PERCUTANEOUS CARDIAC INTERVENTIONS

2016: state of the art

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Purpose of this Talk

- **Milestones in the treatment of cardiovascular disease**
  - We cannot appreciate what we have today unless we understand the contributions of those who paved the way

- **To describe the evolution of**
  - Coronary Artery Bypass Surgery
  - Percutaneous Coronary Intervention (PCI)
  - Pharmacology in PCI
  - Realizing the Generalized Nature of Atherosclerosis and expanding Endovascular Therapy

- **To demystify what is done in the Catheterization Lab**
  - To describe the procedures we presently perform
  - To discuss new procedures that we should bring to Yakima
Milestones in the Care of Cardiovascular Disease

- 1953 Dr. John Gibbon performs the first open heart surgery using a cardiopulmonary bypass machine at Jefferson Medical Center in Philadelphia, PA. He developed the cardiopulmonary bypass machine with the help of the IBM corporation. Thus began the present day surgical therapy of heart disease.

- 1953 Dr. Sven-Ivar Seldinger in Stockholm, Sweden developed the technique we use today to safely access arteries percutaneously.

- 1964 Dr. Vasilii Kolesov, a Russian surgeon, performs the first coronary artery bypass with suture technique. It was done using the internal thoracic artery (IMA) on a beating heart.

- 1968 Dr. Rene Favolaro publishes data on 171 patients he performed coronary artery bypass grafting at Cleveland Clinic, using principally SVGs. With advances in bypass pump technology, CABG flourishes for the next decade, as the only treatment for patients with chronic stable angina.
Milestones in the Care of Cardiovascular Disease

- 1958 Dr. Mason Sones, a Pediatric Cardiologist at Cleveland Clinic, accidentally performs the first coronary angiogram of the RCA when performing an aortic root angiogram. Instead of being in the aorta, the catheter slipped into the RCA. It showed the course of the RCA and the patient did not die. Thus present day coronary angiography was born.

- 1967 Dr. Melvin Judkins, while at the University of Oregon Medical Center, developed flexible diagnostic catheters designed for visualizing the coronary anatomy.

- 1969 Dr. Thomas Fogarty, a surgeon at the University of Oregon Medical Center, developed the first arterial catheter to remove clots. This was the basic platform that future intravascular balloons used.
Milestones in the Care of Cardiovascular Disease: The move toward less invasive

- **1977** Dr. Andreas Gruentzig, a Swiss Radiologist from Zurich, performs the first percutaneous coronary balloon angioplasty. The Schneider Company was formed in 1976 to commercially build the Gruentzig balloon. These initial balloons had a fixed wire on the end and were bulky and non-steerable. Coronary angioplasty was born.

- **1978** 1st coronary bypass surgery was performed in Yakima, WA by CV Surgeons Mark Snyder, Tim Orvald, and Bill Gaskill.

- **1982** Drs. Duane Monick and Richard Spiegel do first angioplasty in Yakima
Milestones in the Care of Cardiovascular Disease
The Rise of Coronary Stents – “The Game Changer”

- 1991 Dr. Julio Palmaz invents the first balloon expandable stent
- 1993 The Gianturco-Roubin coronary stent made by Cook Medical is approved by FDA
- 1994 The Palmaz-Schatz coronary stent made by Johnson & Johnson is approved by FDA
- 1997 The Multilink coronary stent made by Guidant is approved by FDA. This is the design that most of the balloon expandable stents use today
- 2002 The Cypher stent, the first drug-eluting coronary stent, made by Johnson & Johnson is approved by the FDA. They are coated with an immunosuppressant drug, sirolimus, to reduce restenosis
- 2016 The Absorb stent, the first bioabsorbable stent, made by Abbott is approved by FDA
The Original Percutaneous Angioplasty Balloon Design

The original balloon designs by Dr. Andreas Gruentzig in 1974
Balloon Angioplasty
Limitations of Percutaneous Coronary Interventions

- Original Balloon Design was Rigid
- Bulky & Calcified Coronary Lesions
- Recoil & Dissection
- Perforation
- Restenosis
- Thrombosis
  - Acute closure
  - Stent Thrombosis
- LV Pump Failure
- Side Branch Occlusion
Devices to deal with the original rigid balloon design

1982 – John Simpson MD revolutionized PCI with Steerable Guidewires and Over the Wire Balloons
Devices to deal with Bulky & Calcified Coronary Lesions

1990 - Directional Atherectomy
Devices to deal with Bulky & Calcified Coronary Lesions

Figure 5. The nickel-coated brass rotablator burr is embedded with microscopic diamond chips on the front half. Sizes range from 1.25 to 2.5 mm burrs.

1993 - Rotoablation
Devices to deal with Bulky & Calcified Coronary Lesions

Pressure
- Nominal: 6 atm
- RBP: 12 atm

Diameters: 2 mm - 4 mm (0.25 mm increments)
Lengths: 6 mm, 10 mm, 15 mm

2005 - Cutting Balloon
Devices to deal with Peri-procedure Dissection

1994 - Perfusion Catheter
Devices to deal with Recoil & Dissection

Gianturco-Roubin
June 1993

Palmaz-Schatz
Aug 1994

MultiLink, 1997
Devices to deal with Perforation

2001 - GraftMaster Covered Coronary Stent
Devices to deal with Restenosis

- Drug-eluting stents have decreased the restenosis of coronary stents from 25-30% to 15% while allowing us to take on more complex lesions.
- We can now treat coronary artery lesions ranging from 2-6 mm in diameter.

