

Acute Iron Poisoning: A Case of Fulminant Hepatic Failure

Intoxicação Aguda por Ferro: Um Caso de Falência Hepática Fulminante

Maria BOURBON RUÃO¹, Inês PESTANA¹, Rita PASSOS², Júlia Raquel MONTE¹, Aníbal MARINHO¹
Acta Med Port 2024 Jun;**37(6):470-472** • <https://doi.org/10.20344/amp.21071>

ABSTRACT

Acute iron poisoning is an exceedingly rare occurrence, mainly when resulting from intentional ingestion in adults. It can lead to multi-organ toxicity and, in severe cases, may evolve into acute liver failure and cardiovascular collapse, which are the main causes of death. The clinical outcome is largely dependent on the amount of elemental iron ingested and the readiness of treatment, which includes support, early intestinal decontamination and deferoxamine. Despite timely intervention, acute liver failure can be life-threatening, with liver transplantation being the only potentially life-saving measure. In this case report, we describe a case of severe acute iron poisoning due to intentional ingestion that led to fulminant liver failure, which was successfully managed with liver transplantation.

Keywords: Drug Overdose/complications; Ferrous Compounds/poisoning; Liver Failure, Acute/chemically induced

RESUMO

A intoxicação aguda por ferro é uma condição extremamente rara, especialmente em contexto de ingestão intencional no adulto. Pode causar disfunção multiorgânica, podendo, em casos severos, evoluir para falência hepática aguda e colapso cardiovascular, que são as principais causas de mortalidade associadas a esta condição. O *outcome* clínico depende especialmente da quantidade de ferro elementar consumido e da rapidez de tratamento, que inclui suporte, descontaminação intestinal precoce e deferoxamina. Perante o prognóstico reservado associado à falência hepática aguda, a transplantação hepática surge como potencial medida *life-saving*. Neste relato de caso clínico descreve-se um caso de intoxicação aguda grave por ferro, secundária a ingestão intencional, que resultou em falência hepática fulminante, tratada com sucesso com transplante hepático.

Palavras-chave: Compostos Ferrosos/intoxicação; Falência Hepática Aguda/induzida quimicamente; Overdose de Medicamentos

INTRODUCTION

The epidemiology of acute iron poisoning (AIP) varies greatly depending on the type of ingestion, although the literature on this entity is still scarce. This condition is rare in adults and in this population it is typically associated with intentional ingestion, often as a result of suicide attempts. In one of the first institutional reviews of patients with this condition, 80% of intentional ingestions occurred in female patients and mortality was higher in this type of ingestion when compared to unintentional AIP.¹ Iron poisoning can cause gastrointestinal, cardiovascular, metabolic, hepatic, and central nervous system toxicity.¹⁻³ The severity of symptoms and the toxic dose are not well established and are determined by the iron formulation and the dose ingested: intakes ≥ 60 mg/kg of elemental iron are commonly linked to severe toxicity and death.²⁻⁴ Severe AIP can lead to acute liver failure (ALF) and cardiovascular collapse, the main causes of death in AIP.¹⁻⁴ The clinical outcome depends mainly on the amount of elemental iron ingested, other drugs ingested and the timing of initiation of treatment and support.

Most of the current literature on AIP with ALF reports cases with multiple drug overdose, usually with other hepatotoxic drugs. In this case report, we present the case of a female patient with an isolated AIP due to intentional ingestion, who progressed to fulminant liver failure, requiring liver

transplantation.

CASE DESCRIPTION

A 38-year-old woman intentionally ingested 90 tablets of ferrous sulphate (329.7 mg) in a suicide attempt. The total dose of ferrous sulfate was 29.7 g which corresponds to 9.5 g of elemental iron (130 mg/kg). Her past medical history included depression and iron deficiency anemia. The patient presented at the emergency department four hours after ingestion, reporting gastrointestinal symptoms and exhibiting drowsiness while remaining hemodynamically stable. Gastric lavage was performed and activated charcoal was administered. Chelation iron therapy with deferoxamine was started, as an intravenous infusion, at a rate of 15 mg/kg/h, according to guidance from the national poison control center. An infusion of N-acetylcysteine, flumazenil 0.5 mg and fluid therapy were also administered.

The arterial blood gas test presented metabolic acidosis and hyperlactatemia. The complete blood count showed hypochromic microcytic anemia and leukocytosis. Iron testing suggested iron overload as represented in Table 1. Liver parameters were normal at presentation.

The patient was admitted to the Intermediate Care Unit for surveillance. As the clinical condition deteriorated the patient developed acute liver failure with progressive

1. Department of Anesthesiology, Critical Care Medicine and Emergency. Unidade Local de Saúde de Santo António. Porto. Portugal.

2. Department of Critical Care Medicine. Unidade Local de Saúde do Alto Minho. Viana do Castelo. Portugal.

✉ **Autor correspondente:** Maria Bourbon Ruão. mariabourbonruao@hotmail.com

Recebido/Received: 07/01/2024 - **Aceite/Accepted:** 18/03/2024 - **Publicado/Published:** 03/06/2024

Copyright © Ordem dos Médicos 2024



Table 1 – Analytic values

Parameter	Value	Reference value
Hemoglobin	8.3 g/dL	12 – 16 g/dL
Leucocytes	20 200 /uL	4800 – 10 800 /uL
Serum iron level	1045 mcg/dL	50 – 170 mcg/dL
Transferrin saturation	210%	20% – 50%
Transferrin	354 mg/dL	250 – 380 mg/dL
Ferritin	4.2 ng/mL	10 – 291 ng/mL

increase in liver enzymes, worsening of coagulopathy, grade 1 - 2 encephalopathy and hypoglycemia.

