Successful Implantation Techniques of CRT

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COI Disclosure

Sung Soo Kim

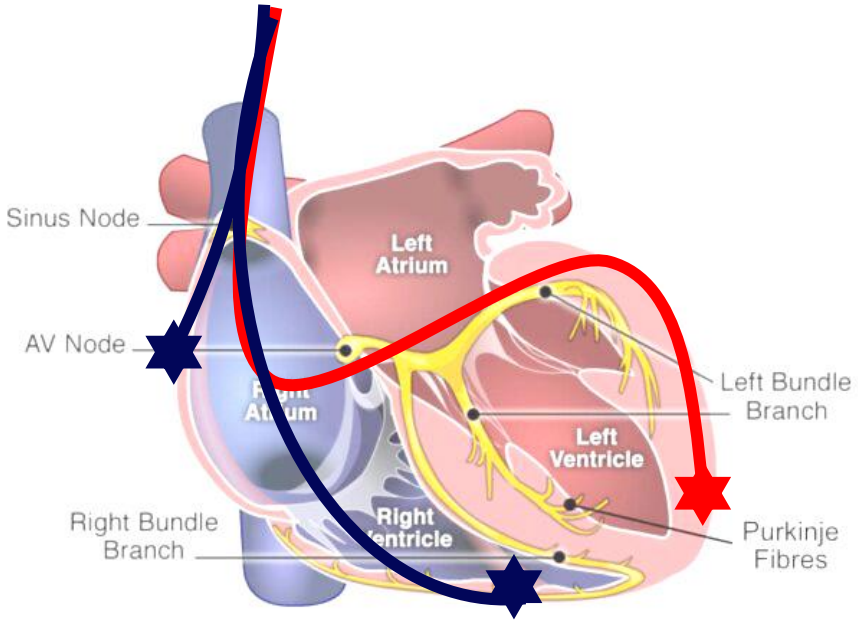
The authors have no financial conflicts of interest
to disclose concerning the presentation

CRT (Cardiac Resynchronization Therapy)

- **CRT is recommended for symptomatic patients with HF in LBBB and with EF <35% despite of OMT**

COMPANION, CARE HF, MADIT-CRT, RAFT study .....

CRT is biventricular pacing where **LV lead** is positioned in the **coronary sinus**.



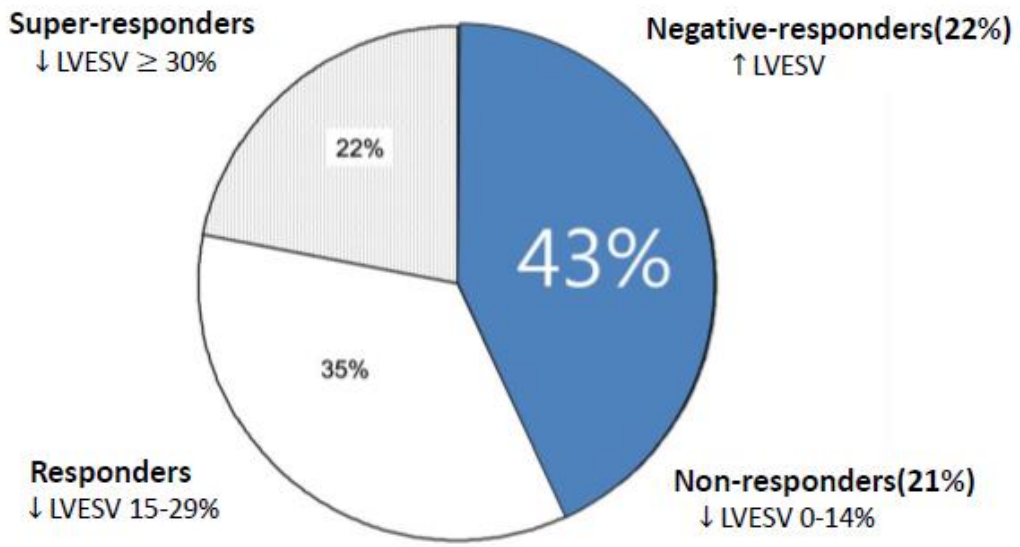
ESC 2021 Guidelines

CRT is recommended for symptomatic patients with HF in SR with LVEF ≤35%, QRS duration ≥150 ms, and LBBB QRS morphology despite OMT, in order to improve symptoms and reduce morbidity and mortality.[37,39,40,254–266,283,284]	I	A
CRT should be considered for symptomatic patients with HF in SR with LVEF ≤35%, QRS duration 130–149 ms, and LBBB QRS morphology despite OMT, in order to improve symptoms and reduce morbidity and mortality.[37,39,40,254–266,283,284]	IIa	B

CRT non responder

Extent of LV Reverse Remodeling After 6 months of CRT

• **43%** of CRT patients was classified as non-responders or negative-responders after 6 months (N=302)



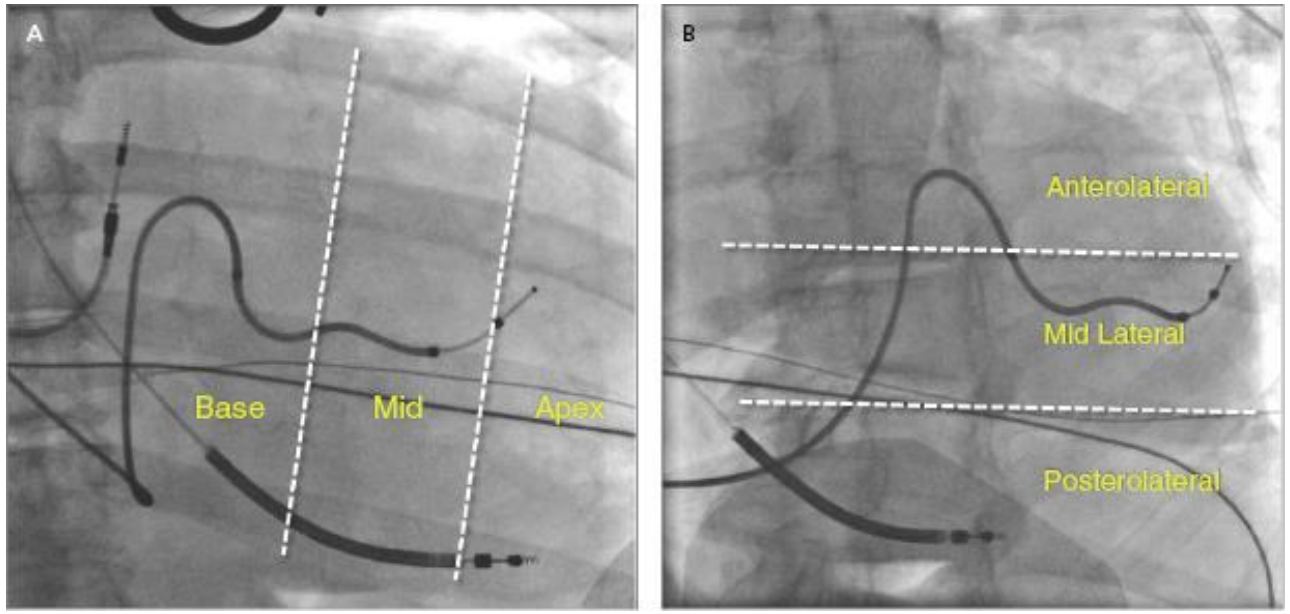
Ypendburg et.al JACC 2009;53:483-490

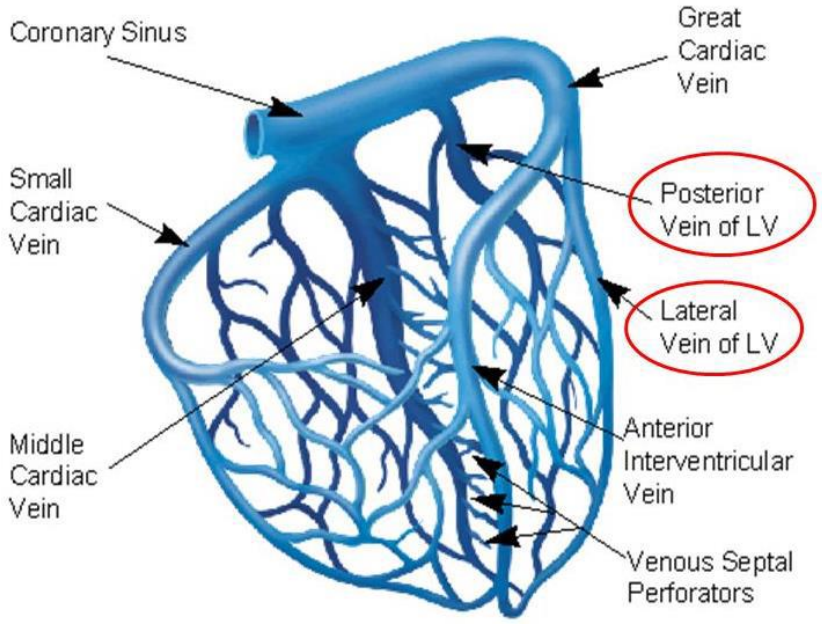
Risk factor
Patient clinical characteristics
Ischemic Cardiomyopathy
Male
QRS duration < 150 ms
RBBB, intraventricular conduction delay
LV end-diastolic volume >240 mL
Ventricular dyssynchrony- Not present
High transmural scar
Right ventricular enlargement, dysfunction
Device-modifiable factors
LV lead position **Anterior or inferior septum, apex**
BiV pacing < 99%, atrial fibrillation, PVC's
Not optimal AV and VV optimization

Optimal LV lead placement

Lateral free wall -Best response

(CRT responses is more favorable when LV lead was positioned at the **posterior lateral branch**, rather than the apex.)





Parameter	Standard	CRT optimization
LV lead position	Posterolateral	Avoid Apical Target latest activated area

Consideration before procedure

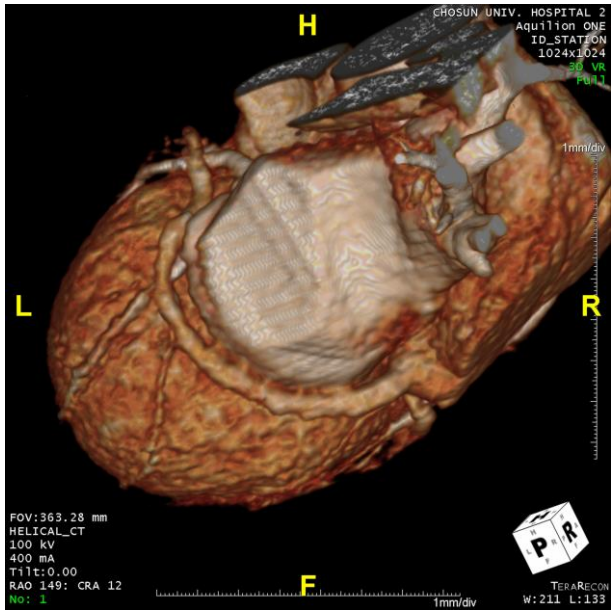
1. Venous access: Subclavian/**Axillary**/Cephalic
2. **Left** or Right sided
3. New implant vs. **upgrade** - Subclavian/SVC stenosis, number of leads
4. **Cardiac anatomy** - Chamber size, PLSVC, Previous surgery
5. Which lead to implant first? 1. **RV lead first** 2. LV lead first

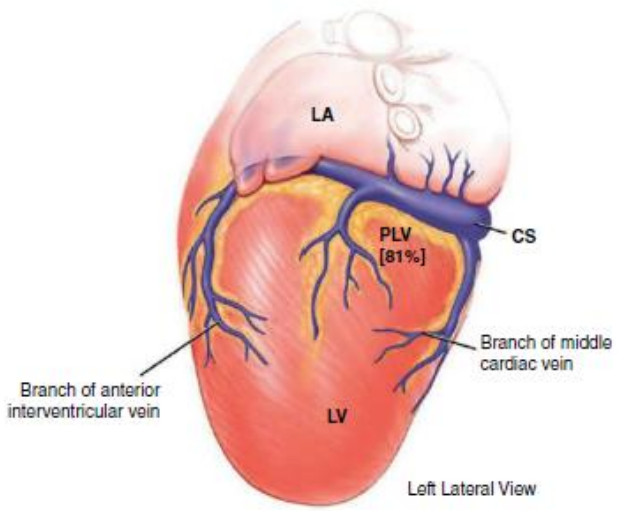
RV lead first - Backup Pacing should be available
(LBBB+RBBB= complete heart block)

