CARDIAC & METABOLIC TESTING
Considerations when screening professional athletes

Javair Gillett – Baseball Conditioning
Head Strength and Conditioning Coach
Detroit Tigers

Joe Rogowski – Importance of Screening
Head Strength and Conditioning Coach
Orlando Magic

Dr. Srijoy Mahapatra – The Heart of a Athlete
Assistant Professor of Medicine and Biomedical Engineering, University of Virginia
Head Team Cardiologist

MLB Winter Meetings, December 5, 2010
Considerations when screening Baseball athletes

Searching for the next, best thing?

Research lends insight to consolidation…

**Athlete + Baseball Specific**

Example protocol – Baseball Athletic Test Battery (B.A.T.)
Frank Spaniol
Strength & Conditioning Journal:
April 2009 - Volume 31 - Issue 2 - pp 26-29

Batted Ball Velocity related to:
body composition, lean body mass, grip strength, leg power, rotational power

Throwing Velocity related to:
Lean body mass, grip strength, leg power
The Heart of an Athlete
Difference between these two workouts?

Player 1 @ 12.0 mph
Player 2 @ 8.0 mph

Player 3
Estimated Max HR: 193
Actual Max HR: 211
LT Threshold: 199
Baseball Bioenergetics

• Few Baseball Studies
  Stockholm, Morris – 175 bpm (1 pitcher, game)
  Szymanski
  - 151.2 bpm (33 pitchers, bp sessions) – 70-75% HR Max
  - Blood Lactate – no pre-post diff.
    (Potteiger, 6 pitchers, bp sessions)
  - Average rest between pitches – 20 seconds
  - PCR – fast recovery = 20 seconds, slow recovery = 3 min
  - Fatigue – pH levels, inorganic phosphates, etc.
  - Chemical ATP resynthesized anaerobically
    (Glaister, Sports Med, 2005)

• Physical and Emotional Stress
• Temperature
• Poor Nutrition/Hydration
• Energy Cost
• Energy Supply
**Testing Work Capacity**

Simple, Stressed Environment

<table>
<thead>
<tr>
<th>Detroit Tigers Gas Analysis Results (2007-2010)</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
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<tbody>
<tr>
<td>Age</td>
<td>27.48</td>
<td>4.95</td>
<td>19.00</td>
<td>44.00</td>
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<tr>
<td>Weight</td>
<td>222.43</td>
<td>15.30</td>
<td>177.00</td>
<td>248.00</td>
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<tr>
<td>Body Fat (6-site)</td>
<td>16.01</td>
<td>3.69</td>
<td>9.02</td>
<td>25.66</td>
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<tr>
<td>Lean Muscle</td>
<td>186.53</td>
<td>11.22</td>
<td>161.03</td>
<td>207.86</td>
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<tr>
<td>Resting Heart Rate</td>
<td>93.69</td>
<td>13.04</td>
<td>70.00</td>
<td>126.00</td>
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<tr>
<td>Anaerobic Threshold</td>
<td>38.50</td>
<td>7.56</td>
<td>21.80</td>
<td>63.30</td>
</tr>
<tr>
<td>Anaerobic Threshold HR</td>
<td>167.17</td>
<td>11.75</td>
<td>136.00</td>
<td>199.00</td>
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<tr>
<td>Estimated Anaerobic Threshold HR</td>
<td>154.01</td>
<td>3.96</td>
<td>140.80</td>
<td>160.80</td>
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<tr>
<td>VO2 Max</td>
<td>47.58</td>
<td>5.49</td>
<td>37.60</td>
<td>67.40</td>
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<tr>
<td>Max Heart Rate</td>
<td>185.74</td>
<td>8.41</td>
<td>168.00</td>
<td>211.00</td>
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<tr>
<td>Estimated HR Max</td>
<td>192.52</td>
<td>4.95</td>
<td>176.00</td>
<td>201.00</td>
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<tr>
<td>Heart Rate Reserve</td>
<td>102.46</td>
<td>33.19</td>
<td>63.00</td>
<td>195.00</td>
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<tr>
<td>Estimated HR Reserve</td>
<td>109.24</td>
<td>30.84</td>
<td>65.00</td>
<td>192.00</td>
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<tr>
<td>Heart Rate Recovery 1 min Post</td>
<td>27.4%</td>
<td>0.09</td>
<td>9.6%</td>
<td>52.4%</td>
</tr>
<tr>
<td>Heart Rate Recovery 2 min Post</td>
<td>52.9%</td>
<td>0.10</td>
<td>30.9%</td>
<td>72.1%</td>
</tr>
</tbody>
</table>

