

RHYTHM DISORDERS AND ELECTROPHYSIOLOGY

CASE REPORT: FIRST IN HUMAN/EARLY REPORTS

Management of Rapid Atrial Fibrillation Using Stellate Ganglion Blockade



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ABSTRACT

BACKGROUND Stellate ganglion blockade has been demonstrated as an efficacious treatment for refractory ventricular tachyarrhythmias. There are no published reports of the use of this technique in management of rapid atrial arrhythmia.

CASE SUMMARY A 73-year-old woman presented to our institution in rapid atrial fibrillation and cardiogenic shock. She was intubated for airway protection and underwent successful electrical cardioversion. However, atrial fibrillation returned multiple times with weaning of sedation for extubation. Stellate ganglion infusion catheter was placed with infusion of ropivacaine and subsequent maintenance of sinus rhythm, with successful extubation, ablation of atrial fibrillation, improvement of left ventricular ejection fraction, and discharge.

TAKE-HOME MESSAGE For selected patients, stellate ganglion blockade can be used as a technique to aid in the management of rapid atrial fibrillation. (JACC Case Rep. 2024;29:102530) © 2024 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

HISTORY OF PRESENTATION

A 73-year-old woman presented to the emergency department with several weeks of worsened dyspnea on exertion, cough, and substernal chest discomfort. Initial laboratory studies showed lactic acidosis of 6.4 mmol/L, brain natriuretic peptide of 22,670

pg/mL, and troponin T of 23 ng/L. She was found to be in atrial fibrillation with ventricular rates in the 130s, and transthoracic echocardiogram demonstrated left ventricular ejection fraction of 15%. Intravenous amiodarone was started for rapid atrial fibrillation; norepinephrine, phenylephrine, and vasopressin were started to support blood pressure; empirical dobutamine was started for inotropy; and she was intubated for airway protection. She was transferred to our institution for further management.

LEARNING OBJECTIVES

- To review what is known about the efficacy of interventions targeted at the sympathetic nervous system in atrial fibrillation.
- To appreciate the potential for stellate ganglion blockade as a management option for atrial fibrillation in select circumstances.

PAST MEDICAL HISTORY

The patient had known nonobstructive coronary disease (mid-left anterior descending 30% lesion on coronary angiography 3 years prior to admission).

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**ABBREVIATIONS
AND ACRONYMS****SGB** = stellate ganglion
blockade

She was diagnosed with paroxysmal atrial fibrillation several years prior to this presentation. However, she had predominantly been in normal sinus rhythm and was in normal sinus rhythm at regular follow-up visit with her outpatient cardiologist 1 month prior to presentation. She had been treated with metoprolol and apixaban.

DIFFERENTIAL DIAGNOSIS

Her cardiomyopathy could be tachycardia related, due to ischemic disease, myocarditis, or idiopathic.

INVESTIGATIONS

Right heart catheterization demonstrated normal biventricular filling pressures and cardiac index of 1.5 L/min/m² body surface area by the Fick method. Transesophageal echocardiogram demonstrated no left atrial appendage thrombus.

MANAGEMENT

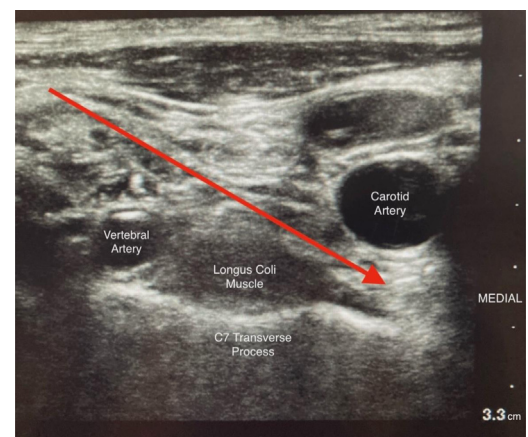
Intra-aortic balloon pump was placed with improvement in cardiac index to 2.1 L/min/m². The patient underwent direct current cardioversion to normal sinus rhythm. However, with weaning of sedation, atrial fibrillation recurred with rapid ventricular rates, which required an increase in vasopressors. She

was treated with digoxin, and sedation was increased with return of sinus rhythm. However, a second attempt at sedation wean resulted in return to atrial fibrillation and hemodynamic worsening.

