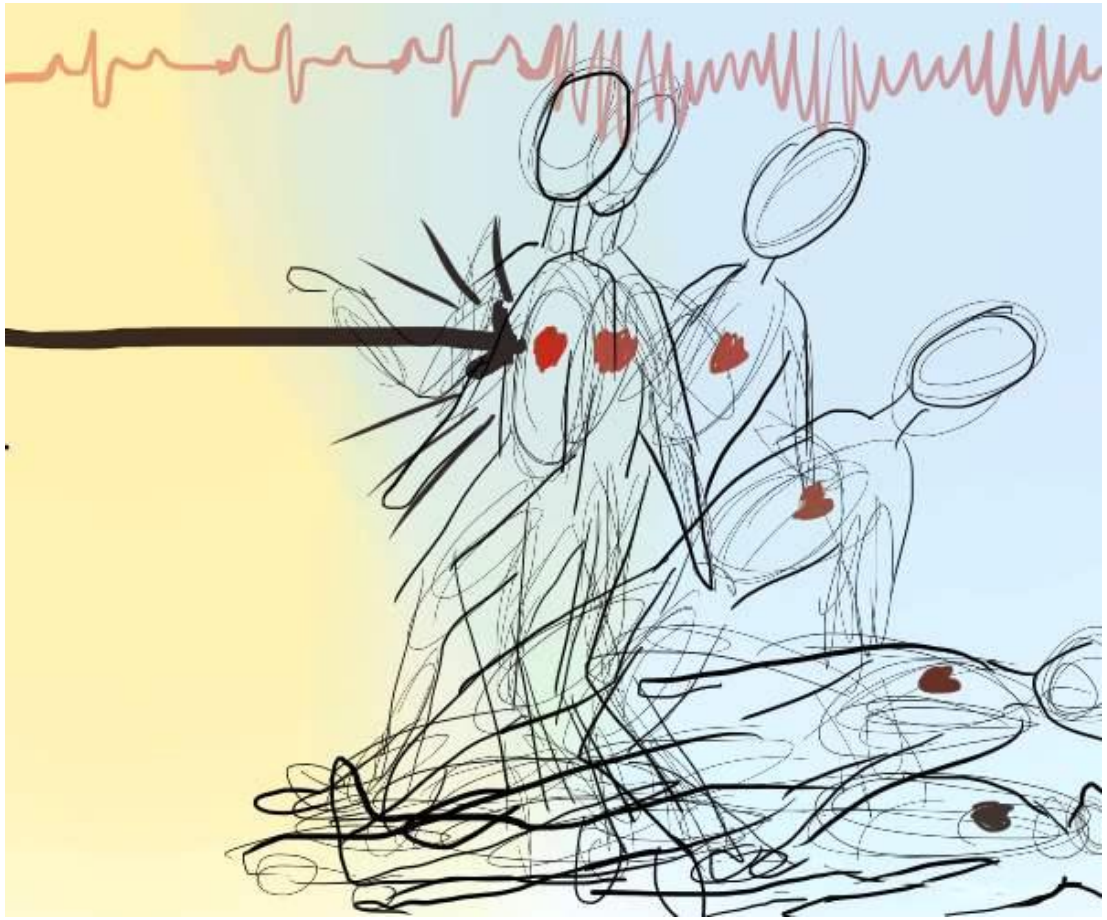
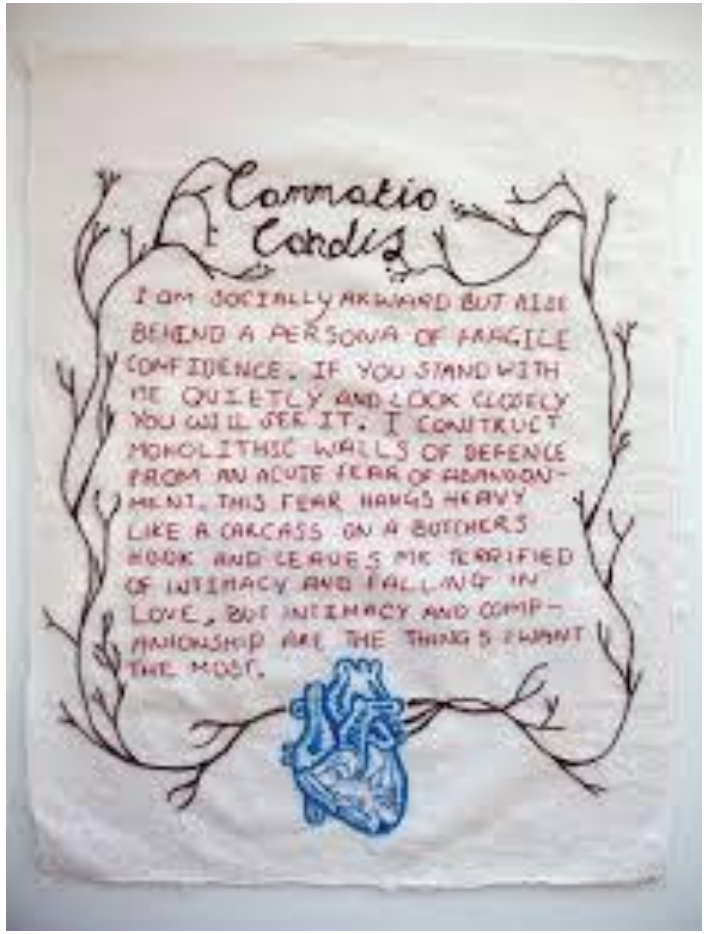
ARISTOTLE UNIVERSITY OF THESSALONIKI, GREECE
SPORTS MEDICINE LABORATORY-TEFAA
DIRECTOR: PROF. E. KOUIDI



COMMOTIO CORDIS

ASTERIOS DELIGIANNIS
EMERITUS PROFESSOR
OF SPORTS MEDICINE,
CARDIOLOGIST

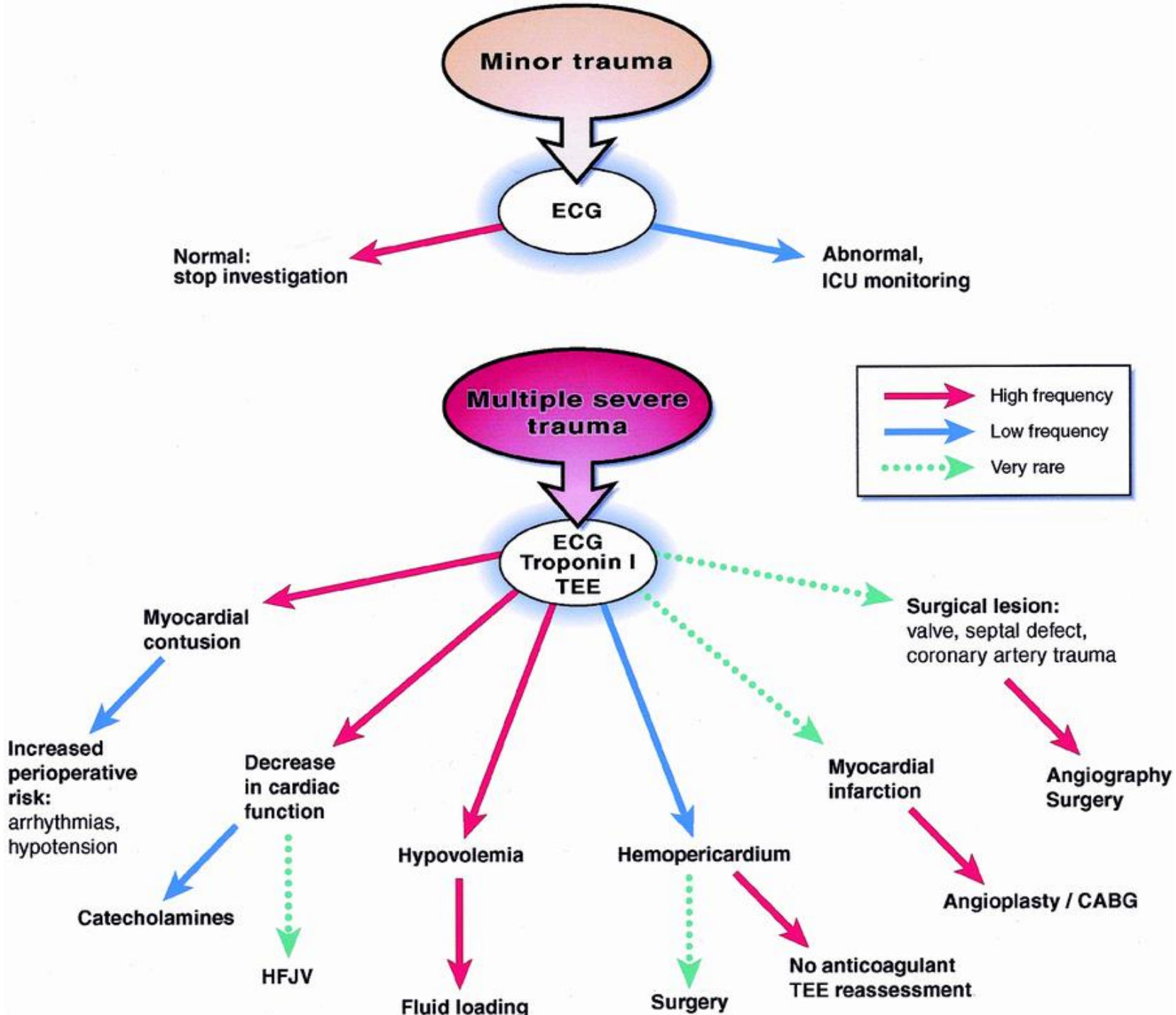
No Conflict of Interest

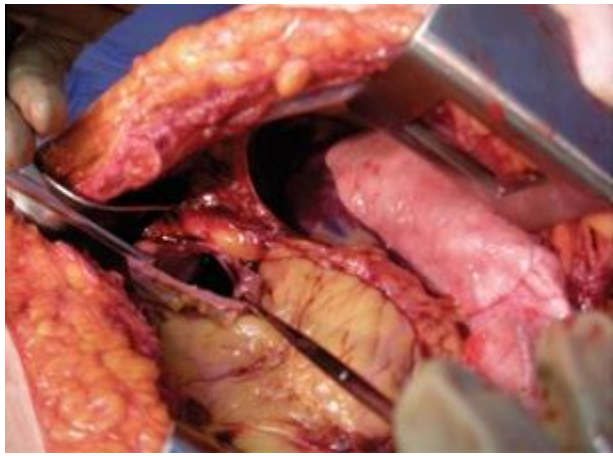


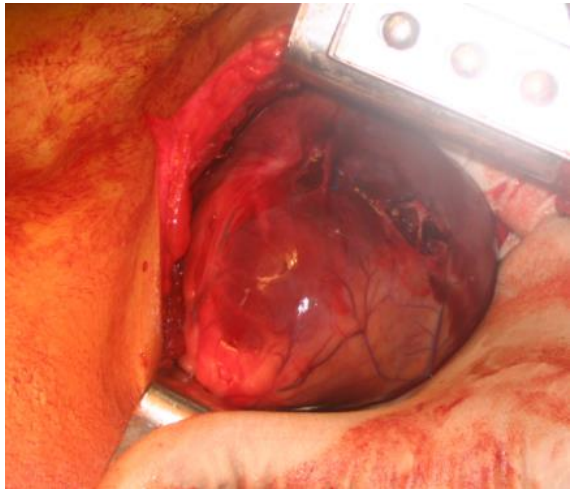
Etiology based on largest US data set

1) **HCM – 36%**
2) **Coronary Anomalies 17%**
3) **Increased Cardiac Mass (possible HCM) 10%**
4) **Ruptured Aorta/Dissect 5%**
5) **Tunneled LAD 5%**
6) **Aortic Stenosis 5%**
7) **Myocarditis 3%**
8) **Dilated CM 3%**
9) **Idiopathic Myocdardial scarring 3%**
10) **Arrhythmogenic RV dysplasia 3%**

- **OTHERS…**
- **MVP**
- **CAD**
- **ASD**
- **Brugada Syndrome**
- **Commotio Cordis**
- **Complete heart block**
- **QT prolongation syndrome**
- **Ebstein's anomaly**
- **Marfan's Syndrome**
- **Wolff-Parkinson White Syndrome – WPW**
- **Ruptured AVM**
- **SAH**

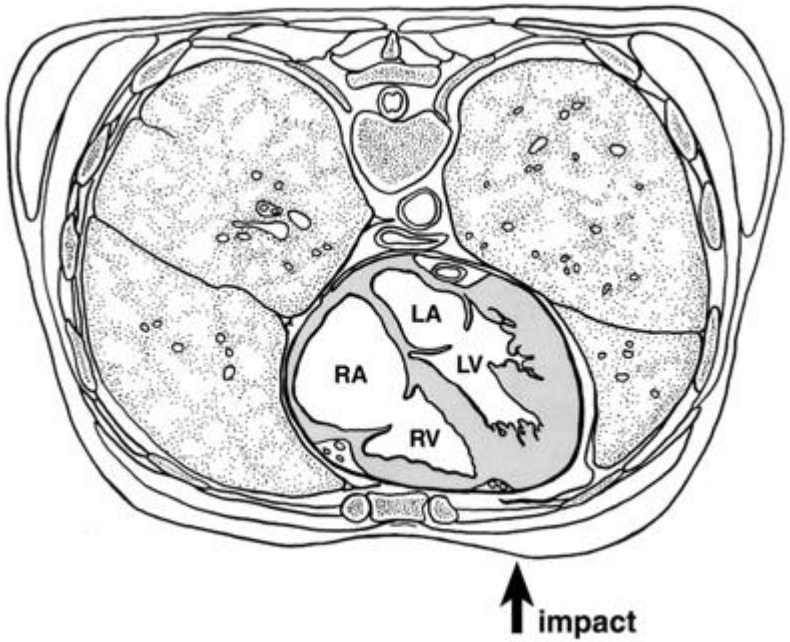

Minor trauma
ECG
Normal:
stop investigation
Abnormal,
ICU monitoring
Multiple severe trauma
High frequency
Low frequency
Very rare
ECG
Troponin I
TEE
Myocardial
contusion
Surgical lesion:
valve, septal defect,
coronary artery trauma
Increased
perioperative
risk:
arrhythmias,
hypotension
Decrease
in cardiac
function
Myocardial
infarction
Angiography
Surgery
Catecholamines
HFJV
Hypovolemia
Hemopericardium
Angioplasty / CABG
Fluid loading
Surgery
No anticoagulant
TEE reassessment



