Cardiac Venous System and CRT Implantation Techniques

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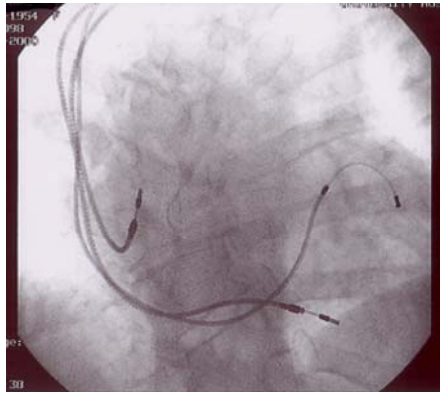
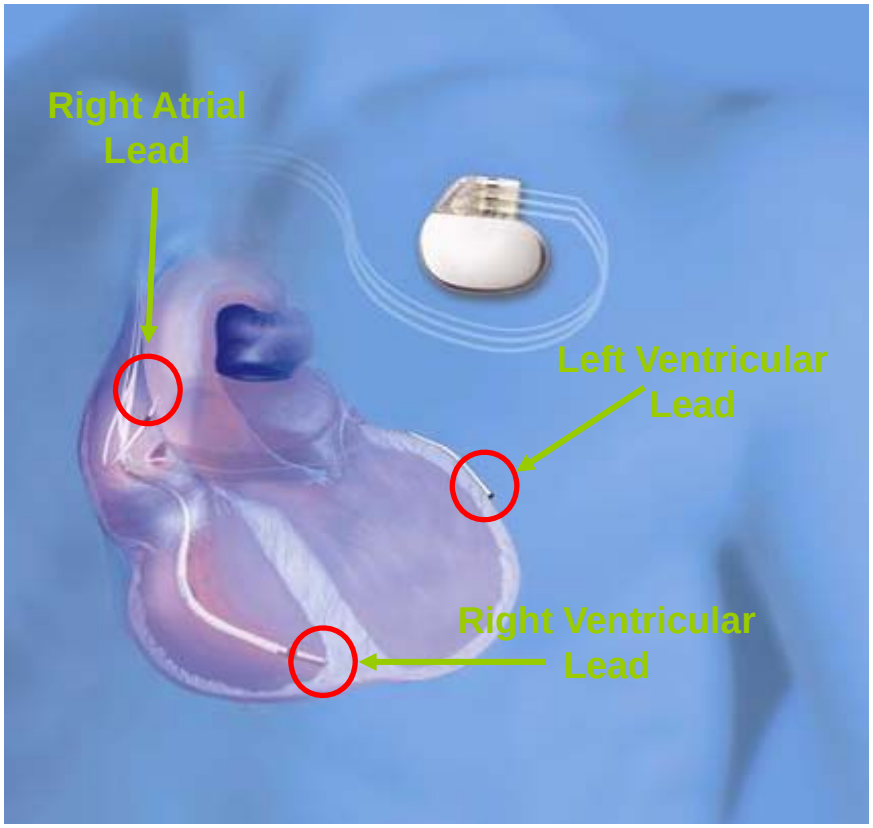
Cardiac Resynchronization Therapy (CRT)

Goal: Atrial synchronous biventricular pacing

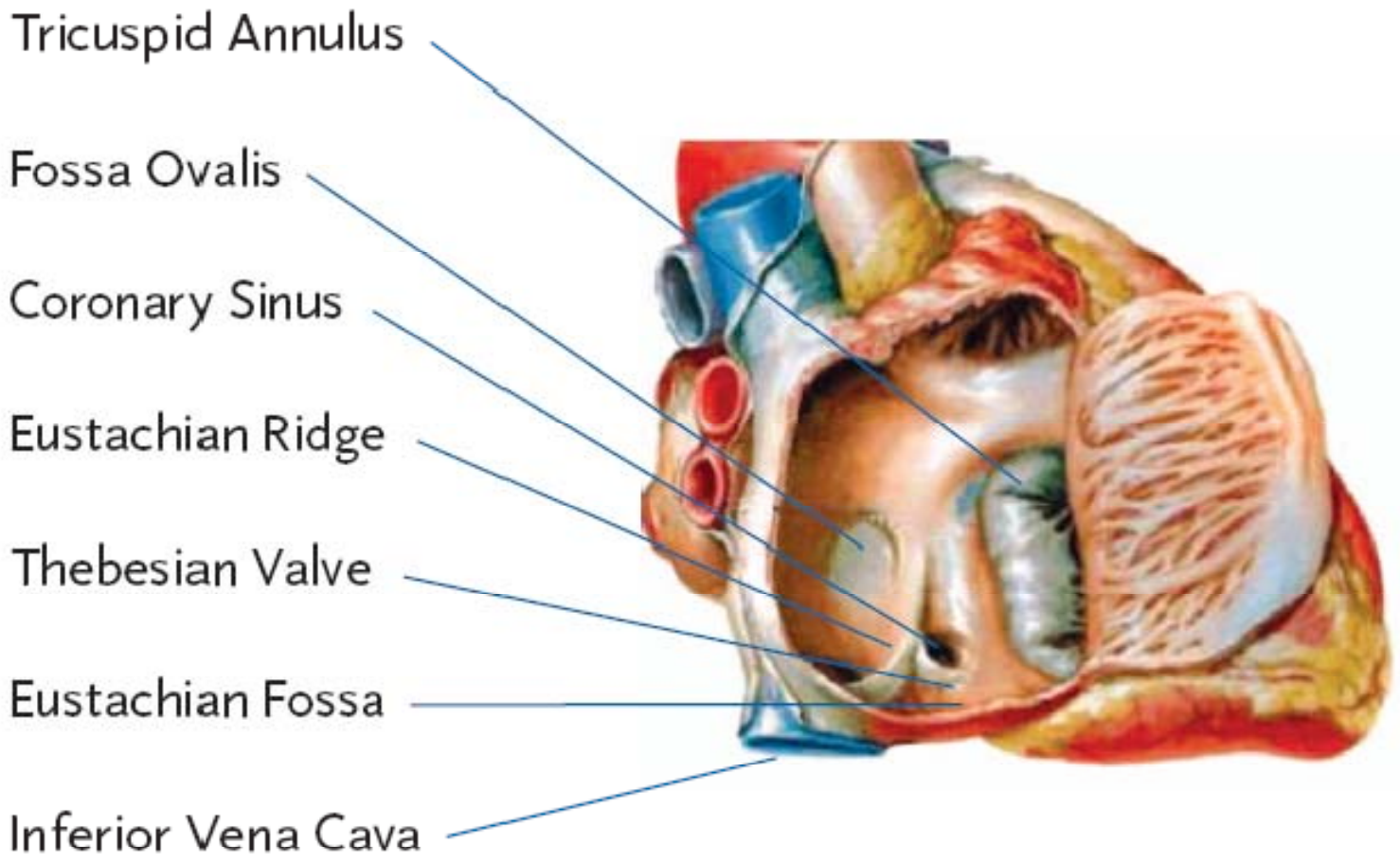
Transvenous approach for left ventricular lead via coronary sinus

