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CASE REPORT

Delayed amyotrophic lateral sclerosis diagnosis with subtle cardiac manifestations: Was anchoring bias contributory?

Neyha Cherin | **Shivani Patel** | **Michelle Jukic**

Department of Physical Medicine and Rehabilitation, Penn State Health Milton S. Hershey Medical Center, Hershey, Pennsylvania, USA

Correspondence
Shivani Patel, Department of Physical Medicine and Rehabilitation, Penn State Health Milton S. Hershey Medical Center, Hershey, PA, USA.
Email: spatel31@pennstatehealth.psu.edu

Abstract

Amyotrophic lateral sclerosis (ALS) is a rare, progressive neurodegenerative disease affecting both upper and lower motor neurons. Throughout medical training, it is taught that the most recognizable clinical presentation involves both motor and bulbar changes. Given the complexity of the diagnosis however, it is no surprise that there is significant multisystem involvement secondary to the autonomic dysfunction associated with the disease. The clinical cognitive biases that exist due to prior educational training and patient provided chief complaint can mislead clinicians and prevent a holistic, inclusive approach toward each patient encounter. This can delay diagnosis and increase unnecessary healthcare spending. In a disease with such a poor prognosis, this effect can be catastrophic, resulting in unacceptable medical, functional, and psychosocial outcomes. As clinicians, it is imperative to acknowledge these cognitive biases through introspection, which can improve clinical outcomes and ultimately patient quality of life for those facing this devastating disease. We report a case of a 55-year-old female who presented with a chief complaint of palpitations and minimal slurred speech on multiple encounters, subsequently leading to a focused cardiovascular workup. It was not until after several hospital encounters that a thorough functional and neuromuscular exam was performed, which ultimately helped to broaden the differential and lead to the diagnosis of ALS. Unfortunately, due to this delayed diagnosis, the patient's functionality was beyond repair. Given the underlying cognitive biases that are present in all clinicians, we hypothesize this patient's sex, presenting symptom, and primary chief complaint misled clinicians to perform limited history and physical examinations, therefore, leading to a narrowed differential. If diagnosed in a timely fashion, vital services such as rehabilitation could have provided this patient with the necessary medical, functional, and psychosocial support to face this devastating disease.

KEYWORDS

healthcare management, medical education, neurology

1 | INTRODUCTION

Amyotrophic lateral sclerosis (ALS) is a rare, progressive neurodegenerative disease affecting both upper and lower motor neurons. It is commonly taught that initial clinical presentation includes focal muscle weakness and wasting in the distal limb muscles with spread as the disease progresses. In addition, patients commonly present as males with muscle twitching/cramping and impaired motor function leading to impaired balance and weakness, along with 25%–30% of cases noting bulbar involvement (dysarthria, dysphagia, and dysphonia).[1] However, beyond the common manifestations seen related to the neuromuscular system, it is essential to remember that ALS also affects the autonomic nervous system, which can result in cardiovascular complications, including heart rate variability and cardiac conduction disorders.[2] Dubbioso et al. noted that while ALS is thought to be a disease solely affecting the motor neurons, there is significant evidence noting multisystem involvement and specifically that autonomic symptoms occur in most ALS patients at the time of diagnosis, with a higher load in patients with initial bulbar symptoms.[3] Piccione et al. noted that cardiovagal abnormalities are present in roughly 50% of patients.[4] Therefore, a thorough history and multiorgan physical examination can expedite the diagnosis, resulting in an improved ability to obtain the proper functional and psychosocial resources to improve patients' functional outcomes.

We report a case of a patient with subtle, nontypical symptoms of ALS (i.e., female gender, cardiac palpitations), which prompted a narrowed history and physical examination that excluded the neuromuscular examination, therefore leading to a delayed diagnosis. This subsequently resulted in significantly impaired function at the time of diagnosis, impeding the patients' ability to obtain rehabilitation services and preventing the optimization of opportunities to improve her quality of life. We hypothesize that the performance of a more thorough history and physical examination during the initial hospital encounters was not completed in part due to underlying cognitive biases. If performed, this could have expedited the diagnosis, prompting the implementation of a timely comprehensive treatment plan involving rehabilitation, resource management, and psychological engagement to reduce the burden of a devastating diagnosis. This could have potentially slowed disease progression, thus improving functionality and quality of life. This case highlights the importance of a thorough functional assessment and physical examination on initial evaluation to improve the timeliness of clinical diagnosis, ultimately improving the likelihood of functional recovery within the spectrum of the medical diagnosis, decreasing hospital length of stay, financial burden, and most importantly improving patient satisfaction.

