Stellate ganglion block as rescue therapy in drug-resistant electrical storm

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ABSTRACT

Electrical storm or incessant ventricular tachycardia is a life-threatening condition and is associated with high morbidity and mortality. Often patients respond to traditional anti-arrhythmia treatment. However, some patients are resistant to the drug therapy and thus, pose huge challenges in effective management. Though stellate ganglion block has been found to be effective in treating patients with electrical storm, it is still under-utilized. In this case report, we successfully managed to revert the drug-resistant arrhythmia to sinus rhythm after ultrasound-guided stellate ganglion block. Earlier utilization of the block can possibly provide effective treatment in drug-resistant ventricular arrhythmias and prevent morbidity and mortality.

Keywords: Electrical storm, stellate ganglion block, ultrasound, ventricular tachycardia

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INTRODUCTION

Electrical storm (ES) is defined as occurrence of multiple episodes of ventricular tachycardia (VT) or ventricular fibrillation (VF) in a short period of time. In patients with automatic implantable cardioverter-defibrillator (AICD), this is often manifested by 3 or more anti-tachycardia pacing (ATP) or ICD shocks delivered within a 24-hour period. It requires aggressive treatment to reduce morbidity and mortality.[1,2] Even, ES can occur in up to 20% of patients where an AICD has been placed. Untreated ES may result in left ventricular systolic dysfunction complicating in heart failure.[2] In some occasions, ES can be resistant to traditional treatment; thus, posing huge challenges in terminating the life-threatening arrhythmia. We present three cases of ES successfully treated with ultrasound (USG)-guided left stellate ganglion block (LSGB).

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CASE DESCRIPTION

Case 1

A 75-year-old male patient presented to the emergency department (ED) with palpitation and history of receiving around 25 shocks through the AICD in last 2 hours. He was an old case of anteroseptal myocardial infarction (MI) and had similar history of palpitations 6 weeks ago. That time he was found to have VT and had an AICD inserted by the cardiologists. He was taking ramipril, torsemide and amiodarone for his heart failure and arrhythmia.

In the ED, acidosis or dyselectrolytemia was ruled out. His electrocardiogram (ECG) revealed VT [Figure 1], but patient was hemodynamically stable. In ED he received intravenous (i.v.) amiodarone 150 mg and then i.v. metoprolol 5 mg slowly. The VT reverted to SR temporarily.

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Then, amiodarone infusion and oral propranolol 40 mg 4 times/day were started. However, VT continued and reverted to SR only temporarily following shocks from AICD. In next couple of hours, patient became severely dyspneic and went into heart failure and needed mechanical ventilation with vasopressor for hemodynamic support. He subsequently improved and was extubated by next day. In between patient received shocks to restore SR. In the meantime, diltiazem, magnesium, and lidocaine were given by the cardiologists, but they were of no significant benefit in terminating VT. As the AICD battery was depleting very fast, cardiologists made some changes in AICD programming which helped in controlling the rate for a short while before the patient went back to incessant VT with hypotension again.

Finally, we were called for a trial of LSGB as a last resort. The procedure was explained to the patient and his family members. After written consent, we performed LSGB under USG-guidance. Patient was placed in right lateral position, and injection site cleaned with chlorhexidine-alcohol solution. Then, with linear-array USG (7-13 MHz GE Vivid iq, GE Medical Systems), we identified C6 vertebra anterior tubercle, longus colli (LCo) muscle, prevertebral fascia (PVF), cervical nerve roots, and surrounding blood vessels. Under real-time USG-guidance, a 21-gauge 50-mm echogenic block needle (UltraplexÒ360, B Braun Melsungen, Germany) was inserted in-plane from lateral to medial targeting the area just below the PVF on the surface of LCo muscle. We injected 6 ml of 0.5% bupivacaine and the local anesthetic (LA) spread was appreciable in the right target with LA surrounding the sympathetic chain [Figure 2]. Patient developed ptosis with miosis in next few minutes in the left eye. Interestingly, patient's VT and rate of 180 beats/min reverted to SR and rate of 70-80 beats/min in next 30 minutes [Figure 3]. He was continued with oral propranolol 80 mg thrice daily and anti-failure medications. As the patient continued with SR and controlled rate, he was discharged successfully in next 3 days.

