The Future of Interventional Cardiology

April 16, 2010
Heart Attack - 1955

**CC:** ‘My chest hurts as though there was 200 pounds on it”

**HPI:** 47 yo Senate Majority Leader. Initial CP two weeks ago - thought it was indigestion. Today he developed CP while visiting Brown Ranch in Virginia. Called LMD who advised him that he was having a heart attack. Was brought to Bethesda Naval Hospital via the local hearse which also served as an ambulance. Intermittent pain during 1.5 hour ride - did not receive any medications.
Heart Attack - 1955

- Placed in oxygen tent
- Heavy sedation for 48 hours
- Complete bed rest for several weeks
- 5 weeks in hospital
- 6 months before he could return to work
Heart Attack - 1955

- Medical therapy = digitalis and nitroglycerin
- Lost 40 pounds
- Quit smoking
- No caffeine
- Regular exercise
- Afternoon naps
Heart Attack - 1973

- 1971 - Resumed smoking and weight increased to > 200 lbs.
- April 1972 – Second MI during a visit to his daughter Lynda Robb in Charlottesville, Va.
- December 1972 – ‘While speaking at the L.B.J. Library of the University of Texas, his voice was noticeably weak. At one point he seemed to rub his lips. Then his tone improved, and he finished his speech. By sleight of hand he had transferred a nitroglycerin tablet from pocket to mouth and slipped it under his tongue.’ (Time Magazine 2/5/73)
- Jan 1973 – Died at the age of 64 yo of an ‘apparent heart attack’.
- Autopsy showed two of his coronary arteries were totally blocked, and the third was 60%-80% occluded.
Heart Attack - 2000

- Admitted to CCU
- MI diagnosed by elevated cardiac enzymes in blood (troponin, CK-MB)
- Angiogram
- Coronary stent
- Discharged after 3 days in hospital
Cardiac History of Richard Cheney

- Heart attack – 1978 (age 37)
- Heart attack – 1984
- Heart attack – 1988 → 4 vessel coronary bypass surgery
- Heart attack – 2000 → coronary stent
- Ventricular tachycardia – 2001 → ICD
- Atrial fibrillation – 2008 → DC cardioversion
- Heart attack – 2/2010
Heart Attack - 2000

- Medical therapy = aspirin, statin, beta-blocker, ACEI, ADP inhibitor
- Lost 25 pounds
- Diet
- Quit smoking
- Regular exercise
Advances in the Cardiac Catheterization Laboratory

- Drug Eluting Stents
- Percutaneous Aortic Valve Replacement
Stenting of Coronary Arteries
The Achilles Heel of PCI - Instent Restenosis
Components of DES

Scaffold (stent)

Polymer

Basecoat (~1 μm thick)
Drug + polymer
Overspray (~0.1 μm thick)
Post-elution - Residual polymer
Angiographic Restenosis in Drug-Eluting stents

<table>
<thead>
<tr>
<th></th>
<th>Bare stent</th>
<th>Drug-eluting stent</th>
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<tbody>
<tr>
<td>RAVEL (sirolimus)</td>
<td>27%</td>
<td>0%</td>
</tr>
<tr>
<td>SIRIUS (sirolimus)</td>
<td>36%</td>
<td>9%</td>
</tr>
<tr>
<td>ELUTES (paclitaxel high dose)</td>
<td>21%</td>
<td>3%</td>
</tr>
<tr>
<td>ASPECT (paclitaxel high dose)</td>
<td>27%</td>
<td>4%</td>
</tr>
<tr>
<td>TAXUS II (paclitaxel slow release)</td>
<td>20%</td>
<td>6%</td>
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Circulation. 2003;107:3003
THE END OF HEART DISEASE

How new treatments are helping beat a killer
Current Results with PCI are Excellent

Event Rate %

- Failure
- Em CABG
- Restenosis
- Stent thrombosis
- VLST

Innovations over time

- POBA early: 1977
- POBA late: 1985
- Stent early: 1994
- Stent late: 1997
- DES: 2003-present
ADVANCED APPROACHES TO DRUG RELEASE

- Bioabsorbable polymers
- Controlled polymer application
- Non polymer release (porous surface)
Surfaces to Encourage Cell Growth

Bioactive surfaces to accelerate functional endothelialization

Orbus – EPC Capture

Example of IrOx

Nanotextured Surfaces

Cell specific peptide linkers (Affinergy)
Bioabsorbable Stents

PLA → H₂O → Hydrolysis → Lactic Acid → Mass Loss → Mass Transport → Krebs Cycle → CO₂ + H₂O
Bioabsorbable Stents

- Igaki-Tamai
- BVS
- REVA
- BIT
- Biotronik

PLA
Tyrosine-Policarbonate
PAE-Salicylate
Magnesium
Effect of Mass Loss on Radiopacity

