OXIDANT-ANTIOXIDANT STATUS IN POSTMENOPAUSAL OSTEOPOROTIC WOMEN IN DUHOK CITY

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ABSTRACT

Background and Objectives: Osteoporosis (OP) is a condition of increasing bone loss which leads to increase bone fragility and fractures. Current studies proved that oxidative stress (OS) has involved in bone resorption. Thus, this study aimed to compare the serum levels of oxidative stress parameters between postmenopausal women with osteoporosis and without osteoporosis to show whether there is a relationship between oxidative stress parameters and bone mineral density (BMD) or not.

Subject and Method: In this cross-sectional study, a total of 150 postmenopausal women who visited Duhok Rheumatoid Center and performed bone densitometry were enrolled. A study questionnaire was used to collect the required information from participants. Serum malondialdehyde (MDA), ceruloplasmin (CP), peroxynitrite (PN), total bilirubin (TBIL), calcium and vitamin D (VD) were studied.

Results According to world health organization (WHO) criteria, normal BMD was determined in 12% of the study population, women with osteopenia represented 52% and 36% of women were identified as having OP. Women with OP had significantly higher mean values of MAD, PN and CP as compared to controls. Mean values of TBIL and calcium remained unchanged. Similarly, VD showed no significant differences between groups with high prevalence of VD deficiency among the study population. This study showed a negative significant correlation between total BMD, lumbar spine (L-spine) BMD and MDA in women with OP.

Conclusions: The present study suggests that oxidative stress parameters may be valuable in diagnosis of low bone mass in postmenopausal women. However, more studies assessing the role of oxidative stress in bone metabolism are needed.

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Keywords: Osteoporosis, postmenopause, oxidative stress, malondialdehyde, peroxynitrite, ceruloplasmin.

Osteoporosis (OP) is an important worldwide health disorder results from a reduction in bone mineral density (BMD) and contributed to development of fractures and subsequent disability, morbidity and mortality in older people[1]. Recently, OP is considered as one of the ten most major disorders affecting the human race, besides other diseases such as diabetes mellitus, cardiovascular diseases, hypertension, and stroke[2]. OP is often referred to as the silent disease because bone loss occurs without noticeable symptoms until the bones are so fragile that a fracture occurs[3]. In women older than fifty years, the risk of osteoporotic fracture is about 35-40%, while inmen it is approximately 15%[4]. Commonly, spinal vertebrae, hip, and wrist are more susceptible to

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fractures, even though they may occur at the whole skeleton [5]. New studies are interested in the effect of free radicalson bone metabolism under pathological and physiological conditions[4]. Oxidative stress (OS), which presumably increases with low levels of circulating antioxidants or age was proposed to be responsible for bone loss and subsequent OP by *in vitro* studies or animal studies[6]. It is investigated evidence that reactive oxygen species (ROS) are involved in bone resorption and that osteoclast-generated superoxide is directly contributed to bone degradation[7]. Over the past time, reliable tests have been made to evaluate OS biological markers, like measuring glutathione peroxidase, lipid peroxidation (LPO), DNA damage, total antioxidant status, superoxide dismutase (SOD), catalase, antioxidant minerals (zinc, selenium) and antioxidant vitamins (A, C and E). OS biomarkers have been investigated in different tissues to assess age-related disease such as osteoporosis, hence; these biomarkers in patients with OS may be valuable in managing osteoporosis [8]. Unfortunately; there is an apparent deficiency in information and knowledge about the extent of this public health problem in our locality. The present research aims to assess the involvement of OS in the OP progression and development since OS markers are newly introduced biochemical markers in the diagnostic field of OP in our area.

PATIENTS AND METHODS

A total of 290 women from various regions of Duhok governorate admitted to Duhok Rheumatoid Centre for evaluation of osteoporosis throughout the period (from Nov. 1st, 2017 to Sep. 31st, 2018). Out of a total population, 150 women met the inclusion criteria were taken into the sample size of this study. Inclusion criteria for participants were being menopause and aged ≥ 40 years old. Subjects with metabolic bone, liver, chronic kidneys, gastrointestinal and chronic inflammatory diseases, thalassemia, cancer, diabetes mellitus type 1, taking antioxidant supplements or hormones replacement therapy were excluded. A questionnaire form was used to collect the required information from patients. After informing each subject about the study and taking their consent, the structured questionnaire was filled through direct interview.

