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CASE REPORT

Sometimes a punch is needed to get started: A case of complete aortic occlusion with complete heart block rescued with percussion pacing

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Abstract

Complete heart block (CHB) is defined as the complete absence of atrioventricular conduction. Electrical pacing is the treatment of choice. We present a case of CHB which is interesting not only due to being a diagnostic dilemma in the emergency department but also for its management and the final diagnosis.

KEYWORDS

complete heart block, complete occlusion of abdominal aorta, mechanical pacing, percussion pacing, transcutaneous pacing

1 | INTRODUCTION

Non-invasive cardiac pacing is the most commonly used pacing technique in the emergency department. Although the use of percussion pacing was reported as early as in 1920,[1] it has been described multiple times as a "forgotten technique"[2,3] in the emergency department. Transcutaneous pacing, introduced by Paul Zoll in 1953,[4] on the other hand, was easily adopted and quickly became a standard of care.

We are presenting, to the best of our knowledge, the first reported case of complete occlusion of the infra-renal abdominal aorta leading to complete heart block which was refractory to transcutaneous pacing and was rescued by additional percussion pacing until transvenous pacing was achieved.

2 | CASE PRESENTATION

A 45-year-old man with a known history of smoking, hypertension, dyslipidemia, and coronary artery disease was airlifted from an offshore oil rig to our emergency department (ED) by emergency medical services (EMS). He had suddenly collapsed at his workplace and lost consciousness for a few minutes, followed by a spontaneous, complete recovery. A physician at the rig administered 2 doses of 0.5 mg atropine intravenously before the transfer as he noticed severe bradycardia. The patient's heart rate (HR) improved from 30s to 70s beats per minute (bpm) temporarily, which again dropped to 34 bpm when the EMS team arrived. He was fully conscious, bradycardiac, and hypotensive (blood pressure of 72/59 mmHg) with cold extremities. His EKG revealed third-degree atrioventricular

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(AV) block (Figure 1). Transcutaneous pacing was started by EMS, with pads in the anterior-posterior position, achieving electrical capture with mechanical function at 70 mA, which was later increased to 90 mA. Electrical capture was confirmed by visualization of QRS complexes on the monitor, while mechanical function was confirmed by palpable radial or brachial arteries. An epinephrine infusion was started at the rate of 0.01 mcg/kg/min for inotropic support.

A detailed history in the ED revealed the absence of chest pain, breathlessness, diaphoresis, or palpitations. He complained of bilateral leg pain and numbness. On examination, he was tolerating transcutaneous pacing at 90 mA with HR of 90 bpm and was oriented to time, place, and person. However, he was unable to move his legs. Peripheral pulses in lower extremities, including the femoral pulse, were absent. Bedside point-of-care ultrasound (PoCUS) did not show any suspicion of abdominal aortic aneurysm. A quick blood gas analysis revealed mixed metabolic and respiratory acidosis with hyperkalemia and high lactate levels (Table 1).

By this time, the top choice on our differential diagnosis list was aortic dissection extending proximally into the right coronary artery and distally to bilateral common iliac arteries, halting perfusion to the atrioventricular (AV) node as well as the lower extremities, leading to complete heart block along with the absence of pulses in the lower limbs bilaterally.

After about 80 min of pacing, the patient again started feeling drowsy, with the Glasgow Coma Scale (GCS) score dropping to as low as 8/15 associated with loss of transcutaneous pacing capture (Figure 2). The transcutaneous pacing current was increased to 120 mA, the epinephrine infusion was increased to 0.1 mcg/kg/min, and an isoproterenol infusion was started at the rate of 4 mcg/min. The transcutaneous pacing pads were also readjusted to achieve the optimal position, both in the anterior-posterior as well as in the anterior-lateral position. Despite all these measures, we failed to achieve any electrical capture or mechanical function. So, percussion (mechanical) pacing was started over the left lower sternum at the rate of almost 100 per minute. An immediate effect was seen with palpable peripheral pulses along with an improvement in the patient's GCS to 15/15. The EKG at this moment showed sinus tachycardia with ST elevation in the inferior leads along with a right bundle block pattern (Figure 3). An urgent EKG-gated thoracic computed tomography (CT) scan was planned to rule out aortic dissection.

