

## Percutaneous Inferior Cervical Sympathetic Ganglion Blockade for the Treatment of Ventricular Tachycardia Storm: Case Report and Review of the Literature

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### Abstract

Running Title: Sympathetic Block for Ventricular Tachycardia Storm

**Introduction**—We present the case of a patient with ventricular tachycardia storm refractory to medical therapy and multiple catheter ablations, successfully managed by percutaneous left inferior cervical sympathetic ganglion block.

**Summary**—A 70-year-old man with a history of ischemic cardiomyopathy and previous placement of implantable defibrillator developed intractable ventricular tachycardia recalcitrant to intravenous amiodarone, lidocaine, and multiple catheter ablations with radiofrequency energy and direct current. The patient received numerous defibrillator shocks that did not result in sustained restoration of sinus rhythm. A percutaneous inferior cervical sympathetic ganglion block was performed under fluoroscopic guidance, with the administration of bupivacaine by infiltration of the tissue between the left internal carotid artery and the cervical vertebral bodies.

**Results**—Two and a half hours after the procedure, ventricular tachycardia converted to sinus rhythm. One month after discharge from the hospital, the patient remained free from sustained ventricular tachycardia and did not report discharges from his implantable defibrillator.

**Conclusion**—Percutaneous cervical sympathetic ganglion blockade appears to be an effective intervention in the treatment of ventricular tachycardia storm. Additional data are required before incorporating this technique into the management algorithm of incessant ventricular tachycardia.

### Keywords

Sympathetic ganglion; ventricular storm; tachycardia; ganglion block

### Introduction

Ventricular tachycardia storm, also known as electrical storm, is defined as the occurrence of multiple episodes of sustained ventricular tachycardia events within a 24 h period in patients with or without an implantable defibrillator [1]. While treatment of the underlying triggering factors is fundamental to the management of ventricular tachycardia storm, antiarrhythmic drugs and catheter ablation of the tachycardia nidus are often used as concurrent management strategies [1,2]. However, not infre-

quently, ventricular tachycardia storm is refractory to conventional treatment modalities [3].

Sympathetic activity is known to play a role in the genesis and perpetuation of ventricular tachycardia. Sympathetic blockade can reduce or even treat intractable ventricular tachycardia in animal models [4]. Anecdotal clinical data supports therapeutic effect of percutaneous or surgical blockade of the cervical sympathetic ganglia

Published December, 2014.

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in patients with recurrent and/or incessant ventricular tachycardia [5,6,7,8,9].

In the 1960s and 1970s, initial attempts were carried out to utilize cardiac sympathetic denervation for the treatment of ventricular tachycardia [10,11,12]. In 2000, a comparative study assessed the survival outcomes of advanced cardiac life support treatment guidelines with sympathetic blockade in treating ventricular tachycardia storm in 49 patients. Sympathetic blockade was achieved either through a percutaneous left cervicothoracic ganglion block with bupivacaine or xylocaine or through intravenous esmolol or propranolol. Overall survival in the sympathetic blockade group was 67% compared with the survival of 5% in the ACLS guidelines treated group [13]. In a recent study, neuraxial modulation with thoracic epidural anesthesia and surgical left cardiac sympathetic denervation were associated with 68%–75% reduction of arrhythmia burden in 14 patients with refractory ventricular arrhythmia and structural heart disease [3].

Despite these data, there remains a gap in both the awareness and understanding of the efficacy and the duration of benefit of sympathetic blockade in ventricular tachycardia storm.

## Case Report

A 70-year-old man was admitted to the hospital with recurrent, sustained, slow, monomorphic ventricular tachycardia leading to multiple, appropriate defibrillator shocks. The patient's medical history was significant for ischemic cardiomyopathy, hypertension, aortic aneurysm, hyperlipidemia, and previous tobacco use. There was no evidence for a primary trigger of ventricular tachycardia such as myocardial ischemia, heart failure, or metabolic abnormality. Arrhythmia control was attempted with intravenous amiodarone and lidocaine. Catheter ablation of the tachycardia substrate was attempted with radiofrequency energy and direct current on the inferoapical region of the left ventricle of the heart. Despite these measures, the patient continued to have up to 18 defibrillator discharges within 24 h. At this point, the interventional neurology team was consulted for percutaneous cervical sympathetic modulation.

