



# Can Extreme Exercise Precipitate Arrhythmias in Young Athletes

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**Research Institute for Sport & Exercise Sciences**  
FACULTY OF SCIENCE



# SCIENCE and the MEDIA

**Circulation**

**Persistent and reversible cardiac dysfunction among amateur marathon Runners (Neilan 2006)**

**The Boston Globe**

**Runners who don't train well can have marathon of miseries. April 17<sup>th</sup>**

**THE TIMES**

**Ironman athletes put hearts at risk of fatal damage, experts warn. January 22<sup>nd</sup>**

**THERE is mounting evidence that endurance athletes risk damaging their hearts if they over-train.**

In the wake of the revelation that Beijing Olympian Erin Densham has become Australia's third world-class triathlete to experience heart problems, there are calls for elite endurance athletes to be more closely monitored.

Former world champions Greg Welch (2000) and Emma Carney (2004) were both forced into retirement after developing ventricular tachycardia, which caused their hearts to race out of control. Both have had cardiac defibrillators implanted in their chests to shock their hearts back into a normal rhythm.



- 1) Athletes, coaches, scientists and clinicians are worried (SCD!)
- 2) Is the risk real .... What's the message for CV health?

# Exercise is Good: Impact on

- Morbidity and mortality
- High blood pressure
- High cholesterol
- Markers of inflammation
- Improves vascular function
- Improves cardiac function
- **EXERCISE is a CV “Polydrug”**

# Acute bouts of prolonged unremitting and exhaustive exercise





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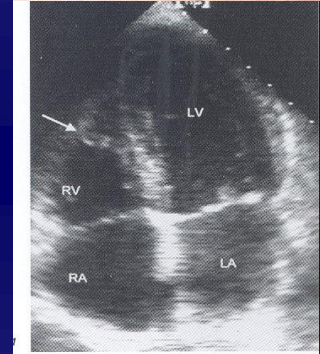