Concomitantly, calcium chloride, salbutamol, sodium bicarbonate, dextrose water, and insulin were administered for the correction of metabolic acidosis and hyperkalemia. We decided to intubate the patient because he was

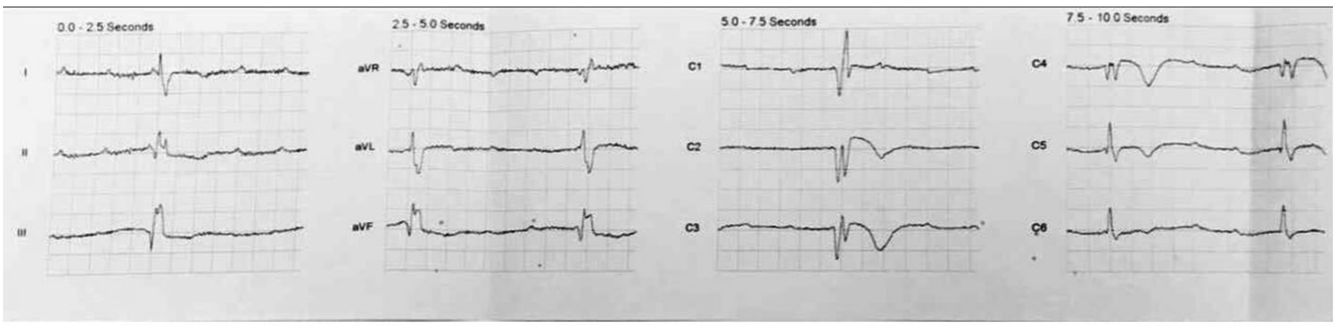

FIGURE 1 Initial 12-lead EKG by EMS showing complete heart block with no atrioventricular conduction

TABLE 1 Serial venous blood gas analysis in the first 12 h of the patient in the ED

Venous blood gas analysis	At presentation (0 h)	At the time of first percussion pacing (1 h)	After Anti-hyperkalemic measures (2 ½ h)	After hemodialysis (12 h)	Normal range
pH	6.797	6.758	7.133	7.383	7.35–7.45
pCO_2 (mmHg)	60	74	54	36	35–45
pO_2 (mmHg)	24	15	48	-	25–40
Sodium (mmol/L)	134	134	143	137	135–145
Potassium (mmol/L)	5.6	7.6	4.7	5.3	3.5–5.5
Chloride (mmol/L)	98	94	95	103	96–110
Bicarbonate (mmol/L)	6.5	6.3	15.2	21.7	23–39
Lactate (mmol/L)	23	26	24	7.5	0.5–2.2