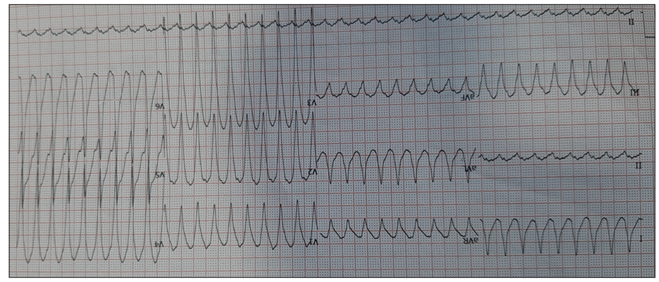

Figure 1: Electrocardiogram of first patient with ventricular tachycardia

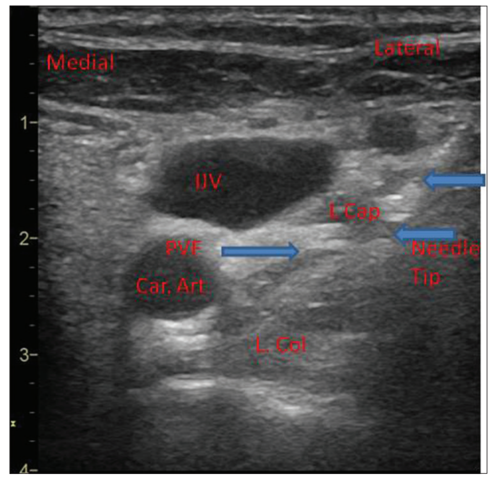

Figure 2: Ultrasound-guided stellate ganglion block with short axis view sonoanatomy at C6 level. Left side blue arrow showing local anesthetic spread just below the prevertebral fascia. Right hand blue arrow shows needle tip just below the prevertebral fascia. (Car. Art.- Carotid artery, IJV- internal jugular vein, L Cap- Longus capitis muscle, L Col- Longus colli muscle, PVF- prevertebral fascia)

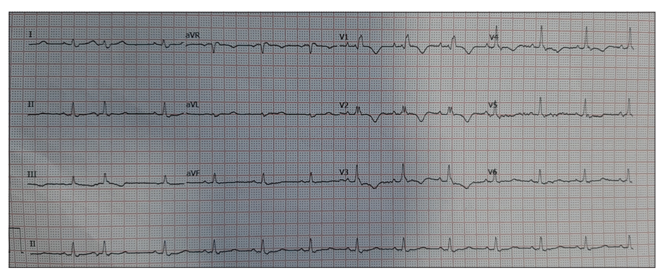

Figure 3: Electrocardiogram showing sinus rhythm following stellate ganglion block

Case 2

A 66-year-old man came to hospital with complaints of recurrent shocks and palpitation. He was a known case of MI with cardiomyopathy and severe LV dysfunction. He had received two stents to his coronaries in the past. He underwent cardiac resynchronization therapy (CRT) in 2014 for his heart failure. His medications included diuretics, valsartan, aspirin, and bisoprolol.

In the ED, he received shocks which temporarily converted his rhythm to sinus. Subsequently, i.v. amiodarone bolus and infusion were started and he was shifted to coronary care unit. In the subsequent days, patient's rhythm switched between SR and VT. Similar to first case, he received all kind of medications but response was only transient. Finally, a LSGB was done on 12-days after continued VT. Again, the technique was similar to the first case and the rhythm reverted to sinus and controlled rate of 70–80 beats/min. In next 48-hours, most of the time his rhythm was sinus except few episodes of VT without any hemodynamic compromise. He was then discharged in next few days with medications.

Case 3

A 58-year-old man with known history of dilated cardiomyopathy on AICD was admitted in CCU with multiple attacks of VT. He was initially treated with traditional anti-arrhythmic drug therapy (ADT) including amiodarone infusion, lidocaine, magnesium, and multiple episodes of DC shock. His rhythm was reverting to sinus temporarily with DC shock. He experienced multiple episodes of hypotension possibly because of amiodarone and ongoing heart failure needing vasopressor support. The hypotensive episodes compelled the intensivists and cardiologists to stop amiodarone infusion. On day 4 of admission into CCU, a request was sent to us (Anesthesiologists) for a trial of SGB. After proper informed consent, we did a LSGB with 5 ml of 0.5% bupivacaine and within 10 minutes the rhythm reverted back to sinus and controlled heart rate of 70-90 beats/min. His vasopressors were slowly weaned off and he was discharged 4-days later from the hospital.