For all participants, lumbar vertebrae (L2-L4), pelvis region BMD and total BMDwere measured by (DEXA) (MEDIX 90) (dual-energy X-ray absorptiometry). Values of DEXA readings were represented as BMD (g/cm2) and T-score was used to assess bone mineral density as defined by WHO. Accordingly, the values of T-score <-2.5 considered as OP, while the values of T-score <-1 and > -2.5 were considered as women with osteopenia and women with a T-score >-1 were considered as healthy individuals.

For each subjects, weightwithout coats and height was taken without shoes in

standing position.Body mass index (BMI) was calculated as the ratio of weight (Kg)divided by height (m2) square meter. An overnight fasting blood specimen was drawn from participants by venipuncture. The tests were performed within 24 h of blood collection for estimation of TBIL and calcium which were determined by commercial kit supplied by (Biolabo SA 02160, Maizy, France). Then, the remaining serum samples were portioned and kept at -20 °C for later examination of MDA, PN, CP and VD which was determined by ELISA kit supplied by (bioactivia diagnostic GmbH).

Determination of serum malondialdehyde levels

Serum malondialdehyde (MDA) level was measured at 100 °C according to the reaction with thiobarbituric acid(TBA)[9]. In this reaction; serum, TBA and trichloroacetic acid were mixed thoroughly in boilingwaterbath for 30 min. To precipitate protein, the test reaction was mixed with trichloroacetic acid. By centrifugation, the precipitate was pelleted after cooling and the absorbance of the colored supernatant was read at 532 nm. Molar extinction coefficient of MDA (1.65 *105 M-1.cm-1) was used to determine the concentration of unknown samples.

Determination of serum peroxynitrite levels

Serum peroxynitrite (PN) measurement was done following Vanuffelen *et al.,* (1998) method [10]. Peroxynitrite radical catalyzes nitration of phenol to yield nitrophenol with an absorption maximum 412 nm. Serum was mixed with a mixture of phenol and sodium phosphate buffer at room temperature for about 2 h followed by addition of NaOH. Concentrations of samples were determined by using molar extinction coefficient of peroxynitrite (4400 M-1.cm-1).

Determination of serum ceruloplasmin levels

P-phenylenediamine oxidase ceruloplasmin method was used to determine serumceruloplasmin(CP)[11]. In test tubes placed within ice-water bath, serum was mixed with substrate solution (p-phenylenediamine solution (50 mg of crystalline p-phenylenediamine + 5 ml DW + 1 ml of glacial acetic acid) was added to sodium acetate tri-hydrate solution (8.15 g of sodium acetate tri-hydrate + 30 ml DW) and the volume was completed to 50 ml DW) and incubated for 15 minute at 37 °C. After cooling, the sample was mixed with inactivating solution (100 mg of sodium azide + 500 ml of DW) and brought to 25 °C in an incubator. Finally, the sample concentrations were determined at 532 nm where the absorbance was measured and the and the absorbance of the colored supernatant was read at 532 nm. Molar extinction coefficient of MDA (1.65 *105 M-1.cm-1) was used to determine the concentration of unknown samples. In this method, ceruloplasmin was mediating the oxidation reaction of p-

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phenylenediamine, resulting in the formation of a blue-violet solution. Determination of blank values was established at 0 °C after inactivation of the enzyme by sodium azide.

STATISTICAL ANALYSIS

The data were analyzed using SPSS software version 23 and expressed as mean ± SD. The comparison between multiple groups was done using one-way (ANOVA). Pearson correlation coefficient was applied to assess the relationship between variables. In all tests, a *p*-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1, elucidate the general characteristics of the study population. Women with osteoporosis and osteopenia presented significantly ($p< 0.01$) higher mean values of age and lower mean values of BMI, BMD and corresponding T-score compared to the healthy group. On the contrary, there was no significant variation in VD, calcium, VD and calcium supplementation, total body fat % (TBF %) and waist circumference (WC) across the groups ($p> 0.05$).

