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Effect of Cigarette Smoking on Some Electrolytes Levels in Men Live in City of Karbala

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Abstract. This study carried out to demonstrate the cigarette smoking effect on some electrolytes such as potassium, sodium, magnesium and calcium in the serum of selected men who have a habit of smoking for 3 years at least . Ninety healthy adult men were participated in this study. Their ages range were (25-40) years.They were divided to the three groups ,the first group was involved thirty healthy adult men; their daily consumption were (10-25) cigarettes(group A).The second group was involved thirty healthy adult men; their daily consumption were (26-40) cigarettes(group B) .The third group was involved thirty healthy adult men volunteers served as control group or(group C) . In this study we found that , there was no significant differences (P>0.05) in the serum levels of either potassium, sodium, magnesium or calcium in group-A of men volunteers who consumed 10-25 cigarettes daily or 26-40 cigarettes daily (group B) for 3 years , when compared to each other and to aged-matched of control men (group C) .

Keywords. Electrolytes, Potassium, Sodium, Magnesium, Calcium, Smoking, Cigarette

INTRODUCTION

The smoking of tobacco is burning the tobacco and inhaling the active substances of the smoke, through the alveoli in the human lungs [1]. The complex and mixture containing at about 5,000 chemical compounds [2] . Probably this mixture is significant source and mediated disease to tobacco in humans [3]. Worldwide 5.4 million premature deaths are due to smoking of tobacco, according to WHO [4]. Chronic obstructive pulmonary disease (COPD) , cardiovascular disease, and many different types of tumors , are the most common tobacco-related death causes , particularly the lung cancer [5] .

Nicotine is a naturally oily liquid alkaloid, its base is a nitrogenous form , which be first isolated from the tobacco ,and considered as a poison [6] . Normally by weight, nicotine makes up at about 5% of a plant of tobacco and depending on the brand, the cigarettes contain (8-20 mg) of nicotine, but during smoking actually only (1mg) is absorbed by the human body [7].

Nicotine metabolized at different rates in different people especially who contain defect genes in the hepatocytes which responsible for the enzymes that participate in breaking down the nicotine, and the metabolizing of it by mutant enzyme is less effective than that by the normal variant ; and usually the smokers carrying this variants are satisfied by many fewer cigarettes because less nicotine needed [8] . Two hours are the half- life time of nicotine to be eliminated from the body [9].

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The common name for the resinous compound in the smoke is a tar ,it is produced by burning of tobacco and other plant material ;it is perhaps contributing to the aroma and taste of cigarettes . In the lungs , the cilia is coated by tar which causing to stop working and prevent the process of gas exchange in alveoli and leading to rough breathing [8] .

Carbon monoxide (CO) gas is generated from insufficient combustion of substances containing carbon , and such amount of CO is generated during smoking of cigarettes, and that is influenced by

puffing methods and design of cigarette ; the large quantities of CO when inhaled , this leading to formation of carboxy-hemoglobin (COHb) [10] . Therefore COHb will not be release the CO, and so Hb will not available to transport oxygen to other parts of the body from the lungs; and this may lead to death, medically that will known as carboxyhemoglobinemia or poisoning by carbon monoxide [11].

The alveoli in the lungs of human can absorb the vaporized gas, resulted from burning the leaves of tobacco and deliver it to blood stream [12]. The trachea and lungs are irritating by high alkalinity of cigar smoke and pipe that are not completely inhaled; the high alkalinity of non-ionized nicotine pH 8.5 compared to pH 5 of cigarette smoke, and readily the mouth and its mucus membrane are the way to absorbed these substances [13].