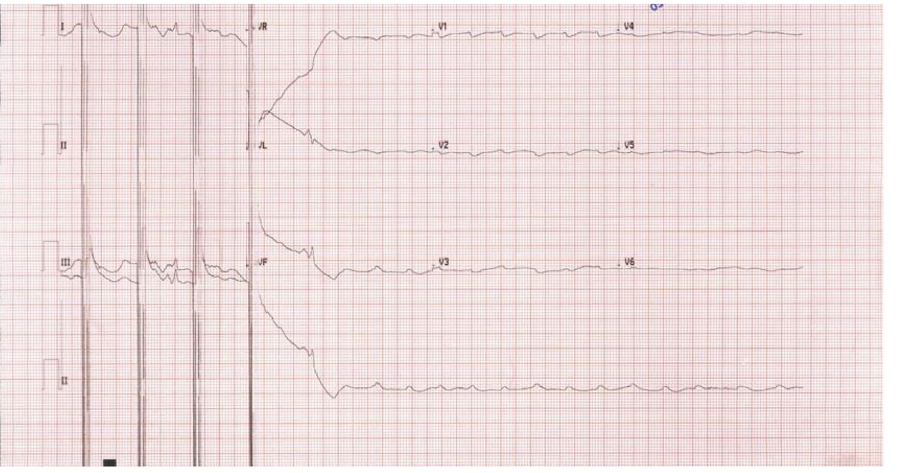

FIGURE 2 12-lead EKG showing the very first failure of transcutaneous pacing

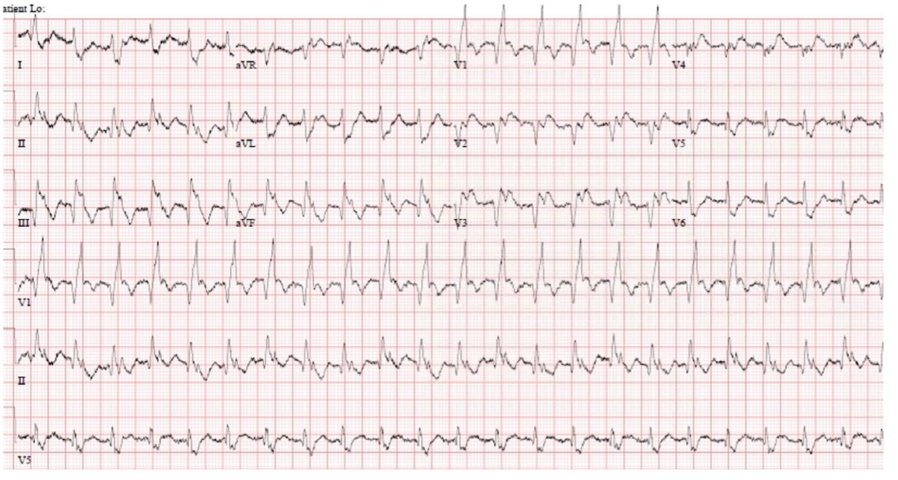

FIGURE 3 12-lead EKG showing electrical capture during percussion pacing

constantly requiring mechanical (percussion) pacing on top of electrical (transcutaneous) pacing. After intubation and correction of metabolic derangements, the patient attained electrical capture as well as mechanical function solely through transcutaneous pacing. But this lasted only for 15–20 min when we had to add percussion pacing to get electrical capture and mechanical function. Despite a transcutaneous pacing current of up to 120 mA and correction of hyperkalemia (initially with medications and later with emergency hemodialysis), the patient required intermittent percussion pacing 6–7 times in the next 4 h until transvenous pacing (Figure 4) was performed.

In the meantime, an EKG-gated CT scan was done and surprisingly showed complete occlusion of the infra-renal abdominal aorta extending into the bilateral common iliac arteries (Figures 5 and 6). This radiological finding served well to connect the dots, in this case, that is, the complete occlusion of the abdominal aorta was impeding the blood supply to the lower extremities, leading to metabolic derangements, resulting in high degree heart block, resistant to drugs, and transcutaneous pacing. Alteplase (15 mg) was administered in the ED to attempt to thrombolysis. In view of the CT findings, a vascular surgeon was consulted and recommended treating the patient conservatively due to his hemodynamic instability. Catheter-guided thrombolysis was done with 5 mg of alteplase by an interventional radiologist before he was admitted to an intensive care unit (ICU) for close observation.

A multidisciplinary approach was needed in this case, involving cardiology, vascular surgery, nephrology, interventional radiology, and critical care medicine. Recanalization was noted in the abdominal aortogram 24 h after initial thrombolysis, which further improved in the next 48 h (Figure 7) with palpable peripheral pulses. We decided to stop alteplase. He was extubated on the sixth day and transferred to the medical floor on the eighteenth day of his admission, where he remained for nearly 6 weeks before being transferred back to the ICU due to a deterioration in his GCS from 15/15 to 12/15. Aside from that, his extremities were warm with palpable pulses. An extensive workup was done during his hospital course for possible causes of thrombophilia (Table 2), including a positron emission tomography (PET) scan, which showed a thickened rectal wall. Later a cytomegalovirus (CMV) infection was confirmed by histopathology and polymerase chain reaction (PCR) studies. His hospital course