Table 1: Principal Characteristics of Healthy, Osteopenic, and Osteoporotic Women

Variables	Controls (n = 18)	Osteopenia (n =78)	Osteoporosis (n = 54)	*p*
Age	**51.33 ± 6.30**	**55.67 ± 8.59**	**67.13 ± 7.86**	**< 0.001**
WC	**113.22 ± 9.84**	**107.29 ± 12.76**	**106.85 ±14.36**	**0.142**
TBF %	**45.68 ± 4.59**	**45.77 ± 4.43**	**45.81 ± 5.49**	**0.996**
BMI	**35.54 ± 5.66**	**31.98 ± 4.84**	**31.30 ± 6.60**	**0.022**
Vitamin D	**19.08 ± 7.74**	**20.01 ± 9.99**	**20.39 ± 11.25**	**0.893**
Calcium	**9.85 ± 0.66**	**9.97 ± 0.61**	**9.90 ± 0.48**	**0.613**
VD supplement intake				
Yes	**11(13.3%)**	**45(54.2%)**	**27(32.5%)**	**0.594**
No	**7(10.4%)**	**33(49.3%)**	**27(40.3%)**	
Calcium treatment intake				
Yes	**12(12.2%)**	**53(54.1%)**	**33(33.7%)**	**0.714**
No	**6(11.5%)**	**25(48.1%)**	**21(40.4%)**	
Total BMD	**0.93 ± 0.05**	**0.79 ± 0.35**	**0.65 ± 0.07**	**< 0.001**
Total BMD *T*-score	**-0.57 ± 0.41**	**-1.80 ± 0.30**	**-3.08 ± 0.59**	**< 0.001**
L-spine BMD	**1.07 ± 0.12**	**0.90 ± 0.09**	**0.72 ± 0.09**	**< 0.001**
L-spine BMD *T*-score	**-0.91 ± 0.80**	**-2.16 ± 0.64**	**-3.48 ± 0.67**	**< 0.001**
Pelvis BMD	**1.09 ± 0.088**	**0.88 ± 0.08**	**0.73 ± 0.09**	**< 0.001**
Pelvis BMD *T*-score	**-0.76 ± 0.67**	**-2.29 ± 0.42**	**-3.49 ± 0.65**	**< 0.001**

Results are expressed as mean ±SD. n = patients number.

Results of serum vitamin D demonstrate that 14.7% of women were vitamin D deficient and below10 ng/ml with Mean ± SD (7.626 ± 1.487), while the % of women determined as having vitamin D insufficient was 70% with vitamin D levels between 11-19 ng/ml and Mean ± SD (18.207 ± 5.276).

Finally, women with vitamin D sufficient represented 15.3% with vitamin D levels ≥ 30 ng/ml and Mean ± SD (41.182 ± 11.308). In general, these findings propose the high prevalence of vitamin D deficiency among the study population (Table2).

Table 2: Classification of Serum Vitamin D levels in General Population

	Serum vitamin D ng/ml		
vitamin D level	**≥ 30 ng/ml Sufficient**	**11-29 ng/ml Insufficient**	**< 10 ng/ml deficient**
n (%)	**22 (15.3%)**	**105 (70%)**	**23 (14.7%)**
Mean ± SD	**41.182 ± 11.308**	**18.207 ± 5.276**	**7.626 ± 1.487**

Results are expressed as mean ±SD. n = patients number.

Regarding oxidative stress parameters, **Table 3** reveal that there were significant differences among groups in terms of serum MDA, PN and CP levels (p< 0.01).

