Women and Arrhythmias

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Gender Gap Increases Women's Heart Risks

“The data suggest there is a disconnect in the way physicians diagnose and treat heart disease in women versus men.”

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Gender Differences

- Mortality
- Arrhythmias
- QT interval and AADs
- Pregnancy
- Devices and trial data

Background

- The pathophysiologic mechanisms by which gender influences cardiac arrhythmias are poorly understood.
- Current knowledge stems from clinical and electrocardiographic observations with sparse experimental data.
- Contributors to the gender gap
  - Hormonal effects on expression and function of ion channels
  - Autonomic tone

Sudden Cardiac Death: Incidence by Age and Gender

- SCD is more common in men.
- In women, incidence of SCD doubles with each decade.
Question:
After cardiac arrest, which gender has a better overall survival?
(1) Men
(2) Women
(3) No Difference

Mortality Rates: Effect of Age, Gender, and Race
- Out of Hospital Arrest
- In-Hospital Arrest

Arrhythmic Death
Documented Rhythm
- VF or VT constitutes 76% of first cardiac rhythm post arrest.
- No gender difference

Structural Heart Disease in Cardiac Arrest Survivors

Gender Differences
- Mortality
- Arrhythmias
- QT interval and AADs
- Pregnancy
- Devices and trial data

Case Study: AVNRT
- 27 year old woman
- Palpitation x 10 years
  - ↑ frequency x 2 years
  - Episodes now last several hours
  - Associated dyspnea, dizziness
  - Patient unable to coach children’s soccer, afraid to travel
- Therapy
  - Failed beta blockers
  - Treated with verapamil
Case Study: AVNRT

I aVR V1 V4
II aVR V2 V5
III aVR V3 V6

Gender Differences

<table>
<thead>
<tr>
<th>Arrhythmia</th>
<th>Male</th>
<th>Female</th>
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<tbody>
<tr>
<td>Bradyarrhythmia</td>
<td>AV block</td>
<td>Sinus Node Dysfunction</td>
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<tr>
<td>Supraventricular Arrhythmias</td>
<td>APCS</td>
<td>AVRT WPW</td>
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<tr>
<td>Ventricular Arrhythmias</td>
<td>PVCs</td>
<td>VT SCD Brugada</td>
</tr>
</tbody>
</table>

Adapted from Rodriguez L, et al. Am J Cardiol. 1992;70:1213-1215

Catheter Ablation of Accessory Pathways, AVNRT, and AV Junction:

Gender Distribution %

- Accessory Pathways: 42% Women, 58% Men
- AVNRT: 70% Men, 30% Women
- AV Junction: 48% Men, 52% Women


Question

- With atrial fibrillation, which gender is at a higher risk of stroke?
  1. Men
  2. Women
  3. No Difference

Adapted from Rodriguez L, et al. Am J Cardiol. 1992;70:1213-1215

Atrial Fibrillation

- Women who have atrial fibrillation are more likely to have a life-threatening stroke.
- Atrial fibrillation diminishes the female advantage in survival.


Atrial Fibrillation Stroke Risk

- ATRIA study
- Women at higher stroke risk

Fong, M et al. Circulation 2005;112:1687-1691
Atrial Fibrillation and Risk of Death


<table>
<thead>
<tr>
<th>Years of Follow-up</th>
<th>Men AF</th>
<th>Women AF</th>
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<th>Women no AF</th>
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<tr>
<td>0</td>
<td>80%</td>
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<td>40%</td>
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<td>30%</td>
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<td>15</td>
<td>50%</td>
<td>40%</td>
<td>30%</td>
<td>20%</td>
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Case Study

- 42 year old woman
  - Exercise induced palpitation
  - Normal echocardiogram
  - Event monitor as follows:

RVOT VT

Right Ventricular Outflow Tract (RVOT) Tachycardia in Women

- Exacerbated by gender specific hormonal fluctuation that can occur with menopause, gestation, and menstrual cycle
- Not always precipitated by exercise

Postulated Mechanisms for Gender Differences

<table>
<thead>
<tr>
<th>Effects on Cellular Electrophysiology</th>
<th>Presence of estrogen receptors</th>
<th>Modulation of L-type Ca receptors</th>
<th>Modulation of potassium channels (IKr, IK1)</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Autonomic Modulation</th>
<th>Stabilized heart rate variability</th>
<th>Heart rate variability</th>
<th>Baroreceptor sensitivity</th>
<th>Muscle sympathetic nerve activity</th>
<th>Dispersion of repolarization</th>
<th>Nitric oxide expression</th>
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<tr>
<th>Combinations</th>
<th>M cells</th>
<th>Long QT syndromes</th>
<th>Dispersion of repolarization</th>
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</thead>
</table>

