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CASE REPORT

BEGINNER

CLINICAL CASE

Spontaneous Pothole Cardioversion of a Wide Complex Tachycardia

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ABSTRACT

External mechanical forces, if properly timed and of sufficient energy, have rarely been reported to convert tachyarrhythmias to sinus rhythm. We report a case of a patient with a wide-complex tachycardia that spontaneously converted to sinus rhythm after an ambulance ran over a pothole during emergency transport to the hospital. (**Level of Difficulty: Beginner.**) (J Am Coll Cardiol Case Rep 2020;2:951–5) © 2020 The Authors. 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/).

A 59-year-old man developed new-onset chest pressure with radiation into his left arm and significant palpitations with a feeling of racing heartbeats while at his workplace. Symptoms persisted for 5 min with no resolution, which prompted a call to emergency medical services. On arrival, patient had a 12-lead electrocardiogram performed, which revealed a wide-complex tachycardia (WCT) at a rate of 235 beats/min (**Figure 1A**) with a blood pressure of 90/65 mm Hg. The decision was made to transport him to the nearest hospital by ambulance.

LEARNING OBJECTIVES

- To understand that external forces, such as large potholes and the precordial thump, have the potential to convert arrhythmias to sinus rhythm.
- To be familiar with the ineffectiveness of a precordial thump in restoring sinus rhythm.
- To be familiar with commotio cordis and the ability of a precordial thump to initiate ventricular fibrillation.

During transport, the patient's heart rate continued to accelerate with declining blood pressure. The patient also began to experience lightheadedness with decreased responsiveness. As the paramedics were preparing to electrically cardiovert him, the ambulance ran over a large pothole in the road resulting in spontaneous conversion back to sinus tachycardia at a rate of 110 beats/min (**Figure 1B**). His palpitations and chest pressure soon resolved after conversion to sinus rhythm.

PAST MEDICAL HISTORY

The patient had a history of chronic obstructive pulmonary disease with prior tobacco use, anxiety, obstructive sleep apnea, gastroesophageal reflux disease, and obesity.

DIFFERENTIAL DIAGNOSIS

Initial diagnostic considerations included ventricular tachycardia and supraventricular tachycardia with aberrancy as the presenting clinical tachycardia with spontaneous conversion by means of external forces.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Case Reports* author instructions page.

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ABBREVIATIONS AND ACRONYMS

EP = electrophysiology

WCT = wide complex tachycardia

INVESTIGATIONS

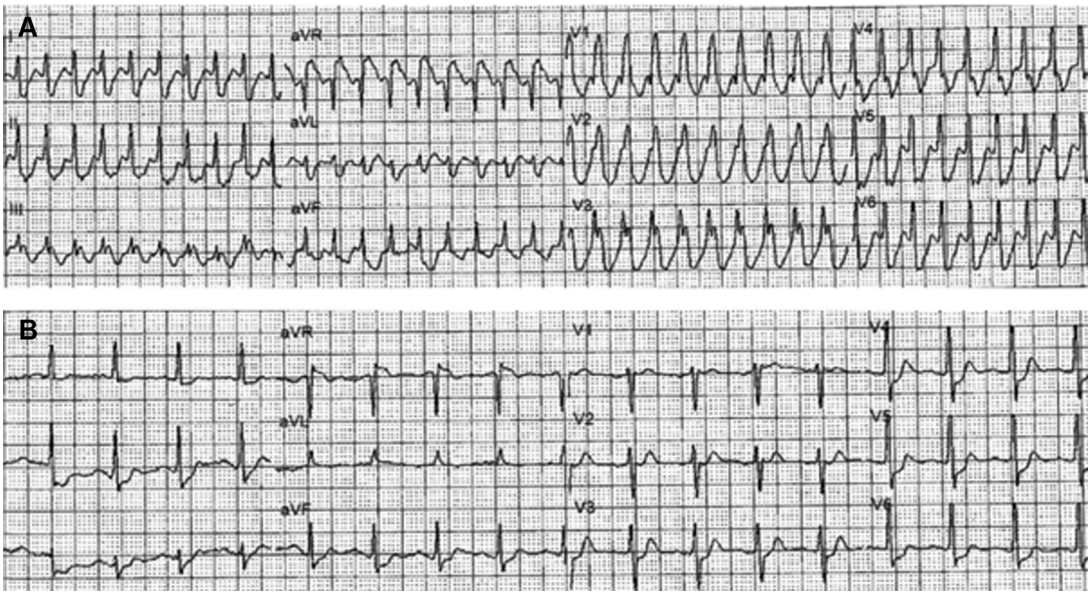
An echocardiogram revealed normal left ventricular systolic function along with mild eccentric left ventricular hypertrophy and grade I diastolic dysfunction. Laboratory work was normal including a troponin level measured at 3 different time intervals along with all electrolytes. A 12-lead electrocardiogram showed sinus tachycardia initially with all subsequent electrocardiograms being sinus rhythm with rates below 100 beats per min and no evidence of pre-excitation.

