

Bone Function Test In Meshraq Sulfur Fields Workers

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الخلاصة:

تم قياس مستوى الكالسيوم والفسفور وفعالية إنزيم الفوسفاتيز القاعدي والألبومين في دم خمسة وأربعون عاملاً في حقول كبريت المشراق وفي دم خمسة وأربعون شخصاً من الناس البعيدين عن حقول المشراق مشابهيهم لهم في العمر والجنس كمجموعة سيطرة. تم أخذ جميع نماذج الدم بدون تورنيكا. أجريت الفحوص في قسم الكيمياء السريرية / كلية طب بجامعة الموصل.

أثبتت النتائج وجود فرق معنوي بشكل نقصان في مستوى الكالسيوم و في مستوى الفسفور وزيادة في فعالية إنزيم الفوسفاتيز القاعدي في العاملين في حقول المشراق مقارنة بالمستوى الطبيعي لتلك المواد في عينات مجموعة السيطرة. بينما وجدنا أنه لا يوجد فرق معنوي في مستوى الألبومين في دم العاملين في حقول المشراق عند مقارنتها بمجموعة السيطرة.

أثبتت النتائج وجود فرق معنوي في الإصابة بتغيرات تشابهه الوهن العظمي في دم العاملين في حقول كبريت المشراق عند مقارنتها بمجموعة السيطرة.

نستنتج مما تقدم أنه من الشائع وجود حالة وهن العظام في العاملين في حقول كبريت المشراق وهذا قد يفسر بعض من الآلام المفصليّة التي يشكو منها عمال كبريت المشراق.

Abstract:

Serum calcium, phosphorus, alkaline phosphatase and serum albumin were estimated in 45 workers in Meshraq sulfur fields and in 45 people far from these fields as a control group. Blood samples were taken without tourniquet. These tests were performed at the laboratory of Department of Clinical Chemistry, Mosul Medical College.

The results showed that there was significant decrease in the level of serum calcium and phosphorus in those who worked in Meshraq sulfur field compared to control group. There was significant increase in serum alkaline phosphatase activity in Meshraq sulfur field worker compared to control group. There was no significant difference in the level of serum albumin between the two groups. The osteomalacia like changes in bone function test was significantly higher in Meshraq sulfur field workers in comparison to control group.

It was concluded from the mentioned above results that there is high incidence of osteomalacia in those who work in Meshraq sulfur field and this in turn might explain some of bone and joints pain from which Meshraq sulfur field workers complain

Key words: Sulfur pollution, Bone function test, Osteomalacia.

Introduction:

Sulfur as a naturally occurring element is very necessary for life, however, when oxidation of sulfur occurs, sulphuric acid can be formed, leading to free radical pathology¹. Sources of sulfur pollution included, combustion of fuels in power stations, motor vehicle emissions, industrial processes , waste disposal and in domestic situations as a food preservative, e.g. in dried fruits^{1,2,3}. Levels of sulfur dioxide can be present in the atmosphere in certain climatic conditions, especially in

smog. Sulfur dioxide gas can become further oxidized by air enriched with water droplets and ozone, particularly in the presence of fog or cloudy air; this causes the formation of free radical¹. The reaction between SO₂, water and ozone resulting in sulphuric acid, this reaction is facilitated by the presence of hydrocarbons and particulates (such as heavy metals like)¹. It is well-known that cadmium and aluminum toxicity cause osteomalacia in bone^{2,3}. Osteomalacia is disorders in which mineralization of the organic matrix of the skelton is defective².

Meshraq sulfur fields started at 1970s; it is situated 50 km to the south of Mosul. It is one of the largest sulfur fields in the world. During April, May and June 2003 huge burn of the fields causes wide sulphur perfumes pollution. More than 300000 tons of sulfur was burned. The damaging effects extended on a wide area around the fields; its damaging effect was largely on farms and different plants. The wide pollution with sulfur perfumes in Meshraq area and the frequent complains of Meshraq sulfur fields workers from bones and joints pain stimulate us to investigate the relation between sulfur perfumes exposure and bone function tests. .

The aim of this study was to assess the bone function test in Meshraq sulfur field workers, looking for a relation between sulfur perfumes exposure in Meshraq sulfur field workers and bone profile test reflected on by calcium, phosphorus, and alkaline phosphates in the serum.

Materials and Methods:

Between July- September 2005, bone function tests done to 45 workers in Meshraq sulfur fields whom they complain of arthralgia and to 45 normal persons. Blood samples (5 ml) were obtained from 45 workers in Meshraq sulfur fields and from 45 apparently healthy persons as

control group by ante cubital venepuncture between 8 a.m. and 9 a.m. without tourniquet. The mean age of the workers of Meshraq sulfur fields were 44 years, their mean duration of working in Meshraq sulfur fields was 16.4 years. The control group was selected from areas far from the fields (from Mosul city) with the same age and sex, the control had no orthopaedic complaint, and their mean age was 43.5 years. All the workers and the control group were males.

