Arrhythmias and sport
Sport and arrhythmias

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Sport used to be simple

Physical activity – Benefits
J.A.M.A – Jul 18 , 1896

- General Miles calls for half an hour every day of gymnastic exercises.
- It will make life more interesting, gives muscular development, grace and suppleness, grit, energy and determination to win.
- It will keep men at home in barracks and away from evil resorts

Physical activity - Benefits

- **Blair S.N et al, J.A.M.A, Jul 1996**

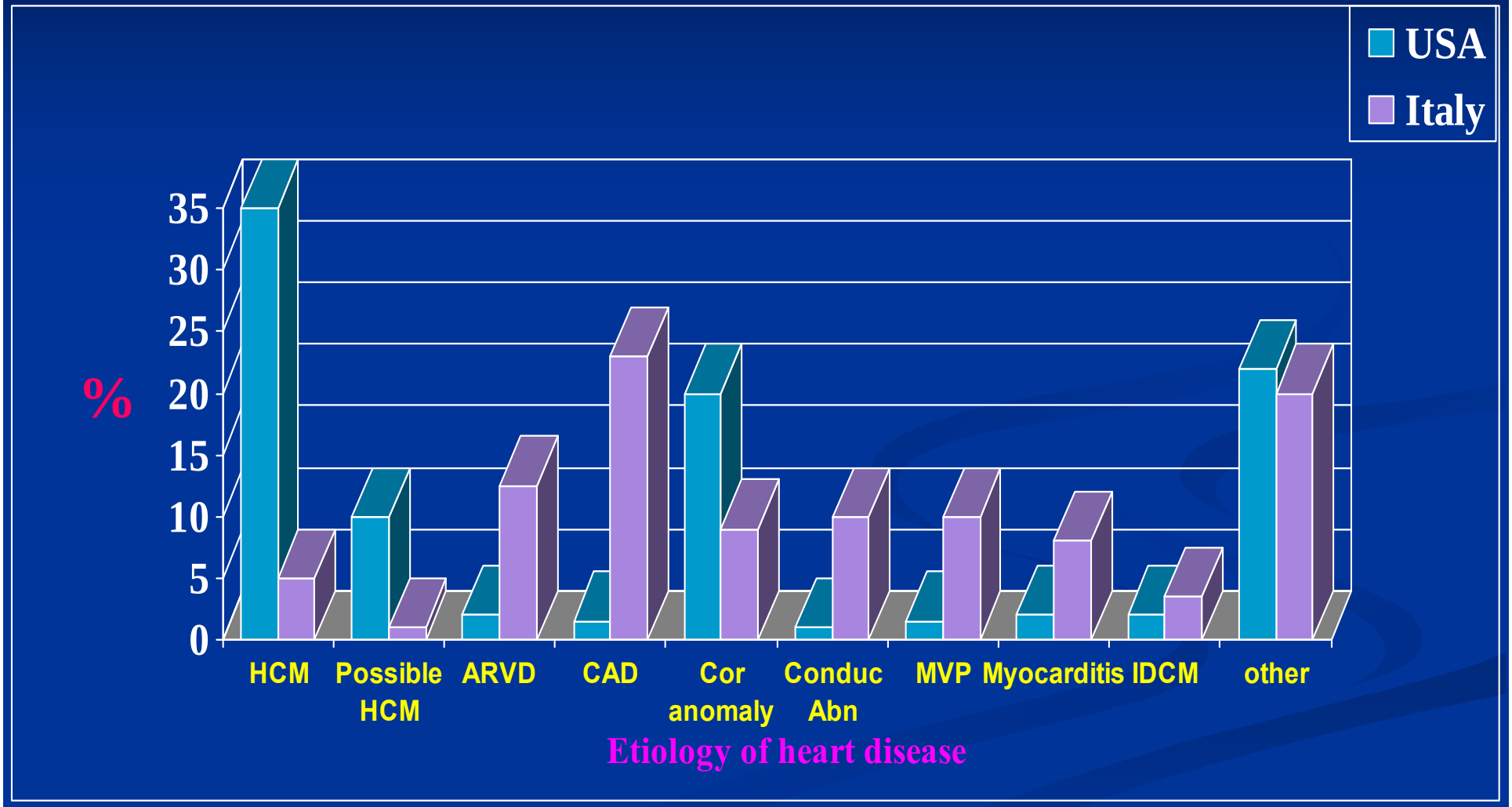
Observational cohort study- 25341 men
7080 women

Low fitness is an important precursor of mortality. The protective effect of fitness held for smokers and nonsmokers, those with and without elevated cholesterol or elevated blood pressure, and unhealthy and healthy persons.

Sport -Risk

- Trends in sudden cardiovascular death in young competitive athletes after implementation of a preparticipation screening program.
  3.6/100,000 (1979-80) to **0.4/100,000** (2003-04)
  Corrado D et al. JAMA. 2006;296:1593-1601.
- Sudden death in young competitive athletes.
  1980-2006: 1866 death.
  Annual rate – **0.6/100,000.**
  Maron B. et al Circ 3/2009. 119:1085-1092.