Back-up epicardial approach



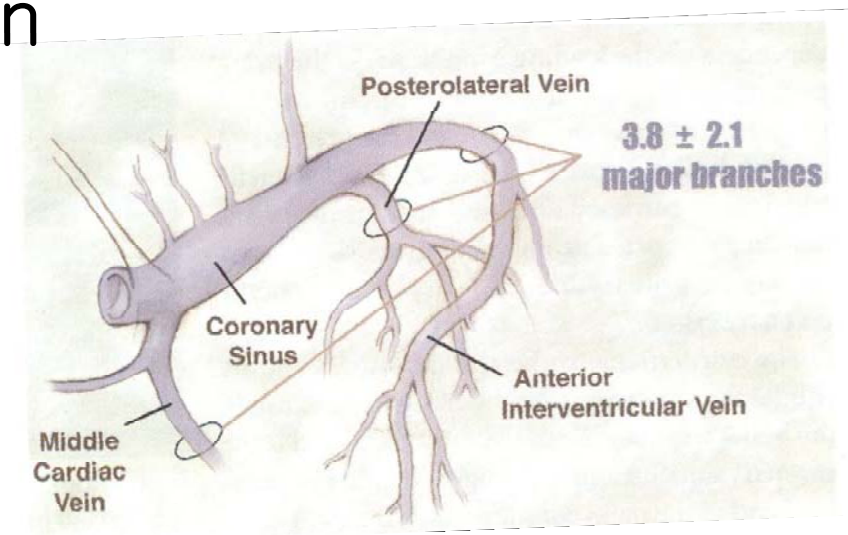


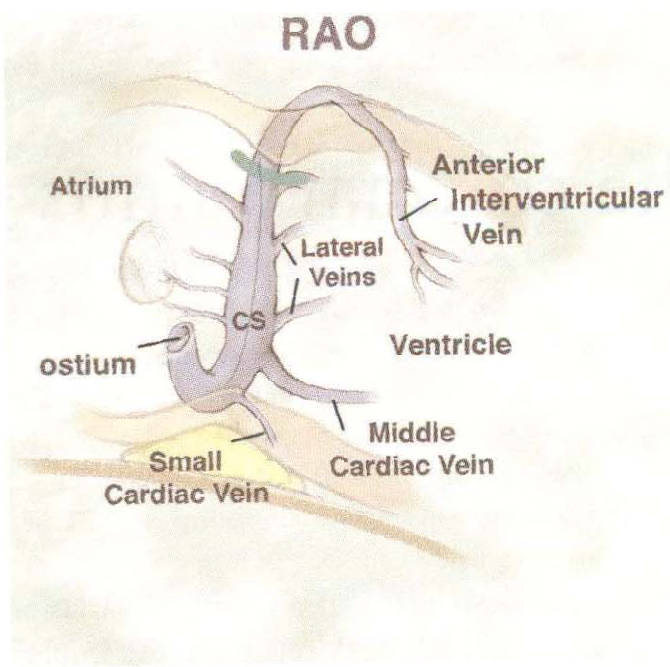
Anatomy of Right Atrium

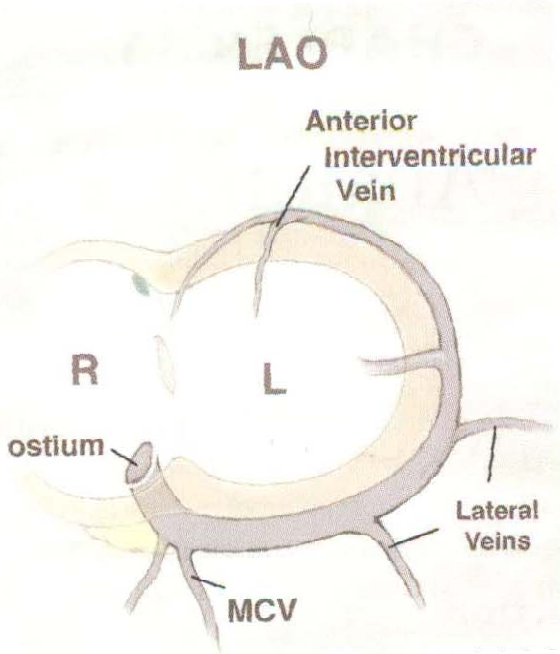


Coronary venous systen

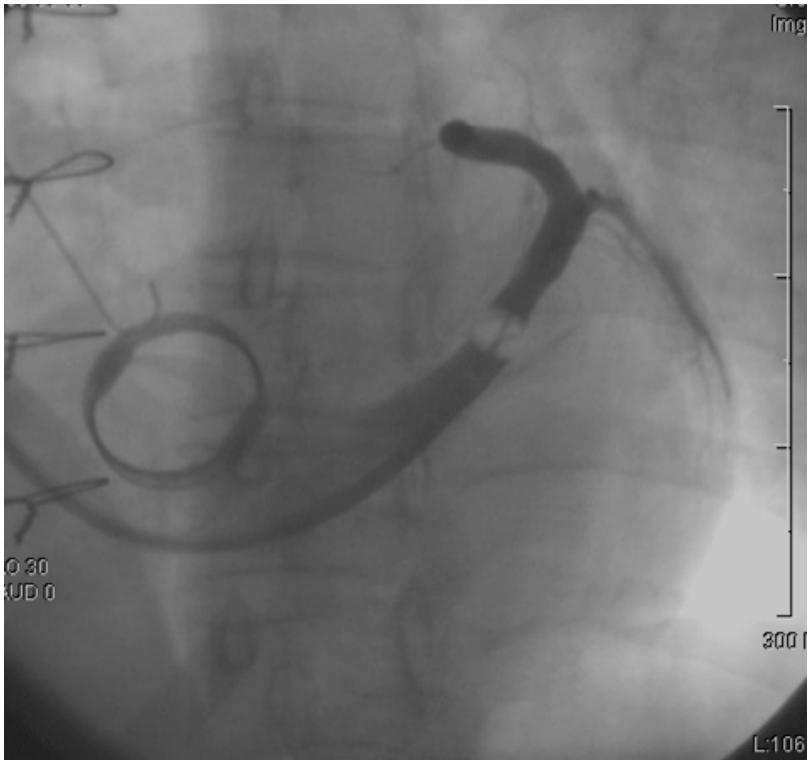
-Gateway for LV lead for CRT
-traverse along the mitral annulus
-Highly variable among individual



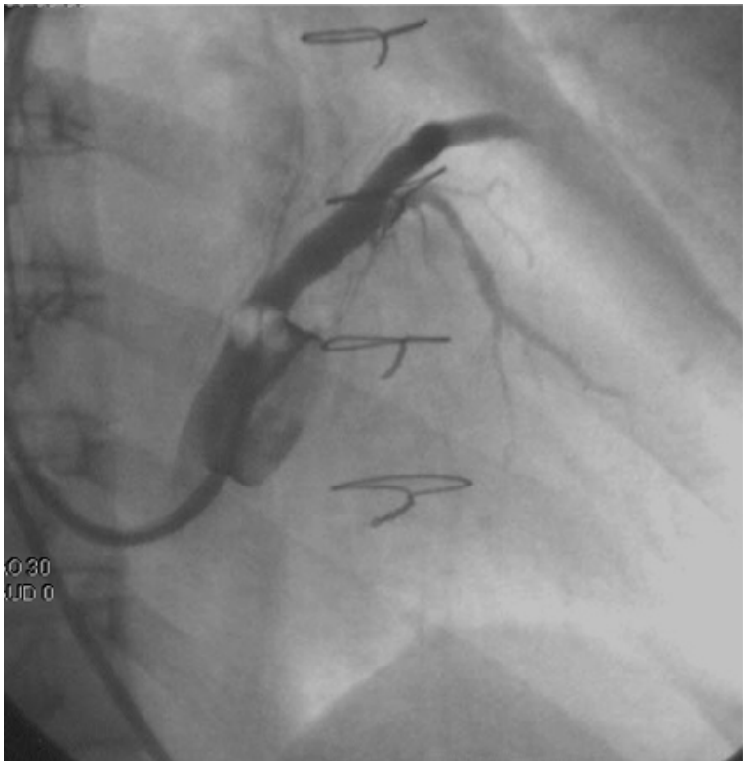




Fluoroscopic view of coronary sinus in relation to tricuspid annulus (mechanical valve)

