

## Brain Metastases

A 59 year-old male with a past medical history of hypertension presents to the emergency department with complaints of constant and progressively worsening dizziness and blurred vision for the past two weeks. He reports associated unsteady gait and dull headaches, which are localized to the occipital region, notably worse in the mornings and do not improve with the use of ibuprofen. He denies any nausea, vomiting, tinnitus, hearing changes, tremors, seizures, as well as any weakness or sensory changes in all four extremities.

Initial vital signs include:

- Temp: 98.5 deg F
- HR: 62 bpm
- RR: 18 br/min
- BP: 155/77 mmHg
- O2 sat: 98% on RA

On physical exam, the patient is a well-appearing male in no acute distress, who is awake and alert, resting comfortably in bed. PERRLA, no strabismus or signs of papilledema. Muscle strength 5/5 bilaterally in upper and lower extremities, DTRs intact, no sensory abnormalities were noted. Cranial nerves were grossly intact, and no FNDs were observed. No meningeal signs, nystagmus, dysdiadochokinesia, or pronator drift. However, the patient exhibited dysmetria on finger-to-nose testing on the right side and a wide-based, ataxic gait. Initial laboratory results are significant for mild hypokalemia of 3.2. As pictured on the right, noncontrast CT brain revealed multiple indeterminate lesions in the cerebellum concerning for neoplasm, including metastatic disease. Based on these findings, what is the best next step to order to further characterize this patient's diagnosis?

- A) CT chest, abdomen and pelvis with contrast**
- B) MRI brain with and without contrast**
- C) Magnetic resonance spectroscopy (MRS)**
- D) Genetic testing**
- E) Surgical exploration and biopsy**

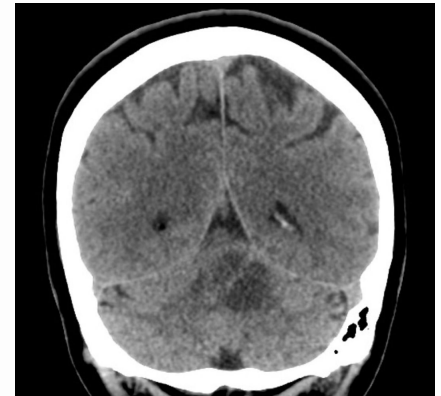


Figure 1. Coronal image of noncontrast CT brain showing multiple cystic lesions within in the right and left cerebellar hemispheres. Creative Commons license: Case courtesy of Dr. Bruno DiMuzio, Radiopaedia.org, rID: 41395.



Figure 2. Axial image of noncontrast CT brain showing multiple cystic lesions within in the right and left cerebellar hemispheres. Creative Commons license: Case courtesy of Dr. Bruno DiMuzio, Radiopaedia.org, rID: 41395.

**The correct answer is B, MRI brain with and without contrast.**

MRI with and without contrast is the first-line imaging modality to evaluate for brain metastases. Standard sequences that should be included to fully characterize brain tumors include T1 and T2, fluid-attenuated inversion recovery (FLAIR), gradient-echo/susceptibility, diffusion-weighted imaging, and postcontrast T1-weighted images.

A. CT with contrast can be used if MRI is not feasible. Of note, if the primary source is unknown, providers may consider whole body CT imaging. Generally, patients who have a possible brain tumor detected on CT or noncontrast brain MRI should undergo brain MRI with contrast in order to further characterize the lesion and help rule out nonneoplastic etiologies.

C. MRS is not routinely indicated when evaluating CNS tumors. Such additional noninvasive data may prove useful in select cases, especially when the imaging appearance is equivocal and nonneoplastic etiologies are under consideration.

D. In the emergency room setting, genetic testing would not be the most appropriate nor time-efficient course of action; though these studies may play a role down the road as part of further workup, given the various genetic syndromes associated with CNS neoplasms.

E. Although a definitive diagnosis ultimately requires examination of permanent tissue sections, the likelihood that a lesion is metastatic should be assessed prior to proceeding to biopsy or resection. In patients with a single intracranial lesion, however, biopsy may be required to make a definitive diagnosis.

