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Case Presentations of the Harvard Emergency Medicine Residencies

FOUND DOWN AT HOME

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Dr. Todd Jaffe: This is the case of a 49-year-old man who presented to the Emergency Department (ED) with unresponsiveness. The patient had a history of hyperlipidemia on rosuvastatin 40 mg daily but was healthy prior to the day of presentation. Per the patient's son, the patient had two glasses of wine with dinner the previous night and was otherwise in his usual state of health prior to going to sleep. He was last seen well at 8:00 PM. The following day, his son heard a loud thud from his father's bedroom at 12:45 PM. He entered the room to find his father on the floor, unable to move, and he immediately called 911. On Emergency Medical Services (EMS) arrival to the scene, they found the patient on the floor intermittently blinking, but not moving his extremities. Finger stick blood glucose was 107 mg/dL. EMS placed a cervical collar at the scene and transported the patient to the hospital. A 12-lead electrocardiogram (ECG) obtained in the ambulance demonstrated a sinus rhythm at a rate of 92 beats/min with evidence of a right bundle branch block, 3-mm ST depressions in leads V4–V6, and 5-mm T-wave inversions in leads V1 and V2 (Figure 1).

On arrival to the ED, the patient was afebrile with a temperature of 37.1°C (98.7°F), heart rate 94 beats/min, blood pressure 160/87 mm Hg, and oxygen saturation 95% on room air. The physical examination was notable for his pupils being equal and reactive bilaterally and the ability to blink to command and move his eyes horizontally. He was otherwise immobile and unable to respond.

Dr. Stuart Harris: At this point, the history of this patient seems limited. What was the differential diagnosis on presentation?

Dr. Jaffe: The ECG findings were certainly concerning for acute coronary syndrome (ACS). However, ACS would be unlikely to explain the profound neurologic deficit seen on examination. Our differential diagnosis included other primary neurologic processes, including acute ischemic or hemorrhagic brainstem stroke, vertebral and basilar artery dissection, meningoencephalitis, and seizure. Patients with vertebral artery dissection may present after spontaneous dissection or secondary to trauma. History and examination are often notable for neck pain and headache, and patients may have neurologic deficits, including aphasia and discoordination (1,2). Furthermore, the presence of vertebral artery dissection is an independent risk factor for the development of acute ischemic stroke, and as such, this diagnosis was certainly a possibility for our patient (3). Infectious meningitis or encephalitis remained lower on our differential given the apparent rapidity of onset and absence of fever or immunocompromised status. Toxic-metabolic etiologies, including alcohol intoxication, other toxic ingestions, hepatic encephalopathy, and electrolyte derangements, such as severe hyponatremia, also remained on our differential. We postulated that the patient may be postictal from seizures, yet the patient had no history of seizures or severe alcohol use disorder—