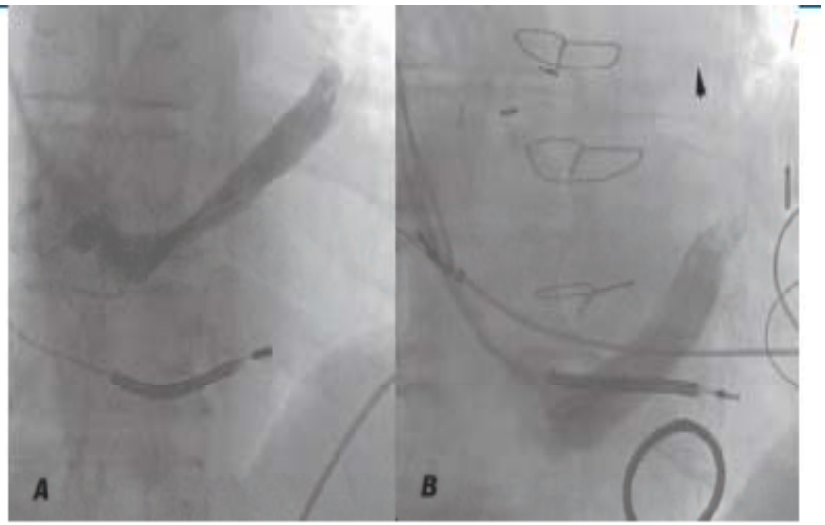


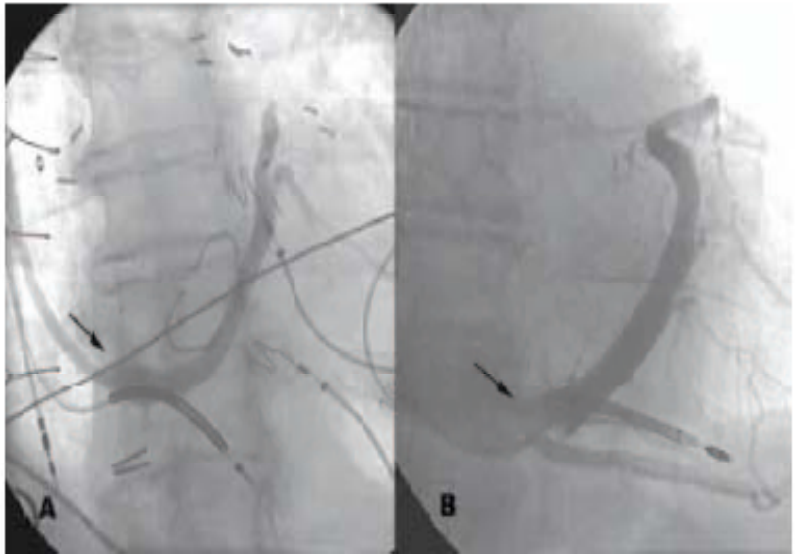
LAO 30



RAO 30

Coronary Sinus Angiography demonstrating the High to Low variability of the Os

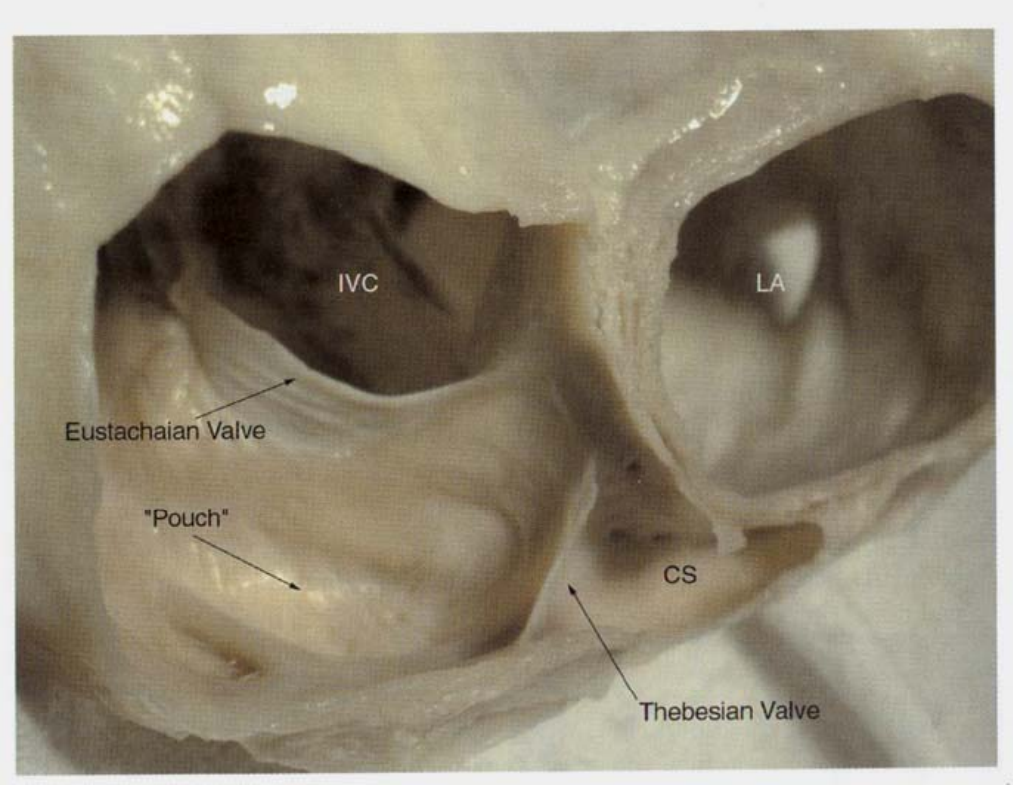




Variability of the Os
Left (arrow) is on the left border of the spine
Right (arrow) is to the right of the spine

Thebesian valve

- Membranous structure occluding CS os
  - crescent shaped
  - semilunar shaped
  - fenestrated
  - band shaped
- It makes difficult to engage the catheter at CS os



