Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Ultrasound-guided stellate ganglion block with lidocaine and dexmedetomidine for refractory electrical storm after acute myocardial infarction: a case report

Lu Kang
First Affiliated Hospital of Hunan Medical University, China
Lizhu Xiao
First Affiliated Hospital of Hunan Medical University, China
Jing Lu
First Affiliated Hospital of Hunan Medical University, China
Xiaohua Zou
Affiliated Hospital of Guizhou Medical University, China
Jiefu Tang
First Affiliated Hospital of Hunan Medical University, China
Wenwen Tang
First Affiliated Hospital of Hunan Medical University,China
Zaitian Zhang
zzt190838699990163.com

First Affiliated Hospital of Hunan Medical University, China

Case Report

Keywords: Stellate ganglion block, Electrical storm, Acute myocardial infarction, Dexmedetomidine, Ultrasound-guided

Posted Date: July 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10147865/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Refractory electrical storm following acute myocardial infarction (AMI) is a life-threatening condition with limited treatment options when conventional pharmacotherapy and electrical cardioversion fail. Stellate ganglion block (SGB) has emerged as a rescue intervention to reduce cardiac sympathetic tone. However, the use of dexmedetomidine as an adjuvant to local anesthetics for SGB in this setting has rarely been reported.

Case presentation

A 46-year-old female patient was admitted to hospital with an acute myocardial infarction (AMI), complicated by cardiogenic shock. The patient required veno-arterial extracorporeal membrane oxygenation (VA-ECMO) and intra-aortic balloon pump (IABP) support following percutaneous coronary intervention. Despite the administration of deep sedation, beta-blockade, and antiarrhythmic therapy, the patient exhibited recurrent ventricular fibrillation (VF) that proved refractory to multiple electrical cardioversions. Following a multidisciplinary discussion, ultrasound-guided left subarachnoid block (SGB) was performed using an in-plane technique at the C6 transverse process level. The first SGB with 4 mL of 0.75% lidocaine resulted in Horner's syndrome and markedly reduced VF frequency. However, VF recurred approximately 48 hours later. A second SGB was then performed using a mixture of 4 mL of 0.75% lidocaine and 0.5 μg/kg of dexmedetomidine at the same site. Following the second block, VF ceased entirely, with only occasional premature ventricular contractions and self-terminating short runs of ventricular tachycardia. The patient was successfully weaned from VA-ECMO one week later, extubated, and discharged home after one month with full recovery.

Conclusion

This case demonstrates that ultrasound-guided SGB with lidocaine combined with dexmedetomidine may provide effective suppression of refractory electrical storm in patients on maximal mechanical and pharmacological support. The staged response in this case suggests that the combination of lidocaine with dexmedetomidine may provide more durable antiarrhythmic efficacy, though larger prospective studies are required to confirm its safety and effectiveness.

Registration

Clinical trial number: not applicable.

Introduction

Refractory electrical storm following acute myocardial infarction (AMI) is one of the leading causes of sudden cardiac death. It is defined as the occurrence of ≥ 3 episodes of sustained ventricular tachycardia (VT) or ventricular fibrillation (VF) requiring electrical cardioversion or defibrillation within 24 hours [1]. A very high in-hospital mortality rate results from certain patients experiencing recurring episodes despite receiving appropriate therapy, such as antiarrhythmic medications, heavy sedation, and catheter ablation [2].

In recent years, stellate ganglion block (SGB) has been shown to rapidly reduce cardiac sympathetic tone and increase the ventricular fibrillation threshold by blocking the cervical sympathetic chain. The efficacy of SGB in terminating electrical storms resistant to drug therapy and electrical cardioversion has been proven [3]. Dexmedetomidine, an α2-adrenoceptor agonist, has been demonstrated to markedly prolong the duration of nerve block when utilised as an adjunct to nerve block [4]. However, there are very few instances of using dexmedetomidine and lidocaine together for ultrasound-guided SGB to treat refractory electrical storms after AMI. The present case study offers a comprehensive overview of the clinical experience of ultrasound-guided sympathetic branch block (SGB) with lidocaine and dexmedetomidine in the management of refractory electrical storm following acute myocardial infarction (AMI). Our case provides fresh perspectives on anti-sympathetic treatment in cardiac critical care.

