Commotio cordis…once again: Unusual occurrence in a noncontact sport

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Introduction

In early January, commotio cordis (CC) achieved substantial visibility and notoriety as a cause of cardiac arrest on the athletic field when Damar Hamlin, a defensive player for Buffalo, was struck in the chest during a collision with an opponent in a U.S. professional football game.[1] Rapid cardiopulmonary resuscitation and defibrillation were life-saving, with the event witnessed by millions on television in real time.

Case report

In comparison, 60 days later and 5000 miles away in Bucharest, Romania, another CC event occurred, this time during a youth basketball tournament game witnessed only by families and friends. An 18-year-old senior high school student of slight build (M.V.; height 72 inches; weight 160 pounds) was struck in the left chest by an inadvertent light blow from an opponent's elbow at close range during a scuffle to secure possession of a loose ball (Figures 1 and 2). The blow momentarily caused him to react with discomfort and disruption in breathing (Supplemental Video 1). However, he remained upright and walked away from the point of contact for a few seconds before collapsing in full cardiac arrest, characteristic of many other CC victims[2–4] who are able to tolerate ventricular tachycardia or ventricular fibrillation (VF) for brief periods of time (Figure 2). First responders arrived immediately and found him pulseless and convulsing.

Cardiopulmonary resuscitation and rescue was particularly rapid. Ventricular tachycardia deteriorated to VF and was terminated by emergency medical services with 1 defibrillation shock (150 J) (Figure 3). Recovery from the event over the next 7 days in the hospital was unremarkable except for modest chest soreness at the point of impact; 48-hour ambulatory electrocardiogram recording was unremarkable and coronary arteriography was normal, thereby excluding congenital coronary anomalies.

Prior to the event, M.V. was completely healthy without cardiovascular complaints; there is no family history of cardiac disease. When evaluated at Lahey Hospital and Medical Center 6 weeks after his cardiac arrest he was asymptomatic and neurologically intact, without residual medical problems, and had begun to resume normal daily activities without difficulty.

Imaging with echocardiography and magnetic resonance showed normal cardiac structure and function with left ventriclular thickness 10 mm, left ventricular end-diastolic and left atrial dimensions within normal limits, and ejection fraction 60%. Twelve-lead electrocardiogram was normal with QTc of 382 ms. Comprehensive cardiovascular genetic

KEY TEACHING POINTS

- Chest blow–induced ventricular tachycardia and cardiac arrest in the absence of underlying cardiac disease (commotio cordis) is an uncommon but important cause of sudden death, often in young people.
- Commotio cordis occurs in athletes during competitive or recreational sports, or is associated with routine everyday activities.
- Commotio cordis chest blows can be substantial or alternatively appear trivial and counterintuitive (as in the subject of this report).
- Timely recognition of a commotio cordis event is paramount, as cardiac arrest is reversible with prompt cardiopulmonary resuscitation / defibrillation.
- Although incompletely understood, the mechanism of commotio cordis requires a precise timing of the blow over the heart to a narrow 20 ms window at the upstroke of the T wave.

KEYWORDS Commotio cordis; Sudden cardiac death; Ventricular fibrillation; Trauma; Implantable defibrillator; Cardiac arrest; Athletes
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Figure 1 Commotio cordis event documented during a high school basketball game in Romania. Top left: There is a scramble for a loose ball and player M.V. (*large white arrow*) is beginning to engage. Top right: The elbow of an opponent can be seen making contact with the chest of M.V. and causing him to react (*white arrow*). Bottom left: In this frame, the elbow is more obviously inflicting a chest blow (*white arrow*), which M.V. now recognized. Lower right: M.V. stumbles but remains upright for a few seconds (*white arrow*) just prior to collapse, a finding virtually pathognomonic of commotio cordis–induced ventricular tachyarrhythmia.

testing panels comprising >100 cardiomyopathy or arrhythmia-based candidate genes failed to identify clinically significant variants, ie, reporting no pathogenic mutations or variants of unknown significance (Ambry Genetics, Aliso Viejo, CA). COVID-19 status was negative. A cardioverter-defibrillator was not recommended, as is standard after an isolated CC event, given the absence of evidence reported in the literature for recurrent CC events in the same patient.[2]

Discussion

The CC event reported here is notable for expanding the clinical spectrum of CC, given that competitive basketball had not previously been associated with this cause of cardiac arrest.[2–4] Sports such as baseball/softball and hockey have dominated CC, owing to the possibility of physical contact and chest blows from hard-core projectiles (eg, balls and pucks).[2–4] In contrast to baseball and hockey, basketball is essentially a noncontact sport (ie, at least at the high school level) and

Figure 2 Left panel: Blow-up of the commotio cordis event shown in upper right panel in Figure 1. The elbow of the opponent making blunt left chest contact is obvious, as denoted by the white arrow. Right panel: The game and the scramble for the ball continues as M.V. collapses in full cardiac arrest.