Substances that inhaled can trigger biochemical reactions in the terminals of nerve and can allow to activate the receptors located in the central nervous system (CNS), ganglia, the junction of skeletal muscles and adrenal medulla [14]. This may lead to increases heart rate and alertness [15]. However, releasing of dopamine by neurons is abundant on nicotine receptors, this receptor is associated with pleasure reinforcing and also memory enhancement [16]. Electrolytes are known as a charged molecules ; in physiology, the main electrolytes are potassium (K+), sodium (Na^{+}), magnesium (Mg2+), calcium (Ca^{2+}), hydrogen carbonate (HCO3−) , hydrogen phosphate (HPO42−) , and chloride (Cl−) [17] .

- **Sodium (Na^{+})**. The main electrolyte found in extracellular fluid is Sodium; its normal level is 136 to 145 mEq/L. and its physiological roles are regulating water and osmotic balance , pairing with $Cl^{-}$and $HCO3^{-}$ to neutralizing charge , conduction of nerve , function of neuromuscular junction , acid-base balance and chemical reactions in the cells as well as membrane transport [18] .
- **Potassium (K^{+})**. The major intracellular fluid (ICF) cation is Potassium , its intracellular levels in the of range 3.5 to 4.5 mEq/ L ; its physiological roles including maintaining cellular neutrality , regulating fluids , ion balancing inside the cell , resting the membrane potential , contraction and conduction of cardiac smooth muscle , transmission of neuromuscular and balancing of acid- bas [19] .
- **Calcium (Ca^{++})**. For living organisms Calcium is essential for cell physiology and cell signaling during the movement of the calcium ion out of and into and the cytoplasm ; it is a major substances used in bone, teeth and shells mineralization [19] . The level of Calcium in plasma is closely related with the level of serum albumin, the protein is calcium bound with it ; so the measurement the level ionized calcium is useful when the albumin ranges in serum is not within normal , or when there is suspecting of calcium disorder , despite a normal level calcium in total [20] .
- **Magnesium (Mg^{++})**. Magnesium is a cation element found intracellularly Its concentration in plasma is 1.8-2.4 mEq/L ; together with calcium and phosphorus at about 70% of the body's supply is found in bones, while the rest 30% is located in the body fluids and soft tissues ; in many essential metabolic processes it acts as a enzymes cofactor, where enzymes activation is necessary for the metabolism ; besides magnesium plays important roles acid-base balance and neuromuscular contractions [21] .

MATERIALS AND METHODS

Ninety healthy adult men were participated in this study; and their informed consent was taken. Their ages range were (25-40) years.Sixty men volunteers were already consumed cigarette smoking for duration at least 3 years. They were divided into two groups according to the number of cigarettes were they consumed daily as follows:

- **Group A**- Thirty healthy adult men; their daily consumption were (10-25) cigarettes.
- **Group B**- Thirty healthy adult men; their daily consumption were (26-40) cigarettes.
- A third group (group C) of healthy men volunteers (thirty nonsmokers, aged-matched to groups A and B) served as control was included in this study.

- **Blood sample:** Five milliliters (5ml) of blood were taken from each men participated in this study. The samples of blood were collected in plane tubes to obtain serum which utilized for the measurement of electrolytes levels (potassium, sodium, magnesiumand calcium). The samples were analyzed by atomic absorption spectrophotometer instrument (Model 210 VGP s/n 560, manufacture Buck).

STATISTICAL ANALYSIS

Analyzing of descriptive data, depending upon the unpaired Student t-test to compare the results between two groups. The data were expressed as mean± SD; where ($P<0.05$) was considered significant in all data presented in this study [22].

RESULTS AND DISCUSSION

Morbidity and mortality are major results for smoking of cigarette worldwide [23]. And the smoking represent an important risk factor for a variety disorders and their pathogenesis [24] .

Smoking of cigarette associated with a different disorders which affecting on various factors, mechanisms and processes ; electrolyte variations are one of set of changes that may occur as a response to smoking . The role of electrolytes during cigarettes smoking is elucidated by several studies as Salih,2015 [13] and Shafagoj and Mohammed, 2002 [11] . In spite of that, there is no enough information to impact the role of smoking on electrolytes in human body and this, may be due to the variation in methods styles which dealing with the clinical and physiological manifestations.

