased potassium in daily diet, potassium content of the bone’s interstitial fluid is directly related to the quantity of potassium consumed and is the skeletal compartment’s first line of defense in buffering metabolic acid loads.[28,29]

The loss micronutrient specially potassium and phosphorus will be effected in bone health and absent of this compound in daily diet probably effect on bone density and also increase in probability of osteoporosis in old age people.[30]

In conclusion, electrolytes ions have significant changes in osteoporosis women in Basra province / Iraq.

REFERENCES

1. Ebeling, P.R. Osteoporosis in Men. N Engl J Med., 2008; 358: 1474-82.
2. Lupsa, B.C.; Insogna, K. Bone Health and Osteoporosis: Endocrinol Metab Clin North Am., 2015; 44(3): 517-30.
3. Wright, N.C.; Looker, A.; Saag, K.; Curtis, J.R.; Dalzell, E.S.; Randall, S.; Dawson-Hughes, B. The recent prevalence of osteoporosis and low bone mass based on bone mineral density at the femoral neck or lumbar spine in the United States. J Bone Miner Res., 2014; 29(11): 2520-6.
4. Khosla, S.; Riggs, B.L. Pathophysiology of age-related bone loss and osteoporosis. Endocrinol Metab Clin N Am, 2015; 34: 1015-1030.
5. Harvey, N.; Dennison, E.; Cooper, C. Epidemiology of Osteoporotic Fractures. Osteoporosis Int., 2013; 2: 3-7.
6. Aron Lazary M.D. Molecular biological approach of osteoporosis and surgical bone substitution Doctoral thesis Semmelweis University Clinical Sciences of PhD Studies, 2009.
7. Johnell, O.; Kanis, J.A. An estimate of the worldwide prevalence, mortality and disability associated with hip fracture. Osteoporos Int., 2014; 15(11): 897- 902.
8. Kakar, S.; Tornetta, P. and Schemitsch, E.H. Technical considerations in the operative management of femoral neck fractures in elderly patients: a multinational survey. J Trauma, 2007; 63: 641-6.
9. Campion, G. and Melton, L.J. Hip fracture in elderly: a worldwide projection. Osteoporosis International., 2012; 2: 285-289.
10. Man, L.P.; Ho, A.W. and Wong, S.H. Excess mortality for operated geriatric hip fracture in Hong Kong. Hong Kong Med J., 2016; 22(1): 6-10.
11. Vondracek SF, Linnebur SA. Diagnosis and management of osteoporosis in the older senior. Clin Interv Aging, 2009; 4: 121-36.
12. Strause, L.; Saltman, P.; Smith, K.T. et al. Spinal bone loss in postmenopausal women supplemented with calcium and trace minerals. J Nutr, 2014; 124: 1060-1064.
13. Chen, L.; Tang, W. Wen, C.; Chih, K.; and Kuo, H. Calcium and Vitamin D Supplementation on Bone Health: Current Evidence and Recommendations. International journal of gerontology, 2014; 8(4): 183–188.

14. Nordin, B.E. Calcium and osteoporosis. Nutrition, 2012; 13(7-8): 664-86.
15. Bolland, M.J.; Tai, V.; Leung, W. Grey, A.; and Reid, I.R. Calcium intake and bone mineral density: systematic review and meta-analysis. BMJ, 2015; 29(3): 341-352.
16. Seiji, F. Phosphate metabolism and vitamin D. Bonekey Rep., 2014; 3: 497-505.
17. Penido, M.G.; and Alon, U.S. Phosphate homeostasis and its role in bone health. Pediatr Nephrol, 2012; 27: 2039–2048.
18. Sara, C.; Alessandra, C.; Walter, A.; and Jeanette, A. M. Magnesium and osteoporosis: Current state of knowledge and future research directions. Nutrients, 2013; 5(8): 3022–3033.
19. Tranquilli, A.L.; Lucino, E.; Garzetti, G.G.; and Romanini, C. Calcium, phosphorus and magnesium intakes correlate with bone mineral content in postmenopausal women. Gynecol. Endocrinol, 2014; 8: 55–58.
20. Wong, C.M.; Tsang, S.Y.; Yao, X.; Chan, F.L.; and Huang, Y. Differential effects of estrogen and progesterone on potassium channels expressed in xenopus oocytes. Steroids, 2008; 73(3): 272-9.
21. Carolyn, M.D. and Peter, C. Estrogen and adenosine triphosphate–sensitive potassium channels. Circulation, 2003; 107: 221-230.
22. Susan, A. Bone health and potassium. Bone Nutrition, 2014; 11(9): 48-60.
23. Ghatta, S.; Nimmagadda, D.; Xu, X.; Rourke, T.; and Stephen, T. Large-conductance, calcium-activated potassium channels: Structural and functional implications. Pharmacology & Therapeutics, 2016; 110(1): 103–116.
24. Wei, A.D.; Gutman, G.A.; Aldrich, R.; Chandy, K.G.; Grissmer, S. and Wulff, H. Nomenclature and molecular relationships of calcium-activated potassium channels. Pharmacological Reviews, 2015; 57(4): 463–72.
25. Frances, A.; Tylavsky, A.; Spence, L.; and Harkness, F. The importance of calcium, potassium, and acid-base homeostasis in bone health and osteoporosis prevention. The Journal of Nutrition, 2008; 138(1): 164–165.
26. Krieger, N.S.; Frick, K.K.; and Bushinsky, D.A. Mechanism of acid-induced bone resorption. Curr Opin Nephrol Hypertens, 2014; 13: 423-36.
27. Bushinsky, D.A.; Gavrilov, K.; Chabala, J.M. and Featherstone, J.D. Effect of metabolic acidosis on the potassium content of bone. J Bone Miner Res., 2017; 12: 1664–71.
28. Lemann, J.; Bushinsky, D.A.; and Hamm, L.L. Bone buffering of acid and base in humans. Am J Physiol Renal Physiol., 2013; 285: 811–32.

29. Rafferty, K.; Davies, K.M.; and Heaney, R.P. Potassium intake and the calcium economy. J Am Coll Nutr., 2015; 24: 99–106.
30. Dawson, A.; and Hughes, B. Interaction of dietary potassium and protein in bone health in humans. J Nutr., 2013; 133: 852–4.