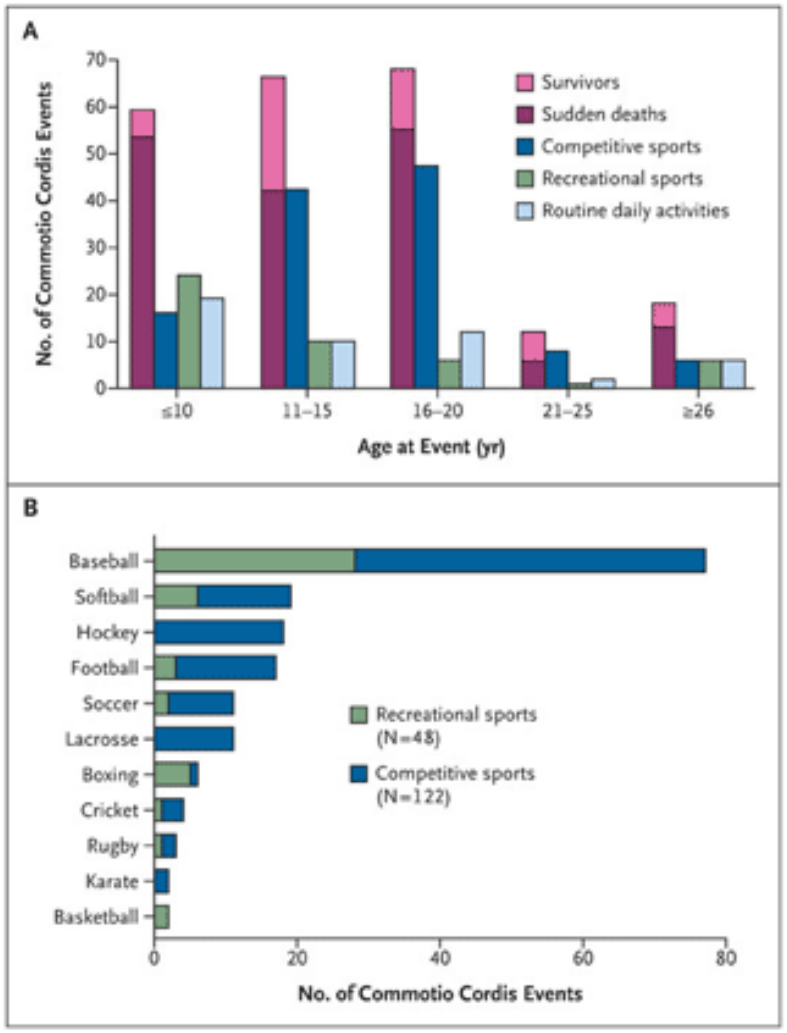


Definition

- Commotio cordis is a fatal mechano-electric syndrome in which a sudden blunt impact to the chest causes sudden death in the absence of cardiac damage.



There are more than 190 reported cases of commotio cordis in the United States. Forty-seven percent of reported cases occurred during athletic participation. Commotio cordis is the second-most common cause of sudden cardiac death in athletes (L. Palacio and M. Link, Sports Health 2009 Mar; 1(2): 174



Distribution of Commotio Cordis event

Freedom of Information (FOI):Mortality and commotio cordis in UK

How many cases have there been of commotio cordis in the UK in the past 5 years? (12 December 2017)

There is no specific ICD-10 code for deaths to commotio cordis. The death would likely be assigned an underlying cause code from chapter XX (External causes of morbidity and mortality) and also a nature of injury code known as a secondary cause code, which in this case would be S26.9 (Injury of heart, unspecified).

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Commotio Cordis Caused by Violence in China

Epidemiological Characteristics Detected at the Tongji Forensic Medical Center

Jiao Mu, MD, Zhenglian Chen, MD, Xinshan Chen, PhD, Wei Lin, MD, and Hongmei Dong, PhD

Gran Bretagna, 15 enne muore per una pallonata: si tratta di commotio cordis

29 novembre 2017 di Gloria Stella Tempo di lettura: 2 minuti

Condividi su Facebook

Commotio cordis o el "toque de la muerte"

Un golpe seco en el centro del tórax mientras se practica deporte puede provocar una arritmia letal

Por TERESA ROMANILLOS | 10 de enero de 2011

Imagen: Little Baby G

Un niño juega a la pelota con un amigo y, en uno de los lanzamientos, la pelota impacta en su pecho. Al cabo de pocos segundos se desploma. En un partido de béisbol, la pelota golpea el tórax de un jugador. Éste se agacha, la recoge y la lanza a otro jugador. Al cabo de unos segundos cae al suelo, inconsciente. Ambos han sufrido un commotio cordis, una entidad poco conocida que afecta sobre todo a individuos que reciben un golpe en el pecho, a menudo, mientras realizan una actividad deportiva. El traumatismo en la pared torácica provoca una fibrilación ventricular y, si no se actúa de manera inmediata, causa la muerte.

Commotio cordis

Wie ein Schlag auf den Brustkorb das Herz still stehen lässt

Herzerschütterungen sind insgesamt sehr selten, gelten aber als einer der häufigsten Gründe für einen plötzlichen Herztod bei jungen, gesunden Sportlern.

Karate gehört zu den Sportarten, bei denen es durch einen unkontrollierten Schlag auf den Brustkorb zu Herzproblemen kommen kann.

European Journal of Preventive Cardiology

EAPC
European Association of Preventive Cardiology
European Society of Cardiology

Commotio cordis – under-recognized in Europe?: a case report and review

Erik Ekker Solberg, Bernt Inge Embrå, Mats Börjesson, , , Johan Herlitz, Domenico Corrado, Erik Ekker Solberg, Bernt Inge Embrå, Mats Börjesson, Johan Herlitz, Domenico Corrado

Show less

First Published February 9, 2011 | Research Article | Check for updates

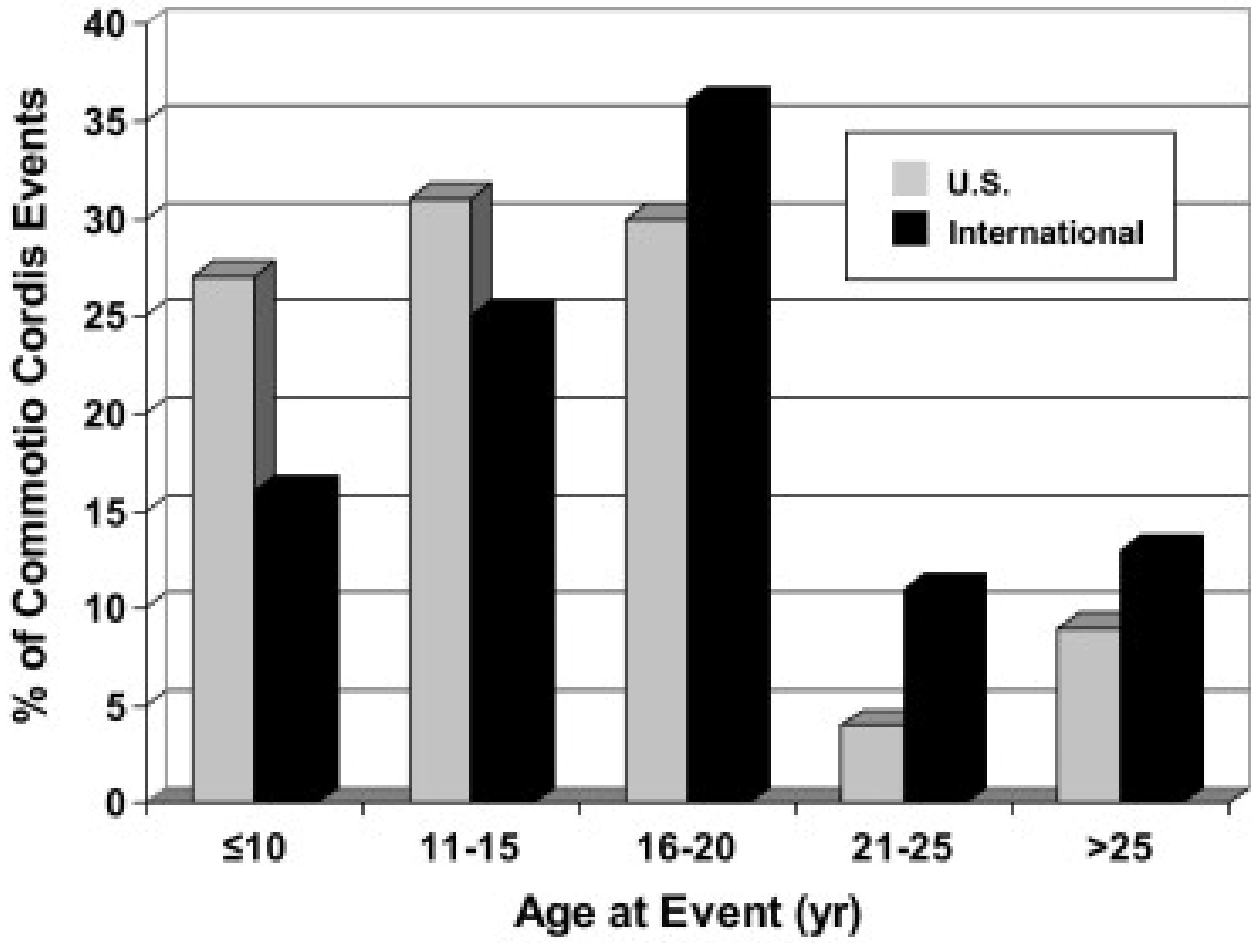
Article information

Altmetric 0

Abstract

This case and the review illustrate the induction of a sudden collapse of a football player secondary to a blow to his chest (commotio cordis) [CC]. The article argues that CC probably is under recognized in Europe and cautions that the mounting intensity and speed inherent in modern sports possibly increase the likeliness of CC in the future. If CC occurs, immediate cardiopulmonary resuscitation and automatic external defibrillator should be used.

Approximately 10 to 20 cases are added to the Commotio Cordis Registry yearly

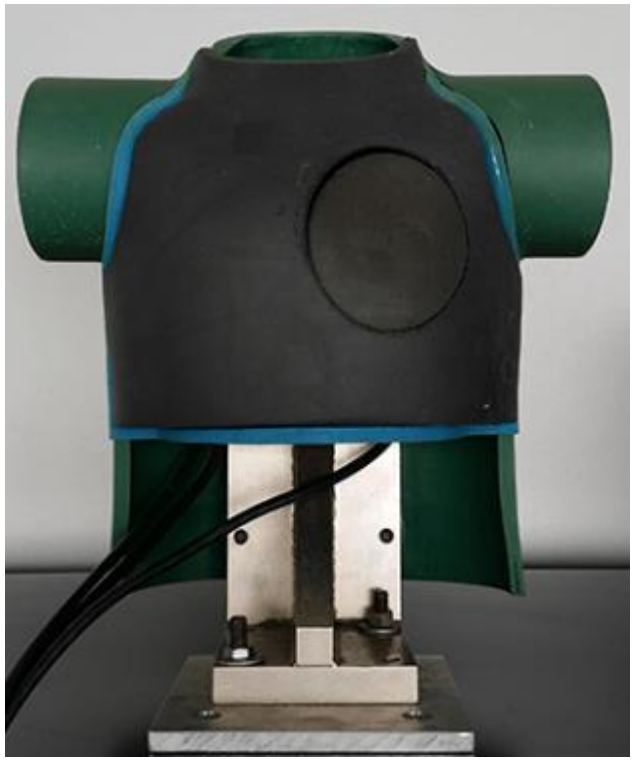


Homicidal commotio cordis caused by domestic violence

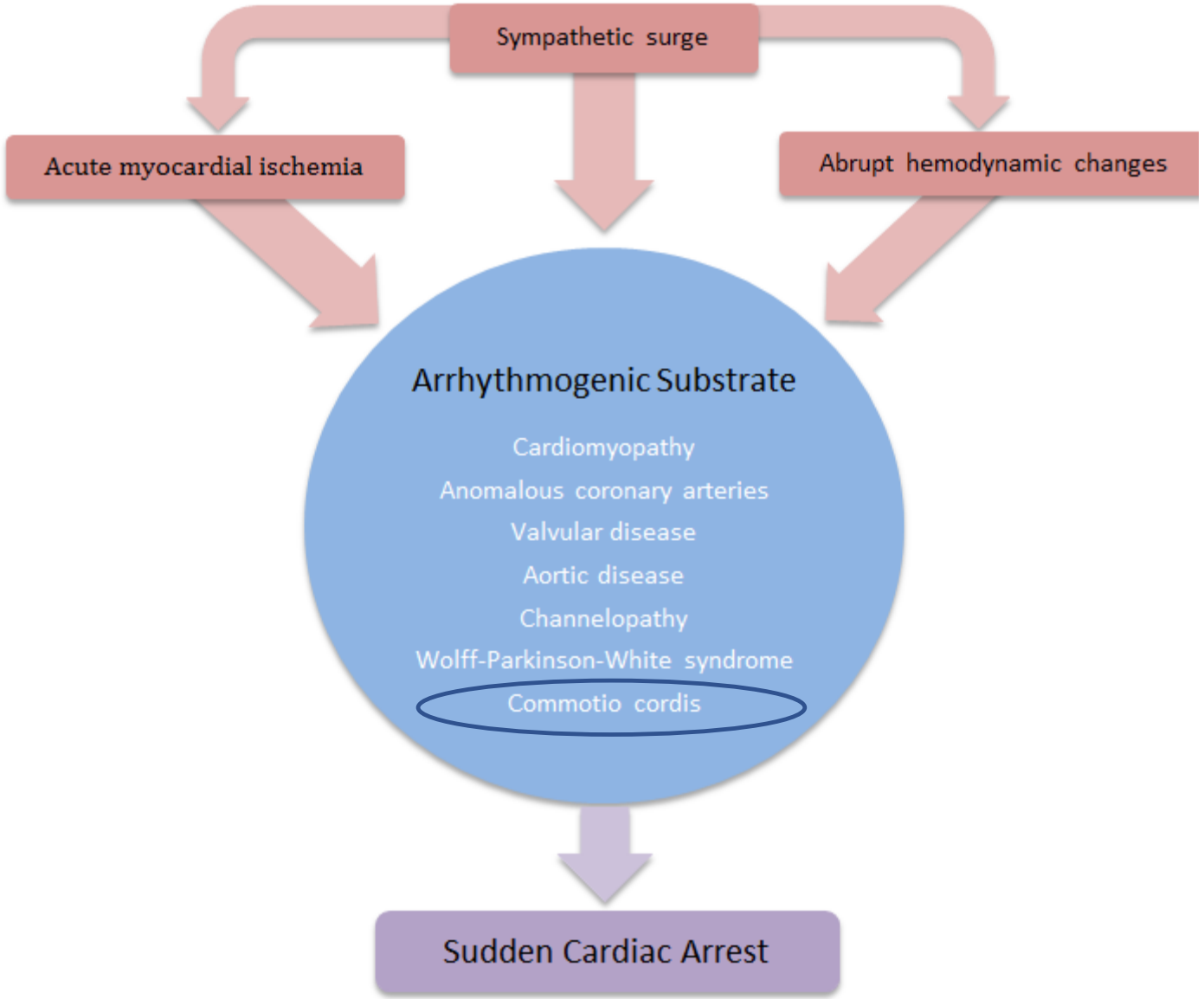
Two cases of sudden death due to homicidal commotio cordis caused violence from an intimate partner

