Early Repolarization in the Aviator

Robert Sarlay, Jr., MD, MPH, FACEP
Lt Col, USAF, MC, FS

USAF School of Aerospace Medicine
WPAFB, OH
RAM 2013
I have no financial relationships to disclose.

I will not discuss off-label use and/or investigational use in my presentation
Preceptor/Investigators

- **Principal Investigator**
  - Lt Col Robert Sarlay, Jr.
- **Preceptor**
  - Maj Eddie Davenport
- **Secondary Investigators**
  - Mr. Jared Haynes
  - Ms. Rosa Alvarado
• Early repolarization pattern (ERP) more common:
  • Young
  • Athletes
• ERP tends to resolve over time
• Prior research often based on single ECG prevalence studies
• ERP is considered benign
• Recent literature contradicts this consensus
  • Pro-arrhythmic trait?
  • Increased incidence sudden cardiac death
• **Prevalence General Population**
  
  • 1-5% prevalence depending on the study
  
  • *Eastaugh (1989)* – Review article first described 1936 young military recruits, 1-2% had ERP
  
  • *Lanza et al. (2012)* – Prospective study of 4176 subjects presenting to hospital without heart disease found 84 (2.0%) had ERP
  
  • *Tikkanen et al. (2009)* – 10,864 patients from general population, 630 had ERP (5.8%)
  
  • *Noseworthy et al. (2011)* – ERP 243 of 3,955 (6.1%) *Framingham Heart Study* and 180 of 5,489 (3.3%) *Health 2000 Survey*
Background / Literature Review

• Prevalence in Athletes
  • Tanguturi et al. (2012) – ERP in athletes range from 20 to 90%
  • Noseworthy et al. (2011) – Cross-sectional cohort of 879 college athletes, 25.1% had ERP; exercise training led to increases in prevalence

• Prevalence in Aircrew
  • Boos et al. (2012) – Reported 11.8% of 868 healthy aircrew had ERP [average age 39.6, 95.4% male]

• Natural History
  • Adhikarla (2011) – 29,281 patients found 479 with ERP, analyzed 244 found that 10 years later 68% no longer had ERP on ECG, at time largest serial comparison
  • Other studies have reported decreasing prevalence with age
Methods

• USAF ECG Library
  • All cardiac data
  • 281,737 aviators
  • 1950-2011 inclusive (60+ years)
  • Age 17 to 65
  • 1.2 million ECG studies

• Inclusion Criteria for ERP
  • \( \geq 0.1 \text{ mv J-point elevation in } \geq 2 \text{ inferior or lateral leads (II, III, AVF; I, AVL, V4-6)} \)
Methods

• Queried database for all ERP ECGs
• Queried any ERP subject for any normal ECG
• Divided results into categories
  • Group 1 – Always had ERP
  • Group 2 – ERP then normal
  • Group 3 – Normal then ERP
  • Group 4 – Variable
Methods

- SAS software used
- Descriptive statistics
- Bonferroni test used to compare:
  - Group 2 – ERP to normal
  - Group 3 – Normal to ERP
Results

- 85,642 ECGs either normal or ERP pattern
- Total 41,327 ECGs with ERP pattern
- Unique 27,797 with ERP pattern
- Groups:
  1) Always ERP = 1570 / 952 complete
  2) ERP → Normal = 12,432 / 5,636 complete
  3) Normal → ERP = 15,562 / 6,697 complete
  4) Variable = 56,078 / 14,516 complete
Results
Results

Histogram

Age 22 initial flying class required ECG

Age 35 required ECG
Results

• Prevalence
  • 9.9% aviators had ERP

• Natural History
  • 20.3% lost ERP over time
  • 27.5% retained ERP over time
  • 52.2% variable
# Results