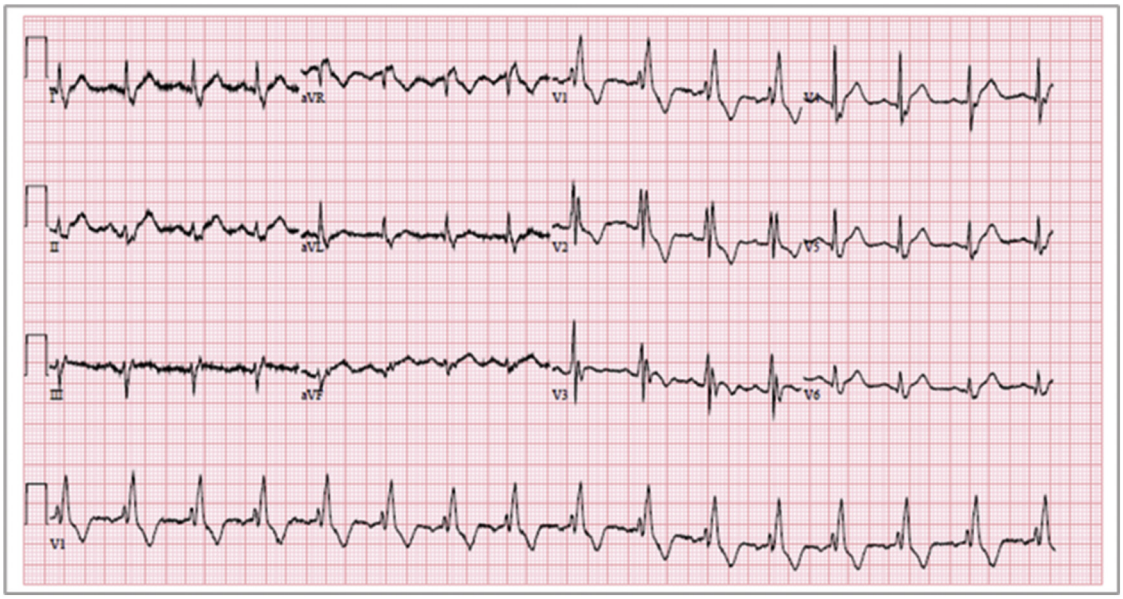

Figure 1. Electrocardiogram demonstrating significant ST changes.

nor would this explain his neurologic findings. Central pontine myelinolysis, which is a form of osmotic demyelination syndrome (ODS), could also have explained our patient's symptoms. The clinical presentation of ODS may vary, but patients can have quadriparesis and only preserved ocular function, as seen in our patient (4). There are multiple causes of ODS, but commonly cited are rapid correction of hyponatremia as well as severe hyperglycemia and hypophosphatemia (4–6). As our patient was otherwise healthy just the day before, this diagnosis remained less likely, however, still plausible given the examination findings.

Dr. Susan Wilcox: What was the initial ED management of this patient?

Dr. Jaffe: Of the broad differential diagnoses, the immediate concerns were acute stroke and myocardial infarction. Given the severe neurologic deficiencies, we activated our "code stroke" protocol. This alert triggers a STAT page to the ED Neurology consultant, neuroradiologist, and computed tomography (CT) technician. In conjunction with our Neurology colleagues, we calculated the patient's National Institutes of Health Stroke Scale (NIHSS) at 23. After the neurologic examination, the patient was found to have increased oral secretions and his oxygen saturation decreased to 86%, which recovered to 100% on a nonrebreather mask at 15 L/min of oxygen. Given concerns for the patient's failure to protect his airway, hypoxemia, and expected clinical course, the care team subsequently performed rapid sequence intubation with etomidate 20 mg intravenous (i.v.) and rocuronium 100 mg i.v. without complication. We discussed appropriate imaging for this patient, including the utility of a CT scan, vessel imaging, and the urgency of a brain magnetic resonance imaging (MRI) scan. After intubation, the patient was sedated with a propofol infusion and taken to the CT scanner for a CT angiogram (CTA) of the head and neck. Laboratory studies resulted while the patient was at CT, demonstrating a creatinine of 0.79 mg/dL, sodium of 139 mmol/L, creatinine kinase of 527 U/L, troponin T-hs Gen5 of 159 ng/L, and international normalized ratio of 1.0.

Dr. Kathleen Wittels: It seems that at this point, the primary concern was acute stroke. You mentioned significant ECG abnormalities. How were these ECG changes interpreted in the context of the patient presentation, and what is the relationship between ECG changes and acute neurologic illness?

Dr. Jaffe: The ECG findings in this case were striking and led to significant discussion. The care team pondered whether these ECG findings were causing the patient's clinical presentation or were secondary to acute neurologic injury. The latter remained more likely, yet neurologic deficits from cardiogenic sources remain common. In fact, cardioembolic phenomena may be responsible for one-fourth of all ischemic strokes (7). ECG changes in acute neurologic injury are most commonly cited secondary to subarachnoid hemorrhage, yet they are also described in acute ischemic stroke. Frequent ECG abnormalities include nonspecific ST-segment changes, inverted T waves, prolonged QT intervals, atrial fibrillation, premature ventricular complexes, and bradydysrhythmias (8). Our patient had prominent ST-segment depressions as well as inverted T waves without evidence of significant dysrhythmia, raising the concern for primary neurologic etiology.

