Cath Lab Interventions

Special thanks to the following contributors:

SICP
CardioVillage.com
Morton Kern, MD
Wes Todd, RCIS
# Disclosures

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OBJECTIVES

• History of PCI and stents
• Describe angioplasty mechanisms and equipment
• Other interventional tools and techniques
History

- 1964 — Transluminal Angioplasty, the concept of remodeling the artery, is introduced by Dr. Charles T. Dotter
History

• 1977 — Andreas Gruentzig performs first coronary angioplasty

• 1986 — First stent performed

• 2003 – First DES
PCI EQUIPMENT

- Guide catheter
- Coronary wire (0.014)
- Pre-dilation balloon
- Stent (Drug Eluting or Bare Metal)
- Post dilation balloon

Other: Indeflator filled with contrast mixture
1 ATM = 14.7 psi
Y-adaptor and torque device
Fig. 9-2  Diagram of components of percutaneous coronary intervention equipment. (From Freed M, Grines C, Safian RD: The new manual of interventional cardiology, Birmingham, Mich., 1996, Physicians’ Press.)
GUIDING CATHETER

Compared with diagnostic catheters:

- Thinner walls
- Larger lumens (contrast injections with balloon in place)
- Stiffer (for added support)
- Tip is NOT tapered (dampening in ostiums)
- Some have sideholes (maintain blood flow)
Guide catheter sizing

- 6Fr standard: POBA, stents
- 8Fr or larger: coronary atherectomy
- 7Fr. Rotational atherectomy (PTCRA) for burrs 1.75mm or >
Guide catheter curves
ANGIOPLASTY GUIDE WIRES

- Small caliber (0.014 – 0.018 inch)
- Steerable to advance beyond the lesion
- The J-tip can be shaped by MD for curves or tortuous vessels
- Extra long (300 cm) wires are used to exchange ‘over the wire’ balloons
- Softer wires: easier, safer (tortuous vessels)
- Stiffer wires: torque control for total occlusions (hydrophilic coated to prevent perforations)
- ‘buddy’ wire: provides a rail to help balloons navigate a curve/straighten a vessel

*
PTCA Balloon Catheters

- Two types: OTW, monorail/rapid exchange
- ‘nominal’ pressure: # atm required to achieve the stated balloon diameter (99%)
- Rated burst pressure (RBP)
BALLOON CATHETERS

Over The Wire:
- Central lumen - length of the catheter for wire and separate lumen for balloon inflation.
- Exchange length guidewires necessary for balloon catheter exchanges

Advantages:
- Maintains distal wire position
- Distal port available for pressure measurement or contrast injections
- Accepts multiple guidewires

Limitations:
- 2 experienced personnel required for exchanges
- More flouro time/ longer procedure times
Fig. 9-4. Schematic design of a typical over-the-wire angioplasty balloon catheter. Note that the guidewire extends the entire length of the catheter. (From Talley JD, Joseph A, Kupersmith J: Preliminary results utilizing a new percutaneous transluminal coronary angioplasty balloon catheter, Cathet Cardiovasc Diagn 20:108-113, 1990, with permission.)
RAPID-EXCHANGE (MONORAIL) BALLOONS

Tip of the shaft has 2 lumens.

Advantages:
- Maintains distal wire position
- Lower profile/Enhances visualization
- Single operator system
- Unable to cross lesion: no balloon is used

Limitations:
- Excellent guide catheter support
- Exchanging balloons at hemostatic valve can be demanding
‘Kissing’ balloon

- Used in bifurcation lesions
- Double wire
- Prevents plaque from shifting to adjacent vessel
TIMI BLOOD FLOW

- Thrombolysis in Myocardial Infarction (TIMI)
- A score for qualitative grading coronary flow
- How quickly contrast is washed out of the coronary
  - 0 = no flow
  - 1 = slow flow
  - 2 = better flow
  - 3 = normal flow
Glagov’s Coronary Remodeling Hypothesis

Progression

Normal vessel → Minimal CAD → Moderate CAD → Severe CAD

Expansion overcome: lumen narrows

Regression

Coronary remodeling in POBA

- Lesion is compressed or spreads out
  - Lesion ‘cracks’
  - Vessels stretches and outer diameter is increased
Restenosis defined

Definition of Restenosis

Angiographic: ≥ 50% diameter stenosis within 6 months of angioplasty

Clinical: the need for target lesion revascularization (TLR)

Components of Restenosis

Acute Recoil

Vascular Remodeling

Neo-Intimal Hyperplasia

Restenosis is a complex process caused by an exaggerated healing response to the vascular injury produced after angioplasty.
Restenosis

- POBA: 30-40%
- BMS: 20%
- DES: 10% OR >
STENTS

- Produces larger luminal diameter
- Maintains arterial patency
- Reduces restenosis
- DES, Bare metal, self-expanding (Wallstent®, Radius®)

- Prepped neutral, inside/outside of body
Drug eluting stents

• Drug is dissolved by the blood
• Drugs inhibit cell reproduction and proliferation
• Anticancer/immunosuppressant
  • Sirolimus (Cypher®/Cordis)
  • Paclitaxel (Taxus®/Boston Scientific)
  • Everolimus (Xience®/Abbott Vascular)
  • Zotarolimus (Endeavor®/Medtronic)
CUTTING BALLOON
Possible Indications for Cutting Balloon

- Ostial lesions
- Fibrotic/Calcific lesions
- Long lesions
- Small vessels
- In-stent restenosis
Atherectomy

• Used for ‘de-bulking’ of lesions
  – Rotational
    • Burr sizes ranging from 1.25 to 2.5mm
• Directional
  • Uses blade on one side of balloon to “shave” away lesions
Rotational Atherectomy (Rotoblator)

Distal half- diamond coated

Uses ‘rotowire’: .0009in diam body/.014in diam tip

160,000-180,000 RPM typically depending on burr size

that can move safely through the circulatory system and out of the body.
Rotational Atherectomy (PTCRA)

- RCA lesions: Temporary pacer/aminophylline drip to prevent bradycardia

- EF <30%: IABP during PTCRA; preserve cardiac output and coronary perfusion
Directional Atherectomy
Foxhollow for Peripherals...

- mechanically shaves and removes atherosclerotic material
- Balloon inflation positions cutter into plaque
- Material is collected in nose cone
Coronary Flow Measurement

• FFR: ratio of the distal pressure vs the Ao pressure:
  $\frac{P_d}{P_a} = \%$
  - Measured at maximum hyperemia (adenosine)
  - Threshold is 0.75
Embolic protection devices

• Distal filter
  – Filterwire® (Boston Scientific)

• Distal occlusion
  – Guardwire® (Medtronic)

• Proximal occlusion
  – Proxis® (St. Jude)
Intravascular Ultrasound

1. 135 cm usable length
2. Marker band 2.5F
3. 1.5 cm guide wire rail length
4. 2.1 cm marker band to transducer
5. Imaging window profile 3.2F
6. 15 cm imaging core pullback

www.bostonscientific.com
Intravascular Ultrasound

Normal/Minimal Disease

Abnormal

Stent

Catheter

Lumen

Stent Struts

Intima

Media

Adventitia

www.teachivus.com
Common Stent Problems

- Incomplete Apposition
- Incomplete Expansion
- Edge Tear
Complications of interventions

- Coronary perforation
  - Guidewire
  - devices
- Treatments:
  - Covered stent
Thank You
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