Question

- Which gender has a higher age-adjusted resting heart rate?
  (1) Men
  (2) Women
  (3) No Difference
Resting Heart Rate
Gender Differences

- 1920s Bazett observed a higher resting heart rate in women
- CARDIA study n=5116 HR in women 3-5 bpm > men
- CSNRT and SNRT< Women
- IST> Women

Heart Rate Variability
Relationship to HRT

- Women after HRT have improved HRV.

Effect of Ovarian Hormones in Palpitation

- Ovarian hormonal levels vary during the menstrual cycle
- Estradiol has calcium-antagonistic (verapamil-like) properties
  - Protective mid-cycle
  - Reduces incidence of SVTs
  - Effect lost premenstrual

Hormonal Effects on PSVT
Estrogen and Progesterone

- With increased Progesterone level
  - ↑ frequency and duration of PSVT
- With increased Estradiol level
  - ↑ frequency and duration of PSVT

Palpitation in Women: Diagnosis

- Work up indicated for:
  - Documented episodes associated with syncope
  - Or inappropriately rapid pulse during symptoms
- Methods of Diagnosis:
  - 12 lead ECG
  - Holter monitor / Event monitor
  - Echocardiogram
  - Exercise testing
  - Referral to an electrophysiologist

Gender Differences

- Mortality
- Arrhythmias
- QT interval and AADs
- Pregnancy
- Devices and trial data
Question

- Which gender has a longer age-adjusted QTc interval?
  1. Men
  2. Women
  3. No Difference

Ventricular Repolarization Gender Differences

200 women and 233 men (age 10-81 years, median age 35 years) in 12-lead electrocardiogram (ECG) ***P < 0.0001.


Long QT

- Congenital Long QT
  - Unexplained female prevalence in Long QT
  - Women more likely than men to have a cardiac event
  - Risk of cardiac events
    - Males until puberty
    - Females during adulthood
  - Inheritance not sex-linked
    Genotypes – same
    Phenotypes – different
    Female carriers have longer QTc than male carriers


Ventricular Repolarization Effect of Low Estrogen States in Healthy Women

- QT dispersion based on estrogen levels
  - Low estrogen state increased QTc

Saha S et al. AACL 2001; 26:4-59

Acquired Long QT

- QTc is 10-20 ms longer in women than men.
- In 332 reported cases of PMVT associated with antiarrhythmic drug therapy – 70% were women.
- QTc prolongation was not related to changes in the menstrual cycle, CAD, or LV dysfunction.

Effect of Anti-arrhythmics??

"Well, the Parkers are dead... You had to encourage them to take thioridazine, didn't you?"

North Ohio Heart Center, Inc.

LONG QT RESULTING IN TORSADES DE POINTE

Comparison of Observed vs. Expected Torsades de Pointes: Female Prevalence

<table>
<thead>
<tr>
<th>Drug</th>
<th>No.</th>
<th>Median Age (yrs)</th>
<th>Observed Female Prevalence %</th>
<th>95% CI</th>
<th>Expected Female Prevalence %</th>
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<td>Quinidine</td>
<td>108</td>
<td>64</td>
<td>60</td>
<td>50-70</td>
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<td>&lt;.002</td>
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<td>Procainamide</td>
<td>39</td>
<td>66</td>
<td>49</td>
<td>32-66</td>
<td>38</td>
<td>.21</td>
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<td>Disopyramide</td>
<td>48</td>
<td>66</td>
<td>66</td>
<td>72-94</td>
<td>63</td>
<td>&lt;.002</td>
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<td>Amiodarone</td>
<td>28</td>
<td>64</td>
<td>68</td>
<td>47-85</td>
<td>32</td>
<td>&lt;.001</td>
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<td>Sotalol</td>
<td>21</td>
<td>65</td>
<td>76</td>
<td>53-92</td>
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<td>&lt;.04</td>
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<tr>
<td>Bepridil</td>
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<td>73</td>
<td>74</td>
<td>53-89</td>
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<tr>
<td>Phenyamine</td>
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<td>71</td>
<td>78</td>
<td>56-93</td>
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<td>&lt;.02</td>
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<td>Two drugs</td>
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<td>66</td>
<td>85</td>
<td>63-99</td>
<td>NA</td>
<td>NA</td>
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</tbody>
</table>

Adapted from Makkar RR, et al. JAMA. 1993;270:2590-2597.