Coronary Sinus Anatomy

Cardiac CT

Evaluation of cardiac anatomy may be performed through cardiac CT





Unfavorable anatomy

– Absence of lateral or posterolateral vein

– Angle from CS < 60° of lateral vein

– Tortuosity of lateral vein

– Diameter of lateral vein < 3 mm

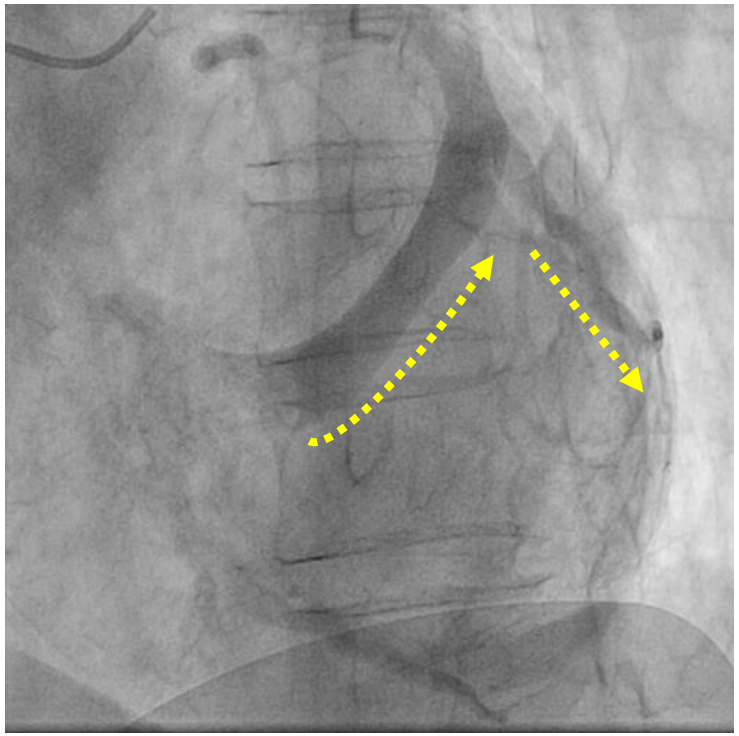
– Diameter of posterolateral vein < 3 mm

Giraldi F et al: Long-term effectiveness of CRT in HF patients with unfavorable cardiac veins anatomy comparison of surgical versus hemodynamic procedure. ***JACC 2011, 58(5):483-490.***

- ❖ Inability to cannulate the CS = 1-5%
- ❖ CS anatomy not good in 20%
- ❖ Tortousity of CS

Coronary Sinus Anatomy

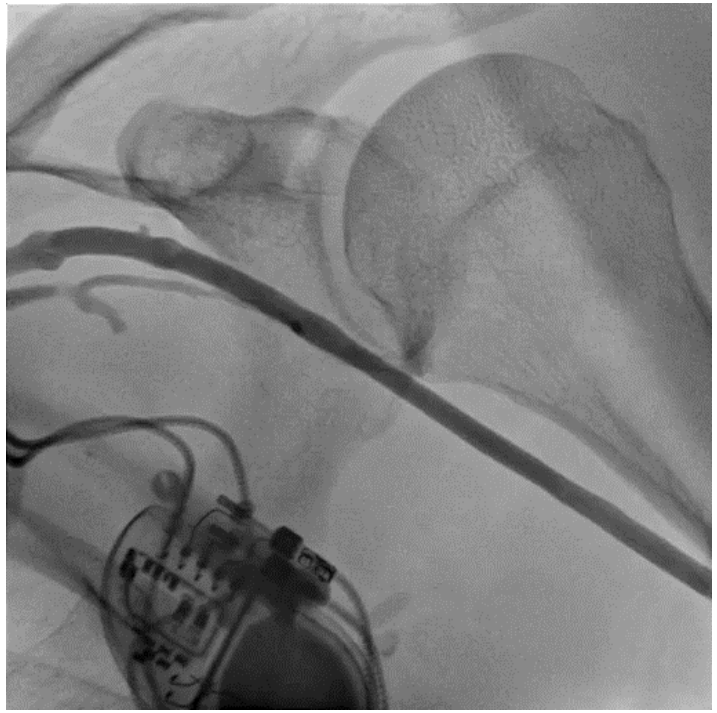
Coronary Angiogram (LCA venophase)



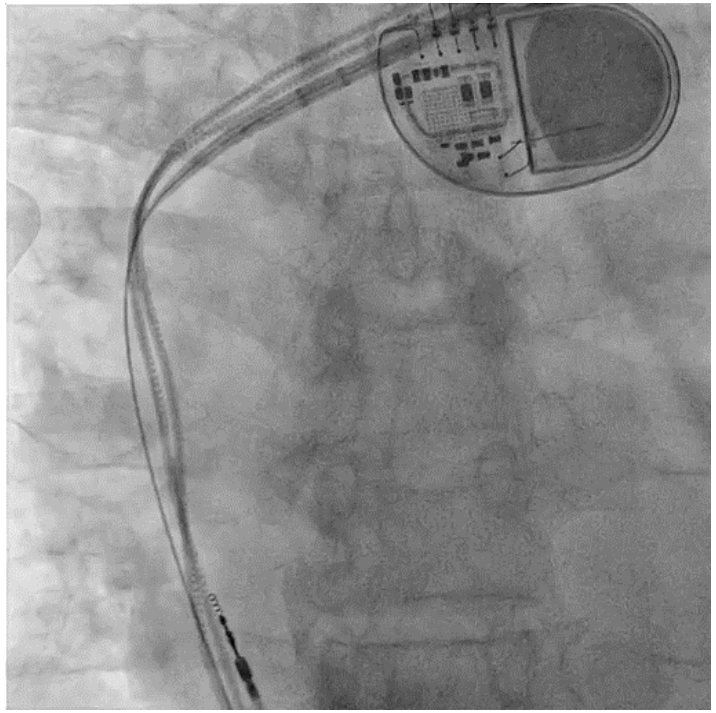
CAG was performed to evaluate the coronary vein anatomy during venophase

Subclavian Vein Stenosis

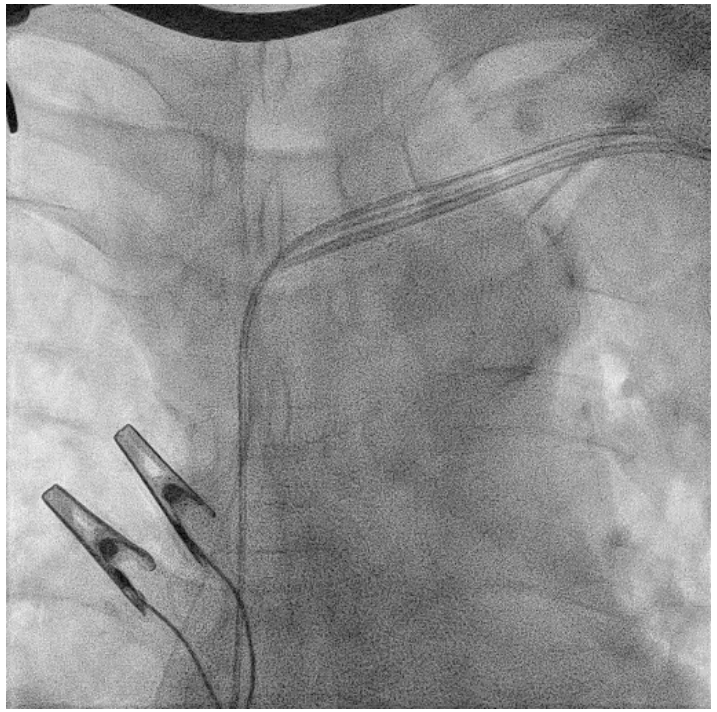
- 20-30% previously implanted leads --> stenosis
- Puncture proximal to stenosis - advance with Terumo hydrophilic guidewires



