Radiotherapy in Adult Medulloblastoma with Synchronous Drop Metastasis: A Case Report

Abstract

Adult medulloblastoma is an uncommon malignancy, and synchronous spinal metastasis at diagnosis represents a rare and high-risk presentation. Evidence guiding management in adults remains limited, with most therapeutic strategies extrapolated from pediatric protocols. We report the case of a 24-year-old patient with medulloblastoma presenting with neuraxial dissemination at initial diagnosis, managed with a multimodal therapeutic approach centered on craniospinal irradiation. Radiotherapy was delivered to the entire neuraxis followed by targeted boosts to sites of macroscopic disease, using conformal techniques to ensure adequate coverage while respecting organ-at-risk constraints. Treatment was well tolerated and resulted in sustained complete remission at follow-up. This case contributes to the limited body of literature addressing radiotherapeutic management of adult medulloblastoma with synchronous spinal metastasis and supports the pivotal role of modern craniospinal irradiation in achieving durable disease control. It also underscores the importance of systematic neuroaxis staging and individualized boost strategies in this rare adult presentation.

Key words:adult medulloblastoma, conformal radiotherapy, craniospinal irradiation, spinal boost, spinal metastasis.

Introduction:

Medulloblastoma is a malignant embryonal tumor of the cerebellum and represents the most common malignant brain tumor in children. In adults, its incidence is markedly lower, accounting for approximately 0.4–1% of primary intracranial neoplasms, with an estimated annual incidence of 0.5–0.6 per million [1,2]. Adult medulloblastoma differs from pediatric disease in epidemiology, molecular distribution, recurrence patterns, and therapeutic tolerance.

According to the current World Health Organization classification, medulloblastoma is divided into four principal molecular subgroups: Wingless/Integrated (WNT)-activated, Sonic Hedgehog (SHH)-activated, Group three, and Group four [3]. In adults, tumors are predominantly SHH-activated and Group four, each characterized by distinct biological behavior and prognostic implications [4,5].

Risk stratification is based on the extent of postoperative residual disease, histopathological features, and neuraxial dissemination according to the Chang staging system [6]. Additional adverse prognostic factors include large cell or anaplastic histology and chromosome 17q abnormalities [7–9].

International guidelines recommend a multimodal therapeutic approach combining maximal safe surgical resection, craniospinal irradiation, and platinum-based chemotherapy for patients with high-risk or metastatic disease [10,11]. However, synchronous spinal metastasis at diagnosis remains uncommon in adults and is insufficiently characterized in the literature. Most therapeutic recommendations are extrapolated from pediatric protocols or derived from retrospective adult series.

Given the well-recognized propensity of medulloblastoma for cerebrospinal fluid dissemination, systematic craniospinal magnetic resonance imaging at initial diagnosis is essential. We report a case of adult medulloblastoma with neuraxial involvement at presentation to emphasize the importance of comprehensive staging and the role of craniospinal irradiation with focal spinal boost within a structured multimodal treatment strategy.

Case presentation:

A 24-year-old male was referred to our oncology center for adjuvant management following partial resection of a posterior fossa tumor. He reported several months of occipital headaches, gait imbalance, and progressive visual blurring, without vomiting or seizures. His medical history was unremarkable except for prior tobacco and cannabis use. Initial computed tomography revealed a left cerebellar mass associated with obstructive triventricular hydrocephalus and early tonsillar descent. Magnetic resonance imaging confirmed a 5 cm left cerebellar tentorial lesion initially suggestive of meningioma. A ventriculoperitoneal shunt was placed, followed by posterior fossa craniotomy achieving approximately 70% tumor resection. Postoperative brain and spine magnetic resonance imaging demonstrated residual vermian and left cerebellar tumor with persistent mass effect, as well as a T5 intradural drop metastasis (Figure 1). Three months later, the patient presented with an Eastern Cooperative Oncology Group performance status of zero, a normal neurological examination, preserved coordination and gait, and no cranial nerve deficits.Histopathological examination revealed a poorly differentiated small round blue cell tumor, and immunohistochemistry confirmed medulloblastoma, World Health Organization central nervous system grade four.