DISCUSSION

ES is a medical emergency as untreated ventricular arrhythmia has catastrophic complications. Additionally, ES is considered an independent predictor of mortality.[3] Common causes of ES include ongoing myocardial ischemia, structural heart disease, and scar-mediated re-entrant circuit. Initial treatment includes identification and treatment of the causative factors. Majority of the patients respond to ADT like beta-blockers, amiodarone, lidocaine, and DC shocks. However, some patients are resistant to treatment as there is usually associated sympathetic surge which is often resistant to ADT.[4]

Although SGB has been demonstrated to be effective in terminating VT long ago, there is lack of robust clinical evidence behind its use. This is because randomized double blind trials are not possible to conduct in such a clinical setting. So far most of our knowledge has been from case reports.[5-8] However, the evidence is increasing with conduct of systematic reviews in recent times.[9] Nademanee *et al.*[4] reported that 1 week survival rates for patients with ES were 82% for those treated with sympathetic blockade and 22% for patients treated according to advanced cardiac life support (ACLS) guidelines. Because of high mortality, the authors recommended that early recognition and utilization of LSGB in drug-resistant ES is superior to ADT. In a recent systematic review, it was found that SGB resulted in a significant decrease in ventricular arrhythmia burden (12.4 ± 8.8 vs. 1.04 ± 2.12 episodes/day, $P < 0.001$) and number of external and ICD shocks (10.0 ± 9.1 vs. 0.05 ± 0.22 shocks/day, $P < 0.01$). After SGB, 80.6% of patients survived to get discharged from the hospital.[9]

Sympathetic innervation to the heart comes from both left and right stellate ganglia via post-ganglionic fibers. But left stellate ganglion is quantitatively dominant at the ventricular level, thus, explaining the possible efficacy of left SGB in terminating VT. However, alternating left and right SGB has been reported in the literature even in patients who were resistant to ablation therapy.[7] In addition to associated sympathetic surge, it has been postulated that increased ventricular arrhythmia threshold following sympathetic denervation as possible explanation for the effectiveness of SGB.[8] Furthermore, recent canine model work suggests that there is increased neural activity and remodeling of stellate ganglion following MI. Whether this neural remodeling directly contributes to arrhythmia is still unclear.[10]

SGB has been traditionally performed by landmark, and later by fluoroscopy. But, in recent times, USG-guidance has improved efficacy as well as low volume drug (4-6 ml) has been found to be effective compared to high volume (10-20 ml) in landmark and fluoroscopy approach. In addition, vascular injury, neural injury, esophageal puncture, and other complications can be easily avoided under real-time USG guidance.[11-13] In a study by Kapral *et al.*,[12] a significant higher incident of asymptomatic hematoma has been reported when it was done blindly. Furthermore, under USG guidance, real-time spread of LA can be appreciated and even intravascular spread can be ruled out.[13] Under USG guidance, it is prudent to identify the PVF overlying the LCo muscle and deposit the drug below the fascia which ensures cephalocaudad spread. This helps in avoidance of unnecessary neural blockade of surrounding neural structures and complications. In addition to the above, another advantage is that the procedure can be done bedside even in hemodynamic compromised patients.

Two of our three patients VT became SR after LSGB and remained SR; whereas third patient's VT became SR following LSGB but next day fluctuated between SR and VT. However, the VT load got reduced greatly and subsequently with medications it slowly became SR. In patients where VT returns after initial response to SGB, repeat block on a periodical basis and even surgical sympathetic denervation has been found to be effective.[5] In all the three patients with drug-resistant ES, their rhythm became sinus and was discharged from the hospital successfully after LSGB. Had VT returned in subsequent days in any of our patients, repeat block or even continuous block through a catheter could have been done. Another important point which we want to highlight is early utilization of SGB. In the 2nd case, the patient's rhythm fluctuated between VT and

SR for quite a long time, and there was a delay in requesting SGB from the cardiologists. After this experience, the subsequent patient (Case 1 in this series) received block on 2nd day and thus, got discharged from the hospital earlier.

CONCLUSION

We report three successful cases of drug-resistant ES who responded to single shot USG-guided LSGB. SGB still remains under-utilized in ES despite its demonstrated superior beneficial effect compared with ACLS. However, our case reports re-emphasizes its use in ES and may help to create awareness among medical community on the utility of this novel technique which can be effective and life-saving. We suggest that anesthesiologists or cardiologists caring for these types of patients for early-utilization of SGB and at the same time emphasize on doing it under USG-guidance to improve safety.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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