Palpitation During Pregnancy

• Clinical experience suggests that pregnancy may be arrhythmogenic in women with and without heart disease
• Some patients with complaints of palpitation improve during pregnancy
• Palpitation in most cases are due to sinus tachycardia and related to circulatory adaptations in pregnancy

**Pregnancy and Arrhythmias**

Holter Monitoring  
N=162

**FDA Pregnancy Risk Classification**

- **Category A**: Controlled studies show no risk
- **Category B**: No evidence of risk in pregnant women. Either animal studies show risk but human studies do not, or animal studies do not show risk but no adequate studies in humans have been conducted
- **Category C**: Studies in pregnant women are lacking, and animal studies are either positive for fetal risk or lacking as well
- **Category D**: Positive evidence of risk. Investigational or post-marketing data show risk to the fetus

**Antiarrhythmic Drugs in Pregnancy**

<table>
<thead>
<tr>
<th>Drug</th>
<th>FDA Class</th>
<th>Placental Transfer</th>
<th>Adverse Effects</th>
<th>Teratogenic</th>
<th>Breast Milk</th>
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<td>quinidine</td>
<td>C</td>
<td>Y</td>
<td>Thrombocytopenia</td>
<td>N</td>
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<td>procainamide</td>
<td>C</td>
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<td>Minor</td>
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<td>disopyramide</td>
<td>C</td>
<td>Y</td>
<td>Uterine contraction</td>
<td>N</td>
<td>Y</td>
<td>Minor (L)</td>
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<tr>
<td>lidocaine</td>
<td>C</td>
<td>Y</td>
<td>Bradyarrhythmia, CNS side effects</td>
<td>N</td>
<td>Y</td>
<td>Minor (L)</td>
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<tr>
<td>mesylate</td>
<td>C</td>
<td>Y</td>
<td>Bradyarrhythmia, low weight, APOGAR, super</td>
<td>N</td>
<td>Y</td>
<td>Minor (L)</td>
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<tr>
<td>tocainide</td>
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<td>Propafenone</td>
<td>C</td>
<td>Y</td>
<td>None (L)</td>
<td>N</td>
<td>Unknown</td>
<td>Minor (L)</td>
</tr>
</tbody>
</table>

*American Academy of Pediatrics considers drug to be “usually compatible with breast feeding.”

**Adenosine Use in Pregnancy**

- Limited experience suggests adenosine is safe and effective for treatment of SVT in pregnancy.

**Arrhythmias in Pregnancy: Management of Reentrant SVT**

- **Vagal Maneuvers**
  - No effect
  - Adenosine 6 mg
  - No effect
- **Terminates**
  - No additional therapy
  - Adenosine 12 mg
  - No effect or hemodynamic instability
  - Sedate
  - Cardiovert
Arrhythmias in Pregnancy: Atrial Flutter and Atrial Fibrillation

• Rare in women of childbearing age with no underlying heart disease
• Cardioversion (if needed) should be performed early to avoid the need for anticoagulation
• Fetal monitoring recommended during and following cardioversion

Arrhythmias in Pregnancy: Atrial Fibrillation

• Anticoagulate chronic AF in patients with risk factors:
  – Diabetes
  – Hypertension
  – Congestive heart failure
  – Previous stroke or rheumatic heart disease
• Warfarin therapy contraindicated during the first trimester
• High-dose SQ heparin is recommended, particularly for the first trimester

Monomorphic Ventricular Tachycardia

Wolbrette D. Current Opinions in Cardiology. 1999;14:36-43.