2002 - Stents coated with immunosuppressive drugs
Devices to deal with Restenosis

2016 – Abbott Absorb Stent

Made of poly-L-lactide
Based upon multilink stent pattern
Coated with everolimus
Fully resorbed in 2-3 years
Devices to deal with Thrombus

2002 - Thrombectomy Catheters used to remove thrombus
Devices to deal with Thrombus

1999 - Angiojet Catheter
Devices to Deal with LV Pump Failure

1980 - Intra Aortic Balloon Pump
Devices to Deal with LV Pump Failure

2015 - AbioMed Impella LV Assist Device
## Historical Outcomes in Elective PCI

<table>
<thead>
<tr>
<th>Year Range</th>
<th>Clinical Success Rate</th>
<th>Mortality</th>
<th>MI</th>
<th>Emergent CABG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977-1984</td>
<td>63%</td>
<td>1.2%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>1985-1993</td>
<td>82%</td>
<td>1.4%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>1994-Present</td>
<td>94% -&gt; 97%</td>
<td>1.9% -&gt; 0.7%</td>
<td>3% -&gt; 2%</td>
<td>2% -&gt; 0.4%</td>
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Pharmacology of Elective PCI

- Prior to Stents – Acute closure after balloon
  - ASA and IV heparin during the procedure

- After Stents – stent thrombosis
  - First stents were treated with ASA, persantine, IV dextran 40, and coumadin anticoagulation (kitchen sink approach)
  - 1998 - Dual Antiplatelet Therapy (ASA 325 mg daily + Thienopyridines)
    - Ticlopidine - BID dosing and serious bone marrow suppression (less bleeding than kitchen sink approach)
    - Clopidogrel - daily dosing, small group of poor metabolizers, decreased effectiveness with concurrent PPI use (particularly prilosec and nexium), caution if GFR<30, safer than Ticlid, now generic. (stop 5 days before elective surgery)
    - Prasugrel - daily dosing, increased bleeding in the elderly (age > 75) and in wt < 60 kg, avoid in pts with prior TIA/stroke, caution if GFR<30, expensive. OK with PPIs. (stop 7 days before elective surgery)
    - Ticagrelor – BID dosing, best with baby ASA, hepatically metabolized, safe in renal dysfunction, expensive. OK with PPIs. (stop 7 days before elective surgery)
  - The discovery that baby ASA (81 mg) daily work best with the newer Thienopyridines
Emergent PCI and Heart Attacks

- 1970s IV Thrombolytic therapy was tried for AMI. But initial studies did not show benefit.
- 1980 Dr. Marcus DeWood in Spokane, WA observes that thrombus leads to acute myocardial infarction when performing emergent CABG for heart attack patients.
- 1982 Temporal relationship between thrombolytic and benefit in AMI. “Door-to-Drug” Time emerges. It was not until this discovery that IV Thrombolytics were given early enough to show benefit. AMI finally has a therapy.
- 1992 Primary Angioplasty found to be superior to IV Thrombolytic therapy for AMIs. “Door-to-Balloon” Time
- 1993 First Primary Angioplasty performed in Yakima
- 1997 YHC staffed full-time Primary Angioplasty for Yakima at Providence Yakima Medical Center
### Historical Outcomes for AMIs in Yakima

<table>
<thead>
<tr>
<th>Period</th>
<th>In-Hospital AMI Mortality</th>
<th>Average Hospital Stay</th>
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<tbody>
<tr>
<td>Before 1980 Pre-Thrombolytics</td>
<td>20-25%</td>
<td>14-21 days</td>
</tr>
<tr>
<td>1980-1993 Thrombolytics</td>
<td>8-12%</td>
<td>7-10 days</td>
</tr>
<tr>
<td>1994-1997 Primary POBA</td>
<td>6%</td>
<td>5-7 days</td>
</tr>
<tr>
<td>1998-Present Primary stenting</td>
<td>3%</td>
<td>2-3 days</td>
</tr>
</tbody>
</table>
The Complementary Nature of Treatment Modalities for CAD

- Atherosclerosis is still a disease without a cure
- Atherosclerosis is still the #1 cause of death in the US
- Presently 3 treatment modalities exist
  - Risk Factor Modification through Medications & Lifestyle changes
  - PCI
  - CABG
The Complementary Nature of Treatment Modalities for CAD

- PCI has evolved into a very effective way of reducing symptoms from CAD. It is less invasive, but is still plagued with ~15% restenosis rate.
- CABG is more invasive, but still remains the revascularization technique of choice for more extensive CAD, especially in diabetics and patients with reduced LV function.
- It is important to remember that neither PCI or CABG cures atherosclerosis, they temporarily ameliorate their symptoms.
- It is best to evaluate each patient individually, based upon their coronary anatomy and comorbid factors, to determine which treatment modality to use. The cardiovascular team includes: the PCP, the CV surgeon, the cardiac interventionalist, the non-interventional cardiologist, the staff that supports these physicians, and a close working relationship with the hospitals where we treat our patients.
Risk Factor Modification