1 Month

12 Months
Advances in the Cardiac Catheterization Laboratory

- Drug Eluting Stents
- Percutaneous Aortic Valve Replacement
Aortic Valve

Structure of the Aorta

Arch

Ascending Aorta

Root

Descending Aorta

Coronary Arteries

Heart
Diseased Aortic Valves
Prosthetic Aortic Valves
Traditional Aortic Valve Surgery
Minimally Invasive Aortic Valve Surgery
Percutaneous Aortic Valve Replacement
Epidemiology of ACS in the United States

- Single largest cause of death
  - 515,204 US deaths in 2000
  - 1 in every 5 US deaths

- Incidence
  - 1,100,000 Americans will have a new or recurrent coronary attack each year and about 45% will die*
  - 550,000 new cases of angina per year

- Prevalence
  - 12,900,000 with a history of MI, angina, or both

* Based on data from the ARIC study of the National Heart, Lung, and Blood Institute, 1987-1994. Includes Americans hospitalized with definite or probable MI or fatal CHD, not including silent MIs. ACS indicates acute coronary syndrome; MI, myocardial infarction; ARIC, Atherosclerotic Risk in Communities; and CHD, coronary heart disease. From American Heart Association. *Heart Disease and Stroke Statistics—2003 Update.*

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AHA Heart Disease and Stroke Statistics — 2009 Update
Good news from the front line in the battle against cardiovascular disease: The heart-attack rate among elderly Americans appears to be falling sharply. The rate of hospital admissions for heart attack was 23% lower in 2007 than in 2002, according to a just-published analysis of Medicare data, with 228,170 fee-for-service Medicare patients admitted in 2007 compared with 297,653 in 2002. That suggests there were nearly 70,000 fewer heart-attack admissions in 2007 than would have been expected had the rate remained constant.

The report covers only the nearly 30 million Medicare beneficiaries in the traditional fee-for-service part of the federal health-care program for the elderly. If the findings are extrapolated based on 38 million Medicare participants, including those enrolled in so-called Medicare Advantage managed-care plans, researchers estimate a 2007 total of 319,063 heart-attack admissions, a reduction of 97,000 versus comparable figures in 2002.

"It's remarkable what has been accomplished," says Harlan Krumholz, a cardiologist at Yale University School of Medicine and principal investigator for the study. He terms the rapid decline in a major public health marker "breathtaking." Behind the drop, he and other heart experts believe, is the cumulative impact of a variety of prevention initiatives that public-health groups, professional organizations and payers of health care have mounted over the past two decades to change health habits and improve treatment of heart patients.

Quit-smoking campaigns, growing awareness of the importance of exercise and healthy diets, increasing use of medicines to control blood pressure and cholesterol and efforts to encourage doctors and hospitals to follow evidence-based guidelines when treating heart patients are among the potential contributing factors. "It looks like our effort with preventive medicine, with guidelines and a systematic approach to caring for patients, is paying off," says Sidney Smith, a cardiologist at University of North Carolina, Chapel Hill, and past president of the American Heart Association, who wasn't involved with the study.

Still, the progress comes with concerns. For one, the reduction in admissions among minority groups, especially African-Americans, wasn't as pronounced as it was among whites—more evidence of inequities in the health-care system. For another, the national obesity epidemic, with accompanying increases in diabetes and a pre-diabetic condition called metabolic syndrome, which increase heart risk, has many experts worried that progress against cardiovascular disease will be reversed in the years ahead.

"These gains shouldn't be taken for granted," says Dr. Krumholz. "They are certainly under threat with the rising girth of society." Over the six-year period covered in the study, there were in all more than 300,000 fewer heart attack admissions than if the rate had remained steady at the 2002 level. If you're a patient, "you want to join the group that is avoiding these problems," Dr. Krumholz adds. "There are still people out there whose risk factors are unknown or not treated." First author of the study, which was published in the March 23 issue of the Journal Circulation, was Jersey Chen, a Yale cardiologist.

Limited available data suggest the beneficial trends seen among Medicare patients are occurring in the general population as well. A 2007 study involving researchers at the data firm Thomson Reuters and published in the Journal of American Cardiology found a steady decline in heart-attack admissions between 2002 and 2005. The findings were from a database that included Medicare admissions and represented about half of all hospital admissions in the U.S.

Janet Young, senior scientist at Thomson Reuters and a co-author of that study, says data current through the third quarter of 2006 show heart-attack admissions continuing to decline. "What we thought was interesting is that the population is getting older and so it would seem like the number of heart attacks should be increasing. But it's not, it's decreasing." The firm's data suggest overall heart-attack admissions peaked in 2001. The heart attack trends are the latest evidence of progress in the prolonged fight against cardiovascular disease. Unless...