On the other hand, serum levels of TBIL remained within normal range and exhibited non-significant differences between groups

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Table 3: Arithmetic mean of Oxidative Stress Parameters for Patient groups and Control Group

OS parameters	**Controls (n = 18)**	**Osteopenia (n = 78)**	**Osteoporosis (n = 54)**	*p*
MDA	**0.757 ± 0.179**	**1.086 ± 0.246**	**1.591 ± 0.271**	**< 0.001**
PN	**0.975 ± 0.278**	**1.131 ± 0.311**	**1.808 ± 0.457**	**< 0.001**
CP	**20.750 ± 5.458**	**23.190 ± 7.341**	**27.220 ± 8.687**	**0.001**
TILB	**0.622 ± 0.251**	**0.746 ± 0.316**	**0.776 ± 0.323**	**0.214**

Results are expressed as mean ±SD. n =patients number.

According to Pearson correlation coefficient, serum MDA had a significant negative correlation with total BMD (r= -0.307, p=0.024) and lumbar spine BMD (r= -0.387, p=0.004) (Figures 1 and 2, Tables 4 and 5).

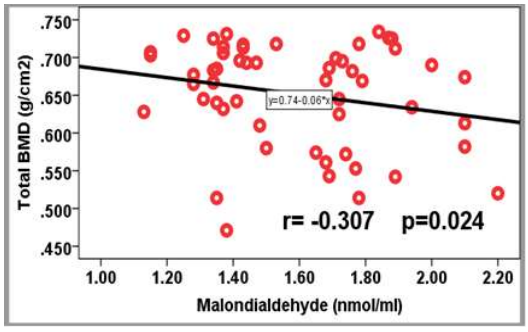

Figure 1: Correlation Analyses Between MDA and total BMD in Osteoporotic Women

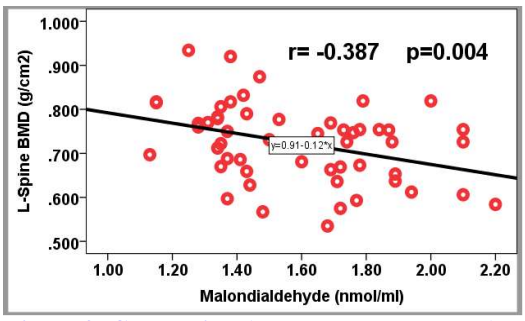

Figure 2: Correlation Analyses Between MDA and L-Spine BMD in Women Osteoporotic

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Table 5: Pearson Correlation Coefficients for the Association of OS Markers with BMD at Different sites in Osteopenic Women

	Pearson correlation coefficients		
OS markers	**Total BMD**	**L-spine BMD**	**Pelvis BMD**
MDA	**-0.215**	**-0.200**	**-0.010**
	***P*=0.384)**	***P*=0.079**	***P*=0.589**
PN	**-0.211**	**-0.025**	**-0.130**
	***P*=0.38)**	***P*=0.384**	***P*=0.384**
CP	**-0.206**	**-0.178**	**-0.034**
	***P*=0.07)**	***P*=0.118**	***P*=0.768**
TBIL	**-0.075**	**-0.039**	**-0.026**
	***P*=0.384)**	***P*=0.384**	***P*=0.384**

Table 4: Pearson Correlation Coefficients for the Association of OS M<arkers with BMD at Different sites in Osteoporotic Women

	Pearson correlation coefficients		
OS markers	**Total BMD**	**L-spine BMD**	**Pelvis BMD**
MDA	**-0.307***	**-0.387****	**-0.226**
	P=0.024	**P=0.004**	**P=0.101**
PN	**-0.110**	**-0.232**	**-0.177**
	P=0.428	**P=0.092**	**P=0.201**
CP	**-0.248**	**-0.147**	**-0.209**
	P=0.07	**P=0.288**	**P=0.129**
TBIL	**0.118**	**0.126**	**0.034**
	P=0.395	**P=0.363**	**P=0.81**

**** Significant correlation at the 0.01 level**

*** Significant correlation at the 0.05 level**

However, no relation was found between MDA and pelvis BMD values. As well as, serum PN, CP and TILB presented no significant relation with measured BMD. In osteopenia, serum oxidative stress levels exerted no significant correlation with BMD.

