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Central nervous system recurrence in a patient treated for acute promyelocytic leukemia, resulting in sideroblastic anemia: A case report

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Abstract

BACKGROUND

Previous cases that have been stated in this article have displayed that around 1% to 7% of patients that have been treated with chemotherapy for acute promyelocytic leukemia developed myelodysplastic syndrome or acute myeloid leukemia. One can see that's why this case presentation of a 60-year-old man that had a good response to acute promyelocytic leukemia treatment, that later presented with a central nervous system recurrence of acute promyelocytic leukemia and acquired sideroblastic anemia (a form of myelodysplasia) from treatment is a unique case report.

CASE SUMMARY

The presence of central nervous system relapse in acute promyelocytic leukemia patients is very unlikely compared to recurring mainly in the bone marrow. It is also uncommon to be diagnosed with sideroblastic anemia (form of myelodysplastic syndrome) as a result from treatment for acute promyelocytic leukemia. This case report highlights the detection, treatment/maintenance with idarubicin, all-trans-retinoic-acid, arsenic trioxide, methotrexate, 6-mercaptopurine, and ommaya reservoir intrathecal methotrexate administration in a patient that had central nervous system relapse of acute promyelocytic leukemia and acquired sideroblastic anemia.

CONCLUSION

In essence, first time relapse concerning the central nervous system in treated

acute promyelocytic leukemia patients who had a good response to therapy is very uncommon. The acquirement of a myelodysplastic syndrome such as ringed sideroblastic anemia is also rare regarding this patient population. Although such cases are infrequent, this case report represents a unique insight of the detection, treatment, and maintenance of a 60-year-old man diagnosed with acute promyelocytic leukemia, resulting in the acquirement of sideroblastic anemia and central nervous system relapse.

Key Words: Acute promyelocytic leukemia; Central nervous system relapse; Sideroblastic anemia; All-trans-retinoic acid; Myelodysplasia; Case report

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Core Tip: Central nervous system recurrence and acquirement of sideroblastic anemia is a rare occurrence on their own and are even more unlikely to occur together in treated acute promyelocytic leukemia patients. We present a case presentation of a 60-year-old man that had a good response to acute promyelocytic leukemia treatment, that later presented with a central nervous system recurrence of acute promyelocytic leukemia and acquired sideroblastic anemia (a form of myelodysplasia) from treatment is a unique case report.

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INTRODUCTION

Acute promyelocytic leukemia is a form of acute myeloid leukemia that is mainly due to a translocation of chromosomes fifteen and seventeen that influence the expression of the promyelocytic leukemia/retinoic acid receptor alpha (*PML-RARA*) genes[1]. It has been noted that myeloid neoplasms related to treatment are more prevalent in solid tumors and lymphomas than compared to a myeloid neoplasm arising from acute myeloid leukemia (AML) or acute promyelocytic leukemia (APL). Denu *et al*[2] 2016 had shown that 1% to 7% of patients that were treated with chemotherapy for acute promyelocytic leukemia developed myelodysplastic syndrome or acute myeloid leukemia. In 1998, Liso *et al*[3] 1998 conducted a review of 120 patients treated with all-trans-retinoic acid (ATRA) and chemotherapy that were seen over a period of nine years at two different institutions. 7 out of the 120 patients were found to have extramedullary disease, but only one patient had disease in the central nervous system (CNS). Montesinos *et al*[4] 2009 conducted a study from 1996 to 2005 that had 739 acute promyelocytic leukemia (APL) patients who received induction therapy with ATRA and idarubicin, as well as consolidation chemotherapy for relapse. There were 11 patients that had confirmed central nervous system (CNS) relapse with a five-year cumulative central nervous system incidence of 1.7%. Latagliata *et al*[5] 2002 discovered that 6.5% of the 77 acute promyelocytic leukemia patients who had a complete response to induction and consolidation therapy acquired therapy-related myelodysplasia, acute myeloid leukemia, or a combination of the two in their study. One can see that's why this case presentation of a 60-year-old man that had a good response to acute promyelocytic leukemia treatment, that later presented with a central nervous system recurrence of acute promyelocytic leukemia and acquired sideroblastic anemia (a form of myelodysplasia) from treatment is a unique case report.