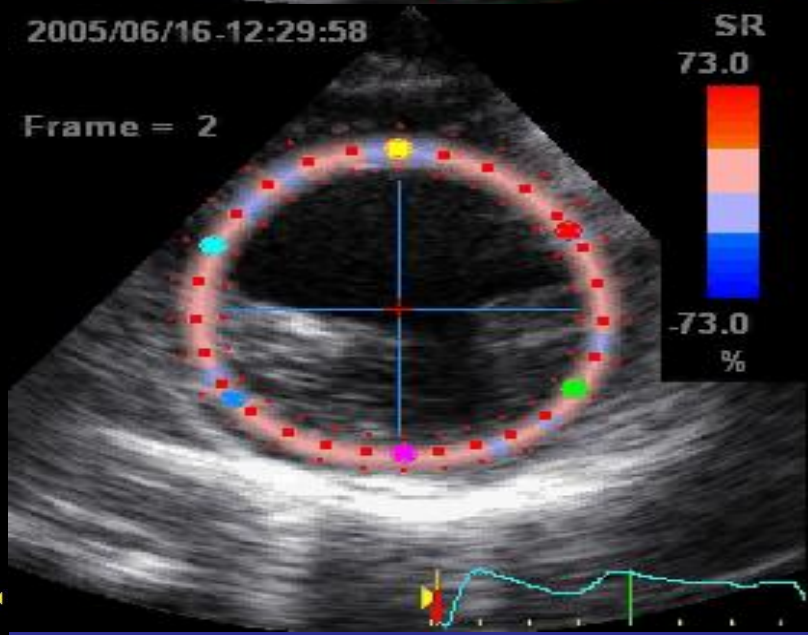
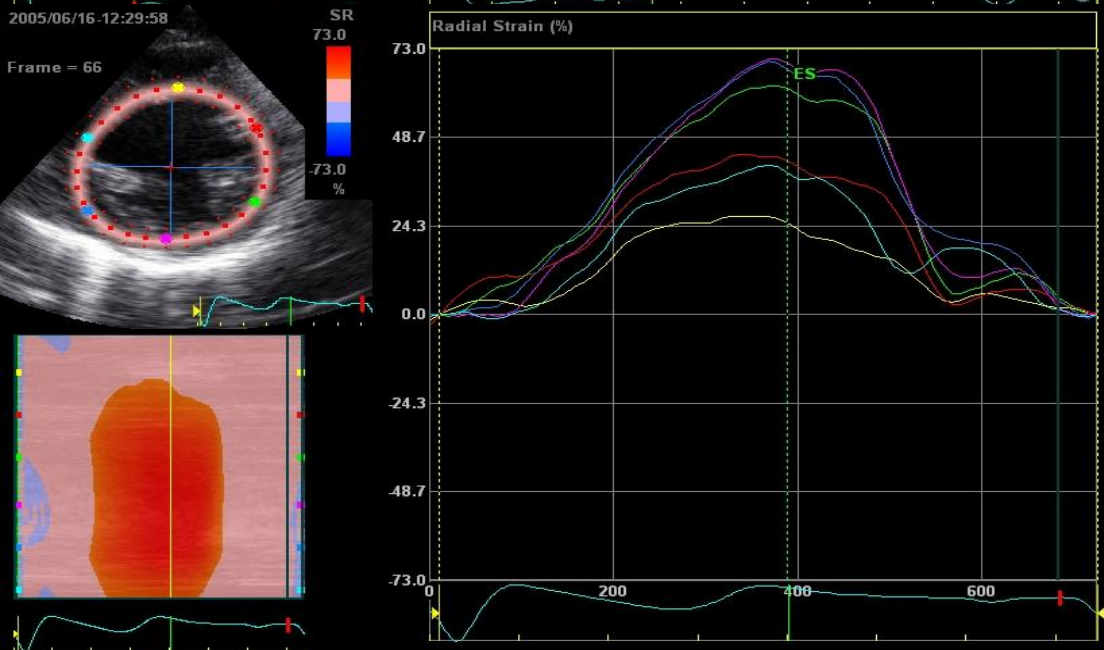
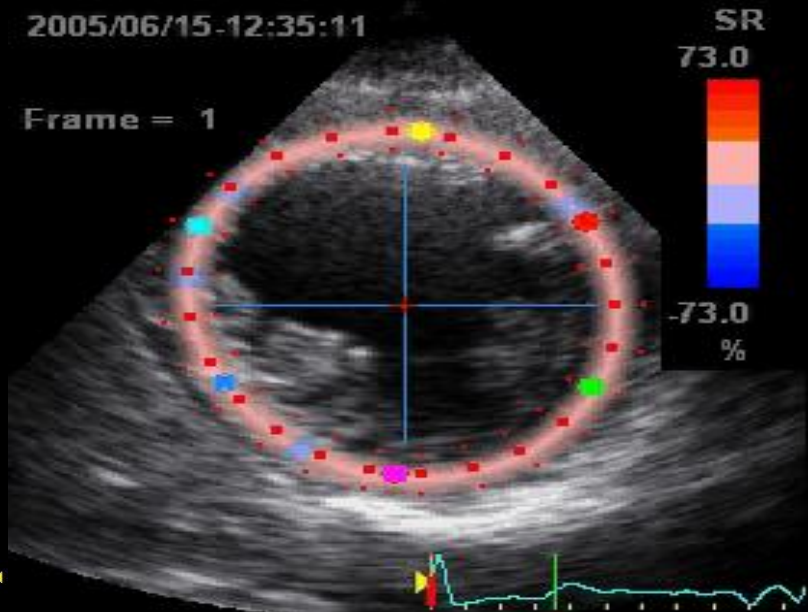