J inteventional Cardiac Electrophysiology 14,89-94,2005

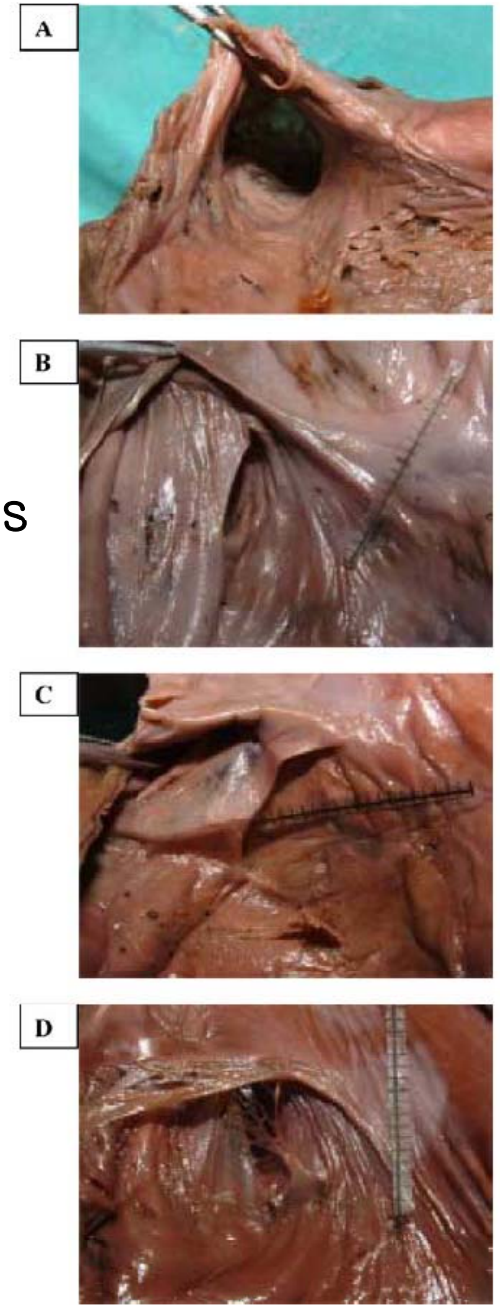
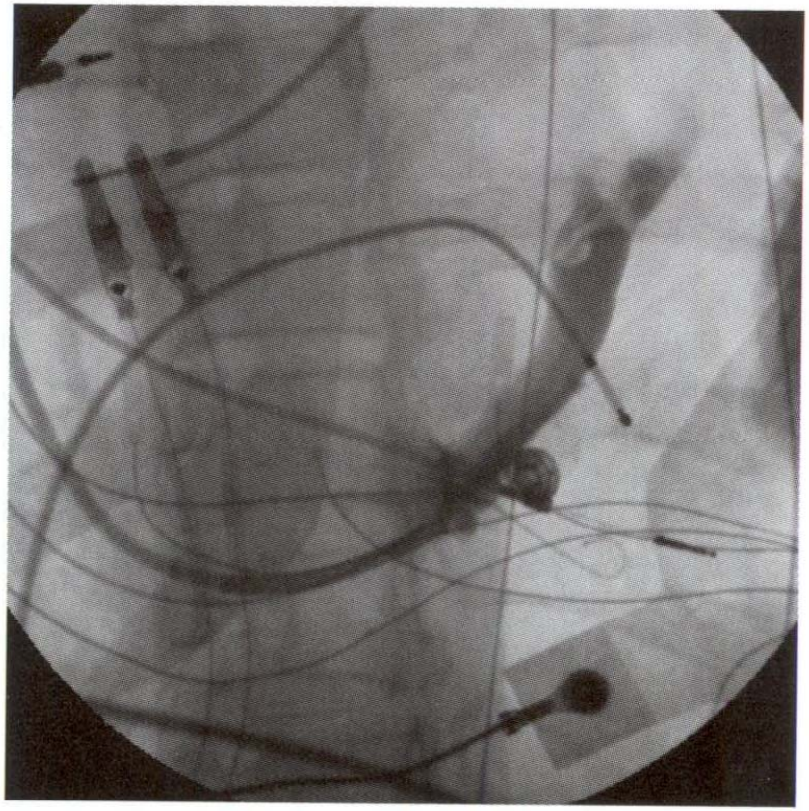


Fig. 2. The different characteristics of the CS Thebesian valve. A: CS os without Thebesian valve, B: Crescent shaped, C: Semilunar, D. Fenestrated.

Vieussens' valve

-located at the transition from coronary sinus to great cardiac vein or at the ostium of vein of Marshall
-It may impending the cahteter advance at coronary sinus



J inteventional Cardiac Electrophysiology 14,89-94,2005

Preparation of patient

- Keep euvolemic state
- If needed, withhold the current drugs ,such as beta blocker, ACE inhibitor or ARB, and nitrate
- Thienopyridine (clopidogrel, ticlopidine) should be discontinued for at least 5 day, because of high bleeding risk.

Preparation of patient

- If on coumadin
  - Switch to heparin before 2-3 days of procedure. IV unfractionated heparin should be discontiuned at least 5 hours prior to procedure. Subcutaneous low molecular weight heparin should be given 24 hours prior to procedure. And resumed after 12 hours of procedure with coumadin.

    : significant frequent incidence of pocket hematoma

  - Perform CRT implantation with therapeutic INR range.

    : risk of cardiac tamponade due to myocardial penetration or coronary venous laceration

LV Lead Implant Procedure

1. Locating and cannulating the CS
2. Obtaining a Venogram
3. Positioning the Guide Wire and LV Lead
4. Evaluating Sensing and Pacing Thresholds
5. Removing the Guide Catheter
6. Securing the lead

