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Study the Relationship between the Concentration of Minerals and Joints Pain

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Abstract : To study the relationship between the high level of electrolytes (sodium and potassium, and calcium) in the blood and the joints pain, as well as to see if we can consider that rise is acting a reason to feel this type of pains, and to study other factors could playing a role in the raising of electrolytes level such as age, weight, and infection with some other diseases ; the concentration of these electrolytes have been measured in the serum of patients whom suffer from joints pain, where this research was done in Imam Hussein Medical city, Hussein General Hospital, Karbala, Iraq.
When we comparing the obtained results for patients with the results of healthy individuals samples we have noticed abnormal levels (in rising levels) of these electrolytes in patients who suffer from pain in the joints and we have found that the result was affected by weight of patients and also in presence of other diseases factor such as blood pressure, Also we have not noticed any effect of the age factor on the results.
Keywords: Concentration of Minerals, Joints Pain.

Introduction

Blood chemistry is a set of blood tests, which include a number of different compounds or ions in the blood, which is to take place in a chemical laboratory. This differs from the rest of the other types of blood during which blood cells combination screening tests, antibodies, clotting, hormones and the like factors. [1]

Minerals are inorganic substances, present in all body tissues and fluids and their presence is necessary for the maintenance of certain physicochemical processes which are essential to life. Minerals are chemical constituents used by the body in many ways. Although they yield no energy, they have important roles to play in many activities in the body [2,3] Every form of living matter requires these inorganic elements or minerals for their normal life processes.[4,5]. Electrolyte are Positively and negatively charged species present in extra-cellular and intra-cellular systems, plasma and fluids. Electrolytes are responsible for maintaining various critical functions within the body [6]

- The minerals required in human nutrition can be grouped into macrominerals and microminerals (trace elements) (Table .1). . [7,8]
- The macrominerals are required in excess of 100 mg/day.
- The microminerals or trace elements are required in amounts less than 100 mg/day

Table 1 : Minerals required in human nutrition

Macrominerals	Microminerals or Trace elements
Sodium	**Cobalt**
Chlorine	**Fluoride**
Phosphorus	**Iron**
Sulfur	**Molybdenum**
Calcium	**Chromium**
Magnesium	**Copper**
Potassium	**Iodine**
	Manganese
	Selenium
	Zinc

Elements or minerals have special chemistry separated from chemistry of other food types, such as fat, carbohydrates and other. It deals with the study of the importance and function of minerals in addition to the implications of the their presence in abnormal amounts i.e. study the diseases resulting from high concentrations of minerals or diseases resulting from the decline it. So in this work will be study the relationship between the level of electrolytes calcium, sodium and potassium in the blood and the joints pain.

Calcium absorption requires calcium-binding proteins and is regulated by vitamin D, sunlight, parathyroid hormone and thyrocalcitonin. Thyrocalcitonin decreases plasma calcium and phosphate levels whereas parathyroid hormone increases them. Dietary calcium and phosphorus are absorbed mainly in intestine [4]. Absorption of calcium is facilitated by a low intestinal pH which is necessary for its solubility and thus normal gastric secretion of hydrochloric acid or H+ is necessary for efficient absorption [9]. Calcium functions as a constituent of bones and teeth, regulation of nerve and muscle function. In blood coagulation, calcium activates the conversion of prothrombin to thrombin and also takes part in milk clotting. It plays a vital role in enzyme activation. Calcium activates large number of enzymes such as adenosine triphosphatase (ATPase), succinic dehydrogenase, lipase etc. It is also required for membrane permeability, involved in muscle contraction, normal transmission of nerve impulses and in neuromuscular excitability. A reduced extracellular blood calcium increases the irritability of nerve tissue, and very low levels may cause spontaneous discharges of nerve impulses leading to tetany and convulsions [9,10]

Sodium and Potassium the principal cations in extracellular fluids. It regulates plasma volume and acid-base balance, involved in the maintenance of osmotic pressure of the body fluids, preserves normal irritability of muscles and cell permeability, activates nerve and muscle function and involved in Na+/K+-ATPase [9].

