




The Effect of Prenatal and Postnatal Treatment with Intravenous Immunoglobulin on Severity of Neonatal Hemochromatosis: The Tale of Two Brothers (Case Report)

Veronica Mugarab-Samedi, MD¹  Michelle D. Ryan, MD² Essa Hamdan Al Awad, MD²
Adel Elsharkawy, MD²

¹Department of Pediatrics, University of Saskatchewan, Saskatoon, Canada

²Section of Neonatology, University of Calgary, Calgary, Alberta, Canada

Address for correspondence Veronica Mugarab-Samedi, MD, University of Saskatchewan, 107 Wiggins Rd, Saskatoon, SK S7N 5E5, Canada (e-mail: vmsamedi@gmail.com).

AJP Rep 2021;11:e102–e104.

Abstract

Keywords

- ▶ neonatal hemochromatosis
- ▶ intravenous immunoglobulin
- ▶ prenatal treatment
- ▶ case report

Background Neonatal hemochromatosis (NH) is a rare condition that was the main reason for liver transplantation in infants. With the realization that NH results from the fetal complement-mediated liver injury, intravenous immunoglobulins (IVIG) were successfully introduced for the treatment.

Case Presentation We present two cases of NH from the same family to illustrate the role of antenatal treatment with IVIG in alleviation and possible prevention of this serious morbidity.

Conclusion A prenatal treatment and early postnatal administration of IVIG are effective ways to manage NH that help to reduce the severity of the symptoms, prevent liver failure, and avoid the need for liver transplantation.

Neonatal hemochromatosis (NH) is a rare condition that presents with early liver failure accompanied by hepatic and extrahepatic iron deposition (sideration).¹ For many years, NH was the main reason for liver transplantation in infants; supportive treatment with antioxidants and chelation was ineffective and was associated with severe side effects.^{1–3} With the realization that NH results from the fetal complement-mediated liver injury, intravenous immunoglobulins (IVIG) were successfully introduced for the treatment that subsequently resulted in increased survival rate and decreased need for liver transplantation.^{3,4}

We present two cases of NH from the same family to illustrate the role of antenatal treatment with IVIG in alleviation and possible prevention of this serious morbidity.

Case Presentation

Case 1

The mother of our patient was an asymptomatic gravida 4 para 2 woman with two previous term deliveries and one miscarriage at 12 weeks. She had regular prenatal follow-up, her antenatal screening showed normal serology, and she denied any history of illnesses during pregnancy. Current pregnancy was uneventful until 28 weeks of gestational age (GA) when fetal ultrasound showed severe oligohydramnios that rapidly progressed to the anhydramnios despite intact membranes. The infant was delivered by emergency caesarian section at 29 weeks due to biophysical profile 0/8 and poor fetal tracing. Apgar scores at birth were 3, 7, and 7 at

received
March 14, 2020
accepted
May 21, 2020

DOI <https://doi.org/10.1055/s-0041-1731311>.
ISSN 2157-6998.

© 2021. The Author(s).

This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (<https://creativecommons.org/licenses/by-nc-nd/4.0/>)

Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA

first, fifth, and tenth minutes, respectively. The infant weighed 840 g (8th percentile) and his initial physical examination was appropriate for the GA. He was intubated in the case room and received a surfactant for respiratory distress. During the next 24 hours, he remained on ventilatory support, and gradually developed hypoglycemia that was managed with glucose infusion. On his second day of life, the infant developed severe hypotension, thrombocytopenia, and progressive hypoxemia. His hypoglycemia precipitously worsens in spite of the increased glucose infusion rate. During this prolonged hypoglycemic episode, a critical blood testing (insulin, cortisol, growth hormone, thyroid function, and lactate), a coagulation panel, and tests for possible metabolic abnormalities were performed as well as a full sepsis workup (complete blood count, C-reactive protein level, blood culture, and cerebrospinal fluid analysis and culture). Treatment with antibiotics (ampicillin and gentamycin) was initiated. Initial blood tests showed leukopenia with normal platelets count, elevated liver enzymes, and evidence of coagulopathy. The next day, the patient's condition deteriorated. He developed progressive abdominal distension with clinical picture of ileus; his liver function precipitously worsened; coagulation tests showed disseminated intravascular coagulation despite treatment with fresh frozen plasma, cryoprecipitate, platelets, and vitamin K. His ferritin level was very high (2750 ng/mL), and he continues to have profound lactic acidosis (lowest lactate level was 7.2 mmol/L and highest 15.1 mmol/L). The metabolic workup was reported as normal. Exploration laparotomy was performed for suspected necrotic bowel and showed mild ascites with multiple hemorrhages within the bowel wall. At the age of 3 days, the patient developed generalized tonic-clonic seizures that were refractory to the phenobarbital, phenytoin, and levetiracetam. The patient remained hemodynamically unstable despite aggressive resuscitation and died at the age of 4 days.

