

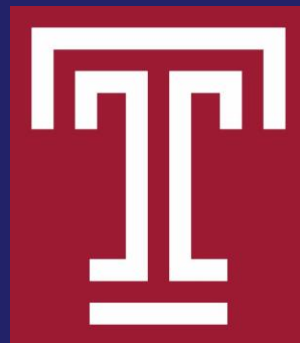
CRT

Pre-Procedure Planning

Joshua M. Cooper, MD, FHRS, FACC

Temple University Health System

Philadelphia, PA, USA



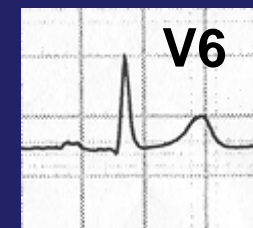
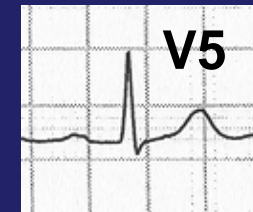
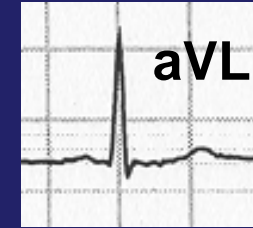
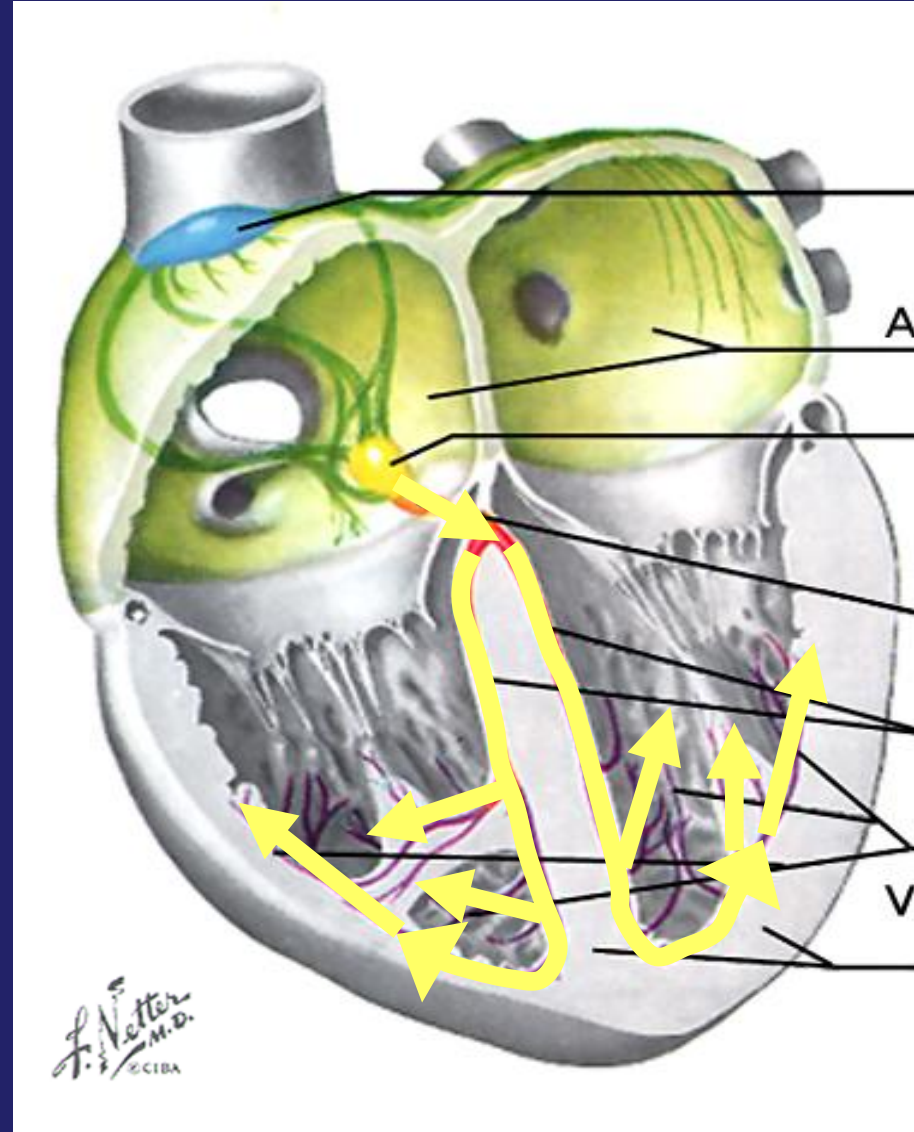
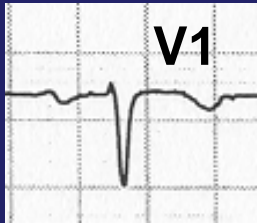
What Are My Goals?