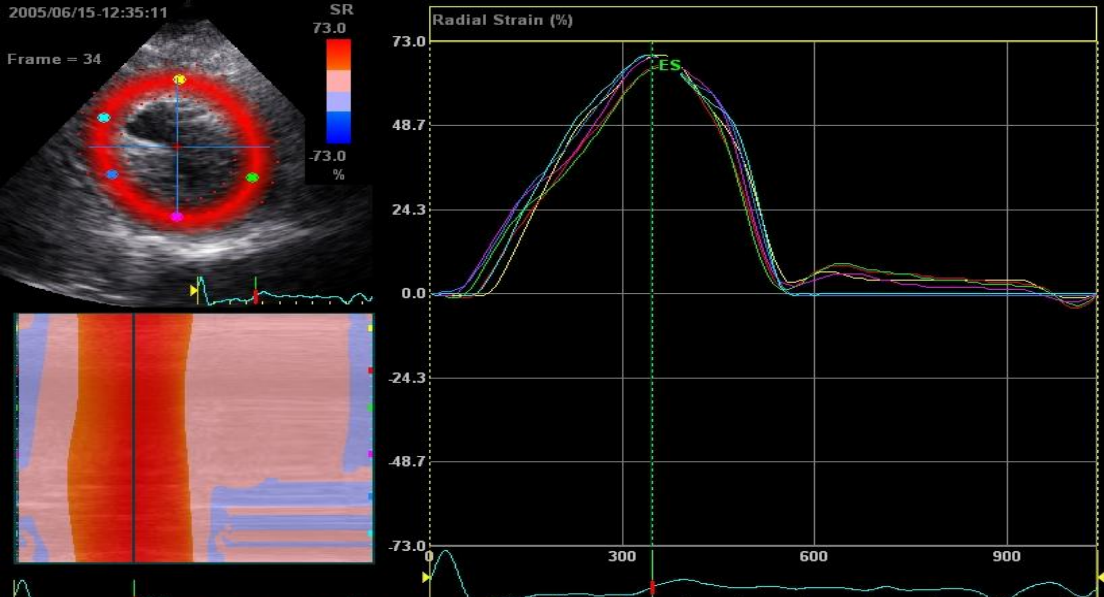
# The Heart and Ultra-endurance Exercise

