Received: 24 May 2024 | Revised: 18 September 2024 | Accepted: 19 September 2024

DOI: 10.1002/ccr3.9527

CASE REPORT

Clinical Case Reports Open Access WILEY

Failure of pacemaker therapy in a pediatric patient with neurally mediated complete heart block and syncope: A case report

Mohammad Dalili[1] | **Feisal Rahimpoor**[2]

[1]Rajaie Cardiovascular Medical & Research Center, Iran University of Medical Sciences, Tehran, Iran

[2]Mashhad Cardiovascular Medical & Research Center, Mashhad, Iran

Correspondence
Feisal Rahimpoor, Rajaie Cardiovascular Medical & Research Center, Iran University of Medical Sciences, Tehran, Iran.
Email: feisalrahimpoor@gmail.com

Key Clinical Message

Neurally mediated syncope (NMS) is a well-known condition that can be subdivided into three subgroups: vasopressor type, cardioinhibitory type, and mixed type. While different degrees of sinus bradycardia occur at the time of syncope in all types, complete heart block is a rare event that can lead to pulselessness during syncope. We present a case of a 14-year-old girl with documented NMS before and after temporary pacemaker implantation, who had complete heart block during syncope. The patient's temporary pacemaker placement was ineffective in preventing syncope during a repeat head-up tilt test, indicating that permanent pacing may not be effective in this patient. Midodrine, an alpha-adrenergic agonist, was started, and the patient experienced complete control of syncope episodes without recurrence during a 2-month follow-up.

KEYWORDS

cardioinhibitory syncope, midodrine, Neurally mediated syncope, pacemaker for syncope, pediatric syncope

1 | INTRODUCTION

Syncope is a sudden and brief loss of consciousness and body tone, often described as fainting. This is a common problem and accounts for 3% of emergency room visits. Up to 25% of healthy adolescents have a history of syncope, especially in situations that trigger fear, hatred, or anxiety, and if it does not recur, no further investigation is necessary. However, relapses can be caused by a number of medical problems that need to be diagnosed and treated. It is important to distinguish syncope from "dizziness," which refers to a change in balance, vision, or environmental perception that is often accompanied by memory loss.

Neutrally mediated syncope (NMS) is a well-known condition. Historically, this type of syncope was subdivided into three subgroups: vasopressor type, cardioinhibitory type, and mixed type.[1] Different degrees of sinus bradycardia occur at the time of syncope in all types; however, sinus bradycardia is the predominant finding in head-up tilt test (HUT) in cardioinhibitory type. Atrioventricular (AV) block could follow the sinus bradycardia and result in pulselessness during the syncope.[2] Pacemaker implantation is recommended (class IIa) for cardioinhibitory NMS in adults aged over 40[3]; the data are scarce in children. Here, we present a 14-year-old girl with documented NMS before and after temporary pacemaker implantation.

2 | CASE REPORT

2.1 | Case History/examination

A 14-year-old girl weighing 78 kg was admitted to our hospital because of frequent syncope. She had a history of ablation of a premature ventricular complex (PVC) originating from her tricuspid valve. Although PVC was not completely eliminated, its number decreased from 32% to about 5%. Her symptoms were unrelated to her PVC, and she developed a syncope episode with prodromal vertigo that ultimately led to a fracture in her hand. Physical examination, echocardiography, electrocardiography, 24-h Holter monitoring, and exercise testing revealed no abnormalities other than PVC. Previous electrophysiological studies after PVC ablation did not detect conduction abnormalities. A head-up tilt test was performed to induce cardioinhibitory NMS with a slight decrease in sinus rate, followed by mild atrioventricular block and finally complete heart block (Figure 1). The patient was discharged with preventive recommendations including increased salt and fluid intake and incline exercise maneuvers. These recommendations were ineffective, and the patient was readmitted with persistent syncope symptoms.

3 | METHODS (DIFFERENTIAL DIAGNOSIS, INVESTIGATIONS, AND TREATMENT)

Given the history of catheter ablation due to PVCs, pacemaker implantation was a likely treatment option, even though the PVCs are far from the conduction system. To evaluate the effectiveness of permanent pacemaker implantation, a temporary ventricular pacemaker with an active fixation lead was implanted via the right subclavian vein in VVI mode and at a frequency of 60/min. HUT was repeated, and despite the use of a pacemaker, syncope recurred during the examination (Figure 2). The patient received 2.5 mg of midodrine orally three times a day, resulting in complete control of the syncopal episodes without recurrence during the 3-month follow-up.