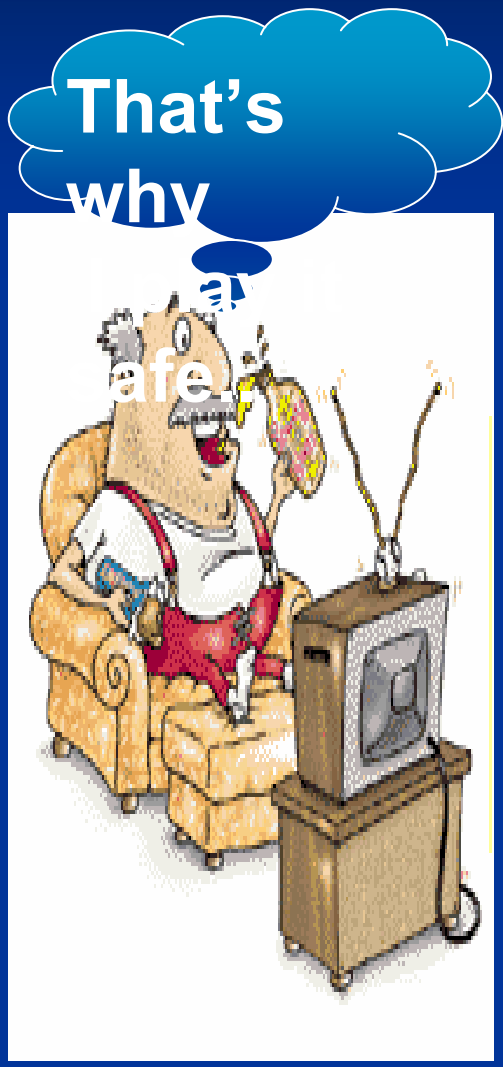
Comparison of the incidence of underlying heart disease in young athletes dying suddenly in the U.S.A and Italy

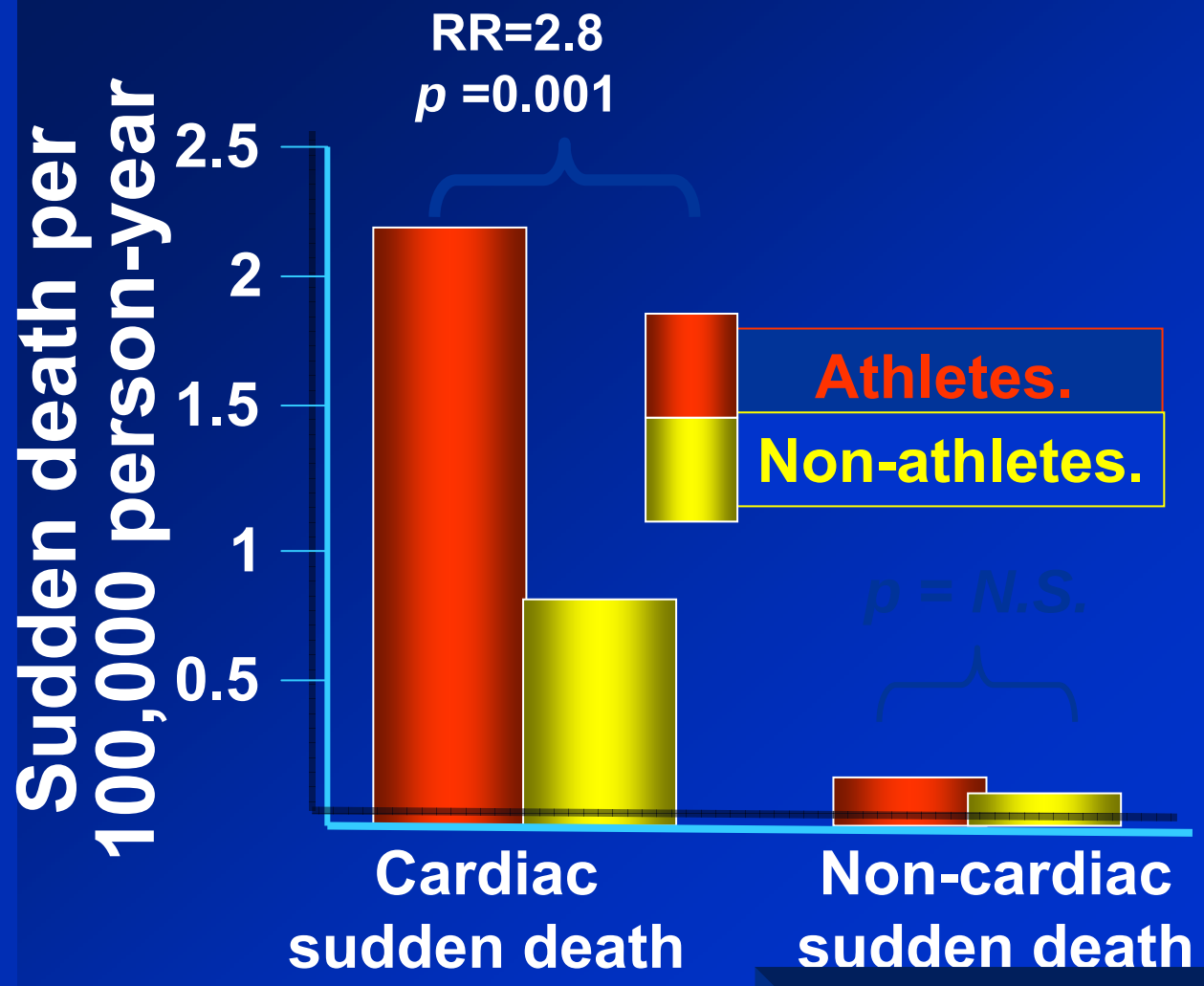


Sudden death in young competitive athletes
Maron et al. Circ 3/2009

- 80% exertional, 20 non exertional.
- 56% definite cardiac cause, 22% blunt trauma, 4% commotio cordis, 8% unresolved cases, 10% miscellaneous.

Sport increases the risk of sudden death in young adults





Corrado, *JACC* 2003

- **Athletes and arrhythmias**

Clinical significance of abnormal ECG pattern in trained athlete

Pelliccia et al , Circ. 102:278-84, 2000

- Compare ECG pattern with cardiac morphology (echo) in the same individual

- 1005 athletes 1993-1995
  440 Olympic level, 565 national level

ECG in Athletes
Pelliccia et al

- **A- Normal or minor alternation:**

1. Increased PR interval
2. Mild ↑ in R or S (25-29mm), any lead.
3. Early repolarization-ST ↑ >2mm in 2 leads
4. IRBBB (<0.12 sec)
5. Sinus bradycardia <60

ECG in Athletes cont'

B – Mildly abnormal – ECG compatible with C.V disease

1. R or S – 30-34 mm in any lead.
2. Q 2-3 mm in >2 leads.
3. Repolarization pattern – flat T, minimally inverted, tall (>15 mm) in 2 leads.
4. Abnormal R wave progression in ant. precordial leads.