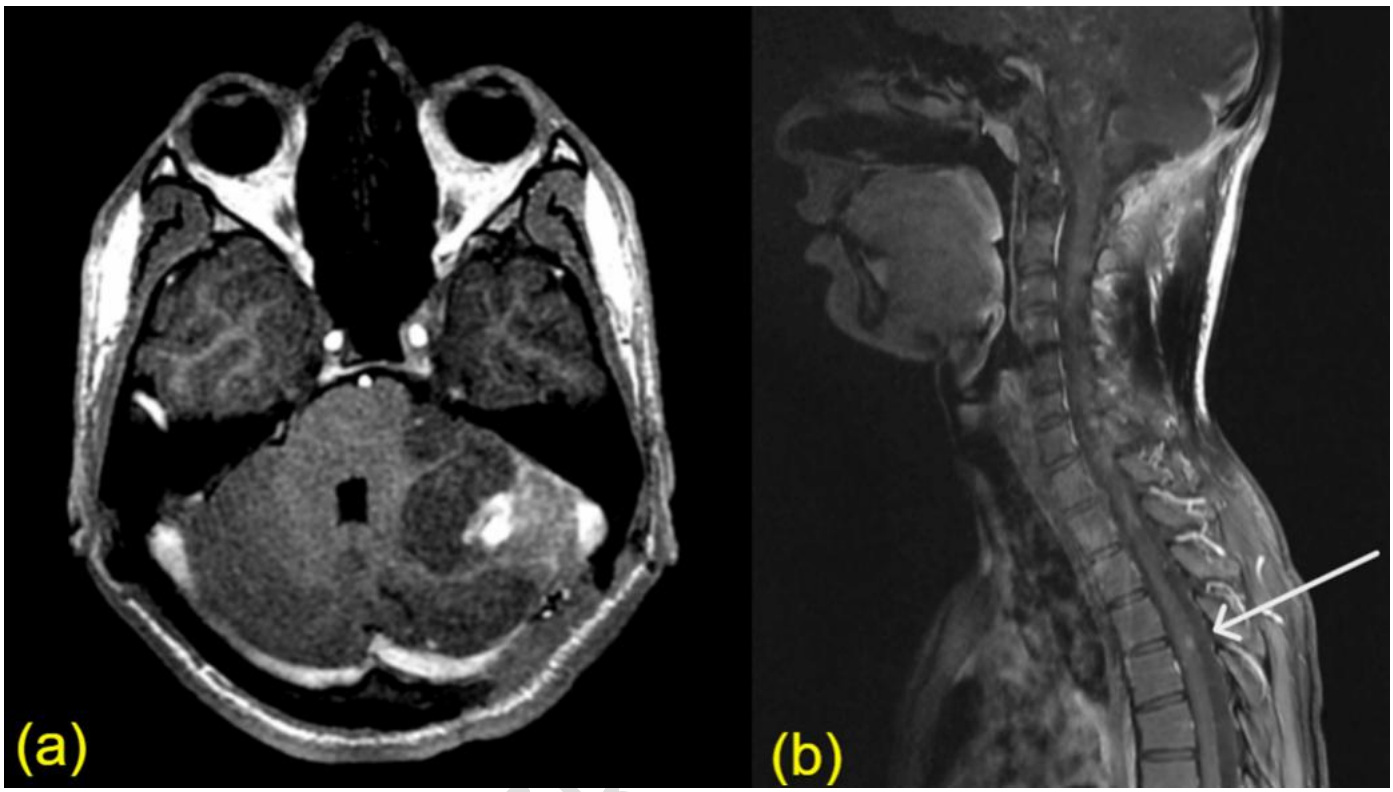

Figure 1: (a) Axial contrast-enhanced MRI of the brain demonstrating a left cerebellar tentorial mass and (b) Sagittal cranio-cervico-thoracic MRI demonstrating an intradural extramedullary drop metastasis at the T5 vertebral level (arrow).

MRI: magnetic resonance imaging

The patient underwent radiotherapy simulation in the supine position using a five-point thermoplastic mask with knee and foot support. Planning computed tomography with 3 mm slice thickness was fused with pre treatment magnetic resonance imaging for target delineation. Target volumes included the entire craniospinal axis, the posterior fossa, and the T5 metastatic lesion. Treatment was delivered using three dimensional conformal radiotherapy. Cranial irradiation was performed with parallel opposed lateral 6 MV photon beams, with collimator rotation to align cranial and superior spinal fields and minimize dose inhomogeneity at the cranio-cervical junction. The spinal axis was treated using two adjacent posterior 18 MV photon fields to account for the 7 centimeters tissue depth between the posterior skin surface and the spinal canal, thereby reducing entrance-dose hot spots. Field matching was achieved using two feathered junctions located at the cranio-cervical and dorsal-lumbar transitions to improve longitudinal dose homogeneity. The craniospinal phase delivered 36 Gy in 18 fractions. The posterior fossa boost increased the cumulative dose to 54 Gy. A focal boost

of 7.2 Gy was delivered to the T5 lesion using a three-field arrangement consisting of one posterior beam and two oblique beams with dose weighting of 50% to the posterior beam and 25% to each oblique beam (Figure 2).