2 | CASE PRESENTATION

A 55-year-old female with a history of bipolar disorder, osteopenia, asthma, constipation, and paroxysmal supraventricular tachycardia (SVT) presented to the Emergency Department (ED) on three separate occasions from August to November with complaints of palpitations, subsequently diagnosed with uncontrolled SVT. During each encounter, the patient underwent an extensive cardiac workup with a plan to consider percutaneous ablation if the arrhythmia was recurrent.

On initial ED evaluation in August, the patient's chief complaint was “palpitations with shortness of breath and new minimal slurred speech.” She was found to be in SVT with hypotension and treated with adenosine. Magnetic resonance imaging (MRI) brain and computed tomography (CT) head were performed for slurred speech and negative for acute intracranial abnormalities, as well as prior stroke. The etiology of slurred speech was not determined. The patient was seen by multiple providers, including three separate specialties, and no neuromuscular examination was documented, despite a neurologic complaint. Neurology was not consulted due to negative imaging and subsequently, patient was not instructed to follow-up with neurology outpatient as well. She was discharged home in stable condition after she was deemed stable from a cardiac standpoint and stroke was ruled out.

The patient returned to the ED in September with a chief complaint of a “racing heartbeat.” Review of systems was positive for slurred speech, however workup was not performed due to the slurred speech being present during the prior hospitalization as well. Again, patient was found in SVT, stabilized with adenosine, and discharged home. As the patient's primary concern was cardiac in nature, only an extensive cardiac examination was performed.

The patient returned to the ED in November with the chief complaint of “palpitations.” Again, she was found to be in SVT as seen in Figure 1, which was corrected with adenosine. During this encounter, the patient complained of progressively worsening dysphagia and dysarthria, which prompted the first documented neuromuscular examination in her chart. Family history was negative for neuromusculoskeletal disorder. Social history was negative for tobacco, alcohol, or recreational drug use. The neuromuscular exam was notable for bilateral lower greater than upper extremity muscle weakness, right foot drop, dysarthria, tongue muscle fasciculations, brisk reflexes throughout all four limbs, and positive bilateral Hoffman's and Babinski reflexes. Additionally, she was found to have severe oropharyngeal dysphagia on speech therapy evaluation, requiring diet modification and placement of a nasogastric tube for nutritional needs. An extensive workup was performed, including MRI brain, CT

