Exercise and the heart: Caring for athletes and sports participants

Sheldon E. Litwin, M.D.

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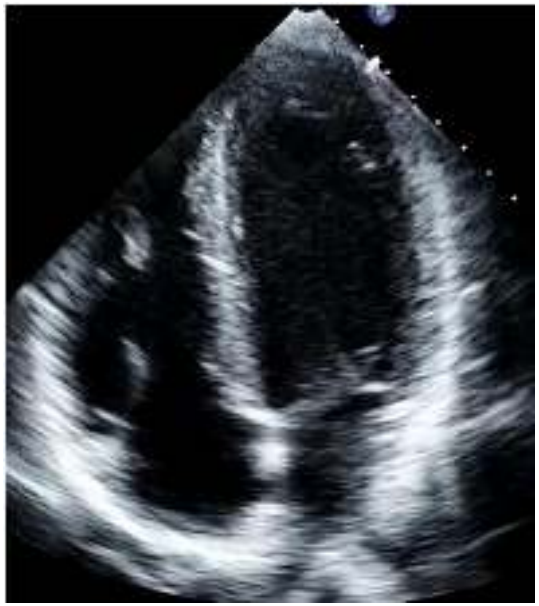
From the outside…..

From the inside…..

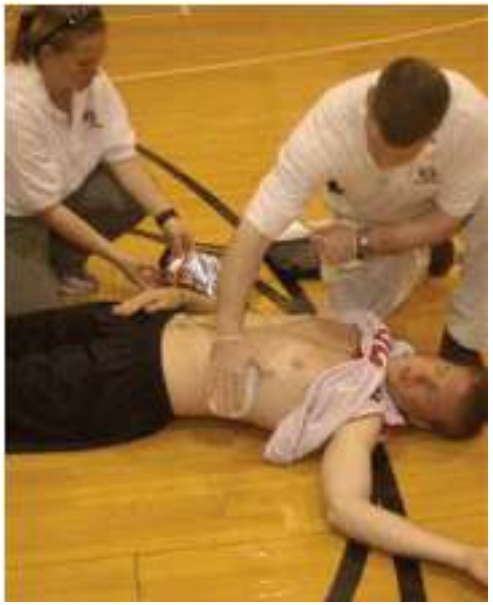


No financial conflicts or disclosures

However, I have a bias….

The problem

- Exercise *is* REALLY good for you
  - Don't over diagnose heart disease in athletes
  - Don't be too restrictive about allowing participation
- Exercise *can be* dangerous (rarely)
  - Don't miss real heart disease in athletes



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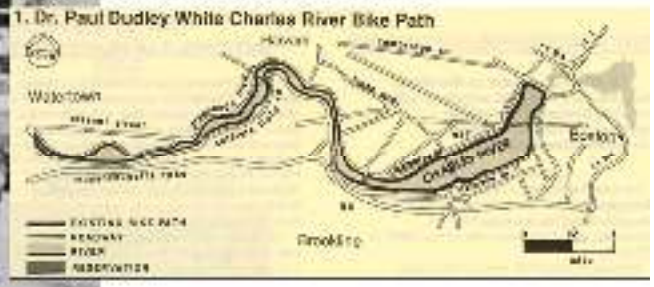
Paul Dudley White

Following the Eisenhower case, White wrote an article on preventing heart attacks, which appeared on the front page of *The New York Times* and other newspapers. The article was said to have reached an audience of over 50 million readers. White presented a philosophy for a healthy way of life that included three main elements: optimism, regular physical activity and work. *He was a staunch proponent of vigorous exercise (bicycling was his favorite),* which was *somewhat contrary to the medical opinion at the time that physical exertion could damage the heart*.



The first marathon and…

Pheidippides as he gave word of the Greek victory over Persia at the Battle of Marathon to the people of Athens. Luc-Olivier Merson, 1869

…the first sports related sudden death

Goals

- Know the expected changes in cardiac structure and function in athletes
- Recognize that there is considerable overlap between normal findings in athletes and patients with heart disease
- There are *NO* definitive findings that exclude or confirm all worrisome conditions
- Make rational, informed, shared decisions about risks and benefits of sports/exercise in people with suspected or known heart disease
- Understand controversy over whether “too much” exercise has detrimental CV effects

Exercise-induced cardiac remodeling

- *Key point 1: The degree of cardiac chamber enlargement is related to the type, duration and intensity of training and is typically reversible upon detraining. Sex, race and age all may influence the degree of cardiac adaptation in trained individuals.*

*Athletes may have large body size that needs to be taken into account

Type of exercise

Strength
Resistance
Power

Power lifting

Basketball

Football

Rowing

Nordic Skiing

Cycling

Distance Running

Aerobic
Cardio
Endurance

Thicker walls

Chamber dilation

Mainly left ventricle

All 4 chambers and major vessels

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Key point 2: Athletes often have symmetrical enlargement of all 4 chambers of the heart. There may also be increased left ventricular wall thickness, most often with normal LV geometry or eccentric hypertrophy.

Case 1

58 y.o. male lifelong recreational athlete, predominantly aerobic (running, cycling, rowing, nordic skiing, weights, etc)

5’ 9”, 150 lbs, BMI 23

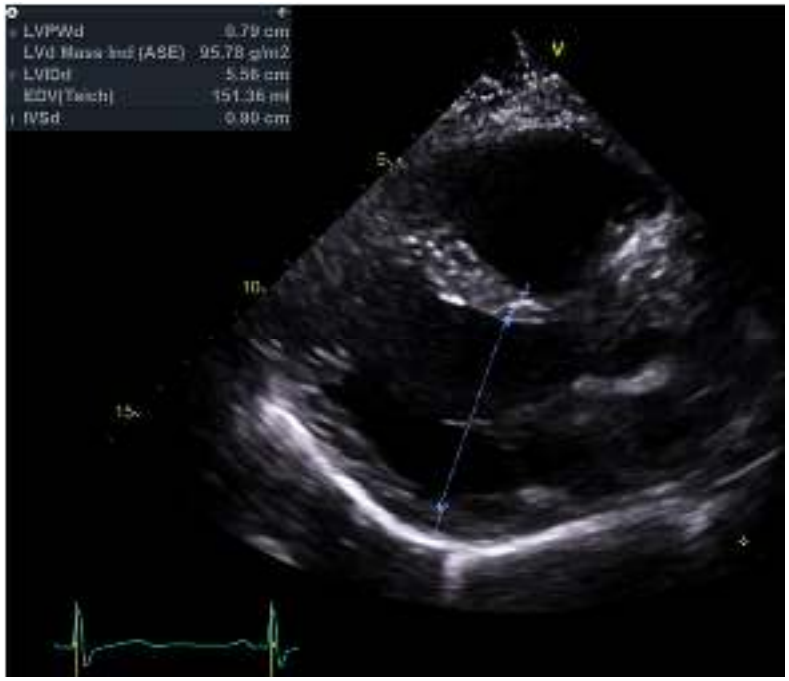
12-15 hours per week moderate to high intensity for > 30 years

Not as fast as he used to be. Concern for possible cardiac condition?

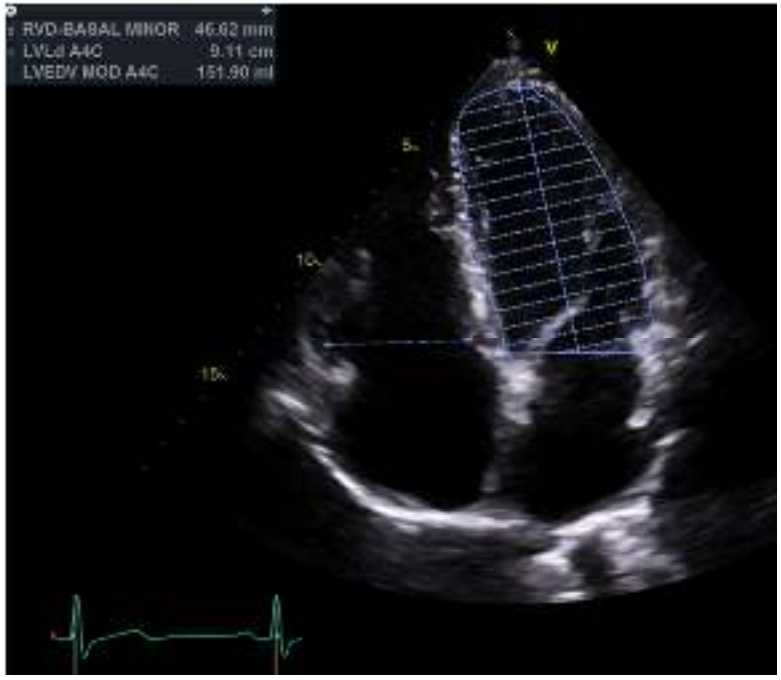
Case 1, Figure 1.

A. Parasternal long axis view. Calculated **end-diastolic volume = 151 ml** (83.8 ml/m^2).
B. Apical 4 chamber view. Calculated end-diastolic volume = 151 ml. RV basal diameter 4.6 cm.
C. Apical 4 chamber view (systole). Calculated LV ejection fraction = **54%**. **LA volume = 84 ml (44 ml/m^2)**. RA = 47 ml/m^2.

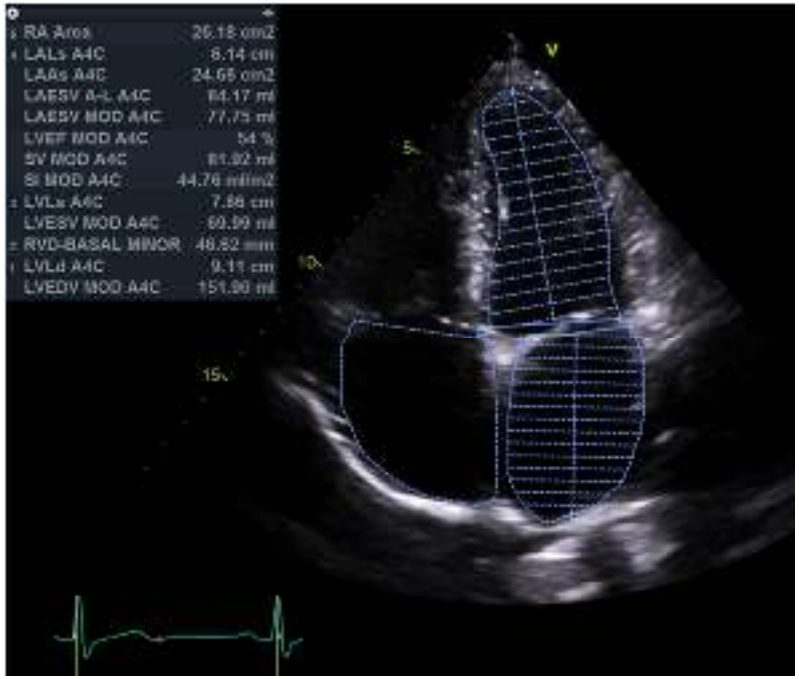
A



B

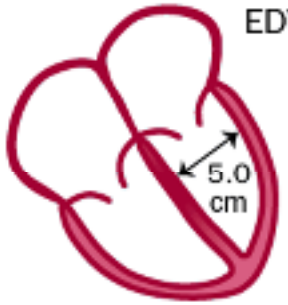
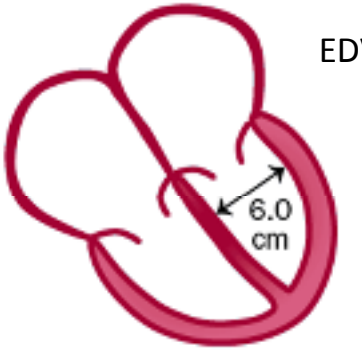


C



Key point 3: The resting left ventricular ejection fraction is usually normal, but may be mildly reduced in healthy athletes. This is due to the presence of cavity dilation, which allows for a normal stroke volume at a lower ejection fraction.

