



Case Report

An overview of intramedullary spinal cord metastases accompanied by a 2D intraoperative video

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ABSTRACT

Background: Metastatic intramedullary spinal cord metastases (IMSCMs) constitute <2% of spinal cord tumors. IMSCM is a late-stage manifestation of cancer with a highly variable presentation and poor survival rate. Here, we present an operative video involving gross total resection of an IMSCM (i.e., non-small-cell lung cancer [NSCLC]) in a 74-year-old male.

Case Description: A functionally independent 74-year-old male with a history of renal cell carcinoma (i.e., prior nephrectomy) and NSCLC presented with progressive right-sided hemiparesis/hemisensory loss. The patient's magnetic resonance imaging showed a right-eccentric metastatic lesion extending from the inferior of C3 to the superior of C5. The patient underwent a laminectomy with C2-C6 instrumentation for focal *en bloc* resection of the tumor (i.e., pathologically proven to be NSCLC). During surgery, dorsal column mapping defined the electrophysiological midline before proceeding with the midline myelotomy. Five months postoperatively, the patient's right-sided motor function continued to improve, and he was able to continue adjunctive therapies for his NSCLC.

Conclusion: This study documents the efficacy/utility of gross total *en bloc* resection in preserving/improving the neurological function of IMSCM lesions in elderly patients.

Keywords: Case report, *En bloc* resection, Intramedullary spinal cord tumor, Metastases, Surgical outcomes

INTRODUCTION

Metastatic intramedullary spinal cord metastases (IMSCMs) are a manifestation of late-stage cancer which presents in 0.9 - 2.0% of all cancer patients.^[2] As imaging modalities and life expectancy with cancer have improved, the incidence of identified IMSCMs has increased.^[2,7]

Recent reports demonstrate the potential benefit of gross total resection (GTR) in the management of IMSCMs, with patients enjoying longer overall survival (OS) and better outcomes after surgery.^[2,4,7,9] In the following report, a 74-year-old-male with a recent diagnosis of non-small-cell lung cancer (NSCLC) successfully underwent C3-C5 "*en-bloc*" resection of an intramedullary magnetic resonance imaging (MRI)-documented lesion accompanied by a C2-C6 instrumented fusion.

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Table 1: Summary and synopsis of references.

Authors/Date	Aim of study/Paper	Type of study	Main findings/Conclusions
Aoude and Amiot (2014)	Tokuhashi versus Tomita scores to assess (OS) with spinal metastasis.	Retrospective	Equal effectiveness in poor prognosis, but Tokuhashi is more accurate in patients with moderate or good prognosis.
Gazzeri et al. (2021)	Determine the effect of surgery for IMSCM on QOL/OS	Retrospective	Surgery – significant risk (36% AE) Preop status determines OS. Systemic Mets=Worse prognosis.
Hashii et al. (2011)	Determine the effect of radiotherapy for IMSCM on OS, QOL, and FS.	Retrospective	Vertebral METS 60 x more frequent than IMSCM. Radiotherapy is not indicated for IMSCM.
Kageyama et al. (2023)	Compare the effect of surgery for IMSCM on old versus young.	Retrospective	MMC is worse in older patients.
Majmundar et al. (2018)	Patient with IMSCM from lung cancer and review of IMSCM treatment.	Case Report and Review	Surgery has better outcomes than radiotherapy or chemotherapy.
Matsuyama et al. (2009)	Determine postop FS after IMSCM resection with IOM.	Retrospective	31% of patients decline postop. Higher Preop MCC is better postop FS.
Payer et al. (2015)	Characterize patients surgically treated for IMSCM.	Retrospective	Lung cancer is the most common primary. Surgery of IMSCM improved MCC.
Saeed et al. (2017)	Compare treatments for IMSCM.	Review	Combination therapy outperforms individual treatment.
Tang et al. (2012)	Relationship between cSVA and postop FS after cervical fusion.	Retrospective	cSVA >40 mm indicates fusion will benefit.
Tokuhashi et al. (2009)	Accuracy of Tokuhashi score in IMSCM prognosis	Prospective	87.9% accuracy in OS based on recommended treatment.