Subclavian vein occlusion

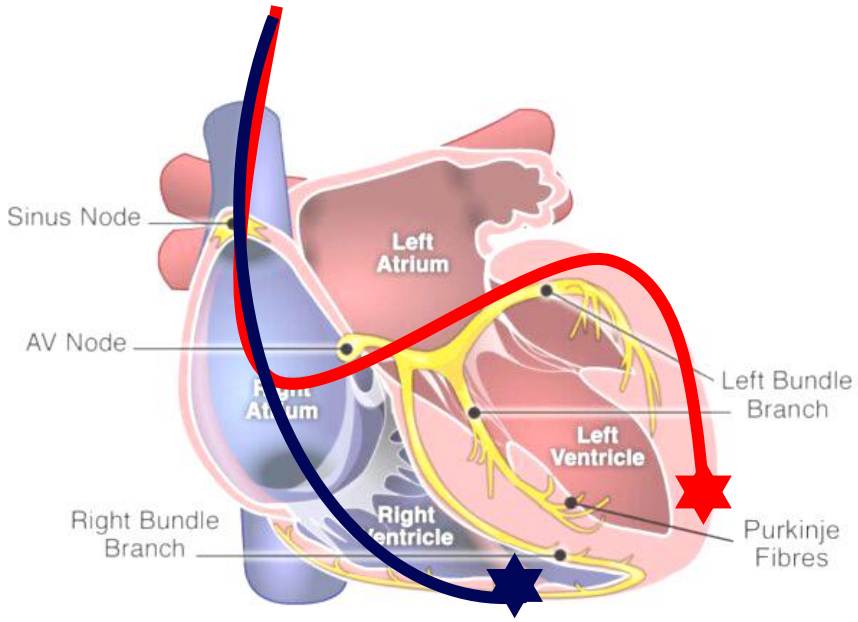


Tortous SVC



SVC dissection

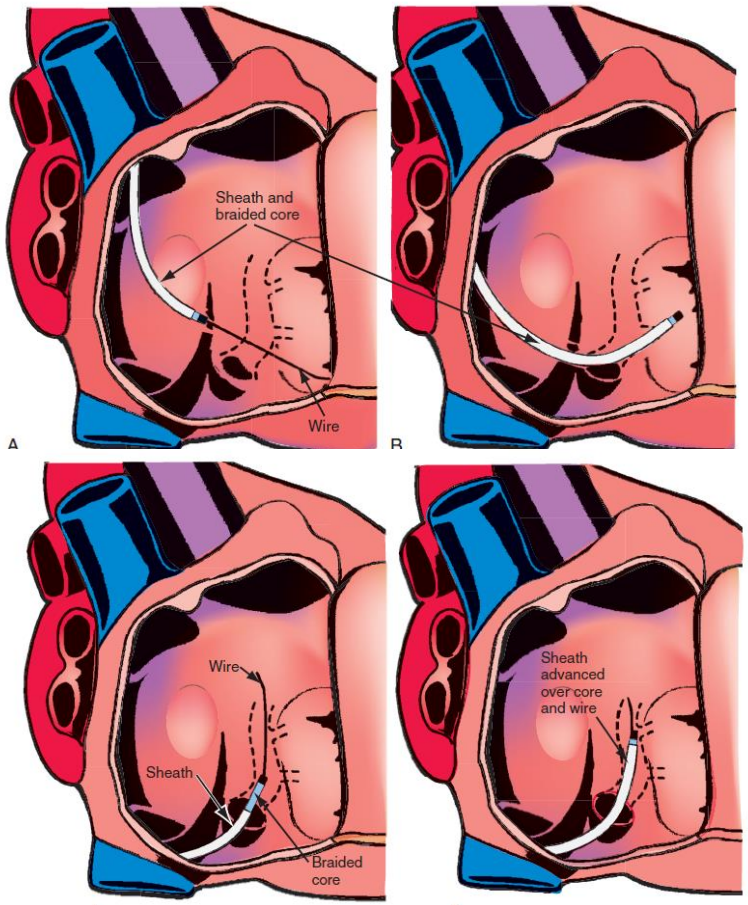
LV lead implantation Procedure

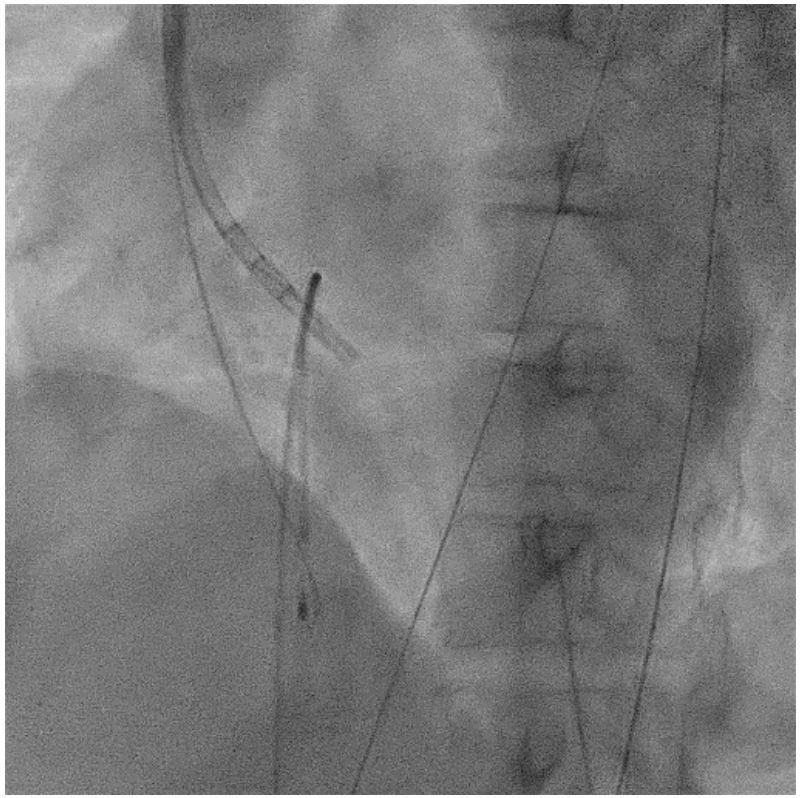


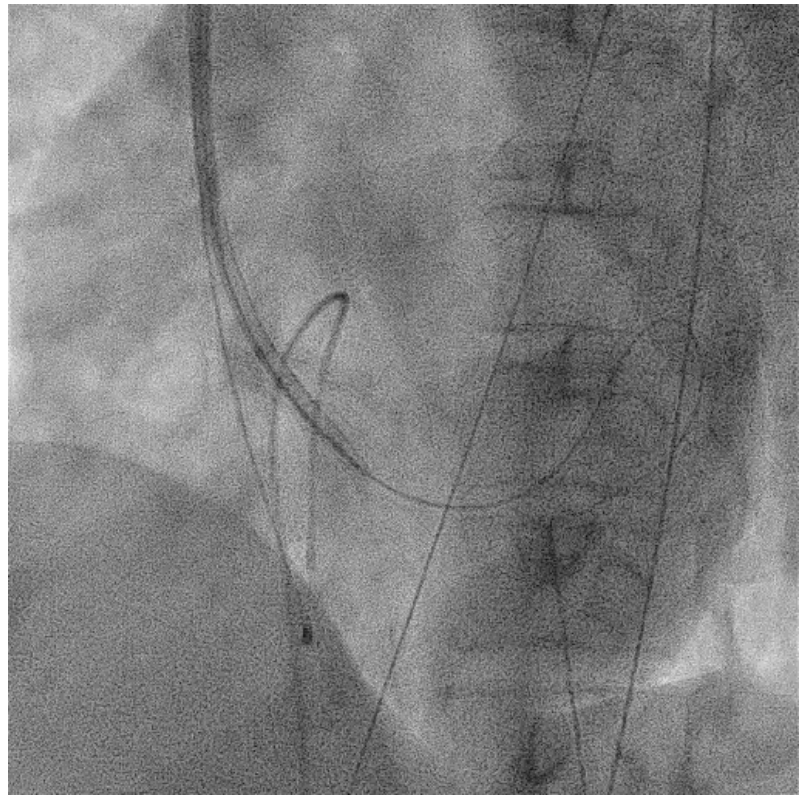
1. CS cannulation
2. CS Venography
3. Target vein Subselection
4. LV lead Delivery
5. Sheath removal

Step 1. Cannulate CS

1. Advancing LV sheath over wire into RV
2. Counterclockwise torque --> Posterior and inferior toward the CS ostium.



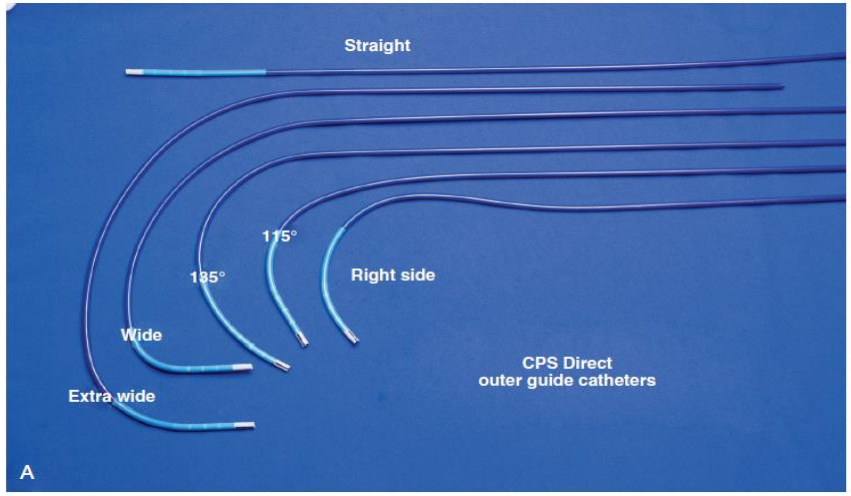


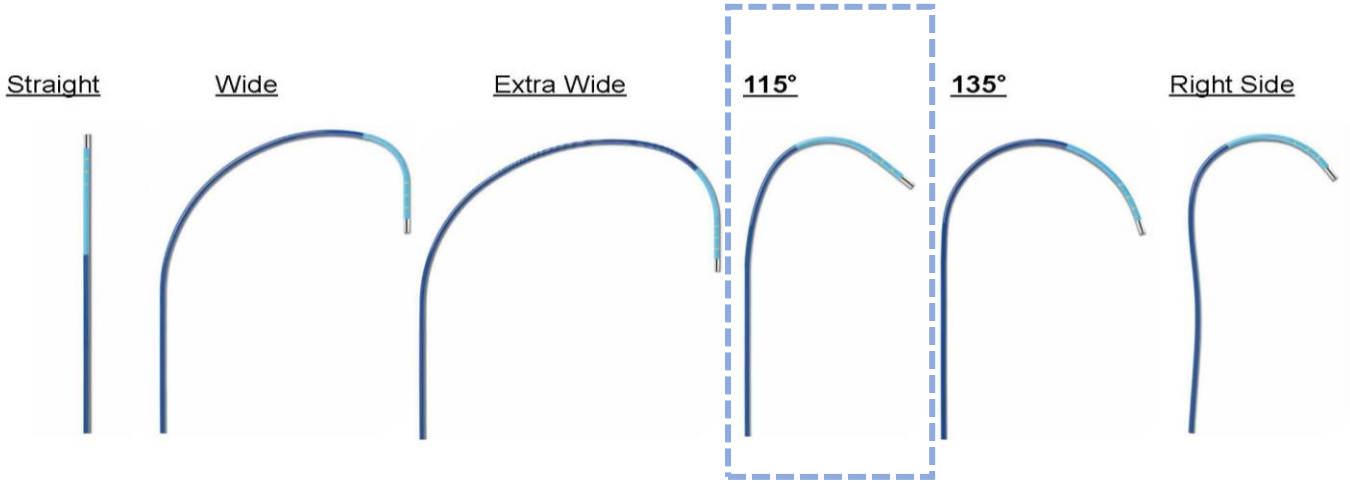


- Probing with a 0.035 hydrophilic wire

Step 1. Cannulate CS

CS access catheter Outer diameter 9 Fr/Inner diameter 7Fr





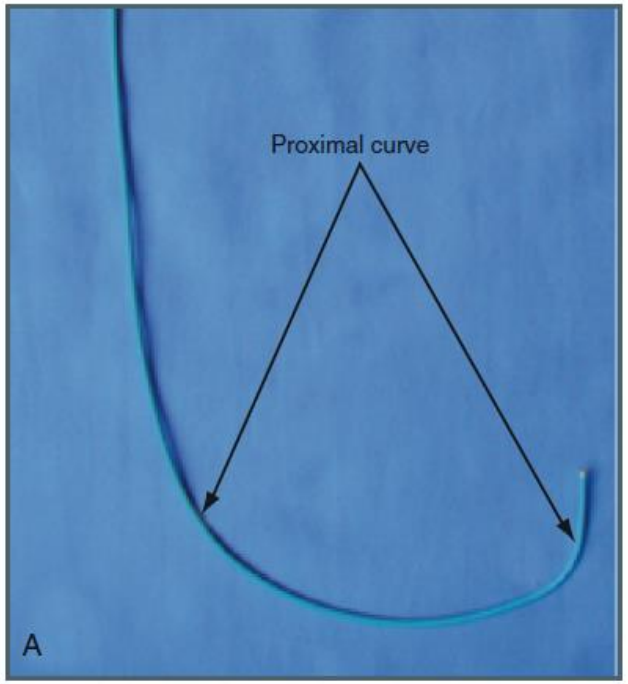
- Non contrast method - EP catheter/Probing with a 0.035 hydrophilic wire
- Contrast method- easy to find CS ostium

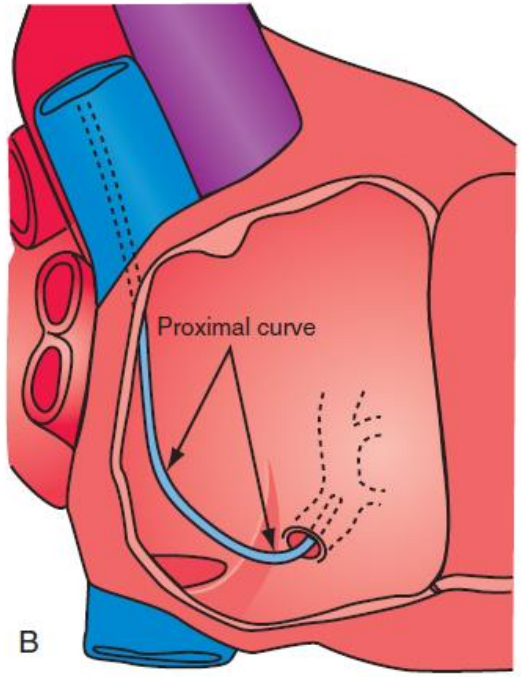
Step 1. Cannulate CS

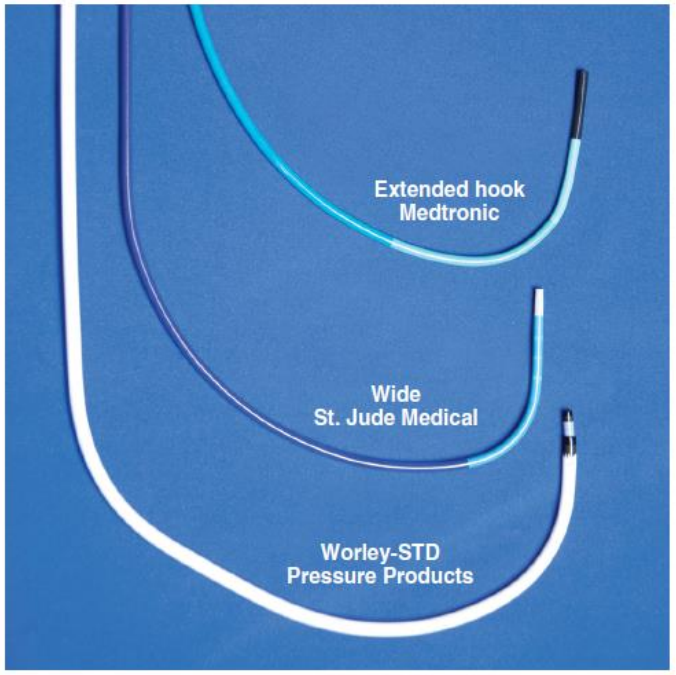
Large RA

Huge RA --> more difficult to cannulate the CS.
Guide catheter with a large proximal curve