	Rest					
	LVID (cm)	EDV (ml)	HR (bpm)	CO (L/min)	SV (ml)	EF (%)
Non-athlete	5.0	118	70	4.8	69	**58**
Athlete	6.0	180	55	4.8	88	**47**

	Non-athlete	Athlete
Diastole	EDV= 118 ml 	EDV= 180 ml 
Systole	ESV = 49 ml EF = 58% SV = 69 ml 	ESV = 92 ml EF = 47% SV = 88 ml 

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Exercise, Diet, and the Heart

Serial Left Ventricular Adaptations in World-Class Professional Cyclists

Implications for Disease Screening and Follow-Up

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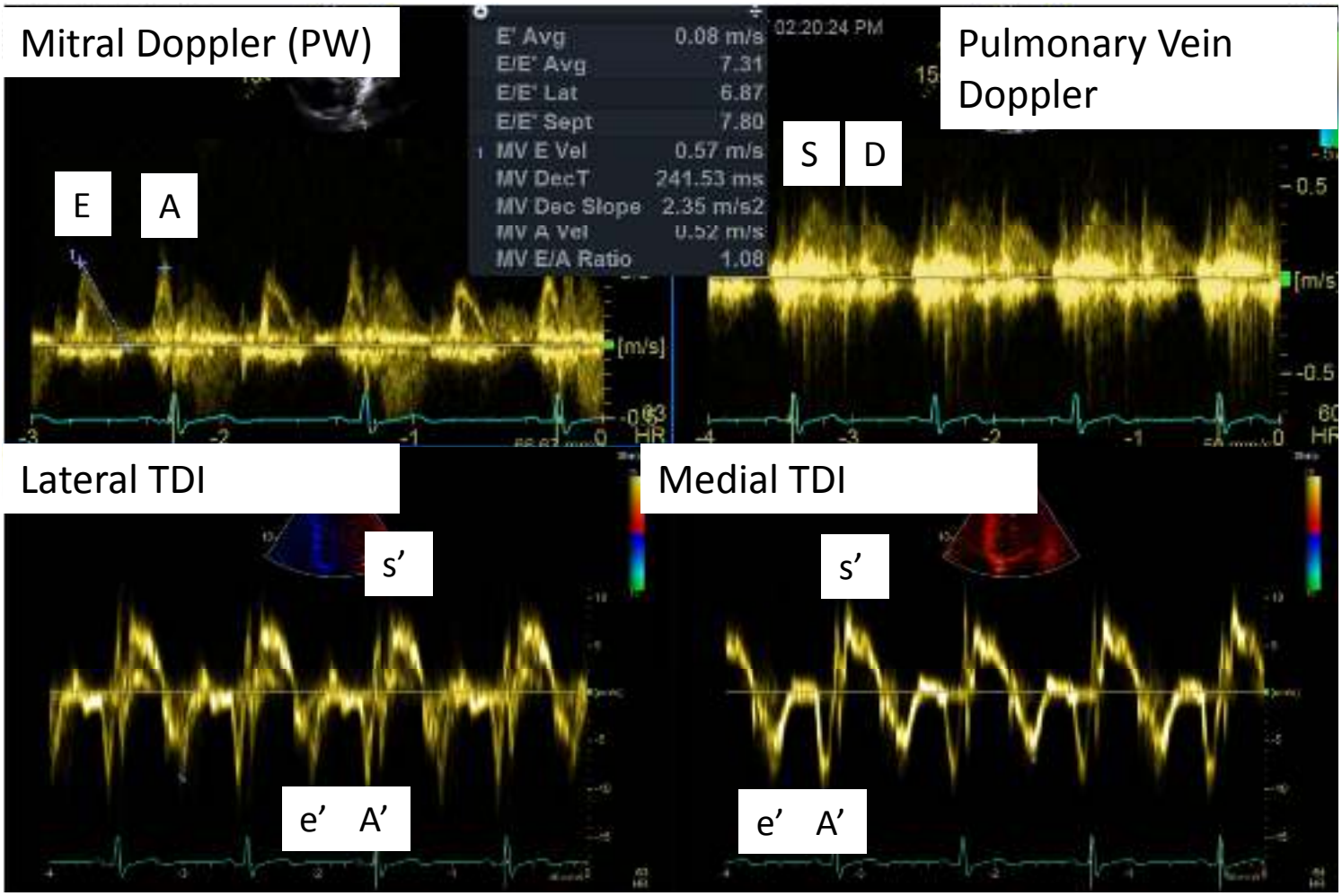
Paris, France

280 former Tour de France cyclists

- **50% had LVIDd > 6.0 cm**
- **11% had EF < 52%**

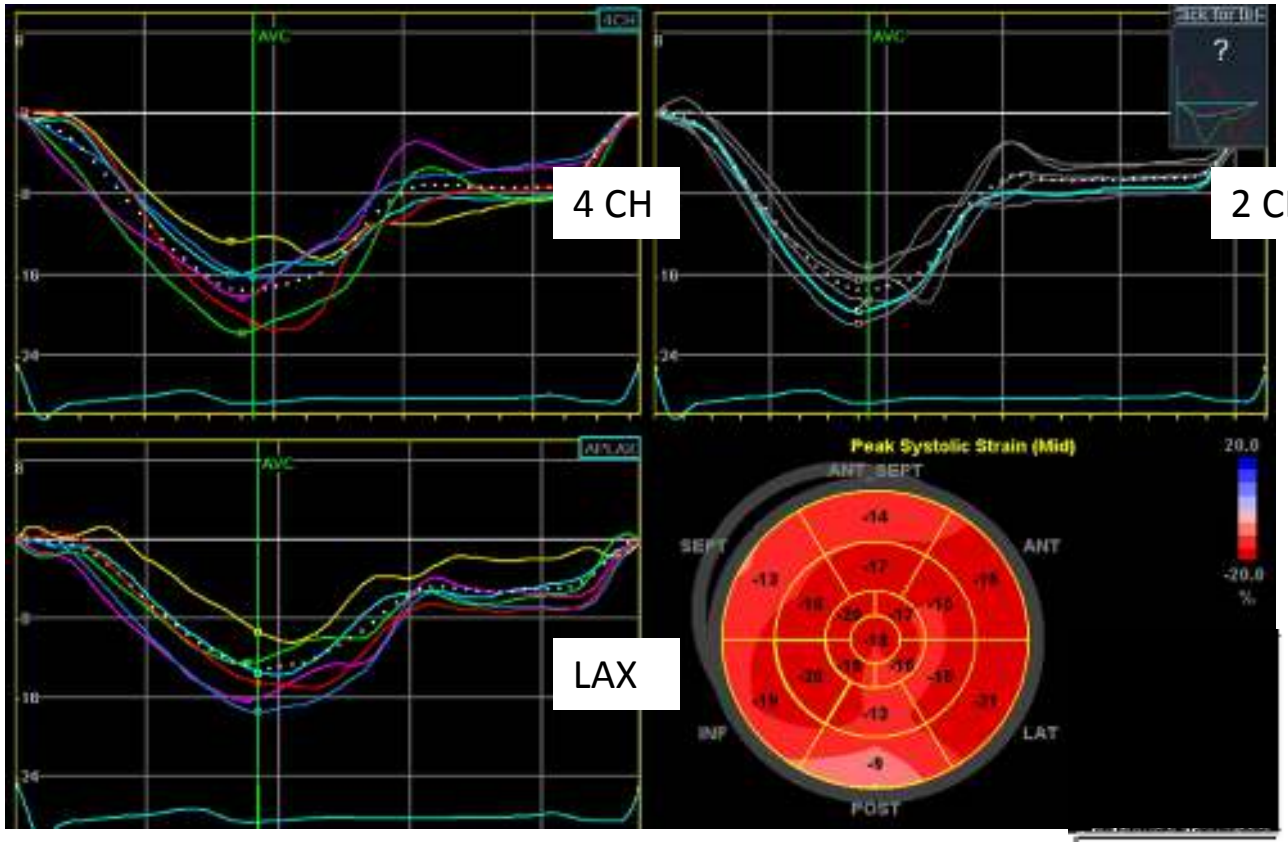
Key point 4: Measures of resting left ventricular function based on tissue Doppler velocities are generally in the normal range, but strain may be lower in athletes than untrained subjects (for the same reason that EF is low).

Case 1, 58 y.o. lifelong athlete concerned about decline in athletic performance



Lateral e' 10 cm/s, Septal e' 7 cm/s. E/e' 7.3. Normal for age.
Supports diagnosis of athletes heart.

Case 1, 58 y.o. lifelong athlete concerned about decline in athletic performance



Global Longitudinal Strain -17%

Strain = (resting length – contracted length) / resting length

If amount of shortening is the same, but resting length is longer (dilated LV), then strain will be lower. Same reasoning as the low EF in athletes.

Patterns of Left Ventricular Longitudinal Strain and Strain Rate in Olympic Athletes

Stefano Caselli, MD, PhD, FASE, Dalma Montesanti, MD, Camillo Autore, MD, FESC, Fernando M. Di Paolo, MD, Cataldo Pisicchio, MD, Maria Rosaria Squeo, MD, Beatrice Musumeci, MD, Antonio Spataro, MD, Natesa G. Pandian, MD, and Antonio Pelliccia, MD, FESC, *Rome, Italy; and Boston, Massachusetts*

