THE HEART OF THE MATTER: CARDIOVASCULAR EMERGENCIES DURING COMPETITION

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Case # 1

- 14 year old high school student playing goal in a lacrosse game was screened by an offensive player and was struck in the chest by the ball.
- He stumbled forward and collapsed face down, unconscious. His teammates surrounded him imploring him to breath and it was several minutes before CPR was begun and EMS called.
- His initial rhythm was ventricular fibrillation and he was defibrillated to a supraventricular rhythm and transferred to the local hospital ED.
Case # 1 (continued)

- He remained hemodynamically unstable overnight requiring pressor and ventilator support. Unfortunately, he never regained consciousness, was deemed to be brain dead and removed from life support the following day.
- Diagnosis: Commotio cordis secondary to being struck in chest by projectile

Commotio Cordis

- From Latin: “Agitation of the Heart”
- Impact of object on chest wall causes ventricular fibrillation and cardiac arrest
  - Hard, spherical objects most frequently:
    - Baseball
    - Softball
    - Lacrosse ball
    - Hockey puck
  - Much less frequently, soccer ball or fist
- Mortality rate very high, although more recent registry data demonstrates improvement to 58%

- Most victims are young and male
  - Median age 15 in USA, 19 internationally
  - Related to exposure to “projectile” sports
  - Also due to increased flexibility of chest wall
  - Males may have increased predisposition to SCD
- Bad timing, bad location
  - Narrow electrical window (upslope of T wave)
  - Directly over the left ventricle
  - Compression of chest wall impinges on LV, suddenly increasing LV pressure (ST elevation)
  - In some respects, resemble VF during acute MI
“R on T” Phenomenon in Setting of Acute Myocardial Infarction

Commotio Cordis

- Object velocity important in precipitating VF
  - Likelihood of VF increases up to ~ 40 mph
  - Direct, rather than glancing blow required
- Commercially-available chest protectors are not effective (may not prevent compression of pliable chest wall)
- Immediate CPR and defibrillation are necessary to prevent death and permanent neurological damage

Case # 2

- 34 year old man, competitive cyclist, fell from his bicycle after passing out. No serious injury
- He had ascending a steep grade with maximal effort and stopped pedaling when he reached the summit. He immediately felt very lightheaded and did not remember falling to the ground.
- He admitted to having milder episodes of lightheadedness in the past following exertion.
- Physical exam, ECG, and echocardiogram normal.
- Had significant drop in systolic BP in early recovery on a treadmill exercise test.
- Diagnosis: Post-Exertional Syncope
Case # 3

- 27 year old woman referred to evaluate episodes of exertional pre-syncope and syncope
- She was a jogger who had noted episodes of lightheadedness while running and at times needed to sit or lie down to avoid passing out.
- Prior to referral, had frank syncope while walking on level ground.
- No associated nausea or other symptoms.

Case # 3 (continued)

- Physical examination unremarkable
- Transthoracic echocardiogram demonstrated asymmetrical septal hypertrophy (ASH) without evidence of outflow obstruction
- Treadmill exercise echo/Doppler stress test performed:
  - Drop in systolic blood pressure at peak exercise with onset of lightheadedness
  - No evidence of dynamic outflow obstruction
- Diagnosis: Hypertrophic Cardiomyopathy (HCM) with high-risk features
- Referred to HCM expert – ICD implantation

Case # 3 (continued)
Asymmetric Septal Hypertrophy
Syncope in the Athlete

- Syncope is a very common problem
  - Estimated lifetime prevalence ~ 40%
  - One screening survey in athletes documented syncope in 6.2% in the previous 5 years
- Should consider the episode of syncope in chronological context
  - Syncope unrelated to exercise
  - Post-exertional syncope
  - Syncope occurring during exercise