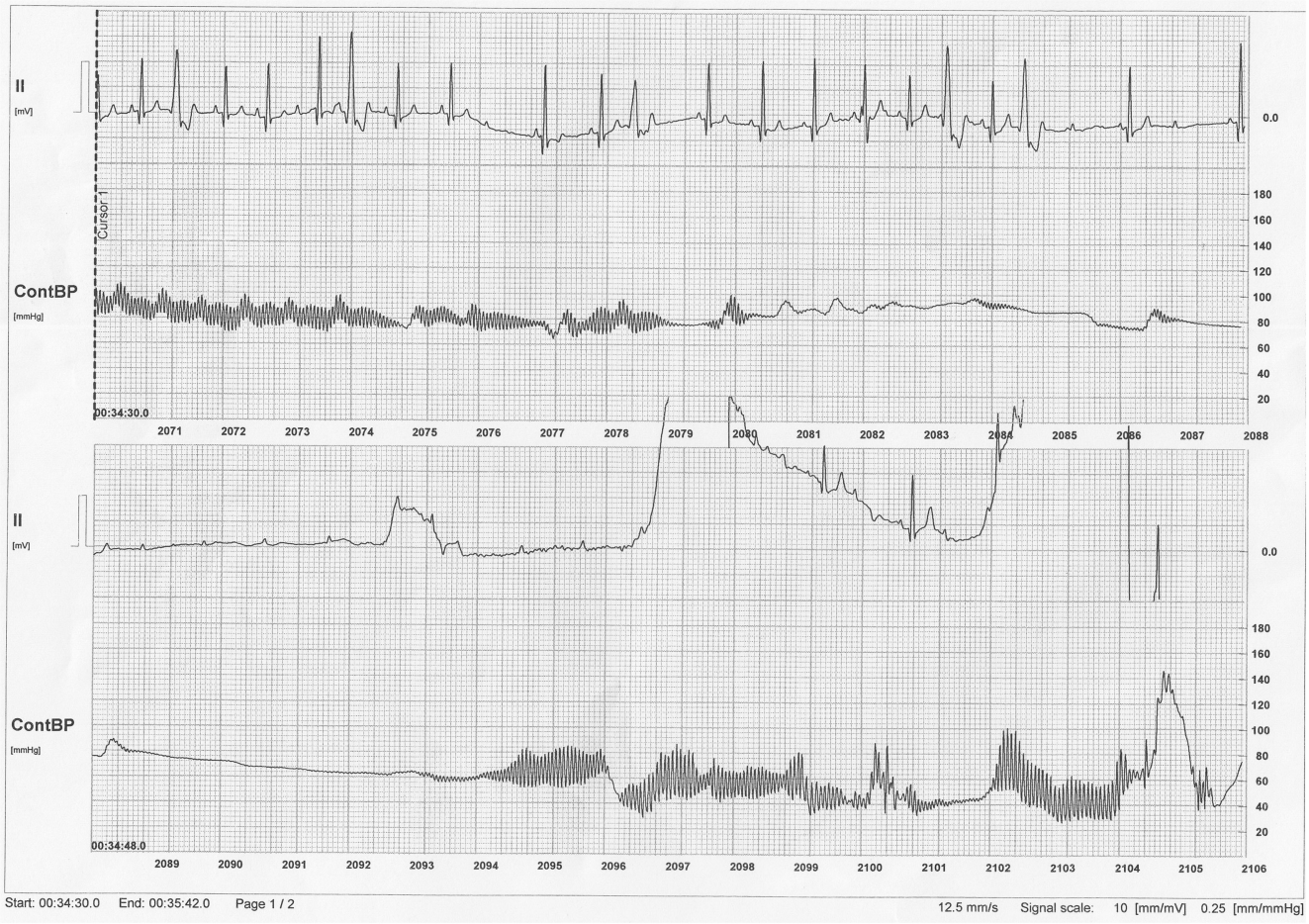

FIGURE 1 Electrocardiogram and continuous blood pressure monitoring during head-up tilt testing in a 14-year-old girl. Note sinus rate slowing followed by low-grade AV block (upper panel). Eventually, complete heart block with ventricular asystole (lower panel) resulted in a significant drop in blood pressure and syncope.