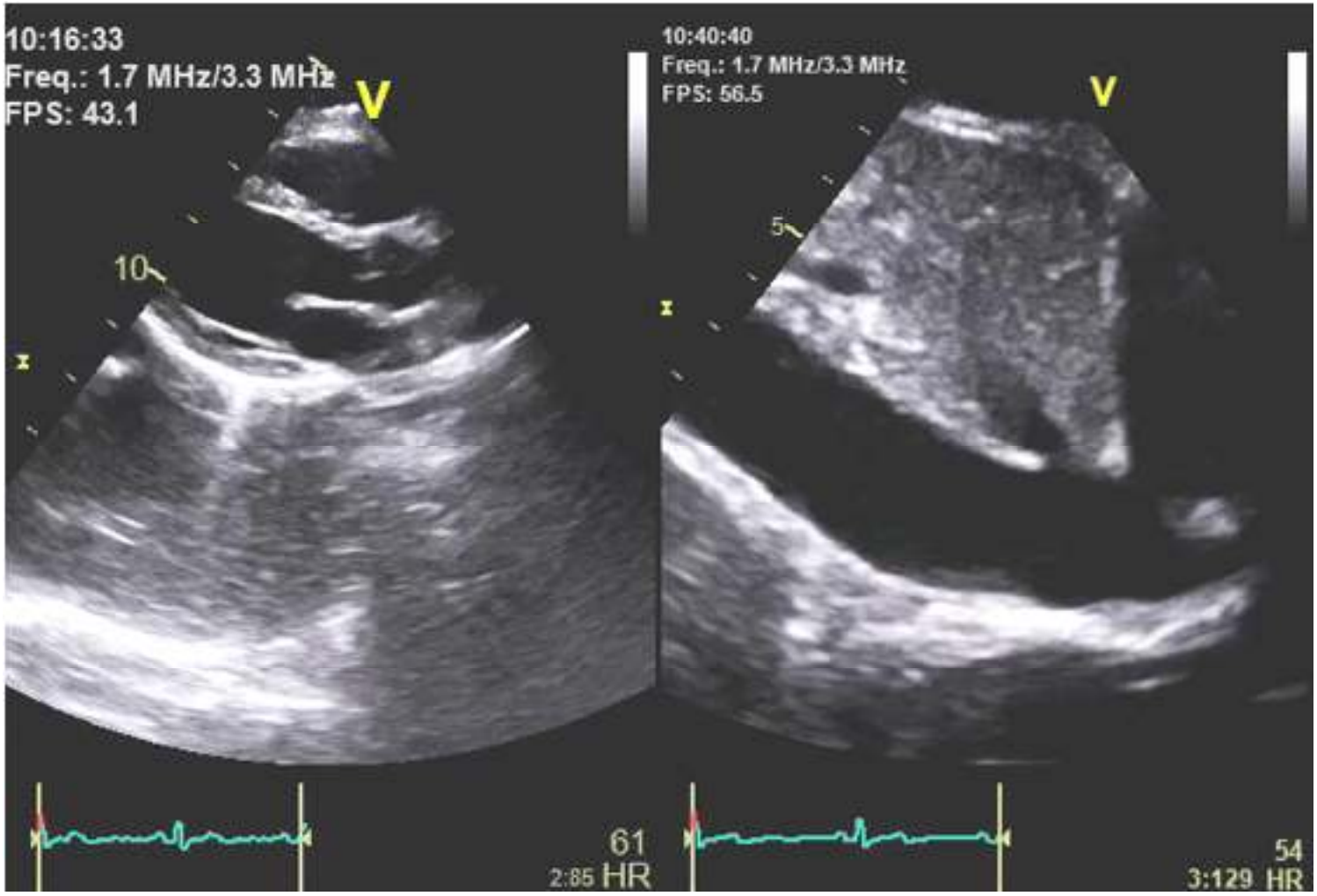
JASE 2015;28:245-53

200 Olympic athletes (various disciplines), 50 controls

Global longitudinal strain was normal (-15 to -22%) in athletes, although *lower than controls* (-18.1% vs. -19.4%)

Exercise and veins…

“My legs look tired.” – Pawal Poljanski (Tour de France rider)



Key point 5: The inferior may vena cava may be dilated and relatively noncollapsible in trained athletes, even though central venous pressure is normal.

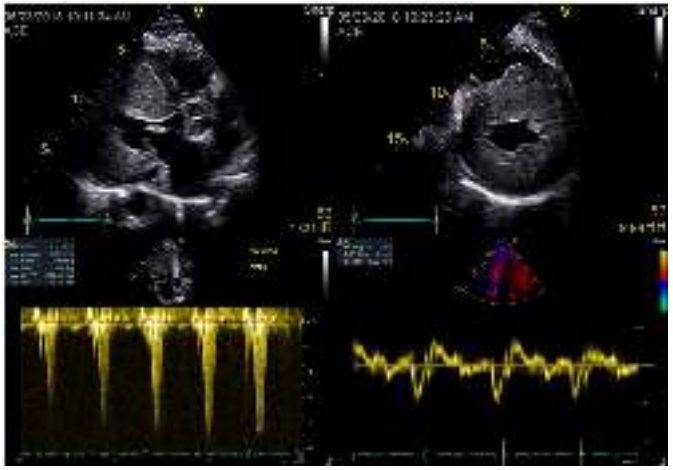
Unexpected death during sports in young athletes (< 35 years)

Reggie Lewis 1987-1993
NBA star
Collapsed during playoff game
- **HCM vs. neurocardiogenic syncope**
- **Public controversy between treating cardiologists**

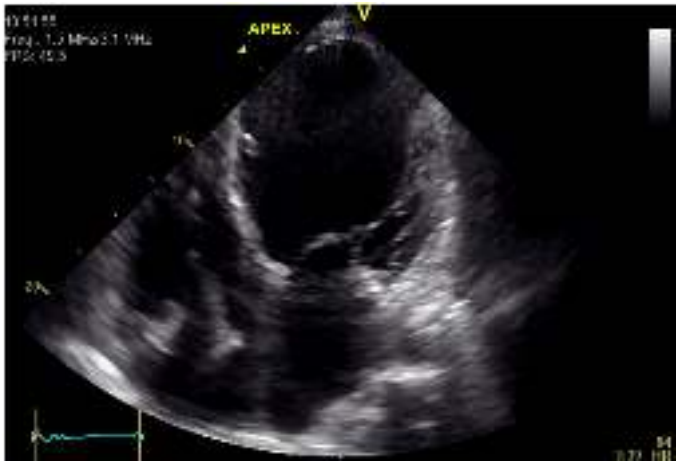
Died after collapsing while shooting baskets (noncompetitive)
Cause of death?

Key point 7: Distinction between athlete's heart and various pathological conditions, particularly, hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy and mild dilated cardiomyopathy can be challenging. Use of tissue Doppler and strain imaging along with MRI may be helpful in distinguishing between these entities. Unfortunately, there are no absolute imaging criteria for ruling in or ruling out these diseases.

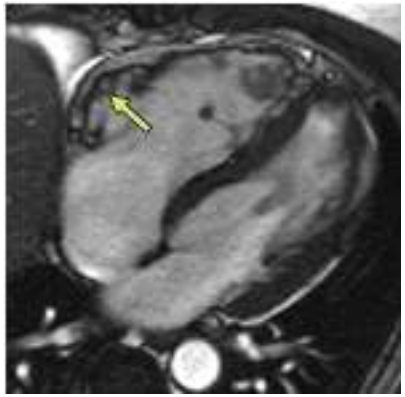
HCM



DCM



ARVC



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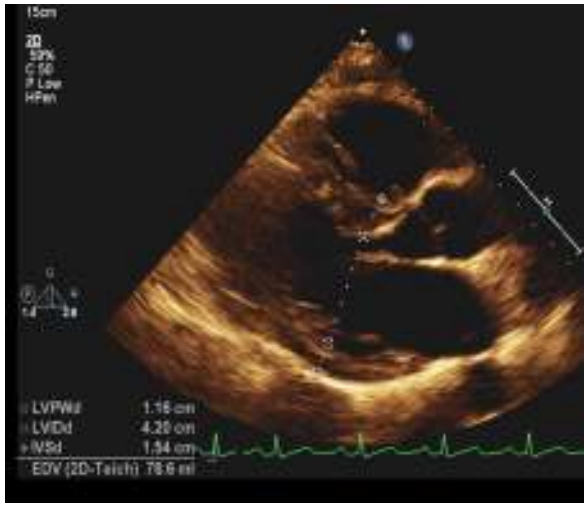
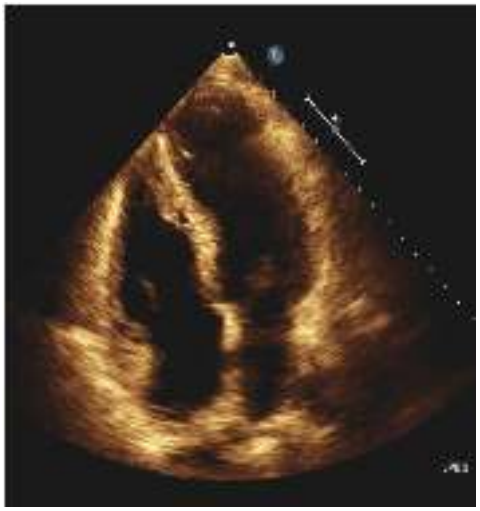
Case 4: 35 y.o. competitive triathlete and ultradistance runner with family history of HCM (father diagnosed after having syncope at end of Boston marathon, age 56)

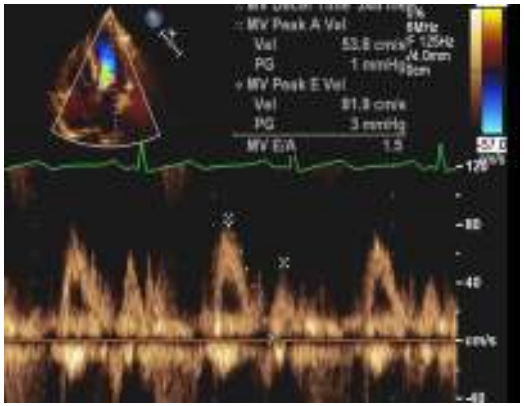
Parasternal long axis view



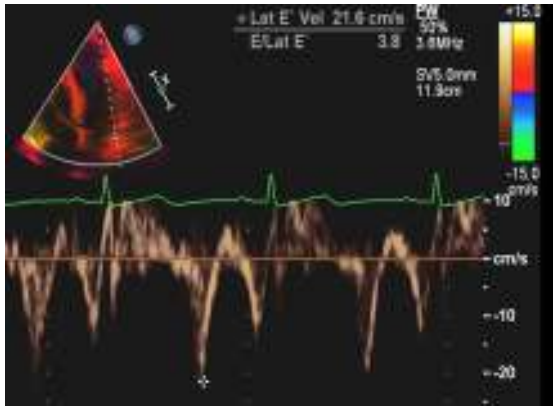
Video 1: apical 4 chamber view



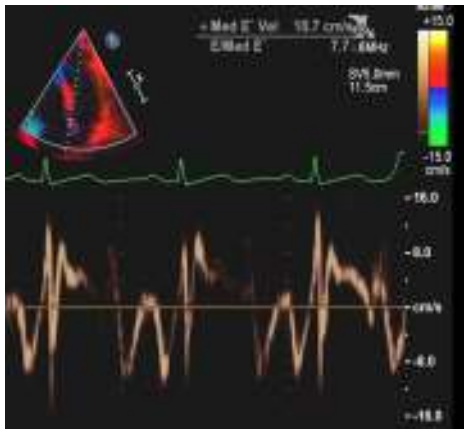
Mildly increased septal thickness (1.4-1.5 cm). No SAM or LVOT obstruction