## Discussion

In the United States, the incidence rate of primary brain tumors in adults is approximately 30 per 100,000 persons [1]. Among primary brain tumors, meningiomas and gliomas together account for more than two-thirds of all adult primary brain tumors. That said, brain metastases are the most common intracranial tumors in adults, occurring in approximately 10% of cancer patients at some point during their illness and accounting for significantly more than 50% of all brain tumors [2]. Lung cancer, melanoma, renal cell carcinoma, and breast cancer are the most common primary tumors that metastasize to the brain, and the most common mechanism of metastasis to the brain is hematogenous spread [3]. Neuroimaging findings that should raise suspicion for metastatic disease include the presence of multiple lesions, a single enhancing tumor that is well circumscribed and associated with surrounding edema, and the involvement of multiple compartments.

Patients with brain tumors may present with generalized signs and symptoms, such as headaches, nausea, vomiting, seizures, decreased level of consciousness or cognitive dysfunction, and/or more focal deficits, including weakness, sensory loss, aphasia, or visual-spatial dysfunction. As was the case with our patient, headache is a common manifestation of brain tumors and is reported to be a presenting symptom in up to 50% of patients. According to the literature, 40-80% of headaches associated with brain tumors are reported to be tension-type, whereas 10% are migrainous in nature [4].

There are many differential diagnoses that should be considered as part of the workup for a possible brain mass. With respect to primary brain tumors, differentials should include glioma, meningioma, pituitary adenoma, vestibular schwannoma, and primary CNS lymphoma. When constructing a differential for metastatic brain tumors, it is important to consider vascular disease (cerebral hemorrhage and infarcts); infections (abscesses, viral infections, progressive multifocal leukoencephalopathy); and inflammatory etiologies (multiple sclerosis, post-infectious encephalitis, granulomatous disease, vasculitis).

## Diagnosis

Adult patients with signs and symptoms of ataxia, diplopia and headache with initial imaging findings concerning for possible brain tumor should undergo proper evaluation for metastatic disease as part of their workup. In our patient with no known cancer history, the decision was made in consultation with neurosurgery to obtain CT chest, abdomen and pelvis to assess for primary lesions. CT chest demonstrated a 4cm spiculated right upper lobe lung mass with right hilar adenopathy. Given these findings and the apparent accessibility of the lung mass, the patient underwent CT guided lung biopsy, revealing adenocarcinoma of the lung as the suspected primary source of metastasis.

## Management

Patient treatment depends upon the overall prognosis; therefore, it is important to assess the patient with a prognostic scoring system prior to the initiation of treatment (e.g., Diagnosis-Specific Graded Prognostic Assessment Score) [5]. The primary approaches to the treatment of brain metastases include surgery, stereotactic radiosurgery (SRS), and whole brain radiation therapy (WBRT). If there are symptoms of edema or mass effect, supportive therapy with glucocorticoids and/or anti-epileptic medications in the presence of seizures may be appropriate. For patients with limited brain metastases, SRS is generally preferred over WBRT. Surgical resection can be considered in select cases in order to manage mass effect or if the lesion is >3cm and easily accessible. For patients with extensive brain metastases, therapy consists of either SRS or WBRT, and palliative surgical resection is reserved for life-threatening mass effect, hemorrhage or hydrocephalus [6]. In our case, neurosurgical recommendations were made for WBRT with radiation oncology and supportive therapy with 4mg Decadron twice daily.

## Take Home Points

- **Metastases are the most common intracranial tumors in adults, accounting for more than 50% of all intracranial tumors.**
- **Contrast-enhanced MRI is the most reliable imaging procedure to make the diagnosis of metastatic brain cancer; however, in patients without a known primary source, CT of the chest, abdomen and pelvis should be prioritized.**
- **The primary approaches to the treatment of brain metastases include surgery, SRS, and WBRT.**

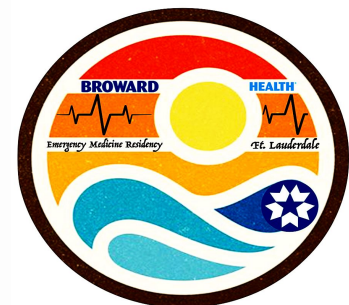


### About the Author

This month's case was written by Kimberly Byrnes. Kim is a fourth-year medical student from Nova Southeastern University KPCOM. She completed her emergency medicine rotation at Broward Health Medical Center in August-September. Kim plans on pursuing a career in General Surgery after graduation.

### References

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