Extended proximal curve Wide or 135' **--> huge RA**





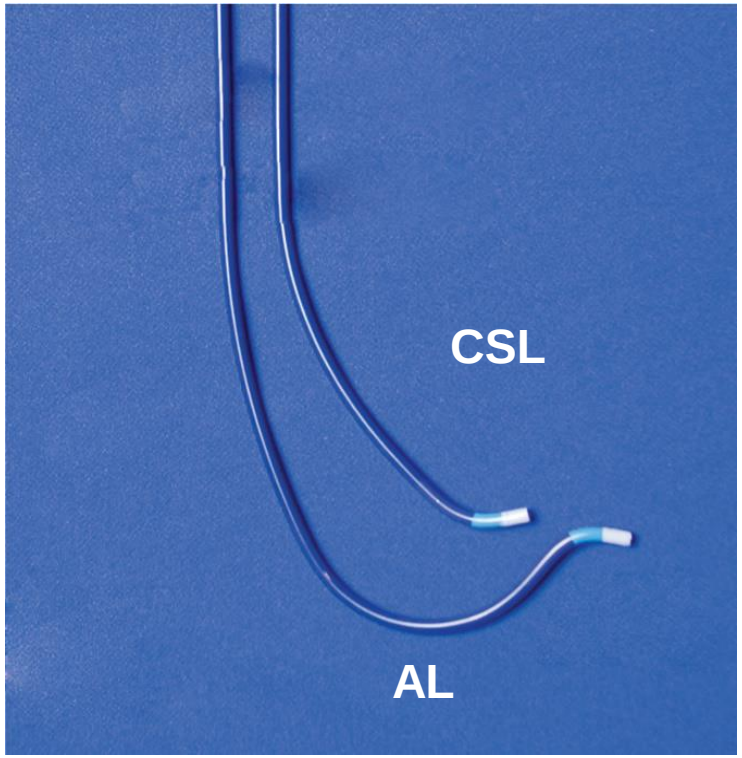


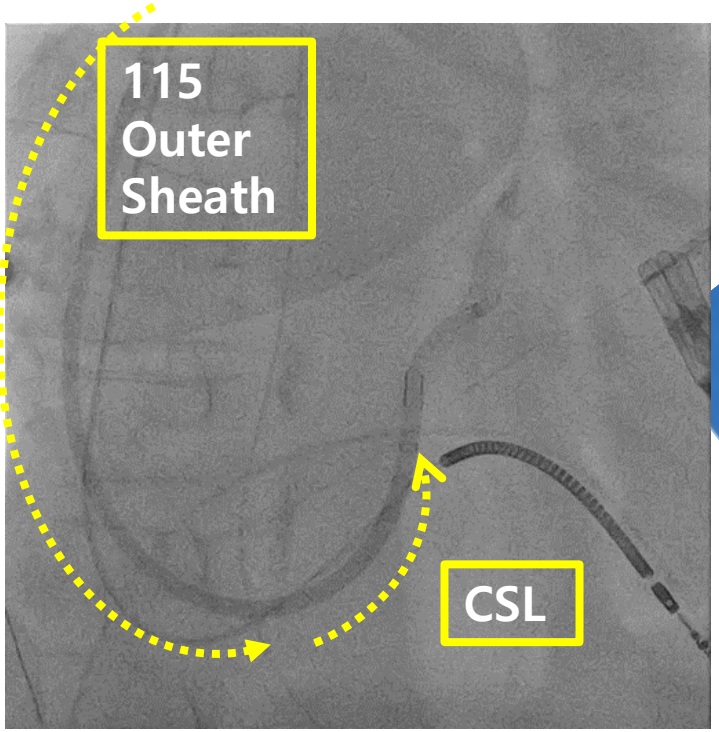
J. David Burkhardt, and Bruce L. Wilkoff Circulation. 2007;115:2208-2220

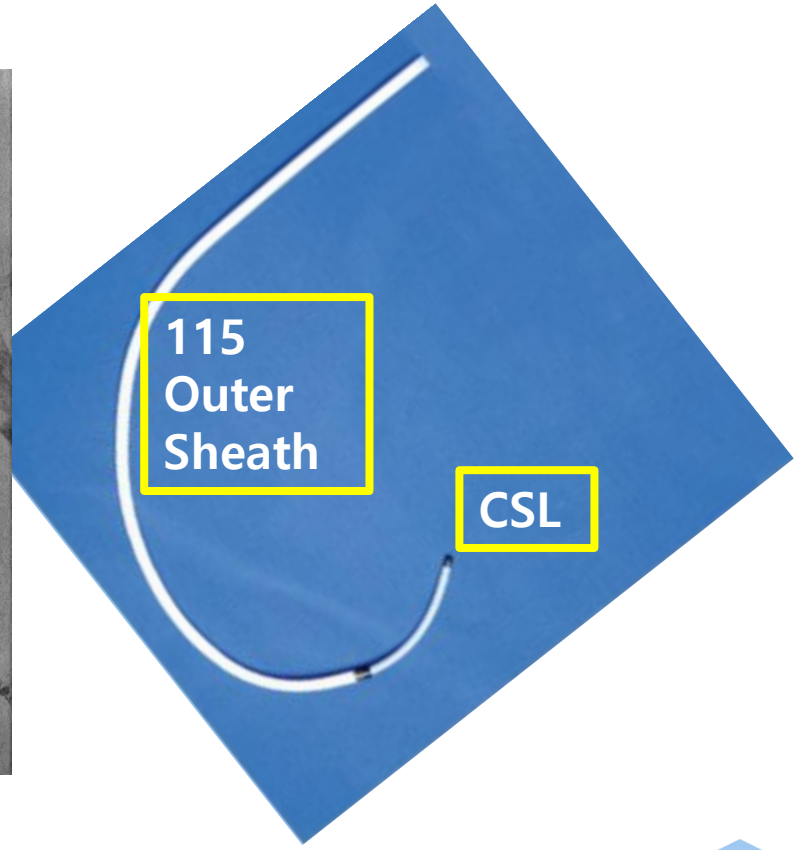
Step 1. Cannulate CS

Tortuous, Sigmoid, Vertical CS → Subselector catheter (CSL, AL)

Subselector catheter



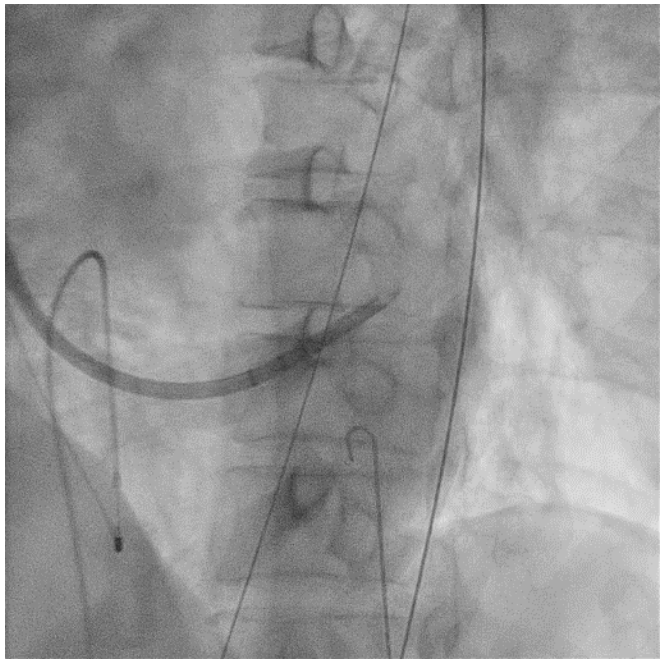




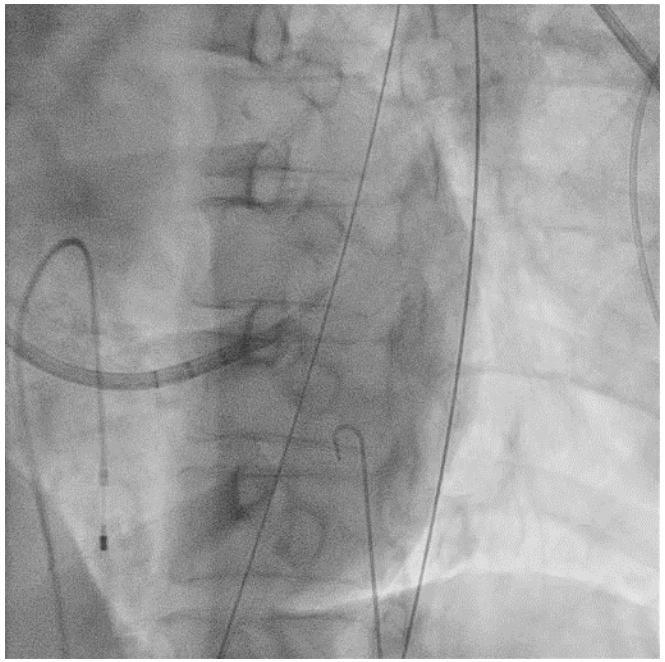
Step 2. Venography

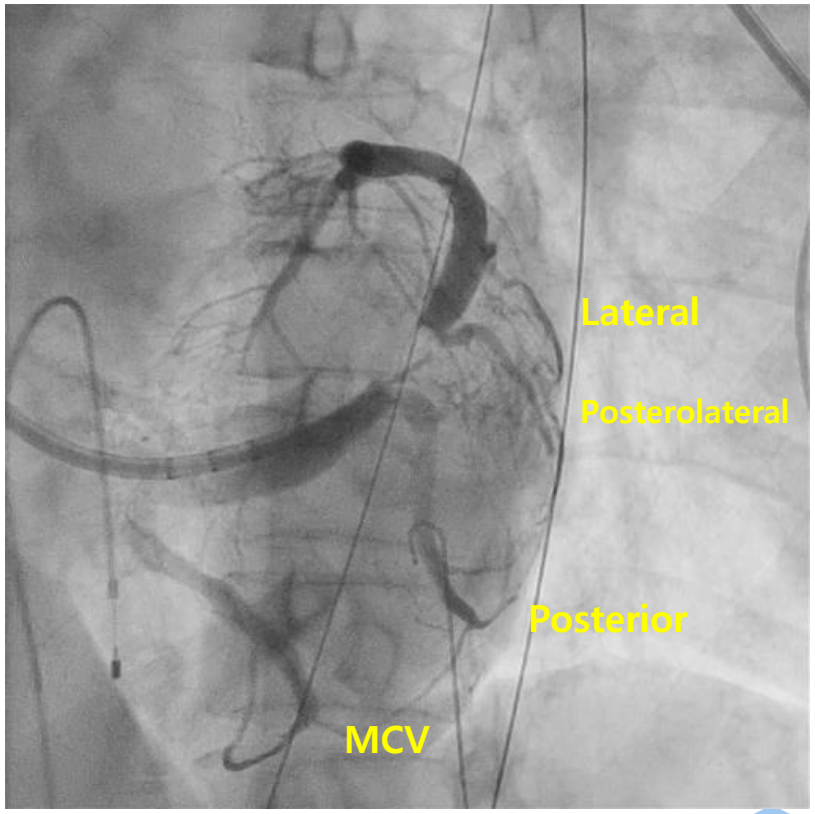
CS venography is needed to visualized the CS anatomy.