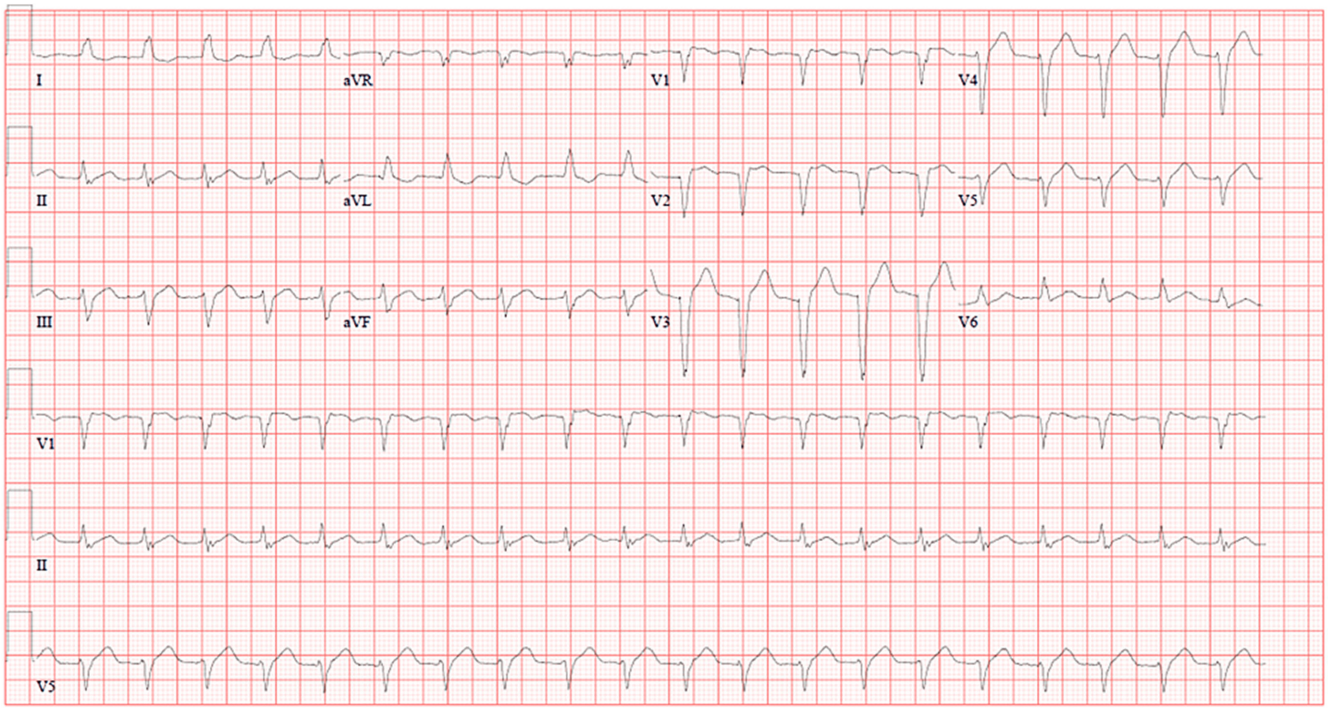

FIGURE 1 Supraventricular tachycardia (SVT) seen on EKG. EKG, electrocardiogram.

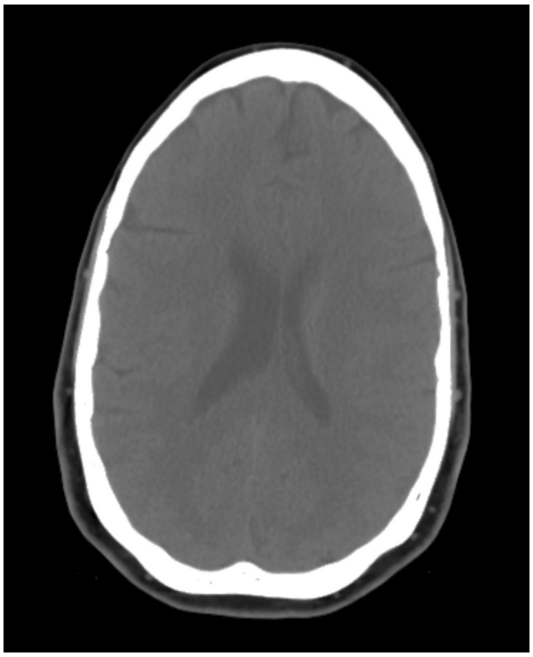

FIGURE 2 CT brain without contrast revealing no acute intracranial abnormality. CT, computed tomography.

head, CT PE, and CT maxillofacial. All imaging studies revealed no acute findings as seen in Figures 2–5. A nerve conduction study (NCS)/electromyograph (EMG) was performed and was significant for motor neuronal and axonal disease at the cranial, cervical, and lumbar regions as seen in Table 1, and the patient was clinically diagnosed with ALS within 24 h of her third ED visit. A Physical Medicine and Rehabilitation (PM&R) consult was obtained at the time, and the patient's functional needs were promptly addressed, including assistance with obtaining therapy and DME services, connecting the patient with community resources, and addressing the neuro-psychosocial needs of the patient, specifically her fears and anxieties associated with this new life-altering diagnosis.

3 | DISCUSSION

ALS is a rare and devastating disease. Throughout training, clinicians traditionally consider ALS in the male population when motor neuron signs and symptoms such as focal muscle weakness and wasting in the distal limb muscles, muscle twitching/fasciculations, and speech and swallowing dysfunction are identified. It is now understood that ALS is a multisystem disease, and autonomic dysfunction is commonly present at the time of presentation secondary to the degeneration of motor neurons and other neural pathways within the central and peripheral nervous systems.[3,5] Given the autonomic impact of this disorder, roughly 50% of patients will experience cardiovagal abnormalities.[4] As time progresses, autonomic dysfunction becomes more clinically significant and is associated with disease progression.[6,7] Dubbioso et al. found the presence of autonomic dysfunction to be an independent factor of disease progression and noted that its presence is associated with more rapid rates of motor

FINDINGS:
CT BRAIN:

PARENCHYMA: No hemorrhage, mass-effect, or midline shift. Normal white matter attenuation.