ECG in Athletes cont'

5.RBBB

6.RAE (peaked P > 2.5mm in lead 2,3 or v1)

7.LAE (prolonged P in lead 2 or v1)

8.Short PR (< 0.12sec)

ECG in Athletes cont'

- **C – Distinctly abnormal – strongly suggestive of C.V disease.**
  1. Striking R or S (>35mm in any lead)
  2. Q > 4mm in > 2 leads
  3. Repolarization- inverted T>2mm in>2 leads
  4. LBBB
  5. Marked Lt(<-30) or RT (>110) QRS axis deviation
  6. WPW

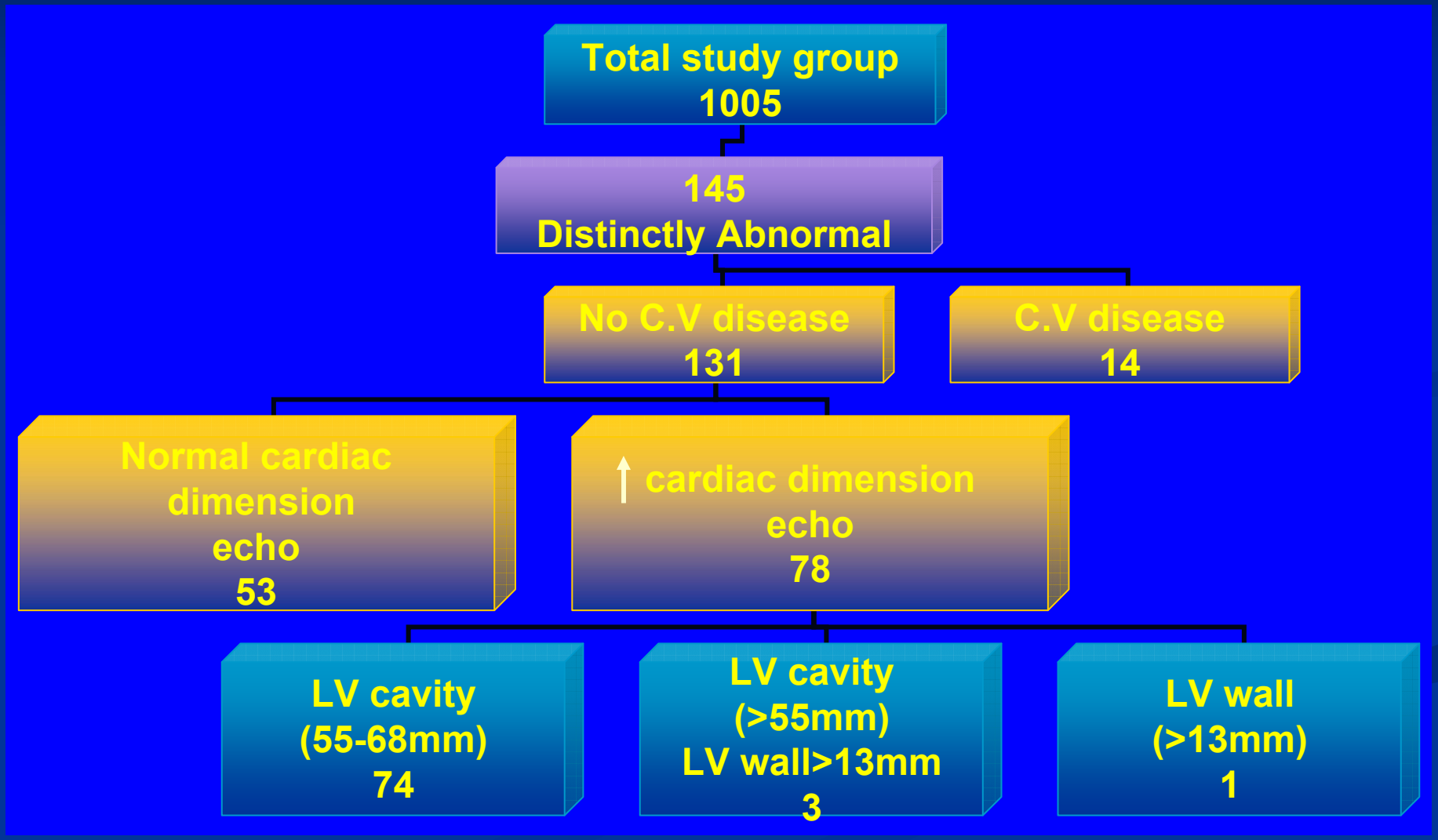
Results

- Abnormal ECG – 402 (40%): **145** distinctly
  257 mildly
- Normal – 603 (60%): 188 completely
  415 minor alternation
- Echo – Abnormal 53 (5%)
  MVP+Mild MR-19, B.Ao.V-10, ASD-6
  DCM-4, WPW-3
- Of the 53 – 27 had abnormal ECG
  26 had normal ECG **(false negative)**

Results cont'

- Of 952 without C.V disease
  577 – Normal ECG
  375 – Mildly or distinctly abnormal
  (false positive)
- Sensitivity – 51%, Specificity – 61%
- Positive predictive accuracy – 7%
- Negative predictive accuracy – **96%**

Distinctly abnormal ECGs



Results cont'

- **Abnormal ECG**

  Male sex

  Endurance disciplines

  Younger athletes (<20y)

Follow-up

- Of 145 with distinctly abnormal ECG, only 1 with DCM (disqualified) developed cardiac symptoms with A.Fib
- Major determinant of altered ECG- Morphological cardiac remodeling: Increased LV cavity size, wall thickness, Lt atrial dimension.