Pitchers (Starters and Veterans 1st)

Spring Training Week 1

Hypothesis: None

Informational Post-Test Usefulness

Results…
Performance Comparisons

Starters vs. Relievers

(p < 0.05)

<table>
<thead>
<tr>
<th></th>
<th>VO2 Mean</th>
<th>AnT Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starters</td>
<td>49.0623</td>
<td>39.983</td>
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<tr>
<td>Relievers</td>
<td>45.7204</td>
<td>36.642</td>
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</tbody>
</table>
In-Season Conditioning

![Graph showing average working heart rates for different work:rest timelines. The graph includes two sets of data: Gas Analysis and Traditional 220-age. The x-axis represents work:rest timelines (1:1, 1:3, 1:5, 1:10) and the y-axis represents heart rate (bpm). The table below the graph shows the heart rate percentages for each timeline: Gas Analysis: 65% = 121, 75% = 139, 85% = 158, 100% = 185; Traditional 220-age: 65% = 125, 75% = 145, 85% = 164, 100% = 193.]

LT = 167
Stamina is Strength

**Purpose to Endurance Testing – Off-Field Fitness**
- Monitor Conditioning, Training Effect, Heart Rate Levels
- Improve Stamina, Recovery, Body Composition
- Initial Peripheral adaptation
- Movement fluidity

**Purposeful Endurance Training in Baseball**
- Deconditioned Athlete
- Unacceptable body fat %
- Older players

**Mode of Training**
- More dynamic
- Fast-twitch
- High duration
- Little to no rest
Maximize Recovery

Resistance training = Central and Peripheral Stress

Creative Consolidation
Complex Training – 2-3 exercise supersets
Rest – ATP/PC recovery
THIS WILL NOT IMPROVE or MAINTAIN POWER
In-Season Conditioning

Primary Focus: Sport-Specific Velocity

Strength and Conditioning Program
Focus: Maintain Rate of Force Production
Duration: Short (<10 seconds)
Rest: Long (1:3 or more)

Rehab or Out of Shape Player
Focus: Anaerobic Capacity
i.e. Cardio, Met Training, Shoulder maintenance

Either way – Strong Heart to play baseball
Safe, Effective Training Environment
CARDIAC & METABOLIC TESTING
Considerations when screening Professional Athletes

Joe Rogowski MA, ATC/L, CSCS>

• University of Central Florida: Exercise Physiology Program
• Orlando Magic ATC / CSCS
• NBA Combine and Summer League Cardiac Coordinator
• Founder of Athletic Heart Mobile Testing & Research Institute (AHI)
• www.athletic-heart.com
THE INTEGRATION OF CARDIAC TESTING AND PERFORMANCE

There is an acute need for development of high quality strength and conditioning programs that can achieve the reduction of injury, detection of cardiac abnormalities, as well as enhance the quality of athletic performance. Present poor exercise techniques sometimes result in poor cardiac response, tissue ischemia, and the use of comparatively musculature for a short duration, which translates to increased risk of dislocation or injury that could lead to failure of a mission.

Conventional EKG screening assessments result in a lower degree of identifying these issues; therefore, implementing a program associated with a scientific approach can increase these risks.

Test (Maximal Oxygen Uptake) with the possibility of an EKG

You will receive information reporting your maximal oxygen consumption (VO2 Max) and heart rate during levels of high intensity exercise; you will also be advised to a 12 lead EKG and have your cardiac function monitored by the duration of the testing procedures. This can help to train more efficiently for your chosen activity. This testing procedure is intended to help augment an existing or future regiment.