VENTRICLES/EXTRA-AXIAL SPACES: Normal size and configuration for age. No extra-axial collection.

CALVARIUM/SOFT TISSUES: Unremarkable.

MISCELLANEOUS: There is no significant abnormality noted otherwise.

FIGURE 3 CT brain without contrast findings. CT, computed tomography.

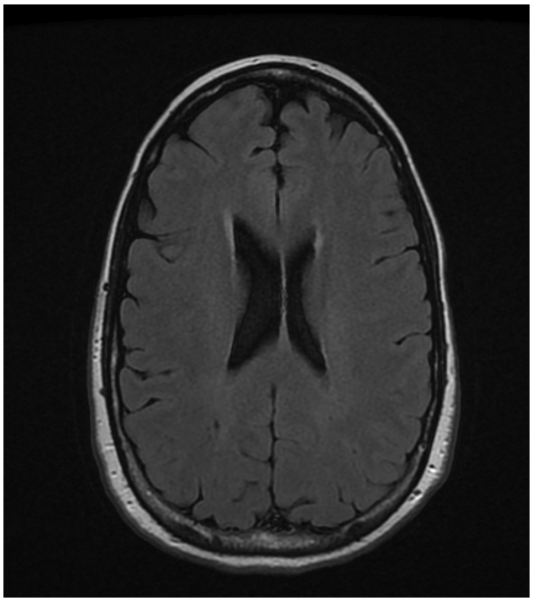

FIGURE 4 MRI brain without and with contrast revealing negative unenhanced and enhanced MRI of the brain. MRI, magnetic resonance imaging.

functional decline and shorter survival.[3] This suggests the importance for clinicians to include ALS on the differential for patients presenting with complaints of cardiac symptoms along with neuromuscular involvement, as a delay in diagnosis can severely impact functional decline, clinical prognosis, and quality of life.

Diagnostic delays are common in ALS patients and, unfortunately, can be devastating. Patients with ALS experience an average delay in diagnosis of 10–16 months from the time of symptom onset.[8,9] There is significant literature addressing this diagnostic delay. ALS is largely a clinical diagnosis, suggesting clinicians require strong history and physical examination skills in order to detect subtle signs that can raise concern for the disease. In addition, throughout medical education, signs of bulbar involvement are taught to be warning signs for possible motor neuron disorders. This has been so well taught that bulbar involvement has been noted to significantly reduce the time to diagnosis.[9] We hypothesize that bulbar involvement can assist in diagnosis as it prompts clinicians to perform a thorough history and neuromuscular examination resulting in extensive diagnostic workup. Unfortunately, bulbar involvement does not guarantee a diagnosis, as seen in the case of our patient. Our patient had three hospital encounters, and unfortunately, it was not until her last encounter (3 months after she first presented) that a thorough history and neuromuscular examination were performed, despite evidence of bulbar involvement during her initial hospital encounter. At that point in her medical stay, she had declined significantly to the point of requiring assistance with speech, swallowing, activities of daily living, and mobility. Unfortunately, our patient's functional decline was so rapid and severe that she ultimately required discharge to a skilled nursing facility. An earlier diagnosis may have provided the patient the opportunity to obtain rehabilitation services to slow functional loss and allowed the patient to obtain the proper resources and community support to safely remain in the comfort of her own home, surrounded by family and friends to assist her in coping with this new terminal diagnosis.

Given the overall poor prognosis of ALS and mean survival time of only 2–5 years from symptom onset, early diagnosis and initiation of management is essential to assist with slowing the loss of physical function and symptom progression to ultimately improve quality of life. The rate of progression of ALS with initial signs of bulbar involvement is quicker with a mean survival time of 2 years from symptom onset.[1] Upon review of this case, clinical cognitive bias appears to be a significant barrier to receiving the proper diagnosis and care. Given the patients' female gender and her presenting chief complaint as cardiac in nature, the clinician teams anchored to this complaint to focus solely on the

TECHNIQUE:
1. Multiplanar multisequence MRI of the brain without and with intravenous contrast was performed and reviewed.
2. Multiplanar multisequence MRI of the cervical spine without and with intravenous contrast was performed and reviewed.
CONTRAST: 6 mL of Gadavist intravenously.