CASE PRESENTATION

Chief complaints

A 60-year-old white male comes into the hospital in 2009 with a complaint of blurred vision in his right eye (ophthalmologist noted occlusion of retinal vein), feeling somnolent, and weak for the past four weeks.

History of present illness

He was admitted to the emergency room for weakness, fatigue, and leukocytosis. The patient attributed his condition to a treated sinus infection he had prior. The patient presentation noted minor bruising

over the arms and legs, and no signs of bleeding episodes, such as, epistaxis, hematemesis, melena, or blood per rectum.

History of past illness

Sinus infection.

Personal and family history

Non-contributory.

Physical examination

Generalized weakness, fatigue, and leukocytosis. The patient attributed his condition to a treated sinus infection he had prior. The patient presentation noted minor bruising over the arms and legs, and no signs of bleeding episodes, such as, epistaxis, hematemesis, melena, or blood per rectum.

Laboratory examinations

White blood cell count of 41600, hemoglobin of 8.4, hematocrit of 23, platelet count of 20000, mean corpuscular volume of 93, segmented neutrophils percentage (seg %) of 2%, lymphocyte percentage of 6%, monocyte percentage of 3%, and absolute neutrophil count of 800. hemoglobin of 14, hematocrit of 39, white blood cell count of 9100, and platelet count of 130000. Three months later in 2020, the patient remained on maintenance low dose methotrexate and had improved blood counts that were a hemoglobin of 13, hematocrit of 40, white blood cell count of 7700, and platelet count of 158000. Hemoglobin of 14, hematocrit of 41, white blood cell count of 8600, and platelet count of 165000. Hemoglobin of 13, hematocrit of 39, white blood cell count of 7400, and platelet count of 157000.

Imaging examinations

Bone marrow biopsy of *PML-RARA* gene fusion by interphase fluorescent *in-situ* hybridization (Figure 1).

FINAL DIAGNOSIS

Central nervous system relapse of acute promyelocytic leukemia and acquired sideroblastic anemia (Figure 2).

TREATMENT

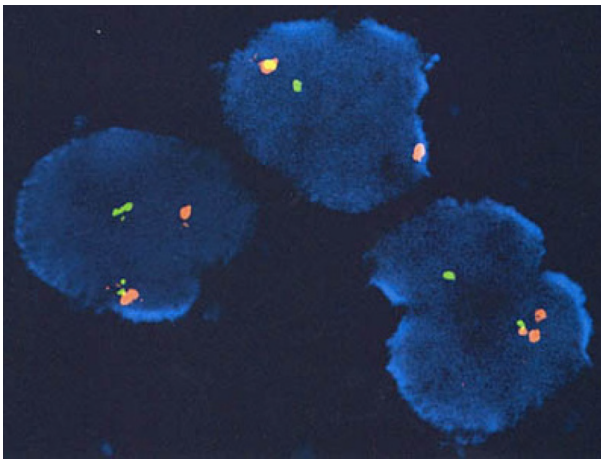
Idarubicin, ATRA, arsenic trioxide, methotrexate, 6-Mercaptopurine, and ommaya reservoir intrathecal methotrexate.

OUTCOME AND FOLLOW-UP

Patient has remained stable as of 2020, being managed with folic acid, thiamine, and pyridoxine.