Arrhythmias in Pregnancy: Ventricular Tachycardia

• If therapy is required, beta-blockers are the drug of choice
• Beta blockers are well tolerated but risk/benefit ratio for mother and fetus must be considered
• DC cardioversion appropriate for hemodynamically unstable VT
• Stable VT – Lidocaine is the acute drug of choice

ICDs and Pregnancy

• Multicenter retrospective study involving 44 women patients who became pregnant
• Therapies during pregnancy:
  – 33 (75%) No shocks
  – 8 (18%) One shock
  – 3 (7%) Multiple shocks
• Outcome
  – 39 (89%) Healthy babies
  – 1 (2%) Stillborn
  – 2 (4%) Small for gestational age

Pregnancy and Arrhythmias

Use of ICD’s


• Conclusions:
  – Pregnancy does not increase the risk of major ICD-related complications or result in a high number of ICD discharges
  – The presence of an ICD should not deter a women from becoming pregnant unless underlying structural cardiac disease is a contraindication
Gender Differences

- Mortality
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ICD’s Class I Indications:

- Primary Prevention
  - CAD or NIDCM, LVEF ≤ 35%, inducible VT on EP study
  - Prior MI, LVEF < 30%, NYHA class III
  - NIDCM, LVEF ≤ 30%, NYHA class III
  - Syncope of unknown origin with clinically relevant hemodynamically significant sustained VT/VF induced when drug therapy is ineffective, not tolerated, or not preferred
- Secondary Prevention
  - Prior spontaneous sustained VT or VF
  - Chronic HF and low LVEF with syncope of unknown origin

2005 ACC/AHA guidelines

Gender Differences in Patients with ICDs

- Women who receive ICDs were:
  - Younger (50 vs 61 yrs)
  - Ischemic (38% vs. 78%) \( p < .001 \)
  - Survival
- Recurrent VT/VF was nearly as common in women as men.
- ICD Rx can benefit women whose mortality may be more closely linked to recurrent VT/VF than underlying heart disease.

Gender Differences in Patients With Life-Threatening Ventricular Arrhythmias (AVID)

- Female clinical characteristics:
  - Younger
  - Less CAD
  - More non-ischemic DCM
  - More idiopathic VF
  - Better ejection fraction
  - More congestive heart failure
- Female coronary risk factors:
  - More hypertension and diabetes
  - Smoked less
- Female index arrhythmia:
  - VF is more common the VT (58% vs 48%) \( p < .05 \)

2005 ACC/AHA guidelines
Gender Differences in Patients With Life-Threatening Ventricular Arrhythmias (AVID)

- Despite differences in gender profile, antiarrhythmic drug therapy and survival were similar in men and women with life-threatening ventricular arrhythmias.

Female Participants in Chronic Heart Failure Trials

Few trials have gender specific data

Risk of Mortality and/or Hospital Stay in Female Heart Failure Patients

Not powered enough to detect gender differences
No clear mortality benefit for women

Question

- Which gender has a higher responder rate to CRT therapy?
  (1) Men
  (2) Women
  (3) No Difference

Response to CRT

No significant difference in responder rate based on gender
- Men 80% vs women 76% responders; p=NS

COMPANION Study (Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure)

- Included 299 women
  - LVEF ≤ 0.35
  - NYHA III to IV despite optimal medical therapy
  - QRS ≥ 120 ms
- ICD decreased total mortality or hospital stay for any cause compared with medical therapy
**CARE-HF Study**  
(Cardiac Resynchronization Heart Failure)

- Included 215 women
  - LVEF ≤ 0.35
  - NYHA III to IV
  - LVEDD > 30 mm
  - QRS > 120 ms
- Trend for improvement in total mortality and hospital stay with CRT compared with medical therapy alone

**MADIT CRT**  
(Multicenter Automatic Defibrillator Implantation Trial with Cardiac Resynchronization Therapy) $n=1,820$

- Ischemic or nonischemic cardiomyopathy
- Class I or II HF
- QRS > 130 ms
- All candidates for ICD
- Randomized to ICD + CRT or ICD alone
- Largest ever % women in any device trial

**MADIT CRT**  
(Demographics)
- Women more likely to have nonischemic CM than men
- Women more likely to have LBBB than men

**MADIT CRT**  
(Results)
- Women with better result from CRT-D therapy than men
- 70% relative risk reduction in HF in women (vs. 35% in men, $p = 0.001$)
- 69% relative risk reduction in death or HF (vs. 28% in men, $p = 0.001$)

**Conclusions**
- Major influences of hormones and ANS in arrhythmogenic substrate
- Major differences in mortality, arrhythmia occurrence, response to common AADs, and event rate in LQTS
- Adenosine and beta blockers effective in pregnancy
- Devices beneficial for recurrent VT/VF and for heart failure
- Trial data sparse

