Correction of insulin resistance syndrome does not cause normalisation of hyperferritinemia

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SUMMARY

The consequences of iron overload from dysmetabolic hyperferritinaemia are a strong motivation for an active medical care program. Venesection therapy is known to be effective in controlling iron overload parameters although no study has evaluated the impact of the normalization of metabolic dysfunction on iron overload.

Aims — To evaluate the impact of normalization of metabolic dysfunction on iron overload.

Methods — Sixty consecutive patients with dysmetabolic hepatosiderosis were included in a prospective study. Patients with hyperferritinaemia above 1 000 µg/L were excluded. Multidisciplinary care was offered to all patients to normalize metabolic disorders (body mass index, arterial hypertension, fasting and postprandial hyperglycaemia, hyperuricaemia, hypercholesterolaemia and hypertriglyceridaemia) every three months. All patients were followed for one year. At clinical examinations, ferritinemia concentrations were measured and all dysmetabolic parameters evaluated. MRI was performed at the beginning of the study and at the one year follow-up, to measure hepatic iron load.

Results — Despite efficient medical care of insulin resistance syndrome, ferritinemia remained stable. In two thirds of the study population, hyperferritinemia reached at least one and a half times the baseline value, although the dysmetabolic disorders of 40% of the patients were strictly normalized. In this group of 44 patients with strict normalization of metabolic functions, 24 (54%) had hyperferritinemia at one year follow-up whereas 16 other (36%) normalized this parameter. Only 4 patients who had a ferritinemia below 450 µg/L at baseline, normalized this value at one year. Intra-hepatic iron overload, evaluated by MRI imaging remained stable except for 2 patients who normalized ferritinemia.

Conclusion — Although efficient handling of dysmetabolic disorders is essential, it is not sufficient to normalize dysmetabolic hyperferritinemia. Only patients with a ferritinemia value below a baseline of 450 µg/L had normalization of iron overload. Therefore venesection must be offered to all patients with a hyperferritinemia above this value.

The full text of this article is available in English on the web at: www.e2med.com
Changes in serum ferritin level in the 44 patients whose metabolic disorders were controlled during the study are presented in figure 3. Normalization of the risk factors in these 44 patients was not correlated with a decrease in serum ferritin at one year: 830 g/L (220-990) in comparison with the serum ferritin level at one year in the group of 16 patients who did not normalize their risk factors: 905 g/L (590-980) (NS). Inclusion, the serum ferritin cut-off level of 450 g/L separated patients who achieved or not a normal serum ferritin level at one year after correction of metabolic disorders. All patients whose baseline serum ferritin was below 450 g/L achieved a normal level at one year and none of the patients whose baseline serum ferritin was greater than 450 g/L presented a normal or decreased level at one year. Considering BM of 27 kg/m² as normal instead of the < 30 kg/m² defined at inclusion, changes in serum ferritin were different in the subgroup of 44 whose metabolic disorders were controlled (figure 4). The number of patients with a stable ferritin level at one year was significantly higher if BM < 27 was achieved than if BM remained above 27 (14 patients versus 2 patients, P < 0.05). Inversely, serum ferritin increased more often among patients whose BM was in the 27-30 range than in those with BM < 27 (P < 0.05). But the median serum ferritin level at one year was comparable: 610 g/L (220-680) for BM < 27 at one year and 840 g/L (240-990) for BM ≥ 27 at one year (NS). The time course of serum ferritin did not exhibit any rapid phase of improvement. There was on the contrary a rather constant progression in the number of patients whose serum ferritin level worsened (figure 5) despite management of their polymetabolic syndrome.

**Hepatic iron overload**

Hepatic iron overload as determined by MRI was assessed before and after the one-year study in 45 patients. In this subgroup, two patients achieved a normal serum ferritin level. In these two patients, iron concentration in the liver was 75 g/L before treatment and < 36 µg/g at one year. For the other 43 patients, including 25 whose serum ferritin level stabilized and 18 whose serum ferritin level worsened despite normalization of metabolic parameters, iron concentration in the liver was com-

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**Table I** – Characteristic features of 60 patients with dysmetabolic hyperferriterinaemia at inclusion and at last follow-up (one year).

