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Ventricular Tachycardia During Neurointerventional Procedures: A Rare Complication

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Abstract:

Anesthesiologists play a critical role in ensuring hemodynamic stability and managing potential complications during neurointerventional procedures. Complications during neurointerventions could be hemorrhagic (aneurysm perforation, intracranial vessel injury, dissection) or occlusive (thromboembolic, vasospasm), contrast related, etc. [1] Cardiac events during neurointerventions are rare but could be catastrophic. Sensitization and readiness of anesthesiologist for such events certainly help to improve patient outcome. The complex bidirectional interaction between brain and heart is well explained in the literature and trigeminocardiac reflex (TCR) is very common example of this.[2] TCR is well studied during neurosurgeries, but it's occurrence during neurointerventions should not be denied. The spectrum of cardiac events during TCR includes bradyarrythmias, hypotension, hypertension, tachyarrhythmias.[3] Cushing's reflex (bradycardia, hypertension, irregular breathing) can be caused by ruptured intracranial aneurysms/ arteriovenous malformation/ dural arteriovenous fistula. Stimulation of stretch receptors in major vessels during catheter manipulation, onyx embolization in cardiac/ pulmonary circulation can also result in arrhythmias during neurointerventions.[4] Here we came across two different cases. In the first case, a 25-year-old female developed ventricular tachycardia after embolization of dural arteriovenous fistula (DAVF), which spontaneously reverted to normal sinus rhythm. In the second case, a 34-year-old male experienced ventricular tachycardia during catheter manipulation, which resolved after catheter withdrawal.

Keywords: Neurointervention, Trigeminocardiac reflex (TCR), Dural arteriovenous fistula (DAVF), Ventricular tachycardia (VT)

Introduction :

The field of neuroradiology is expanding and so the role of anesthesiologist in non operating room anaesthesia. Neurointerventional procedures encompass diverse procedures each with unique complication risks including cardiac arrhythmia. Dural arteriovenous fistula (DAVF) are abnormal shunts between arterial and venous systems located within dura and endovascular approach is the first line of management for most DAVFs. Endovascular embolization with transarterial route is the mainstay of treatment. During this approach various liquid embolic agents are used eg. Cyanoacrylic glue, Onyx, Squid, PHIL (Precipitating Hydrophobic Injectable Liquid).[5] In transarterial approach microcatheters are tracked over microwires to distal locations in feeding arteries, with the goal of getting the microcatheter as close to fistula connection as possible and embolic agent is injected.

Cardiac arrhythmias can occur during these procedures, highlighting the need for vigilant monitoring and prompt management. We present two cases of ventricular tachycardia during neurointerventional procedures under general anesthesia.

Case presentation:

Case 1: A 25-year-old female with no known comorbidities presented with complaints of headache, blackouts and was diagnosed with DAVF. She was posted for embolization. Digital subtraction angiogram (DSA) was suggestive of DAVF with multiple feeders mainly from right external carotid artery (feeders from Occipital artery) and from bilateral vertebral arteries with partial occlusion of superior sagittal sinus, left transverse and sigmoid sinuse. Patient was induced under general anaesthesia with inj. Fentanyl 2 mcg/kg, inj. Propofol 2 mg/kg, and inj. Atracurium 0.5 mg/kg. Airway was secured with LMA to attenuate hemodynamic stress response at insertion and removal of LMA and for smoother emergence.[7] Anaesthesia was maintained with oxygen, air and sevoflurane. Embolization was done under fluoroscopy guidance for real-time visualization of the Onyx injection. Baseline blood pressure was 100/70 mmHg and heart rate was 84 beats per minute. Immediately after Onyx injection patient went into ventricular tachycardia with heart rate of 160-180 beats per minute. Peripheral pulses were palpated (well felt) while waiting for NIBP (Non-invasive blood pressure) as invasive blood pressure monitoring was not done. Interventionist was informed immediately and procedure was stopped. NIBP reading was 140/90 mmHg. Ventricular tachycardia did not revert to normal sinus rhythm even after procedure was stopped. After waiting for almost 45-50 seconds, injection Esmolol (20mg) was given intravenously for rate control. Normal sinus rhythm was observed after 30-45 seconds. Procedure was completed without any other event. Post procedure patient was weaned off from ventilatory support and LMA was removed after normal neurological assessment. Patient was observed in interventional room for 45 minutes and reassessment was done. Patient's neurological examination was normal and patient was hemodynamically stable. Patient was shifted to recovery room. Several case reports suggest trigeminocardiac reflex caused by embolization of DAVF with Onyx.[8, 9] TCR may present with different hemodynamic changes as it's reflex arc involves complex composition of sympathetic and parasympathetic fibres.[3, 10, 11] In our case we suspected TCR as diagnosis of exclusion. Here TCR was caused by stretching of dura by Onyx embolization which precipitated as hypertension and tachycardia (ventricular tachycardia).