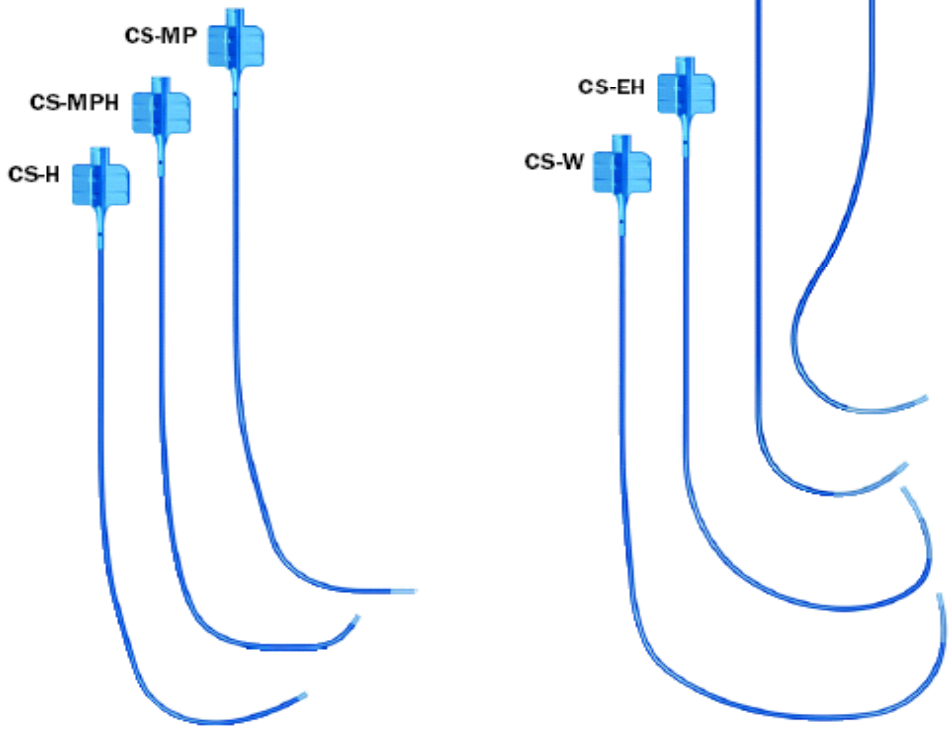
Locating and Cannulating the CS

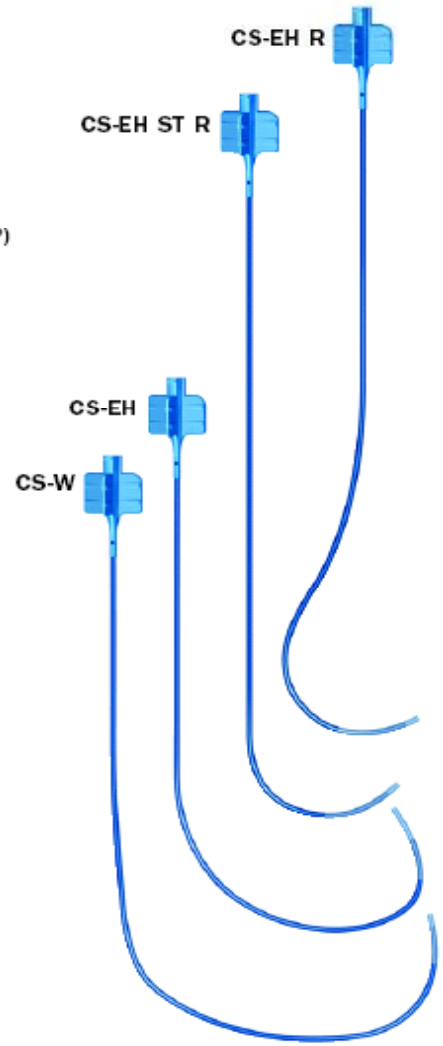
Guiding catheter selection :

RAPIDO Cut-Away Coronary Sinus Hook (CS-H)
Model 7556 — 42 cm working length
Model 7557 — 47 cm working length

RAPIDO Cut-Away Coronary Sinus (CS-MPH) Multi-Purpose Hook
Model 7558 — 42 cm working length
Model 7559 — 47 cm working length

RAPIDO Cut-Away Coronary Sinus Multi-Purpose (CS-MP)
Model 7554 — 42 cm working length
Model 7555 — 47 cm working length





A Selection of RAPIDO Cut-Away Guide Catheter Shapes for Various Patient Anatomies

These shapes gain their support from the superior vena cava (SVC).

RAPIDO Cut-Away Coronary Sinus Wide (CS-W)
Model 7516 — 42 cm working length
Model 7560 — 47 cm working length

RAPIDO Cut-Away Coronary Sinus (CS-EH) Extended Hook
Model 7511 — 42 cm working length
Model 7553 — 47 cm working length

RAPIDO Cut-Away Coronary Sinus (CS-EH-ST-R) Extended Hook Straight Right
Model 7521 — 42 cm working length
Model 7564 — 47 cm working length

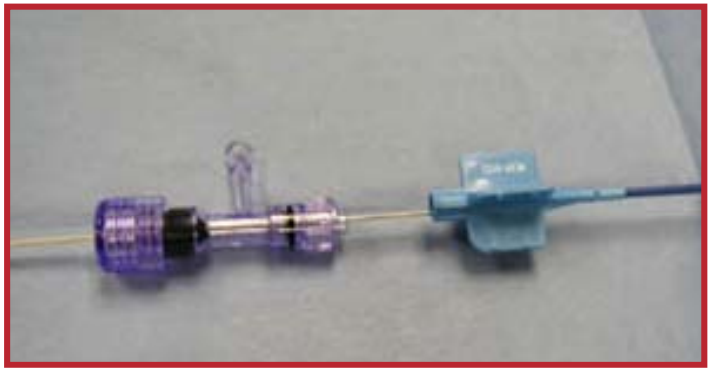
RAPIDO Cut-Away Coronary Sinus (CS-EH-R) Extended Hook Right
Model 7519 — 42 cm working length
Model 7563 — 47 cm working length

Locating and Cannulating the CS

Using the Guide Catheter

Attach a rotating hemostatic valve or bleed back control valve to the guide catheter.

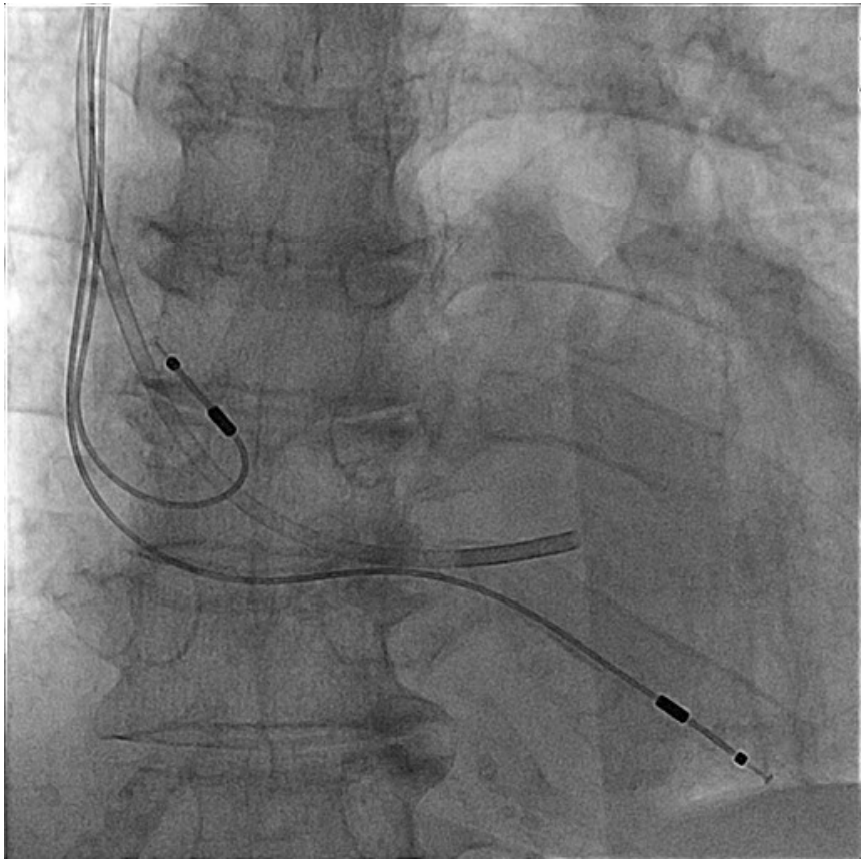
Ensure the correct connection.



Using the Guide Catheter & 0.035 guide wire

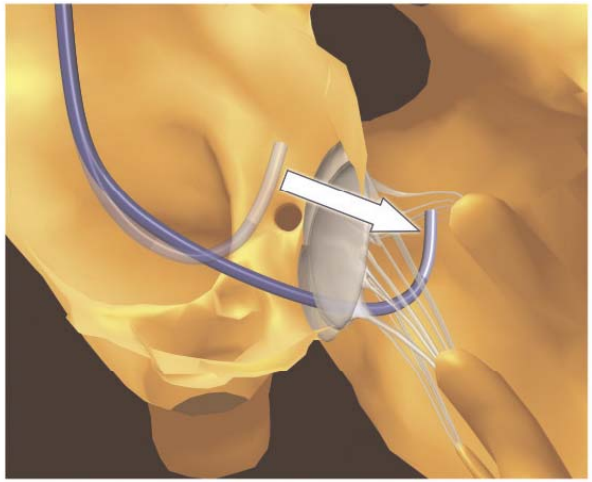
Insert the guide catheter along the 0.035-inch guide wire, and advance to the right atrium.