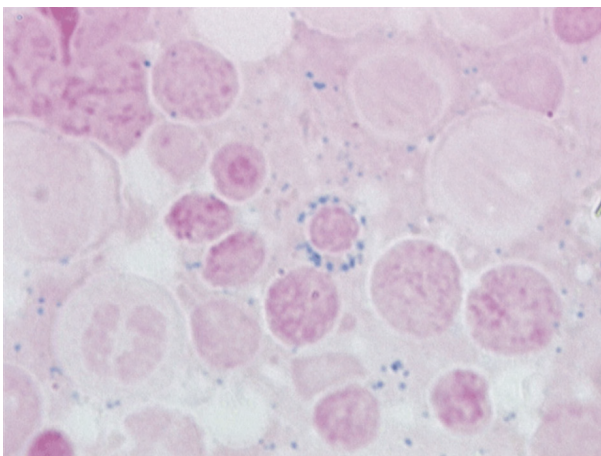
DISCUSSION

One can determine that central nervous system recurrence and acquirement of sideroblastic anemia is a rare occurrence on their own and are even more unlikely to occur together in treated acute promyelocytic leukemia patients. From 1996 to 2008, Montesinos *et al*[6] 2010 analyzed therapy-related myeloid neoplasms in 1025 acute promyelocytic leukemia patients who received anthracycline-based chemotherapy and All-Trans-Retinoic acid. Seven out of the 918 patients that achieved a complete response had developed a therapy related neoplasm after a median of 43 mo from complete response: With a 6-year cumulative incidence of therapy-related myeloid neoplasm of 2.2 %. From 1991 to 1998 Lobe *et al*[7] 2003 dealt with treating 677 newly diagnosed acute promyelocytic leukemia patients. Six hundred and seventeen out of the 677 patients achieved a complete response with combination All-Trans-Retinoic acid and chemotherapy; 246 acute promyelocytic leukemia patients had received maintenance chemotherapy, 6-mercaptopurine, and methotrexate. At the median 51-month follow-up, 0.97% of the treated acute promyelocytic leukemia patients developed myelodysplastic syndrome. De Botton *et al*[8] 2006 discovered that 23% of patients relapsed after obtaining a complete response, and about 5% had a 3-year cumulative incidence for first time central nervous system relapse. The study analyzed potential risk factors for central nervous system relapse: age less than 45 years-old ($P = 0.05$),



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Figure 1 Bone marrow biopsy of promyelocytic leukemia/retinoic acid receptor alpha gene fusion by interphase fluorescent *in-situ* hybridization.



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Figure 2 Bone marrow biopsy and iron staining displaying sideroblastic anemia.

bcr3 PML-RAR-alpha isoform ($P = 0.0003$), and a white blood cell count greater than or equal to $10000/\text{mm}^3$. Specchia *et al*[9] 2001 enrolled patients into two trials that were designed to see if there was any difference in extramedullary disease at relapse regarding combination All-Trans-Retinoic acid and chemotherapy compared to solely chemotherapy. It was discovered that the All-Trans-Retinoic acid plus chemotherapy and solely chemotherapy arms had 0.6% and 2%, respectively. These previous cases highlight the rarity of an acute promyelocytic leukemia patient acquiring central nervous system relapse as well as myelodysplastic syndrome, which make this case report relevant for future treatment applications pertaining to this patient population.

CONCLUSION

In essence, first time relapse concerning the central nervous system in treated acute promyelocytic leukemia patients who had a good response to therapy is very uncommon. The acquirement of a myelodysplastic syndrome such as ringed sideroblastic anemia is also rare regarding this patient population. Although such cases are infrequent, this case report represents a unique insight of the detection, treatment, and maintenance of a 60-year-old man diagnosed with acute promyelocytic leukemia, resulting in the acquirement of sideroblastic anemia and central nervous system relapse.

FOOTNOTES

Author contributions: Morse WJ was a major contributor in the writing of the manuscript; Nawaz H oversaw the patient with the attending physician and contributed to the editing of the paper; Choudhry A helped with the interpretation of the patient data; all authors approved the final manuscript.

