Angina or “Heart Pain”
Well described 600 BCE

- From a cemetery in Cambridge
Classic Heart Attack Symptoms

- Chest Pain
- Shortness of Breath
- Nausea
- Anxiety
- Vomiting
- Light Headedness
- Sweating
- Cough
- Wheezing
Chest Pain Variants

- Localized just under breastbone or in larger area of mid-chest or entire upper chest.
- Common combination mid-chest, neck, and jaw.
- Mid-chest and inside arms. Left arm and shoulder more frequent than right.
- Upper abdomen where most often mistaken for indigestion.
- Larger area of chest, neck, jaw, and inside arms.
- Lower center neck to both sides of upper neck, and jaw from ear to ear. Left arm and shoulder more frequent than right.
- Inside right arm from armpit to below elbow, inside left arm to waist.
Do you know your heart attack symptoms?
Heart Attack Warning Signs

Women

- Lightheadedness or dizziness
- Upper back pressure
- Chest pressure
- Shortness of breath
- Pain in one or both arms, the back, neck, jaw or stomach
- Fainting or extreme fatigue

Women might not experience the chest pain that is often noted as the most common sign of heart attack. Some women who have had heart attacks say they thought they had the symptoms associated with the flu.

Men

- Cold sweat or nausea
- Chest pressure or pain
- Shortness of breath
- Pain in one or both arms, the back, neck, jaw or stomach

If you have any of these symptoms for more than 5 minutes and are unsure of the cause, call 9-1-1.

Treatments work best if given within 1 hour of when heart attack symptoms begin.
Figure A is an overview of a heart and coronary artery showing damage (dead heart muscle) caused by a heart attack. Figure B is a cross-section of the coronary artery with plaque buildup and a blood clot.
All roads lead to Rome
Coronary Catheters

QuickPass™ PTFE inner liner and lined tip

2 x 2 braid pattern
Pt RB

Age 38
1ppd Smoker
Father had MI @ Age 46
Total Chol 189
LDL 138
HDL 25
Death is Chasing Them
Current Concepts in Atherosclerosis

Richard C. Padgett, MD

Oregon Heart and Vascular Institute
Oregon Cardiology, PC
Eugene, Springfield & Florence
Lesion Severity: A Poor Predictor of Survival

From the Coronary Artery Surgery Study (CASS) as reported by Little et al.

Vascular Disease: Scope of the Problem

- Vascular disease—and CAD in particular—is the leading cause of death in the US and other Western nations
- By 2020, cardiovascular disease will become the most common cause of death worldwide
- Due to the high initial mortality of vascular disease, the target of clinical practice must be aggressive risk factor management

Atherosclerosis: A Systemic Disease

Most CAD patients have concomitant symptomatic peripheral or cerebrovascular disease

- CAD + cerebrovascular disease: 32%
- CAD + peripheral disease: 33%
- CAD only: 35%

From a prospective analysis of 1886 patients aged ≥62 years, 810 patients were diagnosed with CAD as defined by a documented clinical history of MI, ECG evidence of Q-wave MI, or typical angina without previous MI. (Adapted from Aronow et al.)

Coronary Artery Disease (CAD): The Diagnosis Often Comes Too Late

Myocardial infarction (MI) or death as initial presentation of CAD

Men: 62%
Women: 46%

(Adapted from Levy et al.)

## Major Risk Factors for CAD

### Modifiable risk factors

- Hypertension
- Dyslipidemia
- Diabetes
- Cigarette smoking
- Obesity
- Physical inactivity

### Nonmodifiable risk factors

- Family history
- Age
- Gender

New Risk Factors

- Homocysteine
- Lp(a)
- Small dense LDL
- Fibrinogen
- Hs-CRP Risk factor or Disease Identifier
- Coronary Calcium
CAD Risk Is Incremental

Age-adjusted CAD death rates

Deaths per 10,000 patient-years

Serum cholesterol quintile (mg/dL)

245+ 221-244 203-220 182-202 <182

142+ 132-141 125-131 118-124 <118

Systolic BP quintile (mm Hg)

(Adapted from Neaton et al.)

Anatomy of the Atherosclerotic Plaque

- Lumen
- Lipid Core
- Fibrous cap
- Intima
- Media
- Elastic laminae
- Internal
- External

Shoulder
Development of Atherosclerotic Plaque
Conventional Concept
Most Myocardial Infarctions Are Caused by Low-Grade Stenoses

(Adapted from Falk et al.)

Lesion Severity: A Poor Predictor of Survival

From the Coronary Artery Surgery Study (CASS) as reported by Little et al.

Glagov's Model
Conventional vs Contemporary
Coronary Remodeling

Progression

Compensatory expansion maintains constant lumen

Expansion overcome: lumen narrows

Normal vessel

Minimal CAD

Moderate CAD

Severe CAD

(Adapted from Glagov et al.)

Transition to Acute Coronary Syndrome
Atherosclerosis Begins in Childhood

(Adapted from Berenson et al.)

One in Six Teenagers Has Atheromas

(Adapted from Tuzcu et al.)