## Group 1 – Always ERP

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Range</th>
<th>Min/Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>28.34</td>
<td>7.7</td>
<td>0.71</td>
<td>42</td>
<td>17 / 59</td>
</tr>
<tr>
<td>Height (in)</td>
<td>70.73</td>
<td>2.6</td>
<td>-0.02</td>
<td>19</td>
<td>60 / 79</td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>169.9</td>
<td>20.2</td>
<td>0.31</td>
<td>149</td>
<td>106 / 255</td>
</tr>
<tr>
<td>Systolic</td>
<td>116.4</td>
<td>10.3</td>
<td>0.05</td>
<td>80</td>
<td>80 / 160</td>
</tr>
<tr>
<td>Diastolic</td>
<td>73.3</td>
<td>8.5</td>
<td>-0.04</td>
<td>56</td>
<td>40 / 96</td>
</tr>
</tbody>
</table>
# Results

## Group 2 – ERP then Normal

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Range</th>
<th>Min/Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>34.2</td>
<td>6.7</td>
<td>-0.03</td>
<td>46</td>
<td>17 / 63</td>
</tr>
<tr>
<td>Height (in)</td>
<td>70.7</td>
<td>2.6</td>
<td>-0.15</td>
<td>20</td>
<td>58 / 78</td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>178</td>
<td>22.6</td>
<td>0.46</td>
<td>209</td>
<td>86 / 295</td>
</tr>
<tr>
<td>Systolic</td>
<td>118.8</td>
<td>11.4</td>
<td>0.50</td>
<td>92</td>
<td>88 / 180</td>
</tr>
<tr>
<td>Diastolic</td>
<td>74.9</td>
<td>8.7</td>
<td>0.07</td>
<td>110</td>
<td>40 / 150</td>
</tr>
<tr>
<td>Time Between</td>
<td>6.9</td>
<td>5.3</td>
<td>0.78</td>
<td>28.4</td>
<td>0 / 28.4</td>
</tr>
</tbody>
</table>
# Results

## Group 3 – Normal then ERP

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skewness</th>
<th>Range</th>
<th>Min/Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>37</td>
<td>7.6</td>
<td>-0.35</td>
<td>46</td>
<td>19 / 65</td>
</tr>
<tr>
<td>Height (in)</td>
<td>70.5</td>
<td>2.6</td>
<td>-0.53</td>
<td>37</td>
<td>43 / 80</td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>174.6</td>
<td>20.5</td>
<td>0.26</td>
<td>165</td>
<td>99 / 264</td>
</tr>
<tr>
<td>Systolic</td>
<td>116.9</td>
<td>10.7</td>
<td>0.43</td>
<td>98</td>
<td>82 / 180</td>
</tr>
<tr>
<td>Diastolic</td>
<td>74.7</td>
<td>8.2</td>
<td>-0.06</td>
<td>61</td>
<td>49 / 110</td>
</tr>
<tr>
<td>Time Between</td>
<td>10.0</td>
<td>6.9</td>
<td>0.63</td>
<td>87.9</td>
<td>0 / 87.9</td>
</tr>
</tbody>
</table>
Results

Compare Group 2 to 3

• Statistical difference between groups
  • Age
  • Weight
  • Systolic BP
  • Time to change

• No statistical difference between groups
  • Height
  • Diastolic BP
Discussion

• USAF aviators have higher prevalence of ERP than general population
  • ? Healthy heart as with athletes

• Prevalence similar to prior aviation studies 9.9% vs. 11.8%

• Retention of ERP similar to prior studies 27.5% vs. 32%
Limitations

- Not all ECGs reviewed
- Only 51 females identified
- Sampling bias because of required ECGs for initial flying physical and at age 35
Conclusion

- Analysis of large database with serial ECGs over time was consistent with prior research in regard to the natural history and prevalence of ERP
Future Research

• Correlate ERP with outcome data to determine if aviators are at increased risk of cardiovascular events or increased mortality

• Further analyze the variable group with regard to consistency of diagnosis

• Prospectively follow ERP diagnosis over time
Bibliography


Questions?