MANAGEMENT AND CLINICAL COURSE

The patient was admitted to the hospital for overnight observation and had no recurrence of WCT. Medical history revealed that he had suffered from episodes of palpitations and racing heartbeats since childhood; however, none of the episodes lasted longer than 30 s and all resolved spontaneously. Extensive examination of the telemetry strips of the WCT revealed a probable diagnosis of supraventricular tachycardia with right bundle branch block aberrancy as the cause of the clinical tachycardia based on the Brugada and Vereckei algorithms. He was started on metoprolol tartrate, 50 mg twice daily, and discharged home in a stable condition with a follow-up appointment to discuss an electrophysiology study (EP) with possible ablation.

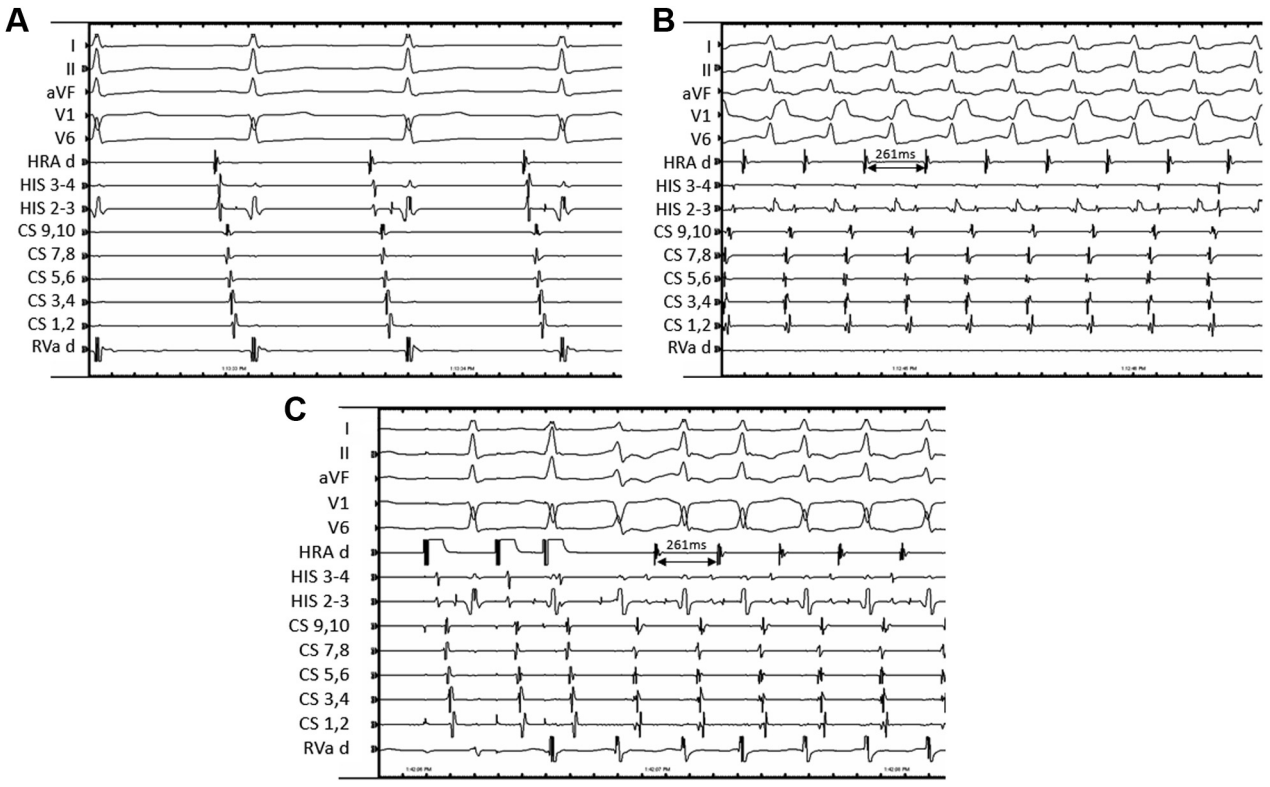
The patient agreed to an EP study and was taken to the EP laboratory. Baseline measurements were obtained, which revealed normal conduction intervals, including a normal His-ventricular interval (Figure 2A). The patient had an episode of WCT with right bundle branch block aberrancy during catheter manipulation, similar to the clinical tachycardia (Figure 2B). It started with a premature atrial complex that resulted in a slight delay in antegrade conduction over the atrioventricular node. The His activation preceded the ventricular activation and the earliest retrograde atrial activation was in the mid coronary sinus. The tachycardia cycle length was 261 ms and the ventricular-atrial interval measured 162 ms. The tachycardia then terminated spontaneously. A full EP study was then performed including atrial and ventricular incremental as well as extra-stimulus testing. Ventricular pacing demonstrated nondecremental