Hypotension and dyspnea during CRT implantation

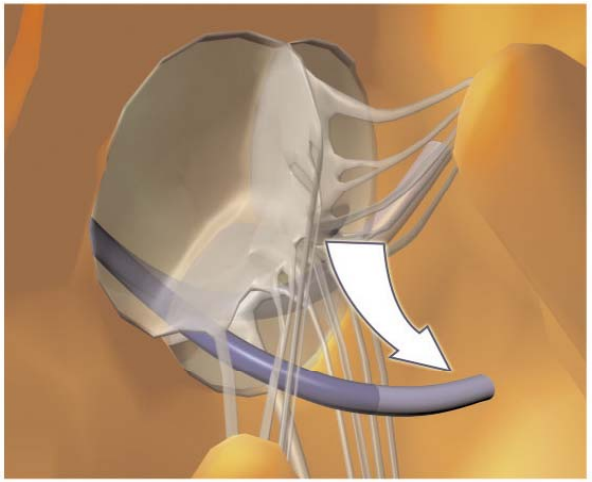


Air embolism

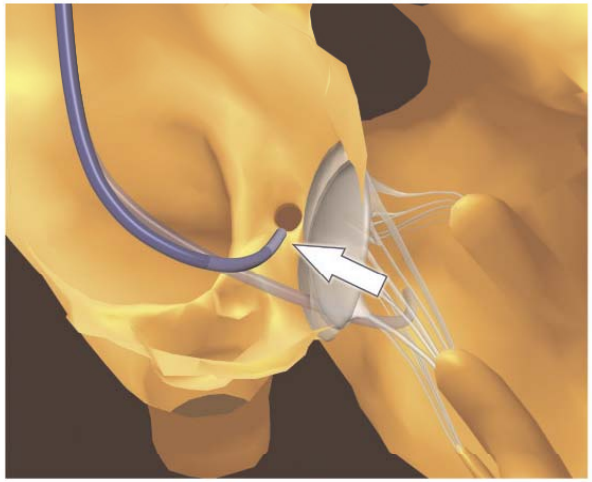
Locating and Cannulating the CS



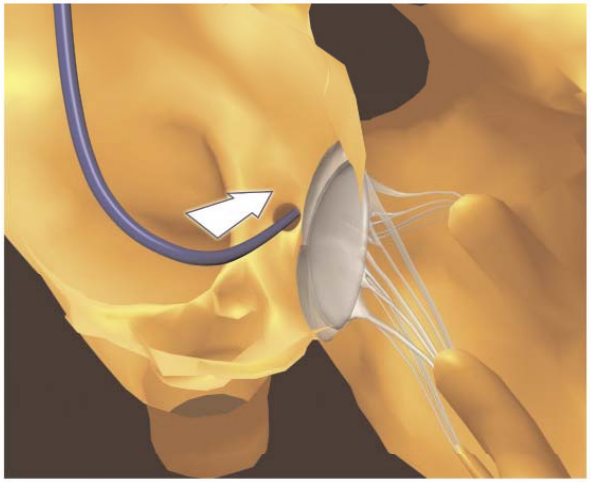
#1 Cross
Advance the guide catheter until it crosses the tricuspid valve



#2 Torque
Torque 90° counterclockwise to maneuver the tip to the same plane as the CS ostium (os)



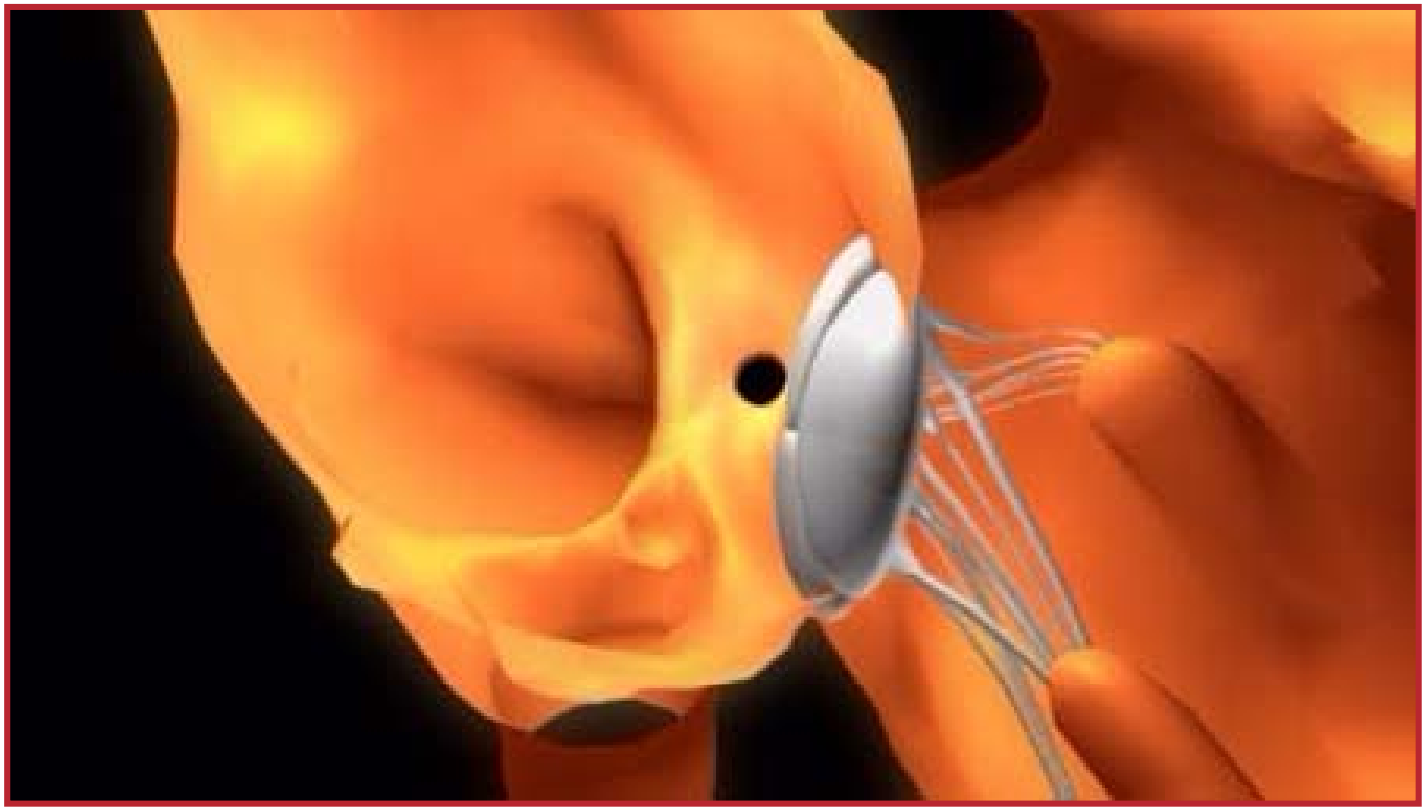
#3 Back
Maintain torque while pulling the catheter back into the RA