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Efficacy of HA330-II column hemoadsorption in Epstein-Barr virus-associated hemophagocytic lymphohistiocytosis combined with liver failure: A case report

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Abstract

BACKGROUND

Hemophagocytic lymphohistiocytosis (HLH) is a severe and potentially deadly condition associated with extensive inflammation and immune activation. Cytokine adsorption may serve as a supportive treatment that can stabilize organ function in affected patients by reducing their circulating cytokines levels. To date, no descriptions of clinical experiences associated with the use of HA330-II column hemoadsorption for the treatment of children affected by HLH have been published.

CASE SUMMARY

We describe the case of an 11-year-old child with Epstein-Barr virus-associated HLH complicated by liver failure. She underwent HA330-II column hemoadsorption and chemotherapy and exhibited reductions in levels of inflammatory cytokines, including interleukin (IL), IL-6, IL-8, IL-10, and interferon- γ . The patient's condition and laboratory parameters gradually improved with treatment.

CONCLUSION

Hemoadsorption may play an important role in cytokine storm elimination in children with HLH combined with liver failure and consequent multiple organ failure.

Key Words: Hemoadsorption; HA330-II column; Hemophagocytic lymphohistiocytosis; Pediatric; Liver failure; Case report

Core Tip: Hemophagocytic lymphohistiocytosis (HLH) is an often fatal disease. We report an 11-year-old female who was diagnosed with Epstein-Barr virus-HLH and presented with coagulation disorders, liver damage, and respiratory insufficiency. In the present case, initially elevated interleukin (IL)-6, IL-8, IL-10, and interferon- γ levels were reduced to within normal ranges following hemoadsorption with HA330-II, and the patient's condition gradually improved. HA330-II hemoadsorption has the ability to bridge the patient until chemotherapy can contribute to reduced HLH disease activity.

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INTRODUCTION

Hemophagocytic lymphohistiocytosis (HLH) is a severe and potentially lethal disorder associated with excessive inflammation and unrestrained immune activation[1]. Patients with HLH exhibit dramatically elevated levels of cytokines, including interleukin (IL)-1, IL-2, IL-6, IL-18, tumor necrosis factor- α , and interferon (IFN)- γ [2]. HLH is classified into two groups: Primary and acquired. Primary HLH primarily develops as a consequence of genetic defects during infancy, while acquired HLH occurs in the context of auto-inflammatory/autoimmune diseases, lymphoma, or certain viral infections, with Epstein-Barr virus (EBV) being a common cause. Animal studies[3,4] and case series have demonstrated that a reduction in circulating cytokine levels achieved *via* hemoadsorption can be effective as a treatment for HLH[5,6]. HA330-II perfusion columns have been reported to be capable of absorbing multiple inflammatory factors and have been successfully used as a component of a double plasma molecular adsorption system to treat patients suffering from liver failure[7,8]. In the present article, we describe one case of a child diagnosed with EBV-associated HLH combined with liver failure who successfully underwent HA330-II column hemoadsorption and chemotherapy treatment. Through these treatments, the patient's condition improved and her recovery was satisfactory.

CASE PRESENTATION

Chief complaints

An 11-year-old female was admitted to our hospital with a 5 d history of high fever with chills and a headache as well as damaged liver function. She did not exhibit a cough, abdominal pain, or vomiting.

History of present illness

Before this visit, she had been given a penicillinase antibiotic for 3 d and azithromycin for 1 d. Her clinical state rapidly deteriorated, and she developed respiratory failure, capillary leak syndrome, and hypotension. As such, she was admitted to the pediatric intensive care unit.

History of past illness

The patient had a history of encephalitis 3 years ago, and she had recovered after treatment for 2 wk.

Personal and family history

This patient had no specific personal or family history.

Physical examination

On initial examination, the patient had a fever with a maximal temperature of 40.0 °C, a respiratory rate of 30 breaths per min, a heart rate of 122 bpm, and a blood pressure of 82/41 mmHg at admission. She was in a poor mental state and presented with jaundice and hepatosplenomegaly. Other physical examinations were normal.