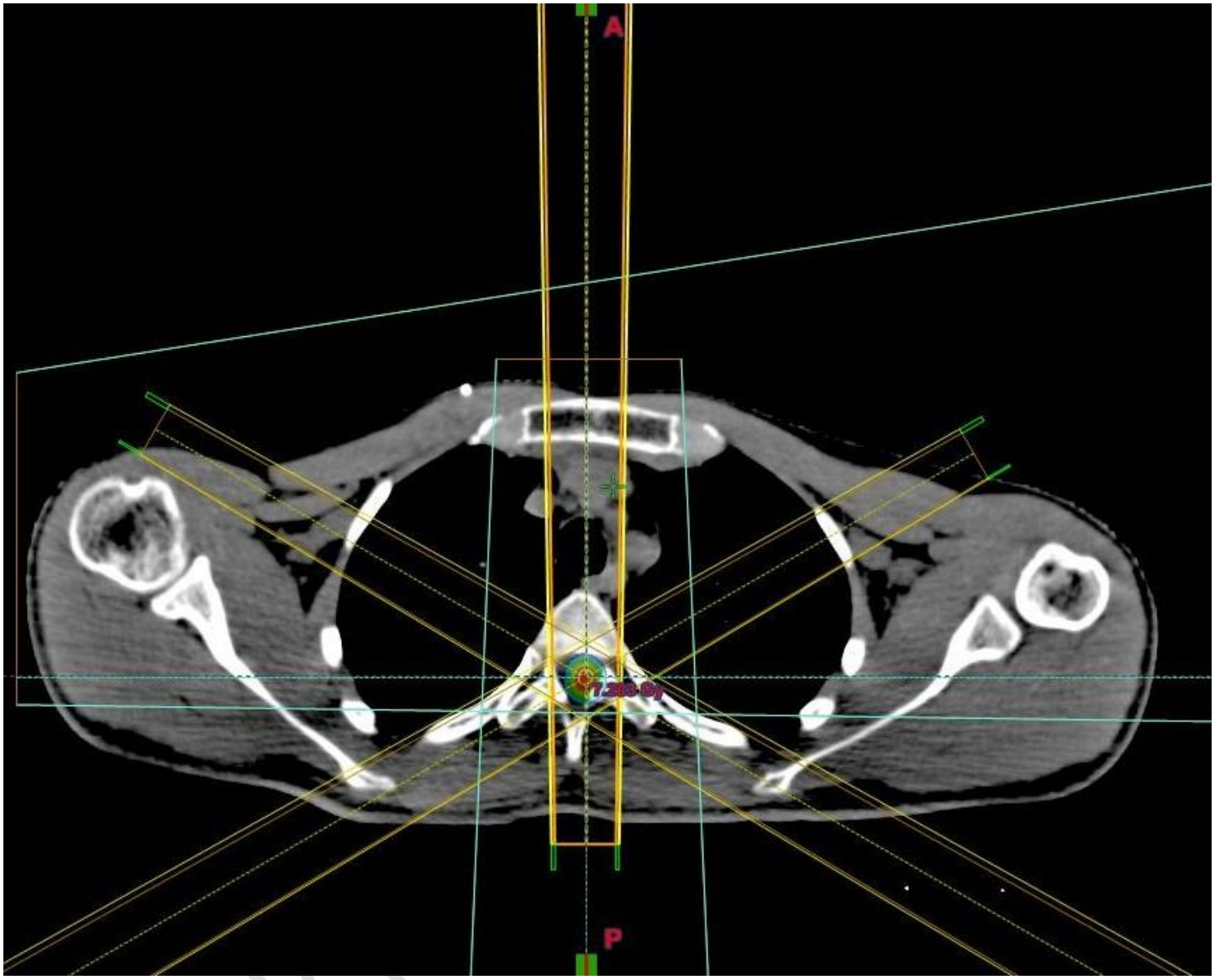

Figure 2: Axial treatment planning image demonstrating three-dimensional conformal radiotherapy boost to the T5 spinal metastasis, illustrating beam arrangement and dose distribution centered on the metastatic lesion.

Radiotherapy was completed without interruption. Acute toxicities were limited to grade one radiodermatitis over the dorsal spine, grade one esophagitis, and occipital-predominant alopecia. Following radiotherapy, the patient received six cycles of cisplatin at 75 mg/m² and etoposide at 100 mg/m² administered over three consecutive days. Chemotherapy was complicated by grade two vomiting, grade two mucositis, dysphagia to solids, odynophagia, and oropharyngeal candidiasis requiring brief hospitalization for supportive care, with subsequent clinical improvement. Post-treatment magnetic resonance imaging demonstrated a left cerebellar gliotic sequellar area without recurrent disease. At approximately 17 months following completion of radiotherapy, the patient remains clinically stable with no radiological evidence of local or metastatic recurrence.