Dr. Wilcox: You also mention the discussion of CT vs. MRI. Could you elaborate more on the imaging decisions in this case?

Dr. Jaffe: We considered multiple clinical factors when deciding the appropriate imaging for this patient. First, we weighed the differential diagnosis. Our leading diagnosis was acute ischemic stroke, yet intracranial hemorrhage remained high on the differential. Second, we discussed the limited history, specifically, the last known well (LKW) time. The patient's son noted that he had a missed call from his father at 12:15 PM. However, it remained unclear what the patient's mental status was at the time of the phone call, and as such, the LKW time was when the family last saw the patient the previous evening.

National guidelines recommend emergency imaging when patients present with suspected stroke, and if thrombolysis remains a consideration, head CT is adequate to rule out intracranial hemorrhage (9). Numerous studies have demonstrated that reducing the time interval from ED presentation to initial imaging can reduce the time to treatment initiation (10,11). Recommendations include use of noninvasive vessel imaging of the intracranial arteries for patients who otherwise meet criteria for thrombectomy (9). Further guidelines state that extracranial vessel imaging including the carotid and vertebral arteries may also be beneficial for potential thrombectomy candidates (9). Given these principles, we selected CTA of the head and neck as our primary imaging modality.

Dr. Harris: What were the findings of the CTA and next steps?

Dr. Jaffe: CTA demonstrated occlusion of the basilar artery just below the level of the superior cerebellar arteries (Figure 2). Given that the LKW time was > 6 h, the patient underwent urgent MRI of the brain to further characterize the evolving infarction. Our institution is a comprehensive stroke center; as such, multiple potential interventions, including endovascular therapy, specifically, mechanical thrombectomy, remained treatment options, depending on MRI findings.

Dr. Wittels: What are the indications for intra-arterial therapy in patients presenting with acute ischemic stroke?

Dr. Jaffe: Per national guidelines, mechanical thrombectomy may be appropriate for patients if they meet all the following criteria: treatment within 6 h of symptom onset; prestroke modified Rankin score of 0 to 2; causative occlusion of the internal carotid artery (ICA) or middle cerebral artery (MCA); 18 years or older; and NIHSS > 6 (9). Regarding patients with longer or unknown LKW times, indications for treatment remain variable, yet the use of more novel imaging analysis has demonstrated promising results.

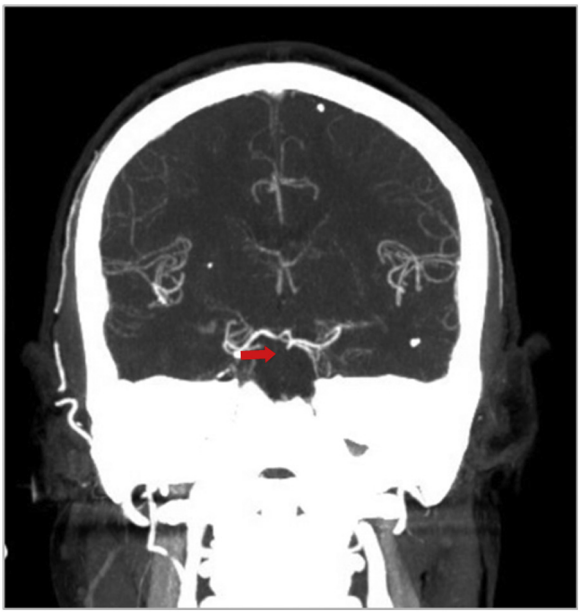

Figure 2. Head and neck computed tomography angiogram demonstrating occlusion of the basilar artery.