Athletic Heart
PO Box 508, Orlando Florida 32809
24-7 732-4424
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Programs offered by Athletic Heart

Pro Heart
A program tailored to meet the needs and demands of the professional athlete.

Tactical Heart
Screening elite military members in becoming optimal warfighters.

Project Athletic Heart
A program tailored to meet the needs of scholastic athletes; as well as, the local community.

Organizations/ Affiliations with Athletic Heart

Orlando Magic
Detroit Tigers
San Jose Sharks
Olympics
University of Central Florida

University Of Miami
Utah Jazz
Indiana Pacers
Boston Celtic
Elite Military Members

Athletic Heart has also serviced the local community such as High Schools and Churches in order to ensure the proper preparticipation screening process is in place.
As an Athletic Trainer, What is our responsibility to our players???

Quote by
Greg McMillan
(Buffalo Bills’ ATC)
Medical and Legal Issues in the Cardiovascular Evaluation of Competitive Athletes

Timothy E. Paterick, MD, JD
Timothy J. Paterick
Gerald F. Fletcher, MD
Barry J. Maron, MD

A
thletes are considered the healthiest members of our society, and an unexpected death during training or competition is a tragic event with widespread implications. Interest in athletic field deaths has intensified and has become a high-profile and compelling medical event. Such tragedies are always unexpected and counterintuitive, provoking several considerations including implementation of preparticipation screening and disqualification from competitive sports to reduce risk.

Liability issues in screening and management of competitive athletes are of increasing concern to the practicing medical community because some athletes’ deaths have triggered disputes in court, holding physicians accountable for alleged grievances. Consequently, a legal framework is evolving related to the alleged failure to properly diagnose, treat, or disqualify individuals from competitive athletics.

Causes of Sudden Death in Athletes

Sudden death in young athletes is largely due to a variety of clinically unsuspected congenital cardiac abnormalities. In the United States, genetic cardiovascular diseases including hypertrophic cardiomyopathy (HCM), arrhythmogenic right ventricular cardiomyopathy, Marfan syndrome, and ion channelopathies (eg, long QT syndrome) account for approximately 40% of sudden deaths in young athletes, with HCM being the single most common cause and accounting for one third of the cases. Other less common causes include coronary artery anomalies, myocarditis, aortic valve stenosis, mitral valve prolapse, dilated cardiomyopathy, and premature atherosclerotic coronary artery disease. Available prevalence data for sudden death in young athletes are limited and may underestimate the magnitude of this public health problem.

Vigorous participation in competitive sports may predispose to sudden collapse by triggering ventricular tachyarrhythmias in the presence of underlying heart disease.

Healthy-appearing competitive athletes may harbor unsuspected cardiovascular disease with the potential to cause sudden death. This fact raises issues of physician responsibility in preparticipation screening and eligibility/disqualification decisions. A number of medical-legal cases now represent a framework for screening and eligibility decision making in high school and college athletes. Physicians screening competitive athletes should strictly adhere to recommendations from the American Heart Association. Precedent exists for disqualifying athletes with heart disease from competition to prevent unnecessary exposure to risk of injury or death. By virtue of the court decision in Larkin v Archdiocese of Cincinnati, high school students with heart disease have no compelling right to participate in interscholastic sports without medical clearance. In Knapp v Northwestern University, an appellate court ruled that college athletes can be medically disqualified from sports and supported the use of national association medical guidelines by team physicians in formulating eligibility/disqualification decisions. This medical-legal analysis provides guidelines for physicians participating in medical evaluations of competitive athletes by clarifying the standard of care, potential pitfalls, and the evolving liability associated with this clinical practice.

Author Affiliations: Division of Cardiovascular Medicine, Mayo Clinic, Jacksonville, Fla (Dr Paterick); and the Hypertrophic Cardiomyopathy Center, Minneapolis Heart Institute Foundation, Minneapolis, Minn (Dr Maron). Mr Timothy J. Paterick is an undergraduate student at Richmond University, Richmond, Va.