Laboratory examinations

Initial laboratory studies in the pediatric intensive care unit revealed excessive hyperferritinemia (58360

ng/mL, reference range: 11.0-306.8 ng/mL), low natural killer cell activity (0.32%, reference range: 5%-26%), hypofibrinogenemia (0.84 g/L, reference range: 1.50-4.35 g/L), leukopenia (2.07×10^9 /L, reference range: $3.5-9.5 \times 10^9$ /L), neutropenia (0.92×10^9 /L, reference range: $1.8-6.3 \times 10^9$ /L) elevated international normalized ratio values (1.92, reference range: 0.8-1.2), thrombocytopenia (42×10^9 /L, reference range: $125-350 \times 10^9$ /L), elevated alanine transaminase (ALT) levels (921 U/L, reference range: 7-40 U/L), aspartate aminotransferase (AST) levels (2223 U/L, reference range: 13-35 U/L), and elevated total bilirubin (TBIL) levels (108.7 mmol/L, reference range: 3.5-23.5 mmol/L). The patient also exhibited high levels of C reactive protein (76.40 mg/L, reference range: 0-8 mg/L), procalcitonin (2.73 ng/mL, reference range: 0-0.05 ng/mL), IL-6 (154.06 pg/mL, reference range: 0-5.4 pg/mL), IL-8 (32.67 pg/mL, reference range: 0-20.6 pg/mL), IL-10 (169.81 pg/mL, reference range: 0-12.9 pg/mL), and IFN- γ (4387.41 pg/mL, reference range: 0-23.1 pg/mL). EBV-DNA loads were also found to be significantly elevated (3.82×10^6 copies/mL). Multiple blood and sputum cultures as well as the other viral polymerase chain reaction tests for common respiratory viruses and cytomegalovirus were all negative. A bone marrow biopsy revealed the presence of hemophagocytosis.

Imaging examinations

A thoracic-abdominal computer tomography analysis revealed pulmonary inflammation and no evidence of tumors.

FINAL DIAGNOSIS

She was diagnosed with EBV-associated hemophagocytic syndrome combined with liver failure in accordance with the HLH-2004 guidelines[9].

TREATMENT

Treatment with meropenem, norepinephrine, intravenous immunoglobulin, ganciclovir, and dexamethasone as well as high-flow nasal cannula placement were initiated. However, these approaches were ineffective as evidenced by sustained fever, hypoxemia, and hypotension. Chemotherapy was recommended for the patient, but her parents refused and asked for other therapeutic options. In light of the refractory state of her HLH and her poor general condition, we next sought to achieve the immediate suppression of hypercytokinemia. Accordingly, we initiated blood purification. Plasma exchange was initially considered but could not be performed owing to reduced plasma separator access due to the coronavirus disease 2019 pandemic. As such, we tried to perform hemoadsorption (HA330-II perfusion column, Zhuhai Health Sails Biotechnology Co., Ltd., Zhuhai, China) in this patient. Informed written consent was obtained from the patient's parent. Heparin sodium was employed for anticoagulation, and the patient was infused with platelets and fibrinogen prothrombin complex concentrate.

On the 1st day of hospitalization, she was in poor condition with respect to her clinical symptoms and biochemical parameters. She also needed a high dose of norepinephrine to maintain appropriate cardiovascular function. On the 2nd day of hospitalization, one round of the above mentioned hemoadsorption strategy was implemented. This hemoadsorption approach was implemented two more times over a 3-d period. On the 5th day of hospitalization, the patient exhibited significantly decreased levels of IL-6 (12.16 pg/mL), IL-8 (10.63 pg/mL), IL-10 (63.38 pg/mL), and IFN- γ (61.99 pg/mL) (Figure 1). She was gradually weaned off norepinephrine treatment, and her fever disappeared while her total leukocyte and neutrophil counts increased. However, no significant improvement in liver function was observed (ALT 766 U/L, AST 1196 U/L, TBIL 170.54 mmol/L, Fib 1.23 g/L), and inflammatory markers rebounded after hemoadsorption had been discontinued for 2 d, at which time the patient again developed a fever that reached as high as 40.0 C. At that time, her parents provided consent for chemotherapy (HLH-2004) treatment (Figure 2), which was initiated in combination with hemoadsorption.