Arrhythmia and sport

Major References

- Report of the NASPE policy conference on arrhythmias and the athlete. J.C.E 12, 1208-19, Oct 2001
- Recommendation for competitive sports participation in athletes with cardiovascular disease: a consensus document from the European Society of Cardiology. Eur Heart J. 2005;26:1422-1445.
- 36th Bethesda Conference: eligibility recommendations for competitive athletes with cardiovascular abnormalities. J.A.C.C 2005;45:1312-1375.

What is competitive?

- Competitive athlete – one who participates in an organized team or individual sport that requires regular competition against others as a central component, places a high premium on exllence and achievement and requires some form of systematic training.
- For children <12y – individual judgment is needed.
- Excessive and unnecessary restriction could potentially create physical and psychological burdens

Classification of sports

	A. Low dynamic	B.Moderate dynamic	C.High dynamic
I. Low static	Billiard, Bowling Cricket, Golf Curling, Riflery	Baseball,Softball Volleyball, Table tennis, Tennis(2)	**Soccer**, Squash Tennis(1), Running(long)
II. Mod. static	Archery, Diving Motorcycling, Archery	Rugby, Surfing Running(sprint) American football	**Basketball**, Ice hockey, Handball Swimming,
III. High static	Weight lifting, Windsurfing, Karate/Judo, Gym	Body building, Wrestling Downhill skiing	Boxing, Cycling, Decathlon, Rowing, Kayaking

Bradyarrhythmias

- **Sinus bradycardia –**

  No symptoms – no further evaluation
  Symptoms – ECG, 24 Hrs Holter, exercise test and if needed – echo

Athletes with or without heart disease – If H.R increase appropriately with exercise – All sports

Bradyarrhythmias – Cont'

- **1st degree AVB + 2nd AVB (Mobiz I)**
  Asymptomatic, no worsening with exercise – All sports
- **2nd AVB (Mobitz II) or C.H.B**
  Asymptomatic, no structural heart disease, resting H.R>40 increasing with exercise, no ventricular arrhythmias during exercise, no or occasional PVC's – all sports

Bradyarrhythmias – Cont'

- **2nd A.V.B (Mobiz II) or C.H.B**
  Symptomatic – Pacemaker

- Patients with pacemakers – **No contact sports**

RBBB and LBBB

- Requires further work-up
- RBBB -If isolated (normal heart) – All sports
- LBBB – EPS should be considered and if normal HV and AV conduction – all sports.

  If abnormal – consider pacemaker.

Syncope

- No sports until cause has been determined and treated, if necessary.

- If clinically attributed to arrhythmias –
  can resume sports if treated and asymptomatic for 2-3M.

Supraventricular arrhythmias

- **P.A.C**

  Asymptomatic – No further evaluation
  All sports

  Symptomatic – ECG, 24 Hrs Holter,
  Exercise test, echo
  Beta-blocker – All sports

S.V.T – A.V.N.R.T

- R.F ablation – 2-4 wks post ablation – All sports

  Medical treatment – 2-3M with no SVT – All sports

W.P.W – A.V.R.T

- ECG, 24 Hrs Holter, exercise test, echo
  Asymptomatic – Controversial
  most expert – E.P evaluation for A.P properties. If A.P allows conduction to the ventricle > 240 BPM – Ablation
  Symptomatic – Ablation (2-4wks – all sports)

Table 1 Summary of Selected Differences Between BC#36 and ESC Recommendations for Competitive Athletes With Selected CV Abnormalities

	Clinical Criteria and Sports Permitted	
	BC#36	**ESC**
Gene carriers without phenotype (HCM, ARVC, DCM, ion channel diseases*)	All sports	Only recreational sports
LQTS	>0.47 s in male subjects, >0.48 s in female subjects	>0.44 s in male subjects, >0.46 s in female subjects
	Low-intensity competitive sports	Only recreational sports
Marfan syndrome	If aortic root <40 mm, no MR, no familial SD, then low-moderate intensity competitive sports permitted	Only recreational sports
Asymptomatic WPW	EPS not mandatory	EPS mandatory
	All competitive sports (restriction for sports in dangerous environment)†	All competitive sports (restriction for sports in dangerous environment)†
Premature ventricular complexes	All competitive sports, when no increase in PVCs or symptoms occur with exercise	All competitive sports, when no increase in PVCs, couplets, or symptoms occur with exercise
Nonsustained ventricular tachycardia	If no CV disease, all competitive sports	If no CV disease, all competitive sports
	If CV disease, only low-intensity competitive sports	If CV disease, only recreational sports

*Long-QT syndrome (LQTS), Brugada syndrome, catecholaminergic polymorphic ventricular tachycardia; †sports in dangerous environments are restricted, given the risk should impaired consciousness occur, such as motor sports, rock climbing, and downhill skiing.

ARVC = arrhythmogenic right ventricular cardiomyopathy; BC#36 = Bethesda Conference #36; CV = cardiovascular; DCM = dilated cardiomyopathy; EPS = electrophysiologic study; ESC = European Society of Cardiology; HCM = hypertrophic cardiomyopathy; MR = magnetic resonance; PVC = premature ventricular complex; SD = sudden death; WPW = Wolff-Parkinson-White syndrome.

The natural history of asymptomatic WPW
Santinelli v, Pappone C et al
J.A.C.C 2009; 53,3:275-280.

- Prospective F/U 1995-2005 of 184 children after EP study (median age-10y[8-12]).
- ECG and Holter every 6M.
- 133 – no arrhythmia and asymptomatic.
- 51 – arrhythmias: **19 life treatening !!!** (documented sust. AF with SPERR<250msec)
- 3 cardiac arrest, 3 syncope, 8 atypical symptoms, 5 minimal symptoms .

Asymptomatic WPW cont'

- Risk factors: APERP < 240msec
  Multiple accessory pathway
  Tachyarrhythmia inducibility (>1min).
- **Editorial (Balaji S.)**
  More malignant natural history then previously reported.