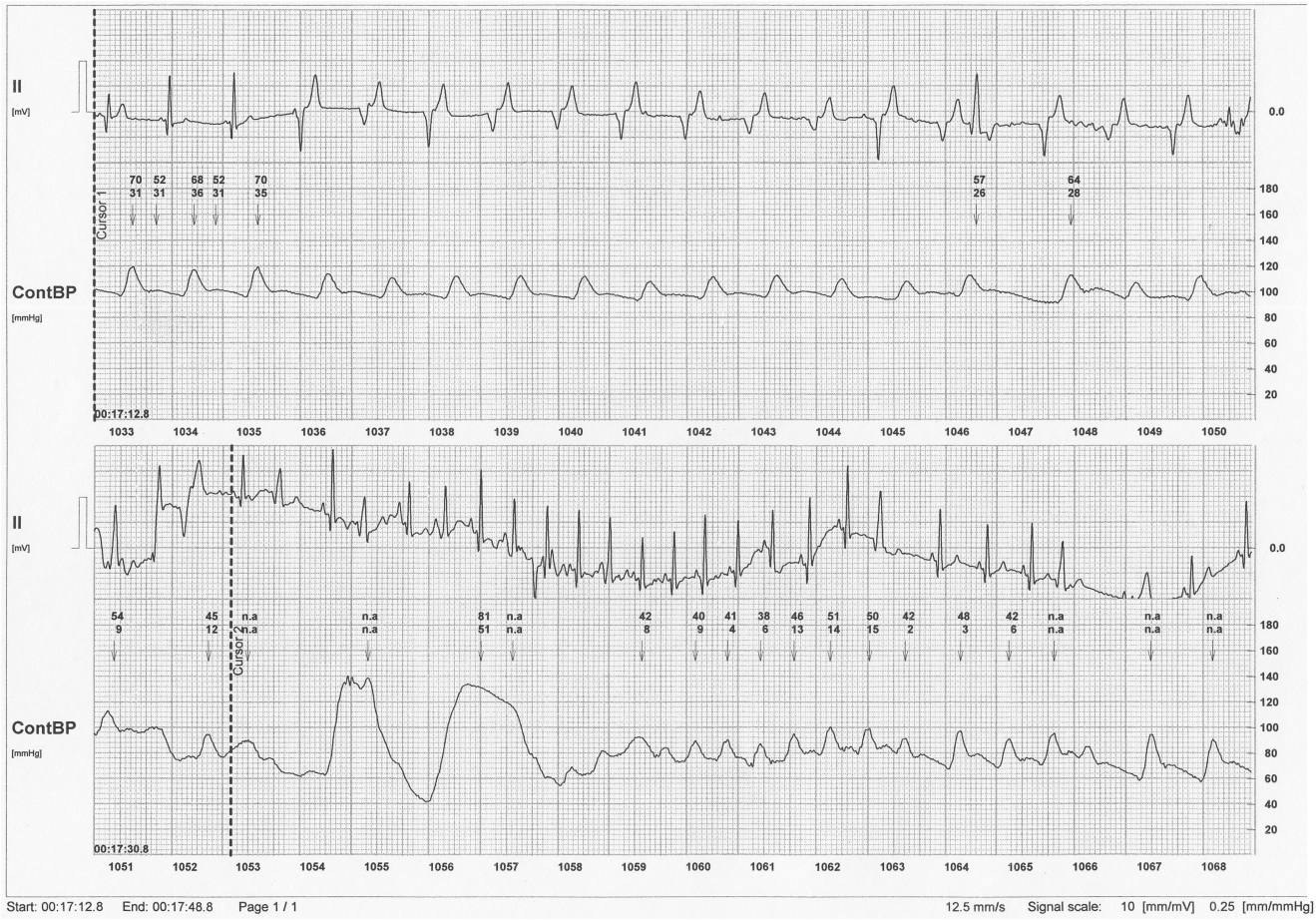

FIGURE 2 Electrocardiogram and continuous blood pressure monitoring during head-up tilt testing in a 14-year-old girl with a temporary pacemaker. Note hypotension and syncope, which occurred in the presence of pacing captures.