Immediate centrifugation at 3000 rpm for 15 minutes was carried out. Serum samples were collected in a small container and stored in deep freeze at -20°C waiting for analysis. Before conducting the assay, thawing of the samples were allowed to take place at 4°C . Serum calcium, phosphorus, alkaline phosphatase activity, and serum albumin measurements were performed in the clinical chemistry Laboratory, Department of biochemistry in Mosul Medical College.

The calcium phosphate product measured in the two groups. The calcium phosphate product (derived by multiplying calcium and phosphorus levels expressed in mmol/L) normally about 3, which is diminished in rickets and osteomalacia and the values less than 2.4 are diagnostic.

The statistical analysis was carried out by student's (t) test. A p-value of < 0.05 was considered statistically significant. Chi-square (X^2) was used for statistical analysis of qualitative data.

Results:

The results of mean serum calcium of workers in Meshraq sulfur fields were 2.158 mmol /dl with standard deviation 0.098. While that of the control group was 2.28 mmol /dl with standard deviation 0.1, so there was a significant difference (Table -1). The mean of serum phosphorus of

workers in Meshraq fields group was .98 mmol /dl with standard deviation 0.1. While that of the control group was 1.138 m mol /dl and standard deviation of 0.105, so there was a significant difference between the two groups ($p < 0.001$) (Table-1).

The mean of serum alkaline phosphatase in the workers in Meshraq fields was 12.3 KAU with standard deviation 1.992, while that of the control group was 7.044 with standard deviation 1.167 and there was a significant difference ($p < 0.001$) (Table-1). The mean of serum albumin was 3.834 gm/ dl in the workers in Meshraq fields with standard deviation 0.225. While that of the control group was 3.789 gm/dl with standard deviation 0.200 in the control group. There was no significant difference between the two groups (Table-1).

The calcium phosphate product was less than 2.4 (indicate osteomalacia) in 21 patients from Meshraq sulfur field workers, and in one of the control group. The difference was highly significant ($p < .001$).

Discussion:

There is compelling evidence that SO_2 has deleterious effects on human health^{4,5,6}. From this study there was a decrease in the level of serum calcium and phosphate and an increase in serum alkaline phosphatase in Meshraq sulfur field workers. The results of Meshraq sulfur field workers were in favor of osteomalacia. These changes are common to almost all types of osteomalacia. Osteomalacias are disorders in which mineralization of the organic matrix of the skelton is defective². The incidence of osteomalacia is very common in Meshraq sulfur field workers. It is difficult to determine exactly the clear cause of these bone changes; since it is not known wither these changes result from sulfur compounds directly or from a secondary effect of aluminum or cadmium toxicity or from other toxic factors. Further study is needed to explain these findings and to study the extent of these changes in the population

living around these fields, and to study the other effect of sulfur pollution on human health, animals, plants and environment.

In nature, acid rain is formed by the wet precipitation of sulphuric and nitric acids caused by the burning of fossil fuels. The rain affected by the sulfur and nitrogen oxides is very acidic^{1,2}. Rain will acidify groundwater and soil. Water of a low pH will leach out metals like cadmium and lead; it also causes aluminum salts to dissolve^{1,2}. These metals will damage plants and may be toxic to animals and they are a known cause of osteomalacia. ^{1,2,3}. Thus the fate of sulfur and sulfur dioxide is closely linked from the atmosphere to the soil and will affect the entire food chain^{1,2,3}.

The acidity (sulfur related) of diet initiates and perpetuates bone demineralization as seen by serial bone mineral density studies done by direct photon absorpiometry^{7,8}. The reduced acid load, milk and its products which are very rich source of calcium, and increased vitamin and mineral content of vegetarian food makes it the preferred food for preventing joint and bone complications ^{8,9}. Furthermore, it has also been noticed that there is a very strong relationship between joint pains like 'frozen shoulder, cervical spondylosis and arthritis and the kind of food taken. The high sulfur content of the food causes acidification of the blood which melts the bones in an attempt to buffer this excess acid load. The kind of food leads to excess acid load in the blood which the kidneys are unable to cope with, Hence this acid causes inflammation of all joints^{7,8}.

It was concluded that prolonged exposure to sulfur foams in Meshraq sulphur field workers causes osteomalacia, and it is essential to study this problem in more details. It is essential to protect workers and local population from sulfur pollution and to initiate a health programme to treat these effects in the future.

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Table -1: Comparison between serum calcium, phosphorus, alkaline phosphate and albumin in Meshraq sulphur field's workers and control group.

Blood test	group	Mean	Standard deviation	t- value	significant
<i>Serum Calcium in mmol/ dl</i>	case	2.158	0.098	6.051	0.001
	control	2.280	0.100		
<i>Serum phosphorus in mmol/ dl</i>	case	0.980	0.100	8.584	0.001
	control	1.138	0.105		
<i>Serum alkaline phosphatase in KA Unit</i>	case	12.300	1.992	15.464	0.001
	control	7.044	1.167		
<i>Serum albumin in gm/ dl</i>	case	3.834	0.225	1.026	N.S
	control	3.789	0.200		