(Mu J. et al.Med Sci Law 2016 Apr;56(2):138-41)

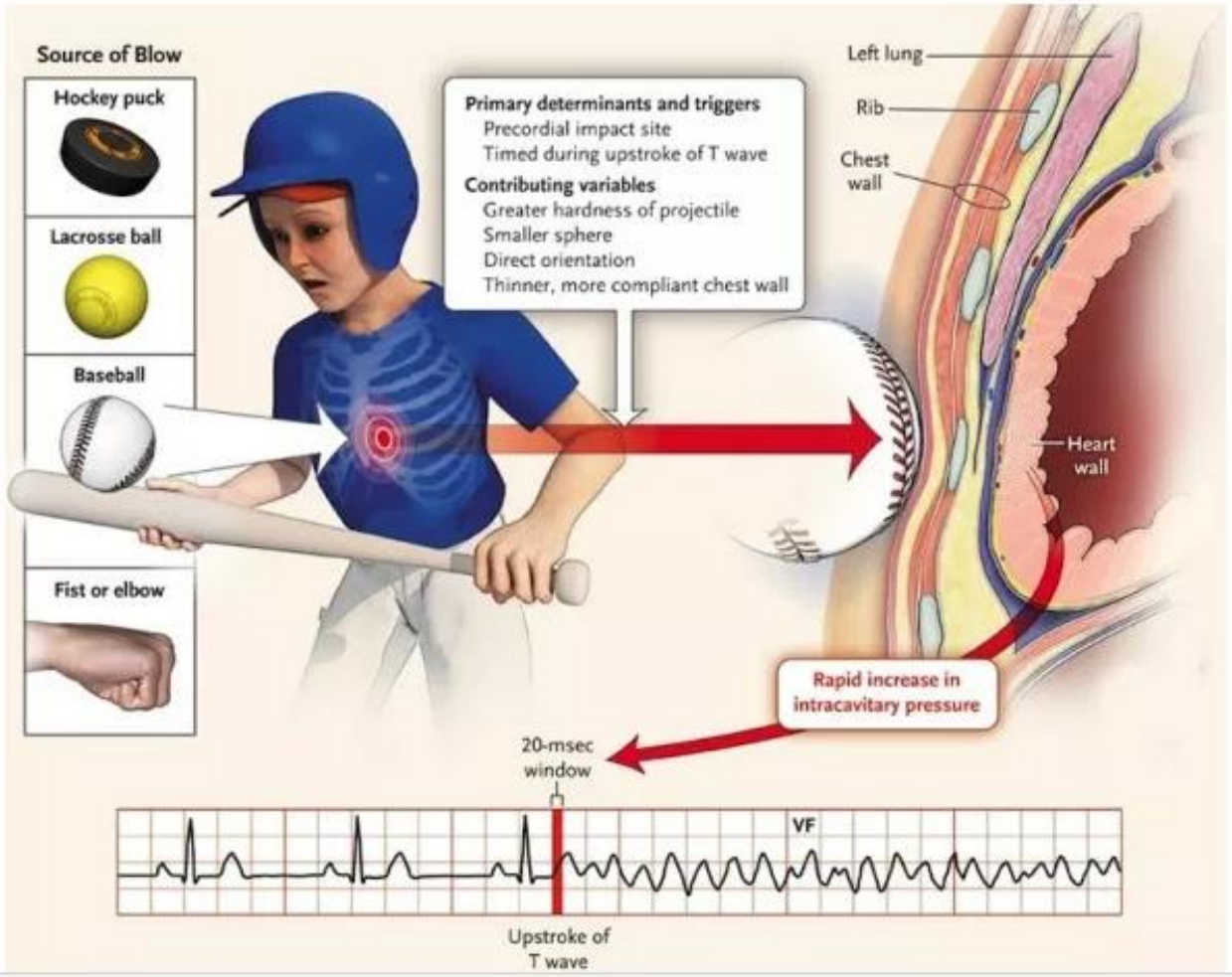
HITS TARGET-POWER AND SPEED-BED LUCK!



Bad Luck

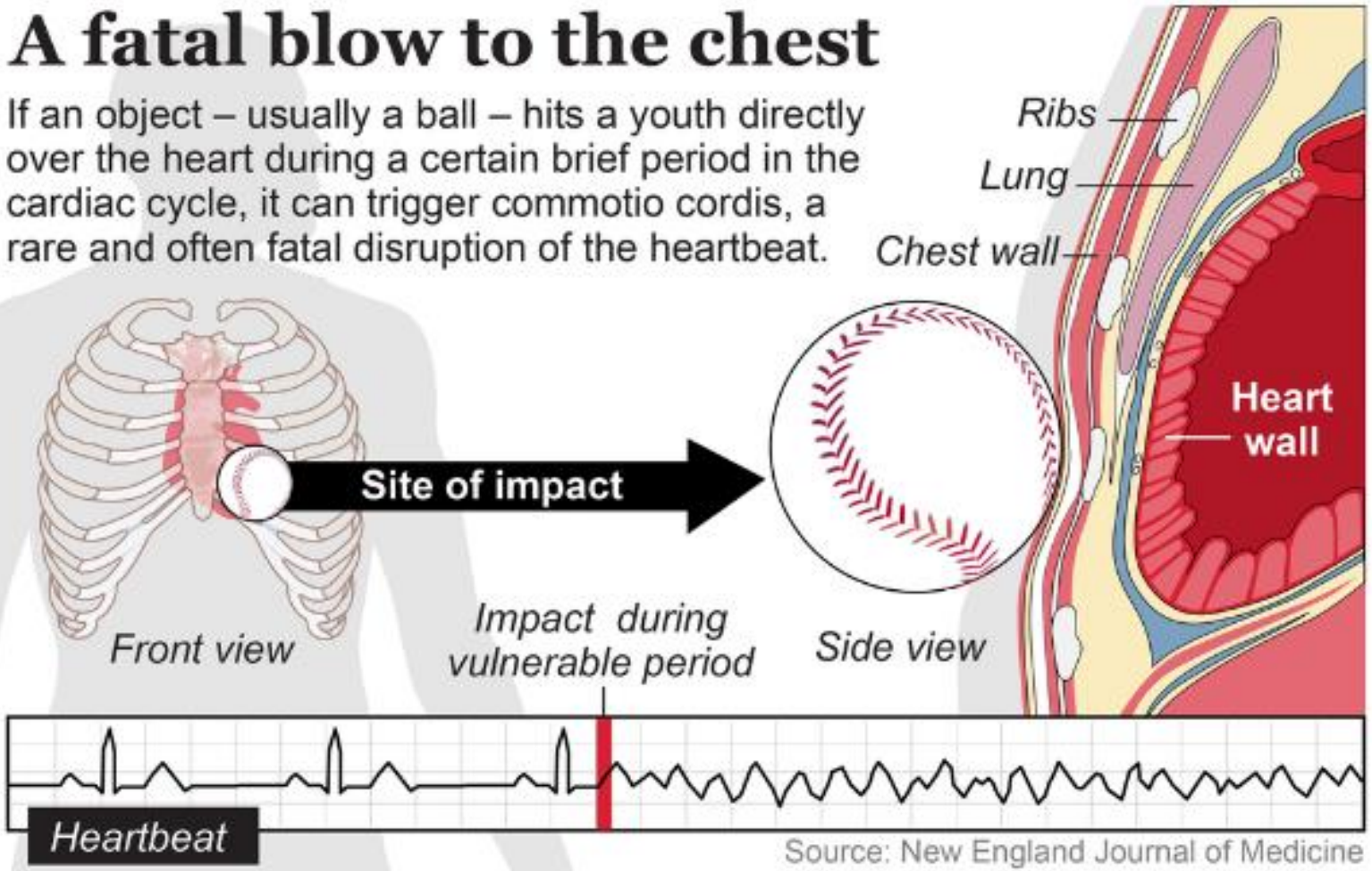

Sympathetic surge
Acute myocardial ischemia
Abrupt hemodynamic changes
Arrhythmogenic Substrate
Cardiomyopathy
Anomalous coronary arteries
Valvular disease
Aortic disease
Channelopathy
Wolff-Parkinson-White syndrome
Commotio cordis
Sudden Cardiac Arrest

Mechanism


Source of Blow
Hockey puck
Lacrosse ball
Baseball
Fist or elbow
Primary determinants and triggers
Precordial impact site
Timed during upstroke of T wave
Contributing variables
Greater hardness of projectile
Smaller sphere
Direct orientation
Thinner, more compliant chest wall
Left lung
Rib
Chest wall
Heart wall
Rapid increase in intracavitary pressure
20-msec window
VF
Upstroke of T wave

A fatal blow to the chest

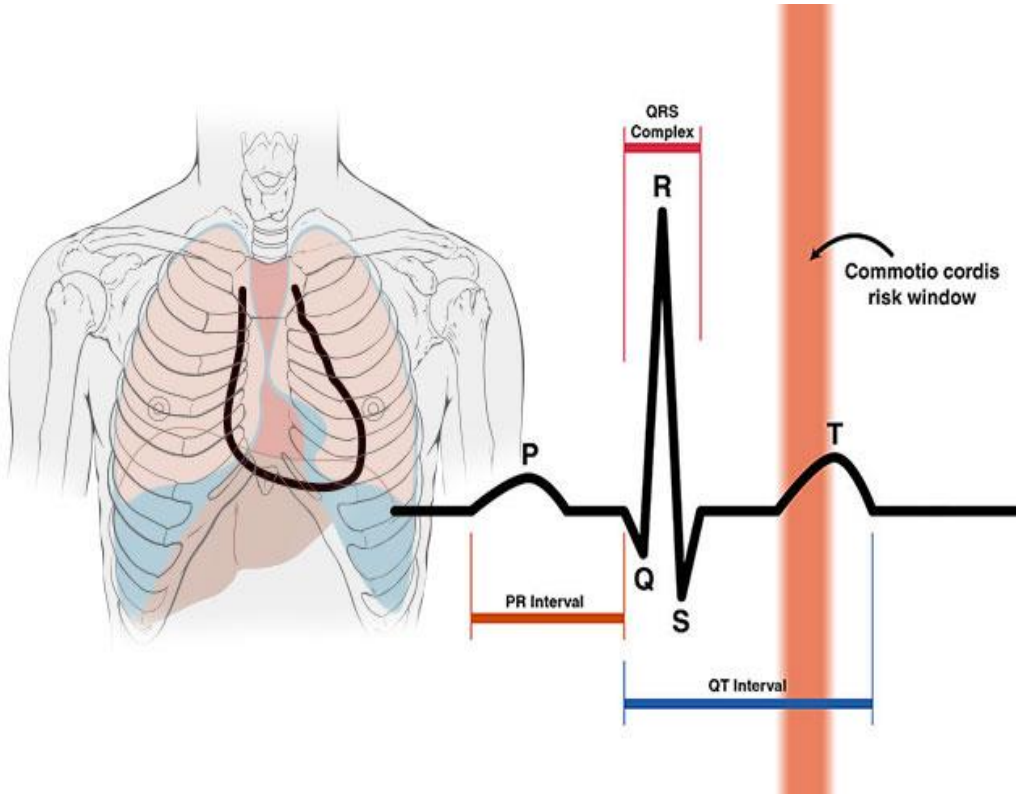
If an object – usually a ball – hits a youth directly over the heart during a certain brief period in the cardiac cycle, it can trigger commotio cordis, a rare and often fatal disruption of the heartbeat.



Source: New England Journal of Medicine

Pathophysiology

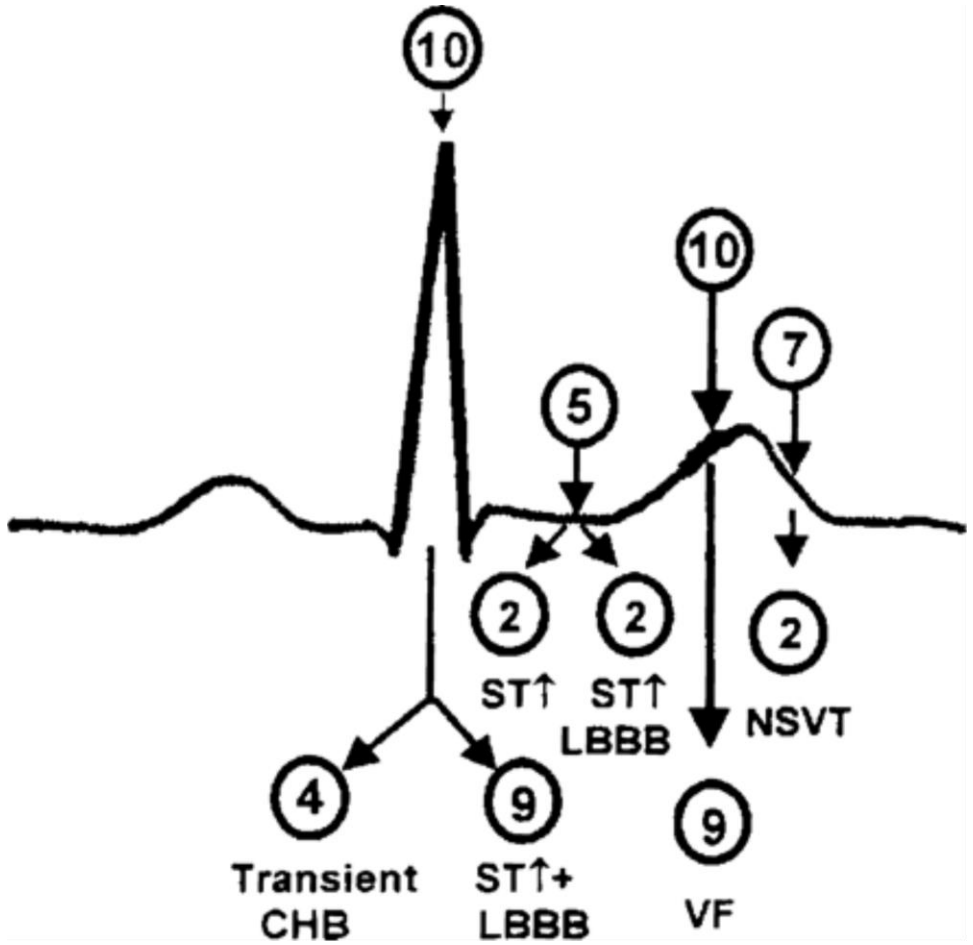
Only impacts on a narrow region on the upslope of the T wave (40 ms before the peak of the T-wave peak to the peak of the T wave) will cause ventricular fibrillation, with a markedly increased likelihood with impacts from 30 to 10 ms before the peak of the T wave