Case 2: A 34-year-old male with no known comorbidities presented with complaints of headache and blurring of vision and was diagnosed with DAVF along left sigmoid , transverse and superior sagittal sinus with multiple feeders from left vertebral and left external carotid arteries. Patient was posted for embolization of the same and was induced under general anaesthesia with inj. Fentanyl 2 mcg/kg, inj. Propofol 2 mg/kg and inj. Atracurium 0.5 mg/kg. Airway was secured with LMA for better hemodynamic response. Right transfemoral artery route was used for embolization. Because of tortuosity of the cerebral vasculature multiple attempts were done to reach feeder vessels. During such attempt whil withdrawing wire from carotid artery through aorta it entered into left ventricular cavity through ascending aorta. This likely resulted into stimulation of myocardial tissue which led to transient ventricular tachycardia and was reverted back to normal sinus rhythm as soon as wire was withdrawn. It did not require any other intervention.

Discussion:

Cardiac arrhythmias during neurointerventions is a significant concern and demands swift action to prevent serious complications. TCR has been defined as the sudden onset of dysrhythmias, hypotension, apnea or gastric hypermobility due to stimulation of peripheral branches of trigeminal nerve.[10, 11] The reflex arc involves afferent pathway consisting of sensory branches of trigeminal nerve that carry neuronal signals to the sensory nucleus of trigeminal nerve via Gasserian ganglion . Internuncial Fibers in reticular formation connect sensory nucleus of trigeminal nerve to motor nucleus of vagus nerve. Vagus nerve along with its motor nucleus forms efferent pathway. Considering this complex composition of parasympathetic and sympathetic fibres, it seems understandable why the TCR presents with different symptoms.[11, 12] We did not find any literature where ventricular tachycardia was documented as TCR, though literature mentions complex interplay of sympathetic and parasympathetic systems during this reflex.[11] TCR has been reported to occur during various neurosurgical procedures such as pituitary surgery, cerebellopontine angle surgeries manipulation of trigeminal nerve as well as neurointerventional procedures such a embolization of DAVF and AVM.

Cardiovascular changes including bradycardia, ST changes, atrioventricular block, tachycardia, ventricular fibrillation, hypertension , hypotension are observed and are attributed to vagus stimulation as a part of TCR reflex arc where stimulation occurs in the vicinity of trigeminal nerve or its meningial branches supplying dura matter.[3] In our case the DAVF was located in posterior cranial fossa as described above. And embolization was done through occipital artery. The dura mater of posterior cranial fossa is innervated in part by branches of trigeminal nerve and receives vascular supply from branches of posterior meningeal artery (arising from vertebral artery) as well as meningeal branches from occipital artery.[6] Hence embolization of these vessels can stimulate the trigeminal nerve and cause TCR.

During neurointerventional procedures, catheter manipulations are frequently done while reaching target site in cerebral vasculature. If during this manipulation there is direct stimulation of ventricular tissue, it can cause disturbance in local electrical activity and can lead to premature ventricular complexes (PVCs), Transient VT, which reverts back once stimulus is removed and rarely needs any intervention.[13] Catheter stimulation or stretch of subclavian, brachiocephalic arteries or ascending aorta may also cause vasovagal reaction. In our case, because of difficult anatomy of vasculature, catheter manipulation was difficult and required frequent attempts and while catheter was getting withdrawn, the tip fell into left ventricular cavity. Prompt withdrawal of catheter resulted into return of normal sinus rhythm.

Conclusion:

Anesthesiologist plays a vital role during neurointerventional procedures, requiring careful consideration of risks, anesthesia management and procedure specific factors. One should possess a deeper understanding of cardiac complications that may arise during neurointerventions to provide optimal patient care.

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