Corresponding Author: Barry J. Maron, MD, Minneapolis Heart Institute Foundation, 300 1st St, Suite 60, Minneapolis, MN 55401 (barry.maron@mayo.edu)

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3005-3011
The preparticipation cardiovascular screening of competitive athletes: is it time to change the customary clinical practice?

Antonio Pelliccia

Institute of Sports Medicine and Science, Largo Papa Gabriele 13, 00157 Rome, Italy

Keywords: Preparticipation screening; Cardiac autore; Electrocardiogram

The recent Recommendations and considerations related to preparticipation screening for cardiovascular abnormalities in competitive athletes (2007 update) have prompted us to reflect on the experience of years of practice in Italy. The preparticipation screening is, in contrast to previous Recommendations of the European Society of Cardiology (ESC) and the International Olympic Committee (IOC). The recommendation is, therefore, proposed by the panel of cardiology that it is time to stop accepting the preparticipation screening of competitive athletes. In addition, recent studies concerning the European Recommendations have provided evidence that sudden deaths in young athletes, especially in the absence of underlying cardiovascular disease, are rare. Therefore, it is time to stop accepting the preparticipation screening of competitive athletes. In particular, this change is supported by the need to focus on a comprehensive approach to the athlete's health.
Clinical Significance of Abnormal Electrocardiographic Patterns in Trained Athletes

A cardiovascular abnormality was identified clinically and/or by echocardiography in 53 athletes (5%); these included 20 of the 785 elite athletes examined as a part of our routine medical evaluations and 33 of the 220 athletes referred to our institution for a suspected cardiac abnormality. The most frequent abnormalities were mitral valve prolapse with mild regurgitation (n=19) and a bicuspid aortic valve with regurgitation (n=10); less common defects were an atrial or ventricular septal defect (n=6), dilated cardiomyopathy (n=4), mild pulmonary artery stenosis (n=2), and myocarditis (n=2); HCM, aortic prosthesis for valvular stenosis, pericarditis, and coronary artery disease were present in 1 athlete each. In addition, Wolff-Parkinson-White syndrome and systemic hypertension were each identified in 3 athletes.

Cardiac abnormalities were present in each ECG subgroup, but they were significantly more common in those athletes with distinctly abnormal ECGs (10%: P<0.001) compared with athletes with mildly abnormal ECGs (5%; P<0.001) or normal ECGs (4%; P<0.001). Specifically, of the 785 athletes examined as a part of our unsolicited medical program, 40% had abnormal ECGs (of which 3% had cardiovascular abnormalities); of the 220 athletes specifically referred for suspected cardiac disease, 38% had abnormal ECGs (15% with cardiovascular abnormalities).

Of 53 athletes with cardiovascular abnormalities, 27 had abnormal ECGs and 26 had normal ECGs (false-negatives).
Previous Screening Problems For Teams:

- Affordable
- Safety
- Convenience
- Lack of Database & Research
- Specific for Athlete Population
- Inferior Equipment for Million Dollar Athlete
Previous Screening Problems Addressed:

- **Cost!!!** – Average Stress Test = $1,200 – $1,500/ player. Magic = $500.00/ player w/ gas analysis, HRR, etc..

- Convenience Factor for Players & Athletes At Facility – 1 Day of Testing Players are Familiar w/ Equipment

- Specialized Athlete EKG and Echo Techs

- Advanced Technology and Equipment (Treadmill, EKG, ECHO, Automated BP, Gas Analysis)

- Coaches!!!!