- Ventricular Systolic and Diastolic Function
  - Biomarkers of cardiomyocyte damage
  - Electrical abnormalities
- 
- Is there a real or long-term risk?

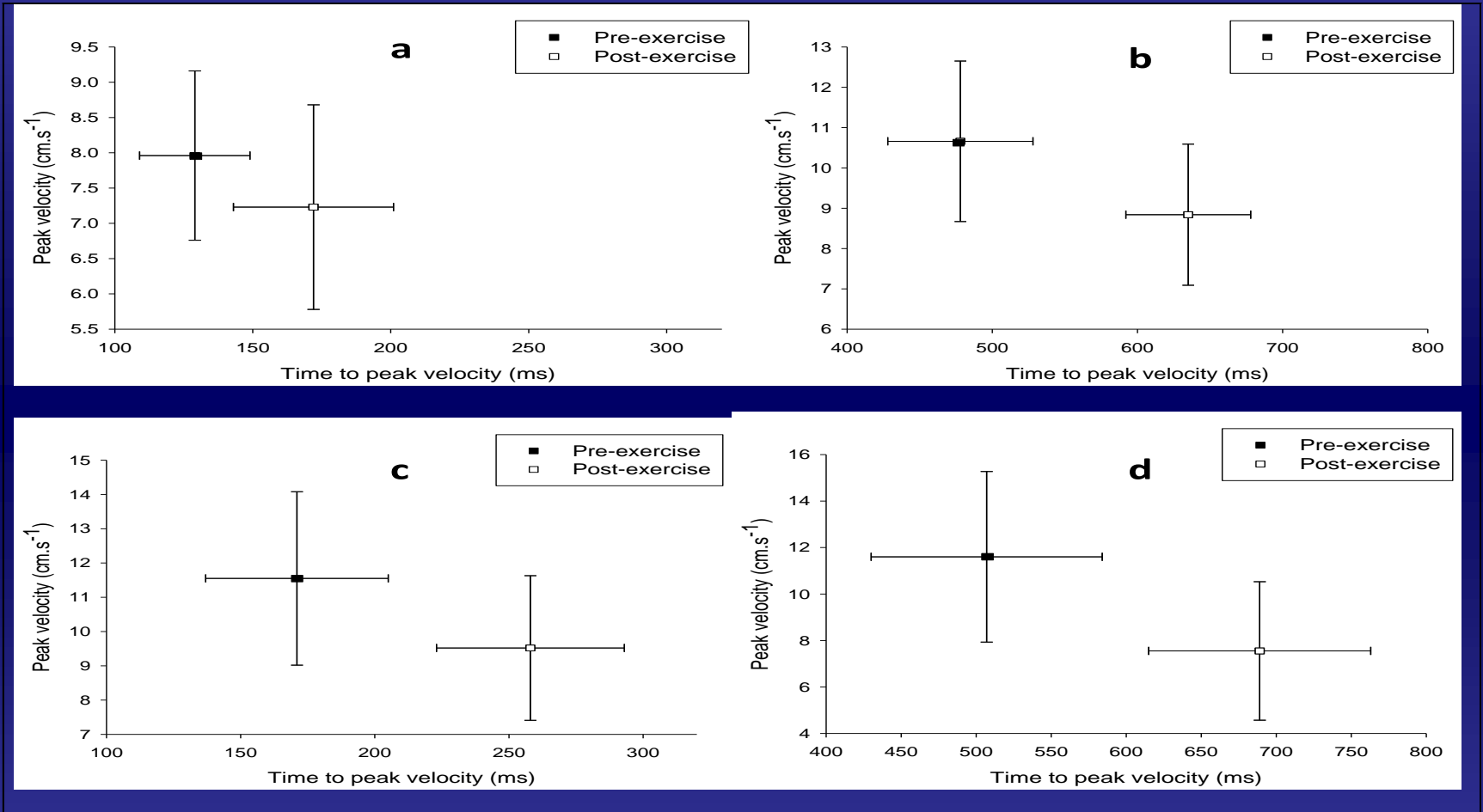
# Comrades Marathon

- 90 km Road Race in South Africa
- Pre- and post-race assessment
  - Echocardiography
  - Blood sample
- Broad age range, mostly men
- Fit subjects (6:20 hr:min)
- Environmental challenge



