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**Juvenile hemochromatosis: *HAMP* mutation and severe iron overload treated with phlebotomies and deferasirox**

Lescano MA *et al.* *HAMP* mutation and severe iron overload

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**Abstract**

Juvenile hemochromatosis (JH) is a rare condition classified as an autosomal recessive disorder that leads to severe iron absorption. JH usually affects people under the age of 30 and presents symptoms such as chronic liver damage, hypogonadotropic hypogonadism, cardiac diseases and endocrine dysfunctions. The present case reports a 29-year-old Brazilian woman with JH condition due to *HAMP* mutation (g.47G>A), treated with phlebotomies and deferasirox. She presented symptoms such as weakness, skin hyperpigmentation, joint pain in the shoulders and hands and amenorrhea. First laboratory tests showed altered biochemical parameters (SF: 5696 ng/mL, TS: 85%). After sessions of phlebotomies (450 mL every 15 d), the patient presented partial symptomatic improvements and biochemical parameters (SF: 1000 ng/mL, Hb: 11 g/dL). One year later, deferasirox (15 mg/kg per day) was introduced to the treatment, and the patient showed total symptomatic improvement, with significant clearing of the skin, SF: 169 ng/mL, and TS: 50%. Furthermore, after the combined deferasirox-phlebotomy therapy, MRI measurements revealed normalized level for liver iron (30 µmol/g; reference value < 36 µmol/g). In conclusion, combined deferasirox-phlebotomy treatment was able to normalize iron levels and improve symptoms.

**Key words:** Genetic disease; Juvenile hemochromatosis*; HAMP* gene; Mutation; Iron chelation

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**Core tip:** A 29-year-old Brazilian woman, from a city in the countryside of the State of Bahia, Brazil, was referred to our service in 2015 because of a hepatomegaly clinical condition, detected by imaging exam. This case study reports a patient with juvenile hemochromatosis condition due to HAMP mutation (g.47G>A) treated with phlebotomies and deferasirox, which were able to normalize iron levels and improve symptoms.

Lescano MA, Tavares LC, Santos PCJL. Juvenile hemochromatosis: *HAMP* mutation and severe iron overload treated with phlebotomies and deferasirox.*World J Clin Cases* 2017; In press

**INTRODUCTION**

Juvenile hemochromatosis (JH), also known as type 2 hemochromatosis, is a rare condition classified as an autosomal recessive disorder that leads to severe iron absorption. JH usually affects people under the age of 30 and presents symptoms such as chronic liver damage, hypogonadotropic hypogonadism, cardiac diseases and endocrine dysfunctions. JH is subdivided into two groups: type 2A (associated to *HJV* - hemojuvelin gene mutation) and type 2B (associated to *HAMP* - hepcidin gene mutation). Both genes are involved in the production of hepcidin, a peptide that regulates iron homeostasis by adjusting its absorption and storage. *HJV* and *HAMP* mutations, therefore, lead to decreased hepcidin levels, and consequently to iron overload in the body[1-3].

**CASE REPORT**

A 29-year-old Brazilian woman, from a city in the countryside of the State of Bahia, Brazil, was referred to our service in 2015 because of a hepatomegaly clinical condition, detected by imaging exam. In the anamnesis, symptoms such as weakness, skin hyperpigmentation and joint pain in the shoulders and hands were observed. The patient had reported amenorrhea since she was 25 years old, whereas transvaginal ultrasound showed uterus and ovaries were not developed. She also reported that her father died before the age of 50 because of non-alcoholic cirrhosis and diabetes. Furthermore, one of her three brothers, who was 31 years old, died because of the same reported father diseases. The patient’s other two brothers, on the other hand, are healthy.

The patient’s first laboratory tests results were: serum ferritin (SF) of 5,696 ng/mL, transferrin saturation (TS) of 85%, hemoglobin (Hb) of 13.3 g/dL, international normalized ratio of 1.3, aspartate transaminase of 91 U/L, alanine transaminase of 69 U/L, alkaline phosphatase of 288 U/L, gamma-glutamyl transferase of 84 U/L, blood glucose of 72 mg/dL, creatinine of 0.7 mg/dL and albumin of 4.3 g/dL. Her echocardiogram was normal and secondary causes of iron overload (hepatitis, chronic hemolysis, oral or parenteral iron overload, metabolic syndrome and alcohol abuse) were excluded. Genetic analysis for mutations in the *HFE* gene (p.C282Y, p.H63D and p.S65C) revealed a heterozygous genotype for the p.H63D. Taking in account the patient’s age and the absence of relevant genetic alteration for hereditary hemochromatosis (HH), the *HJV* (exons 1-4) and *HAMP* (exons 1-3) genes were sequenced [4], as iron overload in a young individual who presents endocrine dysfunctions is suggestive of a JH diagnosis. The *HAMP* sequencing revealed the homozygous genotype for the mutation 5′-UTR G>A at position +14 (g.47G>A), confirming the prior suspicious.

