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Assessment of Serum Iron and Transferrin among Sudanese Cigarette Smoker in Khartoum state, Sudan

Mutaz Ibrahim Hassan[1], Ezeldine K. Abdalhabib[2], Miraz Bashir Mohammed[3] and Jevara Mohammed Abdelmoniem[4]*

1. Faculty of Medical Laboratory Sciences, Shendi University, **SUDAN**
2. Faculty of Applied Medical Sciences, Jouf University, **SAUDI ARABIA**
3. Faculty of Medical Laboratory Sciences, National University, **SUDAN**
4. Alarab Medical Reference Laboratory- **SAUDI ARABIA**

Email: mutazhassan79@gmail.com

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ABSTRACT

Smoking is a practice in which a substance, most commonly tobacco or cannabis is burned and the smoke tasted or inhaled. The most common method of smoking today is through cigarettes. Tobacco use leads most commonly to diseases affecting the heart and lungs, with smoking being a major risk factor for heart attacks, strokes, chronic obstructive pulmonary disease (COPD), emphysema, and cancer. It also causes peripheral vascular disease and hypertension, all developed due to the exposure time and the level of dosage of tobacco.

Keywords: Transferrin, Serum iron, Smoker, Sudanese.

INTRODUCTION

Minerals are very essential substances involved as catalysts in most cellular enzymatic reactions and assume a major role in metabolism. Iron and magnesium are examples of these essential minerals [1]. Functions of iron include involvement in energy metabolism, gene regulation, cell growth and differentiation, oxygen binding and transport, muscle oxygen use and storage, etc. Magnesium is a critical cation and cofactor in numerous intracellular processes [2]. It is involved in more than 300 essential metabolic reactions, some of which are: energy production, synthesis of essential molecules, structural roles, ion transport across cell membranes, cell signaling, and cell migration [3].

Cigarette smoking causes minerals disturbances, which lead to serious consequences, Smoking leads to tissue hypoxia, which leads to inadequate oxygenation of blood circulation that results in erythropoiesis and consequent increased production of erythropoietin, which enhances erythropoiesis and increases red cell mass above normal level [4]. This leads to increase in the number of destroyed red cells in the normal turnover process, which subsequently increases iron overload, which causes hepatocellular damage [5].

Chronic oxidative Assessment of the Levels of Serum Iron in stress may modulate iron uptake and storage, leading to a self-sustained and ever-increasing spiral of cytotoxic and mutagenic events. Smoking causes magnesium deficiency due to decreased supply (lesser appetite) and reduced

absorption caused by disturbances in the digestive system functions. Minerals disturbances may lead to sever and even life-threatening metabolic abnormalities such as coronary heart disease, liver disease, lung infection, kidney failure, and disorders of endocrine system [6].

Iron (Fe) has important functions in the body as a component of hemoglobin and numerous other iron containing proteins. The increased incidence of infectious disease associated with iron deficiency has been attributed to the impairment of the activities of iron containing enzymes in cells of the immune system [7].

Plasma transferrin is an iron-transport protein with a half-life of 8 to 10 days that reflects both protein and iron status. Transferrin increases with iron deficiency and decreases when iron status improves or with protein – energy malnutrition. If a patient has concurrent iron deficiency, it is difficult to determine whether a low transferrin level reflects iron status or protein status. In mild to moderate protein-energy malnutrition, transferrin values may vary, limiting the usefulness of this test [8]. However, markedly low transferrin levels indicate severe protein-energy malnutrition. A value less than 100 mg dL^{-1} may be considered a reliable index of severe protein-energy malnutrition [9].

Human serum transferrin belongs to the transferrin family, which is a group of homologous glycoproteins that are related evolutionarily. Members of this family are widely distributed in the biological fluids of most vertebrates and invertebrates such as serum, egg white, mammalian milk, tears, and leukocytes [9].

Serum transferrin (serotransferrin, siderophilin, or β-1-metal-binding globulin). This is the transferrin found in the serum of vertebrates and other biological fluids including cerebrospinal fluid, milk, and semen. Its main biological function lies in its ability to transfer iron between different biological tissues [10].

Lactotransferrin (lactoferrin) is mainly produced by mucosal epithelial cells of mammals. Thus it is found abundantly in mammalian milk and other secreted fluids, eg, tears, saliva, and pancreatic juice. It can also be present in specific granules of polymorphonuclear leukocytes. Lactoferrin exhibits variable properties that have antioxidant, antiinflammatory, and antimicrobial activities. Therefore, it plays an important role in body defense against infections [11].

Ovotransferrin (conalbumin) is primarily present in bird and reptile oviduct secretions and their eggs. It constitutes about 12–13% of the egg white in birds. It has the same structural protein, but different glycan component, of serum transferrin as they are derived from the same gene. It has also antimicrobial property that is vital to bird's innate immunity [12].

Melanotransferrin traces of this cell surface protein can be found in normal tissues; however, the majority of human melanomas express it. It is one of the first cell surface markers associated with melanomas. Although its exact biological function remains unknown, it is believed that it may have a role in cell proliferation, migration, angiogenesis, and tumorigenesis [13].

MATERIALS AND METHODS

Study design: A comparative case control study conducted at Khartoum state during the period August to November 2019. 45 Sudanese smoker were introduced as case group. 30 Healthy, non smoker individual were introduced as control group, age and sex of control group was matched with case group.

