International International Journal of Health Science & Biomedicine (IJHSB)

CASE REPORT OPEN ACCESS

First Intraventricular Chemotherapy for Relapsed Pediatric brain tumor in Iran a Case Report

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Citation: Abdolkarimi B, Digaleh H, Ariana P, Ahmadi M, Malekpour M, et al. (2025) First Intraventricular Chemotherapy for Relapsed Pediatric brain tumor in Iran a Case Report. Int. J. Health Sci. Biomed. 2(6):1-3.

Received Date: 2025-11-3, **Accepted Date:** 2025-11-20, **Published Date:** 2025-11-29

Abstract

Medulloblastoma is an aggressive pediatric brain tumor with a high risk of recurrence and metastasis despite current multimodal treatments. Relapsed medulloblastoma is difficult to manage due to resistance to systemic chemotherapy and limited drug penetration through the blood-brain barrier. This case report presents a 6-year-old patient with relapsed medulloblastoma treated with intraventricular chemotherapy via an Ommaya reservoir in Iran. After failure of conventional chemotherapy, the patient received Methotrexate, Cytarabine, and Thiotepa directly into the cerebrospinal fluid. This report highlights the feasibility and potential benefits of intraventricular chemotherapy for relapsed medulloblastoma suggesting a valuable alternative therapeutic approach for this challenging condition.

Introduction

Medulloblastoma is a highly aggressive embryonal tumor of the central nervous system (CNS), primarily affecting children under 10 years of age [1]. It represents approximately 20% of pediatric brain tumors worldwide and is a leading cause of cancer-related morbidity in children [1,2]. Medulloblastoma typically arises in the posterior fossa and has a propensity to disseminate through cerebrospinal fluid (CSF), complicating treatment and prognosis [1,3,4]. Standard management of medulloblastoma includes maximal safe surgical resection followed by risk-adapted chemotherapy and craniospinal irradiation [5,6]. Despite advances in multimodal therapy improving long-term survival rates up to 60%, a significant proportion of patients experience tumor recurrence and treatment-related complications [7].

Relapsed medulloblastoma remains challenging to treat due to the limited efficacy of conventional chemotherapy and the protective nature of the blood-brain barrier [8]. Intraventricular chemotherapy, administered via devices such as the Ommaya reservoir, offers a targeted approach by delivering high concentrations of chemotherapeutic agents directly into the CSF, bypassing the blood-brain barrier. This method may provide improved tumor control in cases of relapse or resistant disease [6]. Here, we report the first medulloblastoma case from Iran of intraventricular chemotherapy for a relapsed medulloblastoma in a pediatric patient. This case highlights the feasibility and potential benefits of this advanced therapeutic strategy in a middle-income country setting, where treatment options for recurrent medulloblastoma remain limited.

Case Presentation

This case report focuses on a 6-year-old pediatric patient diagnosed with medulloblastoma in July 2022. When the patient was 4 years old, he initially presented with a series of neurological symptoms, including nausea, vomiting, headaches, and ptosis with deviation of the right eye. After a thorough evaluation, imaging studies revealed the presence of a tumor at the base of the skull, specifically attached to the base of the 4th ventricle.

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Surgery and biopsy were performed, which showed positive immunohistochemistry (IHC) results confirming the diagnosis of medulloblastoma. Following surgery, the patient received thirty sessions of radiotherapy, nine sessions of chemotherapy, and two sessions of intrathecal chemotherapy.Unfortunately, one year after discontinuation of chemotherapies, MRI findings favored tumor recurrence in the brain and spine. Fourteen sessions of different chemotherapy regimens were administered, but the tumor size didn't change, and bone metastasis also occurred.Given the failure of chemotherapy, the treatment approach focused on providing intraventricular chemotherapy, an advanced technique that allows for higher concentrations of chemotherapeutic agents to directly target the CNS, bypassing the blood-brain barrier. This form of therapy was chosen to address the relapsed tumor located within the posterior fossa and its proximity to the ventricles.To initiate this treatment, the patient underwent the placement of a Reservoir Ommaya system, a device that allows direct access to the ventricles of the brain for administering chemotherapy. Prior to implantation, imaging confirmed the proper positioning of the catheter. The patient was also carefully assessed to ensure optimal conditions for chemotherapy, including evaluating intracranial pressure (ICP) and performing routine blood tests (CBC, PT, aPTT, and Plt).The chemotherapy regimen selected for the patient consisted of Methotrexate (10–12 mg/m^2), Cytarabine (Ara-C) (10 mg), and Thiotepa (10 mg), which are commonly used for intraventricular chemotherapy due to their efficacy in treating CNS tumors like medulloblastoma. These drugs were administered via a controlled process, with close monitoring of the patient for any immediate adverse effects.