Arrhythmiogenic mechanism

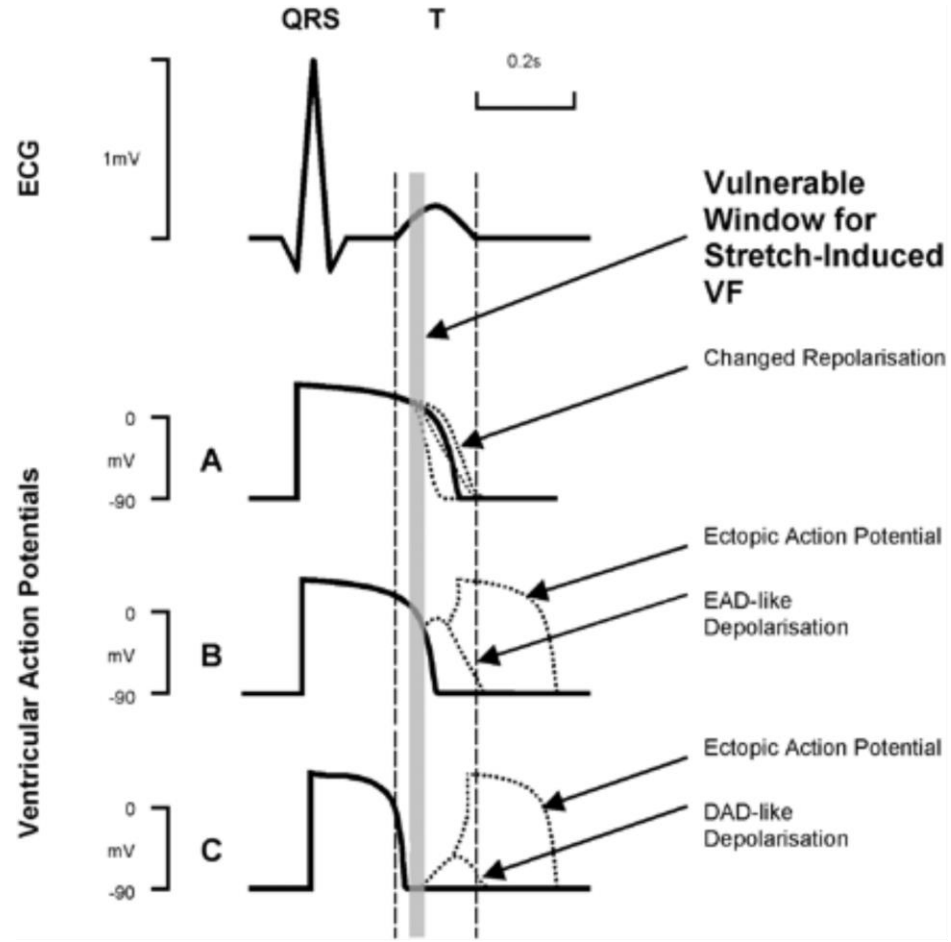
There may be a component of individual susceptibility to commotio cordis, similar to that of individual susceptibility to a prolonged QT interval, Brugada syndrome and torsade de pointes with drugs that affect cardiac repolarization channels.

Link MS et al:An experimental model of sudden death due to low-energy chest-wall impact (commotio cordis) N Engl J Med 1998 Jun 18;338(25):1805-11



From: Sudden cardiac death by Commotio cordis: role of mechano—electric feedback

Cardiovasc Res. 2001;50(2):280-289. doi:10.1016/S0008-6363(01)00194-8



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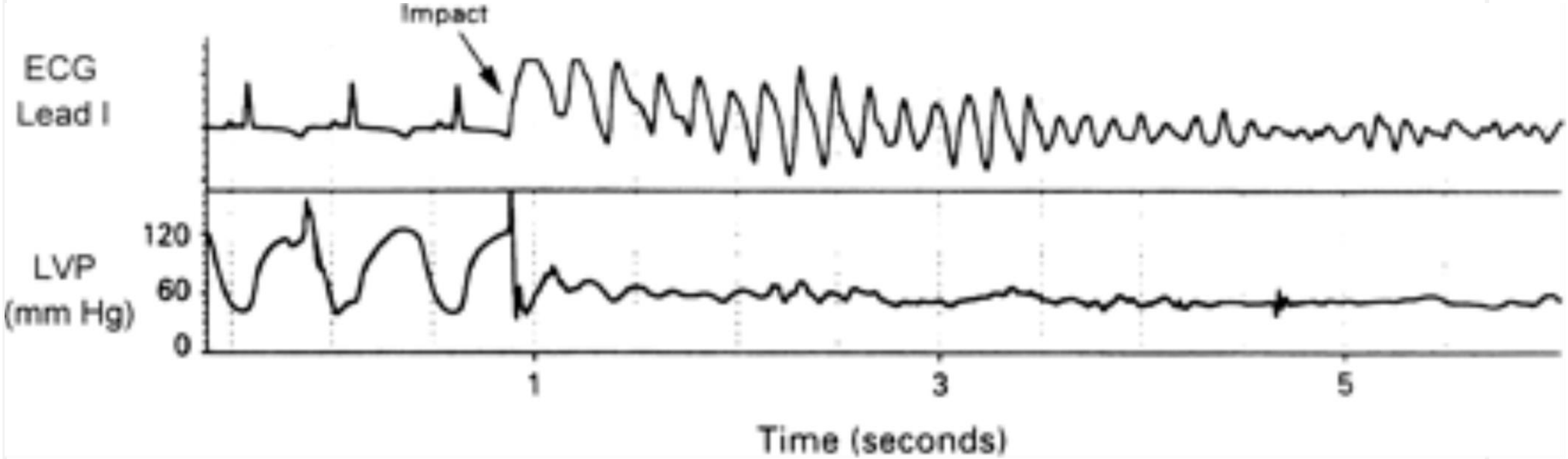

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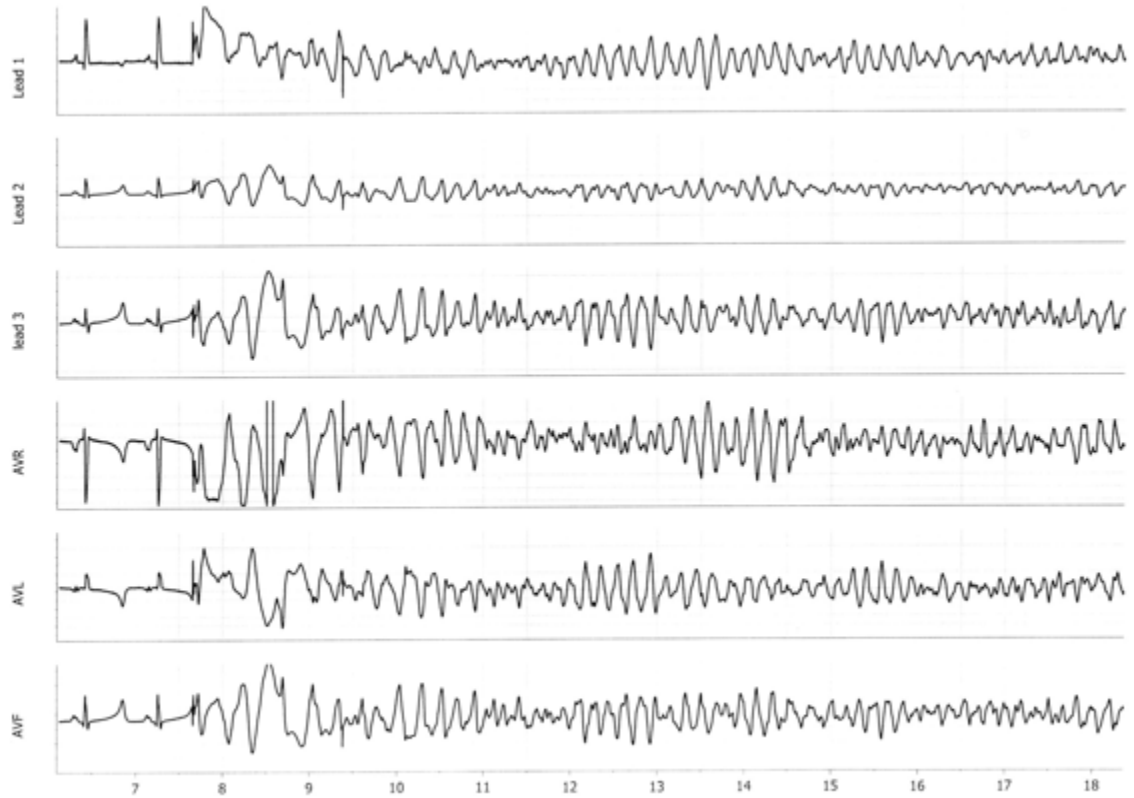
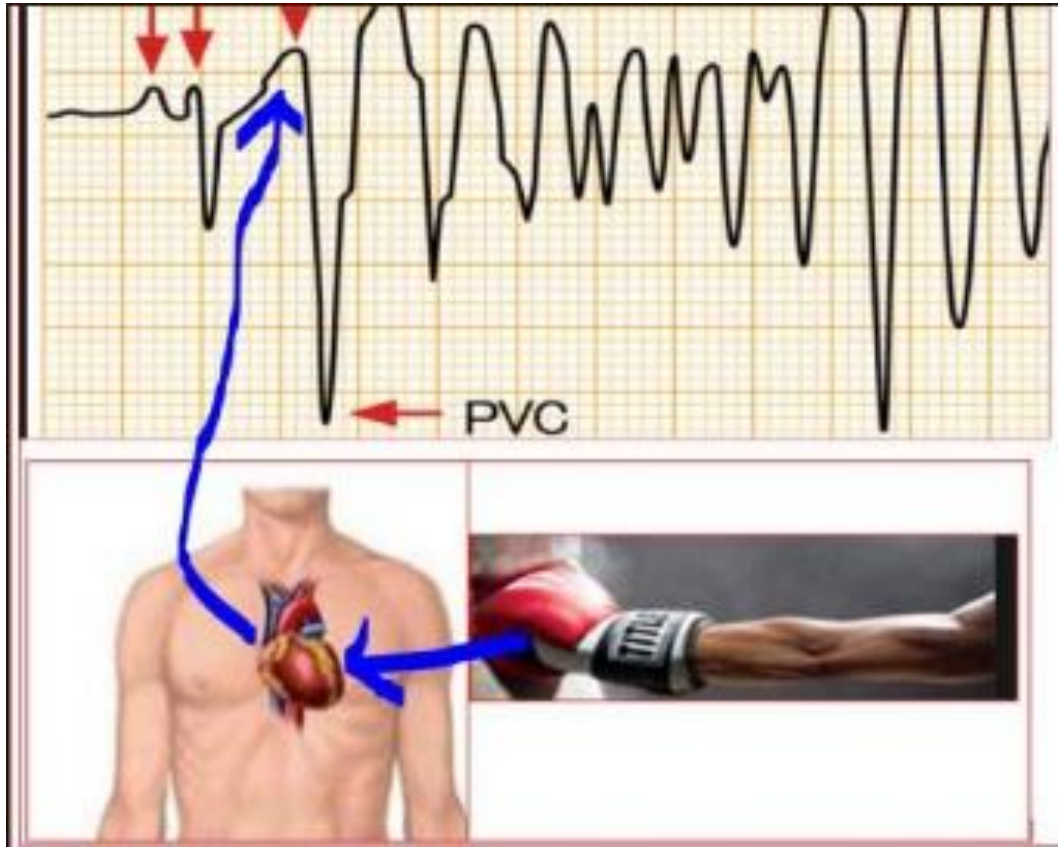


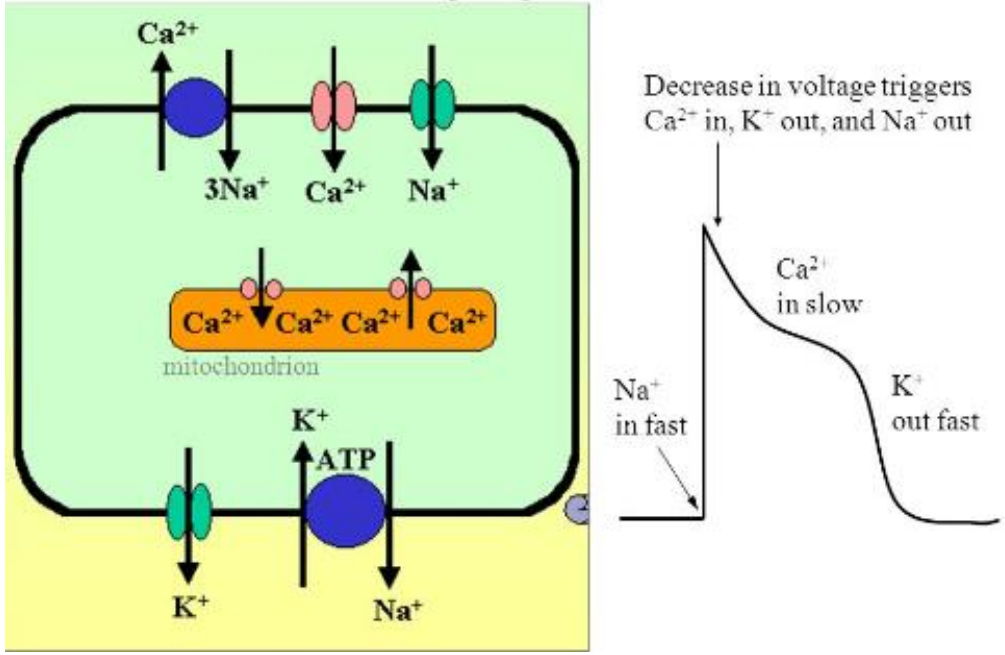
Mark S. Link Circ Arrhythm Electrophysiol. 2012;5:425-432

- This polymorphic ventricular tachycardia was identical in morphology to the initiation of ventricular fibrillation; however, it only continued for up to 10 beats. If the polymorphic ventricular tachycardia continued beyond 10 beats, it degenerated into ventricular fibrillation.

