SCA-Sudden Cardiac Arrest
Risk Stratification, Treatment...

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Deborah Heart & Lung Center
SCA-Where are we?
Leading Causes of Death in the U.S.

- Septicemia
- Nephritis
- Alzheimer’s Disease
- Influenza/pneumonia
- Diabetes
- Accidents/injuries
- Chronic lower respiratory diseases
- Cerebrovascular disease
- Other cardiac causes
- Sudden cardiac death (SCD)
- All other causes
- All cancers

You must combine deaths from all cancers to outnumber the deaths from SCD each year.

The 5 year mortality of survivors of AMI with LV dysfunction after hospital discharge is > 20%

SCD accounts for at least 33% of late mortality

Only 2 to 30% with out-of-hospital cardiac arrest survive
Putting it into perspective

- **42,000 deaths per year from car crashes**
  (5-6 times less annual SCD risk but we now have mandated seat belt laws not to mention the cost to all of us and to the Automobile industry for installing them and the authorities for monitoring their use)

- **41,000 deaths per year from breast cancer**
  (Mammograms are now the standard of care)

- **7,000 children die from SCD each year**
  (Cities across the US are mandating AED’s in schools)
The Magnitude of the Problem

- =350,000 deaths per year
- Likelihood of surviving an episode of sudden death is very low
- Early shocks work
- Late shocks don’t work
- Shocks only work if they can be delivered in the first few seconds

JACC 15 April 1999 (Vol. 83, Issue 8, Pages 1280-1283)
<table>
<thead>
<tr>
<th>Scenario</th>
<th>SCA Survival Rate</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Defibrillation</td>
<td>99%</td>
<td>SCA is treated automatically without need for a second party, and treatment occurs in &lt; 1 minute.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- ICD or Wearable Defibrillator</td>
</tr>
<tr>
<td>Hospital Defibrillation</td>
<td>18%</td>
<td>NRCPR/AHA Mary Ann Peberdy MD (17,991 cardiac arrests / 250 hospitals) 18% Daytime 13% Night</td>
</tr>
<tr>
<td>Bystander Defibrillation</td>
<td>&lt; 10%</td>
<td>SCA must be witnessed, and there is generally a protracted treatment delay.</td>
</tr>
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- EMS 911 Service
- Public Access Defibrillation
One man’s danger is another man’s therapy
ICD history

- 1966: Conception
- 1969: First experimental model
- 1969: First transvenous defibrillation
- 1975: First animal implant
- 1980: First human implant
- 1982: Addition of cardioverting capability
- 1985: FDA approval
- 1988: First programmable device implanted
ICD History

- Initial development pioneered in the late 1960’s by Dr. Michel Mirowski
- Following the death of his Chief of Staff, Dr. Harry Heller he was driven to prevent Sudden Cardiac Death (SCD)
- His dream came to reality in 1985
Secondary Prevention

Primary Prevention
# Evolution of ICD Indications

<table>
<thead>
<tr>
<th>Studies</th>
<th>Incremental Indications</th>
<th>Preventio n Strategy</th>
<th>Year of CMS Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCD Survivors</strong></td>
<td>All survivors of sudden cardiac death</td>
<td>Secondary</td>
<td>1991</td>
</tr>
<tr>
<td><strong>AVID</strong></td>
<td>Sustained VT/VF; EF ≤ 40% with no prior cardiac arrest</td>
<td>Secondary</td>
<td>1999</td>
</tr>
<tr>
<td><strong>MADIT I MUSTT</strong></td>
<td>Prior MI; EF ≤ 40%, non-sustained VT, inducible VT</td>
<td>Primary</td>
<td>1999</td>
</tr>
<tr>
<td><strong>MADIT II</strong></td>
<td>Prior MI; EF ≤ 35%, no EP study required</td>
<td>Primary</td>
<td>2003</td>
</tr>
<tr>
<td><strong>SCD-HeFT</strong></td>
<td>No prior MI, EF ≤ 35%, Class II/III heart failure</td>
<td>Primary</td>
<td>2005</td>
</tr>
<tr>
<td><strong>COMPANION</strong></td>
<td>Class IV heart failure</td>
<td>Primary</td>
<td>2005</td>
</tr>
</tbody>
</table>
Trial Summary: Reduction in All-Cause Mortality with ICDs

ICDs Are Cost Effective

Mushlin, Circulation 1998; 2129-2135
Summary Primary Prevention

Know your EF

Just like Chol., Just like BP

**CAD**
- **EF 30-40%**
  - EPS +/- ICD
  - MADIT,MUST

**EF < 30%**
- ICD
  - MADIT II

**CM +/- CAD**
- **EF <35% CHF**
  - ICD
  - SCD HeFT
Any event not explained...

VF, VT with hemodynamic compromise or symptoms
Therapy Issues
Incidence of SCD in Specific Populations and Annual SCD Numbers

GROUP

General population

Patients with high coronary-risk profile

Patients with previous coronary event

Patients with EF < 35%, congestive heart failure

Patients with previous out-of-hospital cardiac arrest

Patients with previous MI, low EF and VT

Incidence of Sudden Death (% of group)

No. of Sudden Deaths Per Year

Risk Stratification

Under-penetration

SCD-HeFT

AVID, CASH, CIDS

MADIT, MUSTT, MADIT II

Utilization of Primary Prevention ICD’s

“...the most significant takeaway from our analysis on the prevalence pool is that penetration remains relatively low.”