- To make the patient feel better (reduce CHF)
- Efficient, effective procedure
- Minimize risk of complications
- Make the device system work as intended, for as long as possible

Historically, 30% Nonresponder Rate

- Selecting the wrong patient
- Placing the lead in a suboptimal location
 - Anatomically suboptimal (not achieving good LV wall synchrony)
 - Electrically suboptimal (phrenic, long stim-QRS, dead tissue)
 - Physically suboptimal (lead migration or dislodgement)
- Inadequate CRT pacing delivery
 - A.fib, PVCs, VT interfering with pacing
 - Poor programming (AV delay, VV timing)

Normal Conduction System



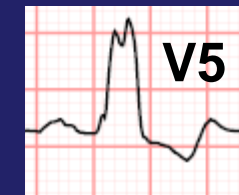
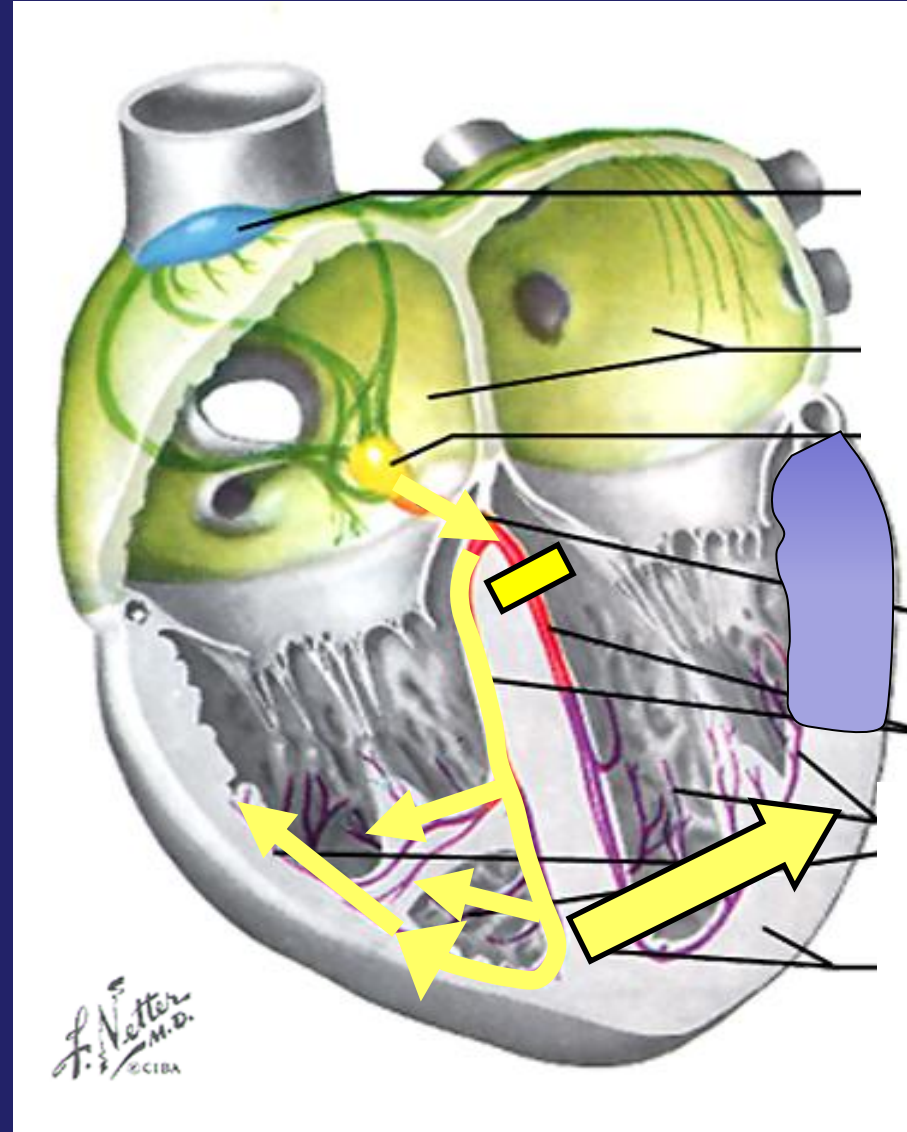
2008 Device Guidelines

Recommendations for Cardiac Resynchronization Therapy in Patients With Severe Systolic Heart Failure