We proposed to conduct a study to demonstrate whether or not, the smoking of cigarette may affecting on serum levels of potassium ,sodium, , magnesium and calcium . The current study indicated that there were no significant differences ($p>0.05$) in the serum levels of potassium, sodium, magnesium and calcium compared with control group. As shown in Table 1. Fig. 1, 2 ,3 and 4.

TABLE 1. The mean and standard deviation of Serum Electrolytes (Na^+), (K^+), (Ca^{++}) and (Mg^{++}) in

Groups (n.)	**Mean and SD (Na^+) mg/dl**	**Mean and SD (K^+) mg/dl**	**Mean and SD (Mg^+) mg/dl**	**Mean and SD (Ca^{++}) mg/dl**
Group A [30]	0.32±0.082 NS	0.013±0.005 NS	1.37±0.08 NS	9.11±0.14 NS
Group B [30]	0.31±0.07 NS	0.014±0.01 NS	1.34±0.06 NS	8.92±0.29 NS
Group C [30]	0.31±0.05	0.014±0.007	1.32±0.03	8.91±0.09

. **P-value* > 0.05 non-significant (NS)

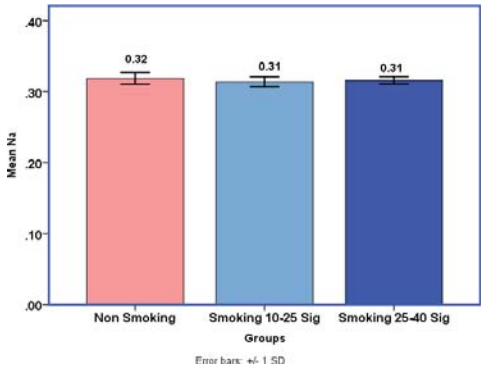

FIGURE 1. The effect of cigarette smoking on serum sodium (Na+) levels (mg/dl) compared to healthy adult men

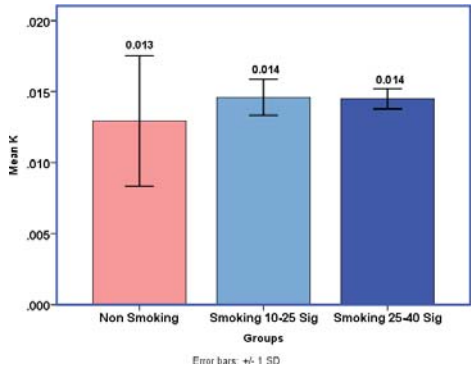

FIGURE 2. The effect of cigarette smoking on serum potassium (K+) levels (mg/dl) compared to healthy adult men

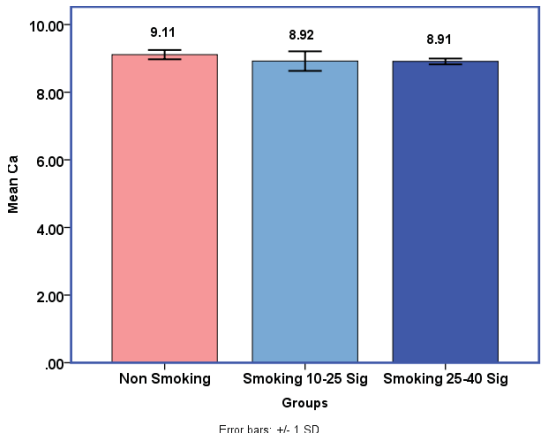

FIGURE 3. The effect of cigarette smoking on serum calcium (Ca^{++}) levels (mg/dl) compared to healthyadult men