Case presentation

We obtained informed consent from the patient for the publication of identifying information/images. A 46-year-old female patient (approximately 160 cm, 80 kg, BMI 31 kg/m²) presented to a local hospital with a 1-day history of persistent retrosternal chest tightness accompanied by decreasing blood pressure and oxygen saturation. The patient had a medical history of hypertension for more than 10 years, irregularly taking valsartan for blood pressure control, with unknown control status. The patient also had a history of type 2 diabetes mellitus for more than 10 years, on long-term oral metformin and gliclazide, with unknown glycemic control. Electrocardiography upon admission showed: (1) sinus tachycardia; (2) ST-segment depression and T-wave inversion; (3) poor R-wave progression in leads V1-V4 with ST-segment elevation. The troponin I level was 0.245 ng/mL. Thus, the patient was definitely diagnosed with acute myocardial infarction (AMI).

Following admission to the intensive care unit (ICU), the patient rapidly developed respiratory and circulatory failure. The patient required extracorporeal membrane oxygenation (ECMO) support due to cardiogenic shock after endotracheal intubation with mechanical ventilation, antiplatelet, and anticoagulant treatment. When the ECMO team from our hospital arrived, the patient's blood pressure was 85/50 mmHg and on the decline. In an emergency, veno-arterial extracorporeal membrane oxygenation (VA-ECMO) was started. The patient was sent right away to our hospital following early haemodynamic stabilisation. Emergency coronary angiography revealed three severe coronary artery lesions: (1) total occlusion of the proximal left anterior descending artery (LAD); (2) 50–90% stenosis of the mid and distal left circumflex artery (LCX); (3) 95% stenosis of the proximal right coronary artery

(RCA) and 70% stenosis of the distal segment (Fig. 1A & 1B). Percutaneous coronary intervention (PCI) with stent implantation was performed in the LAD and the proximal RCA (Fig. 1A & 1B). Postoperatively, the patient was transferred to the ICU, where a comprehensive management plan was implemented, including VA-ECMO support, mechanical ventilation, anticoagulation, and antiplatelet therapy.

On postoperative day 1, electrocardiography revealed frequent premature ventricular contractions (PVCs) (Fig. 2). The administration of sedation and analgesia was escalated accordingly. Serial assessments of internal milieu and fluid status were performed, with continuous monitoring for reperfusion-related sympathetic ES. On postoperative day 2, the patient exhibited VF (Fig. 3). Despite the administration of electrical cardioversion, deep sedation, and intensive anti-sympathetic therapy with intravenous dexmedetomidine and esmolol, VF remained refractory. On postoperative day 4, an intra-aortic balloon pump (IABP) was instituted to reduce cardiac afterload and improve coronary perfusion, resulting in effective control of VF. However, on postoperative day 7, VF recurred at a frequency of approximately five to ten minutes. A repeat transthoracic echocardiogram was performed, revealing the following measurements: left ventricular internal diameter at end-diastole (LVD) 51 mm, E/A <1, ejection fraction (EF) 32% (Simpson's method), left ventricular outflow tract (LVOT) diameter 1.7 cm, velocity time integral (VTI) 12.9 cm, cardiac output (CO) 2.8 L/min and heart rate (HR) 93 bpm. Serial myocardial enzyme levels showed a declining trend (Tab. 1), and there was no evidence of new myocardial infarction.

Tab. 1: Serial changes in myocardial enzyme markers

Marker	Reference range	Hospital day 1	Hospital day 3	Hospital day 5	Hospital day 7
Troponin I (ng/ml)	0–0.1	143↑	21.74↑	21.18↑	15.22↑
proBNP (pg/ml)	0–125.2	11,855↑	5988↑	1257↑	1069↑
Creatine kinase (U/L)	40–200	3248.4↑	393↑	210↑	139↑
Creatine kinase MB isoenzyme (U/L)	0–25	222.9↑	46.93↑	29.67↑	10.6
Lactate dehydrogenase (U/L)	120–250	1546↑	587.5↑	463.8↑	371↑
Myoglobin (μg/L)	0–85	291.8↑	106.9↑	169.7↑	71

Note: ↑ Above the upper limit of the reference range.