In January 2015, the patient started phlebotomies of 450 mL every 15 d. After 12 months of treatment, there was partial improvement of weakness, skin hyperpigmentation and joint pain symptoms. In addition, the hemoglobin level was never below 11 g/dL and, despite an observed decrease in ferritin level, the values were always above 1000 ng/mL. In January 2016, deferasirox (15 mg/kg per day) was introduced to the treatment, concomitantly with the phlebotomies. No side effects were observed and the serum creatinine values remained normal. In September 2016, the patient showed total symptomatic improvement, with significant clearing of the skin, SF values of 169 ng/mL and TS of 50%. The study protocol was approved by the Ethics Committee of Hospital das Clinicas (HC) ofUniversity of Sao Paulo Medical School (FMUSP), Brazil, and consent was obtained from the participants prior to entering the study.

**DISCUSSION**

When compared with *HFE*-hemochromatosis, the frequency of the JH condition with *HAMP* gene mutation is considered very rare. However, some cases were reported[5,6]. Here, we report one case of a Brazilian patient with JH condition due to *HAMP* mutation (g.47G>A), first identified in a Portuguese family[7]. She presented significant improvement of symptoms through combined treatment with deferasirox and phlebotomies.

Phlebotomy is the choice treatment for hemochromatosis. However, iron chelator has been suggested as an alternative treatment option for iron overload, especially when patients have severe iron overload, did not have tolerance to phlebotomies or where it is contraindicated. The dose used in the present case report was previously evaluated in hemochromatosis patients[8]. Cançado *et al*[9] (2015) evaluated the efficacy and effectiveness of deferasirox (doses of 5-10 mg/kg per day) for treatment of hemochromatosis patients. They showed that chelation was safe and effective[9].

It is possible to estimate the quantity of liver iron removed using MRI (magnetic resonance imaging) measurements (given as mg of Fe/*g* of liver). Santos *et al*[10] (2010)performed a study that measured liver iron concentration before and after combined deferasirox-phlebotomy treatment. They observed that approximately two-thirds (5.55 *g*) of the iron removed from the liver could be attributed to the action of deferasirox[10]. In the present case, however, we were not able to perform MRI measurements before and after inclusion of the deferasirox as an adjuvant. Nevertheless, we estimated that phlebotomies were able to remove approximately 8.0 *g* of liver iron (40 phlebotomies and about 200 mg Fe/phlebotomy) in 20 mo. After this period of combined therapy, the MRI showed normal value for liver iron of 30 µmol/g (reference value < 36 µmol/g).

In conclusion, combined deferasirox-phlebotomy treatment was able to promote decrease and normalization of iron levels, besides significant symptomatic improvements.

**ACKNOWLEDGMENT**

We mostly thank the participants of the study. We are also thankful for the technical assistance provided by the staff of the Laboratory of Genetics and Molecular Cardiology, Heart Institute (InCor).

**COMMENTS**

***Case characteristics***

A 29-year-old Brazilian woman, with non-alcoholic cirrhosis and diabetes in the familiar medical history, presented symptoms such as weakness, skin hyperpigmentation, joint pain in the shoulders and hands and amenorrhea.

***Clinical diagnosis***

*HAMP* sequencing indicated juvenile hemochromatosis (JH) condition due tog.47G>A mutation.

***Differential diagnosis***

Patient’s age (29) and absence of relevant genetic alteration for hereditary hemochromatosis (HH) led to sequencing of *HJV* (exons 1-4) and *HAMP* (exons 1-3) genes, as iron overload in a young individual who presents endocrine dysfunctions is suggestive of a JH diagnosis.

***Laboratory diagnosis***

Laboratory tests indicated altered iron biochemical parameters: SF=5,696 *ng/mL* and TS = 85%.

***Treatment***

Patient’s treatment was performed with phlebotomies (450 mL every 15 d) for 20 mo, and the iron chelator deferasirox (15 mg/kg per day) was introduced as adjuvant in the last 8 months of treatment.

***Related reports***

The dose used in the present case report was previously evaluated in hemochromatosis patients. Cançado *et al* (2015) evaluated the efficacy and effectiveness of deferasirox (doses of 5-10 mg/kg per day) for treatment of hemochromatosis patients. They showed that chelation was safe and effective[8]. Besides that, Santos *et al*[9] (2010)performed a study that measured liver iron concentration before and after combined deferasirox-phlebotomy treatment. They observed that approximately two-thirds (5.55g) of the iron removed from the liver could be attributed to the action of deferasirox.

***Experiences and lessons***

Phlebotomy is the choice treatment for hemochromatosis. However, iron chelator has been suggested as an alternative treatment option for iron overload, especially when patients have severe iron overload, did not have tolerance to phlebotomies or where it is contraindicated.

***Peer-review***

In the present case, we have reported a clinical case of a patient with a very rare disorder: juvenile hemochromatosis due to *HAMP* mutation (g.47G>A). The authors presented a successful combined therapy for the iron overload and symptoms caused by the JH condition, performed with the conventional phlebotomies and the iron chelator deferasirox as an adjuvant.

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