Following contact with the liver transplant team, the patient was transferred to our hospital 48 hours after ingestion and was admitted to the Intensive Care Unit. On admission, she was drowsy but easily arousable and cooperating. Flapping and focal neurological deficits were absent. Vasopressor therapy with norepinephrine was started, while maintaining adequate urine output. The medical team decided to maintain deferoxamine infusion and continuous venovenous hemodiafiltration was started, without anticoagulation or ultrafiltration.

Despite these measures, clinical status deteriorated with rapidly progressive liver failure and worsening neurological dysfunction which included flapping, increasing drowsiness and impaired verbal response. Additionally, nonoliguric kidney injury was also present. Deferoxamine was interrupted after 48 hours of infusion due to the lack of clinical improvement.

A multidisciplinary assessment, including psychiatric evaluation, deemed the patient eligible for transplant surgery. However, she was considered to be at risk for impulsive behavior, and additional psychiatric and psychological support was considered necessary.

The patient underwent urgent liver transplantation five days after ingestion. The procedure was complicated by intraoperative hemorrhage. Nevertheless, the patient achieved clinical improvement, with hemodynamic stability and extubation was possible two days after the procedure. She developed partial graft dysfunction that improved during hospitalization and was transferred to the transplantation ward four days after surgery. At the six month follow up, there was no evidence of further complications.

DISCUSSION

Mechanisms of iron toxicity are not completely understood. Due to the iron's direct effect on the gastrointestinal mucosa, ingestion of 10 - 20 mg/kg of iron may cause gastrointestinal symptoms. Systemic symptoms of intoxication usually occur with doses of 40 mg/kg and those who ingest 60 mg/kg or more usually develop serious toxicity, which can be fatal.³ This patient ingested 130 mg/kg of iron which

led to gastroenteritis and development of severe systemic intoxication symptoms, including fulminant hepatic failure and acute renal failure. There are few cases described in the literature of adults with fulminant liver failure due to iron intoxication solely⁴ and an even smaller number of survivors.⁵

The clinical manifestations of acute iron poisoning are typically divided into five stages that often overlap. The gastrointestinal phase (stage I) occurs 30 minutes to 6 hours after ingestion and is characterized by major gastrointestinal manifestations. After 6 to 24 hours of ingestion (stage II – latent phase) there is apparent stabilization with resolution of gastrointestinal symptoms, despite the severity of the intoxication. Stage III is associated with mitochondrial dysfunction and usually begins about 6 to 72 hours after iron intake. At this stage, coagulopathy, acute tubular necrosis, metabolic acidosis, and shock may appear. Hepatotoxicity (stage IV) due to iron toxicity develops within 12 to 96 hours after ingestion and appears to be a dose-related phenomenon.⁴ In addition to liver damage, excessive free radical production can also cause acute lung and kidney injury. After two to eight weeks (stage V), late complications may arise due to gastrointestinal scarring that can cause obstruction.¹⁻⁴

Treatment of iron toxicity includes intensive supportive therapy, early intestinal decontamination, deferoxamine, and, as a last resource, liver transplantation. Deferoxamine is the antidote of choice for severe acute iron poisoning, as it is a specific iron chelating agent. However, in the literature there is evidence of significant pulmonary toxicity after intravenous infusions of deferoxamine for more than 24 hours.⁶

The rescue treatment for acute liver failure is liver transplantation, but the outcomes are unpredictable in patients with iron overdose.⁷ However, liver transplantation should be immediately considered in these cases.⁴

Despite the high severity of the case, this patient's evolution was positive, with complete resolution after liver transplantation.

CONCLUSION

Iron overdose, primarily resulting from voluntary intoxication in adults, is an exceedingly rare occurrence. Severe cases pose a significant risk of complications, multiple organ failure and even death, underscoring the critical importance of prompt recognition and treatment. Despite the available interventions, acute liver failure remains a harsh reality, making liver transplantation a last-resort lifesaving measure. The positive outcome observed in this patient, with complete resolution post-liver transplantation, highlights the potential for successful management even in severe cases.

AUTHOR CONTRIBUTIONS

MBR, IP, RP: Literature review, drafting of the manuscript.

JRM, AM: Critical review of the manuscript.

All authors approved the final version to be published.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association updated in 2013.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in

use at their working center regarding patients' data publication.

PATIENT CONSENT

Obtained.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

FUNDING SOURCES

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Kroeker S, Minuk GY. Intentional iron overdose: an institutional review. *CMAJ*. 1994;150:45.
2. Kundavaram P, Abhilash P, Arul J, Bala D. Fatal overdose of iron tablets in adults - case report. *Indian J Crit Care Med*. 2013;17:311-3.
3. Yesiler FI, Sandur U, Demirel A. Acute iron poisoning: a case report. *MOJ Clin Med Case Rep*. 2018;8:16-8.
4. Robertson A, Tenenbein M. Hepatotoxicity in acute iron poisoning. *Hum Exp Toxicol*. 2005;24:559-62.
5. Kozaki K, Egawa H, Garcia-Kennedy R, Cox KL, Lindsay J, Esquivel CO. Hepatic failure due to massive iron ingestion successfully treated with liver transplantation. *Clin Transplant*. 1995;9:85-7.
6. Howland MA. Risks of parenteral deferoxamine for acute iron poisoning. *J Toxicol Clin Toxicol*. 1996;34:491-7.
7. Yu D, Giffen MA Jr. Suicidal iron overdose: a case report and review of literature. *J Forensic Sci*. 2021;66:1564-9.