DISCUSSION

In the present study, there were increased levels of oxidative stress parameters in osteoporotic and osteopenic women as compared with healthy women recognized by a significant increase in serum malondialdehyde levels. The similar result had been reported by Chavan *et al*(2007) who revealed that the concentrationof serum MDAwas significantlyelevated in osteoporotic women compared with healthy women [12]. As well as, the findings of this study are in accordance with Sontakke and Tare (2002) who proposed that enhanced osteoclastic activity in women with low BMD may have been responsible for increased production of ROS in form of superoxide, which was proved by elevation of serum MDA levels compared with control group [13]. Therefore, MDA may serve as an indicator of lipid peroxidation by ROS and proved by a significant inverse correlation of MDA with total and lumbar spine BMD in osteoporotic women. In contrasts, Maggio *et al*., (2013) determined the marker (plasma MDA) of free radical-mediated lipid peroxidation and noticed no differences among groups[14].

CP is proved to be an antioxidant parameter and acute phase reactant in inflammatory diseases which was noticed in several chronic inflammatory diseases[15,16].

Development of secondary osteoporosis is related to the chronic inflammation[17]. In the present study, investigation of ceruloplasmin revealed significantly (p< 0.01) higher mean values of this marker in osteoporotic and osteopenic women compared with healthy women. These findings come in line with the results of a cross-sectional study of Karakas *et al* (2016) for evaluating CP levels in subjects without chronic inflammatory disease and found that serum CP

levels were higher in osteoporotic women than in healthy individuals[18]. On the contrary, a study of Cervellati *et al* (2014) showed that the difference between CP levels in subjects with OP and healthy subjects was not statistically significant[19].

Another oxidative stress marker studied was peroxynitrite, an oxidant which produced by the rapid reaction between superoxide (O_2^-) and nitric oxide (NO)[20]. Peroxynitrite ($OONO^-$) is considered as a major tissue-damaging species that cause different changes in proteins through oxidation of sulfhydryl groups of methionine and cysteine besides selectively nitrating tyrosine and tryptophan residues[21]. The study of Rocha and Brum-Fernandes (2002) proved that PN addition to human osteoblast-like cells culture inhibits proliferation and differentiation of these cells. Also, it shows that addition of IFN-γ to cultured osteoblast-like cells causes formation of 3-nitrotyrosine, proposing that these cells are able to generate PN under stimulation of cytokine[22]. However, the outcome of this study noticed significant differences between control and patient groups in serum PN levels.

In this study, serum TBIL levels were investigated to study the possible relation between TBIL and osteoporosis. The results are indicating that concentration of TBIL is (0.776 ± 0.323 mg dl) in osteoporotic women, (0.746 ± 0.316 mg/dl) in osteopenic women and (0.622 ± 0.251 mg/dl) in healthy women. The results show that mean values of serum TBIL were within normal range in all groups and that they were less in patients with normal BMD than in patients with low BMD, though it is not significant. In the study performed in human primary osteoblasts and human osteosarcoma cell line(SAOS-2), Ruiz-Gaspa *et al* (2011) demonstrated that bilirubin at low concentration (0.6 mg/dl) noticed in patients without liver diseases wassignificantly elevated viability of osteoblast and increase mineralization of osteoblast[23]. However, several studies proved a positive relationship between BMD and serum TBIL levels [24] due to it is antioxidant and anti-inflammatory effects, which may protect from bone loss [25]. Even though several studies on the relationship between serum levels of TBIL and osteoporosis have been conducted, but the results were controversial and inconsistent. In the cross-sectional study on postmenopausal Korean women, it was found that TBIL showed a weak or no relationship with BMD[6]. Moreover, no certainty is available whether serum TBIL under normal physiologic levels is a protective or risk factor for osteoporosis [26].