Recent studies have highlighted the value of diffusion-weighted MRI and CT perfusion scans to inform intervention decisions (12,13). The DAWN trial used mismatch between infarct volume and severity of neurologic deficit to inform eligibility decisions for anterior large-vessel occlusion thrombectomy in patients presenting within 6 and 24 h from LKW (13). The DEFUSE-3 trial examined a similar patient population and used specific radiologic markers related to the infarct volume and ischemic penumbra to inform thrombectomy decisions for patients with LKW between 6 and 16 h (12). Both studies showed substantial clinical benefit with mechanical thrombectomy, as evidenced by improved functional outcomes for patients at 90 days. Additional studies have shown similar results for patients presenting within 6 h of LKW, as well as thrombectomy for patients after receiving alteplase (14–17).

Although our patient did not have an ICA or MCA causative occlusion, we still found a proximal focal lesion causing significant impairment. Diffusion-weighted MRI demonstrated considerable mismatch with a large confluent region of restricted diffusion within the right, greater than left, pons, consistent with acute infarction.

Dr. Wilcox: How did these indications lead to the ultimate treatment for this patient?

Dr. Jaffe: Given the MRI findings, the patient was taken from imaging to the interventional suite and underwent mechanical thrombectomy. The basilar artery thrombus was identified and removed on the first pass, with excellent reperfusion. Furthermore, intraprocedural fluoroscopy demonstrated an irregularity of the

innominate artery concerning for an ulcerated plaque with superimposed thrombus. The care team hypothesized that this thrombus was likely responsible for an arterioembolic event, which caused the patient's acute ischemic stroke. The patient tolerated the procedure well and was transferred to the neurological intensive care unit (ICU).

Dr. Wittels: What are potential complications of intra-arterial therapy for acute ischemic stroke?

Dr. Jaffe: There are multiple potential complications of intra-arterial therapy worth consideration. As intervention is most commonly initiated via the femoral artery, access-site complications include artery/nerve injury, hematoma, and infection. Damage to the occluded vessel pathway during the procedure is a risk, as is postthrombectomy intracranial hemorrhage. Recent randomized clinical trials have estimated the risk of any complication from mechanical thrombectomy to be about 15%, with the severity of complication having large variability (18).

Dr. Harris: What was the ICU and hospital course for this patient?

Dr. Jaffe: Post angiography the patient was admitted to the ICU for frequent neurological examinations and monitoring. The day after thrombectomy, our patient was able to move all four extremities, briskly follow commands, and was extubated. He was started on aspirin 81 mg and enoxaparin 30 units daily. Neurologic examination was notable for 3–4/5 strength in his left upper and lower extremities, but no other focal neurologic deficits remained. He was transferred to the Neurology floor the following day. The patient was evaluated by Speech-Language Pathology, Physical Therapy, and Occupational Therapy and was ultimately discharged to a skilled neurology rehabilitation facility 6 days after his initial presentation. On follow-up with his primary care provider 1 month later, the patient's neurologic examination demonstrated persistent mild dysmetria and 4/5 strength in his left upper extremity. He otherwise had no other residual neurologic deficits.

Dr. Wilcox: What are the key takeaways for emergency clinicians regarding this case of acute basilar artery stroke?

Dr. Jaffe: The presentation of acute basilar artery stroke can be challenging to identify on initial examination. Emergency providers should keep a broad differential diagnosis for patients presenting with profound neurologic deficits and keep acute cerebrovascular events high on the differential. These patients may present with ECG changes, yet ED providers should bear in mind that ACS is unlikely to lead to significant neurologic disability without evidence of global hypoperfusion. Furthermore, the management of large-vessel occlusions is time-dependent, and early neurology consultation is paramount to coordinate definitive management. In addition, the use of mechanical thrombectomy for large-vessel occlusions is becoming more common; emergency providers should recognize the syndromes associated with large-vessel occlusions and, in these select patient populations, consider timely transfer to centers with intra-arterial therapy capabilities.

This case provides insight into the favorable clinical outcomes possible for patients presenting with acute ischemic stroke who undergo mechanical thrombectomy. Early consideration of an ischemic central nervous system diagnosis, confirmation through appropriate imaging, expert consultation, and robust care processes were paramount to providing timely definitive management. Care of acute ischemic strokes should incorporate these novel and proven treatment modalities to achieve the best patient outcomes.

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