OS: Overall survival, QOL: Quality of life, AE: Adverse event, IMSCM: Intramedullary spinal cord metastases, FS: Functional status, cSVA: Cervical sagittal vertical axis, IOM: Intraoperative monitoring, MMC: Modified McCormick scores, METS: Metastasis

ILLUSTRATIVE CASE

History and physical

A 74-year-old, functionally independent male with a remote medical history of renal cell carcinoma (i.e., status-post nephrectomy) and a recent diagnosis of NSCLC presented with 1 month of progressive right-sided hemiparesis and hemisensory loss. On examination, the patient exhibited 2/5 strength in the right upper and lower extremities in addition to long tract signs (i.e., hyperreflexia and a right-sided positive Hoffman's sign).

Magnetic resonance findings

The preoperative T2 MRI revealed significant spinal cord edema extending from the cervicomedullary junction to the cervicothoracic junction. The preoperative contrasted MRI showed an enhancing intramedullary spinal cord lesion from the inferior C3 to superior C5 levels, eccentric to the right side. The preoperative computed tomography scan was obtained for surgical planning of the proposed C2–C6 instrumented spinal fusion due to the patient's C2–C7 sagittal vertical axis being >40 mm.^[9]

Surgical technique

Utilizing somatosensory-evoked potential, motor-evoked potentials, and electromyographic monitoring cervical

instrumentation was first placed from C2–C6.^[6] Next, a C3–C5 laminectomy was performed, followed by dorsal column mapping to identify the cord's midline to perform the myelotomy. A tissue plane was developed between the tumor and spinal cord tissue, allowing for “*en-bloc*” gross total tumor excision. Routine closure followed [Video 1].

Postoperative outcomes

The postoperative T2 MRI demonstrated GTR of the previously identified lesion. Upright X-rays at 5 postoperative months confirmed the stability of the fusion construct and restoration of horizontal gaze. In addition, this patient's neurological status improved to 3/5 in all right-sided major muscle groups, and he was able to continue systemic adjunctive therapy for his NSCLC.^[1] This patient continued to improve at the five-month timepoint as indicated by his Tokuhashi score.^[10]

DISCUSSION

Metastatic IMSCMs

Most studies indicate that IMSCM frequently appears in the cervical spine [Figure 1].^[2,7] IMSCMs typically present with a clear plane of demarcation that makes GTR possible. However, IMSCMs are associated with significant parenchymal edema that warrants the use of high-dose corticosteroids and intraoperative monitoring.^[5,6,8]