In this study, vitamin D status was evaluated and results show that 70% of women under study had vitamin D insufficient with serum levels 18.207 ng/ml which come in line with the outcome of the cross-sectional study done in Kirkukcity by Ali (2018) who found that 59% of women were suffering from vitamin D insufficient and had mean value less than 20 ng/ml[27]. Another study done in Kingdom of Saudi Arabia revealed that 61.5% of their patients had moderate to severe vitamin D deficiency with serum levels below

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20ng/ml[28]. The reason for the decline in serum levels of vitamin D may be due to less outdoor activities of the women and decrease or covered exposure to sunlight due to clothing habits in the study location, this will prevent the conversion of vitamin D in the skin to the active form[29]which is responsible for maintenance of serum calcium and phosphorus levels. As well as, vitamin D deficiency promotes a compensatory increase in parathyroid hormone levels[30]. As a result, bone loss is accelerated increasing the chance of developing osteoporosis [31]. In addition, this study failed to confirm significant differences in serum vitamin D levels between the study groups because more than one-half (55.3%) of participants were on vitamin D supplementation. Accordingly, the same mean values were observed in subjects with low BMD and subjects with normal BMD. Similar findings were demonstrated by other studies[32,33]. In contrast with these findings, a systematic review of Gaugris *et al* (2005) revealed that an inadequate vitamin D level in postmenopausal women was a common osteoporosis risk factor [34].

The outcome of this study revealed no significant differences in mean values of serum calcium among groups and this result might be because 65% of the women were taking calcium supplement. However, several studies reached the same results and found that serum calcium determination was of no significant values statistically for diagnosis of osteoporosis as their results were within normal range [18, 34]. In conclusions, the outcomes of this study confirm the relationship of elevated serum levels of MDA, PN and CP with reduced BMD in postmenopausal women. In addition, results of correlation analysis showed a positive association between OS parameters and osteoporosis recognized by a significant negative correlation of MDA with total and lumbar spine BMD in osteoporosis women. The results obtained by this study would propose that OS may have a role in the development of OP by enhancing bone resorption rate.

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CONFLICT OF INTEREST

The authors declared that they have no COI.

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ثوختة

باری- دذة تةئةكسودى ل دةف ئافرةتنيَن ل تةمةنىَ بىَ ئوميَيدى ىَ توشبويَن ثيَتى بوونا هيَسكى ل باذيَرىَ دهوكى.

ثيَشةكى و ئارمانج: ثيَتى بوونا هيَسكا بارىَ زيَدةبوونا داخورانا هيَسكى ية كو دبيتة ئةطةرىَ تةنكبونا وشكةستنا هيَسكى. هاتة ديتن كو ثالدانا تةئةكسودى ثةيوةندى دارة ب ساخلةميا هيَسكى. ئةظ ظةكولينا نوكة, بةراوردكرنا نيشانين ثةستانا تةئةكسودى ل شلى(مصل الدم) خوينا ئافرةتيَن ل تةمةنى بىَ ئوميدى دا توشبويين ثيتى بونا هيَسكى و ئافرتيَن ساخلةم دا هاتة كرن ولطةل دياركرنا ثةيوةنديا دناظبةرا ظان نيشاندنا وضربونا ناظةروكا هيَسكى.

ريَكيَن ظةكولينىَ: دظىَ ظةكولينا نوكة دا 150 ئافرةت ل تةمةنىَ بىَ ئوميَدى ىَ دا هاتنة هةلبذارتن ذ وان ئافرةتا كو سةرةدانا سةنتةرىَ نةخوشييَن روماتيزميَ كرين بو تيست كرنا ضريا باريتا هيَسكى, ليستةكا استبيانى هاتة دروست كرن بو كومكرنا زانياريين داخازكرى ذ وان بةشداربويان. ثيظانا ريَذةيا مالونديالديهايد, سيريولوبلازمين, بيروكسى نايترايت, بيليروبينا طشتى, ظايتامين د وكالسيومى د ناظ شلىَ خوينىَ (مصل الدم) دا هاتة ئةنجامدان.