An autopsy was performed and revealed abnormal, cirrhotic liver with nodular appearance, cholestasis and iron deposition in hepatocytes and Kupffer cells. Iron staining was found in thyroid, pancreas, mucous glands of upper respiratory tract, and thymus. Hemorrhage within the lungs, cerebellum, lateral ventricles, and subarachnoid is reported as well. Autopsy findings were consistent with the diagnosis of NH.

Case 2

After confirming the diagnosis of NH, parents were counseled about the risks of morbidity in the next pregnancy and explained that the probability of the next infant to be lethally affected is greater than 90%. However, they were informed that the severity of NH could be considerably alleviated by antenatal IVIG treatment.

The next spontaneous singleton pregnancy occurred 26 months later, and the mother was under close surveillance of high-risk maternity services from 10 weeks of gestation. Preventive treatment with IVIG was initiated at 14 weeks of pregnancy until the end of gestation. The pregnancy was uneventful, and multiple fetal ultrasounds

were reassuring. At 39 + 5 weeks of GA, a male infant was born by spontaneous vaginal delivery. Apgar scores at birth were 7 and 9 at 1st and 5th minutes, respectively. The infant weighed 3,275 g, and his physical examination was unremarkable. He was admitted to neonatal intensive care unit (NICU) for the management of possible NH. His course at NICU was notable for transient hypoglycemia that was treated with intravenous glucose and moderately deranged coagulation profile: low fibrinogen, slightly increased international normalized ratio (INR), and elevated ferritin (950 ng/mL). Although the patient remained asymptomatic, treatment with IVIG 1 g/kg was started immediately. Vitamin E 40 units twice a day was added after consultation with a pediatric gastroenterologist. Following treatment, the patient showed rapid laboratory improvement: fibrinogen (90–175 mg/dL), INR (2.68–1.1), and ferritin (950–510 ng/mL). The patient was discharged home on day 20 of life with planned follow-up with pediatrician and gastroenterologist.

Discussion and Conclusion

NH is a rare but often life-threatening clinical condition, and untreated it is uniformly lethal.^{1–3} Although the inheritance of NH remains unclear, the recurrence of NH in families with one affected child is ~90%.^{3,5} Current clinical evidence explains NH as a maternofetal alloimmune disorder, so this condition is congenital but not hereditary.^{3,4} NH starts at 14 weeks of pregnancy when maternal immunoglobulin G (IgG) began to cross placenta and bind to fetal hepatocytes causing complement-mediated hepatocyte injury.^{5–7} The discovery of the alloimmune etiology of NH advanced prevention, timely diagnosis, and treatment of this condition.^{5,6}

It is well described in the literature that a woman could have multiple unaffected infants before having an infant with NH.^{1–3,6,7} In our case, the mother had two healthy children before the miscarriage, and afterward, an infant with severe NH was born. This fact could be explained by the time-lapse between exposure, sensitization, and production of IgG antibodies against the fetal antigen.^{7,8}

While the majority of NH affected infants present with acute liver failure within hours after delivery, some could have isolated symptoms of hypoglycemia, coagulopathy, or hyperbilirubinemia at birth.^{7,9} Without early and aggressive medical treatment, these infants usually deteriorate within the first week of life.^{10,11} The intrauterine growth restriction, oligohydramnios, and prematurity are common cofoundings in infants with NH.^{11,12}

This diagnosis without family history could be a challenge. Laboratory evaluation is usually significant for hyperbilirubinemia, hypoglycemia, and deranged coagulation factors. Iron studies reveal high serum ferritin levels (>800 ng/mL) that are a sensitive but not specific indicator for NH.^{1,5,11} Placental pathology findings are nonspecific for NH, and consist of edematous placental villi.²

In the first presented case, combination of being small for GA, having highly elevated ferritin levels, and liver failure made the diagnosis for NH most likely, and buccal biopsy was

considered as a confirmation test; however, rapid clinical deterioration makes it unfeasible. The autopsy confirmed the suspected diagnosis of NH and provided with the necessary information for further counseling.