Given that conventional pharmacotherapy and electrical cardioversion had proven ineffective, the multidisciplinary team decided to perform SGB to reduce cardiac sympathetic excitability. Under ultrasound guidance, an in-plane needle technique was utilised (Fig. 4). At the level of the C6 transverse process, 4 mL of 0.75% lidocaine was injected onto the surface of the longus colli muscle, lateral to the common carotid artery. Ten minutes after injection, the patient developed Horner's syndrome,

manifesting as increased temperature and mild flushing of the left side of the face. Subsequent to the initial block, there was a substantial decrease in the frequency of VF. However, the arrhythmia recurred approximately 48 hours later. A second SGB was subsequently performed, during which a mixture of 4 mL of 0.75% lidocaine and dexmedetomidine 0.5 μg/kg was injected at the same anatomical site, again resulting in Horner's syndrome. Following the administration of the second block, VF ceased entirely, with only occasional ventricular premature beats and brief episodes of ventricular tachycardia observed, all of which resolved spontaneously.

Following the stabilisation of the patient's rhythm with the administration of SGB, there was a gradual improvement in cardiac function. VA-ECMO was successfully weaned one week later, followed by tracheal extubation and transfer to the general ward. The patient was discharged home after one month, having made a full recovery.

Discussion

Most ACS-related electrical storms (ES) occur in LAD or proximal occlusion of RCA, often with cardiac insufficiency or low ejection fraction value, or after revascularization. In acute MI patients with VT or VF, if the pathological mechanism persists, it is mainly due to the excessive acti- vation of the sympathetic nerve and abnormal increase of β receptor reactivity, leading to protracted VT or VF that can present as ES[5].

In this case, despite the implementation of PCI, VA-ECMO, IABP, deep sedation, and beta-blocker therapy, the patient continued to experience recurrent VF, thus meeting the diagnostic criteria for refractory ES. Notably, the coexistence of type 2 diabetes mellitus may have compounded cardiac sympathovagal imbalance through autonomic neuropathy, potentially contributing to the intractability of the sympathetic storm. Ultrasound-guided SGB, as a targeted intervention for sympathetic hyperactivity, has become an important rescue option for refractory ES [1]. Based on the anatomical predominance of left-sided cardiac sympathetic innervation [2], left SGB was selected and performed twice, ultimately controlling the arrhythmia and creating the conditions for successful ECMO weaning.

SGB has been shown to reversibly block sympathetic efferent fibres to the heart by injecting local anaesthetics around the stellate ganglion, thereby reducing cardiac sympathetic tone and raising the ventricular fibrillation threshold [2]. A case series of 20 patients demonstrated that sustained ventricular arrhythmic events decreased significantly from a median of 4.5 to 0 episodes within 24 hours of the first SGB [6]. A systematic review and meta-analysis of 15 studies involving 542 patients reported a complete response rate of 64.6% following SGB, with a reduction in arrhythmic events from a median of 3.5 to 0, though the 30-day in-hospital mortality remained 22% [1]. In the present case, VF recurred frequently despite maximal mechanical and pharmacological support, thus justifying the use of SGB.

The staged treatment response is noteworthy. The first SGB with 4 mL of 0.75% lidocaine reduced VF frequency from every 5–10 min to recurrence approximately 48 h later, suggesting effective but time-limited sympathetic suppression. To achieve more sustained efficacy, dexmedetomidine 0.5 μg/kg was

added to lidocaine for the second SGB. Dexmedetomidine, a highly selective α2-adrenoceptor agonist, may enhance and prolong nerve block duration when used as a local adjuvant [7, 8]. Following the second block, VF ceased completely, with only occasional ventricular premature beats and brief episodes of ventricular tachycardia, both self-terminating. This durable response may reflect a synergistic effect between dexmedetomidine and lidocaine. Although the use of dexmedetomidine in SGB is off-label, this experience provides a clinical clue for future exploration of prolonged SGB formulations.