Syncope in the Athlete

- Syncope unrelated to exertion
  - ~ 85% of cases
  - Neurocardiogenic or vasovagal syncope
  - May be due to reduced venous return when standing
  - May be induced by noxious stimulus (sight of blood, unpleasant odor)
  - Sometimes caused by bearing down to pass stool or with micturition
  - Dehydration may cause orthostatic hypotension

Syncope in the Athlete

- Post-exertional syncope
  - Abrupt termination of exercise leads to reduced venous return from lower extremities
  - Reduced venous return will reduce RV and LV filling $\Rightarrow$ enhanced adrenergic tone
  - Increased contractility may cause the Bezold-Jarisch reflex (vagal)
  - Decreased vascular tone and inappropriate bradycardia $\Rightarrow$ hypotension, decreased cerebral perfusion and syncope
  - Potentiated by dehydration/reduced plasma volume
Syncope during exercise – cause for concern
- May indicate presence of structural heart disease
  - Hypertrophic cardiomyopathy
  - Anomalous coronary artery origin
  - Arrhythmogenic right ventricular dysplasia (ARVD)
  - Cardiomyopathy (non-compaction, infiltrative)
  - Myocarditis
  - Presence of bypass tract (Wolff-Parkinson-White)
- May indicate presence of ion channelopathy
  - Brugada syndrome
  - Long QT syndrome (LQTS)

All patients merit a careful evaluation
- Detailed history from athlete and witnesses to the syncopal event (including family Hx)
- Prodromal symptoms (lightheadedness/chest pain)
- Duration of syncope, presence of seizure activity
- Thorough physical exam
- ECG (LVH, ST-T wave changes, evidence of channelopathy or bypass tract)
- Echocardiogram
- Rhythm monitor (24 Holter or continuous loop)
- Exercise test to reproduce condition leading to syncope
- Possibly cardiac CT scan or MRI

Case # 4
- 45 year old active man has been noting mild lightheadedness, sense of racing heartbeat, and chest tightness while running
- Cardiopulmonary exam normal except for widely split S2
- Has chronic RBBB on ECG
- 24 hour Holter monitor recording demonstrated some isolated ventricular premature beat
- Referred for stress echocardiogram
Case # 4 (continued)
- Approaching peak exercise

At peak exercise (mildly lightheaded)

He developed lightheadedness similar to prior episodes
- The narrow-complex tachycardia spontaneously terminated with resumption of sinus rhythm in the 1st minute of recovery.
- Diagnosis: Probable atrioventricular node re-entry tachycardia (PSVT)
- Placed on low-dose beta blocker
Supraventricular Tachycardia

- A variety of rhythms possible
  - Atrial fibrillation is the most common arrhythmia in athletes
    - Association with endurance running
    - May be secondary to left atrial enlargement
    - Atrial flutter may occur with right atrial enlargement
  - Atrioventricular node re-entrant tachycardia (AVNRT)
  - Atrioventricular reciprocating tachycardia (AVRT) due to bypass tracts (W-P-W)
  - Automatic atrial tachycardia

Supraventricular Tachycardia

- Common symptoms
  - Abrupt onset when arrhythmia occurs
  - Palpitations – awareness of rapid heart rate
  - Breathlessness
  - Chest tightness
  - Lightheadedness
- Arrhythmia may terminate spontaneously
  - Sinus rhythm likely present by the time ECG obtained
  - May require long-term monitoring to ID the rhythm
  - Re-entrant rhythms (AVNRT or AVRT) may terminate with Valsalva or carotid sinus massage

Supraventricular Tachycardia

- Medications may prevent re-entrant rhythms or slow AV node conduction of atrial fibrillation/atrial flutter
  - Beta blockers
  - Calcium channel blockers
- Radiofrequency ablation may be necessary to eliminate the re-entrant pathway
  - If W-P-W is present, concern about possible dangerously rapid rhythm if atrial fibrillation occurs
Irregular Wide-Complex Tachycardia

Wolff-Parkinson-White Syndrome

Delta Waves

References