INTRODUCTION/BACKGROUND
Glioblastoma multiforme (GBM) is the most common malignant central nervous system tumor in adults, with a mean survival of 1 year. Despite diagnostic and imaging advances, these lesions are generally poorly delineated, proving complete resection difficult and recurrence common. Utilization of radiotherapy, chemotherapy, and wide surgical resections gives only one tenth of patients an expected survival rate of greater than 2 years. Leptomeningeal carcinomatosis (LC), or neoplastic meningitis, is a complication of cancer that can happen at any time during the course of any type of cancer; it is characterized by the proliferation of cancer cells in the subarachnoid space. LC presents with primary brain tumors at a much lower rate than other malignant tumors (1-2% of primary brain tumors vs 5-15% in leukemias, up to 25% in lung cancer, and 23% in melanomas). Described below are the clinical characteristics and post-surgical outcome of a 60 year old male with a large right frontal lobe GBM, its infiltration of the midline structures, its radiologic presentation and resection, and its subsequent leptomeningeal and cerebellar metastases over one year later.

CASE PRESENTATION
On October 26th, 2008, patient X presented to the Emergency Department of University Medical Center Hospital in El Paso, TX with a 2 week history of right parieto-temporal headaches radiating to the occipital area and both eyes. They were described as 10/10 on a pain scale, pulsatile, dull, and they were accompanied by vomiting and somnolence. The patient was having 2-3 bouts per day, lasting 6-8hrs, without much response to Diclofenac which he had received from a physician in Juarez, Mexico. There was no photophobia, aura, vision changes, memory loss, trauma, personality changes, or nausea associated with the headaches. Prior to his admission, the patient had seen a neurologist in Mexico, and his CT showed a “frontal mass”. No records were available, and these were the only results the patient remembered from his prior visits in Mexico. There was no pertinent medical or past surgical history, except for a 20 year history of cigarette use. The patient’s physical exam, including neurological evaluation, was within normal limits aside from a blood pressure of 164/73. Laboratory values were significant for a mildly elevated WBC count and hematocrit. EKG showed sinus bradycardia and chest X-ray was within normal limits.

Imaging and Intervention
A CT of the head was ordered and the patient was admitted after an impressive enhancing lesion was observed. The following day an MRI of the head was ordered, showing a heterogeneous intra-axial tumor involving the right internal frontal lobe and extending to the ependyma of the adjacent anterior frontal horn. The lesion measured 51.3 x 31.3 mm (Figure 1a), with perilesional vasogenic edema and an intense heterogeneous enhancement after gadolinium administration. There was marked mass-effect to the adjacent structures with rostral displacement of the anterior cerebral arteries and a 10mm midline shift to the left with compression of the left foramen of Monro producing enlargement of the left lateral ventricle with mild transependymal edema, secondary to incipient hydrocephaly. The following day the patient underwent a right frontoparietal craniotomy and resection of the brain mass with intraoperative microscopy and neuroimaging. The pathology report confirmed a grade 4 Glioblastoma Multiforme, and a day later another MRI was performed which identified diffuse pericranial soft tissue swelling secondary to the craniotomy. Oncology followed the patient with radiation therapy and Temozolamide (Temodar©) chemotherapy. He was discharged home on 03 November, 2008 in stable condition.

Complications
Over one year post craniotomy, the patient returned to the same emergency room with a 5 day history of bilateral lower extremity paralysis, which started as numbness on day one, and shortness of breath. The only pertinent finding on physical exam included paraspinal lumbar tenderness, 0/5 motor strength in the bilateral lower extremities, and no sensation below T10. An MRI showed enhancement of the right frontal cortex and a spinal cord lesion compressing T9-T10. The patient was taken to the operating room for decompression. The following day an MRI of the head was ordered, showing a heterogeneous intra-axial tumor involving the right internal frontal lobe and extending to the ependyma of the adjacent anterior frontal horn. The lesion measured 51.3 x 31.3 mm (Figure 1a), with perilesional vasogenic edema and an intense heterogeneous enhancement after gadolinium administration. There was marked mass-effect to the adjacent structures with rostral displacement of the anterior cerebral arteries and a 10mm midline shift to the left with compression of the left foramen of Monro producing enlargement of the left lateral ventricle with mild transependymal edema, secondary to incipient hydrocephaly. The following day the patient underwent a right frontoparietal craniotomy and resection of the brain mass with intraoperative microscopy and neuroimaging. The pathology report confirmed a grade 4 Glioblastoma Multiforme, and a day later another MRI was performed which identified diffuse pericranial soft tissue swelling secondary to the craniotomy. Oncology followed the patient with radiation therapy and Temozolamide (Temodar©) chemotherapy. He was discharged home on 03 November, 2008 in stable condition.

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the Operating Room immediately and underwent a posterior tho-
racic decompression of the spine with a T9-T10 laminectomy and
tumor removal. Pathologic analysis revealed a drop metastasis
from the glioblastoma with spinal cord infiltration and leptom-
eningeal gliomatosis.

DISCUSSION
Patients with LC survive an average of 4-6 weeks without therapy
due to decline in neurological function. If treated, LC patients
usually do not die from LC complications, but rather from compi-
lations of the primary tumor³. Imaging studies are generally more
useful in detecting secondary complications of LC rather than
diagnosing LC. In this case, three crucial imaging modalities were
implemented to rule out the recurrence of the primary tumor. Perfu-
sion scans were performed to exclude angiogenesis in the primary
tumor site post-op (Figure 2a). Since there was a lesion present on
MRI on our patient’s second visit (Figure 1b), MRI Spectroscopy
was performed to differentiate a necrotic lesion from a proliferative
lesion. Lactate is produced in significant amounts in necrotic tis-
sue, therefore lactate spikes on cerebral spectroscopy helped iden-
tify the lesion in question as radiation-induced necrosis as op-
posed to tumor re-occurrence. Lastly, since proliferative tumors
actively metabolize acetylcholine (ACh), ACh uptake studies were
performed (Figure 2b) to ensure that the lesion in the left frontal
cortex was not proliferative tissue.

This proved to be a challenging case of a multicentric/multifocal
glioblastoma multiforme with somewhat unexpected outcomes.
Surviving this long after being diagnosed with such an aggressive
tumor is remarkable, especially with evident metastases. The
neuroimaging spectroscopy and perfusion studies perhaps saved
this patient a second craniotomy. The lesion evident in his frontal
cortex in the spot where his primary tumor was before it was
resected was worrisome initially. With conventional MRI and CT,
it is impossible to tell necrosis from neoplasia. The value of Uni-
versity Medical Center Neuroradiology department was evidenced
by this amazing ability to tell what certain regions of the brain are
metabolizing and where the blood flow is most pronounced, via
MRI Spectroscopy, via MRI Spectroscopy. In summary, the team
of neurosurgeons, oncologists, and radiologists at UMC were able
to help this gentleman attain precious time with his family and
friends for longer than anyone ever expected.

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