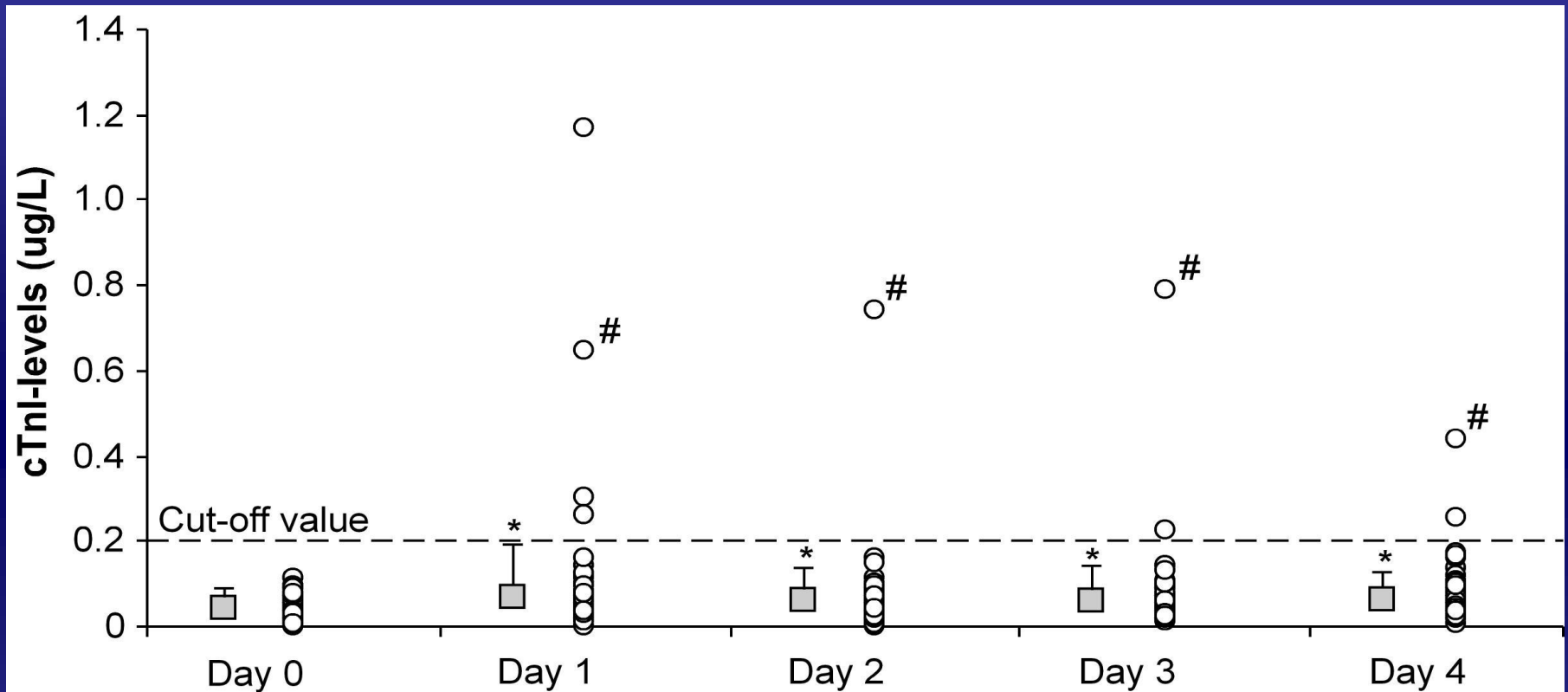


# Electro-mechanical delay





# Nijmegen 50 km Walks



Data has been replicated in adolescents performing running and team sport activity (Tian et al., 2006; Jie et al., 2008; Fu et al., 2009)

# Exercise and ECG Abnormalities

- Exercise as an Arrhythmic Agent (during/post)
  - SNS and catecholamines
  - LA enlargement, MVR
  - Baroreceptor activation
  - Dehydration, temperature, pH, electrolyte shifts
  
- Evidence of Arrhythmia During Exercise
  - Very little data.
  - No Holter monitoring in large scale studies of prolonged endurance exercise.

# Exercise and ECG Abnormalities

- Post-exercise:
  - Most studies use ECG to assess HR.
  - Warburton (2000) few late potentials after a triathlon.
  - Sahlen (2009) increase in repolarisation abnormalities ... “exercise results in a transient state of electrical instability” ... “increased  $QT_c$ ,  $T_{peak-end}$ , widening QRS-T angle associated with an increased propensity for ventricular arrhythmias”
  - Lakeland 100

# Long term training issues

- Elevated risk of AF in endurance athletes (Furlanello 2008; Sorokin 2009; Abdulla 2009)
  - LA size, ANS balance, competitive stress ??
- Some interesting case series
  - Ector et al
  - Heidbuchel et al
- Case studies ...

