Cardiac Cath Lab:
Where We Were, Where We Are and Where We Are Going

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Advocate Heart Institute
1914 Gilles Holst
physicist
Control room of the Faulkner Hospital x-ray department
Brigham and Women's Faulkner Hospital Collection
History of Cardiac Cath

• 1711 Hales performs first cardiac cath of a horse using brass pipes, glass tube and trachea of a goose
• 1844 Bernard coins term cardiac catheterization for intracardiac pressures in animals
• 1929 Dr. Forsmann first human cardiac cath- on himself
• 1941 Cournand & Richards cardiac cath as diagnostic tool to measure cardiac output
• 1956 Forssmann, Cournand and Richards share the Nobel Prize…”the cardiac catheter was the key in the lock”
History of Cardiac Intervention

• 1958- Mason Sones first angiogram
• 1964 Charles Dotter transluminal angioplasty
• 1967 Dr. Rene Favaloro first saphenous vein bypass
• 1974 Andreas Gruentzig first PTA
• 1977 Gruentzig first human coronary angioplasty
• 1985 Dotter, Sones, Judkins and Gruentzig die
Evolution of Cath Lab

- 1980 Geoff Hartzler First Infarct Angioplasty
- 1986 Atherectomy
- 1987-1993 – laser, rotablator, IVUS, stents
- 1989 Pacemaker implants move to cath lab
- 1994 – Palmz-Schatz stent approved
- 2001 - 2 million angioplasties performed
- 2003 Cypher stent by Cordis approved
Multidisciplinary Team

- CTO
- LVAD
- TAVR
- MITRAL CLIP
- WATCHMAN
- CLI SCD
- PCI
- AAA
- PV
- EP
- ABLATION
- SCD
Today

- CTO – Most Chicagoland
- CTO Courses
- CTO Masters
- Impella
- CHIP-
- CHIP Training
- CLI Center
- Afib Ablation
- ICD/Device Implants
- Lead Extraction
- LVAD
- Parachute
- Laser

- Cardiomems
- Leadless Pacemaker #1 In US
- S3 – first commercial
- TAVR # 2 Chicago
- Valve in Valve
- Transapical/Transaortic TAVR
- Transcaval TAVR – First in Illinois
- ECMO
- Mitral Clip
- Watchman Most Implant 23 State
- PERT Centers
- RenalGuard
- CO2 Commander
Equipment

- Diagnostic catheters
- Guide catheters
- Sheaths
- Wires
- Coronary balloons
- Coronary stents
- Peripheral balloon
- Peripheral stents – self expanding, covered and balloon
- Carotid stents
- Filters
Equipment

• Support catheters
• Laser
• Rotablator
• Atherectomy – Silverhawk, Jetstream, Phoenix, CSI
• Aspiration catheters thrombus
• Angiojet
• Infusion catheters – Fountain, EKOS,
• Angiovac
• IVC Filters
• Snares
Equipment

- IVUS
- Optimal Coherence Tomography – OCT
- FFR
- Intracoronary drugs
- Drug Coated Balloons DCB
- Biovascular Scaffold BVS
- Radial/pedal approaches
- Topera
- Cryoablation
Procedures

• PCI stent/BVS
• IVUS
• Pacemaker
• ICD
• Sub Q ICD
• Ablation - afib/Vtach/aflutter/SVT
• Lead Extraction
• Cardio MEMS
• Event monitor
• Tilt table
• PERT
Procedures

- CTO
- CHIP
- Impella
- IABP
- Pulmonary embolism
- AAA Endograft
- Right heart cath for pulmonary HTN
- Myocardial biopsy
- Carotid stent
- CLI
- Pericardiocentesis
Procedures

- TAVR
- Mitral Clip
- Watchman
- Transcaval
- RP Impella
- LUCAS
- Shock Protocols
- Leadless Pacemaker
- Valve in valve
- Valvuloplasty
Average Course for Adults With Valvular Aortic Stenosis

50% of patients died within 1 year without valve replacement.
*Per the Inoperable Cohort of the PARTNER Trial

-5 year survival rate (distant metastases) of lung cancer, colorectal cancer, breast cancer, ovarian cancer and prostate cancer compared to severe inoperable aortic stenosis.
TAVR Approach
Watchman- Left Atrial Appendage Closure Device

- Alternative to long-term warfarin
- Non-valvular atrial fibrillation
- Minimally invasive catheter based
- March 2015 FDA Approval
- MHS largest implanter in 15 state region
Watchman Procedure

- Multidisciplinary team
- One-time implant that does not need to be replaced
- Performed in a cardiac cath lab/EP suite, does not need hybrid OR
- Performed by a Heart Team
  - EP/IC or EP&IC, TEE, General Anesthesia, Surgical Back-up, WATCHMAN Clinical Specialist
- Transfemoral Access: Catheter advanced to the LAA via the femoral vein (Does not require open heart surgery)
- General anesthesia (typical)
- 1 hour procedure (typical)
- 1-2 day hospital stay (typical)
The Hybrid Algorithm for CTO PCI

Dual Catheter Angiography

Yes

No

Antegrade

Retrograde

1. Ambiguous proximal cap
2. Poor Distal Target
3. Interventional Collateral
4. Length < 20mm

Yes

No

Wire escalation

Dissection Reentry (Crossboss-Stingray)

Wire escalation

Dissection Reentry (Reverse CART)
RCA Setup with Dual Angiography
Final Angiogram
A Largely Untreated Patient Population