  The report reinforce the notion that children with asymptomatic WPW should undergo an EP study.

SN reentry, Atrial tachycardia

- If ventricular rate appropriate – all sports.
- Other wise – ablation.
- 2-4 wks post ablation – all sports.

Inappropriate sinus tachycardia

- No structural heart disease and asymptomatic for 2-3M – all sports.

Atrial Flutter

- (no WPW) – no SHD 1A or no sports if SHD

- 1M post successful ablation – if no recurrence – all sports
  2-3M after conversion to S.R with no recurrence and no SHD – all sports.

A. Fib

- Asymptomatic with no S.H.D, who maintain ventricular rate that increases and slows appropriately (comparable to SR)- all sports.
- Anticoagulants – no body collision.
- 4-6 wks post ablation and no recurrence- all sports.
- S.H.D – according to the specific S.H.D

Ventricular arrhythmias

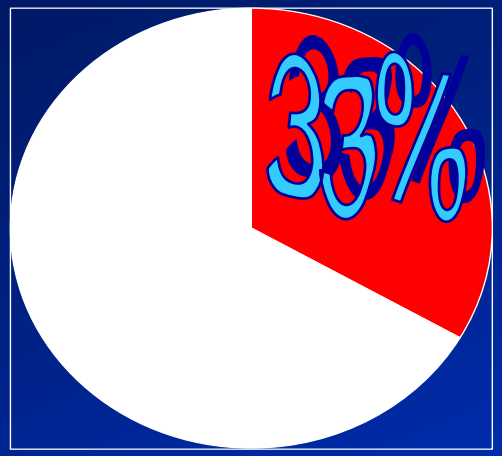
- **P.V.C's**
  ECG, 24 Hrs Holter, exercise test, echo
  Normal heart, no worsening with exercise – All sports
- **N.S.V.T**
  Monomorphic – same as P.V.C's
  Polymorphic – restriction from sport, Beta-blockers

Ventricular arrhythmias in athletes are common!

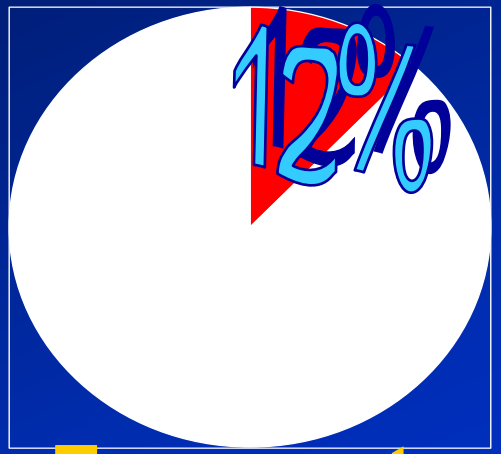
Palatini, *Am Heart J* 1985

Huston, *N Engl J Med* 1985

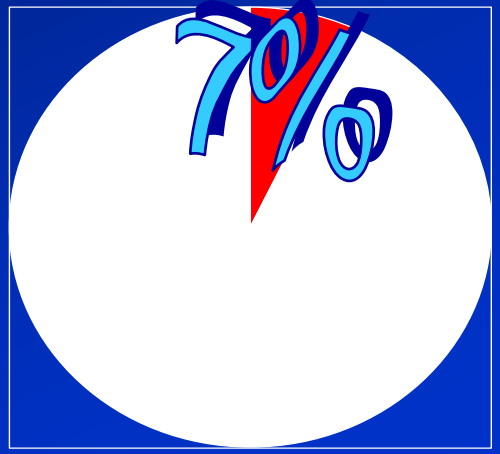
Holter monitoring in consecutive athletes



PVCs



Frequent PVCs



NSVT

Sudden death in athletes Is rare!

Long term significance of frequent P.V.C's and complex V.T in trained athlete

Biffi, Pellicia et al: J.A.C.C 40:446-52, 2002

- 355 competitive athletes with PVC's or NSVT (mean age 24.8+- 12.4Y)
- 1- Frequent and complex P.V.C's + N.S.V.T
- 2 – Less frequent P.V.C's, no V.T
- 3 – Rare P.V.C's, no V.T

Prevalence of structural C.V.D

	Group A (>2000 and NSVT)	Group B	Group C (<100PVC)	P Value
No	71	153	131	
ARVD	7(10%)	0	0	<0.001
MVP	6(9%)	5(3%)	0	0.0042
Myocarditis	4(5.5%)	0	0	0.0003
DCM	4(5.5%)	0	0	0.0003
Total	21(30%)	5(3%)	0	<0.001
Abn. ECG	**15(21%)**	**5(3%)**	**2(1.5%)**	**<0.001**

P.V.C's and N.S.V.T significance – cont'

- P.V.C with LBBB – less frequency of structural cardiac disease (no athlete in group B and C with LBBB had cardiac disease)
- All 71 of group 1 – disqualified (21 – structural abnormalities)
- EPS – done in 24 - 1 positive (ARVD)
- 1 – died suddenly in competitive field hockey- had ARVD, (refused EPS) disqualified but continue to compete in hockey

P.V.C and N.S.V.T – cont'

