NEW YORK INSTITUTE OF TECHNOLOGY
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at Arkansas State University

Broken Heart Syndrome: A Case of Reverse Takotsubo Cardiomyopathy and Coronary Anomaly Induced by a Spinal Arteriovenous Malformation

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Purpose

Though extensive protocols exist for addressing cardiomyopathies, reverse takotsubo cardiomyopathy presents in a unique manner through its connection with cardiac physiology and neurological disease. Understanding this variant of the already interesting takotsubo cardiomyopathy along with its clinical presentation, distinct imaging, and neurological linkage, is vital in propelling further study into heart disease. Osteopathic considerations to aid in the treatment of patients presenting with chest pain are also discussed as well as the uniqueness of the patient presentation.

Case Presentation

24-year-old white male with no known past medical history presented to the emergency room with chest pain. Reportedly, the patient was lifting a heavy piece of equipment when he developed chest pain. EKG results supported that he was suffering from an ST elevation myocardial infarction and a complete heart block. Upon left ventricular angiography, classic wall motion abnormalities of Reverse Takotsubo syndrome were noted. Also, upon coronary angiography an anomalous obtuse marginal branch originating directly from the aorta was discovered. The wall motion abnormalities were confirmed on echocardiography. Later, the patient complained of being unable to move their extremities. An MRI of the spine revealed an arteriovenous malformation with hemorrhage.

Background

Reverse Takotsubo Cardiomyopathy (RTC)

(RTC) is an uncommon variant of stress-induced cardiomyopathy. The condition is characterized by a stress-induced hypokinesis localized to the basal left ventricle [1]. This acute and reversible dysfunction is highlighted by acute chest pain which can mimic acute coronary syndrome [2,3]. Following a stressful episode, the left ventricle develops wall motion abnormalities leading to chest pain and heart failure. Particularly, in RTC, the basal segments of the ventricle fail to contract appropriately. Most individuals afflicted with stress cardiomyopathy are postmenopausal women. However, the RTC variant may also present with patients who are suffering from a neurological disorder [1].

Spinal Arteriovenous Malformation (AVM)

AVMs occur when a group of blood vessels form incorrectly in the body. The arteries and veins are intertwined in such a way allowing them to bypass normal tissue. Many AVMs develop before or shortly after birth. Typically, there are no associated symptoms or presentations of AVM's. Their discovery occurs through imaging for separate concerns or when they rupture. Sometimes, AVMs can decrease the amount of oxygen that is delivered to the brain and spinal cord. Capillaries do not exist within the malformed vessel network. Thus, the velocity of blood is never decreased to deliver oxygen and nutrients to parts of the body [4].

Diagnostic Testing

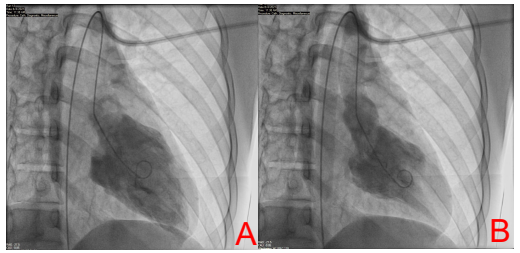

Figure 1A: Angiogram
Angiographic view of the left ventricle. The apex and the base of the heart are in full expansion as the end diastolic volume is reached.

Figure 1B: Angiogram
Angiographic view of the left ventricle in systole. The basal segment remains expanded while the apex of the heart contracts, indicating the reverse variant.

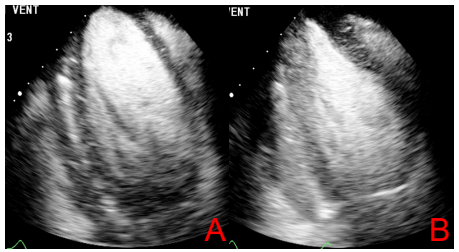

Figure 2A: Echocardiogram
View of the left ventricle in diastole. The apex and basal segments of the heart reach full dilation.

Figure 2B: Echocardiogram
View of the left ventricle in systole. Note apex contraction and sustained dilation of the basal segment.

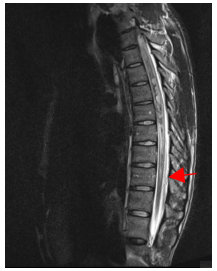

Figure 3: MRI
Spine MRI Without IV Contrast showing a Spinal Arteriovenous Malformation on the T5-T6 level. The associated hemorrhage extends superiorly into the cervical spine.

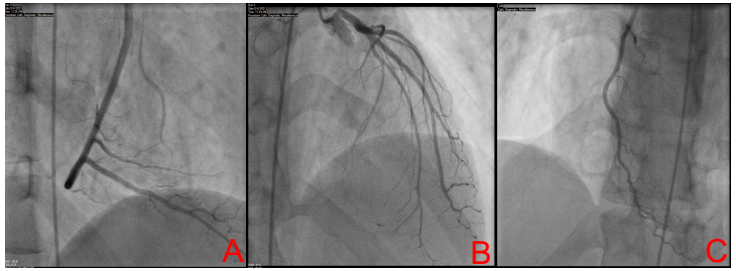

Figure 4A: Coronary Angiogram
A: Normal appearing right coronary artery.