Temporal alteration of the myocardial substrate alone is not sufficient. There also must be a trigger, an initial ventricular arrhythmic depolarization. This trigger could be an afterdepolarization, such as is present in long-QT situations, or a premature ventricular depolarization (induced by the blow), as is present in the R-on-T phenomenon in acute ischemia. Support for this dual-abnormality hypothesis lies in the fact that in impacts that do not induce ventricular fibrillation, 2 predominant abnormalities are observed: that of alteration of repolarization as manifested by ST-segment elevation and that of a premature ventricular contraction.



Ion Channels and Transporters in Cardiac Myocytes

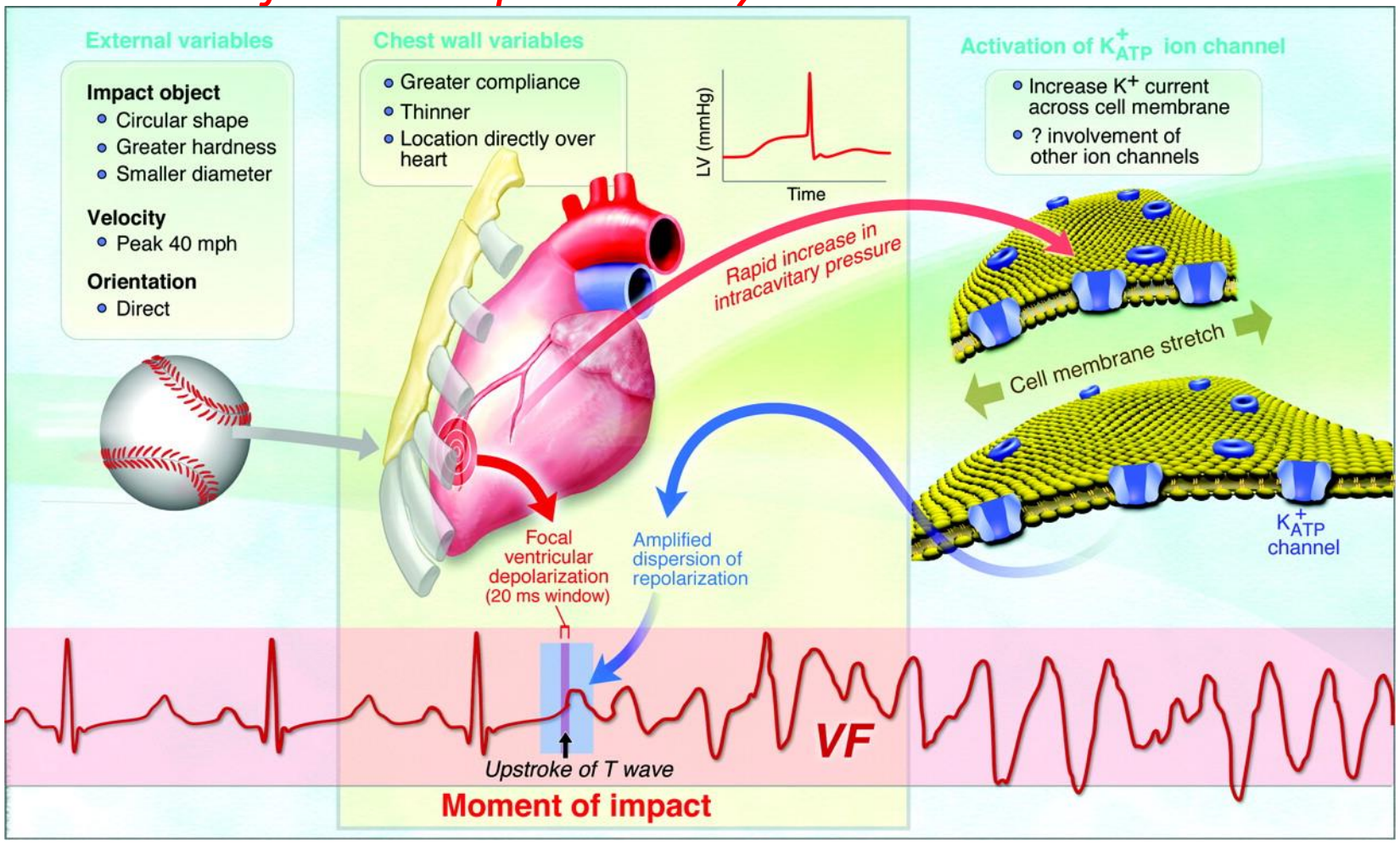


The candidate ion channels for the altered repolarization are those whose conduction is known to be altered by stretch or pressure changes. These channels include the calcium stretch-activated channel, the K_{ATP} channel, certain other known potassium and sodium channels, and possibly even some unknown channels.

Link MS et al:An experimental model of sudden death due to low-energy chest-wall impact (commotio cordis) N Engl J Med 1998 Jun 18;338(25):1805-11

.

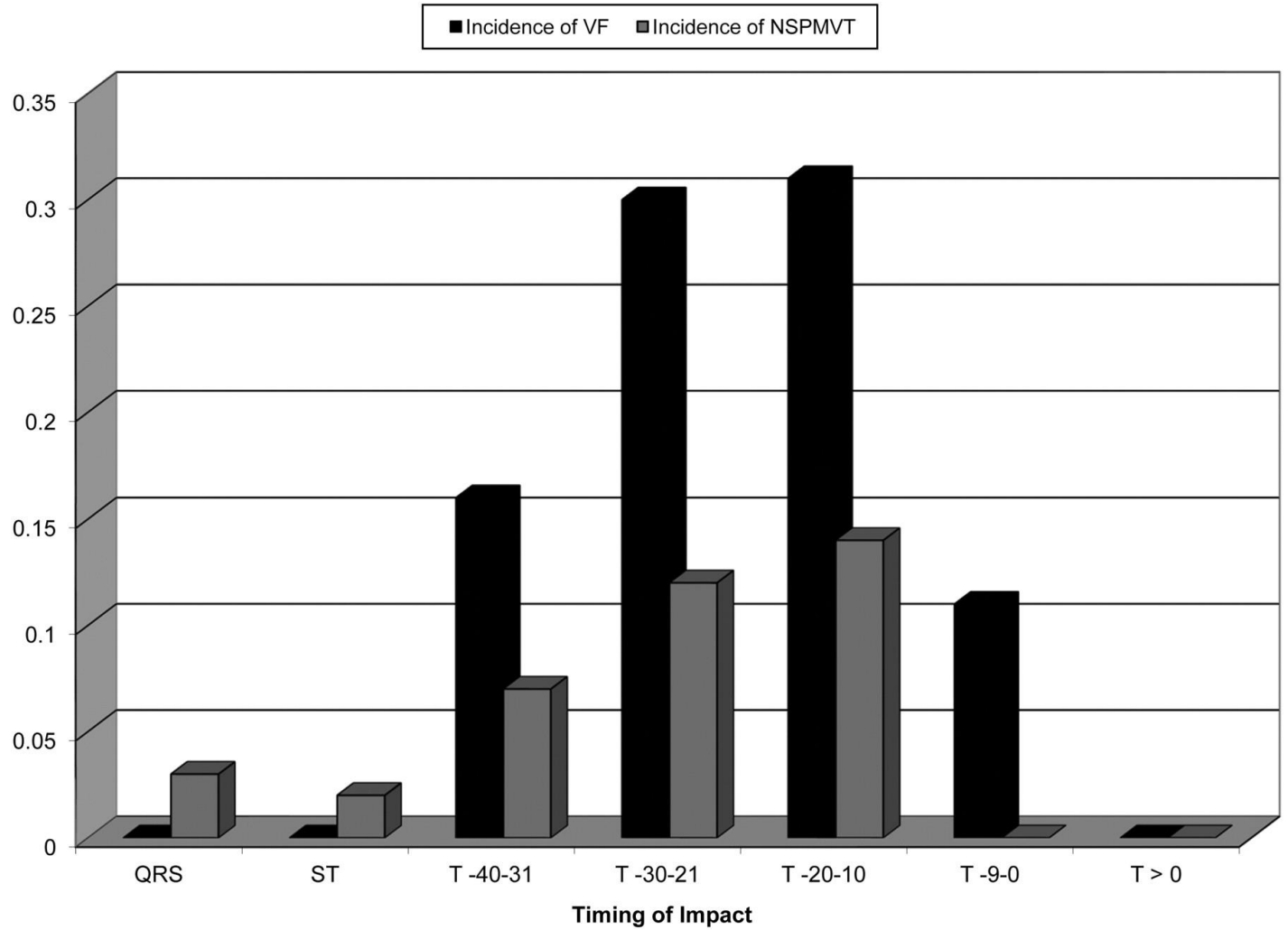
Activation of the K(+)(ATP) channel is a likely cause of the ventricular fibrillation produced by chest wall blows.



Mark S. Link Circ Arrhythm Electrophysiol. 2012;5:425-432

American Heart Association.

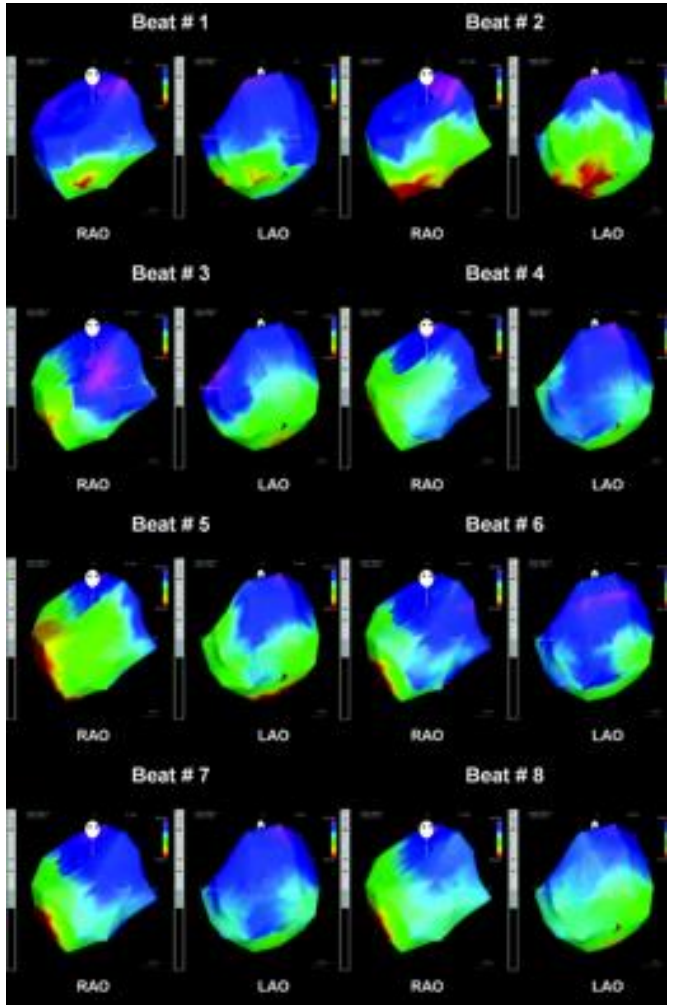
Incidence of ventricular fibrillation (VF) and nonsustained polymorphic ventricular tachycardia (NSPMVT) relative to the timing of the cardiac cycle.



VF was observed in approximately 30% of impacts that occurred in cardiac repolarization 30 to 10 ms before the T-wave peak (Mark S. Link Circ Arrhythm Electrophysiol. 2012;5:425-432)

Three-dimensional endocardial mapping of the first 8 beats of ventricular fibrillation in commotio cordis

- **Alsheikh-Ali AA, Akelman C, Madias C, Link MS. Endocardial mapping of ventricular fibrillation in commotio cordis. Heart Rhythm. 2008;5: 1355–1356**.



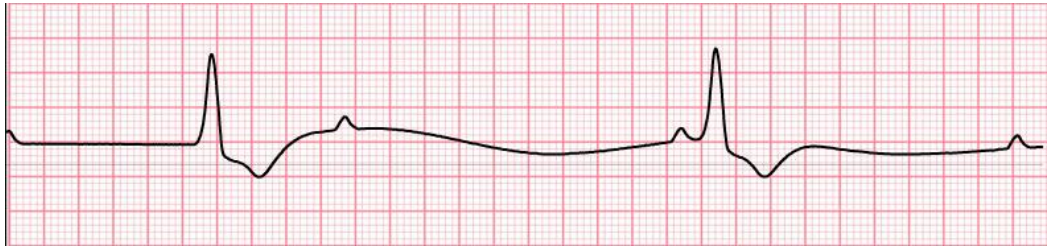
Annals of
Noninvasive Electrocardiology

Complete Heart Block Following a Blow on the Chest by a Soccer Ball: A Rare Manifestation of Commotio Cordis

Saurabh Thakar M.D., Preeti Chandra M.D., Manali Pednekar M.D., Chaim Kabalkin M.D., Jacob Shani M.D.

First published: 23 July 2012 | https://doi.org/10.1111/j.1542-474X.2012.00518.x | Cited by: 4

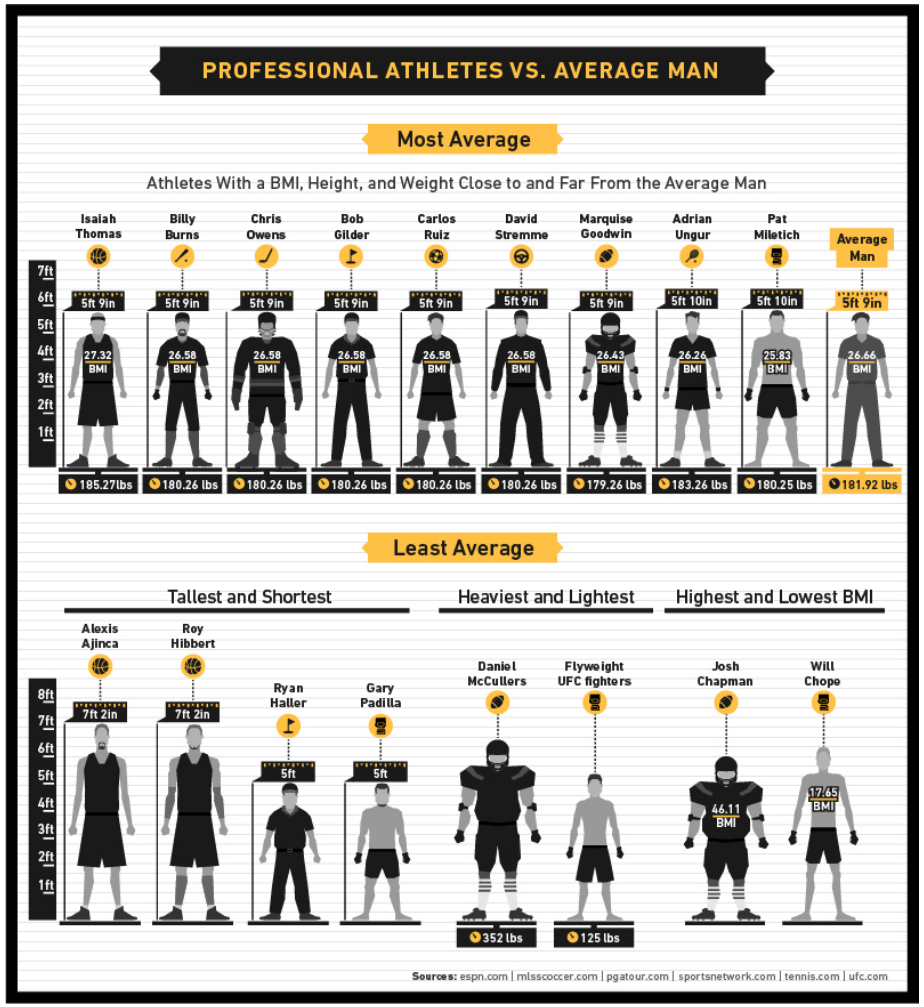
A case of a young patient who presented with a persistent third-degree atrioventricular block and a left bundle branch block, following blunt chest trauma, as a result of blow by soccer ball and subsequently needed a permanent pacemaker.