A) Mitral Doppler



B) Lateral TDI

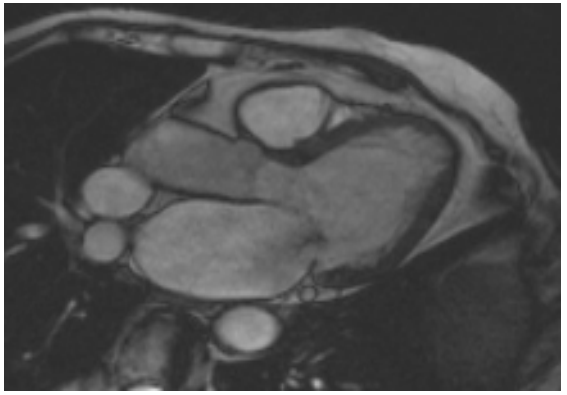


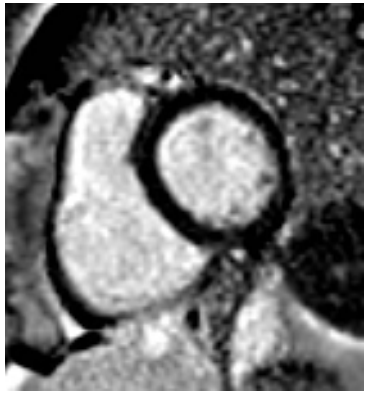
C) Medial TDI

Case 4: 35 y.o. competitive triathlete and ultradistance runner with family history of HCM

cMRI: LV wall thickness 14 mm

No late gadolinium enhancement

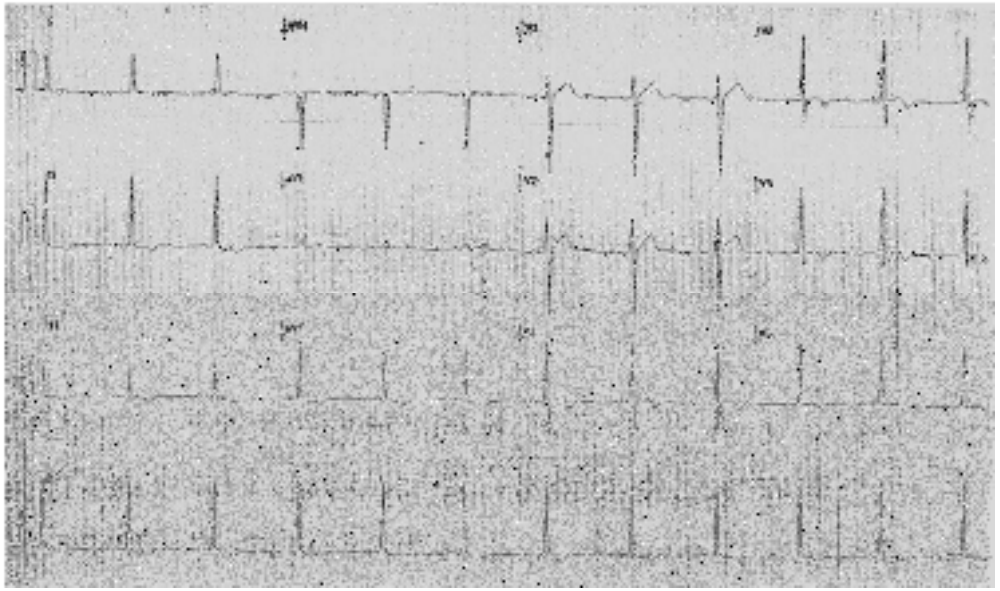




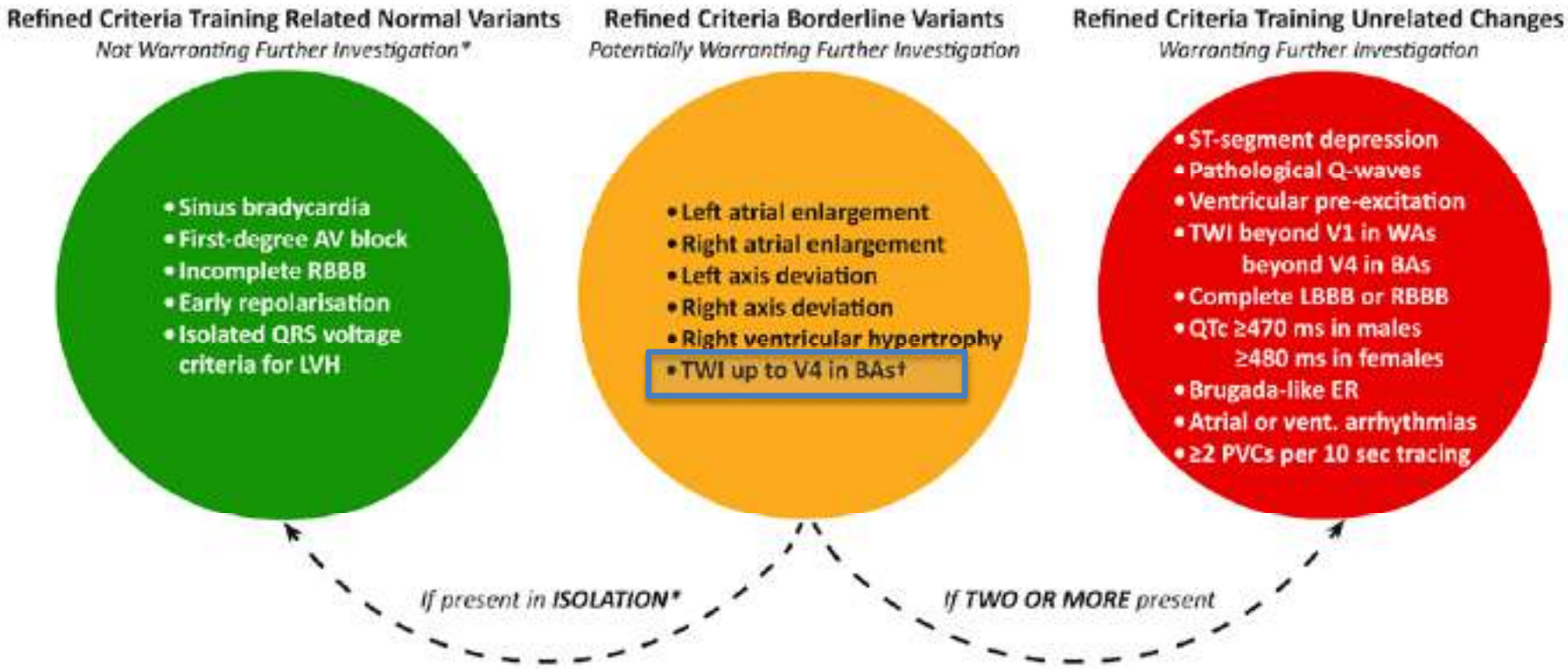
- Genotyped father: Myosin binding protein C mutation (pathogenic)
- Genotyped patient: Myosin binding protein C mutation (pathogenic)
- Recommend retiring from competitive racing. Continued moderate exercise, but concerned about long (remote) runs and swimming where risk of arrhythmias probably higher. Need long term monitoring due to late onset of phenotype in father.

18 y.o. Division 1 College Football player

- Syncopal episode after a game senior year of HS (dehydration)
- 6’3”, 360 lbs AA male
- Defensive tackle (lineman)
- Hx HTN (not taking meds), asthma
- Denies CP, SOB, exercise limitations, palpitations, + snoring
- FH negative for cardiomyopathy or sudden death
- Exam unremarkable except for BP 160/86

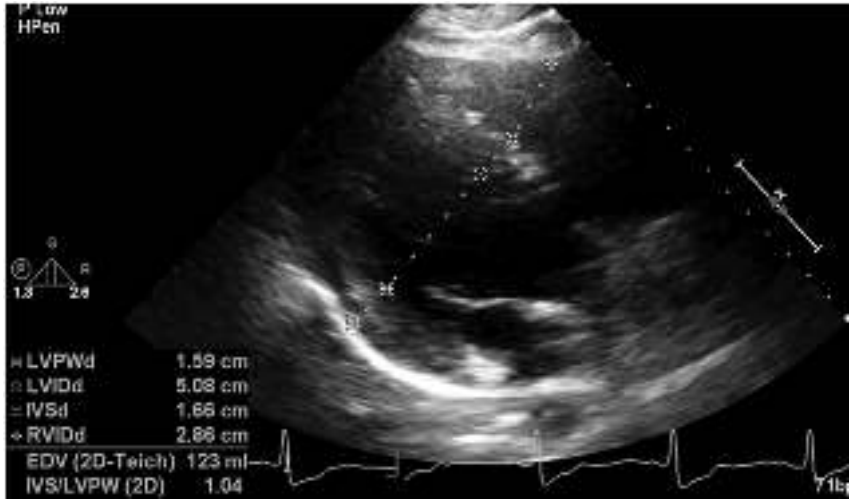


Refined Seattle ECG criteria for black and white athletes



Refined criteria increased specificity from 40% 84% in BA's
Sensitivity for HCM reportedly 98%

Echocardiogram



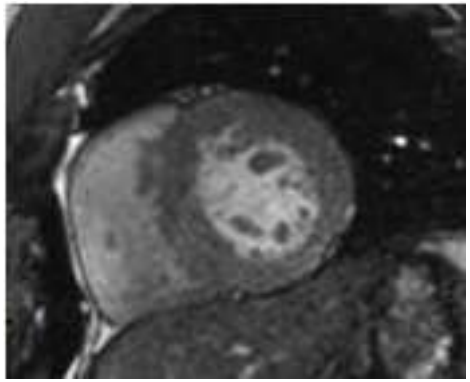
EF 60%

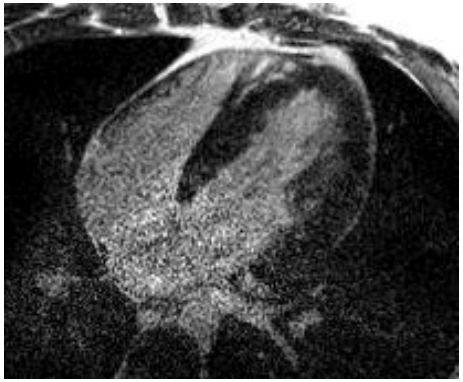
LV mass 374 g, LVMI 129 g/m2, RWT 0.65

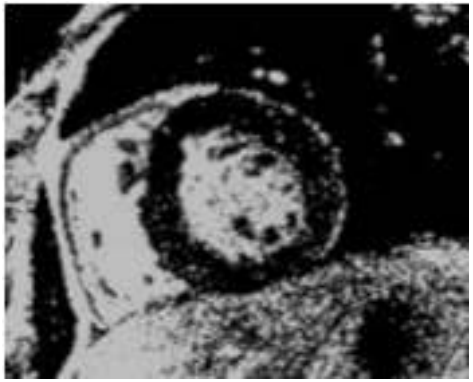
Cardiac MRI

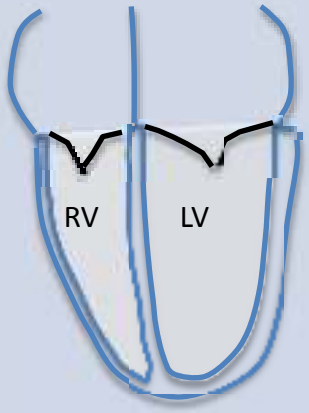
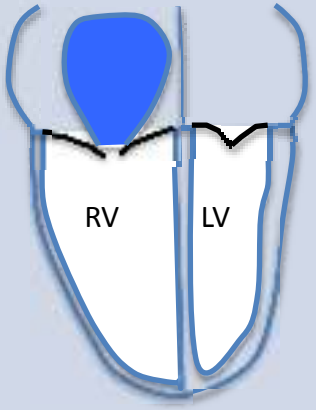
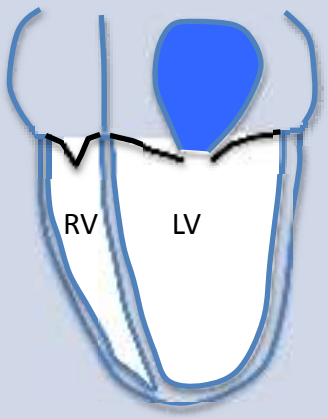
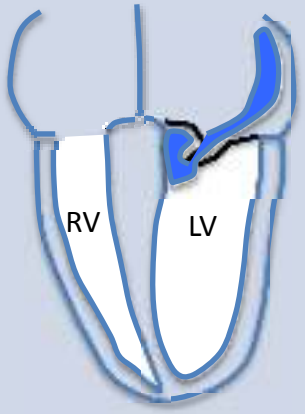
SSFP SAX LV
Wall thickness 15 mm