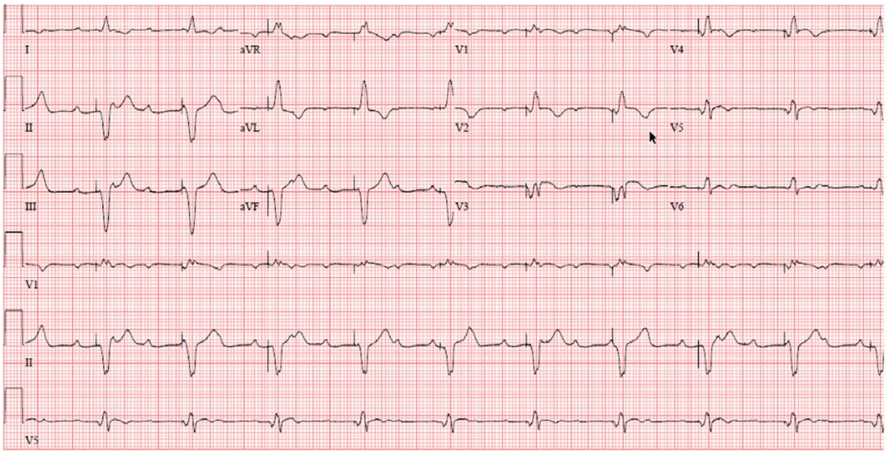

FIGURE 4 12-lead EKG showing electrical capture during transvenous pacing. Pacing spikes are clearly visible

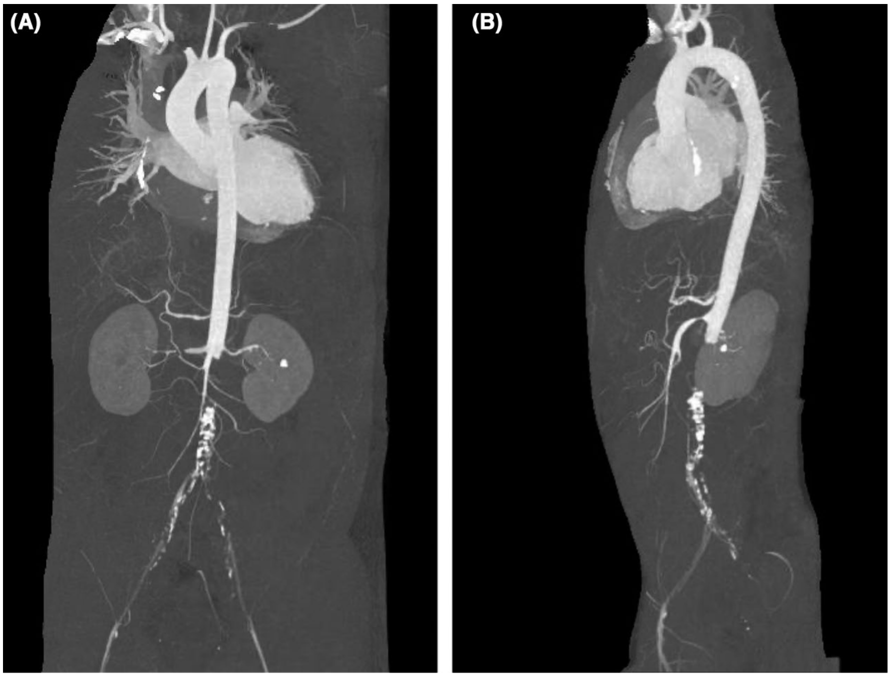

FIGURE 5 MIP (Maximum Intensity Projection) of Contrast Abdominal CT: Coronal (A) and Sagittal (B) view images show the extent of non-opacified infra-renal abdominal aorta to the bifurcation level and extensive atherosclerotic changes with narrowing of proximal SMA (superior mesenteric artery). Left kidney stone is also noted