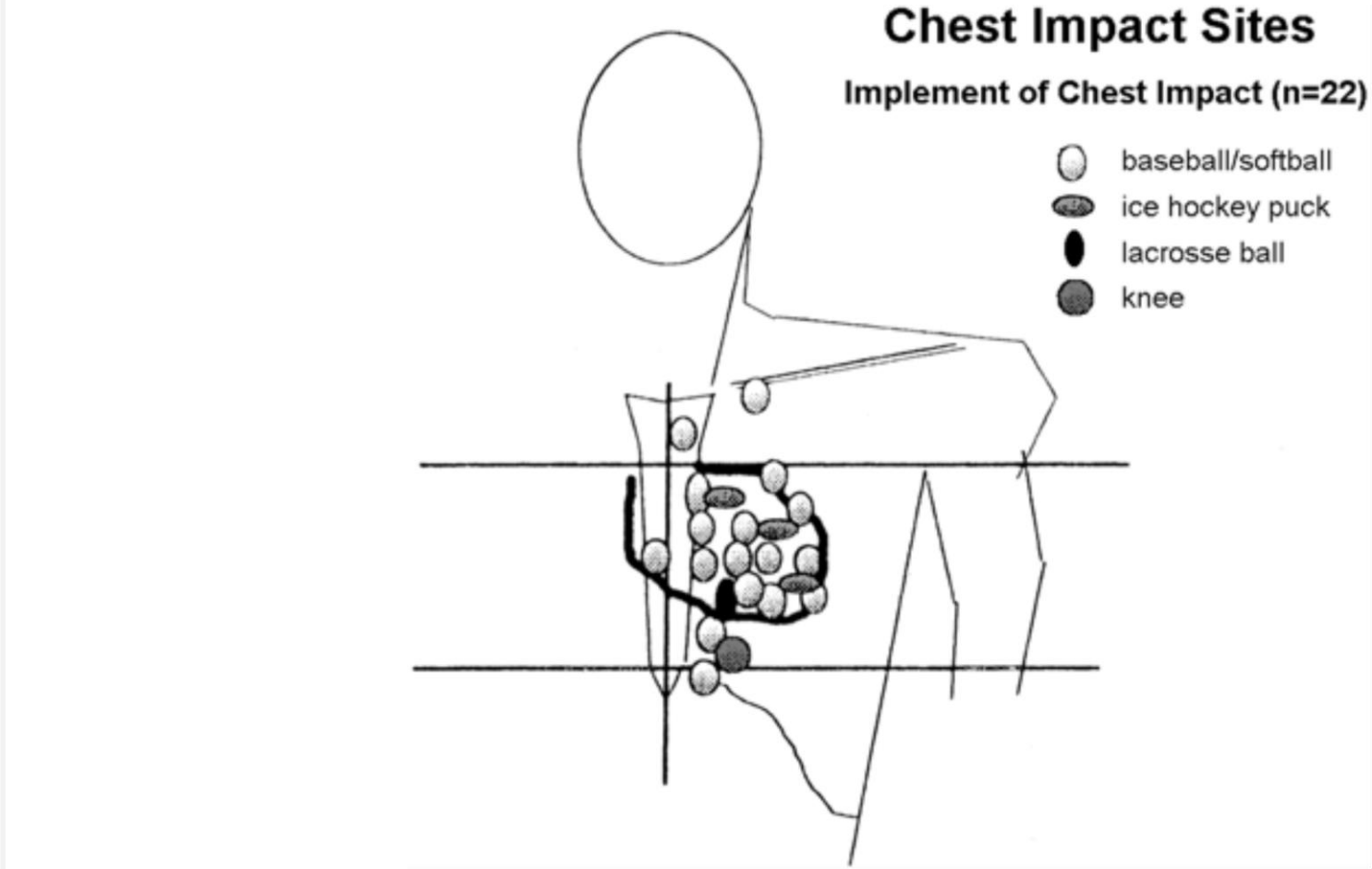


Size as an Important Determinant of Chest Blow-induced Commotio Cordis.

An increase in size of the individual, rather than reduced play of ball sports is the likely reason for the decreased commotio cordis incidence in older individuals .

(Madias C., Maron B. et al..Med Sci Sports Exerc. 2018).





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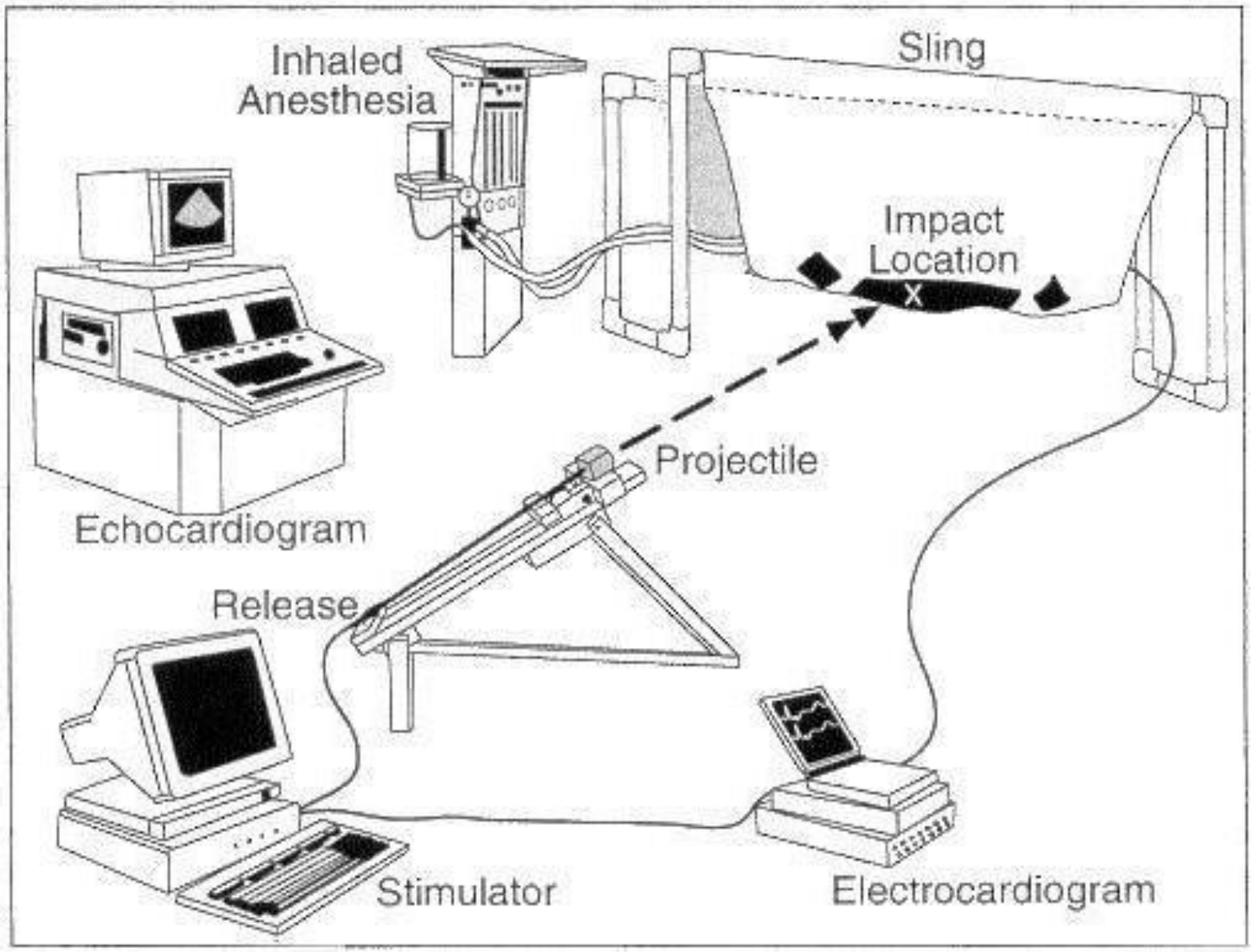
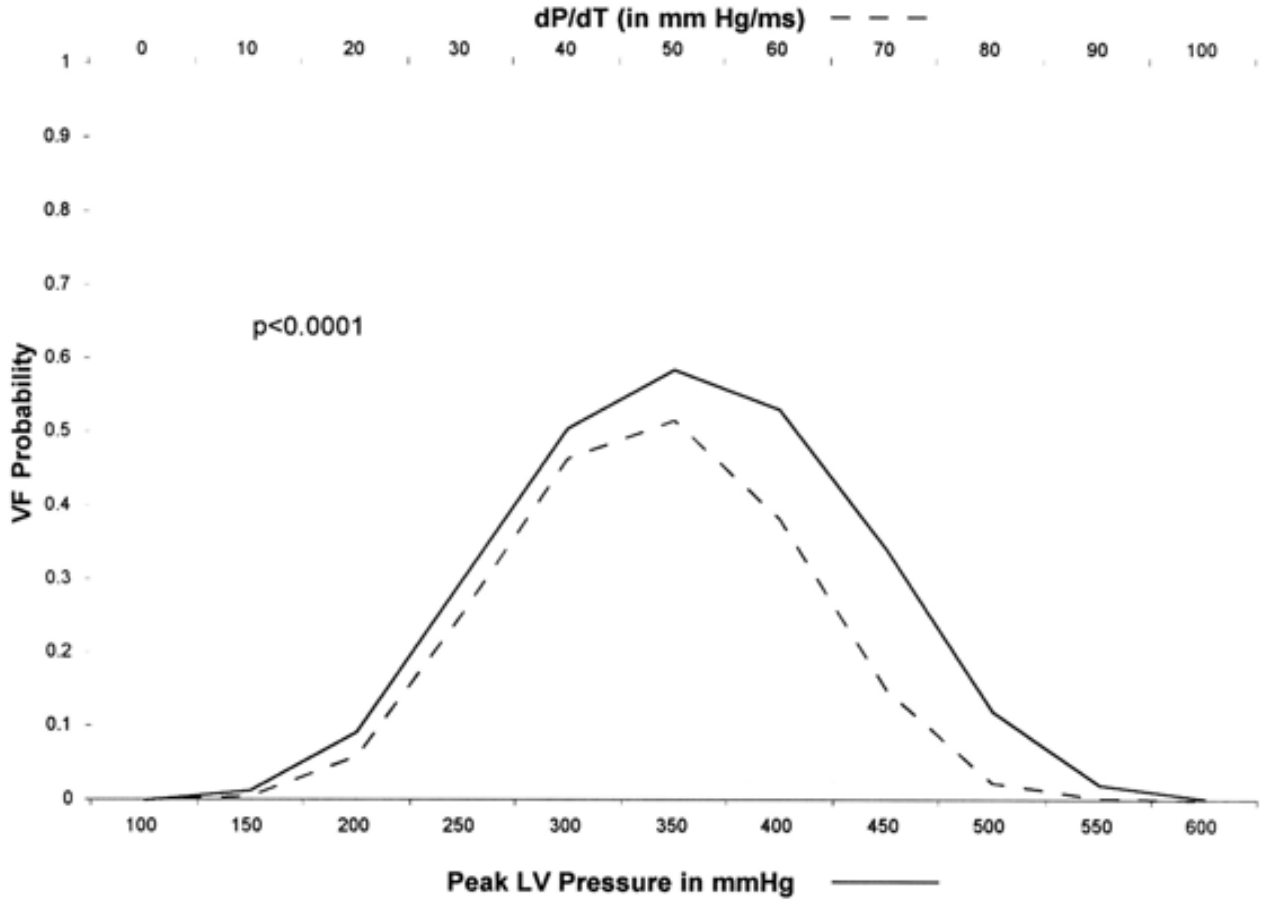

Inhaled
Anesthesia
Sling
Impact
Location
X
Projectile
Echocardiogram
Release
Stimulator
Electrocardiogram

The minimum pressure necessary to induce ventricular fibrillation appears to be 250 mm Hg, and the optimal increase is 400 to 500 mm Hg .Higher-velocity impacts that cause pressure increases of >600 mm Hg typically cause structural damage such as myocardial rupture and acute mitral valve insufficiency.

Montgomery J. and Poden D.Heart Rhythm Case Rep. 2015 Jul; 1(4): 172–175

The association of peak left ventricular (LV) pressure induced by the chest blow and the incidence of ventricular fibrillation (VF).



Mark S. Link Circ Arrhythm Electrophysiol. 2012;5:425-432

Energy of the impact object was also found to be a critical variable with 40 mph baseballs more likely to cause ventricular fibrillation than velocities less or greater than 40 mph. In addition, more rigid impact objects and blows directly over the center of the chest were more likely to cause ventricular fibrillation.

Genetic Susceptibility ?