FIGURE 1 12-Lead ECG Pre- and Post-Arrhythmia Termination



(A) Initial presentation 12-lead ECG of the wide complex tachycardia. **(B)** Post-pothole cardioversion 12-lead ECG. ECG = electrocardiogram.

FIGURE 2 **Intracardiac Electrograms of the EP Study**



(A) Baseline intervals obtained during the EP study. **(B)** Tachycardia with right bundle branch block aberrancy that was provoked during EP testing by catheter manipulation. Earliest atrial activation was in CS 5,6 and the tachycardia cycle length was 261 ms. **(C)** Tachycardia induction with atrial double extra stimuli with similar tachycardia cycle length and atrial activation pattern. This was determined to be the clinical tachycardia on initial presentation. EP = electrophysiology.

retrograde conduction similar to that during tachycardia, which was reproducibly induced with atrial double extra-stimulus testing (Figure 2C).

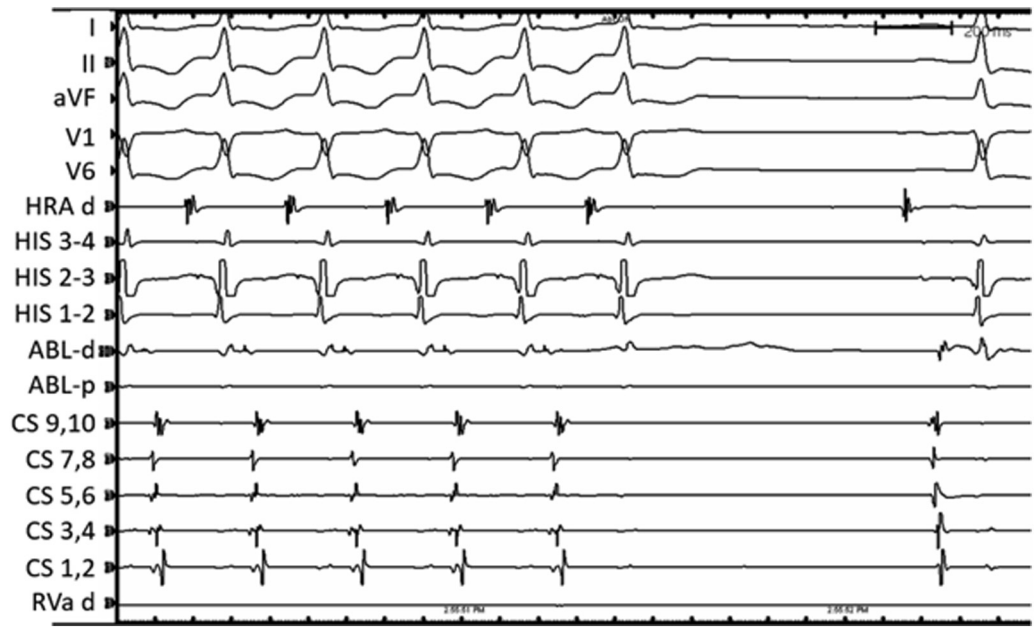
Orthodromic reciprocating tachycardia using a concealed accessory pathway with right bundle branch block aberrancy was thought to be the most likely mechanism of the clinical tachycardia and we decided to proceed with ablation of the accessory pathway, which was successfully performed over the posteroseptal area of the mitral annulus (Figure 3). The tachycardia was then rendered noninducible. Ventricular pacing demonstrated no evidence of retrograde conduction over the accessory pathway.

DISCUSSION

Our case illustrates an interesting and rare mechanism of arrhythmia termination after an ambulance ran over a pothole during emergency transport. Historically, external mechanical forces, such as a "precordial thump" have rarely been successful in converting arrhythmias to normal rhythm. The conversion to sinus rhythm in this case report was attributable to an external mechanical event caused by the pothole, similar to a precordial thump. This rare mode of arrhythmia termination through external mechanical forces has only been reported in 2 prior case reports spanning the last 2 decades (1,2).