Maintenance of membrane potentials, transmission of nerve impulses and the absorptive processes of monosaccharides, amino acids, pyrimidines, and bile salts. [11]. Its metabolism I regulated by aldosterone. Commonly used vegetable foodstuffs do not contain sufficient quantities of sodium to meet the animal's dietary need. This inadequacy is compensated for by including sodium chloride, common salt, in their diet or by allowing them to consume salt. Sodium is readily absorbed as the sodium ion and circulates throughout the body. Excretion occurs mainly through the kidney as sodium chloride or phosphate. There are appreciable losses in perspiration, and the quantities lost by this route vary rather markedly with the environmental humidity [9].

Potassium is also required during glycogenesis. It also helps in the transfer of phosphate from ATP to pyruvic acid and probably has a role in many other basic cellular enzymatic reactions. Its metabolism is regulated by aldosterone. Hyperkalaemia is increased level in serum potassium and this occurs in Addison's disease, advanced chronic renal failure, shock and dehydration. Toxicity disease or symptoms include dilatation of the heart, cardiac arrest, small bowel ulcers. Hypokalaemia is low level of serum potassium and this occurs in diarrhoea, metabolic alkalosis and familial periodic paralysis. When lactating dairy cows have hypokalaemia, the milk production is markedly lowered. Deficiency disease or symptoms occurs secondary to illness,

functional and structural abnormalities including impaired neuromuscular functions of skeletal, smooth, and cardiac muscle, muscular weakness, paralysis, mental confusion. The rapidly growing animals apparently have a higher requirement for potassium, and increasing the protein level increases the requirement. Plant products contain many times as much potassium as sodium. Sources include vegetables, fruits, nuts [4,3,7].

Joint pain is among the most frequent types of pain. The main causes of joint pain are trauma and acute and chronic arthritis. Usually joint pain is associated with disturbed function of the joint, ranging from restricted movements to disability[12]. Diagnosis of joint pain is based on physical examination X-ray, MRI, examination of synovial effusion, and blood tests, Blood tests are used to check inflammatory markers [13]. The articular cartilage of diarthrodial joints serves several important functions: joint lubrication, stress distribution to subchondral bone to minimize peak stress, and provision of a smooth low-friction surface. Repetitive and acute impact, as well as torsional joint loading can damage articular cartilage surfaces of the knee joint. Injury to articular cartilage can lead to pain, swelling, joint dysfunction, and possibly progressive joint degeneration [14,15].

The concentration of these elements could be measured in many ways such as Flame Photometer, Biochemistry autoanalyzer, blood gas analyzers and other methods. A method with autoanalyzer is more common method to determine the concentration of minerals [16,17,18] so we use it in this research.

2- Procedure

The specimens were collected from patients whom suffers from joints pain at Al- Hussein Medical City ,Karbala , Iraq. For period from 1/10/2015 to 1/3/2016. The questioner information has been taken from all studied cases which include Age, sex , Weight , and another chronic disease [19]. 5*mL* of blood was collected from forty five patients and fifteen specimens of as controlling factor for comparison. The concentrations of Na , K , Ca ions were measured by - *Cobas e411* system in laboratory unit , Al- Hussein Medical City. All the results were tabled into healthy and patients' cases. The comparison was done between the healthy and patient person according to : *a*- Weight of persons *b* - Age of persons. *c*-Other disease which patients suffer from it.

3- Discussion

In this type of study should be repeated to be certain that such differences were due to the presence of numerous variables. Therefore, as complete data as possible were collected on each patient. Normal and joints pain subjects were studied simultaneously, and sera from both groups were analyzed at the same time in our the laboratory. Moreover, the serum electrolyte levels were studied in relation to actual values, rather than to just the presence or absence of joints pain and other disease.

Statistical analysis of our data revealed significant relationships between joints pain and these electrolyte concentrations. Each patient in this study was asked: "1- Do you salt your food 2- do you has another disease 3- how old you 4- how much you weighting " These were the same questions used by Dahl[19], who found a direct relationship between elevation of the hyper tension and these meters. We comparing the obtained results for patients with the results of healthy individuals samples we have noticed the following :

3.1 Effect of weight

We noticed through the taken samples that there is a rise in the level of electrolytes (Ca^{+2}, $Na^{+}$and K^{+}) from the normal level in the serum of people whom have obese with varying of values for male and female and is affects on the cartilage composition since the salts of these ions precipitate on the cartilage and may lose some of the its flexibility, which pays for patients identified to feel pain in the arthritis and it is what has been proved in the [20]. The data was tabled in table 3.1 to compare between patients and healthy data .