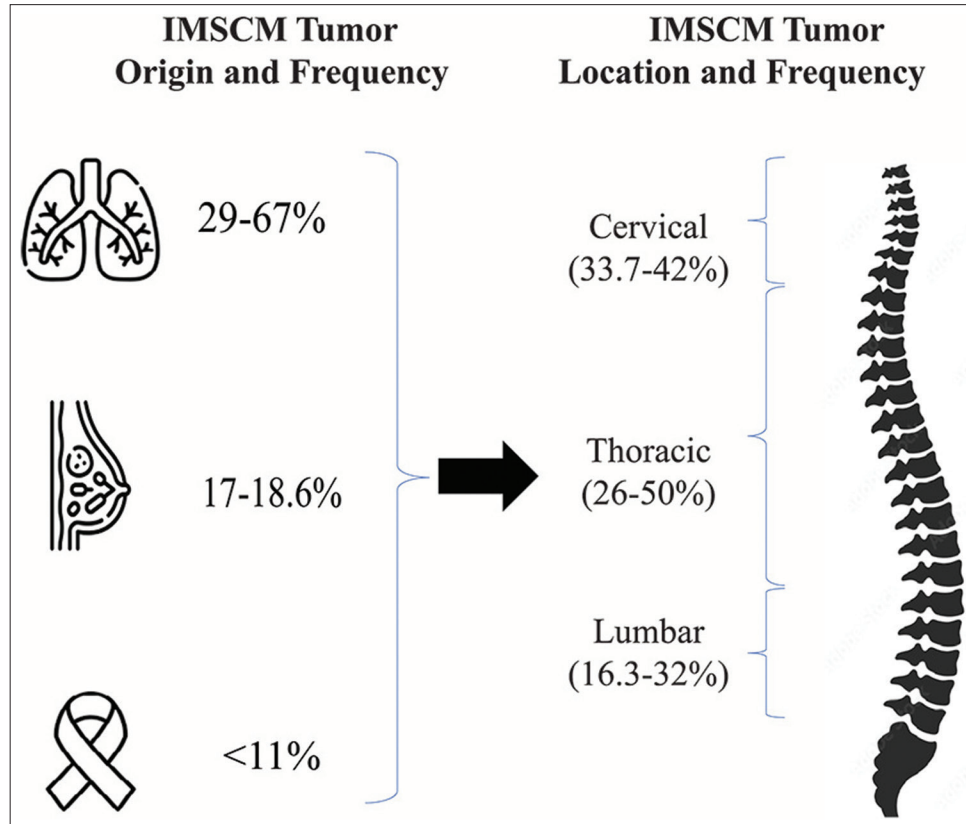
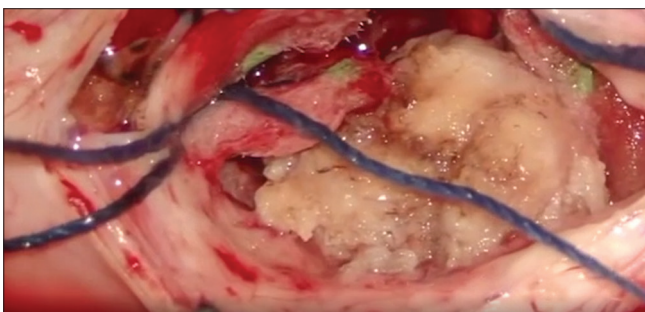


Figure 1: Epidemiology of intramedullary spinal cord metastases (IMSCM). The left panel demonstrates the three most common primaries for IMSCM. Lung cancer is the most frequent origin, ranging from 29% to 67% of identified IMSCMs in a given case report. Breast cancer and lymphoma have been consistently the second and third most frequent, according to our non-exhaustive literature review. The right panel demonstrates the level of the vertebral column in which intramedullary metastatic lesions most commonly appear. No conclusions can be made from our non-exhaustive literature review, as reports present conflicting evidence. This figure is original to this submission, so no credit or license is needed.



Video 1: The attached video demonstrates a nuanced *en bloc* resection with instrumentation of a cervical intradural intramedullary metastatic tumor from a patient with primary non-small-cell lung cancer.

Survival with IMSCM

Lung Metastases: Lung cancer (LC) is the predominant primary (42.4–67.21%) of IMSCM, with small-cell LC being the most prevalent subtype, followed by adenocarcinoma and

squamous cell carcinoma 6.3% [Figure 1].^[5,8] Various reports conclude that surgery has a positive influence on OS, whereas immediate radiotherapy can improve quality of life with no changes to OS.^[3,5] Although single case reports indicate a role for systemic chemotherapy in the treatment of IMSCM, no conclusive benefit has been reported.^[3,9] Notably, IMSCM is a late stage presentation of LC, and survival after diagnosis of IMSCM-LC is 4–6 months [Table 1].^[2,9]

CONCLUSION

Here, a 74-year-old male with history of NSCLC newly presented with a right-sided hemiparesis attributed to a solitary, cervical, intramedullary C3–C5, metastatic lesion. This patient underscores the potential role for gross total resection in elderly patients with adequate functional status. IMSCMs of primary lung cancer have an average four-to-six-month overall survival, however this patient continued to improve at the five-month timepoint as predicted by his Tokahushi score.

Ethical approval

The Institutional Review Board approval is not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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