FINDINGS:
MRI BRAIN:
PARENCHYMA: No hemorrhage, edema, midline shift or mass-effect. Normal white matter signal. No evidence of acute ischemia. No abnormal enhancement after intravenous gadolinium.

VENTRICLES/EXTRA-AXIAL SPACES: Normal size and configuration for age. No extra-axial collection.

FLOW VOIDS: Unremarkable.

MIDLINE STRUCTURES: Unremarkable.

CALVARIUM/SOFT TISSUES: Unremarkable.

PARANASAL SINUSES/MASTOID AIR CELLS: Visualized portions are clear.

MISCELLANEOUS: There is no significant abnormality noted otherwise.

FIGURE 5 MRI brain without and with contrast findings. MRI, magnetic resonance imaging; mL, milliliters.

cardiovascular system during the physical examinations. While the patient did complain of mild speech difficulty initially, the focus of the encounters remained cardiac in nature, and complete neurologic examinations were not performed. On the patient's first encounter, head imaging was used to clear the patient from a neurologic standpoint. Training teaches clinicians that a thorough history and physical examination are hallmarks of a good diagnostician. It provides vital information that lays the foundation for obtaining the correct diagnosis and developing a patient-centered treatment plan, as highlighted here. In this case, the bias of utilizing imaging studies to replace a neuromuscular examination to rule out neurologic manifestations was a severe barrier to the patient obtaining the correct diagnosis and care. We hypothesize if a thorough neuromuscular examination was performed, signs of ALS could have been identified earlier. There were multiple time points in which biases appear to have impeded the dynamic process clinicians utilize to build a solid differential diagnosis and treatment plan. As medical professionals, it is vital to recognize the impact of anchoring bias in our care.[10] A 2020 article by Featherston et al. discussed the impact various biases have to potentially seriously impact clinician care, quality, consistency, and, ultimately, the accuracy of decision-making. It is important to understand that cognitive biases occur specifically when analytical thinking is pushed aside and instead intuitive thinking, such as focusing solely on the chief complaint, guides decision-making.[11] A 2016 systemic review by Saposnik et al. found that clinicians selectively seek out information that supports the initial presentation provided, (i.e., the chief complaint) leading to diagnostic errors, increased medical complications, and errors in treatment,[12] which is consistent with this patient's situation.

Fortunately, as the literature demonstrates, the effects of cognitive bias can be mitigated if recognized and addressed daily. Papathanasiou et al. identified avenues to improve critical thinking behaviors in nursing students. Encouraging independence of thought, humility, integrity, and curiosity should be recommended not only to students but also to working clinicians on a daily basis. Papathanasiou et al. noted that 'those who utilize critical thinking and accept their own personal biases and habits can work to actively interpret and push aside prejudices when treating others'.[13] If as clinicians we are aware of our own underlying biases, we will have a greater understanding of our thought processes and thus a greater ability to avoid errors in judgment and optimizing patient care.

TABLE 1 EMG of the right upper and lower extremities and cranial nerve innervated muscles (pertinent findings).