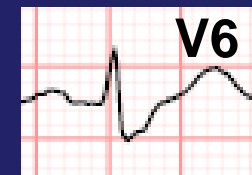
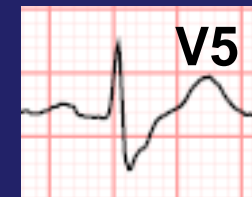
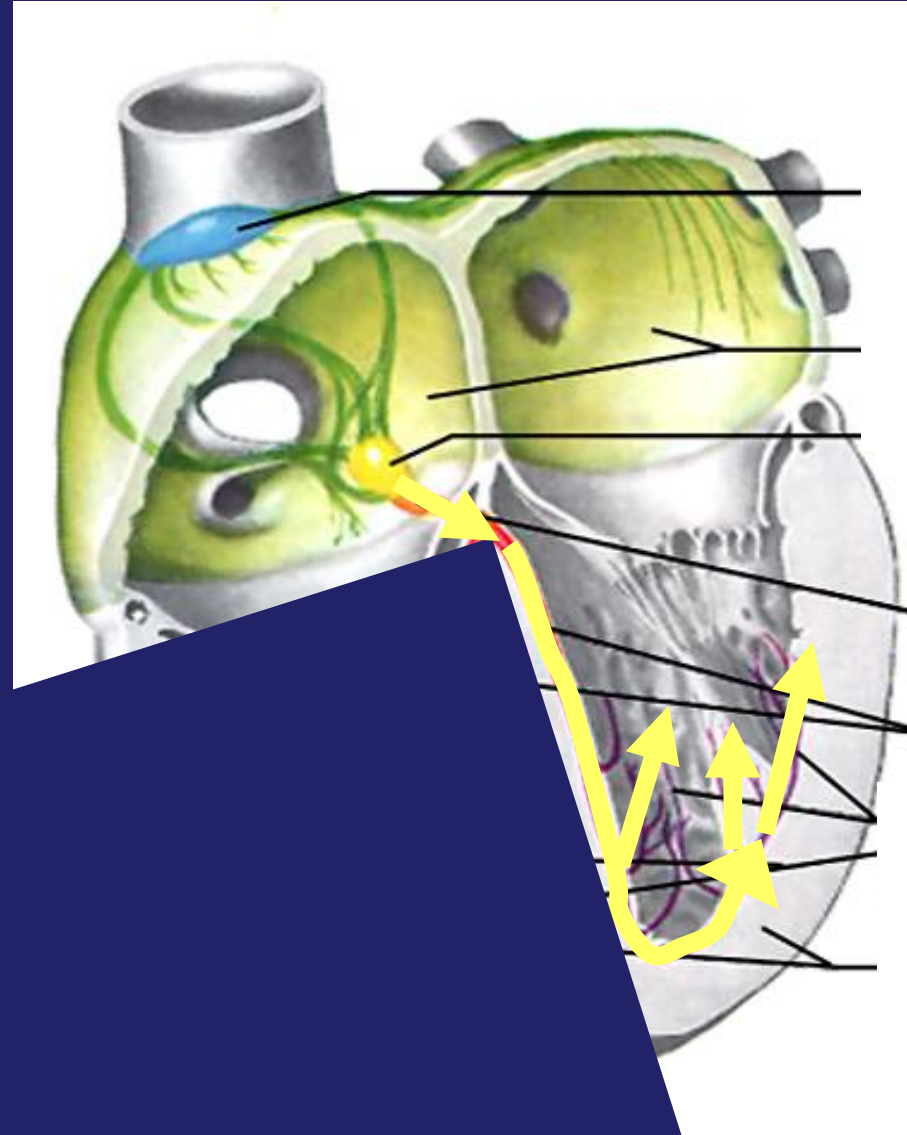
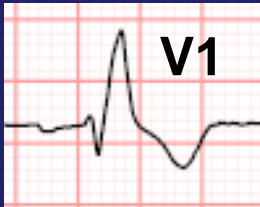
Class I

1. For patients who have LVEF less than or equal to 35%, a QRS duration greater than or equal to 0.12 seconds, and sinus rhythm, CRT with or without an ICD is indicated for the treatment of NYHA functional Class III or ambulatory Class IV heart failure symptoms with optimal recommended medical therapy. (*Level of Evidence: A*)^{222,224,225,231}