**Backup Slides**

Thank you.
Mechanism of SVT and Gender

<table>
<thead>
<tr>
<th>Type of Arrhythmia</th>
<th>Male</th>
<th>Female</th>
<th>Odds Ratio (M/F)</th>
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<td>Atrial tachycardia</td>
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<td>18</td>
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<tr>
<td>AV nodal reentrant tachycardia</td>
<td>51</td>
<td>109</td>
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<td>8</td>
<td>4</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Management of Arrhythmias in Pregnancy

- Document arrhythmia
- Need for treatment must be clear
  - Sinus tachycardia is common in pregnancy
- In patients c/o palpitation without a documented arrhythmia (non-invasive testing), likelihood is low for a life-threatening arrhythmia
- Clinician must consider risk/benefit ratio for both mother and fetus

Gender Influences In LQTS

- Comparison of LQTs in Probands and those with familial history
- Females more affected by LQTs after the age of 15 than males

Shortening of QT in Males After Puberty

- If ICD implantation or invasive EP testing is necessary consider echocardiographic guidance to prevent radiation exposure to the fetus
**Bradycardia in Pregnancy**

- Vasovagal syncope is one of the most common causes of symptomatic bradycardia in women of childbearing age.
- Vasovagal syncope is rare during pregnancy.

**Structural Heart Disease in Cardiac Arrest Survivors**

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD</td>
<td>80%</td>
<td>45%</td>
</tr>
<tr>
<td>VHD</td>
<td>10%</td>
<td>15%</td>
</tr>
<tr>
<td>Other</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Normal</td>
<td>3%</td>
<td>10%</td>
</tr>
</tbody>
</table>

**PVCs As a Risk Factor in Women**

- PVCs in men associated with increased risk of SCD.
- PVCs in women not associated with increased risk of SCD.
- Women with SCD were less likely to have CAD (45% vs. 80%).

**Devices and Mammography**

- Device may hinder mammogram interpretation (10% of women).
- Recommendation: implant the device contralateral to any suspicious areas on prior mammograms.
- Consider future mammograms during implant.

**Prevalence of Torsades de Pointes With d, I-Sotalol by Creatinine Clearance**

<table>
<thead>
<tr>
<th>Dose (mg/Kg/day)</th>
<th>CrCl (ml/min)</th>
<th>Proportion with Tdp (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4.7</td>
<td>&gt; 50</td>
<td>0</td>
</tr>
<tr>
<td>4.7-5.0</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 5.0</td>
<td>&gt; 50</td>
<td>2</td>
</tr>
<tr>
<td>&gt; 5.0</td>
<td>&lt; 50</td>
<td>3</td>
</tr>
</tbody>
</table>

**Device Implantation Techniques in Women**

- Incision site cosmetically chosen – (option) vertical rather than horizontal incision.
- Submammary (under breast):
  - Controversial
  - May interfere with mammogram interpretation.
- Future mammography:
  - Allow for adequate visualization of the breast tail.
  - Implant more lateral than medial.
**Device Teaching and Follow-up in Women**

- Provide adequate counseling in regards to altered body image
- Mammography:
  - Patients should follow the recommended guidelines for breast cancer prevention
  - Provide reassurance that mammography does not hurt the device
  - Radiologists may need to make certain adequate shots of breast tissue are obtained

**ICD Patients**

**Gender Considerations**

<table>
<thead>
<tr>
<th>Sudden Cardiac death</th>
<th>Women vs. Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>Lower</td>
</tr>
<tr>
<td>VF prevalence</td>
<td>Lower</td>
</tr>
<tr>
<td>Resuscitation rate</td>
<td>Higher</td>
</tr>
<tr>
<td>CAD</td>
<td>Lower</td>
</tr>
<tr>
<td>NICM</td>
<td>Higher</td>
</tr>
<tr>
<td>EF</td>
<td>Higher</td>
</tr>
<tr>
<td>Inducibility at EP</td>
<td>Lower</td>
</tr>
</tbody>
</table>

**Risk of Sudden Death in Relation to Complexity of Ventricular Arrhythmia**

- Data from Ruberman W. Circulation. 1981;64(2):297-305.