OUTCOME AND FOLLOW-UP

The hemoadsorption approach was implemented an additional three times over a 5-d period, and the patient's condition gradually improved. On the 13th day of hospitalization, decreased levels of IL-10 (30.06 pg/mL) and IFN- γ (50.69 pg/mL) (Figure 1), improved liver function (ALT 257 U/L, AST 393 U/L, TBIL 79.91 mmol/L, Fib 1.45 g/L) (Figure 3), and increased platelet counts were all evident. She was discharged on the 40th day after admission owing to her good recovery status. The patient underwent an additional 30 d of chemotherapeutic treatment without significant adverse events. Furthermore, no disease recurrence was evident as of 8 mo post-discharge.

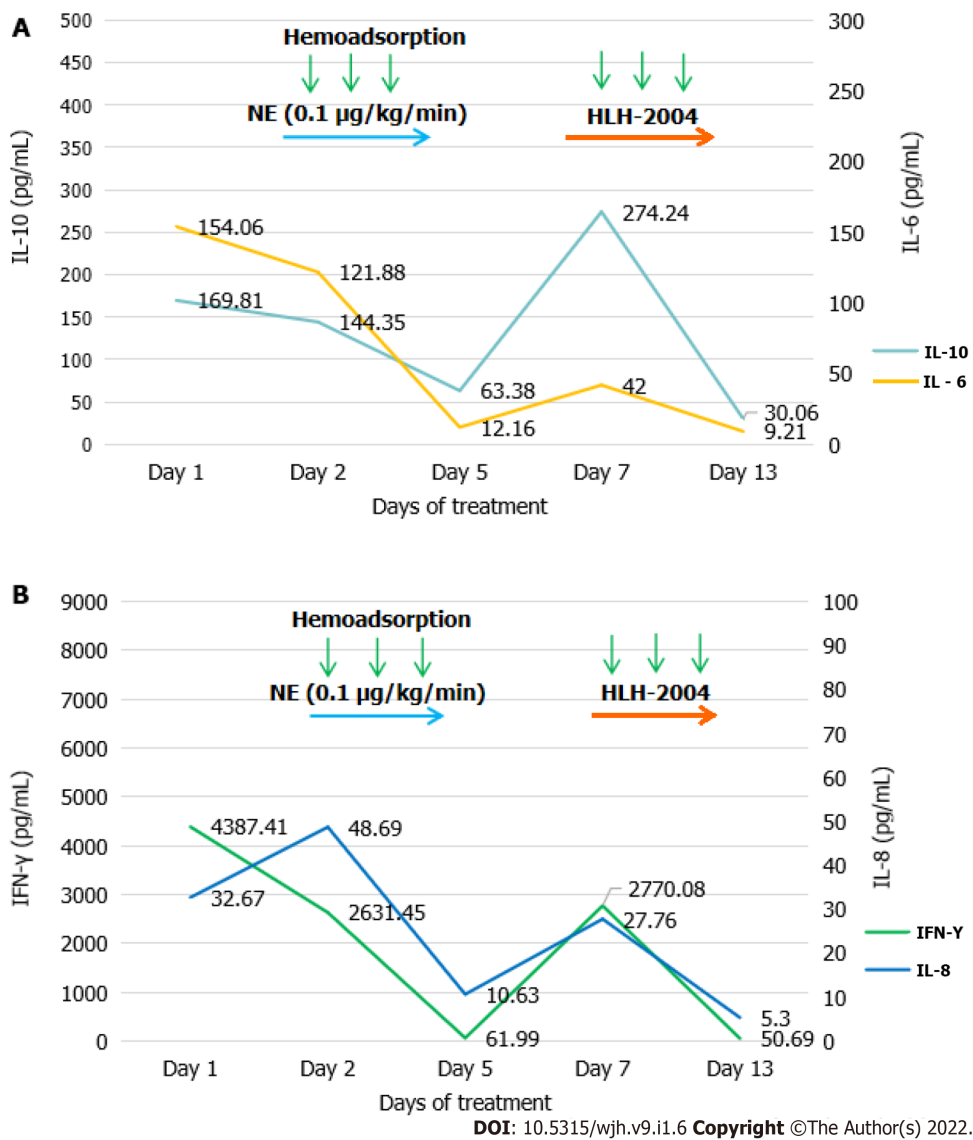


Figure 1 Interleukin 6 and interleukin 10 levels, and interferon-γ and interleukin 8 levels under treatment during the first 13 d after pediatric intensive care unit admission. A: Interleukin 6 and interleukin 10 levels; B: Interferon-γ and interleukin 8 levels. IL: Interleukin; NE: Norepinephrine; HLH: Hemophagocytic lymphohistiocytosis; IFN: Interferon.

DISCUSSION

HLH is an often fatal disease, and affected patients typically present with high-grade fever, progressive hypocytosis, liver dysfunction, and coagulopathy[9]. In our case, the patient presented with a persistent fever that had been present for more than 1 wk, hypocytosis, hypofibrinogenemia, splenomegaly, hyperferritinemia, and lymphohistiocytic accumulation in the bone marrow. HLH was thus diagnosed in this child. The most common