Left Bundle Branch Block



Right Bundle Branch Block



2012 CRT Guidelines



$\leq 35\%$ LBBB $\geq 150\text{ms}$ Class III, amb IV

$\leq 35\%$ LBBB $\geq 150\text{ms}$ Class II

$\leq 35\%$ LBBB 120-149ms Class II, III, amb IV

$\leq 35\%$ non-LBBB $\geq 150\text{ms}$ Class III, amb IV

2012 CRT Guidelines



$\leq 30\%$, ischemic LBBB $\geq 150\text{ms}$ Class I



$\leq 35\%$ non-LBBB 120-149ms Class II, amb IV



$\leq 35\%$ non-LBBB $\geq 150\text{ms}$ Class II

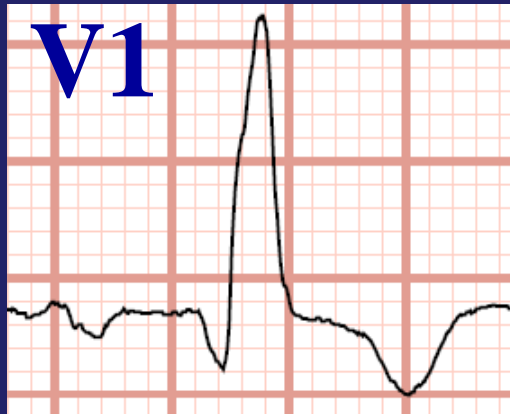
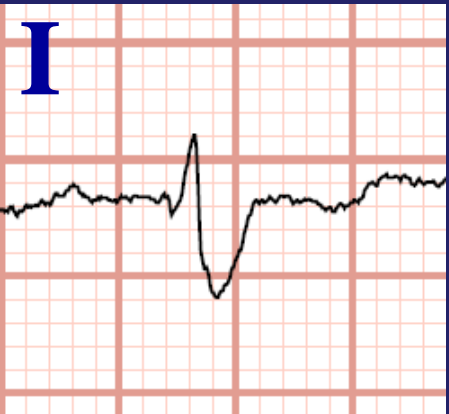
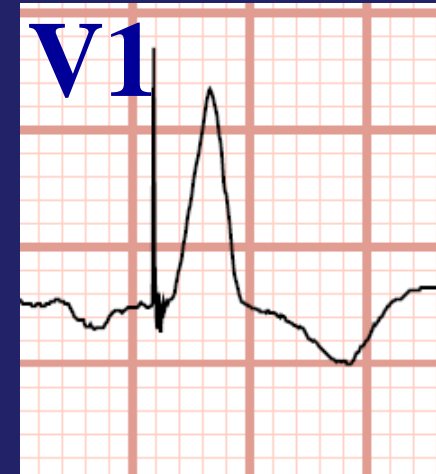
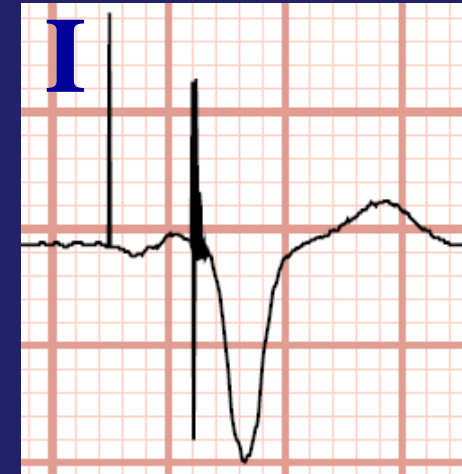


$\leq 35\%$ non-LBBB $< 150\text{ms}$ Class I, II

Can Following Guidelines Cause Harm?

- 76 yo man, isch CMP, EF 30%
- Class 2 CHF
- VVI ICD 2005
- RBBB, QRS 160ms

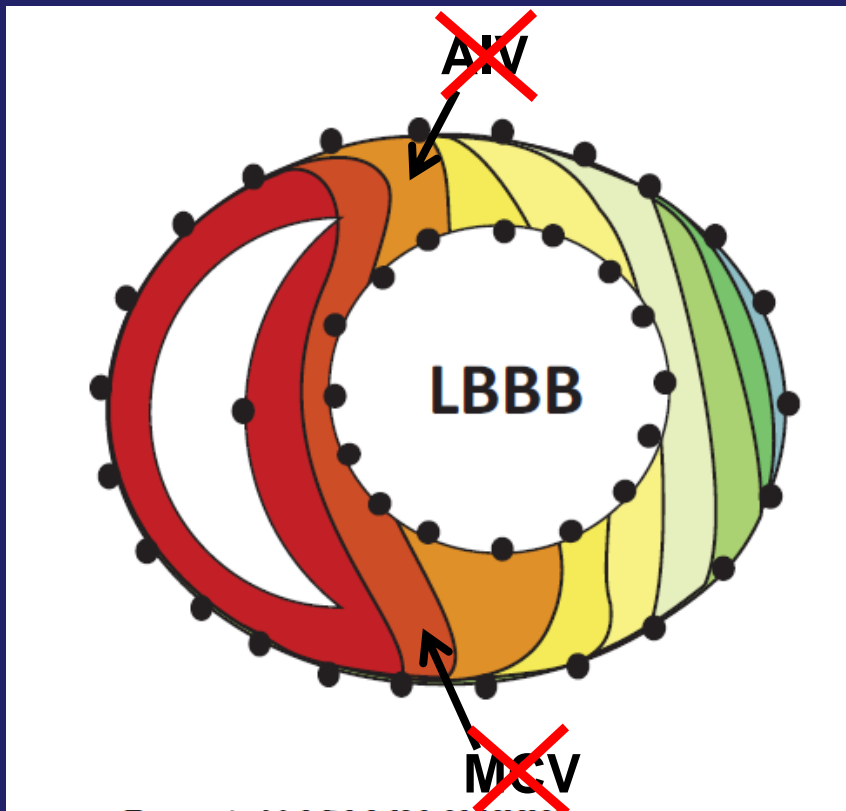
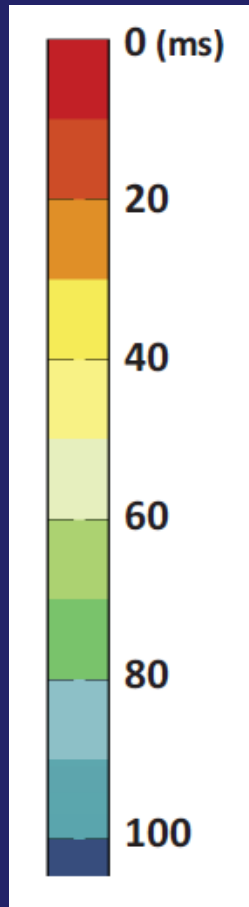
Bi-V ICD upgrade at
gen change 2008