Performing interventional procedures in patients on VA-ECMO with ongoing anticoagulation carries a high risk of bleeding and injury. In this case, real-time high-frequency ultrasound guidance with the in-plane technique ensured accurate needle placement onto the longus colli muscle at the C6 transverse process level. No hematoma, pneumothorax, recurrent laryngeal nerve palsy, or phrenic nerve paralysis occurred, consistent with literature demonstrating that ultrasound guidance substantially improves the safety of SGB [9]. Furthermore, SGB has been demonstrated to modulate the neuro-immune axis and influence inflammatory cell interactions, thereby creating a stable internal environment conducive to cardiac repair. A study conducted in high-risk perioperative settings, such as cardiac surgery, has demonstrated that SGB may exert cardioprotective effects by modulating immune-inflammatory responses [10]. However, given that inflammatory markers such as C-reactive protein and interleukin-6 were not systematically monitored in this case, it is not possible to verify this anti-inflammatory mechanism directly. This hypothesis warrants further investigation in future studies.

Previous literature has described SGB as a bridge to definitive surgical sympathectomy [11]. The present experience extends this concept by demonstrating that, in cases of extreme critical illness, SGB can serve as a bridge between mechanical circulatory support and autonomous recovery of cardiac function, thereby providing a critical time window for myocardial repair. The successful weaning from both ECMO and IABP and subsequent discharge serve to emphasise the pivotal role of timely sympathetic blockade in interrupting the vicious cycle of "sympathetic storm–myocardial ischaemia–haemodynamic deterioration."

Conclusion

In cases of refractory ES, where maximal mechanical and pharmacological support has failed, ultrasound-guided SGB is an effective and safe rescue intervention. The staged response in this case suggests that the combination of lidocaine with dexmedetomidine may provide more durable antiarrhythmic efficacy, though larger prospective studies are required to confirm its safety and effectiveness. This case reinforces the potential role of SGB in cardiac critical care and provides a reference for multidisciplinary management of complex cardiovascular emergencies.

Abbreviations

BMI: Body mass index; AMI: Acute myocardial infarction; ES: Electrical storm; SGB: Stellate ganglion block; VF: Ventricular fibrillation; VT: Ventricular tachycardia; ICU: Intensive care unit; ECMO: Extracorporeal membrane oxygenation; VA-ECMO: Veno-arterial extracorporeal membrane oxygenation; LAD: Left anterior descending artery; LCX: Left circumflex artery; RCA: Right coronary artery; PCI: Percutaneous coronary intervention; PVCs: frequent premature ventricular contractions; IABP: intra-aortic balloon pump; LVD: Left ventricular internal diameter at end-diastole; EF: Ejection fraction; LVOT: Left ventricular outflow tract; VTI: Velocity time integral; CO: Cardiac output; HR: Heart rate; SCM: Sternocleidomastoid muscle; IJV: Internal jugular vein; CA: Common carotid artery;LCM: Longus colli muscle; C6 TP: C6 transverse process; SG: Stellate ganglion; ACS: Acute coronary syndrome.

Declarations

Acknowledgments

We appreciate the support from the Anesthesia Surgery Center and department of cardiology at The First Affiliated Hospital of Hunan University of Medicine.

Registration

Clinical trial number: not applicable.

Authors' contributions

Lu KANG and Lizhu XIAO were responsible for collecting and compiling clinical case data and clinical images. Jing LU completed literature search and sorting. Lu KANG and Lizhu XIAO drafted the initial manuscript, Lizhu XIAO prepared figures 1- 4 and Table 1. Xiaohua ZOU and Jiefu TANG critically revised the manuscript regarding core academic content. Wenwen TANG and Zaitian ZHANG conceived and designed the clinical research scheme, supervised the whole clinical treatment process of this patient, undertook correspondence and revision communication with the journal editorial office. All authors reviewed the manuscript and have approved the final copy of the manuscript.

Funding

This study was financially supported by the Science and Technology Project of Hunan Provincial Sports Bureau, China (Grant No. 2025KT0223) and the Hunan Provincial Demonstration Centre for Clinical Medical Techniques in Spinal Cord Injury and Repair (Grant No. 2021SK4047).

Data Availability

All data generated during this study are provided within this manuscript article.

Ethics approval and consent to participate

This work has been carried out by the Declaration of Helsinki (2013) of the World Medical Association. This study was approved by the Ethics Committee of the First Affiliated Hospital of Hunan University of Medicine, and all participants provided written informed consent.