Discussion:

Spinal metastasis in adult medulloblastoma is an uncommon but clinically significant manifestation reflecting dissemination along cerebrospinal fluid pathways. Although medulloblastoma is the most frequent malignant brain tumor in children, metastatic behavior appears less common and more heterogeneous in adults. Published series estimate that approximately 10-20% of adults develop metastatic disease during the course of illness, whereas synchronous spinal involvement at diagnosis remains distinctly rare [1-4]. The most frequently reported pattern consists of intradural extramedullary drop metastases, although intramedullary and epidural presentations have also been described in isolated adult cases [12-15]. In our patient, spinal dissemination was detected at initial staging and was clinically asymptomatic, emphasizing the importance of systematic craniospinal magnetic resonance imaging even in the absence of spinal symptoms.

Clinical presentation in adult spinal metastasis is variable. Some patients experience axial pain, radiculopathy, or neurological deficits, particularly in epidural or intramedullary disease, while others remain asymptomatic, as observed in our case and in previously reported series [12-15]. Magnetic resonance imaging remains the most sensitive modality for detecting neuraxial dissemination and distinguishing leptomeningeal from parenchymal or epidural involvement. Baseline craniospinal imaging is therefore essential for accurate staging and therapeutic planning. Long-term surveillance is equally important, as delayed spinal relapses have been reported years after initial therapy [12].

Management of adult medulloblastoma relies on a multimodal strategy integrating surgery, craniospinal irradiation, and systemic chemotherapy [7-11]. Maximal safe resection constitutes the initial therapeutic step but does not eliminate the need for adjuvant treatment in metastatic cases [7-9]. Craniospinal irradiation remains the cornerstone of therapy because of the tumor's capacity for diffuse neuraxial spread. Standard adult regimens recommend 30-36 Gy to the entire neuraxis followed by a posterior fossa or tumor-bed boost to approximately 54-55.8 Gy. In our patient, 36 Gy craniospinal irradiation was delivered using a three dimensional conformal technique with meticulous junction management and dosimetric verification to ensure homogeneous longitudinal coverage.

Several radiotherapy techniques are available. Conventional three-dimensional conformal craniospinal irradiation remains widely accessible and can achieve satisfactory dose distribution when careful geometric alignment is applied [16,17]. Advanced modalities such as intensity-modulated radiotherapy and volumetric modulated arc therapy may improve conformity but may increase integral dose exposure [17]. Proton craniospinal irradiation offers superior sparing of cardiac, thyroid, and gastrointestinal structures and may reduce long-term toxicity, although availability remains limited [18,19]. In our setting, conformal craniospinal irradiation provided adequate neuraxial coverage and was well tolerated, demonstrating that optimal disease control can be achieved even in the absence of advanced technologies when planning is rigorous.

The presence of macroscopic spinal metastasis requires additional therapeutic considerations. While surgery may be indicated in cases of spinal cord compression or diagnostic uncertainty, most reported adult spinal metastases are intradural and not amenable to surgical resection [13-15]. Radiotherapy therefore constitutes the primary local treatment modality. In addition to craniospinal irradiation, focal boosting of gross spinal disease is recommended within spinal cord tolerance limits to optimize local control. Our patient received an additional 7.2 Gy focal boost to the T5 lesion, consistent with accepted practice for isolated drop metastases. The sustained radiological response observed at 17 months supports the effectiveness of this combined craniospinal and focal boost approach.

Systemic platinum-based chemotherapy further enhances disease control in high-risk or metastatic adult patients [10,11]. In our case, adjuvant chemotherapy was administered following radiotherapy to address potential microscopic dissemination. Prognosis in adult medulloblastoma is influenced by metastatic status, extent of resection, histological subtype, molecular subgroup, and adherence to multimodal therapy [7-9]. Although molecular profiling was not available for our patient, the favorable clinical and radiological evolution highlights the potential benefit of comprehensive neuraxial irradiation combined with focal spinal boosting and systemic therapy.

Given the rarity of synchronous spinal metastasis in adults, continued reporting of detailed cases with explicit radiotherapeutic parameters is essential to strengthen the evidence base. Our case reinforces the pivotal role of carefully planned craniospinal irradiation and highlights the feasibility of achieving satisfactory neuraxial disease control using conformal techniques within a structured multimodal approach.

Conclusion:

Adult medulloblastoma with synchronous spinal metastasis is rare and represents a diagnostically and therapeutically challenging presentation. This case underscores the importance of systematic craniospinal imaging at diagnosis and supports the role of multimodal management integrating craniospinal irradiation, focal spinal boosting, and adjuvant chemotherapy. The sustained remission achieved in our patient demonstrates that carefully planned three-dimensional conformal radiotherapy can provide effective neuraxial disease control. Continued reporting of similar adult cases is essential to refine evidence-based treatment strategies for this uncommon presentation.

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Conflict of Interest

All authors declare that there are no conflicts of interest regarding the publication of this manuscript. The authors declare no competing financial or non-financial interests.

Ethical Approval

Informed consent was obtained from all individual participants included in the study.

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