Turned OFF
Bi-V pacing

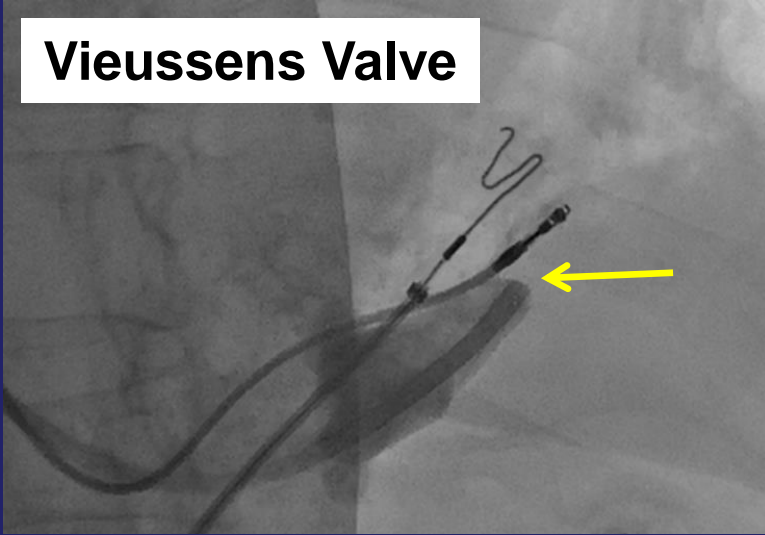
- EF dropped to 20%
- Class 4, new PND, edema
- Creat rose, added meds
- IV milrinone
- Refer to BiV Opt clinic