ئةنجام: ظةكولينا نوكة هاتة كرن لسةر 150 ئافرةتا لديف ريَنمايين ريَكخراوا ساخلةميا جيهانى, ضريبا سروشتى يا بارستا هيَسكى هاتة ديتن 12% ذ طشتى بةشداربووان. ريَذةيا ئافرةتيَن توشى نةرمبونا هيَسكى بوين 52% بوون, بةلىَ ثا ريَذةيبا ئافرةتيَن توشى ثيَتى بوونا هيَسكى بوين 36% بوون. بةهار مالونداليديهايد, سيريولوبلازمين وبيروكسى نايترايت بةرز بوو لدةف ئافرةتيَن توشى ثيَتى بوونا هيَسكى بوين بةراوورد دطةل ئافرةتين نةتوشبوى. تيَكرايا بيليروبين ياطشتى وكالسيوم جيَطير بوون نةهاتنة طوهورين هةروةسا ض طوهورينةكا بةرضاظ ثةيدا نةبوو دبةهاييَن ظايتامين د لطةل بةلاظ بوونا كيَمبونا ظايتامين د ل دةف هةمى ئافرةتيَن بةشداربووى بطشتى.
ظةكولينى دياركر هةبوونا طريَدانةكا نيطةتيف يابةرضاظ دناظبةرا مالونداليديهايد وضريبا بارستا هيَسكى طشتى لطةل بربرا ثشتىَ (فقرات قطنية)ل دةف ئافرةتيَن توشبووى ب ثيَتى بوونا هيَسكى.

دةرئةنجام: ئةنجام ودةستكةفتييَن ظىَ ظةكولينا نوكة ثيَشنياردكةن كو نيشانيَن ثةستانا تةئةكسودى لةوانةية ب نرخ بن بو دةست نيشانكرنا دابةزينا ضريبا بارستا هيَسكى ل لاىَ ئافرةتيَن دذى ىَ بىَ ئوميدى ىَ دا

الخلاصة

حالة التأكسد- مضادات التأكسد لدى النساء في سن اليأس المصابات بمرض تنخر العظام في مدينة دهوك

الخلفية والاهداف: تنخر العظامعبارة عن حالةتناقص الكتلة العظمية والتيتؤدي الى زيادة ترقق العظاموبالتالي سهولة تعرضهاللكسور. وقد ثبت ان الكرب التأكسدي من العوامل المؤدية الى الزيادة في سرعةأرتشاف العظم. وبناء عليه فأن هذه الدراسة تهدفالى مقارنة مؤشرات الكرب التأكسدي بين النساء في سن اليأس واللاتي يعانين منمرض تنخر العظام مع المجموعة الضابطةوايضاح العلاقة بين هذه المؤشرات وكثافة كتلة العظام.

طرق العمل: في هذه الدراسة المقطعية تم اختيار 150 امرأة في سن اليأس ممن ترددن على مركز امراض المفاصل والتأهيل الطبي في محافظة دهوك لاجراء فحص كثافة العظام. وقدتم تصميم قائمة استبيان لجمع المعلومات المطلوبة من المشاركات .مؤشرات الكرب التأكسدي التي تم تقديرها في مصول الدم تمثلتبالمالوندايالديهايد, السيريولوبلازمين, البيروكسي نايترايت و البيليروبين الكلي بالاضافة الى دراسة تاثير الكالسيوم و الفيتامين د.

النتائج: اجريت الدراسة الحالية على 150 امرأة طبقا لمواصفات منظمة الصحة العالمية, قدرت كثافة العظام الطبيعية في 12% من مجموع المشاركات.في حين شكلت النساء المصابات بضعف العظام 52% بينما كانت نسبة النساء المصابات بتنخر العظام 36%. وقد اظهرت نتائج كل من المالوندايالديهايد, السيريولوبلازمين و البيروكسي نايترايت في المرضى وجود دلالة احصائية عند المقارنة مع المجموعة الضابطة في حين لم يتغيرمعدل قيم البيليروبين الكلي والكالسيوم. كما لم يظهر اختلاف ملحوظ في قيم الفيتامين د مع شيوع نقص الفيتامين د بين مجموعات الدراسة.كما بينت النتائج وجود ارتباط سلبي بين المالوندايالديهايد و كثافة العظم الكلي والكثافة العظميةللفقرات القطنية لدى النساء المصابات بتنخر العظام.

الاستنتاجات: تشيرنتائج الدراسة الحاليةالى ان مؤشرات الكرب التأكسدي منالممكن ان ان تلعب دورافي تشخيص انخفاض الكثافة العظمية لدى النساء في سن اليأس.

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