Consent for publication

Written informed consent was obtained from the Patient for publication of clinical detailss (Figs. 1, 2, 3 and Tab.1), Ultrasonic images (Fig.4). The consent form explicitly states that the patient's identifiable features have been anonymized in all published materials.

Competing interests

The authors declare no conflicts of interest.

Author details

[1]Department of Anesthesiology, First Affiliated Hospital of Hunan University of Medicine, Huaihua City, Hunan Province, China.

[2]Department of Anesthesiology, Affiliated Hospital of Guizhou Medical University, Guiyang City, Guizhou Province, China.

[3]Department of Spine Surgery, First Affiliated Hospital of Hunan Medical University, Huaihua City, Hunan Province, China.

[4]Department of Scientific Research Management, First Affiliated Hospital of Hunan Medical University, HuaihuaCity, Hunan Province, China.

References

1. Motazedian P, Quinn N, Wells GA et al. Efficacy of stellate ganglion block in treatment of electrical storm: a systematic review and meta-analysis. Sci Rep. 2024;14(1):24719. PMID: 11494072.
2. Tran HHV, Kianifar IA, Thu A, et al. Stellate Ganglion Block for Recurrent Ventricular Arrhythmias: Mechanisms, Outcomes, and Future Directions. Cardiol Rev. 2025;33(2):89–96. PMID: 40569055.
3. Sreekumar A, Sheikh I, Bhoi S. Percutaneous Stellate Ganglion Block in Electrical Storm: A Scoping Review. J Emerg Med. 2025;68:123–34. PMID: 40961841.
4. Fatma E, Aboharga, Saad A et al. Role of dexmedetomidine as an adjuvant to bupivacaine in external oblique intercostal plane block for post-thoracotomy pain: a randomised controlled trial. Minerva Anestesiol. 1 April 2026. Published online ahead of print. PMID: 41920296.
5. Liu B, Xie B, Chen X et al. A successful case of electrical storm rescue after acute myocardial infarction. BMC Cardiovasc Disord. 2022;22(1):537. PMID: 36494628.

6. Zhang J, Liang J, Liu T et al. Ultrasound-guided stellate ganglion block in patients with electrical storm: A single-centre case series. J Clin Anesth. 2025;91:111284. PMID: 40318515.
7. Laiz GC, Novaes, Daniel M et al. April. Transversus Abdominis Plane Block With Dexmedetomidine and Local Anesthetics compared with Local Anesthetics Alone for Patients Undergoing Caesarean Section: A Systematic Review and Meta-Analysis. Clin J Pain. 6 2026. Published online ahead of print. PMID: 41937563.
8. Rao S, Rajan N. Dexmedetomidine as an adjunct for regional anaesthetic nerve blocks. Curr Pain Headache Rep. 2021;25(4):27. PMID: 33533982.
9. Aleanakian R, Chung BY, Feldmann RE Jr, et al. Effectiveness, Safety, and Predictive Potential of Ultrasound-Guided Stellate Ganglion Blockades for the Treatment of Sympathetically Maintained Pain. Pain Pract. 2020;20(6):626–38. PMID: 32255250.
10. Zhu G, Kang Z, Chen Y, et al. Ultrasound-guided stellate ganglion block alleviates stress responses and promotes recovery of gastrointestinal function in patients. Dig Liver Dis. 2021;53(5):581–6. PMID: 33303314.
11. McWhirter R, Holly T, Ayad IA, et al. Stellate Ganglion Blockade as Rescue Therapy for Recurrent Torsades de Pointes and as a Bridge to Surgical Sympathectomy in a Paediatric Patient: A Case Report. Pract. 2025;19(1):e01899. PMID: 39831719.