Post Gadolinium IR sequence
No delayed enhancement





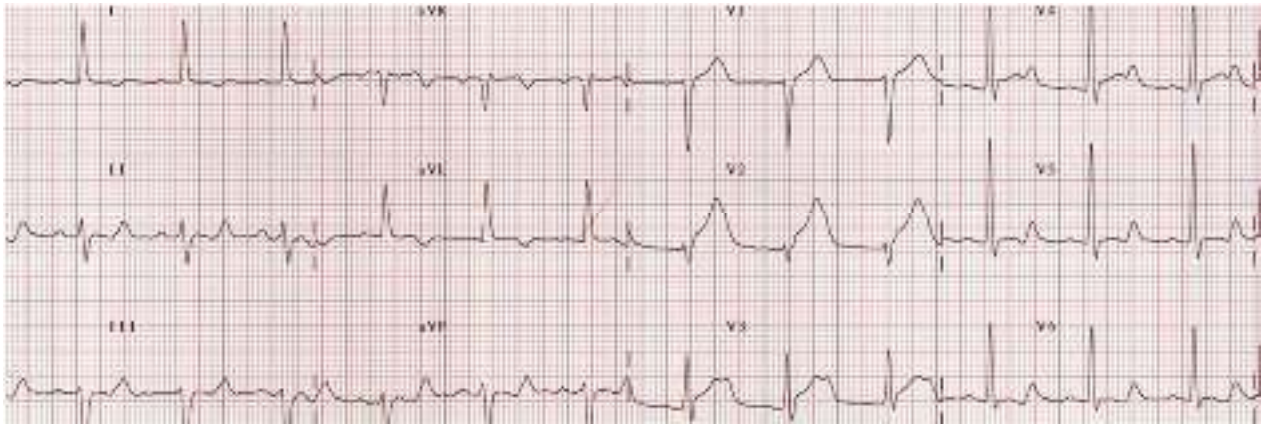


	EICR	ARVC	DCM or ICM	HCM
				
Echo findings	Symmetrical 4 chamber enlargement (usually mild) LV wall thickness < 14 mm Normal or slightly reduced LV EF (> 45%) Normal RV function Normal tissue Doppler velocities Normal GLS PASP < 40 mmHg	RV disproportionately enlarged RV global dysfunction RV regional dysfunction RV aneurysms PASP < 40 mmHg	≥ Moderate LVE (6.0 cm) ≥ Moderate LAE LV disproportionately enlarged LV dysfunction (EF < 45%) LV regional dysfunction Decreased tissue Doppler velocities Decreased GLS Significant MR PASP > 40 mmHg	LV wall thickness > 14 mm Asymmetric hypertrophy (especially septal) Systolic anterior motion of mitral valve ≥ Moderate LAE Decreased tissue Doppler velocities Decreased GLS Significant MR PASP > 40 mmHg
Other	History of aerobic exercise training Good exercise capacity ECG (bradycardia, incomplete RBBB, voltage criteria LVH, early repolarization, TWI V2-4)	Family history Syncope ECG (TWI V1-3, epsilon wave)	Family history Coronary Risk Factors Chest pain ECG (Q waves, ischemic changes) LGE on MRI	Family history ECG (LVH, deep TWI, narrow Q waves lateral leads) LGE on MRI

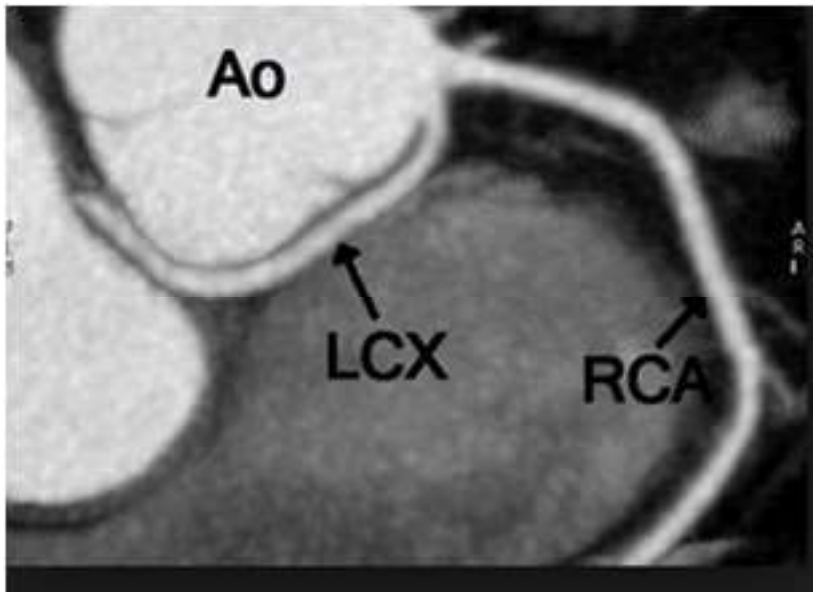
EICR = Exercise induced cardiac remodeling; ARVD = arrhythmogenic right ventricular cardiomyopathy; DCM = dilated cardiomyopathy; ICM = ischemic cardiomyopathy; HCM = hypertrophic cardiomyopathy; LVE = left ventricular enlargement; LAE = left atrial enlargement; GLS = global longitudinal strain; TWI = T wave inversions; LGE = late gadolinium enhancement; MR = mitral regurgitation;

Things we can't diagnose with echo

Long QT



Anomalous coronary artery



The NEW ENGLAND JOURNAL of MEDICINE

N Engl J Med 2017;377:1943-53. DOI: 10.1056/NEJMoa1615710

ORIGINAL ARTICLE

Sudden Cardiac Arrest during Participation in Competitive Sports

Cameron H. Landry, M.D., Katherine S. Allan, Ph.D., Kim A. Connelly, M.B., B.S., Ph.D., Kris Cunningham, M.D., Ph.D., Laurie J. Morrison, M.D., and Paul Dorian, M.D., for the Rescu Investigators*

Rescu Epistry cardiac arrest data base (Canada) 2009-2014

All out of hospital arrests during sports age 12-45

Adjudication based on multiple sources

18.5 million person years of observation, 74 sudden deaths

16 competitive sports, 58 noncompetitive sports

0.76 per 100,000 athlete years

43.8% survival to discharge

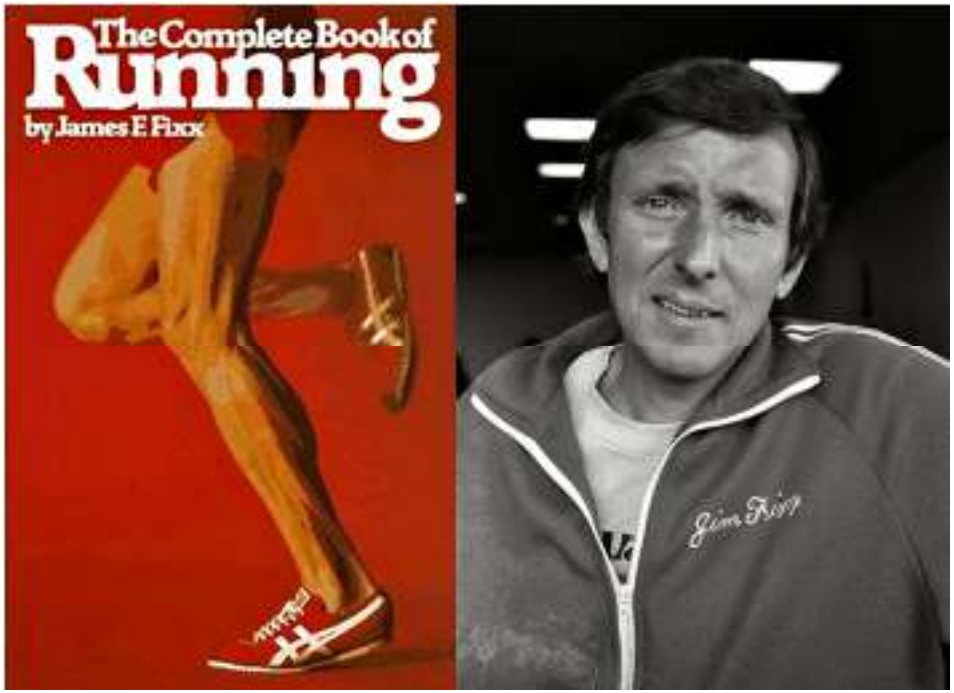
Competitive athletes: 2 HCM, none due to ARVD

3 cases potentially identifiable with pre-participation screening

Table 4. Causes of Sudden Cardiac Arrest among Competitive and Noncompetitive Athletes, According to Age Group.

Variable	Age Group			
	12–17 yr	18–34 yr	35–45 yr	All
Competitive				
No. of athletes	4	9	3	16
Percent of athletes who survived	50.0	44.4	33.3	43.8
Diagnosis				
Ischemic*	0	0	3	3
Primary arrhythmic	0	6	0	6
Structural†	2	3	0	5
Commotio cordis	2	0	0	2
Noncompetitive				
No. of athletes	9	18	31	58
Percent of athletes who survived	66.7	50.0	35.5	44.8
Diagnosis				
Ischemic*	0	5	21	26
Primary arrhythmic	4	5	0	9
Unknown	2	2	0	4
Structural‡	3	6	8	17
Other§	0	0	2	2

Unexpected death during sports in older athlete (> 35 years)



Jim Fixx 1932-1984
Started running age 35, 214 lbs, 2 ppd smoker
Father MI age 35
Died of MI age 52

63 year old man

Active, healthy

Exercises daily (jogs ~ 3 miles)

Family history of coronary disease (Father died in his 50's)

Referred for exercise stress test

13 minutes of treadmill exercise (good)