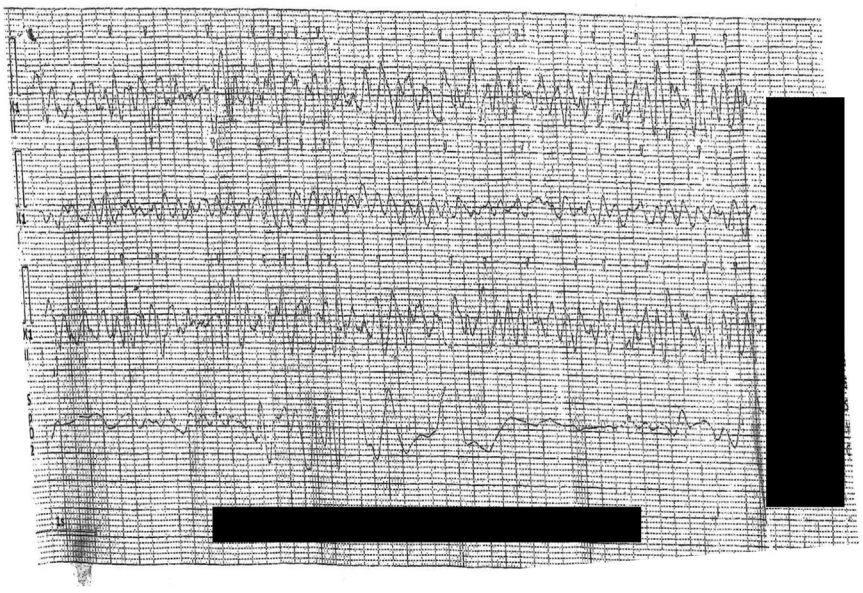

Figure 3 Recording of rapid ventricular fibrillation obtained from emergency medical technicians who performed prompt cardiopulmonary resuscitation / defibrillation.

played with air-filled balls considered to convey low arrhythmic risk on impact.[2–4] Nevertheless, typical of many CC events, the chest blow responsible for VF in the present case, although seemingly innocuous for basketball or any sport, led to the profound consequence of cardiac arrest.

CC events occur globally, reported in >20 countries[5] (and now including Romania), but are extraordinarily rare and virtually always counterintuitive, as with this case. For all these reasons, CC often raises questions about its mechanism, traditionally explained by 2 determinants[2–4,6]: (1) location of a nonpenetrating blunt chest blow directly over the position of the heart (often marked by an impact bruise); and (2) exquisite timing of the blow within a narrow 20 ms window on the T-wave upstroke just below its peak (1% of the cardiac cycle) at the vulnerable moment when dispersion of repolarization is greatest and the myocardium is most susceptible to provoked VF.[6]

It has been suggested (but unproven) that underlying factors could contribute to individual susceptibility for arrhythmogenic risk from CC.[7] For example, there has been speculation that selective activation of the ATP-sensitive-potassium channel by virtue of the chest blow raises a possible linkage between CC and primary arrhythmogenic conditions such as ion channelopathies.[7]

In conclusion, in this report we have underscored once again that CC can occur under virtually any circumstance where there is the possibility of physical bodily contact of any magnitude, or projectile-induced chest blows, but always when least expected.

A sustaining message regarding CC is that although this phenomenon is exceedingly rare, it is in fact a risk of living that probably cannot be extinguished by primary prevention measures, as evidenced by prior unsatisfactory experiences with ineffective and impractical chest protection barriers proposed for use in sports.[8,9] Nevertheless, notably, CC is a reversible (albeit profound) clinical event. This understanding underscores the need for vigilance and prospective preparation in order to effectively manage worst-case scenarios relying on timely secondary prevention with cardiopulmonary resuscitation / defibrillation, that is, as fortuitously occurred in this case and that of Damar Hamlin in professional football last January in Buffalo.

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Appendix

Supplementary Data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hrcr.2023.10.013.

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