**Procedure:** The procedure was performed while the patient was awake and under fluoroscopic guidance. A total of 3 ml of 1% lidocaine was infiltrated to anesthetize the skin and subcutaneous tissues down to the left internal carotid artery. A 22 gauge  $\times$  3.5 inch BD™ Quincke spinal needle was introduced at the level of the



**Figure 1.** Contrast injection from needle placed at the sixth cervical vertebral level prior to injection of 20 ml of 0.25% bupivacaine.

body of the sixth cervical vertebra, medial to the left internal carotid artery. The needle was advanced until it reached the junction between the body and transverse process of the sixth cervical vertebra. Contrast injection demonstrated the position of the needle anterior to the paravertebral muscles, with spread along the axis of the interfascial compartment (Figure 1). A total of 20 ml of 0.25% bupivacaine (Marcaine, Hospira, Lake Forest, IL) was injected over 10 min through the needle. The patient did not experience changes of systemic blood pressure or cardiac rhythm and did not develop unexpected neurological deficits.

The effectiveness of sympathetic blockade was confirmed by postprocedure development of ptosis and miosis in the left eye. The ptosis and miosis improved over the next 24 h.



**Figure 2. Cardiac telemetry rhythm strips prior to and 2 h after the procedure demonstrating slow, monomorphic ventricular tachycardia and sinus rhythm, respectively.**

**Results:** Prior to the procedure, the patient was in incessant and slow ventricular tachycardia with an average ventricular rate of 90 per minute. Two and half hours after the procedure, ventricular tachycardia reverted to normal sinus rhythm with an average rate of 70 beats per minute (Figure 2). The patient continued to remain in sinus rhythm until discharge from the hospital the next day. He reported resolution of intermittent nausea and palpitations. One month after discharge, the patient remained free of sustained ventricular tachycardia, defibrillator shocks, or palpitations.

## Discussion

Anecdotal reports and limited case series support the efficacy and benefit of autonomic neuromodulation with sympathetic blockade in refractory ventricular tachycardia storm either as a sole modality or in conjunction with other management strategies [3,5,6,7,8,9,10,11,12,13]. Treatment modalities attempted in these reports include percutaneous pharmacologic block of the left cervicothoracic ganglion, with particular emphasis on the left inferior cervical sympathetic ganglion, or bilateral cervical/thoracic sympathectomy. The duration of the beneficial effects of cervical sym-

thetic block varies widely from temporary relief of ventricular tachycardia to a sustained effect over months.

A recent, single-center, retrospective, observational study of 41 patients who underwent left or bilateral cardiac sympathetic denervation for ventricular tachycardia showed that bilateral, more than left, cervical sympathetic denervation had beneficial effects that extended beyond the acute hospitalization period [14]. Almost 50% of the patients were completely free of defibrillator shocks at the 1-year follow up. Furthermore, the burden of defibrillator shocks was significantly reduced after cardiac sympathetic denervation by 90% in 90% of the patients.

Percutaneous inferior cervical sympathetic block can rarely be associated with cellulitis or osteitis of the vertebral body and transverse process [15]. Although less common with fluoroscopic guidance, an improperly inserted needle may lead to hematoma formation from injury to the carotid or vertebral arteries. Inadvertent systemic injection of the local anesthetic agent could result in seizures [15]. Direct injury to or pharmacological paralysis of the recurrent laryngeal nerve or the phrenic nerve may lead to hoarseness of voice and respiratory dysfunction [15]. There is a higher risk of respira-

tory dysfunction in bilateral inferior cervical sympathetic block, particularly if the patient has preexisting unilateral phrenic nerve paralysis [15].

Additional data are required for the incorporation of percutaneous inferior cervical sympathetic ganglion blockade or other forms of sympathetic neuromodulation to an evidence-based algorithm for the treatment of cardiac ventricular storm. Prophylactic Bilateral Cervicothoracic Sympathectomy for Prevention of Ventricular Tachyarrhythmias is a randomized clinical trial, currently being designed to address some of these questions [16].

## Conflict of Interest

All the authors have no conflicts of interest to disclose.

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