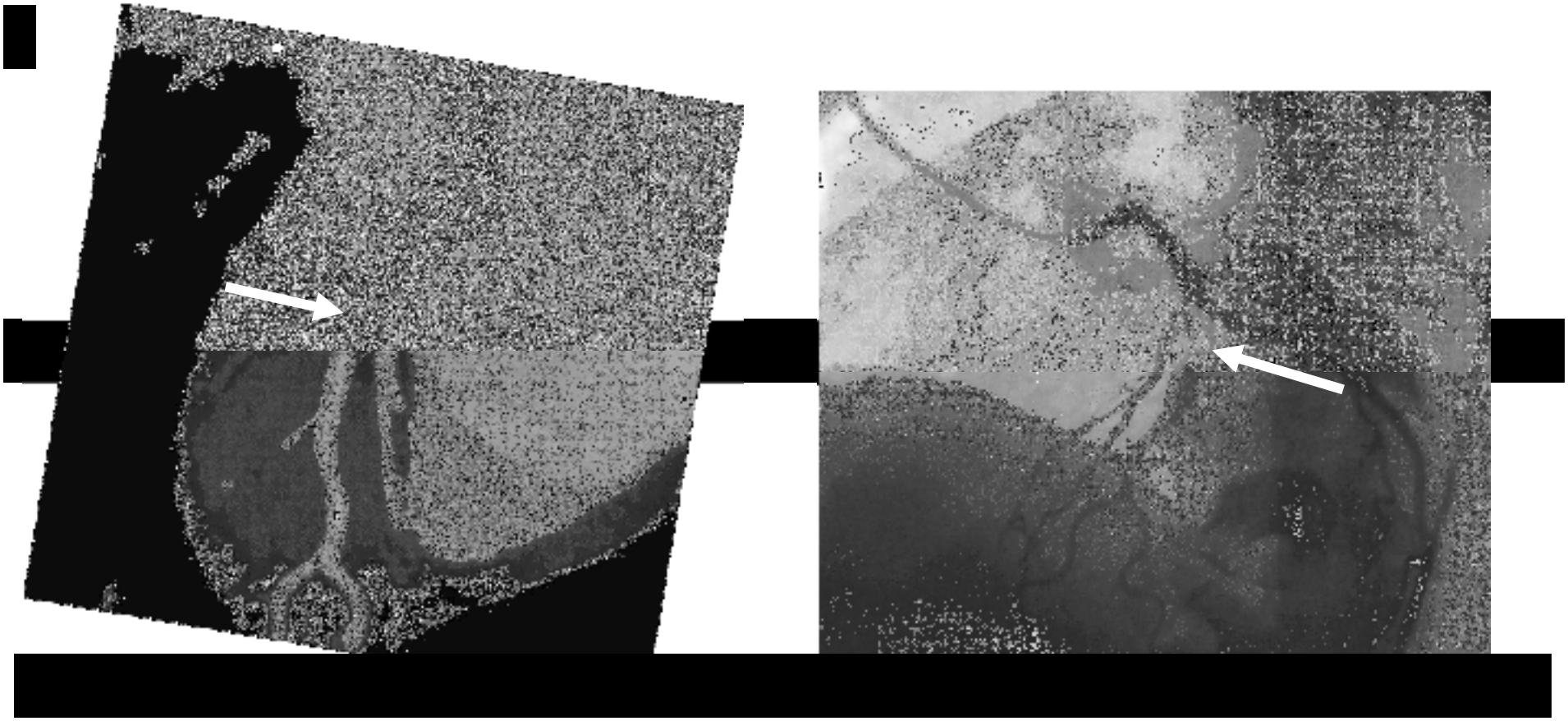
No chest pain during the test

ECG minimal changes, "not meeting criteria for ischemia

Sheldon E. Litwin, M.D.

“Widowmaker” blockage in the left anterior artery

CT Scan **Angiogram**



DES to LAD, home next day

Pearl: Athletes hide CAD well. High exercise capacity. Low symptoms. Lack of ECG changes. Be concerned in setting of strong family history.

Sheldon E. Litwin, M.D.

63 y.o. recreational triathlete with known cardiac disease

Hx of bicuspid aortic valve

Bioprosthetic AVR and aortic root replacement (emergent) ~ 1
years ago with perioperative MI (embolic)

Clinically stable without CP, DOE, edema

Exercises daily for up to 2 hours (no change)

Enters olympic distance triathlons, but no longer “competitive

AHA/ACC Scientific Statement

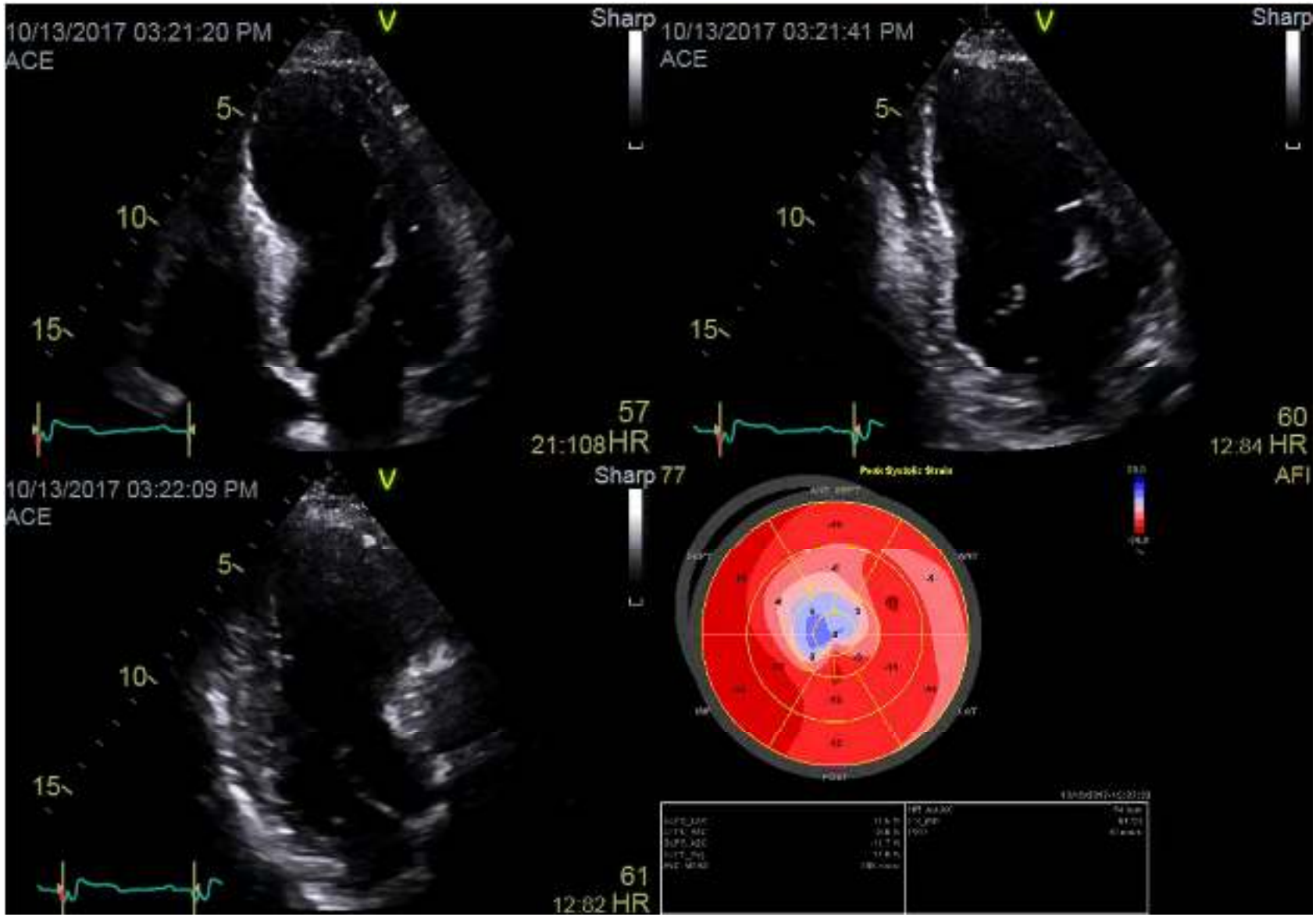
Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Preamble, Principles, and General Considerations

A Scientific Statement From the American Heart Association and American College of Cardiology

Barry J. Maron, MD, FACC, Co-Chair; Douglas P. Zipes, MD, FAHA, MACC, Co-Chair; Richard J. Kovacs, MD, FAHA, FACC, Co-Chair; on behalf of the American Heart Association Electrocardiography and Arrhythmias Committee of the Council on Clinical Cardiology, Council on Cardiovascular Disease in the Young, Council on Cardiovascular and Stroke Nursing, Council on Functional Genomics and Translational Biology, and the American College of Cardiology

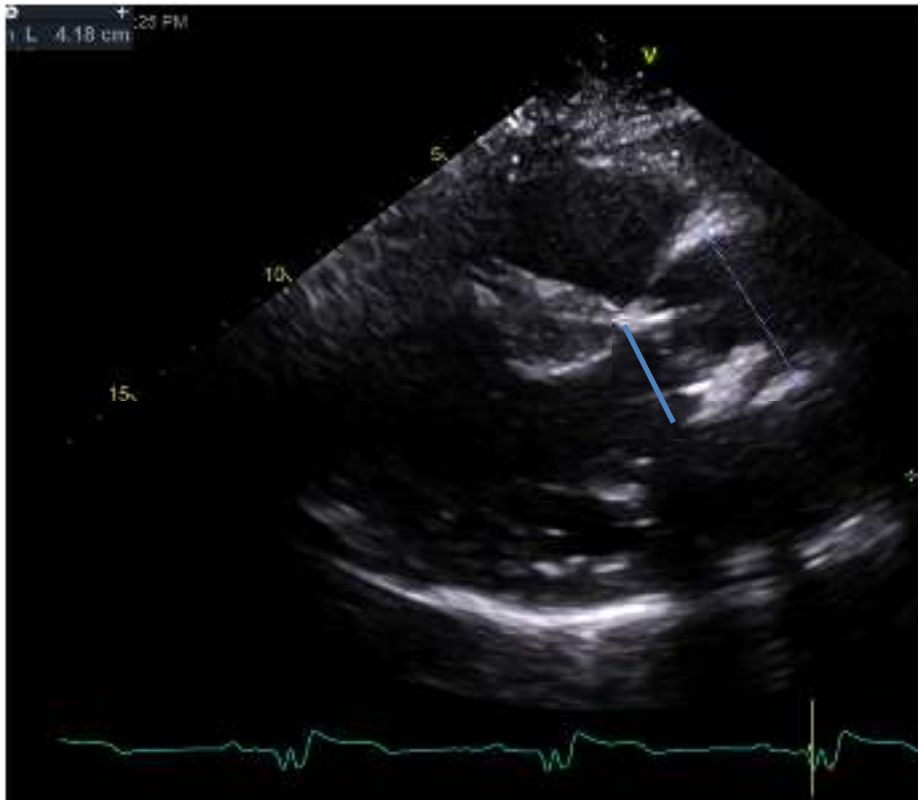
The most recent update published in 2015, uses the standard recommendation classification system and includes a large number of Class IIa and IIb recommendations with wording such as "*may be reasonable*" or "*may be considered*," providing sports cardiologists and their patients an opportunity to engage in ***shared decision making*** in situations with uncertain risk and limited outcomes data. This approach represents *an important departure from prior versions of this document, which gave a dichotomous yes/no recommendation for sports eligibility*.