LV Lead Pacing Location

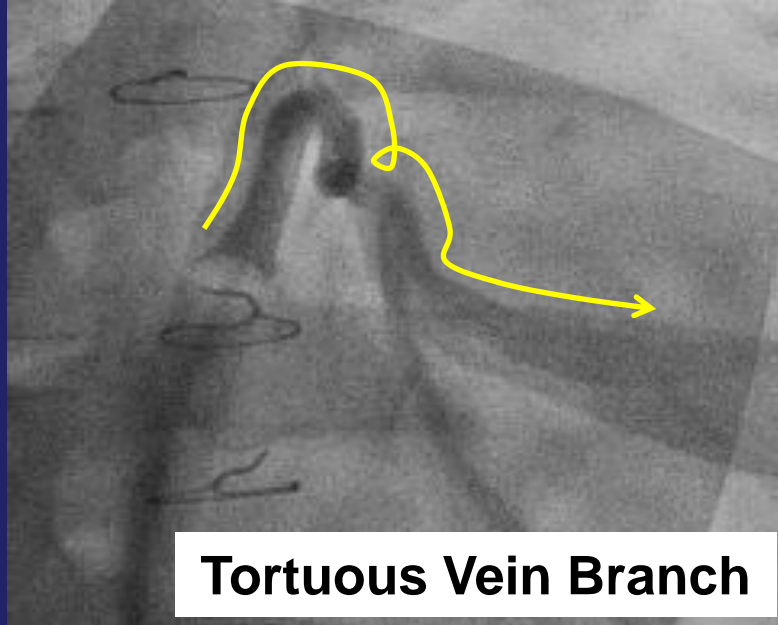


Planning Ahead

Vieussens Valve



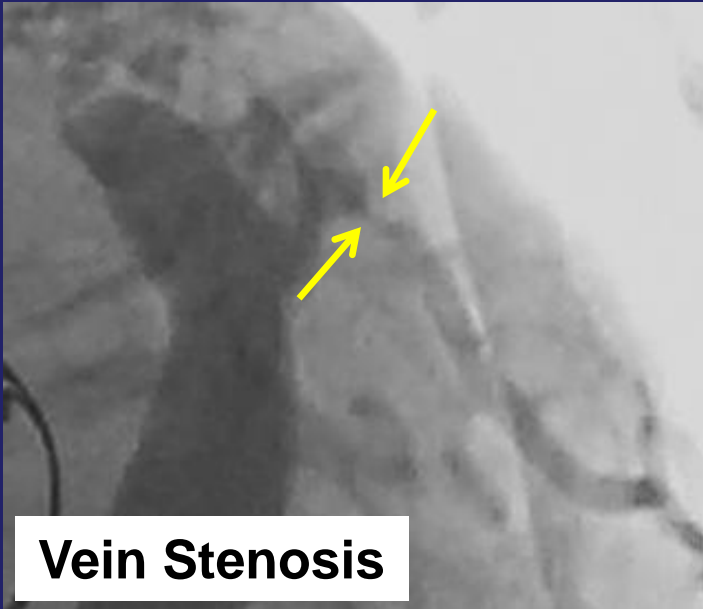
Tortuous Vein Branch



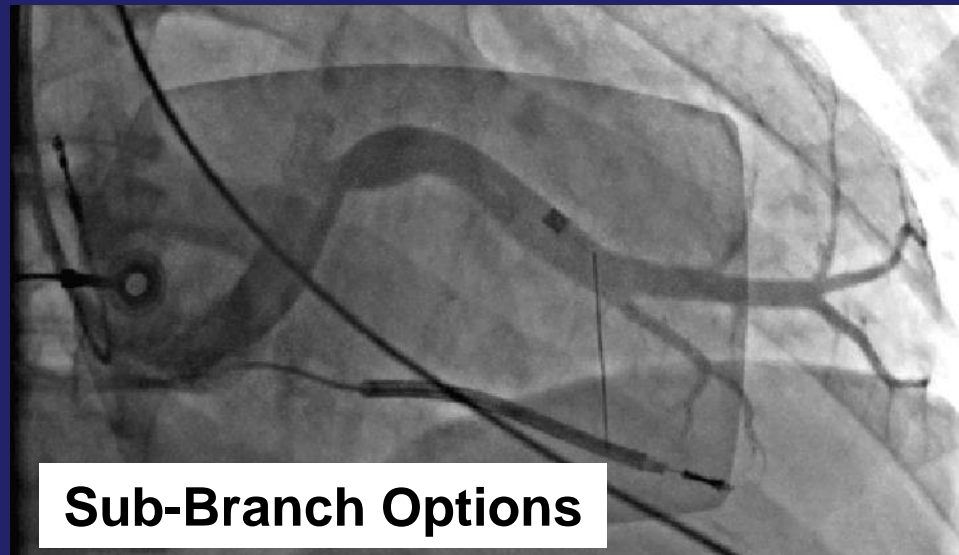