4 | CONCLUSION AND RESULTS (OUTCOME AND FOLLOW-UP)

Cardioinhibitory NMS can cause complete heart block, leading to pulseless syncope. Pacemaker therapy is recommended for patients with cardioinhibitory NMS, but this method may not be effective in all patients. Midodrine may be an effective alternative treatment option for patients with cardioinhibitory NMS who do not respond to pacemaker therapy. Also, in patients suspected of getting neurally mediated syncope, findings of cardiac inhibitory mechanism at the time of spontaneous syncope, and as a result advocate the ability advantage of pacing remedy.

As alternative treatment, cardioneuroablation could be consider but not yet being officially included in the guidelines due to its novelty.

5 | DISCUSSION

Neurally mediated syncope (NMS) is a well-known condition that can be subdivided into three subgroups: vasopressor type, cardioinhibitory type, and mixed type. While different degrees of sinus bradycardia occur at the time of syncope in all types, complete heart block is a rare event that can lead to pulselessness during syncope.

Cardioinhibitory syncope is a subtype of neurally mediated syncope (NMS) in which sinus bradycardia or asystole is the predominant mechanism of the syncopal event.[4] This type of syncope is often associated with a reflex response to a trigger such as emotional stress, pain, or orthostasis, resulting in a sudden and transient decrease in blood pressure and cerebral perfusion.[5] In the current reports and guidelines, the focus is on sinus bradycardia or sinus pause as the causes of bradycardia or asystole. However, in our case, complete AV block was the main observation during the syncope. As the patient had a history of PVC ablation, it was not clear whether it had a contribution to developing the syncope. The HUT clarified the mechanism of syncope and confirmed that the PVCs did not have any role. Investigations confirmed the diagnostic value of HUT in the setting of cardioinhibitory syncope.[6] During the HUT, the patient's response to the tilt is monitored, and a positive test is defined as

the development of syncope associated with bradycardia or asystole.[7] Pacemaker therapy is recommended for patients with cardioinhibitory NMS who have recurrent syncope and significant bradycardia or asystole during syncope or HUT.[8] Permanent pacemaker implantation is likely to be effective in preventing syncope in patients with cardioinhibitory NMS who have failed other conservative management options.[9] This was demonstrated in a randomized controlled trial of patients with cardioinhibitory NMS, where pacemaker therapy was associated with a significant reduction in syncope compared to medical therapy.[10] Based on the available literature, the patient was managed with a temporary pacemaker, which was ineffective in preventing syncope during a repeat HUT. As pacing captures were clearly at the time of blood pressure drop, it appears that the bradycardia and hypotension are simultaneous, rather than sequential events in the setting of cardioinhibitory syncope in our case. The clinical response to midodrine supported this finding.

Exploring alternative pacing strategies is crucial in managing cardioinhibitory syncope. While our patient was temporarily paced in VVI mode with a fixed rate of 60 BPM during the syncopal episode, the effectiveness of ventricular pacing at a faster rate, AV synchronous pacing, or specific pacing algorithms remains uncertain. Further research is needed to evaluate their potential in preventing neurally mediated events and optimizing patient outcomes. Individualized approaches based on patient characteristics and response patterns may hold the key to successful management and reducing the burden of syncope in cardioinhibitory NMS.

Midodrine commonly causes hypertension and is not well tolerated by many patients. Furthermore, it is an expensive medication. Will this young patient be able to maintain this therapy indefinitely? It is a therapeutic alternative when there is predominantly vasodepressor neurocardiogenic syncope; however, in this case, there was a high-grade AV block of functional origin, whose treatment should consider other alternatives beyond the pacemaker. In this regard, we recommend that cardioneuroablation may be useful for this patient. This technique was introduced in 2004,[11] and in 2006, the first case of cardioneuroablation specifically for the treatment of high-grade AV block of functional origin was published,[12] similar to what is being described in the present study. Naturally, in a young patient, the possibility of resolving the condition with ablation without the need for drugs or a pacemaker is highly desirable. Despite cardioneuroablation not yet being officially included in the guidelines due to its novelty, it has been widely accepted and used in all major centers, and there is currently extensive literature on this subject.

