

Iron status in metabolic syndrome

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ABSTRACT

Objectives: This study aimed to determine the changes in iron status in MS-individuals and to determine the effects of sex on iron status in MS individuals.

Patients and methods: Fifty individuals (30 males and 20 females) had at least 3 criteria of metabolic syndrome according to WHO criteria, and other fifty apparently healthy individuals (30 males and 20 females) considered to be control group. Fasting blood samples were taken from the patient and control groups and analysed for serum iron, ferritin, glucose and triglycerides.

Results: Serum iron, serum ferritin, glucose, triglycerides and saturation % showed significant increase in MS individuals ($p < 0.05$) than control individuals, while serum HDL-C showed significant decrease in MS than in control ($p < 0.05$). Serum ferritin showed a significant increase in male individuals with MS than in female individuals ($p < 0.001$), while serum HDL-C showed a significant reduction in male with MS than in female with MS ($p < 0.01$).

Conclusion: Metabolic syndrome caused significant changes in patient iron status parameters. Serum ferritin was significantly less than males.

هدف الدراسة: كان هدف الدراسة هو تحديد التغيرات في واجهة الحديد في الدم عند المصابين بالمتلازمة الايضية وكذلك تحديد تأثير عامل الجنس في واجهة الحديد في الدم.

المرضى وطرائق العمل: أجريت هذه الدراسة على خمسين شخصا (30 من الذكور و 20 من الإناث) مصابين بالمتلازمة الايضية وفقا لمعايير منظمة الصحة العالمية وخمسين شخصا من الاصحاء كمجموعة سيطرة. اخذت عينات الدم بعد الصيام من مجموعة المرضى ومجموعة السيطرة وتم تحليل مصل الحديد و الفيريتين والكلوكوز والشحوم الثلاثية.

النتائج: اظهرت الدراسة ان مصل الحديد والفيريتين والكلوكوز والشحوم الثلاثية و نسبة تشبع بالحديد زيادة معنوية لدى الأفراد المصابين بالمتلازمة الايضية مقارنة مع مجموعة السيطرة ، في حين أظهر كولسترول البروتين عالي الكثافة انخفاضا معنويا عند المصابين بالمتلازمة الايضية أكثر مما كانت عليه في مجموعة السيطرة. وأظهر الفيريتين زيادة معنوية عند الذكور المصابين بالمتلازمة الايضية مقارنة بالإناث، في حين أظهر كولسترول البروتين عالي الكثافة انخفاضا معنويا في الذكور المصابين بالمتلازمة مقارنة بالإناث المصابات

الاستنتاج: ان متلازمة الايضية سببت تغيرا معنويا في المعلمات واجهة الحديد عند المصابين بالمتلازمة الايضية بالمقارنة مع مجموعة السيطرة و كان مصل الفيريتين اقل معنويا عند الإناث المصابات مقارنة بالذكور.

Metabolic syndrome (MS) is a condition of increasing incidence all over the world in both developed

and developing countries as in Iraq. According to the National cholesterol education program Adult Treatment

Panel-III (ATP III) guideline define MS: as any subject with at least three of the following criteria: BMI ≥ 30 kg/m², serum triglyceride (TG) ≥ 150 mg/dL, low serum high density lipoprotein (HDL-C) ≤ 40 mg/dL in male and ≤ 50 mg/dL in female, blood pressure $\geq 130/80$ mm Hg and fasting serum glucose (S.G) ≥ 110 mg/dL¹.

Metabolic syndrome may be related to changes in serum ferritin, iron and transferrin. Although ferritin is an indicator of cellular iron store in healthy subject, it provides little information on iron turnover in the body.^{1,2}

Transferrin is transporting protein (Shuttle protein) mainly synthesized in the liver and its principle role is the transport of ionic-iron to the liver, spleen and bone marrow.³ Transferrin level rises in iron overload and falls with iron depletion status.⁴

MS is associated with hyperglycemia and liver abnormality in addition to low grade inflammatory reaction, which may cause changes in serum iron and iron transporting proteins.⁵

This study was conducted to determine the changes in iron status in MS individuals compared with the controls, and the effects of sex on iron status in MS individuals.

Materials and methods

This study was conducted in the period from January through September 2011 in Private internal medicine clinics in Al-Drkzilea area, Mosul. This study received approval from ethics and scientific committee in the department of Clinical Pharmacy, University of

Mosul. Fifty MS-individuals (30 males and 20 females) had at least 3 criteria of metabolic syndrome according to WHO criteria¹, and other fifty apparently healthy individuals (30 male and 20 female) were considered to be the control group.