Non -Occlusive venogram (Catheter only)



Occlusive venogram (Balloon)

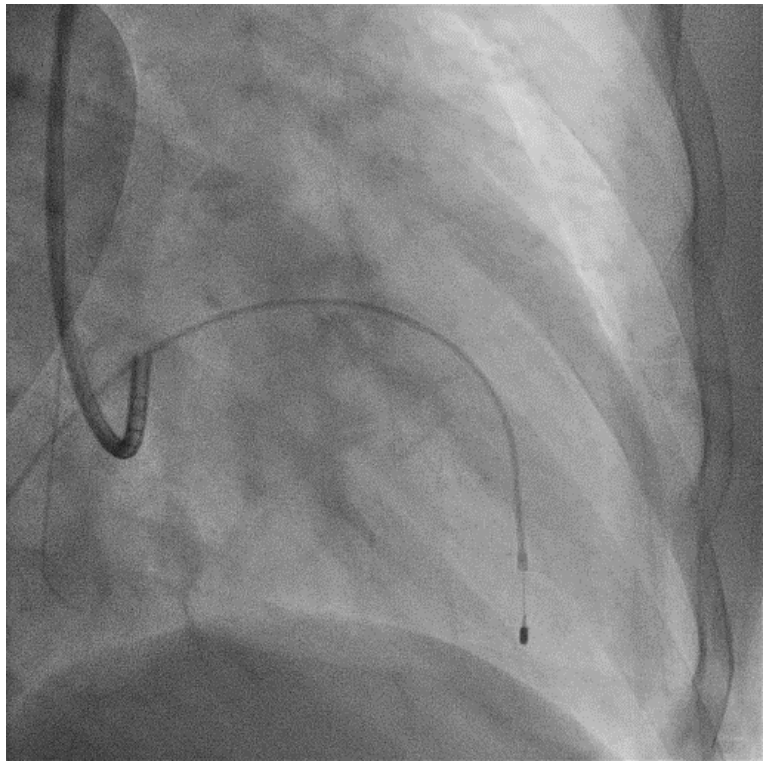




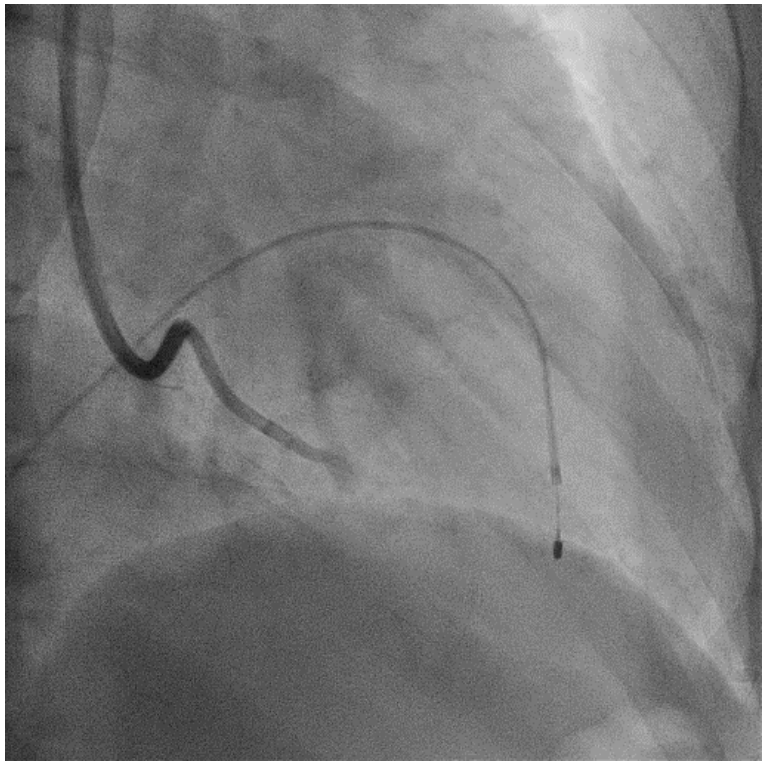
Step 2. Venography

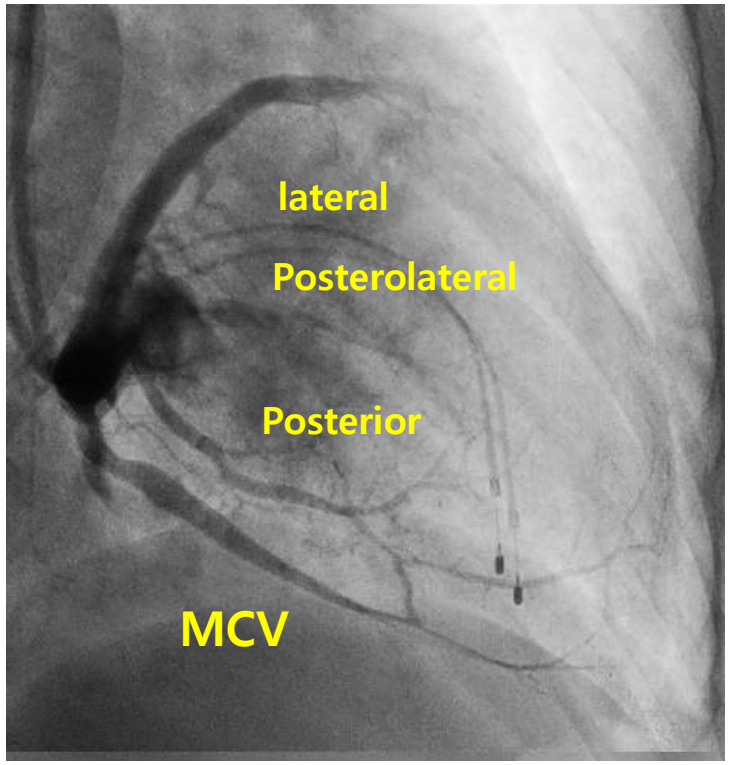
After subselecting the target vein, an angiogram could be performed via the inner sheath.

Non-Occlusive Venogram



Inner Sheath Venogram

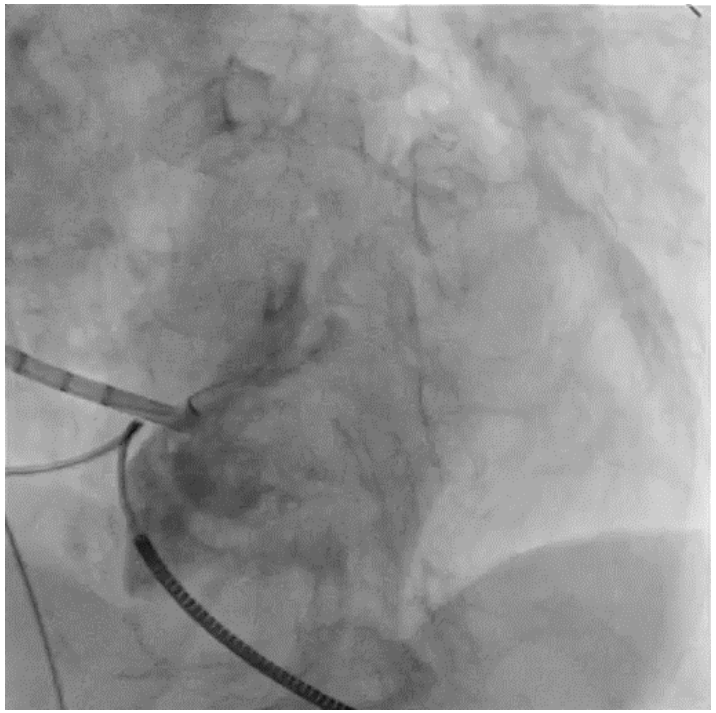


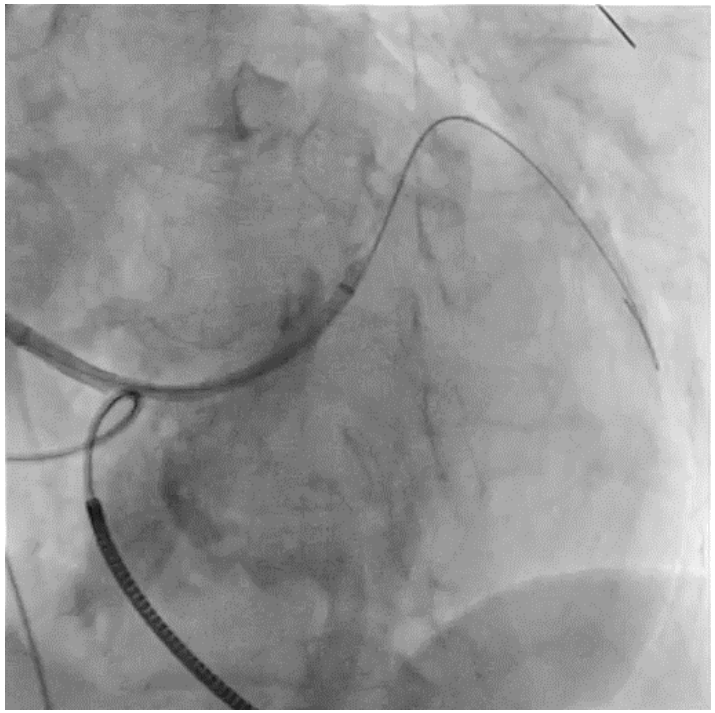


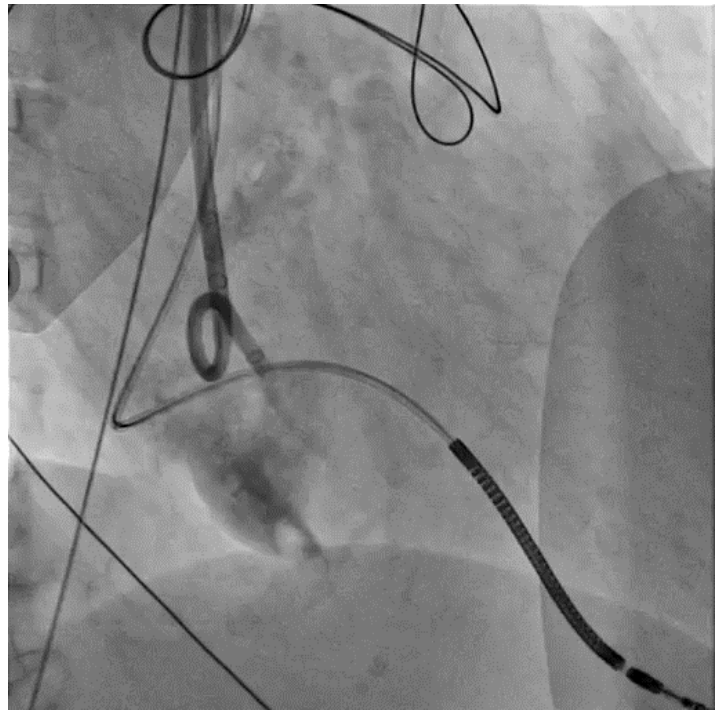
It reveals the presence of
a collateral branch

