Evaluation of Copper , Zinc , Manganese , and Magnesium Levels in Newborn Jaundice in Baghdad

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Abstract

Trace elements concentrations are frequently reported to be a good indicator for diagnosis and prognosis of some disease. The levels of copper, zinc, manganese, and magnesium were measured in serum of two group. Group one contains (52) newborn jaundice patients while the second group contains (20) healthy newborn used as controls.

In this study the concentration of Cu, Zn, Mg, and Mn were measured using atomic absorption spectrophotometer (AAS). It has been found that zinc level is significantly lower in newborn jaundice patients compared with normal subjects at $(p < 0.05)$, also the level of Cu, Mg, and Mn were significantly higher in newborn jaundice compared with control group.

Keywords: Jaundice; Zinc; Copper; Magnesium; Manganese

Introduction

Jaundice occurs when the blood contains excessive amounts of bilirubin, the deposition of this highly insoluble substance colored the skin and the whites of the eyes yellow. Jaundice is probably the most common symptom in neonatal period[1,2]. Temporary jaundice is observed during the first week of life in approximately 60% of term infants and 80% of preterm infants[3,4].

Trace elements are necessary for normal function and are therefore associated with morbid deficiency states. Those elements are found in body tissues at levels in the micrograms per gram of tissue or less. Some elements are essential trace elements (like Fe and Zn) and some are not essential (like Cu and Mn) but have well defined evidence in human metabolism[5]. Trace elements are essential micronutrients for growth, development, and maintenance of healthy tissues. The role of trace elements in body metabolism is of prime importance. Their deficiency causes diseases, whereas their presence in excess may result in toxicity to human life [6].

Zinc (Zn) is essential component of many metalloenzymes involved in virtually all aspects of metabolism. Zinc is an integral component of nearly 300 enzyme in different species of all phyla[7,8]. Important zinc-containing metaloenzymes in humans including carbonic anhydrase , alkaline phosphates, RNA and DNA polymerases, thymidine kinase, carboxypeptidases, and alcohol dehydrogenase. Zinc stabilizes the structures of proteins and nucleic acids, participates in transport prosses[9]. Copper (Cu) may present in biological

system in both the +1 and +2 valence states, the major functions of copper metalloproteins involve oxidation –reduction, most known copper – containing enzyme bind and react directly with molecular oxygen[10]. Copper is an integral component of many metalloenzymes, including ceruloplasmin, cytochrome c oxidase, superoxide dismutase, dopamine −β− hydroxylase, ascorbate oxidase, lysyl oxidase, and tyrosinase[11,12].

Magnesium (Mg) catalyzes or activates more than 300 enzymes in the body. Magnesium acts as an essential cofactor for enzymes concerned with cell respiration, glycolysis, and trans-membrane transport of other cations such as calcium and sodium[13]. Magnesim can effected enzyme activity by binding the active site of the enzyme (pyruvate kinase, enolase), by ligand binding (ATP- requiring enzyme), by causing conformational changes during the catalytic process (Na- K- ATPase), and by promoting aggregation of multienzyme complexes[7,14].

Manganese (Mn) is present in biological systems bound to protein in either the +2 or +3 valence state. Manganese is associated mainly with the formation of connective and bony tissue, with growth and reproductive functions, and with carbohydrate and lipid metabolism[15]. The biochemical basis for manganese essentiality is its function as a constituent of metalloenzymes and as an enzyme activator[16,17]. Important manganese containing enzymes include arginase, pyruvate carboxylase, and manganese superoxide dismutase in mitochondria[18].

Material and Method

All blood samples were collected from the Ibn- Albalady hospital in Baghdad. The first group consisted of 55 blood samples of jaundice newborns (32were male and 23 females) , their ages ranged from 1-3 days. Twenty healthy volunteers were used as a second group and their ages were matched with patients group. Blood samples are drown using 10ml syringes with steel needles. A3ml blood sample was drown from each patient. The whole blood was immediately transferred to plain tube. These samples were allowed to stand at room temperature for 10 minutes for clotting, the clots were separated from the wall of the tube using wooden applicator stick. The tube was centrifuged for 10 minutes at 3000(r.p.m). The serum was then transferred to a second tube using micropipette and stored at -20 C^0 until the day of analysis.