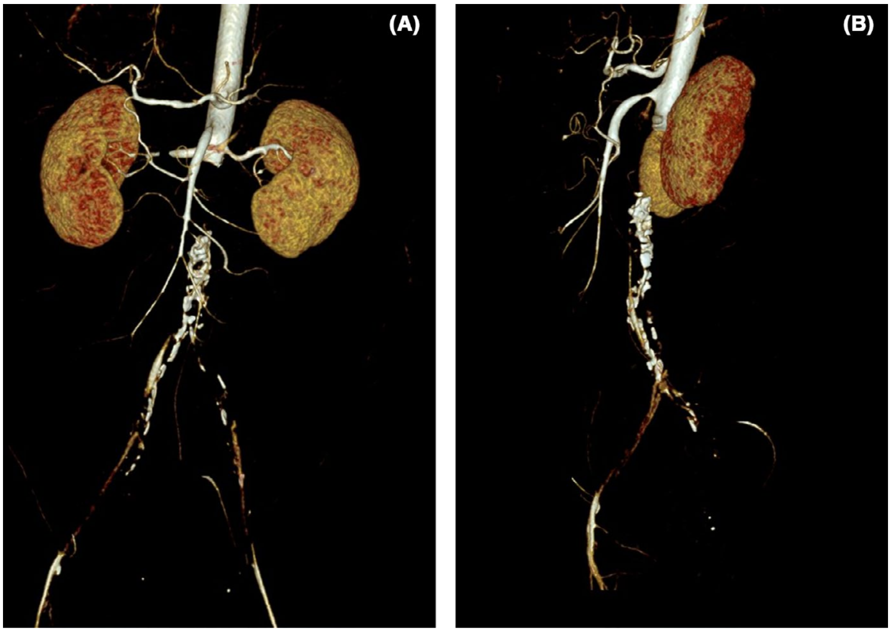

FIGURE 6 3D VRT (3-Dimensional Volume Rendering Technique) of Contrast Abdominal CT: Coronal (A) and Sagittal (B) view images showing complete occlusion of infra-renal abdominal aorta extending to the bifurcation level with narrowing of proximal SMA (superior mesenteric artery)

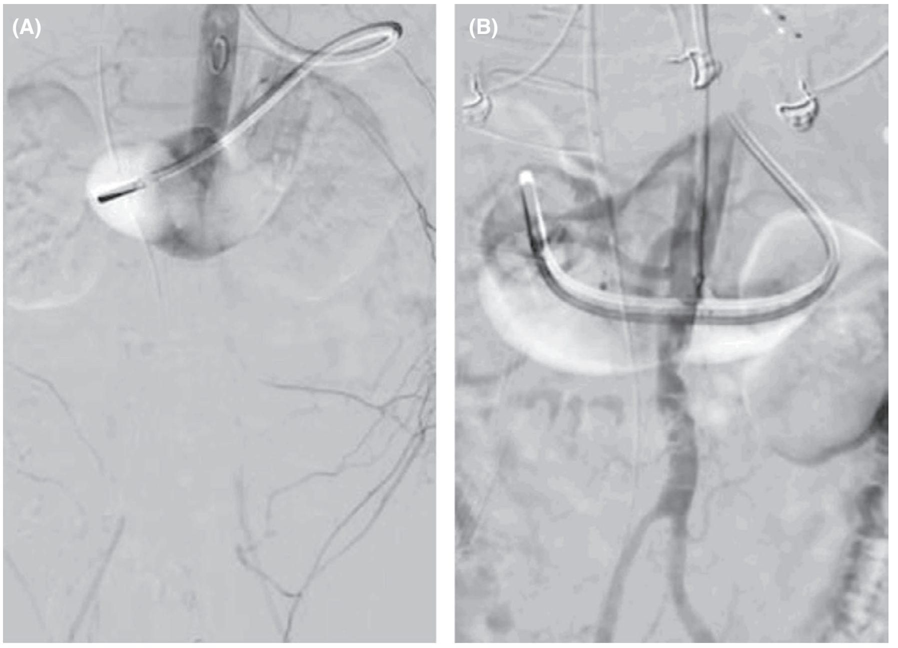

FIGURE 7 Angiography: Selected images through brachial access showing total occlusion of infra-renal aorta with filling of iliac arteries through collaterals (A) while (B) displays satisfactory filling of infra-renal aorta and iliac arteries after thrombolysis with no filling defect