#4 Forth
Maintain torque and advance the catheter forward into the CS os

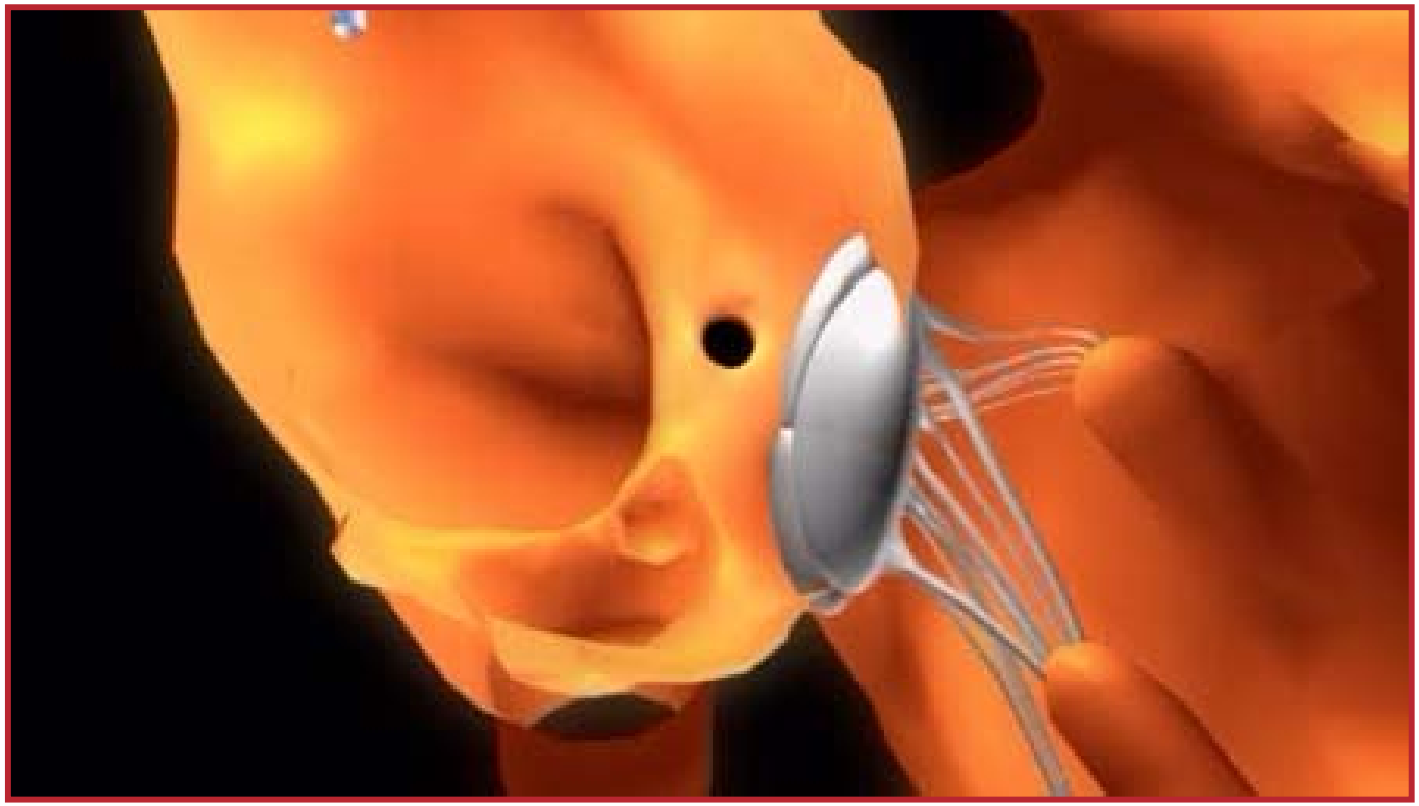
Locating and Cannulating the CS

Cross, Torque, Back and Forth



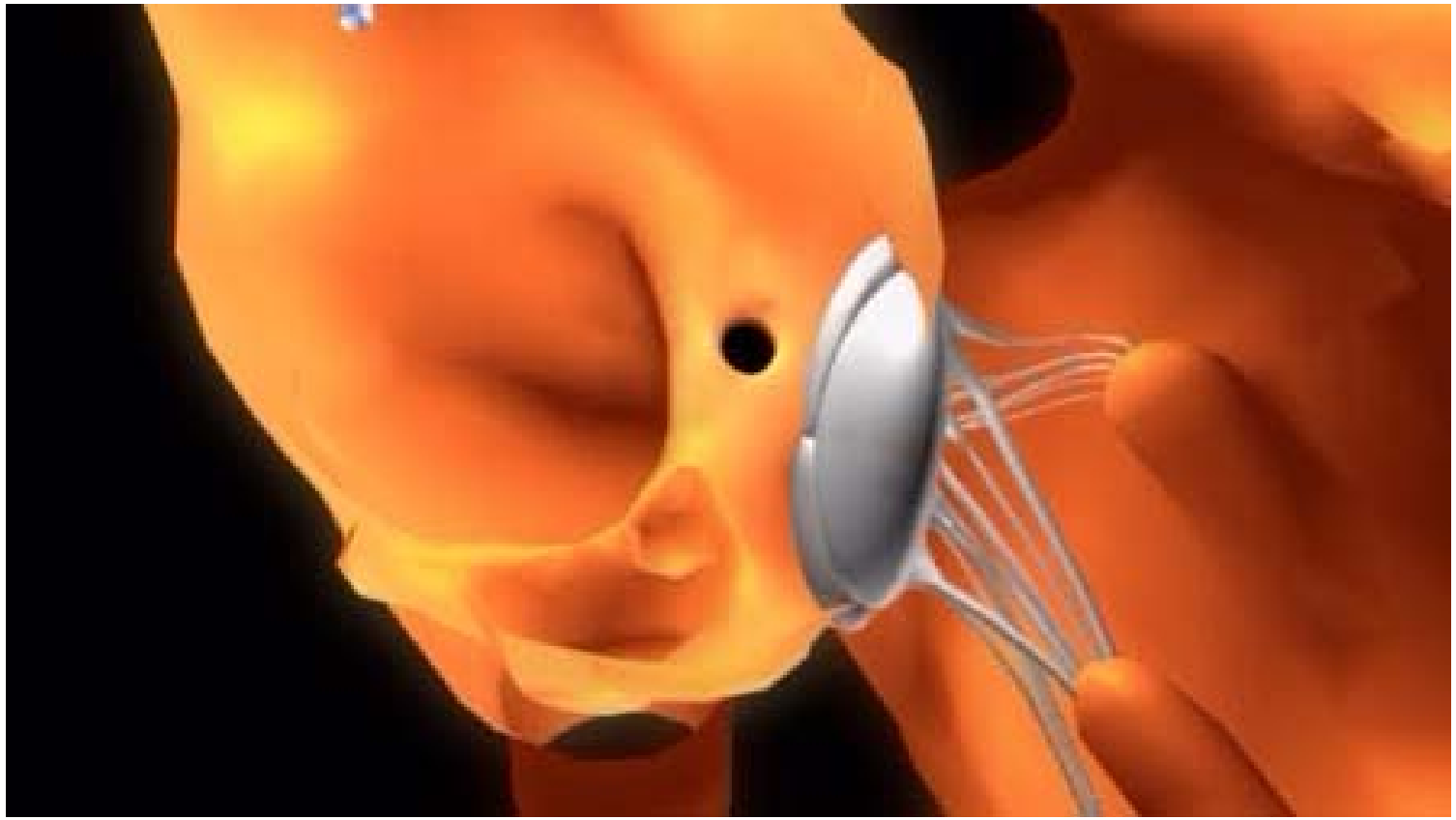
Locating and Cannulating the CS

Guide Wire Search



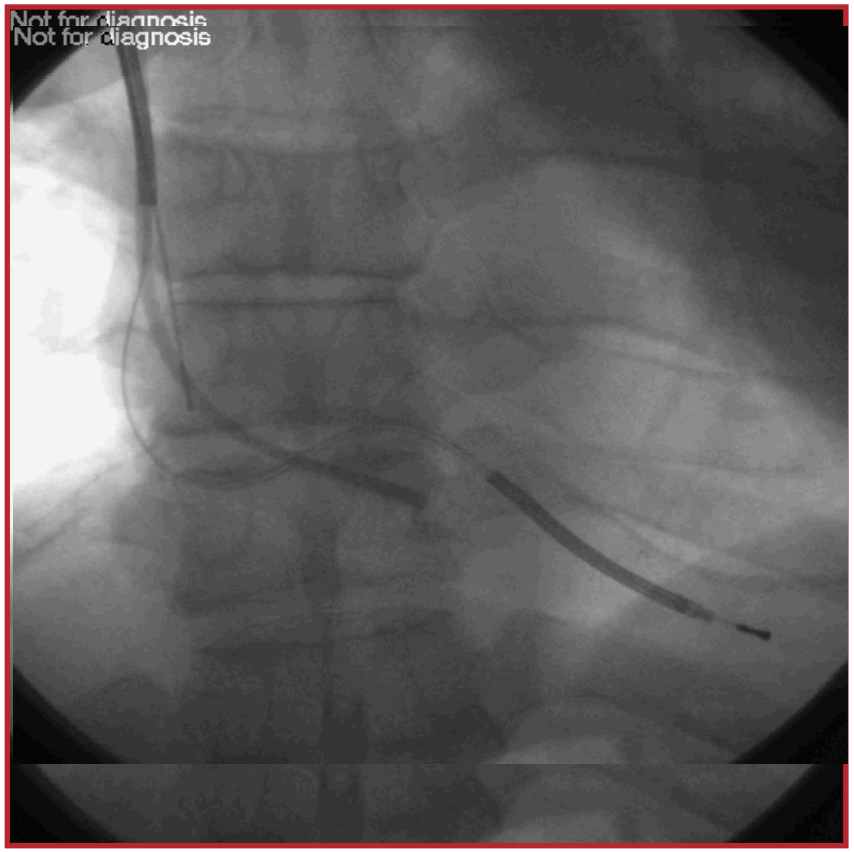
Locating and Cannulating the CS

Dual-catheter System and Out-of-Plane Search



Locating and Cannulating the CS

Confirming 8 Fr Guide Catheter Location in the CS



Movie

Completing CS cannulation

- Proper seating of CS guide catheter
  - Push-pull method for sheath delivery
  - Wire: the farther, the better
  - Sheath or catheter: 3-4cm from CS os
- Navigate beyond sharp angle
  - Counterclockwise or clockwise torque