Thebesian Valve



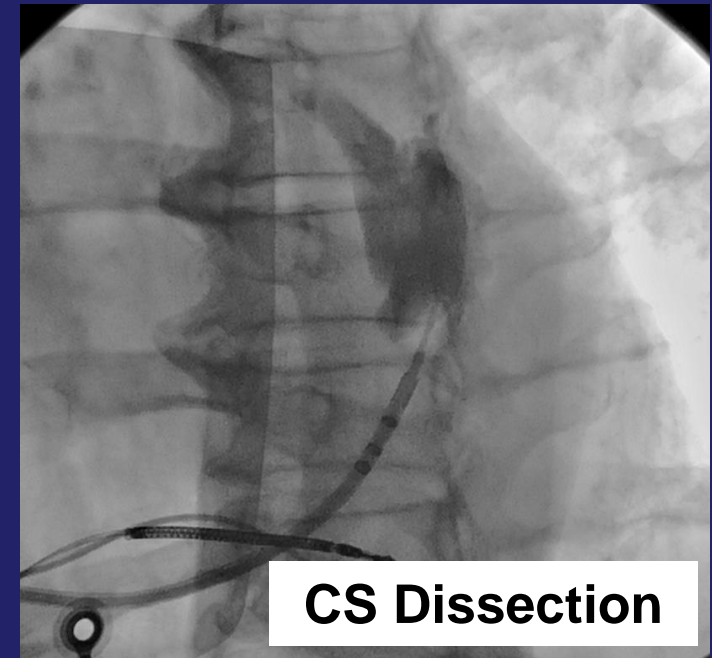
Vein Stenosis



Sub-Branch Options



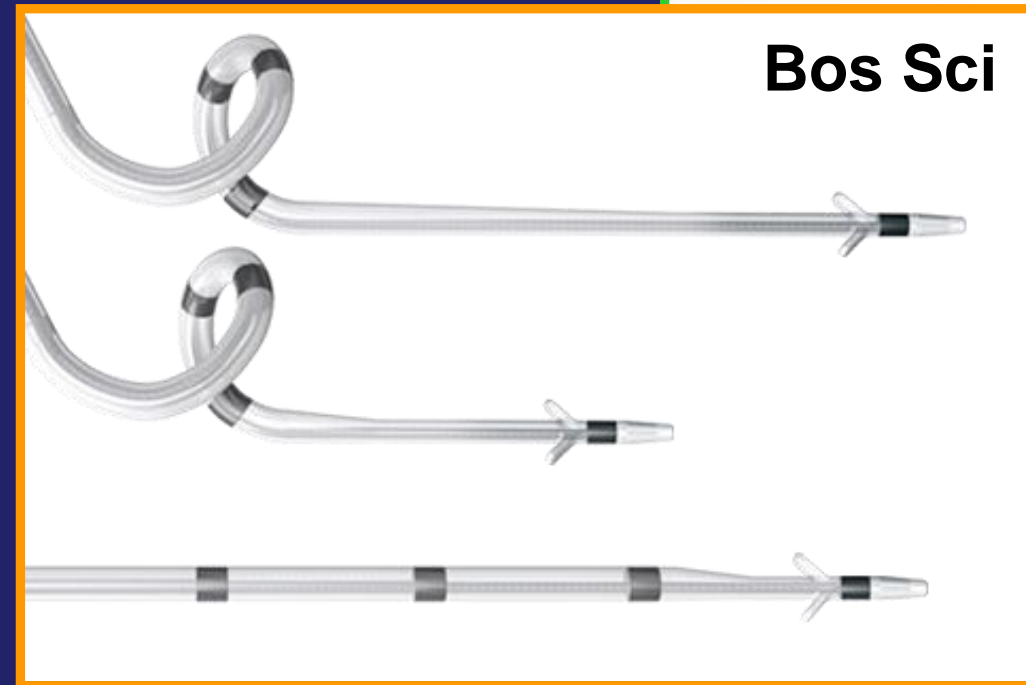
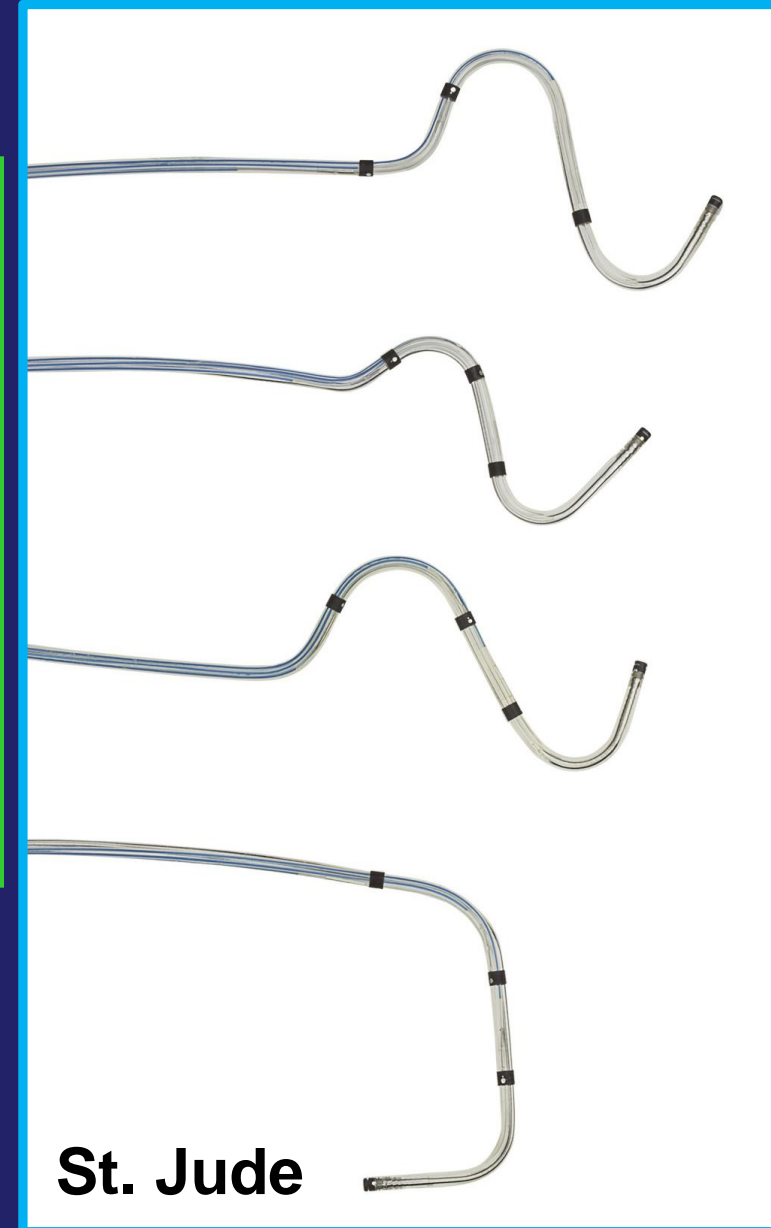
CS Dissection



