Procedures and Imaging:
What’s New in the Cath Lab in 2015

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Disclosures

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It’s Not The Same Old Cath Lab!

- Coronary
- Peripheral
- Structural
- Carotid
- Miscellaneous
Choice of Equipment When I was in Training

The Interventional Cardiologist in 2015

Coronary:
- PCI (DES and BMS, and other new stent technologies)
- CTO program
- Atherectomy (Rotational, Orbital, Laser)
- Coil Embolization
- Alcohol Septal Ablation (HSS)
- Covered Stents
- Visualization (IVUS, OCT)
- Hemodynamic Evaluation: FFR
- High Risk PCI with Hemodynamic Support: IABP, Impella (Left Main PCI, single patent vessel, poor EF)
Peripheral:
- Iliac
- Aortic
- Femoral
- Below the knee
- Mesenteric / Renal
- Novel Access (pedal and digital)
- PEVAR / EVAR
- Thoracic Aneurysms
- Peripheral Aneurysms
- Coarctation
- Critical Limb Ischemia / Limb Salvage
  - Balloons, Stents (DES and BMS), Drug Eluting balloons, Bioabsorbable Technologies
  - Atherectomy and CTO devices, dissection and re-entry devices

Structural Heart Disease:
- TAVR
- (Mitral Clip and MVR)
- LAA closure
- Mitral and Aortic Balloon Valvuloplasty
- ASD
- VSD
- PFO
- Para-valvular Leak
- LV remodeling (Parachute)

Carotid and Miscellaneous
- Carotid Stenting (Distal or Proximal protection)
- Renal Denervation for HTN
- Venous Ablation Therapy (Venous Reflux disease)
- Percutaneous Management of Acute and Chronic DVT
- Thrombectomy for Acute PE
- IVC Filter Placement
- Venous Stenting (May-Thurner Syndrome)
- Uterine Artery Embolization for Fibroids
- Pudendal artery stenting for ED
Cath Lab Imaging

- Standard fluoro and Cineangiography but:
  - lower frame rates
  - better shielding
  - less scatter
  - improved image processing
  - higher resolution
  - dose monitoring/ Zerogavity™
  - robotic systems

Other Imaging Techniques

- IVUS
- Duplex
- OCT
- TEE
- FFR

How IVUS Can Help

Should I stent?
- Assess lesion severity

How should I stent?
- Assess lesion size, length, reference vessel diameter, plaque burden, morphology
- Plan adjunctive strategies

Did I do it right?
- Evaluate expansion, apposition, edges, and coverage for dissections
In-Stent Restenosis

Images courtesy of Gary Mintz, MD. Case study results are not a predicate of results in other cases. Results in other cases may vary.
Negative FFR

TAVR Case Study & Plan

FFR Wire: FFR 0.4 without Adenosine!!
TEE: used in
- TAVR
- Watchman
- ASD/VSD/PFO closure
- Most Structural Heart Cases

AF is a Growing Problem Associated with Greater Morbidity and Mortality
- Higher stroke risk for older patients and those with prior stroke or TIA
- 15-20% of all strokes are AF-related
- AF results in greater disability compared to non-AF-related stroke
- High mortality and stroke recurrence rate


Stroke Risk by Age

Percent of total strokes attributable to atrial fibrillation

Age
- 50-59: 10%
- 60-69: 15%
- 70-79: 20%
- 80-89: 25%
Connection Between Non-Valvular AF-Related Stroke and the Left Atrial Appendage

AF Creates Environment for Thrombus Formation in Left Atrium

- Stasis-related LA thrombus is a predictor of TIA and ischemic stroke.
- In non-valvular AF, >90% of stroke-causing clots that come from the left atrium are formed in the LAA.

CHA2DS2-VASc Score

<table>
<thead>
<tr>
<th>Condition</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure (left ventricular systolic dysfunction)</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension; blood pressure consistently above 140/90 mmHg (or treated hypertension on medication)</td>
<td>1</td>
</tr>
<tr>
<td>Age ≥75 years</td>
<td>2</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Prior Stroke or TIA or thrombembolus</td>
<td>2</td>
</tr>
<tr>
<td>Vascular disease (e.g., peripheral artery disease, mycocardial infarction, aortic plaque)</td>
<td>1</td>
</tr>
<tr>
<td>Age 61–75 years</td>
<td>1</td>
</tr>
<tr>
<td>Sex category (e.g., female sex)</td>
<td>1</td>
</tr>
</tbody>
</table>

Annual Stroke Risk

<table>
<thead>
<tr>
<th>CHA2DS2-VASc Score</th>
<th>Stroke Risk %</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>1.3</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>2.2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>3.2</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>4.0</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>6.7</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>9.8</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>12.5</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>15.2</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>
### Rx Recommendations

<table>
<thead>
<tr>
<th>Score</th>
<th>Risk</th>
<th>Anticoagulation Therapy</th>
<th>Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (male) or 1 (female)</td>
<td>Low</td>
<td>No antithrombotic therapy</td>
<td>No antithrombotic therapy</td>
</tr>
<tr>
<td>1 (male)</td>
<td>Moderate</td>
<td>Oral anticoagulant should be considered</td>
<td>Oral anticoagulant, with well-controlled Vitamin K Antagonists (VKA, e.g., warfarin with time in therapeutic range &gt;70%, or a Non-VKA Oral Anticoagulant (NOAC, e.g., dabigatran or rivaroxaban)</td>
</tr>
<tr>
<td>2 or greater</td>
<td>High</td>
<td>Oral anticoagulant is recommended</td>
<td>Oral anticoagulant, with well-controlled Vitamin K Antagonists (VKA, e.g., warfarin with time in therapeutic range &gt;70%, or a Non-VKA Oral Anticoagulant (NOAC, e.g., dabigatran or rivaroxaban)</td>
</tr>
</tbody>
</table>