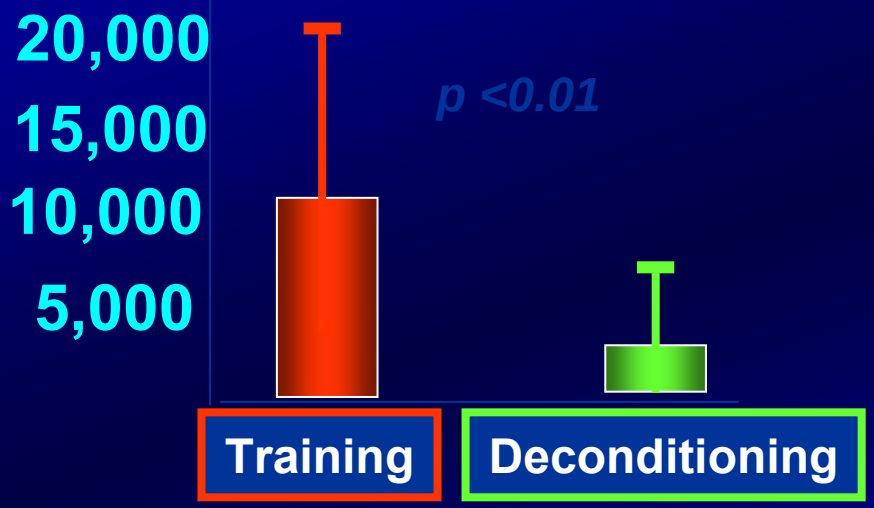
- Most athlete showed no P.V.C's or N.S.V.T during exercise testing

- Frequent P.V.C's and N.S.V.T in the absence of C.V abnormalities do not convey adverse clinical significance, appear to be expression of athlete's heart syndrome and do not per se justify a disqualification from competitive sports.

Impact of deconditioning on cardiac arrhythmias

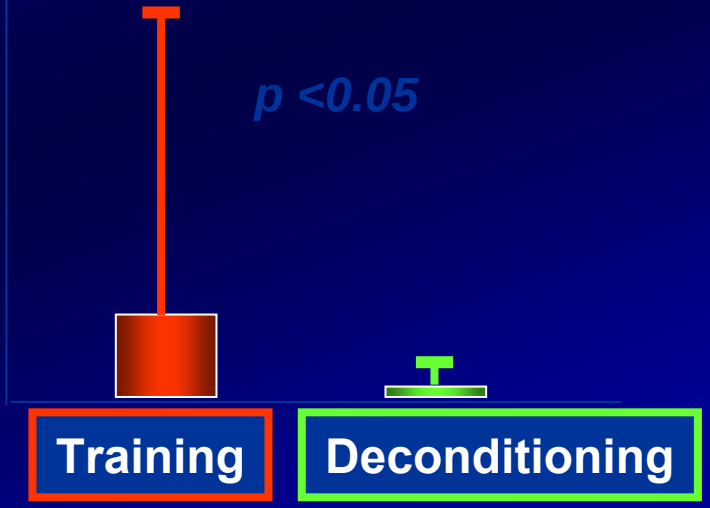
Ventricular extrasystoles

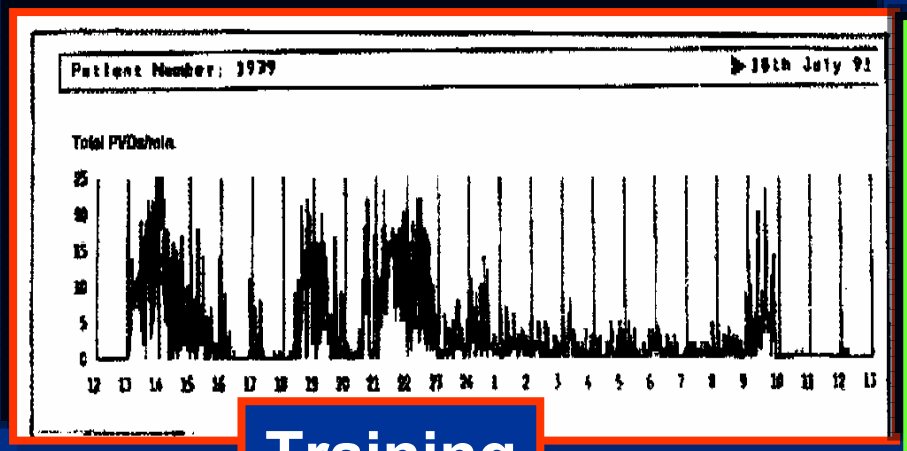
PVCs / 24 hours.

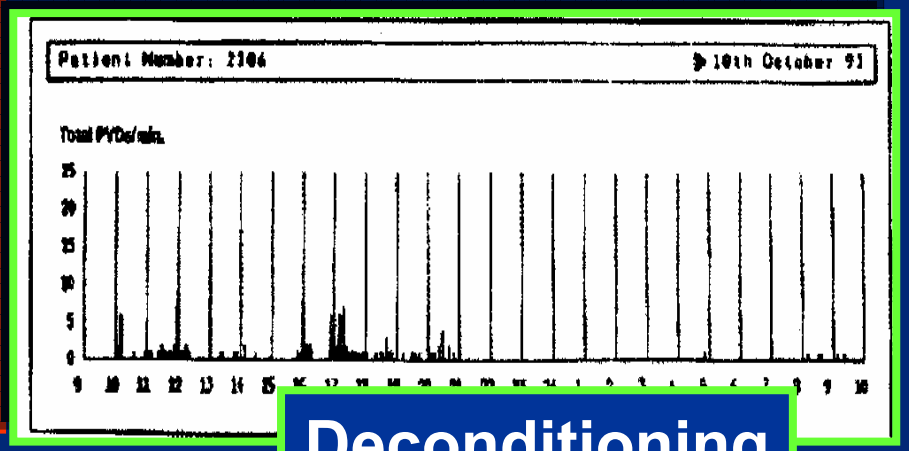


Non-sustained VT

NSVT / 24 hours.







Biffi, *JACC* 2004.