<table>
<thead>
<tr>
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<th>Baseline</th>
<th>One year</th>
</tr>
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<tbody>
<tr>
<td>Age (years)</td>
<td>55 (30-66)</td>
<td>56 (31-65)</td>
</tr>
<tr>
<td>Sex ratio</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Type 2 diabetes* (N, %)</td>
<td>39, 65%</td>
<td>10, 17%</td>
</tr>
<tr>
<td>Dyslipidemia (N, %)</td>
<td>24, 40%</td>
<td>3, 5%</td>
</tr>
<tr>
<td>Class B (N, %)</td>
<td>24, 40%</td>
<td>10, 17%</td>
</tr>
<tr>
<td>Hypertension* (N, %)</td>
<td>30, 50%</td>
<td>3, 5%</td>
</tr>
<tr>
<td>Serum ferritin*</td>
<td>680* (360-990)</td>
<td>880 (220-990)</td>
</tr>
<tr>
<td>Male: ULN &lt; 300 g/L</td>
<td>Females: ULN &lt; 180 g/L</td>
<td></td>
</tr>
<tr>
<td>Asat (ULN &lt; 30 IU/L)</td>
<td>68 IU/L* (34-110)</td>
<td>65 IU/L (22-105)</td>
</tr>
<tr>
<td>Alat (ULN &lt; 30 IU/L)</td>
<td>54 IU/L* (31-83)</td>
<td>51 IU/L (18-81)</td>
</tr>
</tbody>
</table>

* m e d i a n.
* Type 2 diabetes: fasting blood glucose (twice) > 1.27 g; blood glucose at any time > 2 g.
* Hypercholesterolemia > 240 mg/dl, hypertriglyceridemia > 2 G/L.
* Body mass index > 30 kg/m².
* Systolic pressure > 150 mmHg, diastolic pressure > 90 mmHg.
* P = non significant.
ULN: upper limit of normal.
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parable before and after treatment (median 100 g/L [72-122] before treatment and median 98 g/L [74-119] at one year) (NS).

Serum aminotransferase levels

At inclusion serum aminotransferase levels were not correlated with serum ferritin level. Among patients whose aminotransferase levels were elevated at inclusion, only three achieved normal levels at the end of the study. These three patients also normalized their metabolic parameters during the study and were classed stage 0 at the baseline abdominal ultrasound.

Search for HFE gene mutation

HFE gene mutation was observed in half of the patients: 18 H63D heterozygous patients and 12 C282Y heterozygous patients. At inclusion, serum ferritin was not correlated with the presence or absence of HFE gene mutation. Median serum ferritin levels were comparable between patients with and without HFE gene mutation (NS).

Hepatic steatosis at abdominal ultrasound

At inclusion, the abdominal ultrasound identified stage 0 steatosis in 19 patients, stage 1 in 32, stage 2 in six and stage 3 in three. There was no correlation between the severity of steatosis defined ultrasonographically and serum ferritin or serum aminotransferase levels. Thirty-six patients who did not achieve normal serum ferritin levels after treatment of their polymetabolic disorders underwent a control ultrasound before initiating veno-section at one year. The stage of steatosis was unchanged in all 36. At inclusion, liver biopsy was performed in 15 patients who did not have a baseline MRI. Besides the iron overload, histology revealed hepatic steatosis in six patients, steatohepatitis in four, and fibrosis in three. There were no cases of cirrhosis.

Discussion

Management practices for patients with dysmetabolic hyperferrinemia are not clearly defined. Although there is no prospective evidence demonstrating that normalization of serum ferritin level and reducing hepatic iron overload has a beneficial effect, this appears to be a rational approach. Even moderate iron overload is known to favor hepatic [4] and extrahepatic [5] cancer. Several case-control and longitudinal studies have demonstrated a significant relationship between iron overload and cancer morbidity and mortality [11]. Moreover, iron overload could worsen risks of atherosclerosis which are already significant in patients with polymetabolic syndromes [12]. The presence of iron overload might also be associated with more severe fibrosis in patients with non-alcoholic steatohepatitis [3].

Our work clearly demonstrated that if serum ferritin is greater than 450 g/L, careful regular control by a pluridisciplinary team of the polymetabolic disorders is not sufficient to normalize the ferritin level, which can even rise significantly in more than half of patients. It was noted however that among patients whose ferritin did increase, metabolic control did not achieve the objectives in four out of ten patients. According to these results,
hyperferritinemia patients. There has been just one report by but not sufficient to obtain a normal iron level in dysmetabolic date demonstrating that normal metabolic levels are necessary [3].

Hepatic iron overload has been observed in nonalcoholic steatohepatitis [13, 14]. A correlation between the level of hyperferritinemia and hyperinsulinism syndromes linked to insulin receptor mutations on the surface of hepatocytes and inversely transferrin has an ance patients [15]. Insulin increases the expression of transferrin and blood glucose levels has also been reported in insulin resist-

Physiological clearance of excess iron would appear to be the shorter duration of the disease in these patients and in part to strict normalization of the metabolic levels and in part to the shorter duration of the disease in these patients and their shorter history of diabetes and hypertension (less than one year). Physiological clearance of excess iron would appear to be insufficient in patients with significant tissue overload. The 450 g/l ferritin level might correspond to a threshold of physiological iron overload clearance capacity.

Although we did not perform precise tests, our results con-

REFERENCES


9. Association AD. Consensus development conference on insulin re-

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Fig. 5 – Changes in serum ferritin over time (N = 60).

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