Figures

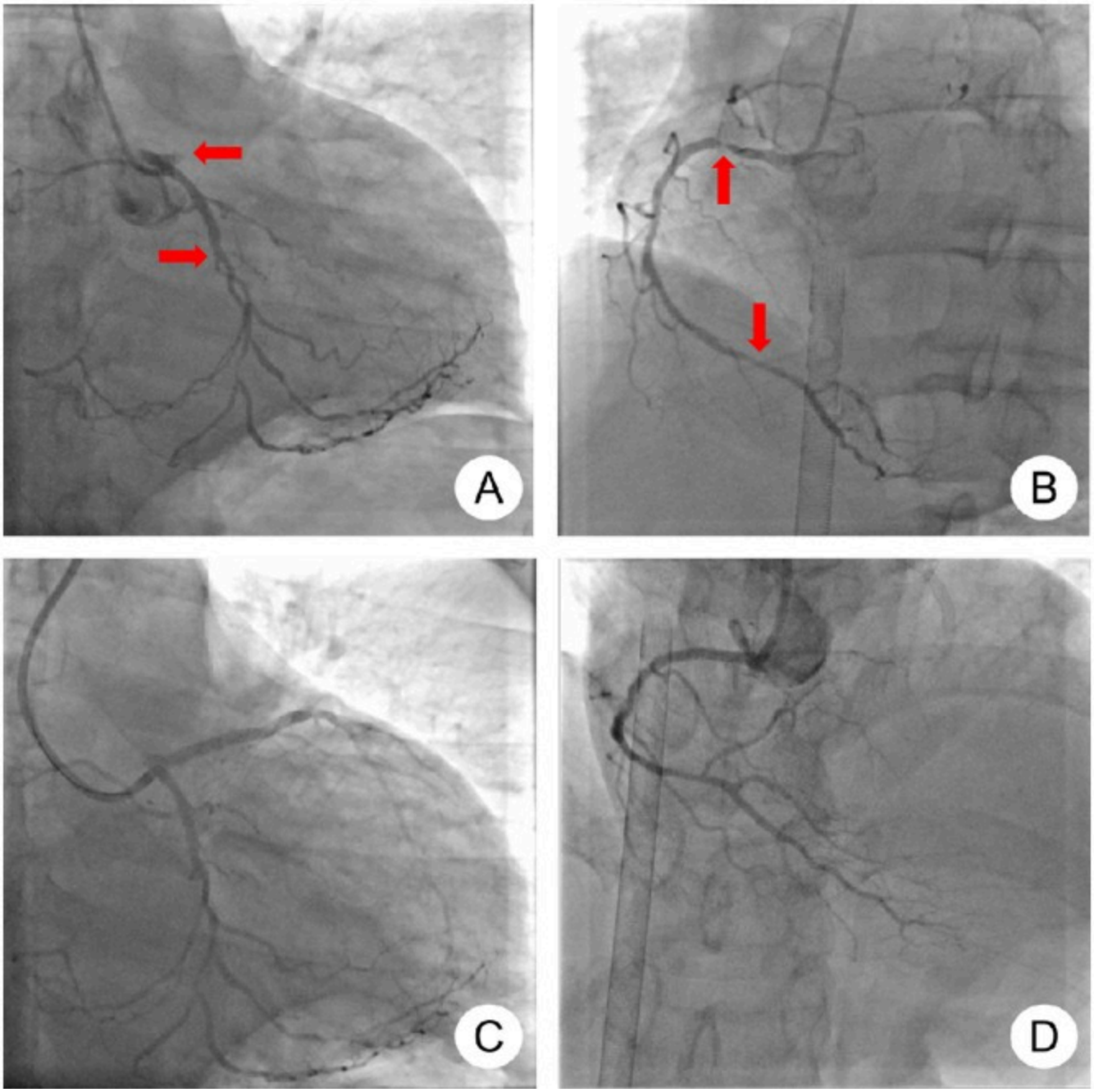


Figure 1

Coronary angiography of a patient with a refractory electrical storm after acute myocardial infarction (AMI)

Figure legends, red arrows indicate stenotic lesions. **(A)** Left anterior descending artery (LAD): total occlusion from the proximal segment; left circumflex artery (LCX): 50%–90% stenosis in the mid and mid-distal segments. **(B)** Right coronary artery (RCA): 95% stenosis in the proximal segment and 70% stenosis in the distal segment. **(C)** LAD after percutaneous coronary intervention (PCI). **(D)** RCA after PCI.