Atomic Absorption Spectrophotometer (AAS) model AA-6200 (shimadzu _ Japan) fitted with air – acetylene flame were used for the determination of Copper, Zinc, Manganese, Magnesium.

1- Preparation of standard solutions for AAs measurements cpper

Copper stock solution (1000ppm) was prepared by dissolving (0.1 gm) of copper metal in 5ml of 5 M nitric acid, and then diluted to 100ml with deionized water.

Zinc

Zinc stock solution (1000ppm) was prepared by dissolving (0.1 gm) of zinc pellet using concentrated hydrochloric acid, and the volume was completed into 100ml with deionized water.

Magnesium

Magnesium stock solution (1000ppm) was prepared by dissolving (0.1 gm) of magnesium metal in 5ml of 5 M nitric acid, and then diluted to 100ml with deionized water.

Manganese

Manganese stock solution (1000ppm) was prepared by dissolving (0.1 gm) of manganese metal in 5ml of 5 M nitric acid, and then diluted to 100ml with deionized water.

1-   Calibration curve for A.A.S measurements
1-   The standard solutions for copper ion were prepared by subsequent dilution stock solution (1000ppm) of copper and diluted to (10, 5, 1, 0.5, 0.1 ppm).
2-   Iron standard solutions were prepared by subsequent dilution stock solution (1000ppm) of iron to (10, 5, 1, 0.5,and 0.1 ppm).
3-   The standard solutions for magnesium were prepared by subsequent dilution stock solution (1000ppm) of magnesium ion and diluted to (100, 50, 10, 5,and 1 ppm).
4-   The standard solutions for manganese ion were prepared by subsequent dilution stock solution (1000ppm) of manganese and diluted to (20, 15, 10 ppm).
All above standard solutions were diluted to 100ml in a volmatric flask with deionized water.

Result and Discussion

A linear calibration curve was obtained extended from (0.1- 10) ppm for copper, zinc, manganese, and magnesium as shown in the (1,2,3,4) figures

The results were shown that there was significant difference in the levels of zinc, copper, manganese, and magnesium in newborn jaundice and control group, at p value of ($<$ 0.05), Zinc levels was significantly lower in jaundice patients (0.0012 ± 0.002) compared with the healthy newborn (0.0021 ± 0.0036) . Copper levels was significantly higher (0.198 ± 0.341) in jaundice patients compared with control group (0.238 ± 0.411). Magnesium levels was significantly higher in patient (1.48 ± 2.96) than the control group (1.293 ± 1.829). Manganese levels was appeared to be significantly higher (0.0277 ± 0.0391) in jaundice patients compared with control (0.015 ± 0.031). As shown in table (1) .

Zinc and magnesium are very important co-factors for a lot of enzyme systems and play an important role in the synthesis of nucleic acids [19,20]. Zinc prevents the lipid depolarization of the cell membranes and hypozincemia may modulate the erythrocyte membrane. It may result in deficient synthesis of assorted enzymes that play a role in the bilirubin metabolism[21], Hypozincemia may also cause structural defects in the erythrocyte membranes, resulting in hemolysis [22]. An elevated level of serum copper is documented in liver disease like cirrhosis , obstructive jaundice and cholestasis [23]. In newborn with jaundice , the high serum copper may be of intracellular (erythrocyte) origin [24]. Manganese absorbed from food is avidly taken up by the liver and distributed to tissues bound to transferring and albumin[5].The serum levels of magnesium and manganese become high , depending on the existence of mild hemolysis in newborn , the fact that these elements are high depend on being high in erythrocytes, especially reticulocytes than in serum concentrations (25), and may depend on passing into the serum as a result of hemolysis.

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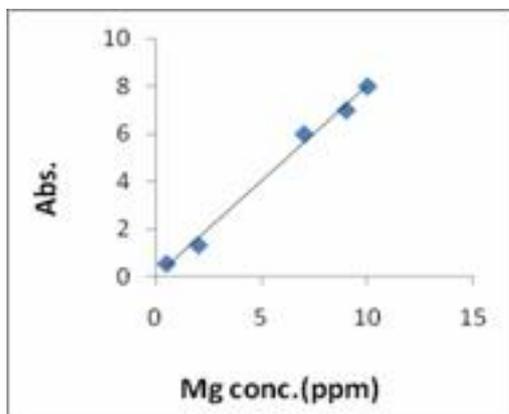**Table (1): The mean values for the Cu, Zn, Mg, Mn compared to the control group with p value < 0.05**