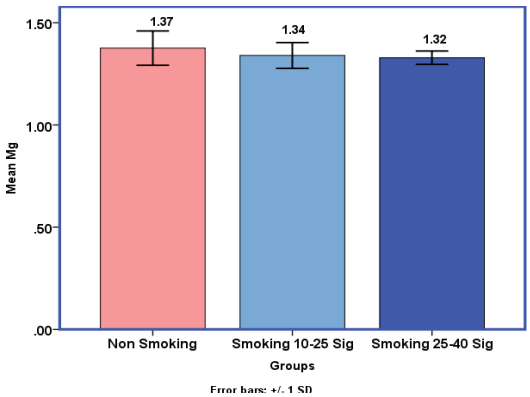

FIGURE 4. The effect of cigarette smoking on serum magnesium (Mg^{++}) levels (mg/dl) compared tohealthy adult men

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The investigators Avşar et al.,2009 [25] and Padmavathi et al.,2010 [26] reported that , there was a decrease in sodium and potassium levels in men smoking at least four cigarettes daily and the changes in these levels occur at systemic , cellular and molecular level (25, 26). The results of this study were in agreement with Erdemir and Erdemir 2006 [27] who demonstrated that , there was no significant difference in the levels of calcium ,sodium and potassium in the saliva of smokers and nonsmokers.

The changes of levels of certain electrolytes did not seem to be mediated by nicotine directly , but the influence of nicotine may reduce the weight of body and decrease the electrolytes levels indirectly [28]. Balance of electrolyte plays a major role in the function of the cells properly ; in addition potassium and sodium play an important role in conduction of nerve, contraction of muscle, and transport of substances across the membranes [29]. In this study the insignificant ($P<0.05$) differences in level of potassium which observed among the smoker groups may be due to the continuous repletion of potassium ions from intracellular compartment which may contribute to correction of plasma potassium level.

Nicotine is a factor that contributing in the immunosuppression because it caused a depletion in the inositol-1,4, 5-trisphosphate-sensitive Ca2+ stores ; these enzymes have an important role in maintaining neuronal activities, impulse propagation and membrane potential due to binding to membranes [30]. The accumulation of sodium and calcium ions and balance disturbance of electrolytes along with depletion in potassium was noticed so decreased of sodium/potassium-ATPase activity was found in smokers that consuming 12 ± 2 cigarettes daily for 7-10 years [26].

Amiloride (100 μM) can lose its inhibition ability in the presence of nicotine completely ; moreover , amiloride-insensitive channels of sodium did not show the nicotine effect ; the investigation found that , the blocker of Na+ channel manifested increased Ca2+ intracellular so, Ca2+-dependent protein kinase is stimulated by intracellular rising calcium which induced by the nicotine [31]. In pulmonary neuroepithelial bodies, nicotine at 50 and 100 μM suppressed inactivating K+ current slowly [32]. Probably , this suppressed activity was not reversed by mecamylamine that have a direct effect of nicotine on K+ channels

.The function of slowly inactivating A-type pottasium channels can effected directly by exposure to nicotine, which involved in smoking-related disease in lung ; nicotine may increase concentration calcium intracellular [33]. This information identifies the nicotine molecular mechanism of action in embryonic malformations and apoptosis

Chronic smoking causes disturbance of T-cell energy by the antigen receptor mediated signal transduction that leads to depletion of stores of inositol-1,4,5-trisphosphate-sensitive Ca2+ [30]. Besides , it was found, nicotine can increase the expression of the alpha 3,4,5, and 7 nicotinic receptors , that modulate the metabolism of calcium and regulate the adhesion and respiratory epithelial cells motility ; so long-term exposure to nicotine gave a steady increase of intracellular calcium which may lead to cell damage [34] .

A previous study performed by Supervía et al., 2006 [35] told that , tobacco can increase bone restoration and affect bone mass by some alterations in metabolism of sex hormones in both genders , in addition to alterations in vitamin D concentration ; moreover, smoking abstinence for one month did not produce changes in serum levels of calcium, magnesium and phosphorus ; these results may reflect the insensitivity relativeness of these parameters to the changes by exposure to smoking , very likely because of the efficient regulating mechanisms these [35].

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