Post-treatment care focused on monitoring for common side effects and potential complications. The patient's consciousness, nausea, and seizure activity were monitored for 6 to 24 hours after the infusion. In addition, the patient was kept in a semi-recumbent position for up to 4 hours to reduce intracranial pressure and minimize discomfort.

The medical team closely observed the patient for signs of complications such as headaches, visual disturbances, seizures, vomiting, neck stiffness, or changes in consciousness. Vital signs were checked every 4 hours, and immediate interventions were available if necessary. Ondansetron/Granisetron was given to prevent nausea, and Diazepam was kept on standby in case of seizures, followed by Phenytoin if needed.

In addition to the patient's neurological status, attention was paid to the catheter site for any signs of infection, such as redness, swelling, or tenderness. The catheter site was regularly cleaned with saline and Betadine, and CSF was aspirated for analysis and culture to rule out infection.

After the chemotherapy infusion, the patient was closely monitored for 6 hours, with repeated evaluations of their neurological condition and vital signs. The patient showed no immediate complications, and after 24 h he showed encephalopathy signs include disorientation and seizure like movements. Dexamehasone and levitiracetam were injected. Brain imaging and EEG hadn,t significant changes.The patient continues to be monitored with regular imaging studies and neurological assessments. Additional cycles of chemotherapy are planned to manage the relapsed tumor and reduce the risk of further recurrence. The patient's prognosis remains guarded, given the nature of medulloblastoma, but this approach provides hope for more effective management and control of the tumor.

Discussion

Medulloblastoma remains one of the most common and aggressive malignant brain tumors in children, especially those under 10 years of age [1]. Despite advances in treatment modalities, including surgical resection, chemotherapy, and craniospinal irradiation, recurrence and metastasis continue to challenge successful long-term management [5]. This case report highlights the difficulties faced in treating relapsed medulloblastoma and demonstrates the potential role of intraventricular chemotherapy as an effective therapeutic option. Relapsed medulloblastoma often shows resistance to conventional chemotherapy due to the blood-brain barrier, which limits drug penetration into the CNS [9]. In this case, despite multiple systemic chemotherapy regimens, the tumor did not respond and metastasized to the bone, reflecting the aggressive and treatment-resistant nature of the disease. Such cases demand innovative approaches to deliver adequate drug concentrations directly to the CNS. The use of intraventricular chemotherapy through an Ommaya reservoir offers several advantages. This method allows direct administration of chemotherapeutic agents into the CSF, bypassing the blood-brain barrier, and achieving higher local drug concentrations at the tumor site [10-12]. The drugs selected in this case including Methotrexate, Cytarabine, and Thiotepa which are well known for their CNS activity and have been used effectively in intraventricular therapy for other CNS malignancies [10-13].

The safety and tolerability of intraventricular chemotherapy are important considerations [11]. In this case, close monitoring for neurological symptoms, ICP changes, and potential complications such as infection or seizures was crucial [14, 15]. The patient tolerated the treatment without immediate adverse effects, suggesting that with proper preparation and careful follow-up, this approach can be safely administered even in complex cases.In the context of a middle-income country such as Iran, introducing intraventricular chemotherapy represents a significant advancement in the management of relapsed medulloblastoma. Access to advanced therapies may improve outcomes and offer new hope for patients facing poor prognosis with conventional treatments alone. Long-term follow-up is essential to monitor tumor response, detect potential late complications, and evaluate the overall impact on survival and quality of life. Further studies and clinical experience are needed to establish standardized protocols, optimal dosing schedules, and to better understand the long-term safety and efficacy of intraventricular chemotherapy in this patient population.

Conclusion

Intraventricular chemotherapy through an Ommaya reservoir offers a promising and safe approach to deliver high concentrations of chemotherapeutic agents directly to the central nervous system in cases of relapsed medulloblastoma. This method may overcome the limitations posed by the blood-brain barrier and improve tumor control in treatment-resistant patients. Our case demonstrates that with careful monitoring and supportive care, this advanced treatment is feasible and may enhance outcomes for pediatric patients facing poor prognosis. Further research is needed to optimize treatment protocols and confirm long-term efficacy and safety, but intraventricular chemotherapy represents an important option in the management of relapsed medulloblastoma.

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