Tuzcu EM et al, in press.
CAD: Silent Disease Necessitates Aggressive Risk Factor Management

- IVUS corroborates necroscopy studies, proving that atherosclerosis begins in youth.
- CAD progresses silently; the initial presentation is usually MI or sudden death.
- Most atheromas are extraluminal, rendering them angiographically silent.
- The only reasonable approach is early and aggressive risk factor management.

The Correlation Between Atherosclerosis and Risk Factors Begins Early

(Adapted from Berenson et al.)

CAD: Not Just a Lipid Disease

- Half of all MIs occur in normolipidemic patients

- **Smoking**
  Accounts for 200,000 cardiovascular deaths annually

- **Diabetes**
  Affects 16 million Americans—and is growing

- **Hypertension**
  Confers as much risk for MI as smoking or dyslipidemia
  - Systolic hypertension is an even greater indicator of CAD risk than diastolic hypertension

Conclusions: Critical Lessons in Understanding Atherogenesis

• CAD is a ubiquitous, systemic disease that requires a systemic solution

• Most patients progress to MI or sudden death before a diagnosis of CAD is ever considered

• IVUS demonstrates that remodeling causes angiography to underestimate the extent of disease

• Extraluminal, angiographically silent atheromas are responsible for most acute coronary events, including sudden death

“Awaiting overt signs and symptoms of coronary disease before treatment is no longer justified.”

“In some respects, the occurrence of symptoms may be regarded more properly as a medical failure than as the initial indication for treatment.”

—William B. Kannel, MD
Department of Medicine
Boston University Medical Center
The CVD Pandemic: Annual Incidence

> 15 Million Fatal Heart Attacks Each Year

Source: World Heart Federation

Incidence rates based on 1995 data
Adapted from American Heart Association: Heart and Stroke Statistical Update, 1998.
Cardiovascular Disease

- Every 33 seconds, someone dies of a heart attack
- For 60% this is their first sign of Heart Disease
- The number-one killer in the United States since 1900, except during the 1918
- It has killed more Americans than all wars, infectious disease and cancer…Combined
But Who is at Risk?

- Jim Fixx, 53 †
- Sir Winston Churchill, 91 †

- Not Overweight
- Very Fit
- Non-Smoker
- Overweight
- Not Fit
- Heavy Smoker
80.6% of American adults have one or more risk factor for heart attack!
Eradication of Heart Attack

dream or reality?

- Most heart attack is preventable
- Heart attack remains the #1 killer

Traditional approach has failed
Prevention of heart attacks must be the primary goal.

Treatment should be regarded as “locking the barn door after the horse is stolen”

Eugene Braunwald
Screening for Atherosclerosis
Risk Factors vs Disease

Numerous Risk Factors
- High LDL
- Low HDL
- High BP
- Diabetes
- Smoking
- CRP
- Metabolic Syn
- Lp(a)
- Homocysteine
- Dense LDL
- Lp-PLA2
- ApoB/ApoA
- Family History
- Sedentary Life
- Obesity
- Stress
- ...

Over 200 risk factors have been reported.

Examples of Arterial Structure Tests
- Carotid IMT and Plaque Measured by Ultrasound
- Aortic and Carotid Plaque Detected by MRI
- Coronary Calcium Score Measured by CT
- Ankle Brachial Index
- Brachial Vasoreactivity Measured by Ultrasound
- Vascular Compliance Measured by Radial Tonometry

Examples of Arterial Function Tests
- Microvascular Reactivity Measured by Fingertip Tonometry
AEHA
Leading the Way to Eradicate Heart Attacks

Era of Screening
Regular Screening & Interventions
Get in SHAPE
Screening for Heart Attack Prevention and Education

Era of “Polypill”
Chronic Prophylactic Drug Therapy
Combined Aspirin, Statin, ACE, ...

Era of Vaccine
Prevention and Stabilization of Atherosclerosis by Vaccination and Immune Modulation Strategies

Learn about the AEHA Vaccine Initiative Mission 2020

AEHA Calls for a Marriage between Fitness and Screening Centers to Proliferate SHAPE Compatible Clinics and Help Fight the Epidemic of Obesity, Diabetes, and Coronary Heart Disease

Shifting Cardiovascular Healthcare to Out of Hospital

The Burden of Sudden Heart Attacks Today
19 million deaths every year

$280 Billion / Year only in the USA
Aortic Stenosis
An Increasing Burden

Burden of Valve Diseases in the US

Disease | Year 2000 | Year 2030
---|---|---
AS  | 2.5 millions | 4.6 millions
MR  | 2.7 millions | 4.8 millions
Aortic Stenosis: Natural History

[Graph showing survival percentage over age with onset of severe symptoms and average age at death.]
## Aortic Stenosis

<table>
<thead>
<tr>
<th>Symptom/Sign</th>
<th>Live expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angina</td>
<td>5 years</td>
</tr>
<tr>
<td>Syncope</td>
<td>2-3 years</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>1-2 years</td>
</tr>
</tbody>
</table>

**Therapy:** Valve replacement for severe aortic stenosis  
Operative mortality (elderly) ~ 4-24%/Morbidity ~ 3-11%  
Event rate in asymptomatic severe AS ~ 1%/year
Standard Therapies are Inadequate