EMG summary table												
			Insertional	Spontaneous					MUAP			
Muscle	**Nerve**	**Roots**	**Insertional**	**Fib**	**+ Wave**	**Fasc**	**Other**	**Dur**	**Amp**	**Recruit**	**Poly**	**Max effort**
R first dorsal interosseous	Ulnar	C8-T1	Incre	None	None	Many	None	Incr2+	Incr2+	Decr3+	None	Max
R abductor pollicis brevis	Median	C8-T1	Incre	None	None	Many	None	Incr1+	Incr1+	Decr3+	None	Max
R flexor carpi radialis	Median	C6-C7	Incre	None	None	Many	None	Incr1+	Incr1+	Decr2+	None	Max
R triceps brachii	Radial	C6-C8	Incre	None	None	Many	None	Incr1+	Incr1+	Decr1+	None	Max
R deltoid	Axillary	C5-C6	Incre	None	1+	Few	None	Incr1+	Incr1+	Decr1+	None	Max
R extensor digitorum communis	Radial	C7-C8	Incre	1+	2+	Few	None	Incr1+	Incr1+	Decr1+	None	Max
R genioglossus	Hypoglossal	Medulla–	Incre	None	None	Many	None	Incr2+	Incr2+	Decr2+	None	Max
R tibialis anterior	Deep peroneal (fibular)	L4-L5	Incre	None	2+	Many	None	Incr1+	Incr1+	Decr2+	None	Max
R gastrocnemius (medial head)	Tibial	S1-S2	Incre	None	None	Many	None	Incr1+	Incr1+	Decr1+	None	Max
R vastus medialis	Femoral	L2-L4	Incre	None	None	None	None	Incr1+	Incr1+	Decr2+	None	Max
R iliopsoas	Femoral	L2-L3	Incre	1+	1+	Few	None	Incr1+	Incr1+	Decr2+	None	Max
R tensor fasciae latae	Superior gluteal	L4-S1	Normal	None	None	None	None	Incr1+	Incr1+	Decr1+	None	Max

Abbreviations: Amp, amplitude; Decr, decreased; Dur, duration; EMG, electromyograph; Fasc, fasciculations; Fib, fibrillations; Incr, increased; Poly, polyphasia; Recruit, recruitment.

As PM&R clinicians, we are strongly involved in the care of patients with ALS. Patients with ALS require individualized treatment plans to optimize function, quality of life, energy conservation, safety with mobility/ADLs, and DME considerations.[14] In fact, given the disease complexity, the American Academy of Neurology recommends multidisciplinary involvement for all ALS patients, with PM&R being a vital component to assist along each disease stage. PM&R clinicians act to address and coordinate the functional needs of the ALS community. As disease involvement progresses, patients' functional and ADL requirements grow. PM&R clinicians provide comprehensive care including various rehab strategies to optimize the quality of life for both the patient and their caregivers.

In summary, this case highlights multiple preventable errors. First, each patient encounter should start with obtaining a thorough history and curating an individualized physical exam, differential diagnosis and treatment plan tailored to that patient based on the information gathered from the history. Each complaint addressed by the patient should be acknowledged even if it is not the primary complaint. Second, acknowledging the impact of clinicians' own biases can aid in ensuring the patients' needs are addressed as a whole and areas of care are not overlooked. Last, medical professionals should practice a holistic patient-centered approach in order to best address the various factors contributing to a patient's presentation. Early diagnosis would have not only improved functional outcomes in this patient, but would have also decreased unnecessary health care spending by eliminating multiple encounters and repeat studies, shortened length of stay, and most importantly provided the patient with the necessary time and resources to face her new reality.

While ALS may be rare, our ability as clinicians to accurately diagnose and treat patients with the disease should not be. Given the complexity of the diagnosis, it is vital to understand the multiorgan involvement and autonomic nuances of ALS, as this will enhance the clinical picture and prompt appropriate clinical examination, diagnostics, and treatment plan. Additionally, as clinicians, it is imperative to understand our own biases and their subsequent impacts on patient care. By initiating self-reflection, we can develop strategies to overcome this barrier, ultimately improving the ability to diagnose patients with ALS, ensuring timely consultation with the rehabilitation multidisciplinary team, and hopefully improving patients' functional outcomes and ultimately quality of life.

4 | CONCLUSION

Early diagnosis and rehabilitation in ALS patients can prove beneficial in accelerating muscle strengthening, improving mood and quality of life, and helping patients obtain the proper resources within the community. It is, therefore, imperative to recognize barriers that can delay treatment, such as underlying cognitive biases in patient care, to assist with early diagnosis and intervention of those with nontypical ALS signs to ultimately improve functional outcomes within the spectrum of the medical diagnosis.

AUTHOR CONTRIBUTIONS

Neyha Cherin: Conceptualization; resources; supervision; writing – original draft; writing – review and editing. **Shivani Patel:** Conceptualization; resources; writing – original draft; writing – review and editing. **Michelle Jukic:** Conceptualization; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

None to declare.

DATA AVAILABILITY STATEMENT

Data sharing not applicable—no new data generated.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

ORCID

Shivani Patel https://orcid.org/0009-0007-6426-9542

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