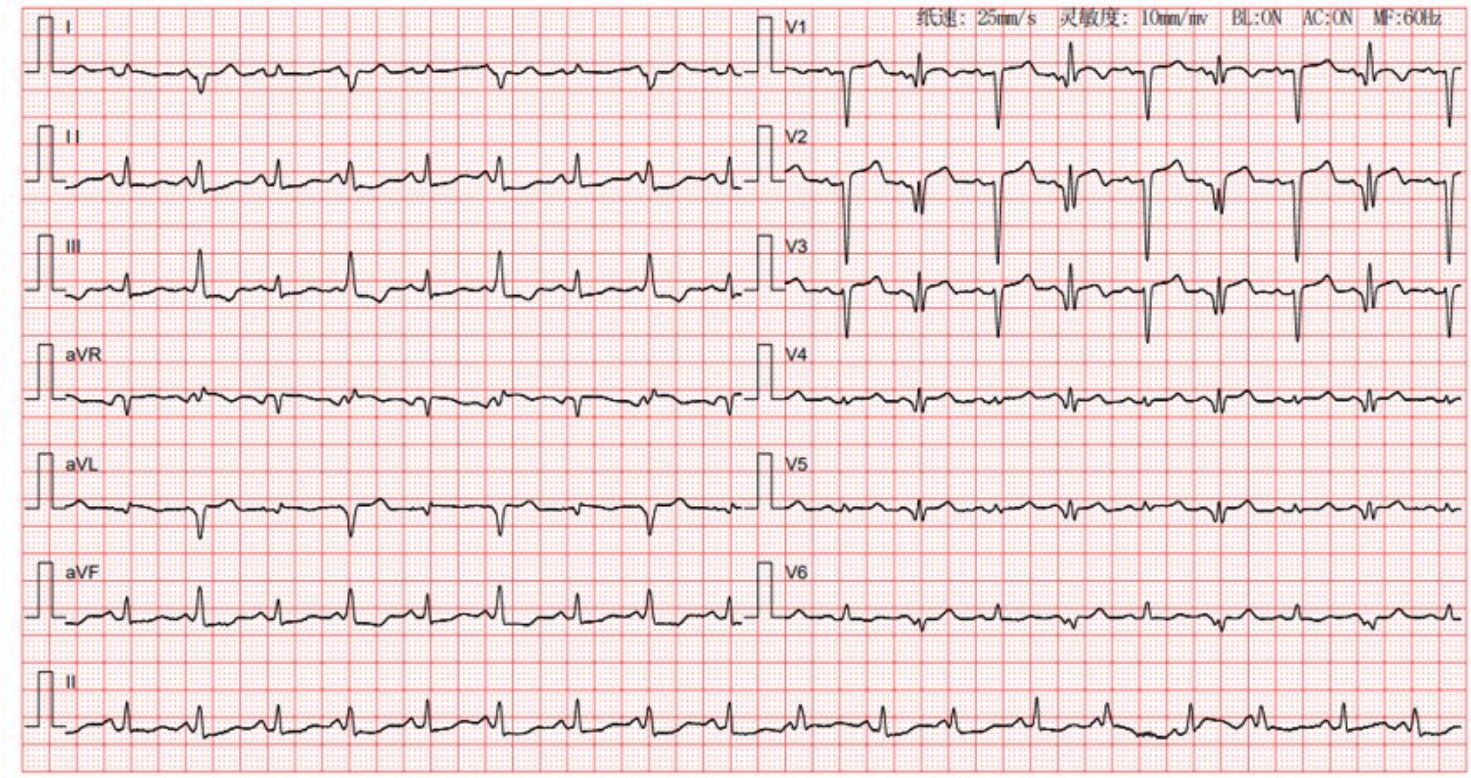


Figure 2

Electrocardiogram on postoperative day 1

Figure legends, 12-lead electrocardiogram demonstrating frequent premature ventricular contractions (PVCs).



Figure 3

Electrocardiogram on postoperative day 2

Figure legends, 12-lead electrocardiogram demonstrating ventricular fibrillation(VF).