- Despite frequent BAV, **standard therapy did not alter the dismal course of disease for inoperable patients** in The PARTNER Trial
  - 50% died within 1 year
  - 68% died within 2 years
Worse Prognosis than Many Metastatic Cancers

- 5 year survival of breast cancer, lung cancer, prostate cancer, ovarian cancer and severe inoperable aortic stenosis

*Using constant hazard ratio. Data on file, Edwards Lifesciences LLC. Analysis courtesy of Murat Tuzcu, MD, Cleveland Clinic
Absolute Reduction in Mortality in Inoperable Patients

The Edwards SAPIEN valve significantly improves survival

24.7% absolute reduction in mortality

Despite expert care and frequent BAV, standard therapy failed to alter the dismal natural course of disease
ANIMATION
Transfemoral Deployment of Edwards SAPIEN Transcatheter Heart Valve in Calcified Aortic Valve
A Collaborative Treatment Decision

1. Patient with Severe Aortic Stenosis Identified by Referring Physician

2. Patient Referred to TAVR Valve Clinic

3. Additional Testing Completed

4. Multidisciplinary Review and Treatment Decision by TAVR Heart Team

5. Treatment Decision Discussed with Referring Physician

Devising a Treatment Plan is a Collaborative Process

Ultimate treatment choice is a collaborative decision between the physicians, patient and patient’s family.
A Dedicated Heart Team

Requires marriage of OR & Cath Lab staff

- Cardiothoracic Surgeon Learns: Large bore catheter technology and wire techniques
- Interventional Cardiologist Learns: Structural heart & aortic stenosis
- OR and Cath Lab staff both have to learn new equipment and processes
To ensure the success of the hybrid approach, the multidisciplinary team approach has developed

- Facilitates joint pre-operative decision-making and intra-operative collaboration between surgery and cardiology

**Old Paradigm**

Interventionalists

Patient

Cardiologist

Surgeon

**Emerging Paradigm**

Interventionalists

Patient

Surgeon

Cardiologist

Reference: Maisano 20120
Summary JS

- 85 y.o. male
- STS 10%
- EuroSCORE 3%
- NYHA III

Clinical History

- Increasing fatigue and exercise intolerance
- Work-up for total knee replacement; echocardiogram shows progression of aortic stenosis, now severe.
- Alzheimer's dementia.
- CAD - moderate
- Chronic kidney disease.

- Creatinine 1.2  BUN 14
- Hgb 12.9
- PLT 130  BNP 422

- Hypertension
- Hyperlipidemia,
- Diabetes/ Diabetic neuropathy.
- Obesity.
- History of osteomyelitis of the ankle/ foot.
- BPH./ prostate cancer
- Arthritis.
- Gout.
- Suspected carrier of methicillin-resistant Staph aureus.
Echocardiography – JS

- TTE performed on 6/12/2015

<table>
<thead>
<tr>
<th>Required Measurements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Velocity</td>
<td>4.29 m/s</td>
</tr>
<tr>
<td>Mean Gradient</td>
<td>44.4 mmHg</td>
</tr>
<tr>
<td>Annulus Diameter</td>
<td>21 mm</td>
</tr>
<tr>
<td>AVA</td>
<td>0.80 cm</td>
</tr>
<tr>
<td>Ejection Fraction</td>
<td>65 %</td>
</tr>
</tbody>
</table>

Findings
- Severe aortic stenosis
- Mild aortic regurgitation.
- Trace mitral regurgitation
- Trace tricuspid regurgitation
3Mensio – area 473.0 (26 Valve)
Ostial heights  Lt: 12.5  Rt: 13.6
JS access
Deployment angle  RAO 3  Cranial 2
### Minimal Luminal Diameters

<table>
<thead>
<tr>
<th></th>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Iliac</td>
<td>8.0 mm</td>
<td>Common Iliac</td>
</tr>
<tr>
<td>Prox external Iliac</td>
<td>8.8 mm</td>
<td>Prox external Iliac</td>
</tr>
<tr>
<td>Mid external iliac</td>
<td>9.0 mm</td>
<td>Mid external iliac</td>
</tr>
<tr>
<td>Common Femoral</td>
<td>8.8 mm</td>
<td>Common Femoral</td>
</tr>
</tbody>
</table>
This patient is suitable for transfemoral TAVR with Sapien XT

- Concern of calcium extending into LVOT
- Plan B - Dr. Koh – support only

<table>
<thead>
<tr>
<th>Annulus Diameter Measurement</th>
<th>THV Valve Size Proposed</th>
<th>Femoral Access Side Proposed</th>
<th>Smallest Vessel Diameter Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.7 cm</td>
<td>26 mm</td>
<td>Right</td>
<td>8.0 mm</td>
</tr>
</tbody>
</table>
First TAVR @ OHVI  Sept 12th 2012
Percutaneous treatment of Mitral Regurgitation

The Mitra Clip procedure
The four chambers of the Heart
Sacred Heart Medical Center Riverbend
Oregon Heart & Vascular Institute, Springfield OR