Since the introduction of IVIG preventive therapy, mortality and morbidity rate among neonates with NH decreased dramatically.⁷⁻⁹ Feldman and Whittington developed an effective protocol of NH prevention, with the use of IVIG at 14, 16, and 18 weeks, and then weekly until the end of pregnancy in mothers with a history of fetal or NH.³ They reported good outcomes in 99% of cases.³ Several studies support this approach and report similar effectiveness.^{6,8,9} In situations when mothers were unable to receive preventive therapy with IVIG, exchange transfusion, IVIG, and chelation-antioxidant therapy remain the treatment choices for the neonates with NH.^{5,9}

In our second case, the mother received preventive therapy with IVIG that helped to preserve pregnancy until term (previously, she had a miscarriage and preterm birth at 29 weeks). This infant was born appropriate for GA and was clinically asymptomatic. His laboratory findings (elevated ferritin, deranged coagulation profile) on the first day of life were suggestive of impaired liver function; so, IVIG was administered aiming to reduce the ongoing hepatocyte injury. We believe that the early use of IVIG in this patient helped to preserve hepatocytes and normalize liver function. His hospital course was straightforward; he was observed for 3 weeks and discharged home with no active concerns.

A prenatal treatment and early postnatal administration of IVIG are effective ways to manage NH that help to reduce the severity of the symptoms, prevent liver failure, and avoid the need for liver transplantation.

Declarations

Ethics approval and consent to participate: no ethics approval required, informed consent from the patient received.

Consent for Publication

Written informed consent was obtained from the parents for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Availability of data and material: available for review.

Authors' Contributions

VMS provided informed consent, collected the data, reviewed the literature, prepared the manuscript preparation, and had direct involvement in patient care.

MR was involved in initial drafting of manuscript, literature review, and had direct involvement in patient care.

EA and AE edited the manuscript and had direct involvement in patient care.

All authors have read and approved the manuscript.

Funding

Not funded.

Conflict of Interests

No competing interests.

Acknowledgments

We would like to acknowledge Neonatal Intensive Care medical term, Foothills Medical Centre, Calgary, Canada.

References

- Murray KF, Kowdley KV. Neonatal hemochromatosis. *Pediatrics* 2001;108(04):960-964
- Sigurdsson L, Reyes J, Kocoshis SA, Hansen TW, Rosh J, Knisely AS. Neonatal hemochromatosis: outcomes of pharmacologic and surgical therapies. *J Pediatr Gastroenterol Nutr* 1998;26(01):85-89
- Feldman AG, Whittington PF. Neonatal hemochromatosis. *J Clin Exp Hepatol* 2013;3(04):313-320
- Taylor SA, Kelly S, Alonso EM, Whittington PF. The effects of gestational alloimmune liver disease on fetal and infant morbidity and mortality. *J Pediatr* 2018;196:123-128.e1
- Heissat S, Collardeau-Frachon S, Baruteau J, et al. Neonatal hemochromatosis: diagnostic work-up based on a series of 56 cases of fetal death and neonatal liver failure. *J Pediatr* 2015;166(01):66-73
- Rand EB, Karpen SJ, Kelly S, et al. Treatment of neonatal hemochromatosis with exchange transfusion and intravenous immunoglobulin. *J Pediatr* 2009;155(04):566-571
- Whittington PF, Hibbard JU. High-dose immunoglobulin during pregnancy for recurrent neonatal haemochromatosis. *Lancet* 2004;364(9446):1690-1698
- Pan X, Kelly S, Melin-Aldana H, Malladi P, Whittington PF. Novel mechanism of fetal hepatocyte injury in congenital alloimmune hepatitis involves the terminal complement cascade. *Hepatology* 2010;51(06):2061-2068
- Whittington PF, Kelly S. Outcome of pregnancies at risk for neonatal hemochromatosis is improved by treatment with high-dose intravenous immunoglobulin. *Pediatrics* 2008;121(06):e1615-e1621
- Tanaka H, Haba R, Itoh S, Sakamoto H, Hata T. Prenatal high-dose immunoglobulin treatment for neonatal hemochromatosis: a case report and review of the literature. *J Obstet Gynaecol Res* 2011;37(12):1891-1894
- Jimenez-Rivera C, Gupta A, Feberova J, de Nanassy JA, Boland MP. Successful treatment of neonatal hemochromatosis as gestational alloimmune liver disease with intravenous immunoglobulin. *J Neonatal Perinatal Med* 2014;7(04):301-304
- Babor F, Hadzik B, Stannigel H, Mayatepek E, Hoehn T. Successful management of neonatal hemochromatosis by exchange transfusion and immunoglobulin: a case report. *J Perinatol* 2013;33(01):83-85