22-36%

Source Morgan Stanley Estimates
Know Your Numbers

140/90
Blood pressure

200
cholesterol

40
Ejection fraction
Do You Know YOUR Numbers?

N = 1007

563
NO knowledge

444
SOME knowledge

250
Know 1 CRF
12 EF only
190 BP only
48 CHOL only

162
Know >1 CRF
142 BP & CHOL
18 BP & EF
2 CHOL & EF

32
Know ALL CRF

Do You Know YOUR Numbers?
For the most part, all these numbers are silent killers, without symptoms or warning signs.

If symptoms arise, it’s might be too late.
ICD History! Not What They Look Like

- Epicardial Systems
ICD Implant Morbidity is low

% Complications

Thoracotomy
NTL, abdom
Pectoral ICD
DDD PPM

Current Opinion in Cardiology 2001 16:66-71
Can we say the same for drugs…

- ICD complication Rates

**Table 7. Rates of Any Complication Among Subgroups in the Matched Cohort**

<table>
<thead>
<tr>
<th></th>
<th>Chamber ICD, No. (%)</th>
<th>P Value</th>
<th>P Value for Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single (3.51)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>408</td>
<td>548</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>Dual (4.72)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-75</td>
<td>256 (3.45)</td>
<td>373 (5.03)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>&gt;75</td>
<td>152 (3.63)</td>
<td>175 (4.16)</td>
<td>.21</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>260 (3.08)</td>
<td>346 (4.08)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Women</td>
<td>148 (4.68)</td>
<td>202 (6.43)</td>
<td>.002</td>
</tr>
<tr>
<td>Presence of renal dysfunction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>366 (3.49)</td>
<td>486 (4.63)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Yes</td>
<td>42 (3.73)</td>
<td>62 (5.58)</td>
<td>.04</td>
</tr>
</tbody>
</table>

Abbreviation: ICD, implantable cardioverter defibrillator.
Can we say the same for drugs...

Complication rates

Pooled complication rates of chronic total occlusion percutaneous coronary interventions. **CABG** = coronary artery bypass graft; **CN** = contrast nephropathy; **MACE** = major adverse cardiac events; **MI** = myocardial infarction; **QWMI** = Q-wave myocardial infarction
Secondary Treatment Options

AED
For Emergency
Use Only
Alarm Will Sound If Opened
Secondary Treatment Options

SMASH VT: Is there benefit to prophylactic VT ablation after one episode for ICD recipients with prior MI?
Reddy et al NEJM 2007

133 patients having ICD placed for VT
Randomized to substrate-guided ablation vs no ablation

Primary End Point:
Survival Free from ICD Therapy

Substrate guided ablation:
- Reduced VT
- No impact on mortality
- No negative impact on LV function on serial echocardiograms
Secondary Treatment Options
Secondary Treatment Options
Secondary Treatment Options
Secondary Treatment Options

Substrate Modification-No VT needed
Summary

- SCA remains an under-recognized and undertreated issue...
- Non pharmacologic therapy, the ICD is our most effective strategy
- ICD issues...
- VT ablation is a useful but secondary treatment option, substrate modification...
SCD in Preserved LVEF

Community-based studies of SCD

- **Stecker et al (2006)**
  - 714 SCD cases in Multnomah County, OR (2002-2004)
  - Only one-third of the evaluated SCD cases had severe LV dysfunction meeting current criteria for prophylactic ICD implantation
  - “These findings support the aggressive development of alternative screening methods to enhance identification of patients at risk.”

- **deVreede-Swagemakers et al (1997)**
  - 515 SCD cases in Maastricht, Netherlands (1991-1994)
  - 56.5% of all SCA victims had an LVEF > 30%


Remaining Issues

- Under-penetration in the current primary prevention population
  - Patient identification (education, resources)
  - Patient selection (advanced age, co-morbidities)
  - Reluctance
    - **Physician:** Is EF the best risk stratifier?, recalls, inappropriate shocks, optimization of pharmacologic therapy
    - **Patient:** psycho-social aspects of ICD, morbidity, recalls
    - **Societal:** cost-effectiveness, number needed to treat (NNT)

- Identification of high-risk patients who do not meet current primary prevention indications
LifeVest System 3100

ECG Electrodes
- 4 Total
- No adhesive & no gel

Self-Gelling Defibrillation Electrodes

Response Buttons

Monitor
- 1.8 lbs
- 150 joules
- Stores ECG, daily use, etc.
LifeVest may be used as a:

**Bridge to ICD**
Outpatient, immediate, automatic, non-invasive protection against SCD, until ICD, or until no longer at risk
Awaiting post MI, post revascularization, post explant period

**Scheduling Tool**
Patient overflow

**Discharge Planning Tool**
Weekends
Holidays