It has been demonstrated that the precordial thump, under normal oxygenation, opens nonselective stretch-activated channels that repolarize the cell. "Commotio cordis" is the lethal disruption of the heart rhythm that occurs as a result of a mechanical blow to the precordium at a critical time during the cardiac cycle, producing an R-on-T phenomenon and ventricular fibrillation that leads to the condition (3). A 2007 prospective study in which 80 patients with malignant ventricular arrhythmias were exposed to a precordial thump as an initial means of cardioversion revealed that it was unsuccessful in 99% of patients in restoring sinus rhythm (4). A similar study performed in 2009 also found that the precordial thump

FIGURE 3 Arrhythmia Termination by Ablation



Ablation over the posteroseptal area of the mitral annulus resulting in immediate termination of the tachycardia with no recurrence.

was ineffective at restoring sinus rhythm in 98.7% of patients with unstable ventricular arrhythmias (5).

There are limited clinical scenarios in which the precordial thump has been recommended for use in restoring sinus rhythm. Indications include a witnessed cardiac arrest where a defibrillator is not immediately available with an unstable ventricular tachycardia observed on a monitor (6). The precordial thump should also be performed by someone with clinical experience in performing the procedure. Inexperienced individuals risk harm to themselves and to the patient including sternal fractures, osteomyelitis, and thromboembolic strokes (6). An incorrectly delivered blow to the chest also risks dislocation of the xiphoid with resultant injury to internal organs in the immediate vicinity (7).

Because of limited clinical scenarios for which the precordial thump is recommended, multiple prospective trials that have demonstrated its ineffectiveness in restoring sinus rhythm, the need for experienced individuals to perform the procedure, and the risk of harm to the operator and the patient, the authors do not support the use of the precordial thump in the attempt to restore sinus rhythm caused by unstable ventricular arrhythmias. Because of a lack of supportive data, the American Heart Association also no longer recommends the use of the precordial thump in its advanced cardiac life support guidelines for cardiac arrest. The amount of energy delivered by a precordial thump has not been determined. The energy delivered would have to be enough to result in cardioversion of supraventricular tachycardia, and at least 50 J, based on current advanced cardiovascular life support guidelines (6).

FOLLOW-UP

Post-ablation, the patient did not have recurrence of palpitations or racing heartbeats that he had noted since childhood. His metoprolol tartrate was, therefore, discontinued.

CONCLUSIONS

An external mechanical force, such as a large pothole or precordial thump, may terminate an arrhythmia if properly timed and of sufficient energy. However, because of the risks associated with commotio cordis, lack of supportive data, unknown efficacy, and uncertain amount of energy delivered, the precordial thump is no longer recommended in an advanced cardiovascular life support situation to restore sinus rhythm. The authors recommend following current American Heart Association guidelines as the primary

methods of arrhythmia termination. Because potholes and other road hazards may be impossible to avoid, the patient's rhythm should be reassessed when such an external force is transmitted to the patient during medical transport.

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REFERENCES

1. Bauer S. "Pothole" conversion: external mechanical force reverses supraventricular tachycardia. JEMS 2009;34:30–2.

2. Wong MP, Armstrong PW. Supraventricular tachycardia terminated by external mechanical stimulation: a case of "pothole conversion." Pacing Clin Electrophysiol 1999;22:376–8.

3. Link M. Commotio cordis. Ventricular fibrillation triggered by chest impact-induced abnormalities in repolarization. Circulation 2012;5:425–32.

4. Amir O, Schliamser JE, Nemer S, Aria M. Ineffectiveness of precordial thump for cardioversion of malignant ventricular tachyarrhythmias. Pacing Clin Electrophysiol 2007;30:153–6.

5. Haman L, Parizek P, Vojacek J. Precordial thump efficacy in termination of induced ventricular arrhythmias. Resuscitation 2009;80:14–6.

6. Cave D, Gazmuri R, Otto C, et al. CPR techniques and devices. Circulation 2010;18 Suppl 3:S270–8.

7. Hutchison J, Hu EW. Precordial Thump. StatPearls [serial online]. January 2020. Available at: https://www.ncbi.nlm.nih.gov/books/NBK545174/. Accessed December 15, 2019.

KEY WORDS ablation, electrophysiology, supraventricular arrhythmias, tachycardia