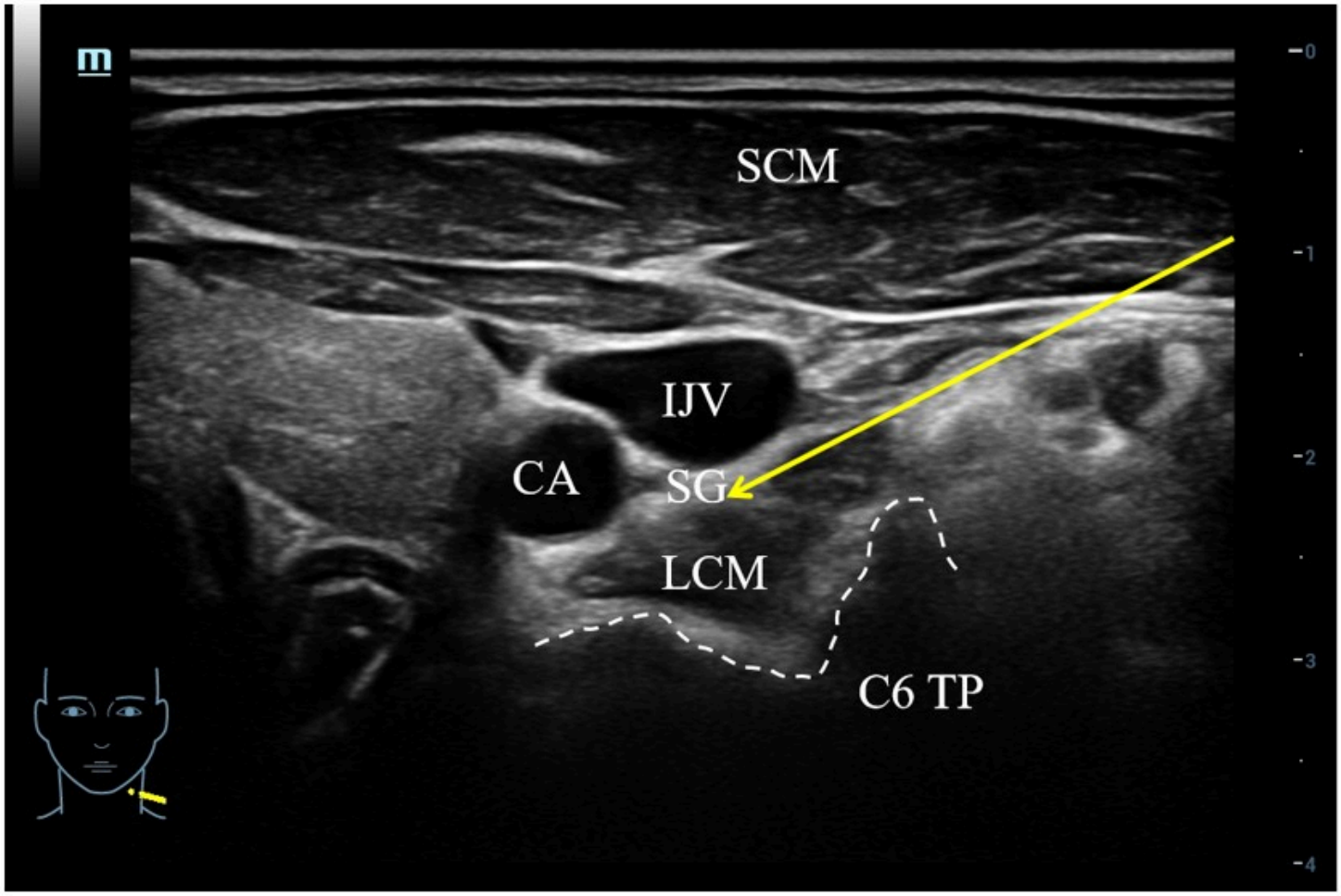


Figure 4

Ultrasound-guided left stellate ganglion block

Figure legends, the yellow arrow indicates the ultrasound-guided in-plane needle trajectory. **SCM:** sternocleidomastoid muscle; **IJV:** internal jugular vein; **CA:** common carotid artery; **LCM:** longus colli muscle (the stellate ganglion is located on its surface, deep to the prevertebral fascia); **C6 TP:** C6 transverse process (the anterior tubercle appears as a "camel-hump" shape); **SG:** stellate ganglion.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- CAREchecklistEnglish2013BMC.pdf