AUTHOR CONTRIBUTIONS

Mohammad Dalili: Formal analysis; methodology; visualization. **Feisal Rahimpoor:** Formal analysis; investigation; methodology; writing – original draft; writing – review and editing.

ACKNOWLEDGMENTS

The authors want to appreciate the electrophysiology staff of the Rajaie Cardiovascular Medical and Research Center.

FUNDING INFORMATION

No fund was received for this study.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Further data will be available in case of appropriate request by the corresponding author, Dr. Feisal Rahimpoor (feisalrahimpoor@gmail.com).

CONSENT

The patient provided informed consent for the publication of this report, and the procedure was performed in accordance with the center's ethical policy. Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

ORCID

Feisal Rahimpoor https://orcid.org/0000-0003-3869-4151

REFERENCES

1. Brignole M, Menozzi C, Alboni P, et al. The effect of exogenous adenosine in patients with neurally-mediated syncope and sick sinus syndrome. *Pacing Clin Electrophysiol*. 1994;17(11 Pt 2):2211-2216. doi:10.1111/j.1540-8159.1994.tb03828.x
2. Brignole M, Rivasi G. New insights in diagnostics and therapies in syncope: a novel approach to non-cardiac syncope. *Heart*. 2021;107:864-873. doi:10.1136/heartjnl-2020-318261
3. Glikson M, Nielsen JC, Kronborg MB, et al. 2021 ESC guidelines on cardiac pacing and cardiac resynchronization therapy. *Eur Heart J*. 2021;42(35):3427-3520. doi:10.1093/eurheartj/ehab364
4. Sheldon RS, Grubb BP 2nd, Olshansky B, et al. 2015 heart rhythm society expert consensus statement on the diagnosis and treatment of postural tachycardia syndrome, inappropriate sinus tachycardia, and vasovagal syncope. *Heart Rhythm*. 2015;12(6):e41-e63. doi:10.1016/j.hrthm.2015.03.029
5. Kenny RA, Bhangu J, King-Kallimanis BL. Epidemiology of syncope/collapse in younger and older Western patient populations. *Prog Cardiovasc Dis*. 2013;55(4):357-363. doi:10.1016/j.pcad.2012.11.006

6. Brignole M, Moya A, de Lange FJ, et al. 2018 ESC guidelines for the diagnosis and management of syncope. *Eur Heart J*. 2018;39(21):1883-1948. doi:10.1093/eurheartj/ehy037
7. Brignole M, Alboni P, Benditt DG, et al. Guidelines on management (diagnosis and treatment) of syncope—update 2004. *Europace*. 2004;6(6):467-537. doi:10.1016/j.eupc.2004.08.008
8. Moya A, Sutton R, Ammirati F, et al. Guidelines for the diagnosis and management of syncope (version 2009). *Eur Heart J*. 2009;30(21):2631-2671. doi:10.1093/eurheartj/ehp298
9. Shen W-K, Sheldon RS, Benditt DG, et al. 2017 ACC/AHA/HRS guideline for the evaluation and management of patients with syncope: executive summary: a report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines and the Heart Rhythm Society. *J Am Coll Cardiol*. 2017;70(5):620-663.
10. Connolly SJ, Sheldon R, Roberts RS, Gent M. The North American vasovagal pacemaker study (VPS). A randomized trial of permanent cardiac pacing for the prevention of vasovagal syncope. *J Am Coll Cardiol*. 1999;33(1):16-20. doi:10.1016/s0735-1097(98)00549-x
11. Pachon JC, Pachon EI, Pachon JC, et al. "Cardioneuroablation"—new treatment for neurocardiogenic syncope, functional AV block and sinus dysfunction using catheter RF-ablation. *Europace*. 2005;7(1):1-13. doi:10.1016/j.eupc.2004.10.003
12. Pachon MJC, Pachon MEI, Lobo TJ, et al. Syncopal high-degree AV block treated with catheter RF ablation without pacemaker implantation. *Pacing Clin Electrophysiol*. 2006;29(3):318-322. doi:10.1111/j.1540-8159.2006.00340.x

How to cite this article: Dalili M, Rahimpoor F. Failure of pacemaker therapy in a pediatric patient with neurally mediated complete heart block and syncope: A case report. *Clin Case Rep*. 2024;12:e9527. doi:10.1002/ccr3.9527