- “Fuel” Model
  - Diabetes control, keep Hgb A1c < 7.5
  - Control HTN, the lower the SBP, the better, ideally SBP 100-120 if tolerated.
  - Control cholesterol, LDL of 70-100, HDL > 40, TGs < 150
- Lifestyle Changes
  - A heart healthy low cholesterol diet
  - Stop Smoking, no tobacco products, marijuana is showing similar effects as tobacco
  - Regular exercise
  - Stress management
Procedures performed in the Cardiac Catheterization Labs

- Cardiac procedures
  - Diagnostic left and right heart catheterization
  - Primary PCI for heart attacks (24/7)
  - Elective complex PCI for chronic angina
  - Pericardiocentesis
  - Temporary Transvenous pacemaker leads placement
  - Permanent Pacemaker and ICD placement
  - Cardiac Resynchronization Therapy (biventricular pacing)
  - Electrophysiologic testing
  - Arrhythmia Ablation Therapy
Procedures performed in the Cardiac Catheterization Labs

- Peripheral procedures
  - Carotid Stenting with distal protection
  - Abdominal Aortic Aneurysm Endographs
  - Mesenteric & Renal PTA/Stenting
  - Upper & Lower Extremity Arterial PTA/Stenting
  - Intra-Arterial Thrombolysis
  - Venous PTA/Stenting
Future Percutaneous Procedures

Future Percutaneous Procedures we would like to see in Yakima

- TAG - Thoracic Aortic Grafting
- TAVR – Transcatheter Aortic Valve Replacement
- ASD (Atrial Septal Defect) Closure
- LAA (Left Atrial Appendage) Occlusion
- MitraClip
- Acute Stroke Prevention
Thoracic Aortic Aneurysm Grafts
Transcatheter Aortic Valve Replacement

Edwards Sapien

Medtronic CoreValve
Atrial Septal Defect Closure
Left Atrial Appendage Occlusion

PLAATO Device

Watchman Device
MitraClip
Acute Ischemic Stroke Intervention

**CENTRAL ILLUSTRATION:** New Standard-of-Care in Acute Ischemic Stroke Intervention: Mechanical Thrombectomy With IV-rtPA for LVO Ischemic Stroke

Acute Ischemic Stroke Intervention: Mechanical Thrombectomy Devices

Newest Stent Retriever Devices
Cerebral angiogram of an occlusion of the M1 segment of the left MCA (see arrow picture A), and after recanalization with mechanical thrombectomy (see arrow picture C)
Acute Ischemic Stroke FAQs

- >750,000 strokes annually in US
- 5th Leading cause of Death
- 1st Leading cause of Disability
- Costs $70 billion annually
- Between 20-30% of strokes are due to large vessel occlusion with a Incidence of 15-25 large vessel strokes/100,000 population, these are the patients with the largest strokes with the worst outcomes who benefit most from IV-tPA & mechanical thrombectomy
Acute Ischemic Stroke FAQs

- IV-tPA only recanalizes flow in 13-50% of large vessel occlusions (LVOs)

- Overall Outcomes with IV-tPA for LVOs
  - >50% were still severely disabled or dead.
  - 90 day mortality of 15-20%
  - 90 day Functionally Independent Outcome (FIO) occurs in 30%

- At Comprehensive Stroke Centers (CSCs) that can provide endovascular cerebral procedures 24/7, outcomes for patients who present within <6 hours of symptoms are now
  - 90 day mortality down to <10%
  - 90 day FIO up to 60%
Comprehensive Stroke Center

- CSCs have a marked impact on stroke outcomes
  - With rapid identification of large vessel obstruction with improved CTA and MRA techniques
  - With the understanding that for every 30 min delay in recanalization there is a 12-15% decline in reaching a good outcome
  - With improved workflow design, patients are treated faster
  - With the ability to offer mechanical thrombectomy devices, principally stent retriever devices, recanalization is successful in 85-90% of cases

- We should work toward developing a CSC soon in Yakima to service stroke patients in Central Washington
Thank you for your support to provide this specialized care to your patients, family members, and friends.

Atherosclerosis is implicated in three of the top 10 diseases that kills and disables Americans: heart disease, stroke, and Alzheimer’s disease. It is responsible for 30-40% of all deaths in the United States.

To provide this type of comprehensive cardiovascular care to Yakima, requires an amazing level of collaboration between our medical staff and hospitals. With all of your help and support, we look forward to bringing new technology to Yakima.

We need to continue to think about treating the “untreatable” and providing timely, excellent, local care.

A special thanks to Dr. Baljit Sharma, our cardiothoracic surgeon, who single-handedly provides a significant portion of this cardiac care to Yakima.

As Ralph Waldo Emerson said “Nothing Great was ever achieved without Enthusiasm”, nor was it built in Isolation. It requires Teamwork and we have a dedicated Team.