Table 2: comparison between patients and healthy data according to BMI

BMI (weight Kg / tall m^2)	Values of Electrolytes		
	Calcium N.V= (8-10 mg / dL)	**Potassium N.V = (3-5 mg / dL)**	**Sodium N.V = (135-145 mg / dL)**
< 20	**9.2-9.8**	**3.0-4.2**	**136-142**
20-25	**9.1 – 10**	**3.8 – 4.5**	**140-145**
25-30	**9.5 – 10.2**	**4.3 – 5.1**	**142-148**
35-40	**9.5 – 10.5**	**4.8 – 5.5**	**144 – 155**

The level of obesity was measured by body mass index equation [21] as shown in the fig 3.1 below

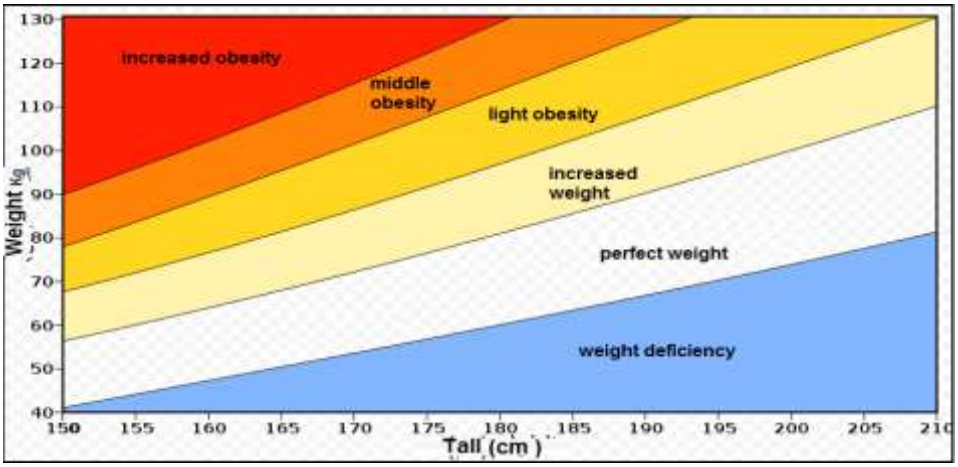

Fig.1 BMI index

3.2 Effect of Age

The obtained results isolated and classified it according to age into several periods to ease of comparison and then statistically treated, we have found the concentration of electrolytes (Ca^{+2} , Na^{+} and K^{+}) did not influenced by age for the patients and healthy people, furthermore that the change of electrolytes values are disproportionate with age in cases of high or low amounts of these elements and the increasing and decreasing about the normal level resulting from other causes will be described in other section in this chapter . Table 3.2 show the distribution of the taken samples according to age .

Table 3: the distribution of the taken samples according to age .

Age (Years)	Values of Electrolytes		
	Calcium N.V= (8-10 mg/dL)	**Potassium N.V = (3-5 mg / dL)**	**Sodium N.V = (135-145 mg / dL)**
50-55	**7.5 – 9.1**	**3.80 – 4.12**	**128 – 161**
55-60	**7.5-9.2**	**4.02 – 4.51**	**151 – 157**
60-65	**7.77 - 9.25**	**4.52 – 4.99**	**138 - 149**
65-70	**7.23 - 9.33**	**4.11 – 5.01**	**139 – 151**
70-75	**7.01 - 10.2**	**3.55 – 5.20**	**140 – 145**
75-80	**8.5 - 10.5**	**3.09 – 4.85**	**135 – 146**
80-85	**9.22 - 9.91**	**3.88 – 4.88**	**136 – 147**
85-90	**8.25 - 11.09**	**4.21 – 4.98**	**139 – 150**

3.3 Effect of another disease

As we said previously that the high and the low level of these electrolytes values in the blood serum may be caused by another factors , not from previous scales. The most important of these factors are an other diseases which the patient suffered it in addition to Arthritis inflammation like Blood pressure that also caused by rise in level of electrolytes, especially sodium, which We had it a special section isolated from the other disease, such as diabetes, myocardial disease, anemia and kidney disease.