Sampling: Venous blood was collected from participants by clean venipuncture in plain containers. Clotted samples were centrifuged after at 3000 rpm for no less than 10 min. Serum, removed from the tube within 60 min using a plastic pipette and stored in plastic tube used to measure iron and transferrin.

Ethical consideration: Ethical consideration was taken verbally. This study posed no physical risk to participants though an interview of 10 min might have been convenient to some participants. It is a convenient study, thus neither the participants name nor his institution in use in any of the study materials and each participant was assigned a unique identification number. Collected data will be secured in a computer protected by password.

Measurement of serum iron: Serum iron was measured photometrically using Jenway colorimeter by CAB method (chromazurol B). Iron react with chromazurol B and acetyl tri methyl ammonium bromide (CTMA) to form a colored ternary complex with an absorbance maximum at 623 nm. The intensity of the color produced was directly proportional to the concentration of iron in the sample. The procedure of this method included addition of 50 µL of sample (non hemolysed serum) and standard to1 mL of reagent pipetted into two separate test tubes, with incubation time of 15 min, also 1 mL of the reagent with 50 µL de ionized water were pipetted into a third tube as blank. Then the absorbance of the sample and standard was measured at 623 nm against the reagent blank within 60 minutes. Serum iron concentration was calculated according to formula: C (µg dL^{-1}) = C (STD) × ΔA sample ÷ ΔA STD.

Measurement of Serum Transferrin: The solid phase Receptacle (SPR) serves as the solid phase as well as the pipetting device for assay. Reagents for the assay are ready to use and pre dispensed in the sealed reagent strips. The instrument performs all of the assay steps automatically. The UN bound components are eliminated during the washing steps. During the final detection step, the substrate (4 - methyl-umbelliferon). The fluorescence of which is measured at 450 nm. The intensity of the fluorescence depends on the concentration of alkaline phosphate present on (SPR) that transforms the substrate.

Statistical analysis: All data was analyzed using statistical analysis soft ware (SPSS) version (21). Statistical analysis included description statistic of mean and standard deviation.

RESULTS AND DISCUSSION

The results of this study revealed that there is no significant variation in serum iron level between case and control group, but only mild decreased in serum iron in smoker group when compare to nonsmoker one and this finding agreed with pervious study performed by Chan H. Lee in 2016 in korea). Iron is an essential micronutrient that is used in almost every aspect of normal cell function. However, its ability to catalyze the formation of reactive oxygen species can also be a health threat, which can lead to oxidative stress and damage cellular membranes Cigarette smoke contains numerous oxidants and prooxidants capable of producing free radicals and enhancing oxidative stress.

Table 1. Serum iron and transferrin concentration among smoker/nonsmoker groups

Serum components	Study Group	N	Mean ± SD	P. Value
Serum Iron (mg dL^{-1})	Case	45	84± 8.5	0.31
	Control	30	87± 11.5	
Serum Transferrin (mg L^{-1}l)	Case	45	202±14	0.52
	Control	30	200 ±16.9	

P. value is significant at the level of 0.05 or less

Table 2. Level of serum iron according to number of cigarette per day

Number of cigarettes per day	Serum iron mg dL^{-1}			P. value
	N	Mean	Std. deviation	
1-10	26	81	8.7	0.30
11-20	11	86	6.4	
21-30	8	88	9.5	

Table 3. Serum transferrin level according to number of cigarette per day

Number of cigarettes per day	Transferrin mg dL^{-1}			P. value
	N	Mean	Std. deviation	
1-10	26	194	7.9	
11-20	11	209	12.8	0.40
21-30	8	207	17.8	

P. value is significant at the level of 0.05 or less

Table 4. level of serum iron according to duration of smoking per years

Duration of smoking	Serum iron mg dL^{-1}			P. value
	Samples number	Mean	Std. deviation	
1-10 years	26	81	8.4	
11-20 years	11	86	6.5	0.31
21-30 years	8	88	9.5	

P. value is significant at the level of 0.05 or less

Table 5. Level of serum transferrin according to duration of smoking per years

Duration of smoking	Serum transferrin mg dL^{-1}			P.value
	N	Mean	Std.deviation	
1-10 years	29	202	13.9	
11-20 years	14	202	14.1	0.75
21-30 years	2	218	12	

P. value is significant at the level of 0.05 or less

It denoted that serum transferrin was increased in smoker group. Tobacco smoking has an influence on number of sialic acids residues in the transferrin.

Transferrin is a glycoprotein that binds iron and transports it into cells via transferrin receptor-mediated endocytosis. Because cancer cells have a high rate of proliferation, they have a greatly increased need for iron to carry out cellular functions, which results in an over expression of the transferrin receptor. This demonstrated that serum iron and transferrin was increased with number of cigarettes smoked per day and duration of smoking.

APPLICATION

The present study is shedding a light on the deleterious effect of smoking on the serum transferrin and iron level. This may alert the decision makers to the socioeconomic and medical problems caused by intensive tobacco smoking.

CONCLUSION

It concluded that serum iron showed mild decreased in smoker whereas transferrin was increased in same group. Both serum iron and transferrin were increase with duration of smoking and number of cigarette per day.

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