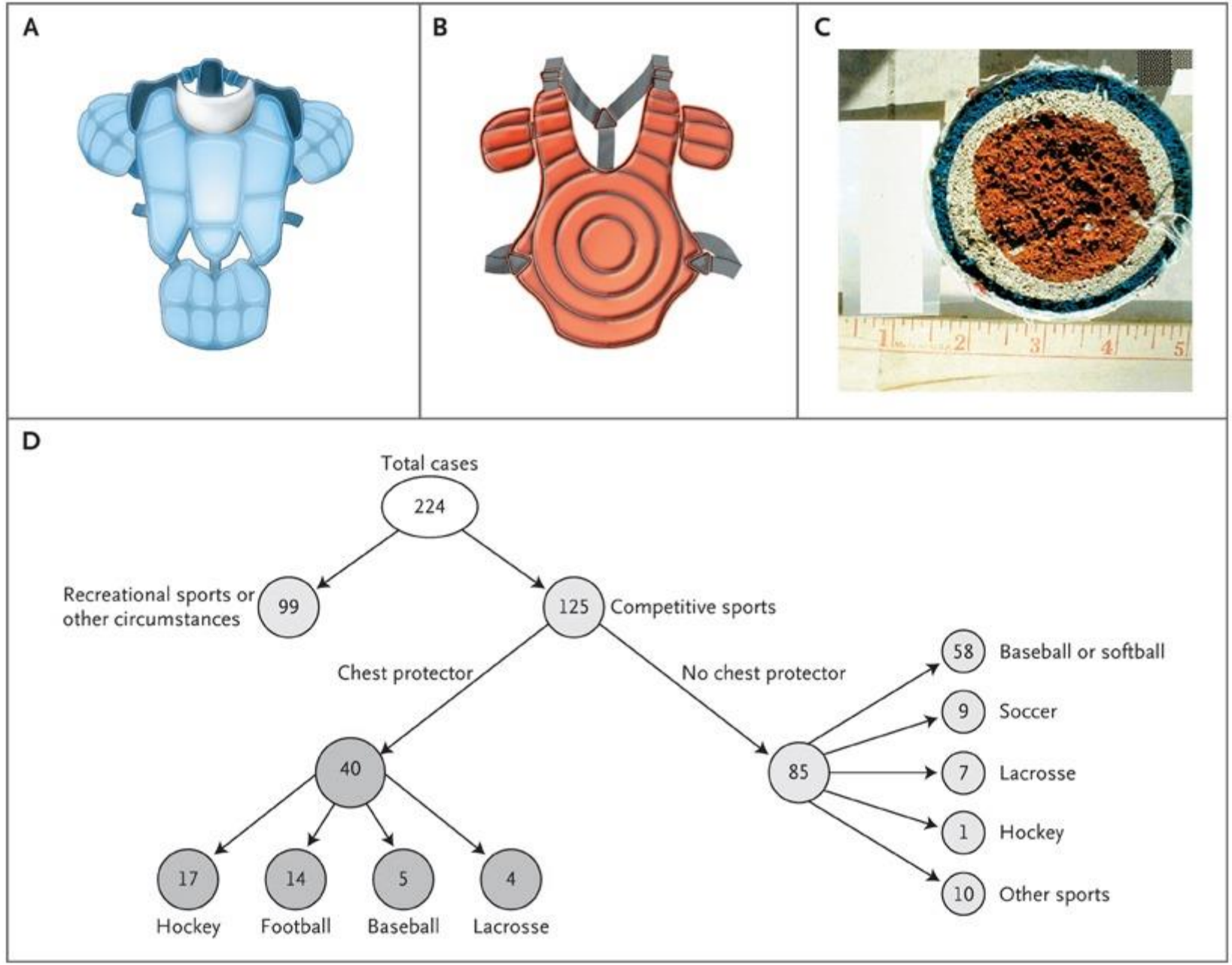
- **In this study of 1274 total impacts in 139 swine, 360 impacts (28%) resulted in ventricular fibrillation; however, in 38 animals, none of the impacts resulted in ventricular fibrillation, and only 7 swine (5%) had >80% occurrence of ventricular fibrillation with chest impacts. On the basis of that swine study, they believe that the animals that exhibit unique susceptibility to ventricular fibrillation with chest impact may carry indolent forms of long-QT syndrome.**

Prevention of Commotio Cordis

- These safety baseballs are available in different degrees of hardness. Safety baseballs marketed for T-ball are quite pliable and elastic; however, there are more playable balls for older age groups that are intermediate in pliability between the T-balls and standard baseballs
- Chest protectors are another potential means to prevent commotio cordis; however, their benefit has not yet been shown.

Prevention

While softer-than-standard safety baseballs reduce the risk of CC, commercially available chest protectors are ineffective in preventing CC. The development of more effective chest protectors and more widespread use of automated external defibrillators at youth sporting events are needed (Madias C.,Maron B. et al J Cardiovasc Electrophysiol 2007 Jan;18(1):115-22).

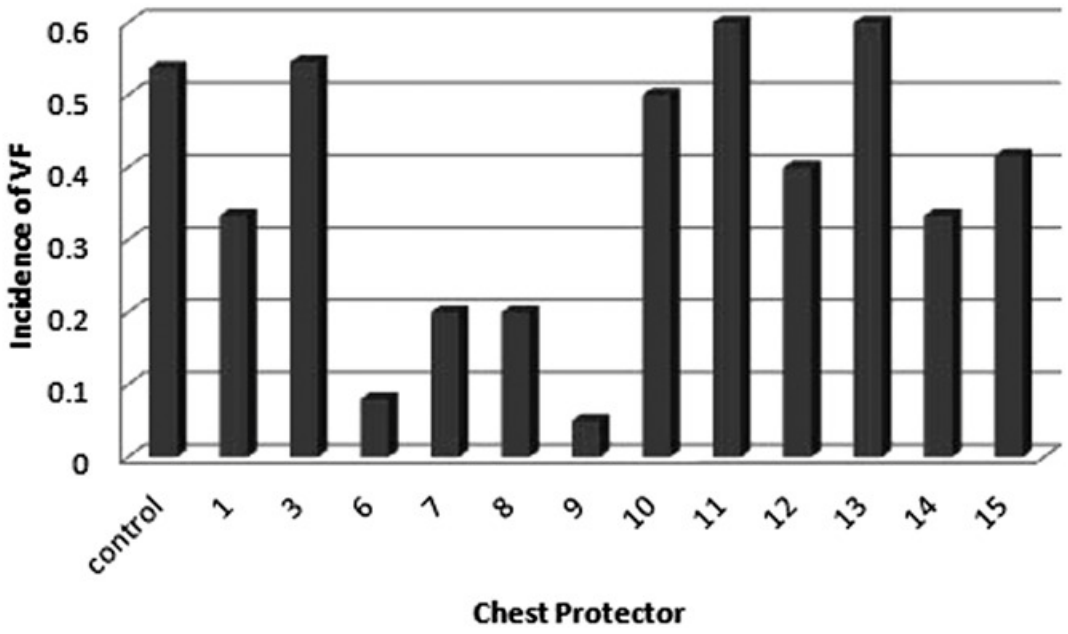

A
B
C
D
Total cases
224
Recreational sports or other circumstances
99
125
Competitive sports
Chest protector
No chest protector
40
85
17
Hockey
14
Football
5
Baseball
4
Lacrosse
58
Baseball or softball
9
Soccer
7
Lacrosse
1
Hockey
10
Other sports

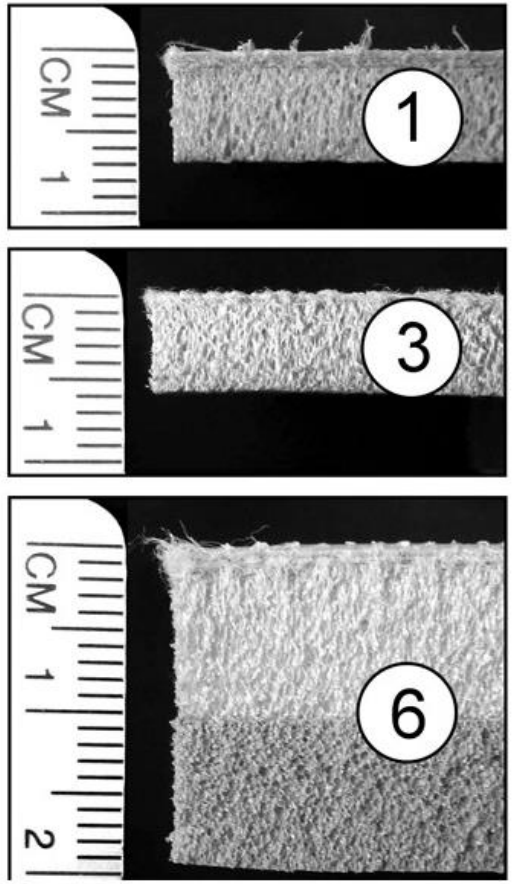
Development of a Chest Wall Protector Effective in Preventing Sudden Cardiac Death by Chest Wall Impact (Commotio Cordis).

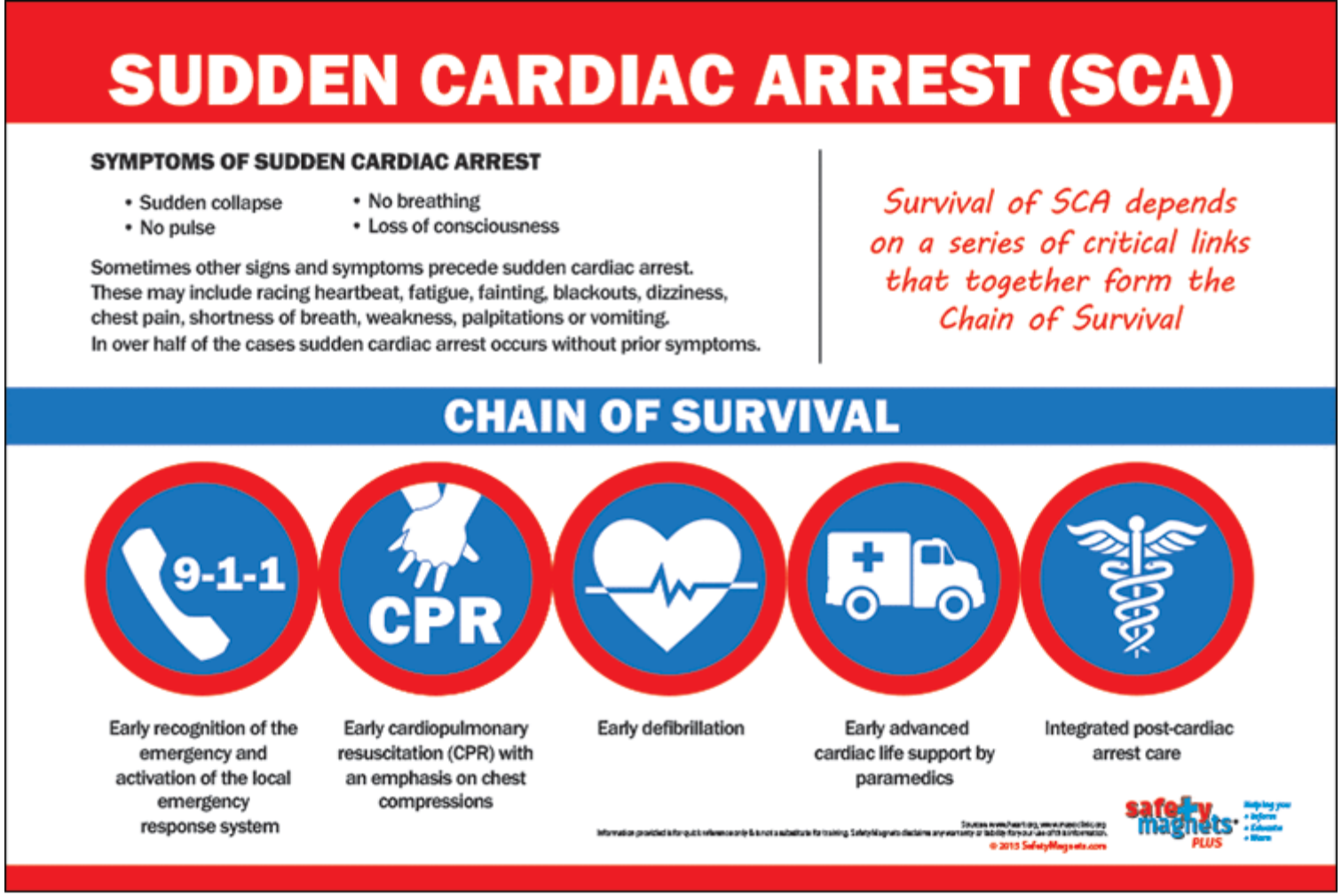
PMC full text: Clin J Sport Med. 2017 Jan; 27(1): 26–30.
Published online 2016 Dec 23. doi: 10.1097/JSM.0000000000000297

<< Prev FIGURE 5. N

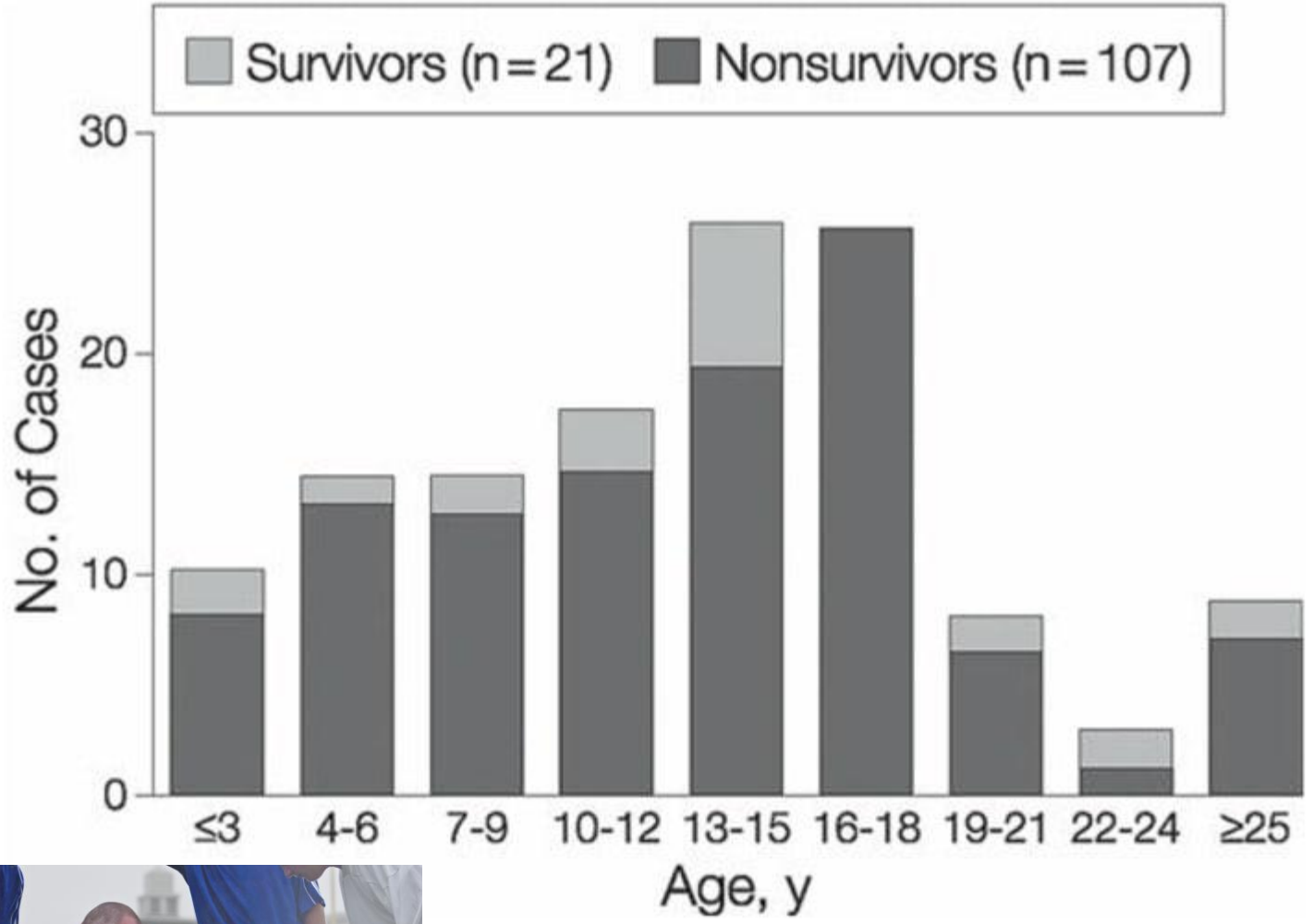
FIGURE 5.