3.3.1 Blood Pressure

When comparing the obtained results for people who suffer from high blood pressure and also have arthritis inflammation with people whom have just arthritis inflammation noticed a rise in the level of electrolytes in both cases when you compare them with healthy people, but we observed that rise of concentrations of electrolytes (Ca^{+2} , Na^{+} and K^{+}) people who suffer from high blood pressure and also have arthritis inflammation more than values in case people whom have just arthritis inflammation.

Over this note from the table below that the high concentration of sodium more than the other electrolytes and this is expected result of sodium fact has a direct effect on blood pressure for it and how much is expected that those who suffer from high blood pressure to have an increase in the concentration of ions in the serum and is what also it affects the cartilage composition as precipitate salts of these ions in the cartilage, which lose part of its flexibility and therefore the patient feels pain in the joints. Also must note here that the rise in blood pressure is not a reason for joints pain but increased sodium ion concentration is a cause of high blood pressure [19] and arthritis inflammation [22]. The following table 3.3 shows a comparison between the concentrations of ions in people who suffer from high blood pressure and also have arthritis inflammation with people whom have just arthritis inflammation

Table 4: comparison of electrolytes concentration people who suffer from high blood pressure and also have arthritis inflammation with people whom have just arthritis inflammation

Cases	Values of Electrolytes		
	Calcium N.V= (8-10 mg/dL)	**Potassium N.V = (3 -5 mg / dL)**	**Sodium N.V = (135-145 mg / dL)**
With Hyper tension	**8.25 – 11.05**	**4.72 – 6.22**	**145 – 157**
Without Hyper tension	**8.30 – 10.55**	**3.53 – 5.91**	**144 – 155**

3.3.2 other disease

When comparing the results of people who have other disease not high blood pressure, such as heart and kidney disease as well as aching joints and compared them statistically with people who have arthritis inflammation just also found a rise in the concentration level of ions (Ca^{+2} , Na^{+} and K^{+}) as we show in table 3.3 this rise may be the result of an imbalance in the work of the kidney and filtered salts for these ions, leading to remain it in blood and may be transport to the joints and precipitation on the cartilage, leading to the loss of the cartilage of a part of its flexibility and a sense of the person feel pains in the joints.

Table 5 : concentrations of electrolytes in patients have other disease

Cases	Values of Electrolytes		
	Calcium N.V= (8-10 mg /dL)	**Potassium N.V = (3-5 mg / dL)**	**Sodium N.V = (135-145 mg / dL)**
Without other disease [only arthritis inflammation]	**8.30 – 10.55**	**3.53 – 5.91**	**144 – 155**
Within other disease	**9.5 - 12.2**	**5.52 – 6.72**	**149 – 156**

4- Conclusion

The concentration of the electrolytes (Na , Ca and K) was measured in the serum of forty five patients whom suffer from joints pain and fifteen specimens was collected from healthy persons for comparison. The questioner information has taken from all studied cases which include Age , sex , Weight , and another chronic disease.

Statistical analysis of our data show that there is a rise in the level of electrolytes (Ca^{+2} , Na^{+} and K^{+}) from the normal level in the serum of people whom have obese with varying of values for male and female, while the values did not influenced by age for the patients and healthy people also we observed that rise of concentrations of electrolytes (Ca^{+2} , Na^{+} and K^{+}) people who suffer from high blood pressure and also have arthritis inflammation more than values in case people whom have just arthritis inflammation. When comparing the results of people who have other disease not high blood pressure, such as heart and kidney disease as well as aching joints and compared them statistically with people who have arthritis inflammation just also found a rise in the concentration level of ions (Ca^{+2} , Na^{+} and K^{+}) this rise may be the result of an imbalance in the work of the kidney and filtered salts for these ions.

Finally we conclude that presence this electrolytes in high amount in the body make it precipitated as salt on the cartilage , leading to the loss of the cartilage of a part of its flexibility and a sense of the person feel pains in the joints. Also we recommend to study effect the rising of this electrolytes concentration on another disorder in the body such as blood pressure , heart impulse rate, etc.

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