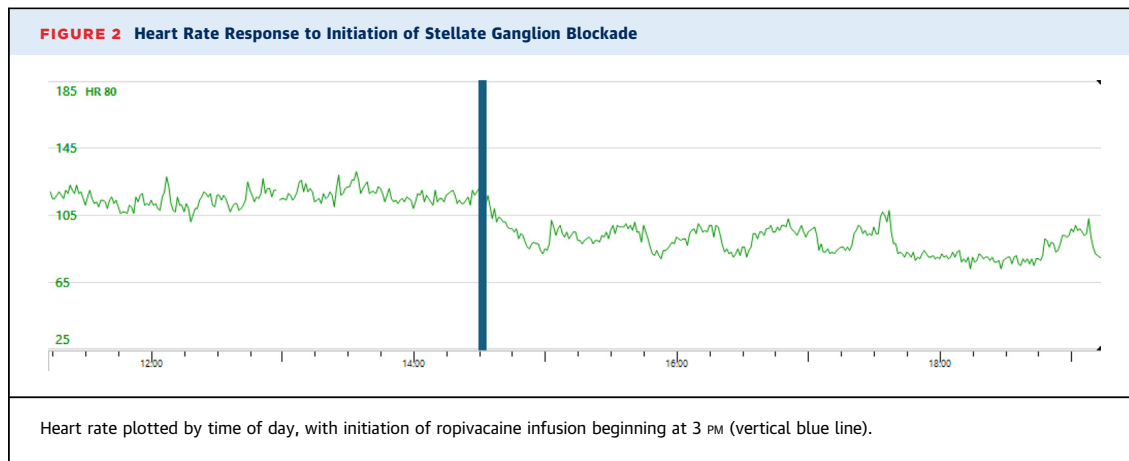
At this time (hospital day 4), left-sided stellate ganglion catheter was placed percutaneously under ultrasonic guidance with infusion of ropivacaine 0.2% at 5 mL/h (Figure 1). Ventricular rates decreased from 116 to 86 beats/min within minutes of ropivacaine initiation (Figure 2). The patient underwent a second direct current cardioversion on hospital day 5 with maintenance of sinus rhythm and was successfully extubated later that day. Cardiac index improved to 2.7 L/min/m², and intra-aortic balloon pump and Swan-Ganz catheter were removed on hospital day 7. Given slowly rising white blood cell count to 13.5 g/dL, the ropivacaine infusion catheter was removed on hospital day 7. The patient had recurrent atrial fibrillation on hospital day 8. Pulsed field ablation was performed on hospital day 11 involving pulmonary vein isolation, posterior wall isolation, lateral mitral annulus line, and cavotricuspid isthmus line. Transthoracic echocardiography with sonographic enhancing agent on hospital day 13 demonstrated left ventricular ejection fraction of 25%. She was ultimately discharged on amiodarone given early return of atrial fibrillation on postablation day 3 (amiodarone initially held postablation).

Timeline of the Case	
Hospital Day	Events
0	A 73-year-old woman was transferred to our hospital intubated, sedated, and on intermittent hemodialysis for new renal failure after presenting to initial facility in atrial fibrillation with left ventricular ejection fraction estimated 10%-15%.
1	Underwent TEE without evidence of left atrial appendage thrombus. Right heart catheterization with cardiac index 1.5 L/m ² BSA by the Fick method. IABP subsequently placed.
2	Successful direct current cardioversion to normal sinus rhythm.
3	Return of rapid atrial fibrillation with weaning of sedation for extubation. Subsequently treated with increased sedation and digoxin with return of normal sinus rhythm.
4	Patient converted back to atrial fibrillation with a second attempt at weaning of sedation. After this, stellate ganglion infusion catheter placed with decrease of heart rate by approximately 20 beats/min.
5	Patient underwent a second direct current cardioversion with conversion to sinus rhythm. Sedation weaned and patient extubated with maintenance of sinus rhythm.
11	Patient underwent successful pulmonary vein isolation ablation for atrial fibrillation (infusion catheter removed on hospital day 7, recurrence of atrial fibrillation hospital on day 8).
13	Transthoracic echocardiogram demonstrates left ventricular ejection fraction of 25%. Patient subsequently discharged to rehabilitation facility with plan for outpatient follow-up.

BSA = body surface area; IABP = intra-aortic balloon pump; TEE = transesophageal echocardiogram.

FIGURE 1 Ultrasound Image of Stellate Ganglion Catheter Insertion

Red line indicates needle path and target.



DISCUSSION

Interest in modulating cardiac arrhythmias via manipulation of the sympathetic nervous system is increasing. Several recent studies have demonstrated the efficacy of treating refractory ventricular arrhythmias with stellate ganglion blockade (SGB).^{1,2} In addition, several studies have explored the use of SGB to prevent atrial fibrillation after cardiac surgery.³⁻⁵ The utility of SGB for management of acute atrial fibrillation is not as well understood.

In a previous trial of 36 patients with paroxysmal atrial fibrillation, pharmaceutical SGB with lidocaine prolonged atrial effective refractory period, reduced atrial fibrillation inducibility, and decreased atrial fibrillation duration compared with placebo injections.⁶ SGB has been suggested to function primarily via suppressed sympathetic activity and downregulation of β_1 -adrenergic receptors. The relative vagal stimulation—with altered release of serotonin and norepinephrine—and nitric oxide release may also contribute to its effects on atrial tachyarrhythmias.⁶ To our knowledge, this is the first published case of the clinical use of SGB for acute treatment of atrial fibrillation.

Although this technique is not indicated in most cases of atrial fibrillation, several elements of this case made SGB an appealing management option. This patient's atrial fibrillation was highly sympathetic-dependent, as demonstrated by reinitiation of rapid atrial fibrillation while weaning of sedation resulting in failure of extubation, heart rate trends after SGB (Figure 2), and the return of atrial fibrillation with discontinuation of the SGB catheter postextubation. The presence of increased atrial fibrillation burden coupled with newly reduced left ventricular ejection fraction increased our suspicion that the cardiomyopathy had been driven by atrial

fibrillation. The ability to provide a continuous infusion of ropivacaine to the stellate ganglion, as opposed to single injections, proved to be useful as she was treated for cardiogenic shock. Favorable responses to continuous infusion of stellate blockade have been demonstrated in treating storms of ventricular arrhythmias, but it has not been used in this way for atrial fibrillation.⁷ Finally, the potential of using SGB as a bridge strategy to stabilize the patient before pursuing a more durable solution for atrial fibrillation is desirable.

FOLLOW-UP

The patient was discharged to a subacute rehabilitation facility in normal sinus rhythm with plan for outpatient follow-up.

CONCLUSIONS

In selected cases, SGB can be used in management of atrial fibrillation with rapid ventricular response.

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KEY WORDS atrial fibrillation, cardioversion, electrophysiology, supraventricular arrhythmias