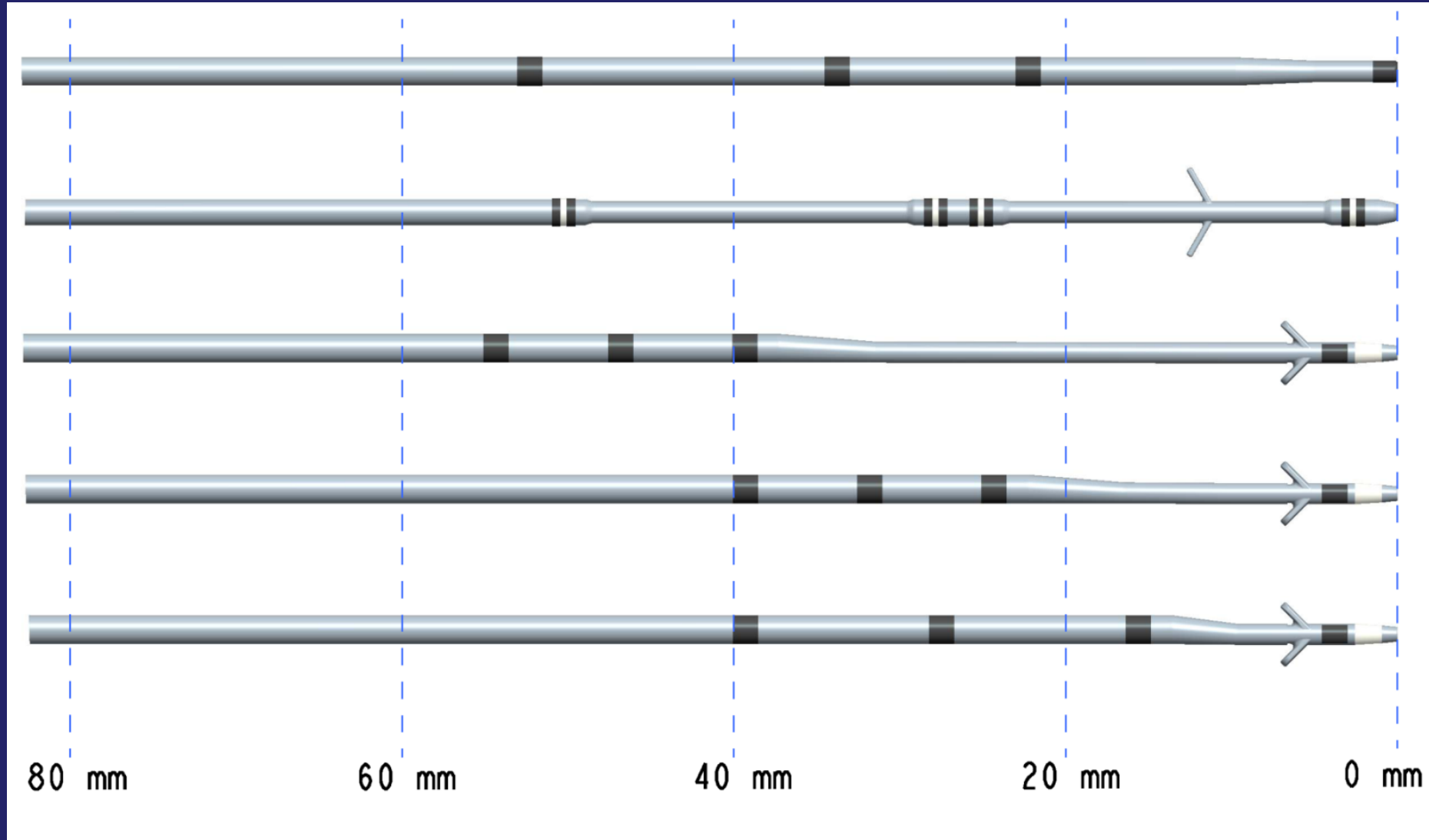
Having and Knowing Your Toolbox

- Sheaths
 - CS access “outer” sheaths
 - Subselection “inner” sheaths
 - Sub-subselection “vein selector” sheaths
 - Worley sheath system
- Balloons
 - CS venogram balloon
 - Venoplasty balloons
- Wires and Catheters
 - Wholey wire
 - Shaped decapolar catheter
 - Steerable catheter
 - Angled-tip angioplasty wires
 - Stiff vs flexible wires
- Snares and Other tools
 - Gooseneck snare
 - Hydrophilic glide catheter

Quadripolar Lead Shape Options



Electrode Spacing Options



St. Jude QUARTET

MDT PERFORMA

Bos Sci ACUITY X4
Long Tip Bias

Bos Sci ACUITY X4
Short Tip Bias

Bos Sci ACUITY X4
Straight Tip

The Holy Grail of CS Lead Placement

1. Good anatomic location
 - Lateral LV territory, not too apical
2. Good pacing threshold
 - Ensure LV capture and good battery longevity
3. No phrenic nerve capture
 - Ideally none @ 10V on the table, supine
4. Good lead stability
 - Dislodgement usually requires reoperation

Work Flow Plan to Optimize LV Pacing

- Advance Quad lead to wedge position for stability
- Check each electrode at max output in unipolar config to look for phrenic
- Check pacing threshold in each unipolar config
- Assess anatomic location of 4 electrodes
- Check latest activation during native conduction and/or during RV pacing
- Check different vectors using target electrode as cathode

Pulse Generator Features

- Pacing vectors
- Battery longevity
- “Autocapture” feature
- V-V timing options
- Vector data management
- Triggered bi-v pacing
- “Adaptive” CRT
- Latest activation measurement
- Atrial tracking recovery / hysteresis

CRT Response Rates in 2016

- Better understanding of who to implant
- Better implant tools and techniques
- Better knowledge of where and how to pace
- Better leads to achieve “holy grail” of LV implant
- Appreciation for importance of 12-lead ECG

Should now have >90% “responder” rate!