Complication – 1. CS dissection

CS dissection - Bifurcation of side branch, or Deep engagement into the CS



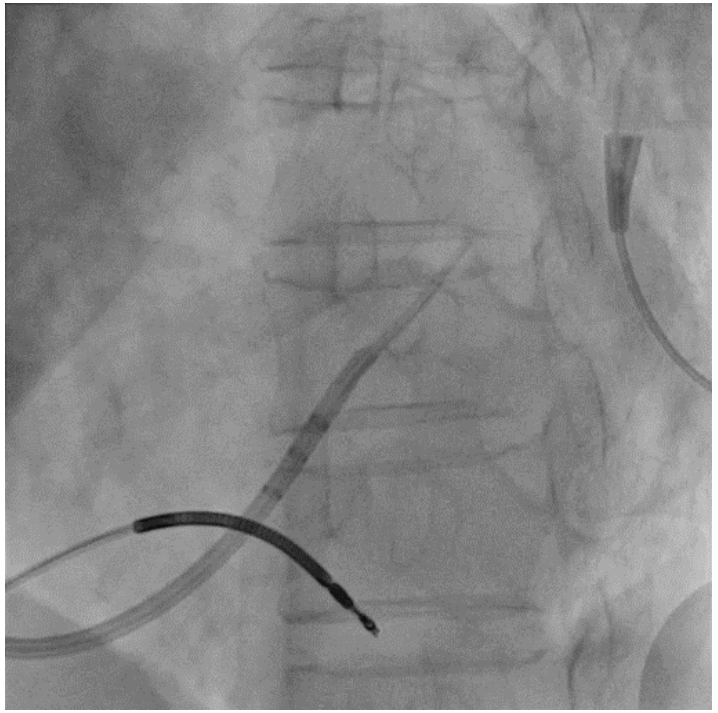




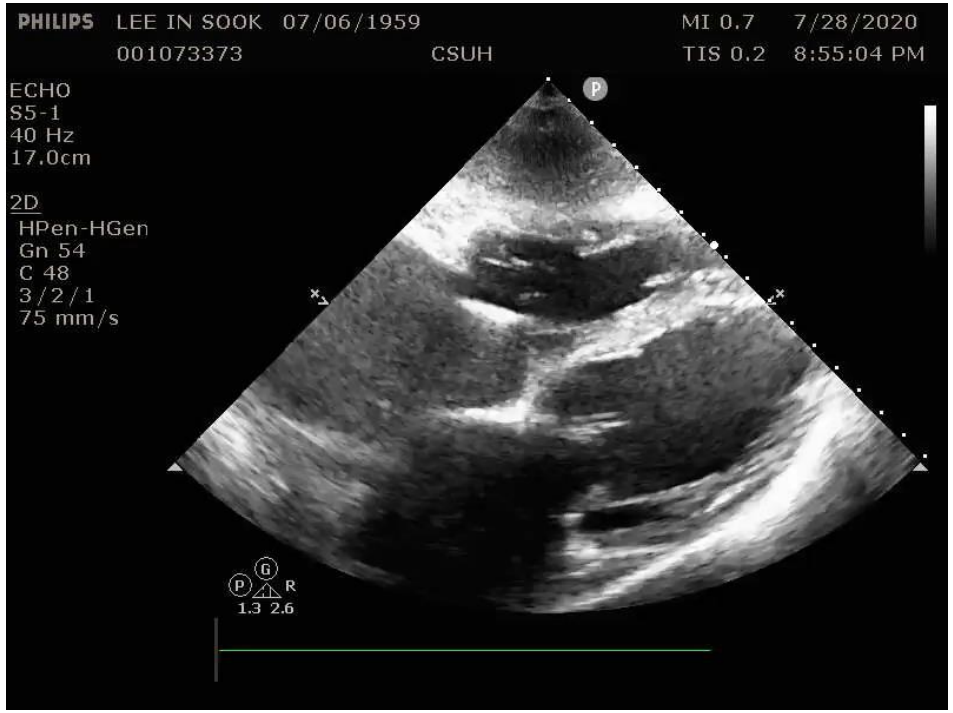
In that case, after wiring into the **true lumen** and subselecting the target vein, CS venogram might be performed.

Complication – 2. Perforation

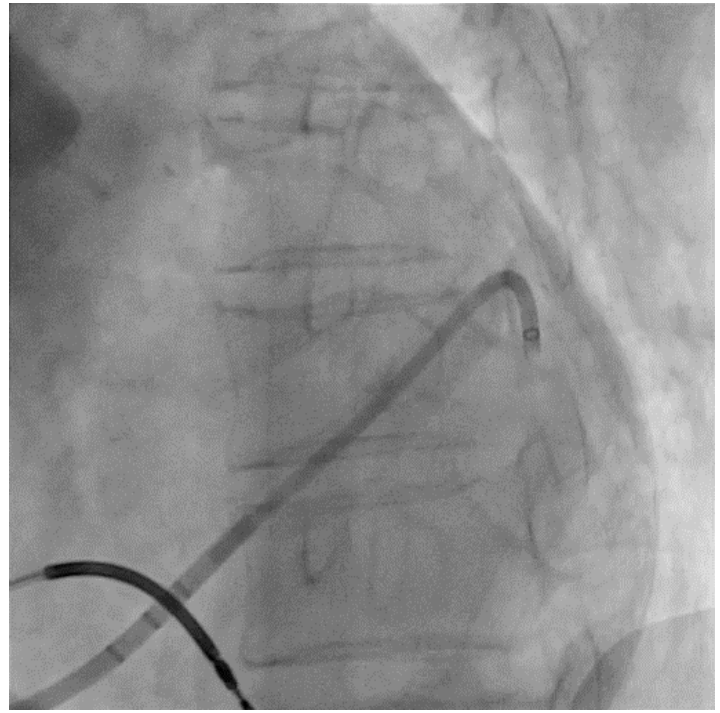
Perforation – Balloon is inflated at the small side vessel



If **balloon is inflated at the small side vessel**, there is a risk of **perforation.**



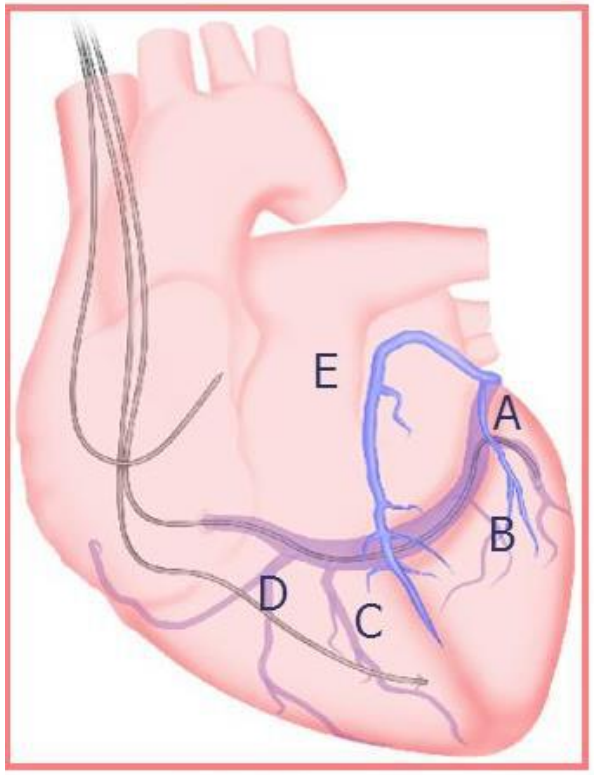
The procedure can be safely performed, by **monitoring vital sign** and checking **pericardial effusion.**



After wiring into the **true lumen** and subselecting the target vein, CS venogram might be performed.

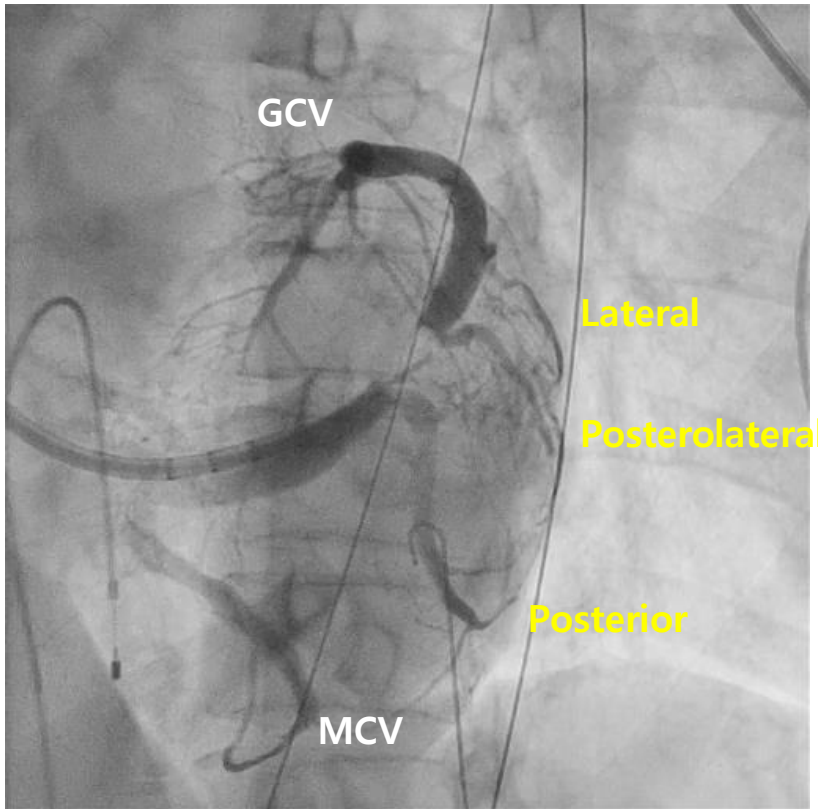
Step 3. Selecting the Target Vein

Posterolateral branch is chosen for LV lead placement.

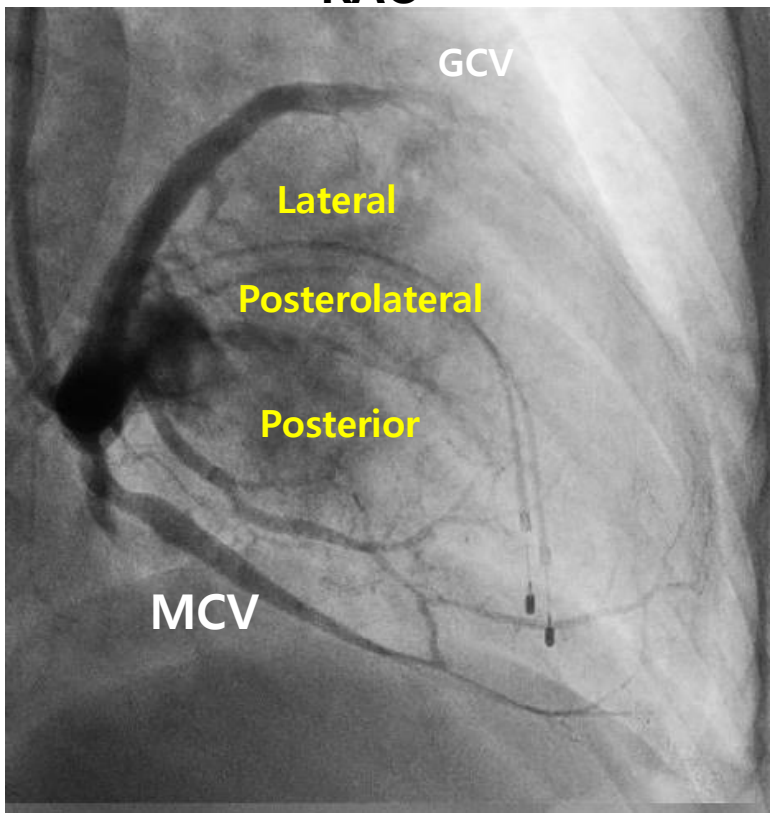


LAO View

LAO



RAO



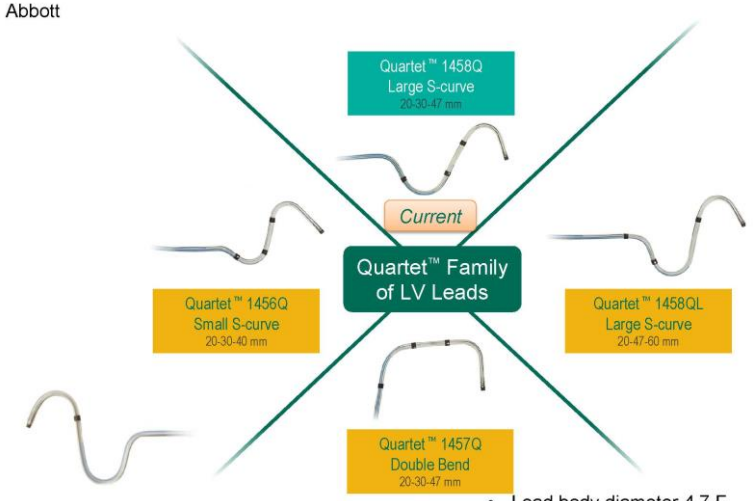
Veins in the 2-5 o'clock positions (LAO) are the best

If not available, angiogram via inner sheath can be performed to identify any **collateral branches**