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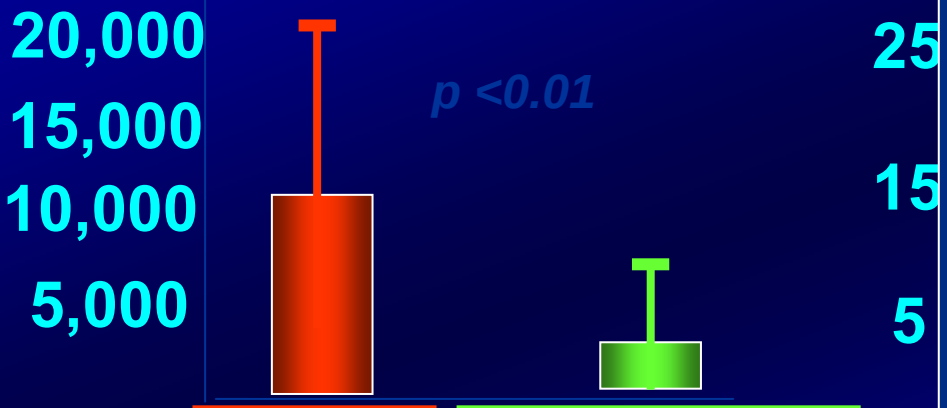

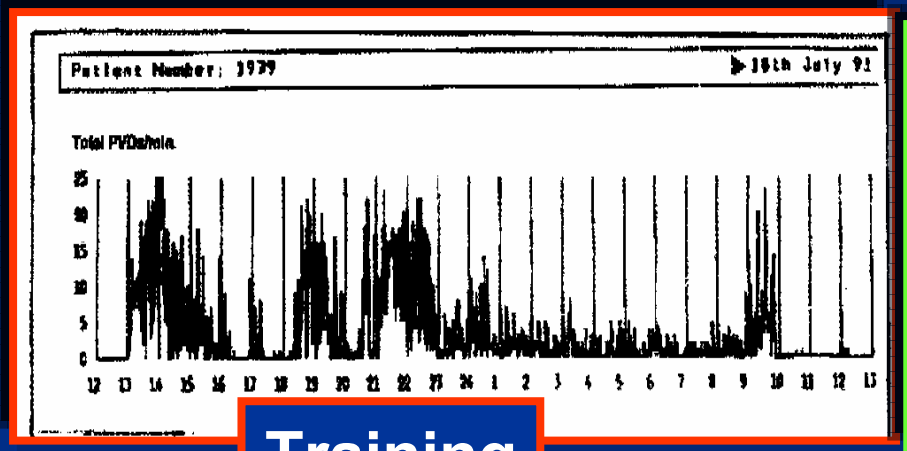

Biffi, *JACC* 2004.

V.T

- **Idiopathic RVOT VT or LV VT**
  Ablation (3M post ablation with normal exercise test and no symptoms – all sports)
  Medical treatment
- Those with SHD – 1A

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V.T

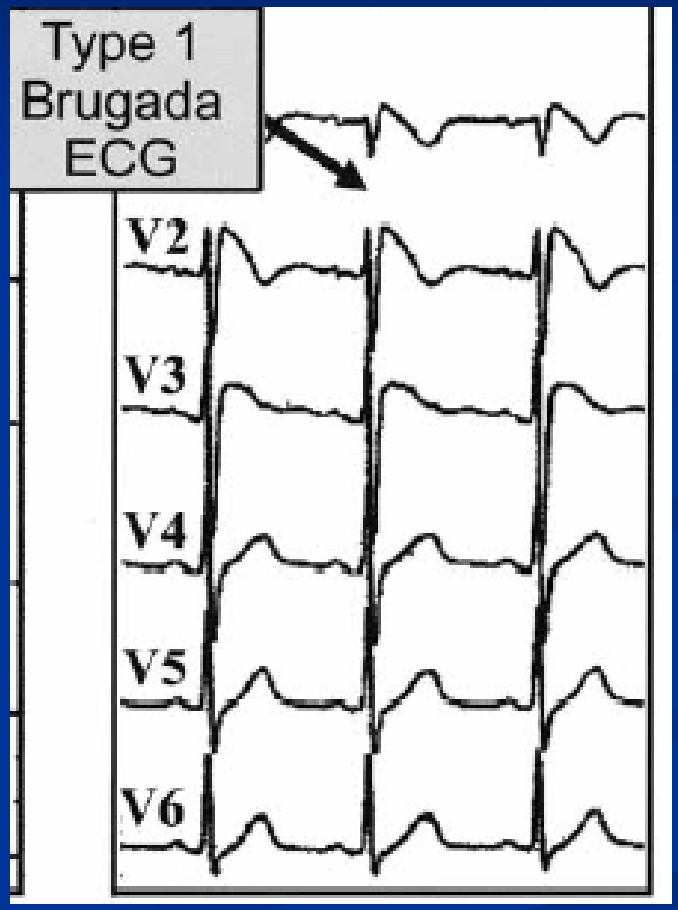
Diagnosis	ECG	VT	Treatment	Sport
H.C.M	LVH	PMVT/VF	BB,AAD,ICD myomectomy	1A
A.R.V.D	↓T Epsilon w.	LBBB Inf axis	AAD, ICD	1A
D.C.M	LBBB T changes	RBBB LBBB	Amiodarone ICD	1A
LQTS	Long QT	TDP	BB.PPM.ICD	1A
Brugada	RBBB ST↑ V1-3	VF	ICD	1A

Brugada type ECG

- RBBB
- “coved” type ST elevation > 0.2mv in v1 to v3 (+/- sodium channel blockers)
- “saddle” type ST elevation >0.2mv in v2 or v3