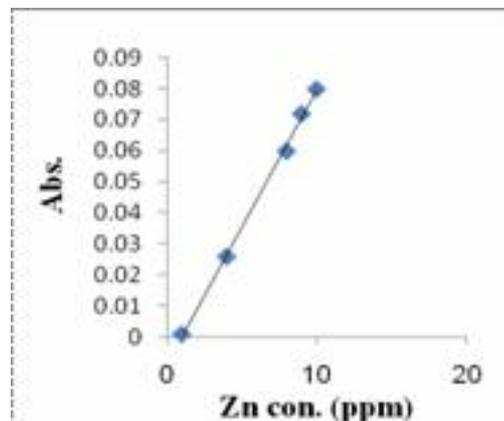| Trace elements	Mean ±SD ppm of patients	Mean ±SD ppm of controls
Cu	0.238 ± 0.411	0.198 ± 0.341
Zn	0.0012 ± 0.002	0.0021 ± 0.0036
Mg	1.48 ± 2.96	1.293 ± 1.829
Mn	0.0277 ± 0.0391	0.015 ± 0.031
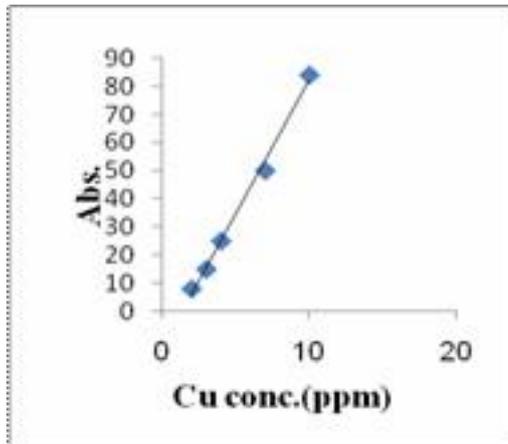
Fig. (1):Calibration curve for

copper
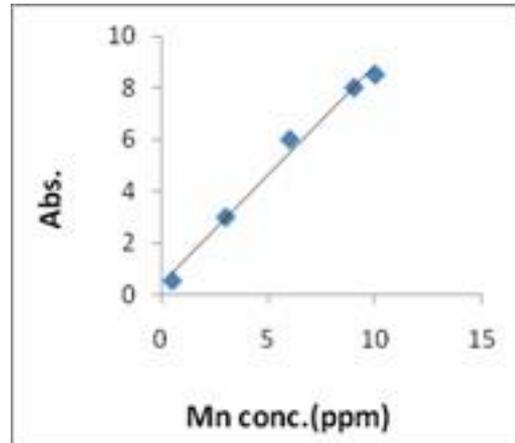
Fig.(2):Calibration curve for

manganese

Fig. (3):Calibration curve for

magnesium

Fig.(4): Calibration curve for

zinc

تقييم مستويات النحاس ، والخارصين ، والمنغنيز ، والمغنيسيوم في مرضى اليرقان الحديثي الولادة في بغداد

ايناس جبار حسن

قسم العلوم ، كلية التربية الأساسية ، الجامعة المستنصرية

الخلاصة

تعد تراكيز العناصر النزرة كواشفا جيدة لتشخيص وتخمين بعض الامراض ، تتضمن الدراسة قياس مستوى النحاس ،و الخارصين ، والمنغنيز ، والمغنيسيوم في أمصال مجموعتين من الأطفال حديثي الولادة ، تتكون المجموعة الأولى من (52) طفلا حديث الولادة مصاب باليرقان ، بينما تتكون المجموعة الثانية من (20) طفلا حديث الولادة طبيعيا تم اعتمادها مجموعة سيطرة . حسبت تراكيز مستوى النحاس ، والخارصين ،و المنغنيز ، والمغنيسيوم باستعمال طريقة طيف الامتصاص الذري ، وكان متوسط تركيز الخارصين في مصل دم المرضى اقل معنويا(p<0.05)   من تركيزه في مصل دم مجموعة حديثي الولادة الأصحاء وكذلك وجد ان متوسط تراكيز النحاس ،والمغنيسيوم ، والمنغنيز اعلى من تركيزهم في مصل دم مجموعة الأصحاء .

الكلمات المفتاحية : اليرقان، الخارصين، النحاس، المغنيسيوم، المنغنيز