TABLE 2 Extensive hemophilia workup done during hospital stay

Hemophilia workup	Patient's value	Normal range
ANA	Negative	
ANCA	Negative	
Lupus anticoagulant	Not detected	-
Lupus screen time	47.0	27.7–33.5
Lupus confirm time	44.2	30.4–45.3
Lupus screen/confirm ratio	1.06	1.01–1.41
Anticardiolipin antibody IgM (MPL)	2.00	<10 (Negative) 10–40 (Weak positive) >40 (Positive)
Anticardiolipin antibody IgG (GPL)	2.20	<10 (Negative) 10–40 (Weak positive) >40 (Positive)
Anti-B2 Glycoprotein IgM (U/ml)	<2.90	<7 (Negative) 7–10 (Equivocal) >10 (Positive)
Anti-B2 Glycoprotein IgG (U/ml)	3.40	<7 (Negative) 7–10 (Equivocal) >10 (Positive)
Protein C (%)	83.1	70–140
Protein S (%)	45.7	72–126
Antithrombin III (%)	94.5	79.4–112
C3	0.90	0.90–1.80
C4	0.28	0.10–0.40
Hepatitis B core antibody	Non-reactive	
Hepatitis B surface antibody	Non-reactive	
Hepatitis B surface antigen	Non-reactive	
Hepatitis C antibody	Non-reactive	
HIV antigen/antibody Combo	Non-reactive	

was compromised by multiple complications, including acute kidney injury (AKI), sepsis, heparin-induced thrombocytopenia (HIT), melena due to a bleeding peptic ulcer requiring a blood transfusion, and a myocardial infarction (MI) with cardiogenic shock. Unfortunately, the patient did not survive those complications and died after about 2 months of hospitalization.

3 | DISCUSSION

Cardiac pacing is broadly classified into two categories: invasive and non-invasive. Invasive pacing includes transvenous pacing, which can be temporary or permanent, while non-invasive pacing is always a temporary pacing modality. It can be done either electrically, via transcutaneous pacing, or mechanically, referred to as percussion or fist pacing. Percussion pacing is described as the delivery of serial, rhythmic, relatively low-velocity blows near the sternum with a closed fist.[5] Eduard Schott first described it when he reported a case of a lady with recurrent Adams-Stokes attacks due to complete heart block who was successfully paced as much as 15 times until finally attaining a normal sinus rhythm.[1]

The recommended method of percussion pacing is to deliver repeated blows to the precordium, lateral to the lower left sternal edge, raising the hand about 10 cm above the chest for each blow. If initial blows fail to produce a QRS complex, it is recommended to use harder blows and move the point of contact across the precordium to find the best site for the pacing.[6]

The European Resuscitation Council (ERC) recommends using percussion pacing in hemodynamically unstable, conscious, bradycardia patients, who do not respond to medication, as a bridge to electrical pacing.[7] The mechanical energy given by the blow generates an electric impulse sufficient to cause myocardial depolarization and contraction. Although it was included in the 2021 ERC resuscitation guidelines just as a rescue pacing measure,[6] it has never been a main part of Advanced Life Support (ALS), mainly due to the scarcity of data and the poorly understood mechanism of action. The evidence for the effectiveness of fist pacing is limited to some case reports and three case series[8–10] suggesting that cardiac output can be maintained if fist pacing is initiated very quickly after the onset of asystole or severe bradycardia.

Our case is unique as the patient was successfully paced by the percussion technique while transcutaneous electrical pacing was failing repeatedly during emergency resuscitation. Improper positioning of pads or malfunctioning of the machine was very unlikely as there were periods of electrical capture and mechanical function with pulse restoration when the rhythm was solely produced by electrical pacing with pads at the same position. In contrast, the literature suggests equal efficacy of both electrical and mechanical pacing.[9] In our clinical practice, electrical pacing is used mostly due to its reliable delivery of predetermined electric current at a fixed rate.