Case 3: 63 y.o. recreational athlete with prosthetic aortic valve

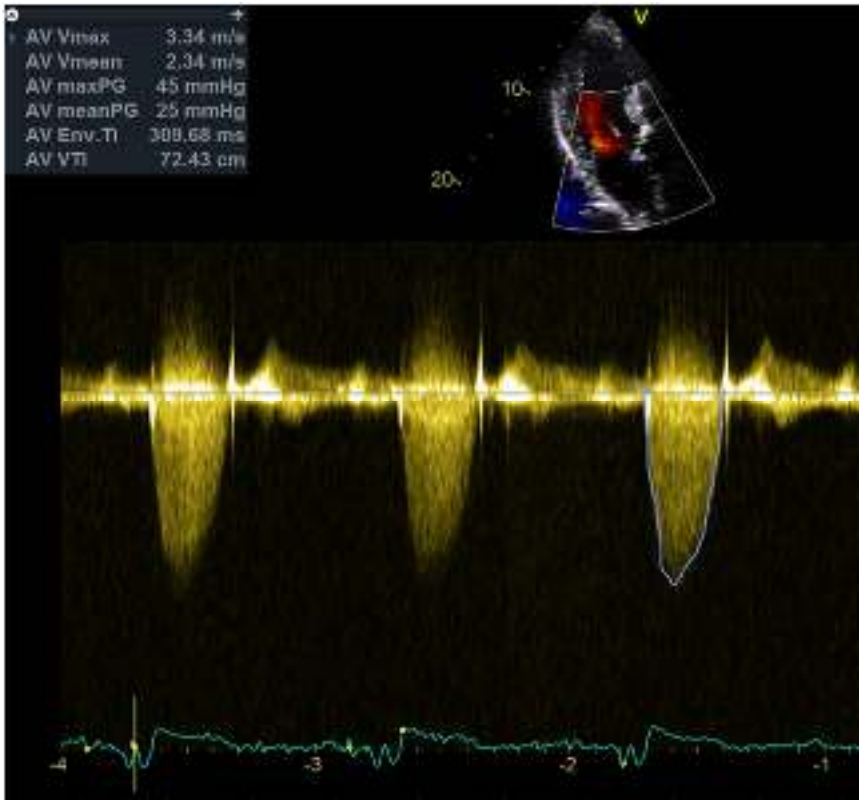


Case 3: Figure 1. 64 y.o. recreational athlete with bioprosthetic aortic valve

Parsternal Long Axis View
LVOT dimension 2.3 cm
Aortic root 4.2 cm



Continuous Wave Doppler across aortic valve (mean gradient 25 mmHg)



Eligibility and Disqualification Recommendations for Competitive Athletes With Cardiovascular Abnormalities: Task Force 8: Coronary Artery Disease

A Scientific Statement from the American Heart Association and American College of Cardiology

JACC 2015, 66:2406-11

It is *reasonable* for athletes with aortic or mitral bioprosthetic valves, not taking anticoagulant agents, who have normal valvular function and normal LV function to participate in *low-intensity and some moderate-intensity competitive sports* (classes IA, IB, IC, and IIA) (Class IIa; Level of Evidence C).

Athletes with moderate AS (stage B) can participate in *low and moderate static or low and moderate dynamic competitive sports* (classes IA, IB, and IIA) *if exercise tolerance testing to at least the level of activity achieved in competition and the training regimen demonstrates satisfactory exercise capacity without symptoms, ST-segment depression, or ventricular tachyarrhythmias, and with a normal blood pressure response* (Class IIa; Level of Evidence C).

It is reasonable for patients with clinically manifest ASCAD to participate in all competitive activities if their resting left ventricular ejection fraction is >50%, they are asymptomatic, and they have *no inducible ischemia or electrical instability* (Class IIb; Level of Evidence C).

The risk

- Running on treadmill
- Witnessed cardiac arrest
- Paramedics => ROSC (epinephrine)
- Cooling protocol
- Hemodynamically stable after initial need for pressors
- Oxygenating well (ventilator, 40% FIO2)
- Making urine with normal kidney function
- Echo unchanged
- Irreversible anoxic brain injury

Eddie Merckx “The Cannibal”
Arguably greatest cyclist of all time
Tour de France 5 x winner
Giro d’Italia 7 x winner
Vuelta a Espana 1 x winner
19 classic race victories
World Champion 3 x
World record 1 hour distance

- During 1968 Giro d’Italia a leading cardiologist was invited to do ECG’s on some of the riders
- Dr. Lavazerro was “shocked” by Merckx’s ECG – looked like he was in the middle of a heart attack
- “Lavezzaro returned to his home in Turin and fully expected to hear news every day over the next fortnight of a Merckx collapse during race.”
- Family history of multiple men dying suddenly at young ages
- Likely has HCM
- *Would have been banned from competition today*
- Still alive (age 73)

Exercise at the Extremes

The Amount of Exercise to Reduce Cardiovascular Events

Thijs M.H. Eijsvogels, PhD,* Silvana Molossi, MD, PhD,† Duck-chul Lee, PhD,‡ Michael S. Emery, MD,§ Paul D. Thompson, MD¶

ABSTRACT

Habitual physical activity and regular exercise training improve cardiovascular health and longevity. A physically active lifestyle is, therefore, a key aspect of primary and secondary prevention strategies. An appropriate volume and intensity are essential to maximally benefit from exercise interventions. This document summarizes available evidence on the relationship between the exercise volume and risk reductions in cardiovascular morbidity and mortality. Furthermore, the risks and benefits of moderate- versus high-intensity exercise interventions are compared. Findings are presented for the general population and cardiac patients eligible for cardiac rehabilitation. Finally, the controversy of excessive volumes of exercise in the athletic population is discussed. (J Am Coll Cardiol 2016;67:316–29)

FIGURE 1 The Curvilinear Relationship Between Physical Activity and Cardiovascular Risk

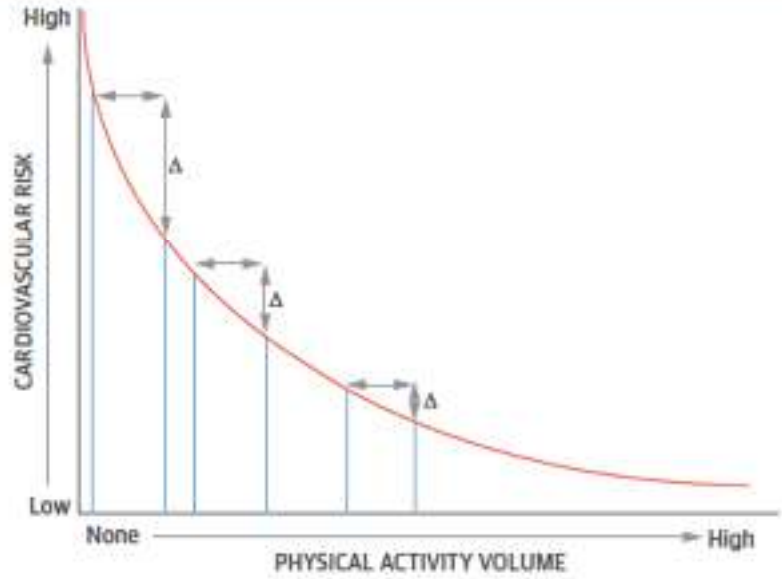
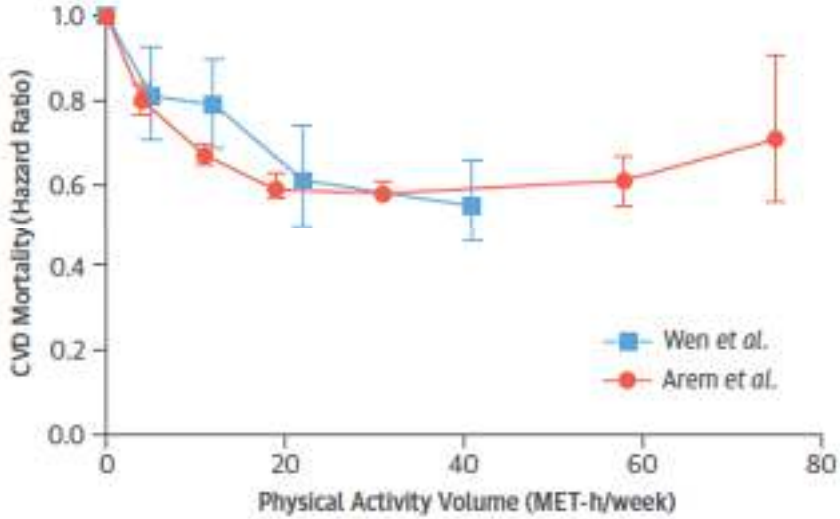
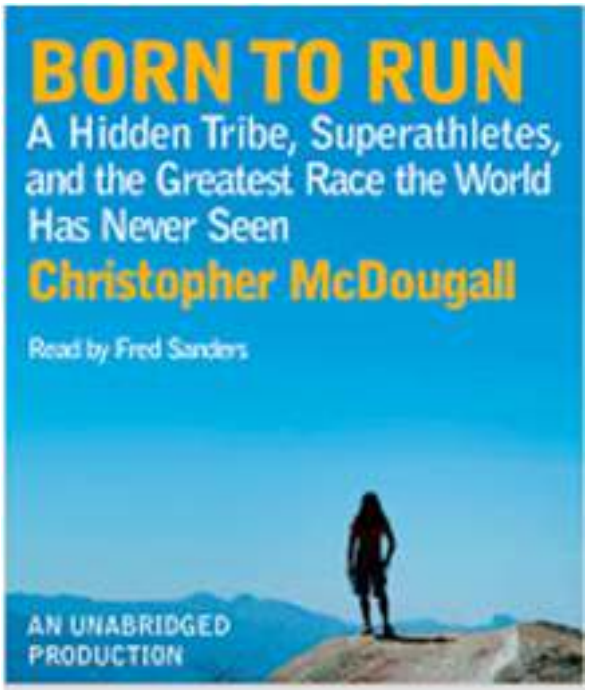


FIGURE 2 The Dose-Response Curve of Physical Activity and Cardiovascular Mortality



Vigorous activity transiently increases the risk of acute events, but reduces overall risk



Micah True “Caballo Blanco”
Ran ~ 170 miles/week for many years
Died during a trail run in the Gila wilderness area at age 58
Autopsy showed unspecified cardiomyopathy

The Goldilocks Zone for Exercise: Not Too Little, Not Too Much

by James H. O'Keefe, MD, Evan L. O'Keefe, MS & Carl J. Lavie, MD

"…middle-aged and older individuals engaging in *excessive strenuous endurance exercise appear to be at increased risk* for a variety of adverse cardiovascular effects including atrial fibrillation, myocardial fibrosis and coronary atherosclerosis."

"…moderate doses of physical activity significantly reduce long-term risks for both total mortality and CV mortality, however, *at very high doses of chronic strenuous exercise much of the protection…is lost*."

"…150 minutes per week of moderate-intensity aerobic exercise or 75 minutes per week of vigorous-intensity aerobic activity, but *not more than 4-5 hours per week of vigorous (heart-pounding, sweat-producing) exercise*, especially those over 45 years of age."