Blood samples (5 ml) were taken from the patient and control groups for analyses. Serum fasting glucose was assayed by glucose oxidase/peroxidase colorimetric method¹. High density lipoprotein-cholesterol (HDL-C) was measured by Lopez-Virella method² and triglycerides (TG) were measured by Fossati-enzymatic method³. Serum iron was estimated by using Ferrozine method⁴. Serum ferritin was estimated by turbidimetric latex immunoassay¹. Serum transferrin was measured by using immunological turbidimetric method¹¹. Total iron binding capacity (TIBC) was measured by modification in Ransays method¹², while transferrin saturation % (Sat.%) was obtained by the following equation¹³:

Saturation % = serum iron / total iron binding capacity * 100

Data are presented as mean \pm SD, unpaired t-test was used to compare between parameters, $p < 0.05$ was considered significant.

Results

This study revealed that serum iron, serum ferritin, glucose, triglycerides and transferrin saturation % showed significant increase in MS individuals ($p < 0.05$) compared with the controls, while serum HDL-C showed significant decrease in MS than controls ($p < 0.05$) as shown in Table 1.

Table 1: Total serum iron status parameters in metabolic syndrome (MS) individuals and controls

Parameter	Control n=50	MS n=50
Serum iron ($\mu\text{g/dL}$)	60.90 \pm 8.27	87.4 \pm 16.0***
Transferrin (mg/dL)	20.2 \pm 26	198 \pm 30
Ferritin ($\mu\text{g/dL}$)	90.9 \pm 28	119.7 \pm 41*
Fasting serum glucose (mg/dL)	92.30 \pm 0.73	110.9 \pm 10.***
Triglycerides (mg/dL)	93.40 \pm 8.3	162.1 \pm 23.2***
HDL-C(mg/dL)	48.00 \pm 4.84	33.6 \pm 3.38***
TIBC($\mu\text{g/dL}$)	202 \pm 33.3	247.2 \pm 37.3
Sat. %	23.60 \pm 1.90	30.7 \pm 6.14***

TIBC: Total iron binding capacity, Sat. %: transferrin saturation percentage

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Total iron status parameters in males and females with metabolic syndrome

Parameter	Male n=30	Female n=20
Serum iron ($\mu\text{g/dL}$)	88.6 \pm 12	87.2 \pm 20
Transferrin (mg/dL)	190.8 \pm 24.1	200 \pm 36.1
Ferritin ($\mu\text{g/dL}$)	107.1 \pm 28	82.3 \pm 12.9***
Serum glucose (mg/dL)	112 \pm 10.6	109.7 \pm 9.8
Triglycerides (mg/dL)	114.7 \pm 24.6	109.0 \pm 22.7
HDL-C	31.0 \pm 2.09	30.7 \pm 2.70**
TIBC ($\mu\text{g/dL}$)	249.8 \pm 40	244.0 \pm 30
Sat. %	30.9 \pm 8.02	30.0 \pm 3.89

TIBC: Total iron binding capacity, Sat. %: transferrin saturation percentage

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Serum ferritin showed a significant increase in male individuals with MS than females ($p < 0.001$), while serum HDL-C showed a significant reduction in males with MS than in females ($P < 0.01$) as shown in Table 2.

Discussion

In the present study, serum iron showed significant increase in MS patient, these result are consistent with other studies⁷ and this increase may be due to increases in the intestinal

absorption of this element. High serum iron can also related to the pro-inflammatory process that usually associated with MS⁸ (as we exclude other causes of inflammation).

In this study, serum ferritin which is an acute phase protein showed significant increase in MS individuals, the increase in serum ferritin was related to iron body store^{10,11}. In addition, some researchers considered serum ferritin as component of MS¹².

The study showed no significant changes in serum transferrin between MS patient compared to controls and this consistent with results described by other workers^{13,19}, while other studies showed a significant change in serum transferrin in MS individuals^{7,14}.

TIBC refer to the amount of iron that could be bound to saturating transferrin other minor iron binding protein present in the serum or plasma sample this normally form one third of iron binding sites on transferrin¹⁷. In this work TIBC showed no significant change between MS individuals compared to controls and this can be related to non-significant changes in serum transferrin level between MS.

Serum transferrin saturation percentage showed significant increase in MS compared with controls and this increase in the percentage may occurred due to significant increase in the serum iron showed in MS individuals^{2,21}.

Serum ferritin showed significant decrease in female patients compared to male patients and this consistent with other studies that relate this reduction to menstrual bleeding in female patients that lead to significant reduction in serum iron body store which reflected as iron deficiency anemia in such individuals^{13,18,19}.

Serum glucose and serum triglycerides showed significant increase in MS compared to controls, while serum HDL-C showed significant decrease in male patients when compared to female patients and this may be due to insulin resistance and female sex hormones¹⁷.

In conclusion, metabolic syndrome can cause significant changes in iron status parameters. Serum ferritin in females was significantly lower than that in males.

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