treatment for HLH at present is chemotherapy[9]. However, when patients also present with serious organ damage, chemotherapy may not work, as the existence of severe multiorgan failure at presentation can lead to a high mortality rate[10]. At admission, our patient was in poor condition and presented with coagulation disorders, liver damage, and respiratory insufficiency. In such a context, cytokine adsorption has the potential to bridge the patient until chemotherapy can contribute to reduced HLH disease activity[5].

The primary pathophysiological characteristics of HLH include excessive cytotoxic T cell and macrophage activation and expansion. These activated immune cells, in turn, produce excessively high levels of inflammatory cytokines, including IL-1, IL-2, IL-6, IL-10, TNF-α, and IFN-γ, which can promote further cytotoxic T cell and macrophage activation and expansion, thereby exacerbating the ongoing cytokine storm and driving consequent multiple organ failure[2]. On admission, patients present with increased circulating levels of certain inflammatory cytokines, such as IL-6, IL-8, IL-10, and IFN-γ, suggesting an ongoing systemic inflammatory reaction. HA330-II is a neutral microporous resin column with abundant micropores and a high specific surface area[11]. HA330-II cartridges have the ability to adsorb medium and large-sized inflammatory cytokines, including those of the IL and TNF families. In

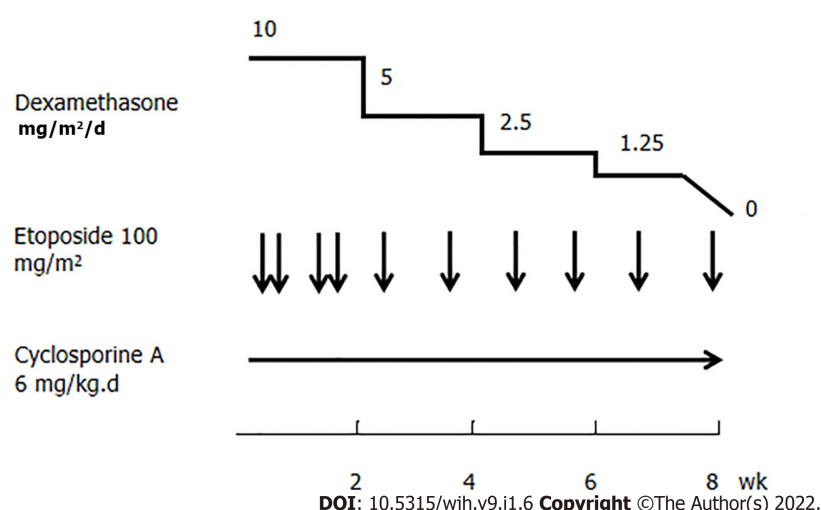


Figure 2 Chemotherapy protocol for the treated patient.