- One of a kind Elite Athlete Database for one’s sport !!!!
<table>
<thead>
<tr>
<th>Name</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vince Carter</td>
<td>8:00 AM</td>
</tr>
<tr>
<td>JJ Redick</td>
<td>8:40 AM</td>
</tr>
<tr>
<td>Brandon Bass</td>
<td>9:20 AM</td>
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<tr>
<td>Marcin Gortat</td>
<td>9:40 AM</td>
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<tr>
<td>Malik Allen</td>
<td>10:00 AM</td>
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<tr>
<td>Q Richardson</td>
<td>10:40 AM</td>
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<tr>
<td>Chris Duhon</td>
<td>11:20 PM</td>
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<tr>
<td>Jameer Nelson</td>
<td>12:00 PM</td>
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<tr>
<td>Dwight Howard</td>
<td>12:40 PM</td>
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<td>Michael Pietrus</td>
<td>1:20 PM</td>
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<tr>
<td>Daniel Orton</td>
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<tr>
<td>Rashard Lewis</td>
<td>2:40 PM</td>
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<td>Ryan Anderson</td>
<td>3:20 PM</td>
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<tr>
<td>Jason Williams</td>
<td>4:00 PM</td>
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<tr>
<td>Dave Twardzik (GM)</td>
<td>4:40 PM</td>
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<tr>
<td>Stan Van Gundy</td>
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<tr>
<td>Patrick Ewing</td>
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<td>Steve Clifford</td>
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<tr>
<td>Bob Bayer</td>
<td>7:00 PM</td>
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Gas Analysis
An Additional Tool

- VO2 Max
- Lactate Threshold
- Specific HR zones
- Specific Calorie Expenditure
- Specific Conditioning Programs
Abnormal HR Can Indicate Cardiac Abnormality.
Orlando Summer League 2010

• 30 Athletes Tested EKG & ECHO or Stress Test

• ECHO Diagnosed Abnormalities:
  – 1 ASD (normal EKG)
  – 1 Bicuspid Valve (normal EKG)
  – 1 High Pulmonary Pressure (normal EKG)

• EKG Diagnosed Abnormalities:
  – 1 AFIB
  – 1 Hypokalemia
  – 3 HOCM (All False Positives) after echo
Dwight Howard Stress Test w/ Gas Analysis
AHI:  www.athletic-heart.com

Email:  jrogowski@athletic-heart.com  
jrogowski@orlandomagic.com

Cell:  407-733-6424
Screening Baseball Players for Heart Disease

Srijoy Mahapatra, MD FHRS
Assistant Professor of Medicine and Biomedical Engineering
Head Team Cardiologist
University of Virginia
Outline

• Athletes can die of cardiac disease
  – Incidence unclear
  – Devastating when occurs (cannot calculate costs)
• Baseball players have more CAD
• Most disease can be detected
• Most disease can be treated without DQ
Potential Causes of Death in Baseball Players

- Coronary Artery Disease
  - Stress test detects
  - Usually easy to treat

- Arrhythmias
  - EKG and stress may detect
  - Generally easy to treat

- Hypertrophic Heart Disease
  - Echo detects

- Cardiomyopathy
  - Echo detects
Athletic Heart

- A disease detection program customized for athletes
- Data to your cardiologists
- Cardiologist who specialize in athletes available for advice

- Baseline EKG
- Stress echo test
- Fasting Glucose
  - Includes LpA
  - LDL subtype
- Sleep apnea questionnaire
Disease Detected

- CAD
  - Stress tests
- Metabolic syndrome
  - Cholesterol, Glucose, LDL subtype, Subtype
- Arrhythmia
  - Baseline EKG and Stress test (for Outflow VT)
- HOCM
  - EKG and echo
- Long QT
  - EKG
- ARVD
  - EKG and echo pick up some
- Myocarditis
  - Echo
Athletic Heart Treadmill Protocol

Customized for Athletes

<table>
<thead>
<tr>
<th>Average Max Heart Rate</th>
<th>n = 77 (2006 Combine)</th>
<th>n = 57 (2007 Combine)</th>
<th>n = 37 (Orlando Magic, Summer League, Detroit Tigers)</th>
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<tr>
<td>160</td>
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<tr>
<td>190</td>
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</table>
Maps to Free Wall RV
Post Ablation
18 year old Baseball Player
Cardiac MRI confirms ARVD

- RV fat
- Poor function
Research Protocols

**UVA Athletes**
- Cost and Yield of Screening
- Echo screening for athletes
- Effect of Stimulants on Athletes
- Detecting abnormal coronary origin in Athletes

**National Programs**
- NBA Treadmill protocols
- Heart Rate Recovery in the NBA athlete
- NBA: EKG and Echo Predictability
- Military Special Ops. Pulmonary results
- NHL “normal” Echo
- Normal Blood Pressure Response in Elite Athletes