There is only a single case reporting efficacy of all the emergency pacing modalities, which demonstrated that percussion pacing was as effective as transcutaneous and transvenous pacing as long as there is an electrical capture to reverse ventricular asystole. As a matter of fact, percussion pacing produced the highest amount of stroke volume (66 ml) as compared to transcutaneous (56.5 ml) and transvenous (54.4 ml) pacing.[11] This explains the possible physiology of the superiority of percussion pacing over transcutaneous pacing in our case, by generating higher stroke volumes for better cerebral perfusion.

Regarding abdominal aortic occlusion (AAO), a large population-based cohort study done in Sweden (1994–2014) including 715 cases identified its incidence as 3.8 per 1 million person-years. The most common treatment strategies were thromboembolectomy, thrombolysis, axillary-bifemoral bypass, and aorto-bi-iliac/bifemoral bypass surgery. Moreover, there has been a major shift toward endovascular techniques for recanalization since 2008.[12] The available literature supports the use of systemic thrombolysis in an emergency setting for either peripheral arterial disease[13] or hypernatremic dehydration-induced AAO in neonates.[14] No such data are available for AAO in adults.

Another fact worth mentioning in our case was the diagnostic quandary in the emergency department. The patient presented as a case of syncope due to complete heart block and ended up having complete occlusion of the infra-renal abdominal aorta. The metabolic derangements can be explained by ischemia of the lower extremities leading to cellular hypoxia, resulting in anaerobic respiration as well as cell death, causing lactic acidosis, and hyperkalemia, respectively. Consequently, hyperkalemia impeded AV nodal conduction[15] resulting in complete heart block which minimized cerebral perfusion and resulted in syncope.

While investigating this case for other possible causes of thrombophilia, we found that the protein S level was low. Causes of low protein S level might be hereditary or acquired. Acquired causes may include acute thromboembolism, liver disease, oral anticoagulation, and post-viral infection among others.[16] The low amount of protein S in this patient may be explained in one of two ways: either an active viral infection caused thrombosis by lowering protein S, or this reduction happened secondary to the thromboembolism. We are unable to draw any conclusions since we do not have a post-recovery protein S level. CMV infection can also lead to a hypercoagulable state, as supported by more than ten reported cases where CMV infection has been associated with different forms of thrombophilia, predominantly venous thrombosis.[17] To the best of our knowledge, this is the first case of CMV infection having complete occlusion of the abdominal aorta.

4 | CONCLUSION

Due to the excellent outcomes and great safety profile of electrical pacing, the use of percussion pacing is neither focused on during ALS courses nor routinely practiced in emergency departments. This case report highlights the need for thinking outside of the box. Though further studies are warranted to discover more about the true mechanism and efficacy of percussion pacing, we would suggest using percussion pacing not only as a bridging modality to transcutaneous pacing but also as an add-on technique in refractory bradyarrhythmia if transvenous pacing is not readily available. Additionally, educating physicians about this life-saving procedure should be included as an important learning component of ALS courses.

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CONFLICT OF INTEREST

In compliance with the ICMJE uniform disclosure form, all authors declared no conflict of interest.

AUTHOR CONTRIBUTION

Muhammad Abd Ur Rehman involved in data curation and wrote original draft. Ahmed Kassem validated, wrote, reviewed, and edited the manuscript. Hina Akram conceptualized the study and did literature review. Salah A. Almughalles wrote, reviewed, and edited the manuscript. Shabbir Ahmad supervised the study.

ETHICAL APPROVAL

The initial manuscript of this article was submitted to the medical research center in Hamad Medical Corporation, and an approval letter was obtained from ethics committee as well as institutional review board with approval number of MRC-04–21–569.

CONSENT

An informed written consent was obtained from patient's family, and we took approval from the online platform of Hamad Medical Corporation "abhath.hamad.qa/abhath" for publication of this article after anonymizing all the personal details of the patient.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

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