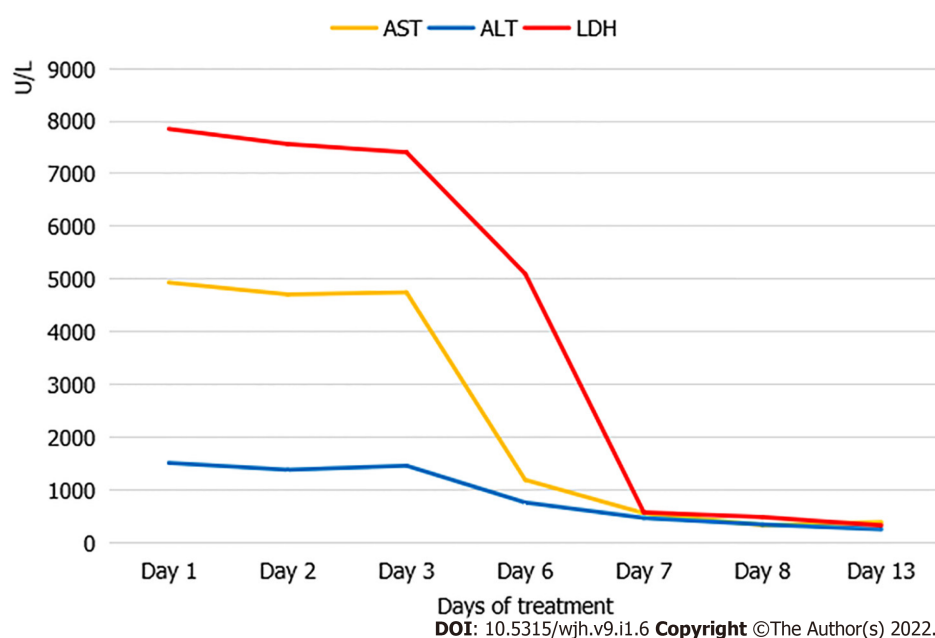


Figure 3 Changes in laboratory values during the first 13 d after pediatric intensive care unit admission. AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; LDH: Lactate dehydrogenase.

the present case, initially elevated IL-6, IL-8, IL-10, and IFN- γ levels were reduced to within normal ranges following hemoadsorption with HA330-II. This indicated that this column was able to reduce effectively inflammatory cytokines levels in our treated patient. However, this approach was unable to remediate effectively HLH-related liver failure in this patient, whereas hemoadsorption combined with chemotherapy was found to be more effective than hemoadsorption alone.

With respect to hemoadsorption, the CytoSorbTM column or endotoxin-binding polymyxin B-immobilized fiber column hemoadsorption approaches have also been reported for the treatment of HLH[12,13]. Cytokine adsorption associated with the CytoSorbTM column results in an improvement in the condition of treated patients, thus aiding in achieving symptom relief in affected individuals. Polymyxin B-immobilized fiber columns have also contributed to the recovery of circulatory dynamics associated with HLH. Several recent studies have demonstrated that HA330-II hemoadsorption plays a critical part in the elimination of inflammatory cytokines[14,15]. To the best of our knowledge, this is the first report to describe the clinical application of an HA330-II perfusion column in children suffering from HLH. However, as this is a report of outcomes for a single patient, large-scale trials will be necessary to investigate the clinical indications for such hemoadsorption treatment.

CONCLUSION

In summary, for EBV-associated HLH, HA330-II column-mediated hemoadsorption can safely reduce the levels of circulating inflammatory cytokines, serving as a beneficial and essential supplement to chemotherapy.

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FOOTNOTES

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