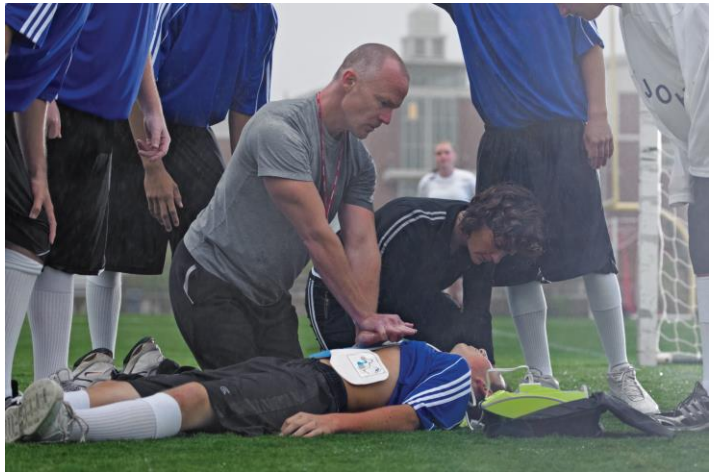




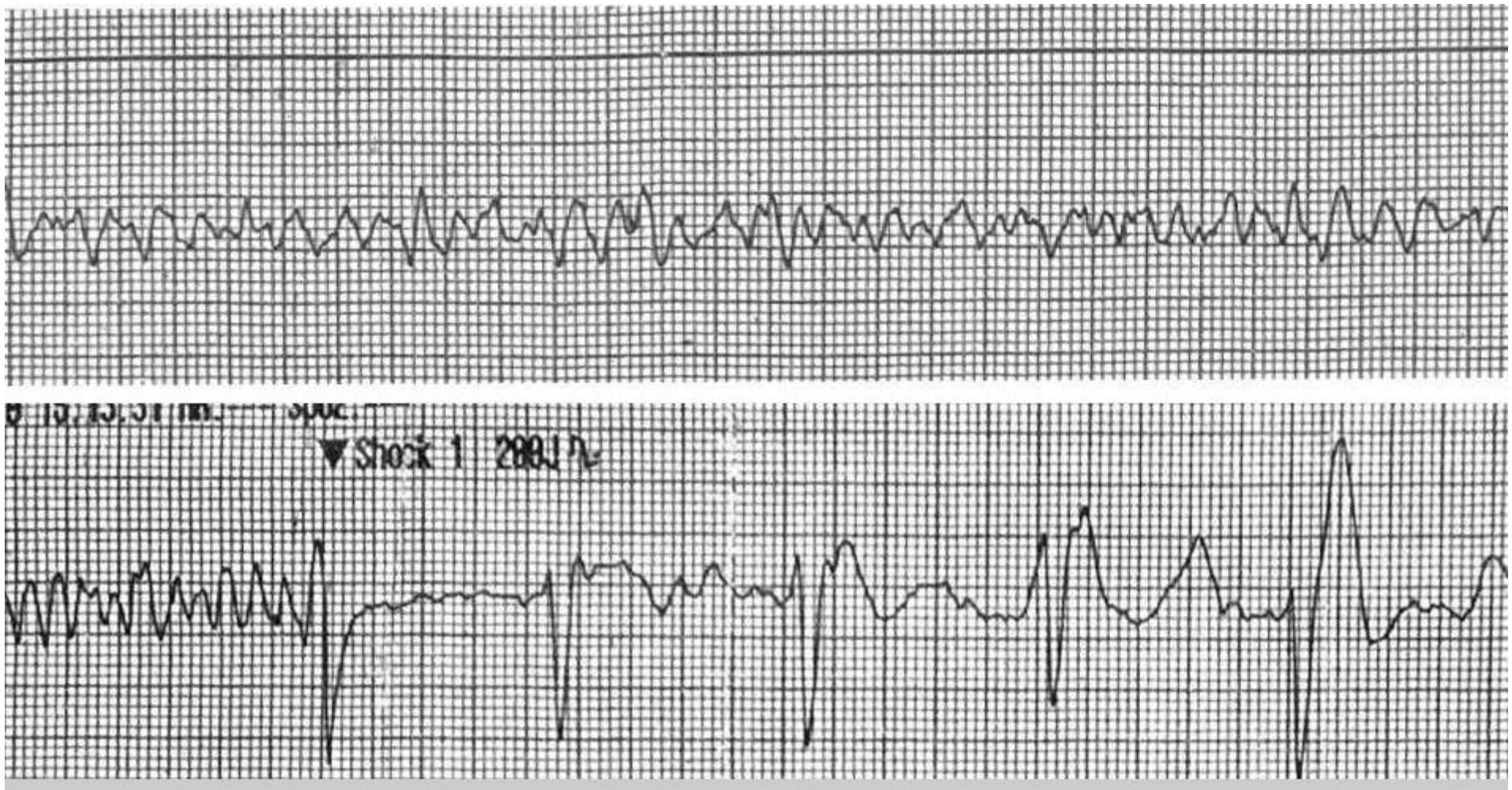


Educational campaigns among students, closer team surveillance, implementation of the sports arenas with adequate rescue devices and medical assistance remain mandatory items in contact sports activity. ***(Class I; Level of Evidence B)***.

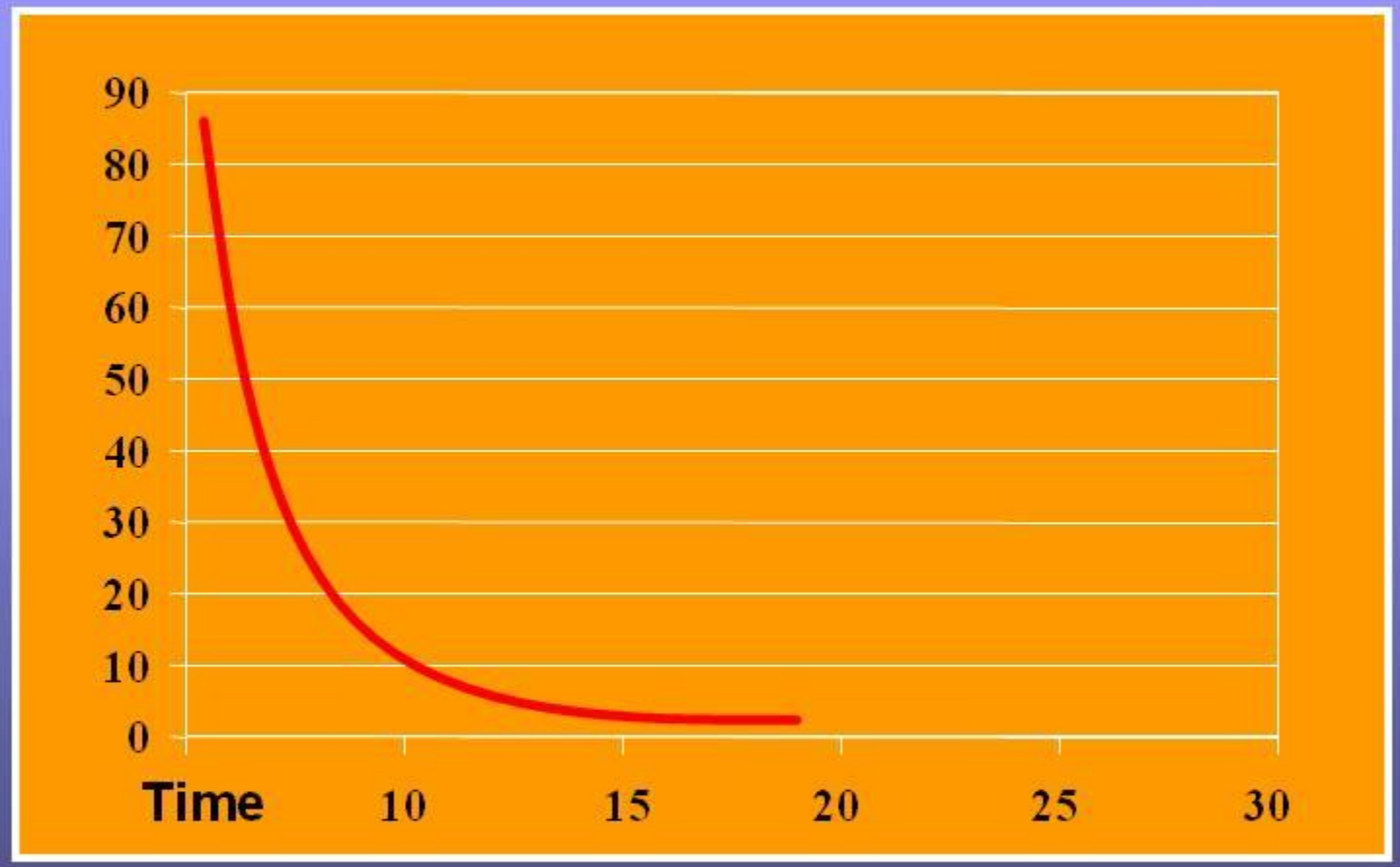

Survivors (n=21)
Nonsurvivors (n=107)
No. of Cases
30
20
10
0
≤3
4-6
7-9
10-12
13-15
16-18
19-21
22-24
≥25
Age, y




Initial Rhythm


Shock 1

Survival is reduced by 7-10% for each minute that defibrillation is delayed



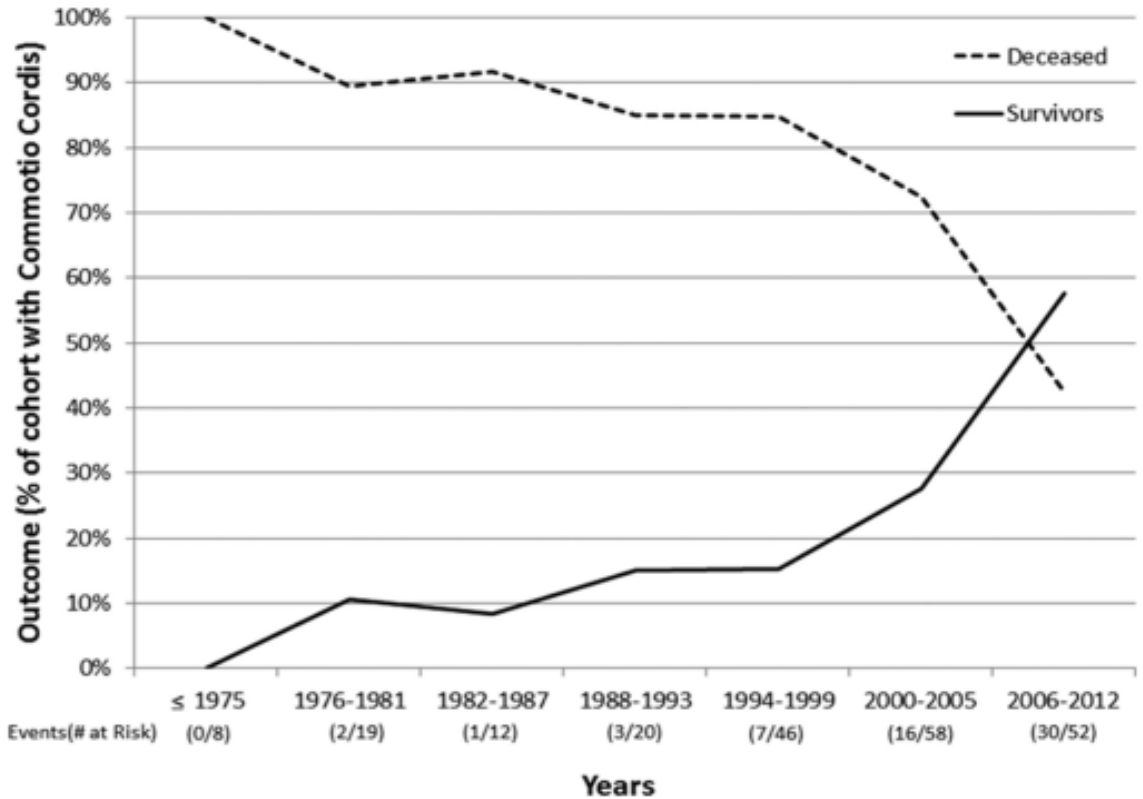
To extend life,
on-site action is essential …

AHA/ACC SCIENTIFIC STATEMENT

Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Task Force 13: Commotio Cordis (Mark S. Link, N.A. Mark Estes, Barry J. Maron)

1.A comprehensive evaluation for underlying cardiac pathology and susceptibility to arrhythmias should be performed in survivors of commotio cordis[2,4] *(Class I; Level of Evidence B*).
2.It is reasonable to use age appropriate safety baseballs to reduce the risk of injury and commotio cordis[6,8] *(Class IIa; Level of Evidence B*).
3.Rules governing athletics and coaching techniques to reduce chest blows can be useful to decrease the probability of commotio cordis *(Class IIa; Level of Evidence C)*.
4.If no underlying cardiac abnormality is identified, then individuals can safely resume training and competition after resuscitation from commotio cordis *(Class IIa; Level of Evidence C)*.

Increasing survival from commotio cordis reported to the national Commotio Cordis Registry.



Mark S. Link et al. Circulation. 2015;132:e339-e342

American Heart Association.

More.....


Cardiac Risk in the Young
Professor Sanjay Sharma discusses
"commotio cordis with regards to young sudden cardiac death.."