Step 4. LV lead delivery

Abbott

Abbott

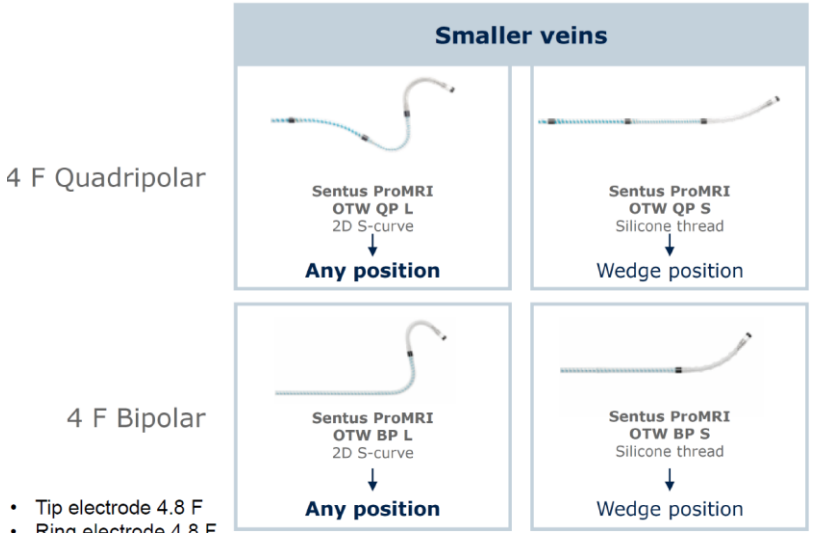


- Lead body diameter 4.3 F
- Distal tip diameter 4.0 F

- Lead body diameter 4.7 F
- Electrode diameter 5.1 F
- Distal tip diameter 4.0 F

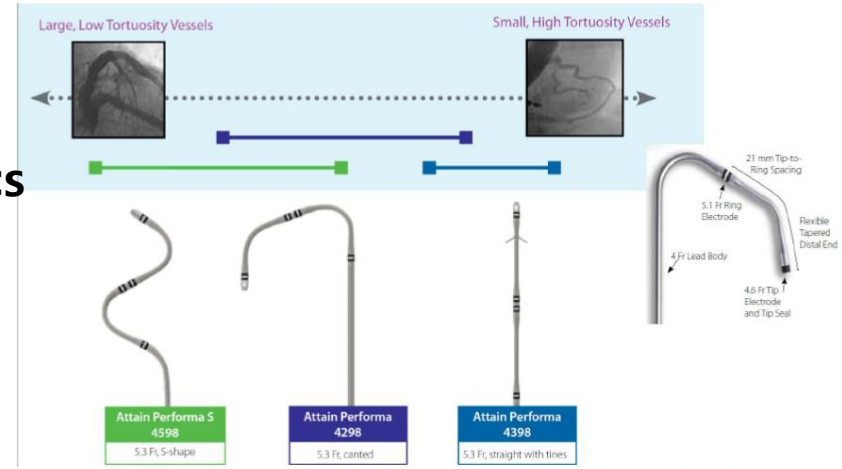
Biotronik

BIOTRONIK



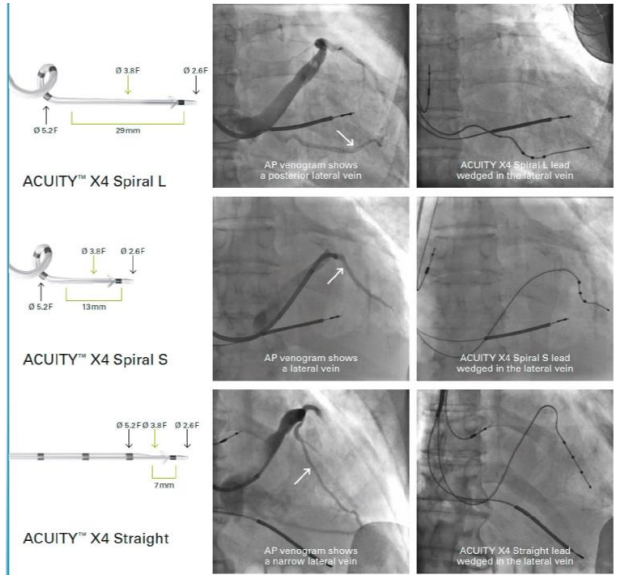
- Tip electrode 4.8 F
- Ring electrode 4.8 F

Medtronics

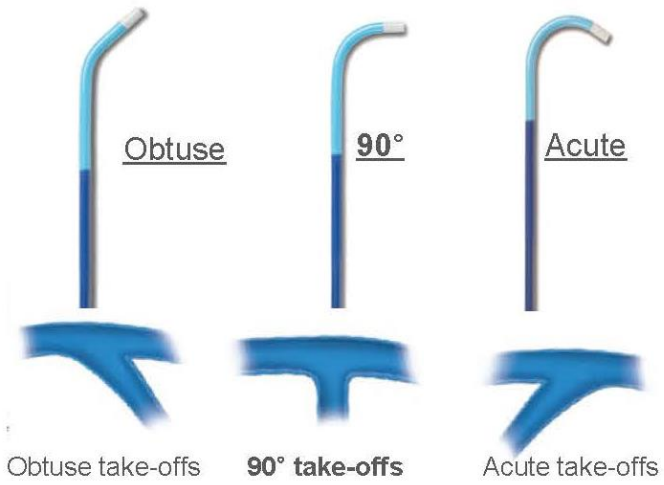


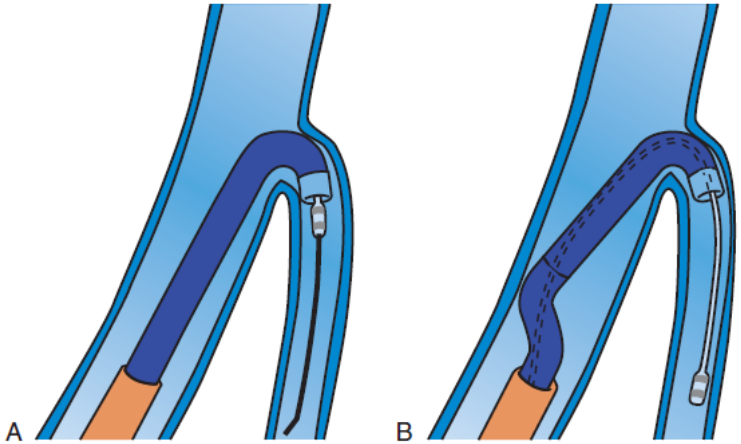
- Lead body diameter 5.3 F
- Electrode diameter 5.1 F
- Distal body diameter 4.0 F

Boston

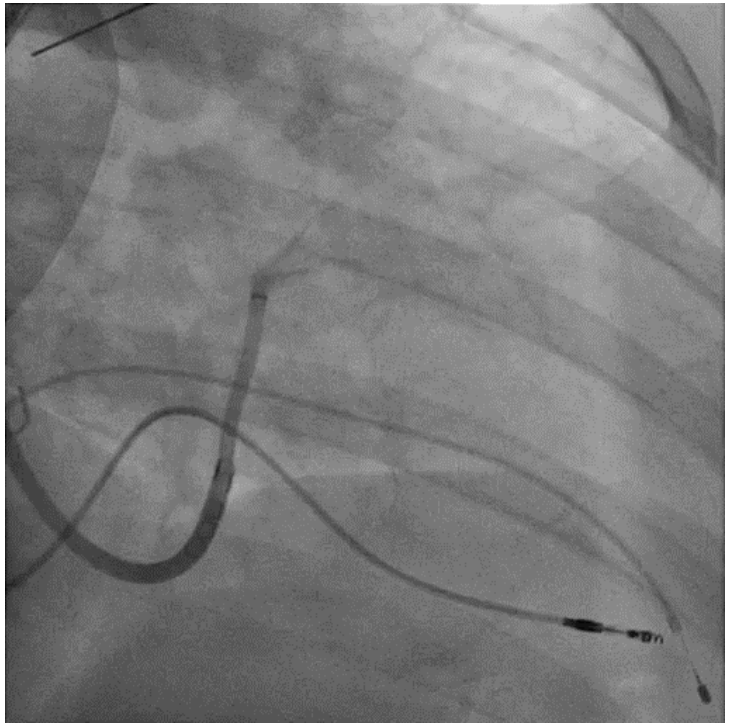


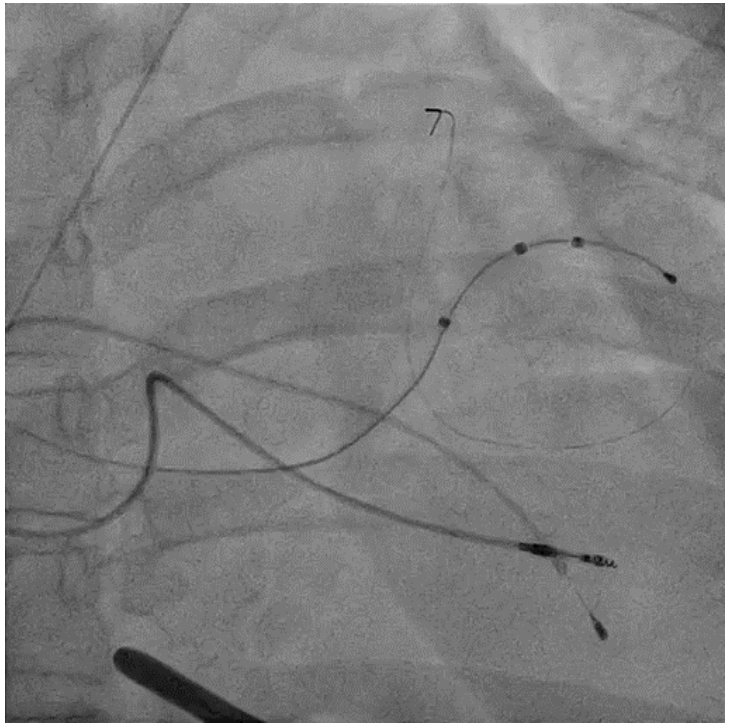
Step 4. LV lead delivery





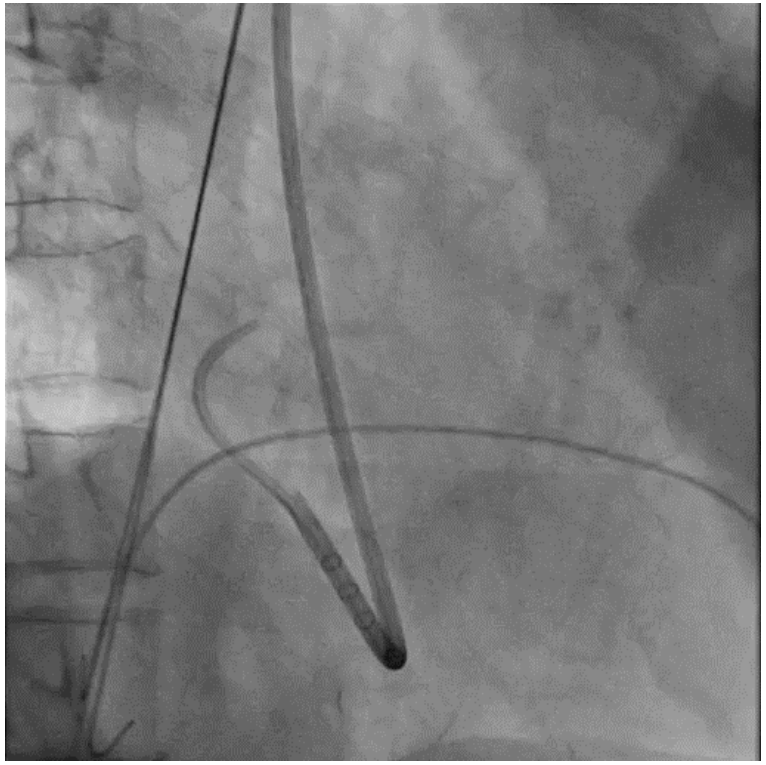
When target vein has an **acute angle**, an inner sheath is used to provide backup support.