Type I- Diagnostic

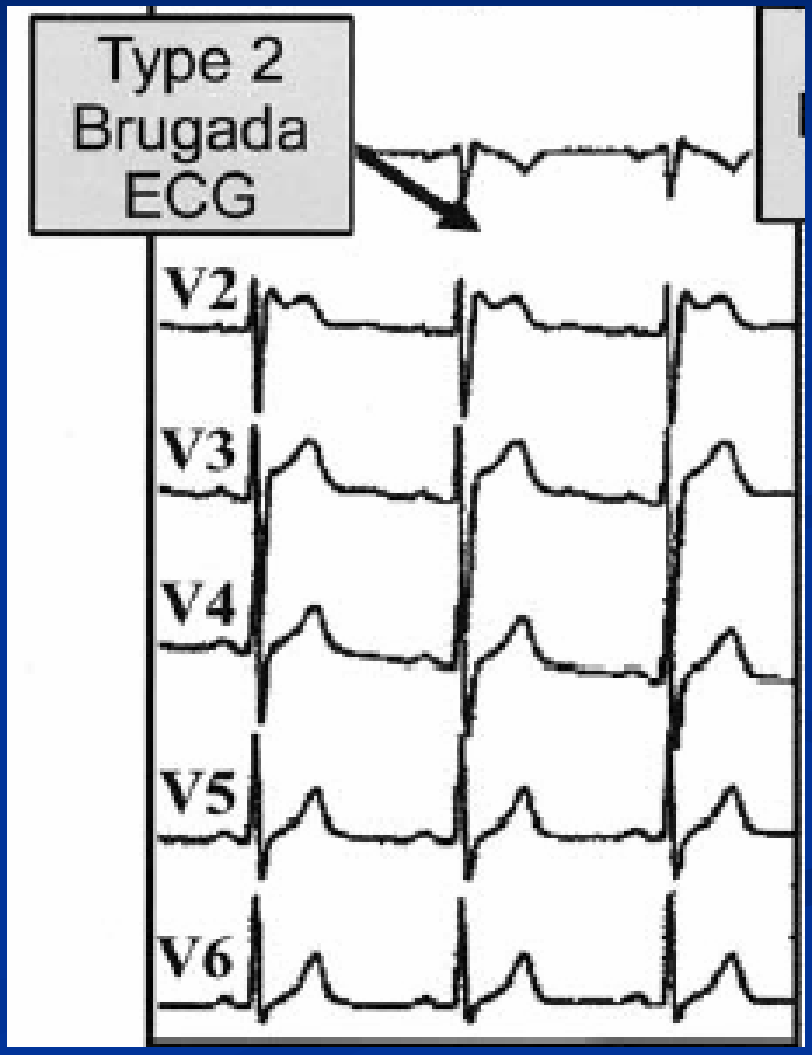
- V1-V3 (at least two leads) ST segment elevation >2mm, "coved" shape, inverted T-wave.
- Coupled with
  - Documented VFib
  - Polymorphic VT
  - FH of sudden cardiac death <45 yo
  - Type I EKG in family members
  - VT inducable in EP lab
  - Syncope
  - Nocturnal agonal respiration



Types II and III- Suggestive

II: V1-V3 ST segment elevation >2mm, "saddleback" shape, pos or biphasic T.

III: <1 mm elevation, either coved or saddleback.



Brugada Syndrome in children

- Probst et al – Circ. 2007; 115:2042-2048
  30 children (<16y) from 13 refferal centers in 3 European countries during 15y. (<3 for each center).
  90% males, 60% asymptomatic (found during family screening).
- Type 1 Brugada ECG is rare in children.

  0.02% - 4/21,944 children (Hioki OE et al- PACE 2005; 28:6 549-554. All had no episodes of arrhythmia or sudden death during 7-10y F/U.

Automatic external defibrillator (A.E.D)

- Small size, low maintenance, inexpensive
- Few Hrs of training required for nonmedical or medical responders
- Greater potential for higher efficacy rate of resuscitation

Automatic external defibrillator (A.E.D)

- Cecchin et al, Circ:103, 2483, 2001
  "A.E.D has excellent rhythm analysis sensitivity (96%) and specificity (100%) in all age groups for VF and nonshockable rhythm"

- A.E.D should be available at athletic events


Wrong
way to
resuscitate
HAPOELTA.COM

חוק הספורט -1988

- ספורט – פעילות משחקית, בין תחרותית ובין שאינה תחרותית אשר נדרש לה מאמץ גופני.
- תקנות הספורט (בדיקות רפואיות) -1996:
  ספורטאי עד גיל 17ש פטור מבדיקה ארגומטרית לפני כניסתו לפעילות תחרותית, אלא אם כן מדובר בהשתתפות בנבחרת ארצית או אזורית.
- בדיקה גופנית כללית תיערך לספורטאי – עד גיל 34 מדי שנתיים. מגיל 35 מדי שנה.
- ארגומטריה – בשנה בה הגיע לגיל 17,23,27,32,34 ומגיל 35 כל שנה.

מה בין מאמץ תחרותי למאמץ לא תחרותי

- מעבר להמלצות הארגונים השונים. ומעבר לספורט תחרותי על הגדרותיו השונות, איך והיכן שמים את קו ההגבלה?
- למשל ילד עם MOD AS

Ritalin & Friends

- Incidence of ADHD – 5-8%
- Increase the amount of Dopamin and Norepinepherin at the synapse.
- Mode of action – unclear.
- Heart rate increase by 10%, B.P by 10mmHg.

What raise the Balagan

- Out of millions of children received Riatlin or Concerta, there were very few cases of sudden death, most of those were on children with: HCM, Channelopathy.
- AHA – Recommended, beside history and P.E an ECG to be done for every child before initiating the drug and be read by an expert ECG reader.

AHA- cont'

- The committee admit that there is no research base for this decision and that it is not clear that the mortality rate is different from the general population.

A.A.P Response

- The AHA recommendation is not evidence based.
- The mortality is not different from the general population .
- ECG is not recommended as a routine test.
- History: cardiac problems, palpitation, syncope, seizures, family history
- Physical examination.

Ritalin in children with no cardiac disease

- No limitation

Children with cardiac disease

- In cases where 10% increase in BP and pulse could be significant:
- Severe obstructive lesions- AS, HOCM, PS, Coarc.
  Channelopathies- LQTS, CAPMVT, Brugada.

Summery

- Ritalin is not risky for children without cardiac problems.
- History and P/E are enough before initiation.
- When cardiac problem is suspected – further evaluation is needed.
- Ritalin shouldn't be given to children with- obstructive cardiac disease or channelopathies