**Clinical Characteristics of Long QT Patients with Cardiac Events**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Female Probands (n=259)</th>
<th>Male Probands (n=107)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at first cardiac event, yrs</td>
<td>14 ± 10</td>
<td>8 ± 7</td>
<td>0.001</td>
</tr>
<tr>
<td>First event age &lt;15 yrs, n (%)</td>
<td>130 (60)</td>
<td>98 (52)</td>
<td>0.001</td>
</tr>
<tr>
<td>Median No. of cardiac events</td>
<td>6</td>
<td>4</td>
<td>0.002</td>
</tr>
<tr>
<td>Median event rate per year</td>
<td>0.24</td>
<td>0.27</td>
<td>NS</td>
</tr>
<tr>
<td>Ventricular tachyarrhythmias</td>
<td>150 (58)</td>
<td>41 (38)</td>
<td>0.011</td>
</tr>
<tr>
<td>Age at ECG, yrs</td>
<td>21 ± 12</td>
<td>13 ± 11</td>
<td>0.001</td>
</tr>
<tr>
<td>Heart rate, bpm</td>
<td>71 ± 10</td>
<td>72 ± 22</td>
<td>NS</td>
</tr>
<tr>
<td>QTc, ms</td>
<td>519 ± 61</td>
<td>519 ± 58</td>
<td>NS</td>
</tr>
<tr>
<td>QTc &gt; 470 ms, n (%)</td>
<td>205 (79)</td>
<td>95 (89)</td>
<td>NS</td>
</tr>
<tr>
<td>QTc &gt; 500 ms, n (%)</td>
<td>117 (46)</td>
<td>52 (49)</td>
<td>NS</td>
</tr>
</tbody>
</table>


**Arrhythmic Events in HF**

- Patients admitted for decompensated HF
  - All measures of ventricular ectopy were markedly lower in women

**Ventricular Repolarization**

- Estradiol (EST) and DHT response in ovariectomized rabbits

- Data from Aronson D et al. PACE 2002 25: 1206-1211
- Data from Hara et al. JPE 1998;285: 1068-72
Long QT: Torsades de Pointes

- Torsades de pointes – PMVT occurring in the setting of a lengthened QT interval
- Reflects prolonged cardiac repolarization
- May cause syncope or even precipitate VF and cardiac arrest
- May be congenital but most common as an acquired disorder (drugs, hypokalemia)

SVT: Inducibility During Menstruation

- Premenstrual clustering of spontaneous arrhythmia has been observed in women with SVT
- Scheduling elective EP procedures at times of low estrogen levels may facilitate successful procedures

Palpitation During Menopause or Perimenopause

- Treatment:
  - Not required
- Improvement of symptoms:
  - Beta blockers if palpitation persist after initiation of ERT
  - Progesterone may trigger cardiac arrhythmia in certain patients

Estrogen Modulation in Mice

- Estrogen modulates autonomic inputs into murine SA and AV nodes
- Normal estrogen states increase sympathetic input
- Low estrogen decrease AVN conduction times and RV refractory periods
- Estrogen replacement restores these parameters
- ? Clustering of arrhythmias around menses

Cyclical Variation in SVT in Women

- ![Graph showing cyclical variation in SVT in women](image)
  - Number of episodes of SVT and symptomatic episodes
  - *p < 0.02

Palpitation During Menopause or Perimenopause

- Menopause:
  - ↓ estradiol production
  - Associated with ↑ and uncontrolled adrenergic activity
  - Palpitation frequent CV complaint
- Perimenopause:
  - Palpitation often due to sinus tachycardia
  - Related to ↑ sympathetic drive
**Mortality Trends (Age-Adjusted)**

*Effect of Race and Gender*

- Out of Hospital Arrest
- In-Hospital Arrest

---

**Autonomic Blockade**

*Gender Differences*

- Baseline
- Post Blockade

---

**Response to Autonomic Blockade:**

*Menstrual Effects*

The sinus cycle length was significantly longer (*P < 0.03*) during the menstrual phase of the cycle at baseline.

---

**Palpitation in Women**

- Palpitation represent 15-25% of symptoms reported by female cardiology patients
- Occur frequently during the luteal phase of the menstrual period, pregnancy, and perimenopause

---

**Palpitation in Women:**

*Associations*

- Young women and rapid HR
  - Frequently re-entrant tachycardias
  - Associated with mitral valve prolapse
- Pregnancy
  - SVT may be due to mechanical stimuli or possible arrhythmogenic effects of pregnancy
- Perimenopause
  - Usually benign
  - May be due to ↑ sympathetic activity in menopause