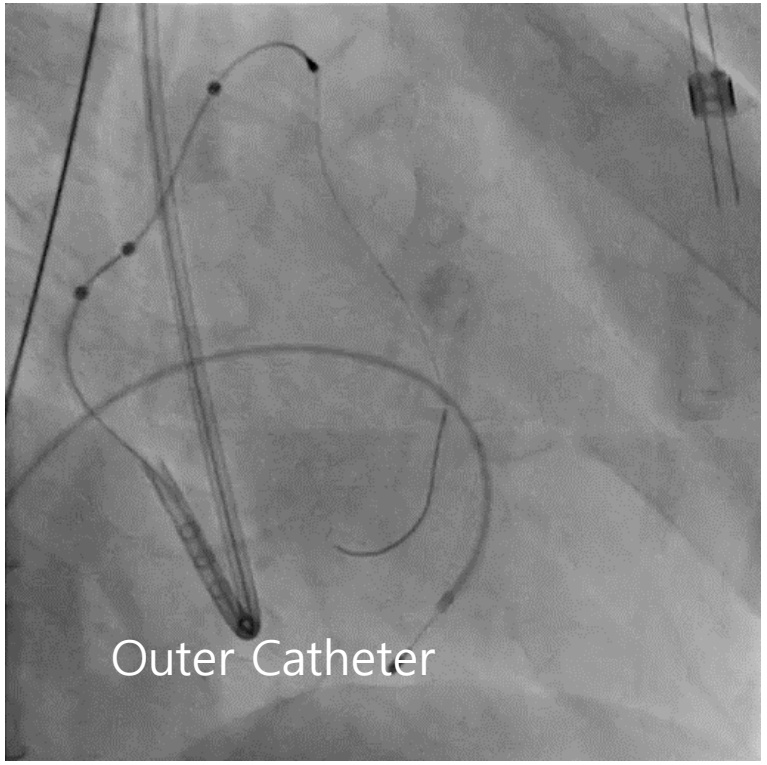


After successful wiring into the target vein, inner sheath was advanced to the ostium of the target vein.

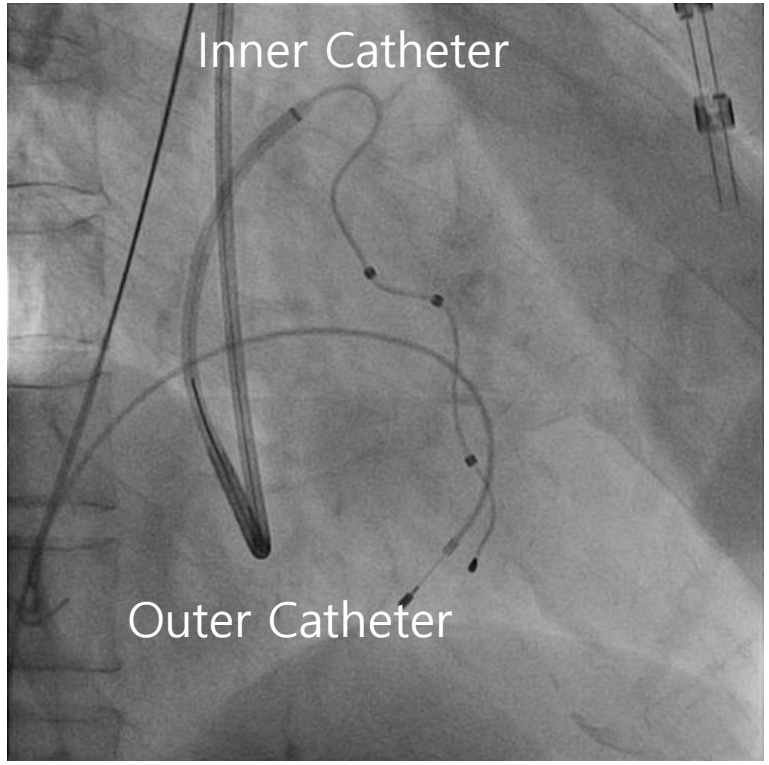
Step 4. LV lead delivery



CS venogram revealed an **acute angle** of target vein



CS assess catheter Only
→ LV lead delivery (X)

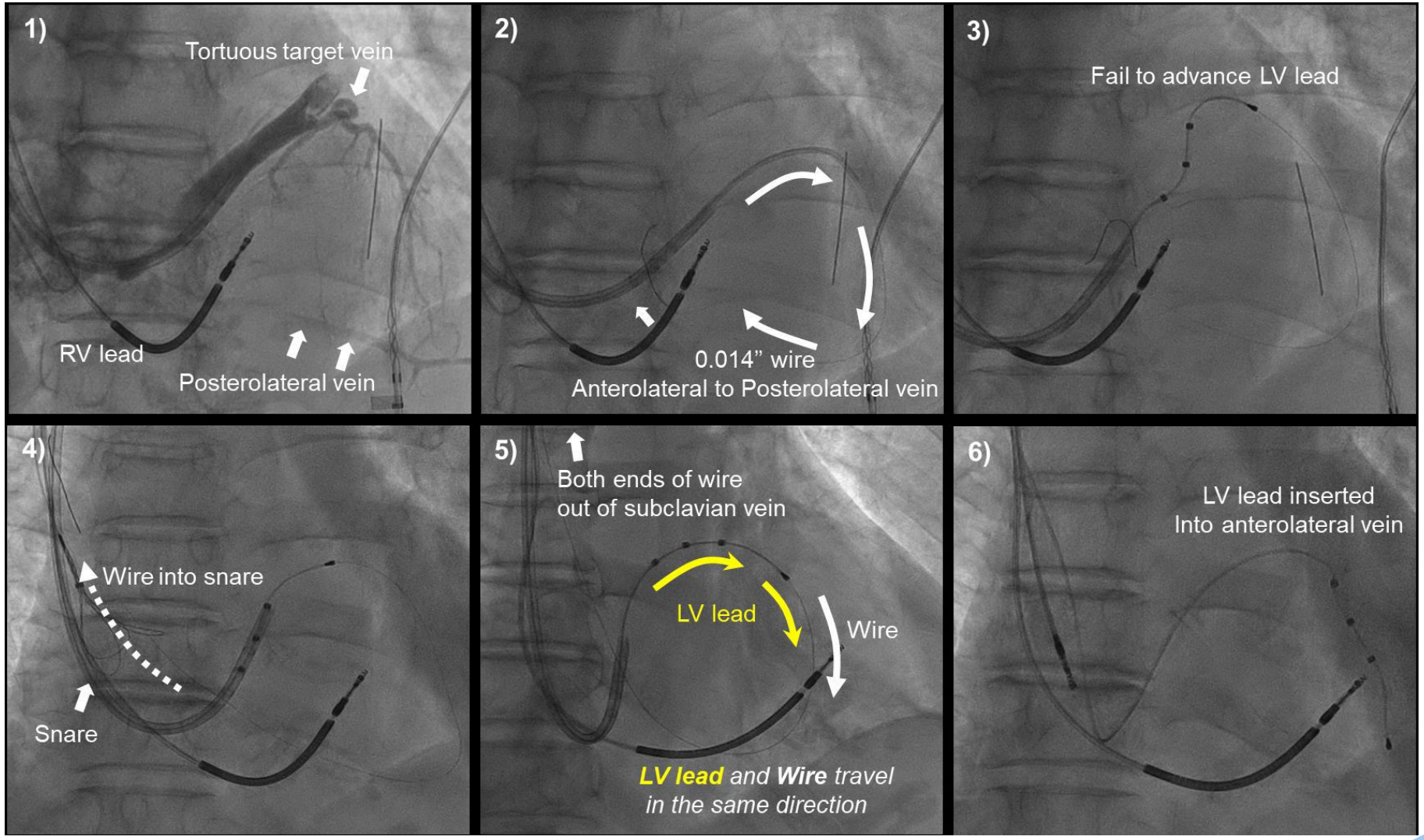


Outer catheter was advanced to CS Inner Catheter – Target vein ostium
→ LV lead was delivered (O)

Step 4. LV lead delivery

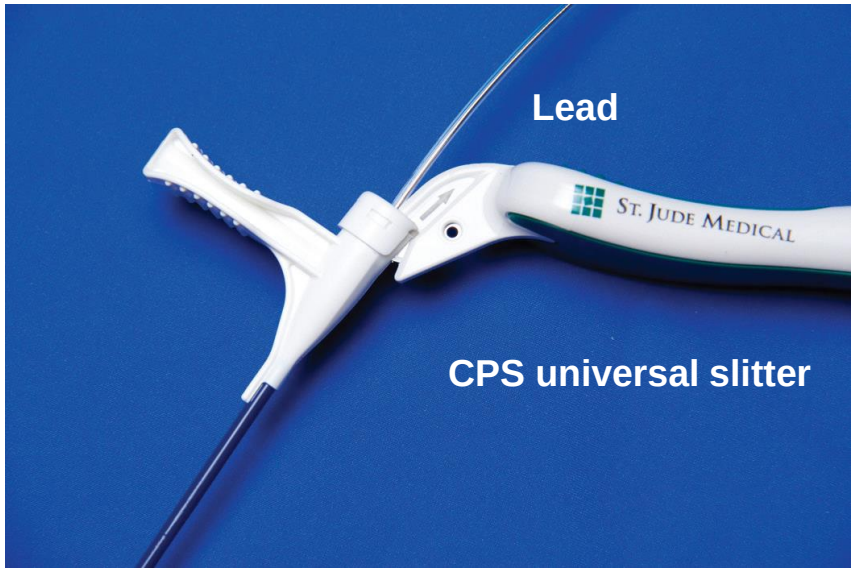
Snare technique

- **Orthodromic**
- **Backup support**



Kim J, Park SJ et al. Orthodromic and Antidromic Snare Techniques for Left Ventricular Lead Implantation in Cardiac Resynchronization Therapy. J Clin Med. 2022 Apr 11;11(8):2133

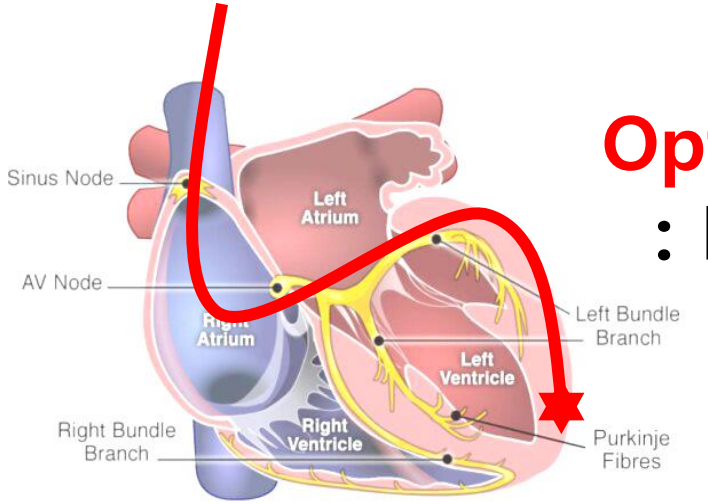
Step 5. Sheath Removal



Integrated Sliceable Hemostatic Hub Technology

Universal Slitter and Guide Hub(Medtronic)

Summary



Optimal LV lead implantation
: Posterolateral branch, non apical

1. CS Cannulation --> Accessing the CS and advancing a sheath into it. (**Sub-selector catheter**)
2. CS Venography --> Using contrast to visualize the venous tree (**Occlusive, Inner sheath Angio**)
3. Target vein Subselection --> Accessing the desired branch vein
   Establishing a means of delivering the lead into that vein
4. LV Lead Delivery --> Delivering the lead into the target vein (Inner sheath – Target vein OS) (Snare)
   Testing for capture thresholds and avoidance of PNS
5. Sheath removal --> Removing the delivery sheath from the body via slitting


THANK
YOU
GRACIAS
ARIGATO
SHUKURIA
BOLZÏN
MERCI
BÏYAN
SHUKRIA
TINGKI
DANKSCHEEN
SPASSIBO
NUHUN
SNACHALHUYA
CHALTU
YAQHANYELAY
TASHAKKUR ATU
YUSPAGARÀTAM
HUI
WABEEJA
MAITEKA
SUKSAMA
EKHMET
GUI
HATUR
SPASIBO
DENKAUJA
NENACHALHIYA
UNALCHÉÉSH
DHANYAVAAD
AHHA
ATTO
MIRSI
EKOJU
SIKOMO
MAKETAI
MINMONCHAR
SAHCO
MERASTAWHY
GAEJTHO
TAVTAPUCH
MEDAWAGSE
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MAAKE
GRAZIE
MEHRBANI
PALDIES
LAH