Mitral Clip-Evalve-TMVR

- Reduction of significant symptomatic mitral regurgitation (MR ≥ 3+)
- Minimally invasive catheter based
- Avoid cardiopulmonary bypass
- Over 20,000 patients worldwide
- MHS 1st implant March 2015
  - 1 of 6 hospitals in Illinois
MitraClip® System
Lithoplasty®

Lesion modification using lithotripsy in a balloon

Tissue-selective:
• Hard on hard tissue, Soft on soft tissue
• Lithotripsy waves travel outside balloon
• Designed to disrupt both superficial, deep calcium

• Designed to normalize vessel wall compliance prior to controlled, low pressure dilatation
• Effective lesion expansion with minimized impact to healthy tissue
• Familiar Balloon-based endovascular technique
• “Front-line” balloon strategy (.014”compatible)
Impella RP® Heart Pump

Percutaneous Right-Side Support

- Supports flow from the Inferior Vena Cava (IVC) to the Pulmonary Artery (PA)
- 22F pump, 11 Fr catheter
- Up to 4 liters/min of flow
- Single vascular access (femoral vein)
- No sternotomy required
- No extracorporeal circulation
- 2nd Generation Canula and guidewire for improved placement (2017)

Indication for Use

Provides circulatory assistance for up to 14 days in pediatric or adult patients with a body surface area (BSA) ≥ 1.5 m² who develop acute right heart failure or decompensation following left ventricular assist device implantation, myocardial infarction, heart transplant, or open-heart surgery.
Expandable Cardiac Power

Impella ECP™

- Small 9F pump & catheter, expands to 18F in LV
- Est. flow >3 liters / minute
- Designed for duration up to 6 hours
- Wireless advancement into LV over pigtail
- Smooth atraumatic membrane sits across the aortic valve.

Impella ECP™ is in development and is not approved for use or sale.
Impella BTR™

• Full hemodynamic support with 5.5 L/min
• 19F pump & 9F catheter
• 45% shorter pump for improved deliverability
• Est. Flow 5.5 Liters / Minute
• Designed for duration of up to 1 year
• Axillary insertion/explant
• Patient discharge is possible with a wearable driver

Impella BTR™ is in development and is not approved for use or sale.
Innovation
Where to?
Tomorrow

- Tricuspid clips
- Mitral replacement
- Tricuspid replacement
- Biovascular scaffolds will lead market
- CT FFR
- Shock Wave PTA
- Increase in Robotics
- More Interventions and Less Diagnostics
- Door to Unload
- Percutaneous LVAD
- 50% of PCI will be home same day
Future

- CT FFR will grow to be the predominant diagnostic tool
- Cath lab will become like an I Phone. You will be able to open a wide variety of apps at the table side to diagnose more accurately and treat your patients more precisely
- Home monitoring, testing and evaluation of patients will continue to expand – Amazon Prime
- Call a friend - FaceTime
- CHIP will grow to be 30% of cath lab volume
- TAVR will be an outpatient procedure
- MVR, TVR will dwarf TAVR
- Cath lab 15 years from now will have no radiation
Thank You
Technology and Innovation
Abiomed Innovation Roadmap

Protected PCI – Ease-of-Use in Cath Lab, Lowering Access Complications

- Improved 14F Peel Away Sheaths (2017)
- Fast Set-up Interface (2016)
- Expandable Sheaths (2018)
- 9Fr Impella ECP (2019)

Cardiogenic Shock – Ease-of-Use in ICU, Enhanced Flow and Duration

- Guidewire Access (2017)
- Guidewire re-access (2017)
- Impella RP 2nd Gen (2017)
- Impella 5.5, Impella BTR (2019)
- Optical Pressure Sensor Technology (2018)
- Remote Monitoring (2018)

Some products shown are in development and not approved for use or sale.
Automated Impella® Fast Start Upgrade

Improved Ease of Use in Cath Lab

• < 2 min setup time
  – Automatically skips completed steps

• Improved illustration and animation to reduce common errors

• Clinical best practice reminders

• Algorithm changes including reduction of false alarms
14F Long & Short Introducers

For Use with Impella CP® Heart Pump
13cm and 25cm* lengths

- Improved femoral access for tortuous patients
- Peel-away design
- Improved hemostasis for short and long introducers with a newly designed valve

*25cm length is in development and is not approved for use or sale.
Updated Guidewire Access Repositioning Sheath

Impella CP®

- Facilitates escalation of care, closure, or pump replacement
- Simple guidewire placement with an 0.035” guidewire or smaller
- Improved femoral access in large patients with a 4cm longer wound closure sheath (same OD as previous sheath)
- Enhanced stability in Axillary patients with additional suture ribs for graft attachment
Integrated Optical Placement Sensors

Impella CP® Optical Pressure Sensor

- Simplifies device set-up
- Improved placement accuracy & ease of use
- Better sensor location distal to outflow
- Improved detection of valve plane
- Reduced complexity with no pressure lumen to purge or maintain

The Optical Sensor is in development and is not approved for use or sale.
Remote Link

AIC w/ Remote Link

- Wireless transmit of the display screen over a secure server.
- Fast remote viewing of patient status by clinicians, Abiomed field teams or the Abiomed Customer Support Center staff.
- Historical data capture provides a retrospective review of the critical performance parameters and alarms.

Wireless Remote Link is in development and is not approved for use or sale.
Enhanced Flow & Deliverability

Impella 5.5™

- Full hemodynamic support with 5.5 L/min
- 19F pump & 9F catheter
- 45% shorter pump for improved deliverability
- Designed for duration up to several months
- Percutaneous or axillary insertion/explant

The Impella 5.5™ is in development and is not approved for use or sale.