Figure 4B: Coronary Angiogram
B: Normal appearing left coronary artery.

Figure 4C: Coronary Angiogram
C: Anomalous obtuse marginal branch originating directly from the aortic root.

Uniqueness of Case

Takotsubo cardiomyopathy is responsible for 0.02% of all hospitalizations across the United States. It is seen only 2% of the time in all acute coronary syndrome presentations [5]. The reverse variant only makes up about 23% of all Takotsubo cardiomyopathy cases. This condition also predominantly affects women and older individuals with more than 90% of cases being seen in women aged 58 to 75 [6]. Symptoms are usually triggered by a psychiatric episode leading to a catecholamine surge and effects in heart contractility [7]. In this case, the patient is a young male who developed the reverse variant after the dislodgement of a spinal AVM. This is separate from the known emotional triggers of RTC as seen in previous reports. Catecholamine toxicity triggered hypokinesia in the left ventricle of the heart causing the sole contraction of the basal segment. The uniqueness of this case is further represented in the coronary anomaly seen in the obtuse marginal branch stemming from the aortic root. The presence of coronary artery anomalies may have a played a role in the further exaggeration of symptoms and the exhibited reverse phenotype.

Osteopathic Considerations

A patient presenting with an acute ST-elevation myocardial infection (STEMI) may benefit from an osteopathic approach to treatment following thrombolytic therapy and regained sinus rhythm. In this case the following indications are made for The Five Models of Osteopathic Treatment.

1. **Biomechanical:** Identify dysfunctions along the affected T1-T5 cardiac segments and treat.
2. **Neurological:** Identify and treat cardiac viscersomatic reflexes from T1-T5 on the left and chapman's reflexes located anteriorly on the left 2nd intercostal space near the sternum. Posteriorly, between the transverse processes of T2 and T3.
3. **Respiratory/Circulatory:** Treat associated spinal columns, ribs, and diaphragm allowing for an increase in blood and lymphatic circulation.
4. **Behavioral:** Counsel patient on exercise and diet to improve and maintain adequate cardiac health.
5. **Metabolic:** Blood oxygenation and workload on the heart will improve with heightened circulation and immune system function.

Discussion/Conclusion

This is a case of a young male patient presenting with reverse takotsubo cardiomyopathy, a rare presentation of an already rare condition. RTC usually presents with chest pain and dyspnea preceded by an emotional or physically stressful event. Patients present frequently with mild congestive heart failure and a decreased ejection fraction. EKG typically reports ST elevations as well as QT prolongation and inverted T waves. Many of these indications align with ST-elevation myocardial infarctions which the patient was immediately treated for. However, further complications developed upon arrival to the catheter lab. After becoming quadriplegic and losing the ability to speak, a spinal MRI portrayed the presence of an acute hematoma in the cervical spine which extended superiorly from the thoracic spine. Further diagnostic imaging of the heart indicated hypokinesis of the basal segment making up the left ventricle. Angiographic imaging was conducted and led to the discovery of a coronary anomaly (Figure 4C). The unique aspects of this case as well as the string of unfortunate events within the patient's stay at the hospital prompts consideration into how further complications could have been prevented. Since RTC corresponds with a previous stressful episode triggering a catecholamine surge, it is suspected that the dislodgement of the spinal AVM may have led to the findings seen on cardiac imaging. The initial physical exertion with the use of back muscles by the patient led to the hematoma observed on spinal MRI (Figure 3). The spread of blood within the spinal column led to sympathetic activation of the body and the release of hormones to the heart. The presence of an anomalous coronary branch alongside the neurotransmitter toxicity sustained by the patient contributed to the hypokinesia of the heart. The apex of the left ventricle continued its contraction while the basal segment adopted a sustained dilation through subsequent cardiac cycles. Consequently, portraying significant EKG changes leading to a suspected acute myocardial infarction. A diagnosis of RTC can be managed with many different options. Beta blockers can be used to reduce the contractility of the affected myocardial segment. If thrombus formation within the akinetic basal segment is suspected, prophylactic anticoagulation can be used. Magnesium sulfate can also be used for the QT prolongation observed on EKG. Inotropes are fully contraindicated in patients suffering from RTC as they can precipitate cariogenic shock [8]. Though the epidemiology of RTC is significantly different than the presentation of this case, it is important to consider the various etiologies behind acute coronary syndrome. One of them being takotsubo cardiomyopathy as well as its reverse variant. Patients presenting in a similar manner must be considered for stress induced cardiomyopathies, especially if the history is consistent with emotional and physical triggers before the onset of symptoms.

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