European Heart Journal (2013) **34**, 3624–3631
doi:10.1093/eurheartj/eht188

CLINICAL RESEARCH
Sports cardiology

Risk of arrhythmias in 52 755 long-distance cross-country skiers: a cohort study

Kasper Andersen[1]*, Bahman Farahmand[2,3], Anders Ahlbom[2], Claes Held[1], Sverker Ljunghall[1], Karl Michaëlsson[4], and Johan Sundström[1]

[1]Department of Medical Sciences, Uppsala University Hospital, Entrance 40, 5th floor, SE-751 85 Uppsala, Sweden; [2]Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden; [3]Department of Neurobiology, Care Sciences and Society (NVS), Karolinska Institutet, Alzheimer Disease Research Center (KI-ADRC), Stockholm, Sweden; and [4]Department of Surgical Sciences, Uppsala University, Uppsala, Sweden

Received 11 October 2012; revised 9 April 2013; accepted 14 May 2013; online publish-ahead-of-print 11 June 2013

Participants who completed Vasaloppet (90 km cross country ski race) 1989-98
Followed through national registries until 2005
919 experienced arrhythmia (1.7%)
Adjusted HR for *number of races* (> 5 vs. 1) = 1.3 (any arrhythmia), 1.29 (afib), 2.1 (brady)
Faster finishing times also had higher risk. HF 1.3 for 100-160% of winning time vs. > 240%

AF incidence in Framingham study (men aged 55-64) = *31 per 10,000 person years* at risk
This study, AF = *49 per 10,000 PYAR's*

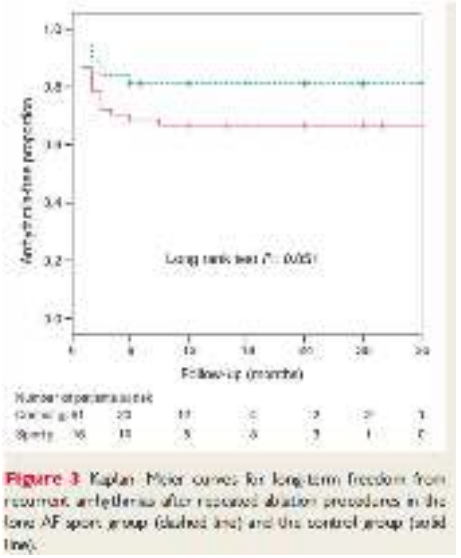
Europace (2010) 12, 30–36
doi:10.1093/europace/eup320

Efficacy of circumferential pulmonary vein ablation of atrial fibrillation in endurance athletes

Naiara Calvo†, Lluís Mont*†, David Tamborero, Antonio Berruezo, Graziana Viola, Eduard Guasch, Mercè Nadal, David Andreu, Barbara Vidal, Marta Sitges, and Josep Brugada

- 182 consecutive PVI patients (81% men; 59% lone AF, LA diameter 42+/-6 mm)
- Endurance athletes (n=42) engaged in > 3 hr/week high-intensity exercise
- Mean age 48 (athletes) vs. 52 (controls)
- Freedom from arrhythmia no different between groups (59% athletes vs. 48% controls after 1 procedure, 1 year)
- Only predictors of recurrence were LA size and longstanding AF

Risk of arrhythmias in athletes appears to be almost exclusively in men



Journal of Internal Medicine 2003; 253: 276–284

Mortality amongst participants in Vasaloppet: a classical long-distance ski race in Sweden

B. F. FARAHMAND[1], A. AHLBOM[1], G. EKBLOM[2], B. EKBLOM[2], W. HÄLLMARKER[3], D. ARONSON[3] & G. PERSSON ERGERT[4]

From the [1]Institute of Epidemiology, Karolinska Institute, Center of Public Health, and Institute of Environmental Medicine, Karolinska Institute; [2]Institute of Physiology and Pharmacology, Karolinska Institute, Stockholm; [3]Department of Internal Medicine, Sälen Hospital and [4]Järnvägsgatan K & H, Hedemora, Sweden

49,219 men; 24,403 women

Standardized mortality ratios (SMR) calculated from national death registry

-adjusted for age and calendar year

410 deaths compared to 850 expected (*SMR 0.48*, CI 0.44-0.53)

Lowest SMR in older participants and those who participated in several races

Decreased mortality for cancer, circulatory diseases, injuries, suicide and poisoning

Physical training vs. related lifestyle factors vs. genetics (or combination)

European Heart Journal (2013) 34, 3145–3150
doi:10.1093/eurheartj/eht347

FASTTRACK CLINICAL RESEARCH
Sports cardiology

Mortality of French participants in the Tour de France (1947–2012)

Eloi Marijon[1,2,3,4*], Muriel Tafflet[1,2,5], Juliana Antero-Jacquemin[1,5], Nour El Helou[1,5,6], Geoffroy Berthelot[1,5], David S. Celermajer[7], Wulfran Bougouin[1,2,4], Nicolas Combes[8], Olivier Hermine[1,9,12,13], Jean-Philippe Empana[1,2], Grégoire Rey[10], Jean-François Toussaint[1,5,11†], and Xavier Jouven[1,2,3,4†]

768 cyclists who participated at least once in TDF
268 deaths by 2012 (26%); median duration of f/u 37 years
Neoplasms and CVD main causes of death
Standardized mortality ratio (SMR) 0.59 (41% reduction) compared to French males
SMR for CVD 0.67 and for neoplasms 0.56

OPEN ACCESS Freely available online

PLOS | ONE

Row for Your Life: A Century of Mortality Follow-Up of French Olympic Rowers

Juliana Antero-Jacquemin[1,2*], François Deni Desgorces[1,2], Frédéric Dor[1], Adrien Sedeaud[1], Amal Haïda[1], Philippe LeVan[3,4], Jean-François Toussaint[1,2,5]

203 French olympic rowers (1912 – 2013)
Causes of death from national registry
Overall cohort: *42% reduction in mortality (SMR 0.58)*
1912-1936: 37% reduction in mortality (SMR 0.63)
1948-2012: 60% reduction in mortality (SMR 0.40)
Mortality due to CVD significantly reduced (SMR 0.41)

SWEAT SCIENCE

There's Finally Heart Health Data on Extreme Exercise

A new analysis tracks people doing 35 hours of exercise per week for a decade, and finds no evidence of heart risks

Outside Magazine

AHA 2019

66 “extraordinary exercisers”, 12 were women, average age of 53.2, exercised on average **35.1 hours/week and accumulated 13,921 MET-minutes per week**. They had been exercising for an average of 28.5 years. That data allows us to determine that their average exercise intensity was 6.6 METs.

After an average of 10 years of follow-up, **two of the 66 extraordinary exercisers had died**. **Neither of the deaths were related to heart disease or other cardiovascular conditions**. Overall, the results for the extraordinary group looked pretty much identical to the plain old high exercise group. They had similar BMI, VO2max, cholesterol, coronary artery calcification, and so on.

On the glass-half-full side, it looks like going to extremes is not going to kill you either.

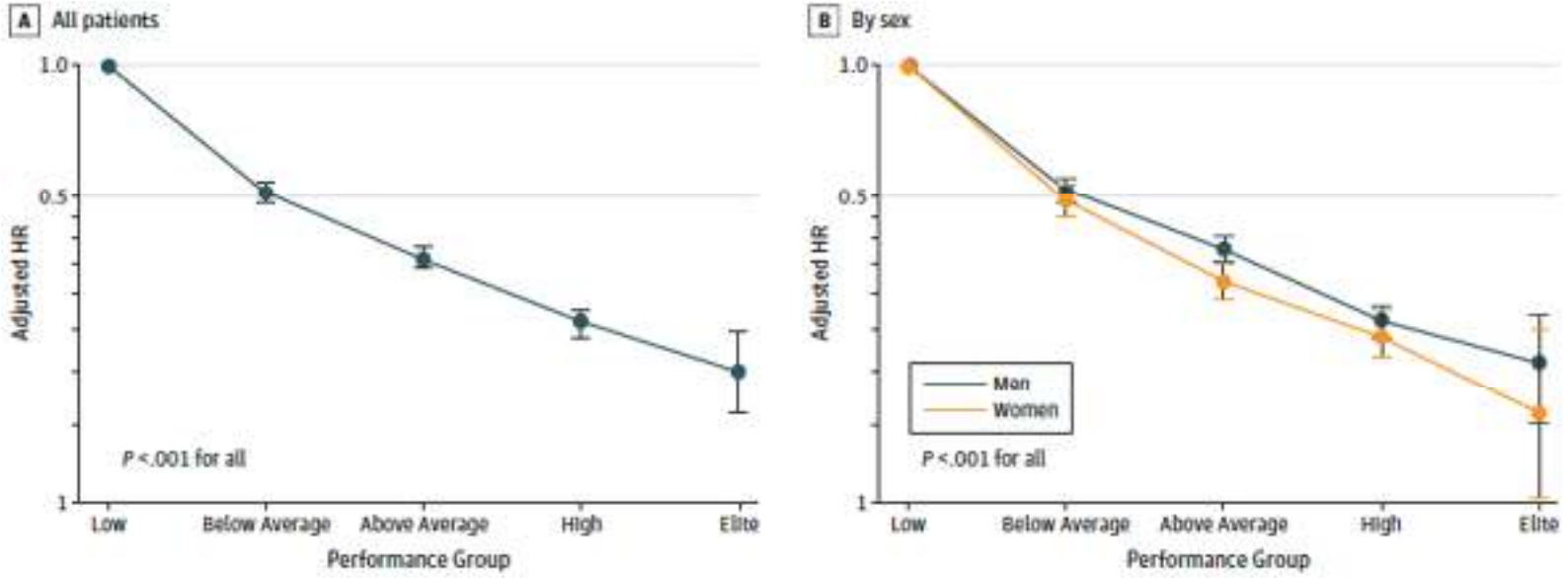
JAMA Network | Open

Original Investigation | Cardiology

Association of Cardiorespiratory Fitness With Long-term Mortality Among Adults Undergoing Exercise Treadmill Testing

Kyle Mandsager, MD; Serge Harb, MD; Paul Cremer, MD; Dermot Phelan, MD, PhD; Steven E. Nissen, MD; Wael Jaber, MD

N=122,007, mean age 53
13,637 deaths, 1.1 million person years of f/u
Fitness: low (<25th percentile), below avg (25-49), above average 50-74, high 75-97.6, elite >97.7 percentile)
Risk of low fitness (HR 5.04) > traditional clinical risk factors
Elite level had lowest risk adjusted mortality HR 0.2 (0.16-0.24)
No observed upper limit of benefit



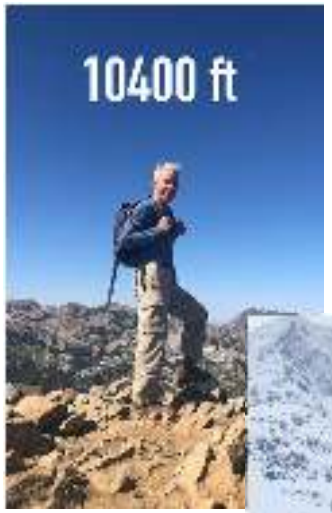
Summary

- Things that may be normal in athletes
  - 4 chamber enlargement
  - LVH
  - Low normal or mildly reduced LV EF
  - Mildly elevated pulmonary artery pressure
  - Dilated IVC
  - Low normal strain
  - Abnormal ECG
- Refer for additional imaging testing when needed
- Inherited diseases main risk for younger athletes, CAD main risk for older athletes
- Shared decision making for patients with known disease
- Exercise and high levels of physical activity are strongly protective
  - However, very high, chronic levels of exercise *may* have deleterious effects, especially arrhythmias

If you keep on moving, you never grow old

Carl Kjeldsberg, M.D.

Snowbird Hill Climb circa 1998



Harry Hill, M.D.