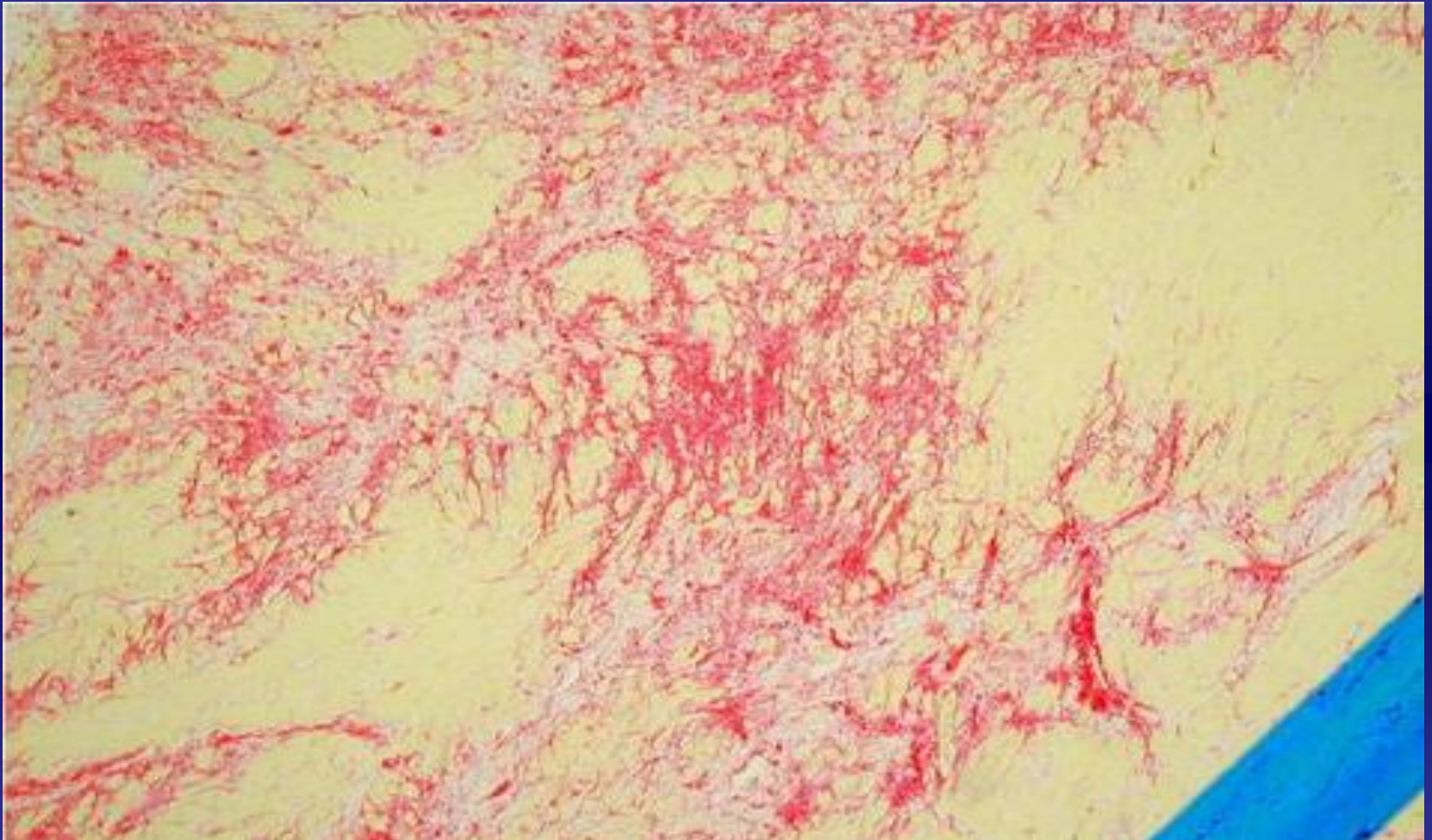
# Heidbuchel et al., (2003)

- 46 endurance athletes with ventricular arrhythmias
  - 45 male (cyclists) , median age 31, symptomatic referrals
- HCM, CAA, CAD less than 5%
- RV involvement 89%
- Median follow up 4.7 years
  - 18 major arrhythmic events, 9 SCD
- Only induction of VT or VF on EP predicted outcome.
- “Endurance exercise ... in some ...related to development / progression of underlying arrhythmic substrate”

# Ector et al., (2008)

- 22 athletes with VA, 15 athletes no VA, 10 controls
- Assessment of RV structure and function
  - Multiple angiographic measures
- RV arrhythmogenic involvement in 82%
- RV EF significantly lower in VA athletes (49%) compared to no VA athletes (63%)
- “VA in endurance athletes .. Originate mildly dysfunctional RV”
  - “does exercise act as a trigger for VA through RV functional change ....”

# Case study of Fibrosis



# Pelliccia et al., (2008)

- From a database of 12 550 athletes (Veneto)
  - 81 major depolarisation abnormalities (no cardiac disease)
  - 229 matched athletes no ECG abnormalities
- Follow up median 9 years
  - 229 controls no events
  - 5/81 cardiomyopathy (1 SCD, 1 aborted CA)
- “markedly abnormal ECG in young (healthy) athletes may be early representation of pathology”

# Summary

- There are exercise-related arrhythmias that lead to sudden cardiac deaths (but prior risk).
- In healthy asymptomatic ... prolonged exercise represents ...
  - Extreme cardiac work and physiological stress
  - Environmental challenge(s), high motivation etc....
- Prolonged exercise can results in
  - Evidence of LV dysfunction
  - Release of biomarkers of myocyte insult
  - Some evidence of ECG changes

} Post-exercise
- Clinical significance and long term effects of acute exercise not known .... should be given more consideration and research effort.

# Thank-You – Questions?

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