### Treatments for Chronic A-Fib

<table>
<thead>
<tr>
<th>DRUGS</th>
<th>IMPLANT</th>
<th>SURGERY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Aspirin</td>
<td>A. BSX (Abiomed) Watchman</td>
<td>A. Suture (Ethicon, Teleflex)</td>
</tr>
<tr>
<td>B. Warfarin (Coumadin)</td>
<td>B. SJM (AGA) Amplatz Cardiac Plug</td>
<td>B. Clips (Atricure, LAAx)</td>
</tr>
<tr>
<td>C. Xa Inhibitors (Dabigatran, Apixaban)</td>
<td>C. Coherex Wavecrest</td>
<td>C. Staplers (Ethicon, Covidien)</td>
</tr>
</tbody>
</table>

- Not a permanent solution
- Not suited for active or risk of full pils
- Requires invasive surgery, often with CPB
- Technique affects clinical outcomes
- Anatomically challenging to achieve
- Requires post procedure management
- Niche for patients eligible to anticoagulation
- Not available until safety studies completed
- Requires anticoagulation, applicable?
- Not a stand-alone option
- Target market of patients

### Oral Anticoagulation is Standard of Care, but Not Ideal for All

<table>
<thead>
<tr>
<th>Warfarin</th>
<th>Novel Oral Anticoagulants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding risk</td>
<td>Bleeding risk</td>
</tr>
<tr>
<td>High non-adherence/reluctance</td>
<td>High non-adherence/reluctance</td>
</tr>
<tr>
<td>Regular INR monitoring</td>
<td>Novel Oral Anticoagulants</td>
</tr>
<tr>
<td>Field self-dose validation</td>
<td>Composites surgical procedures</td>
</tr>
<tr>
<td>Anticoagulation Use</td>
<td>Lack of reversal agents</td>
</tr>
</tbody>
</table>

![Graph showing Anticoagulation Use and Increased Stroke Risk](https://example.com/graph)

3. No implants are presently approved for sale in the USA.
Anticoagulant Therapy Carries Risk of Intracerebral Hemorrhage or Death

Despite Increasing NOAC Adoption, Overall Rate of Anticoagulation in High Risk NVAF Patients has Not Improved

Results from the NCDR PINNACLE Registry

WATCHMAN™ Left Atrial Appendage Closure Device

- Designed to reduce the risk of stroke by closing off the left atrial appendage, which is known to be the main source of blood clots in patients with non-valvular atrial fibrillation
- Extensively studied device with >2,400 patients, ~6000 patient years follow-up
- Commercially available internationally since 2009, with over 9,000 implants worldwide
- Approved in over 70 countries
Watchman Device

Nitinol frame with anchoring barbs
Fabric cover

Sizing

LAA measured at 0°, 45°, 90°, and 135° on TEE

Trans-Septal Cath

Posterolateral and inferior
Sheath Across Septum/
Stiff Wire in Pulmonary Vein

Pigtail in LAA

Angiogram of the LAA
TEE Image of Device Deployed

LA
Watchman Device
LAA

Color Flow

No flow (no Color) in LAA

Favorable Procedure Safety Profile
7-Day Safety Events

Patients with Safety Event (%)

PROTECT AF 1st Half
No Data
2nd Half
4.9%
Learning Curve

CAP

PREVALE
1.9%
2.6%

CAP2

4.1%
3.8%
Complex PCI

RCA CTO

Trans-collateral
- 50 y/o male
- CTO RCA
- Maximal medical therapy
- Persistent Sx
Baseline angiogram

Surfing collaterals

Finally Across into the RCA
Evolution of AAA Repair

- **Open Surgical Repair**
- **EVAR with Surgical Cutdown**
- **Percutaneous EVAR**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Open Surgical Repair</th>
<th>EVAR</th>
<th>Percutaneous EVAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 day Mortality</td>
<td>4.3%</td>
<td>1.8%</td>
<td>0.6%</td>
</tr>
<tr>
<td>All-cause mortality</td>
<td>10%</td>
<td>17%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Length of hospital stay (days)</td>
<td>18</td>
<td>3.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>


30 day Major adverse event Rate

- JAAA (Juxta-renal AAA)

- Aneurysm extends to renal arteries

- Wall of Aneurysm

- Localizing Renal Arteries

- Wire/guide in left renal

- Pigtail in Aorta
Both Renals Wired for “Snorkeling” (Bilateral Brachial artery Puncture)

Renal Stents Positioned Before Advancing the Graft

Covered Renal Stents Inflated While Graft also Deployed
Deployment of Remainder of Main Body

Post-dilation of Main Body
(With balloons up in renals)

Endo-leak from Right Renal
Extension of Right Renal
With 2nd Covered Stent

Final Result/Leak Resolved

Follow-up
- Both femoral punctures closed with Prostar® devices (Abbott Vascular)
- Both brachial artery puncture sites closed with manual compression
- Pt discharged 24 hours later with 4 band-aids and is doing well
AAA in Women: (myth that AAA is a man’s disease)

- Often not diagnosed or missed in women.
- Percutaneous repair limited due to large size of delivery catheters.

**Lucy Trial:** smaller catheter size!! (now 12 and 14)

CLI

Occluded plantar arch

Plantar Arch Not Intact
Carotid Stenting

CREST-2

Carotid pre

Carotid post
Conclusions:

- The Cath Lab is not just for CAD, but peripheral intervention, structural heart disease, carotid disease, etc, etc, etc
- Virtually any vascular bed can now be approached and treated, including CTOs
- Multiple modes of visualization beside angiography are now used routinely used routinely in the modern cath lab

Thank You