  - Flushing at RAO & LAO to confirm CS main body

Tough CS cannulation

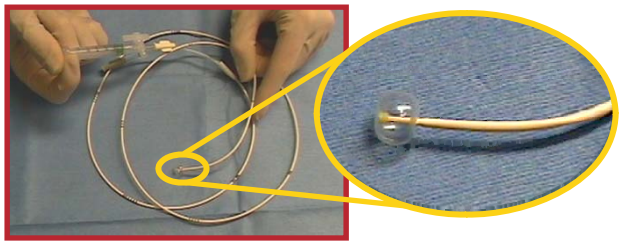
- Contrast flushing at LAO in low RA
- Change sheath of different curve
- Deflectable EP catheter via short sheath
- Cannulate CS os from femoral vein
- Coronary angiogram levo phase

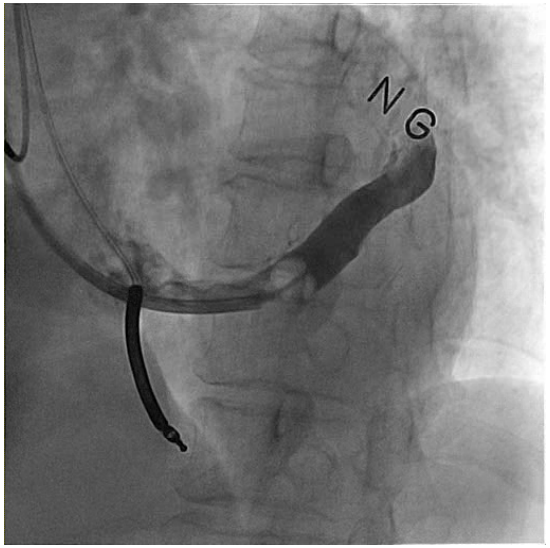
Obtaining a Venogram

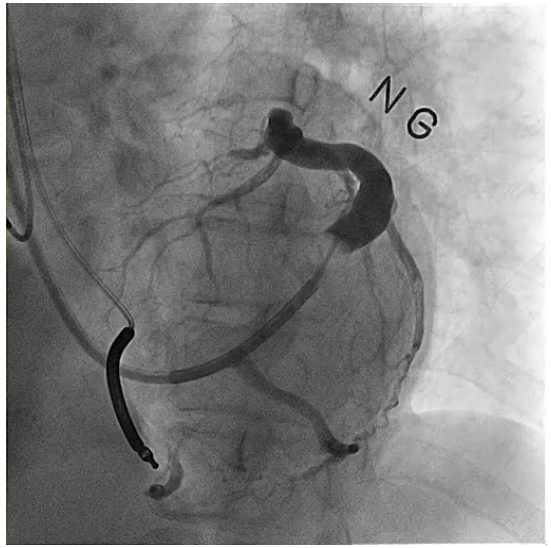
Using an Occlusion Balloon Catheter

An occlusion balloon catheter may be used to prevent back flow of contrast during the venogram

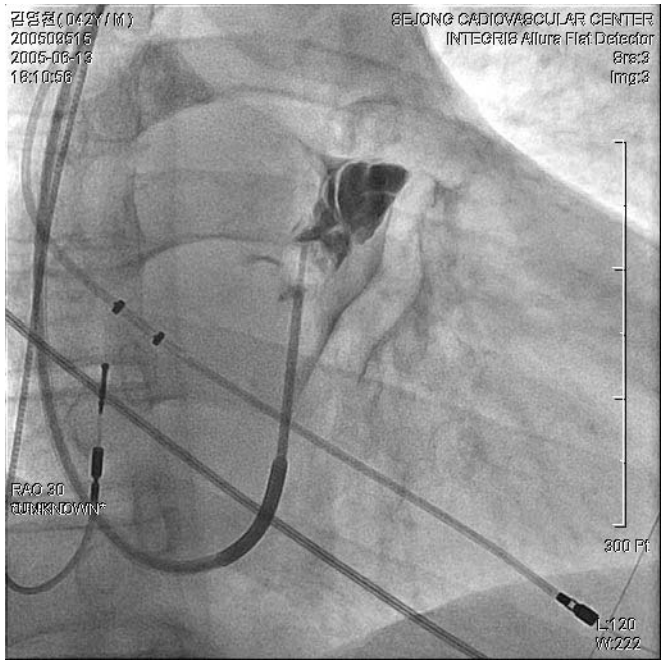
- This may provide better visualization of the distal vein branches
- Verify the balloon tip location by contrast puff
- Proper position and pressure of balloon to get the good image

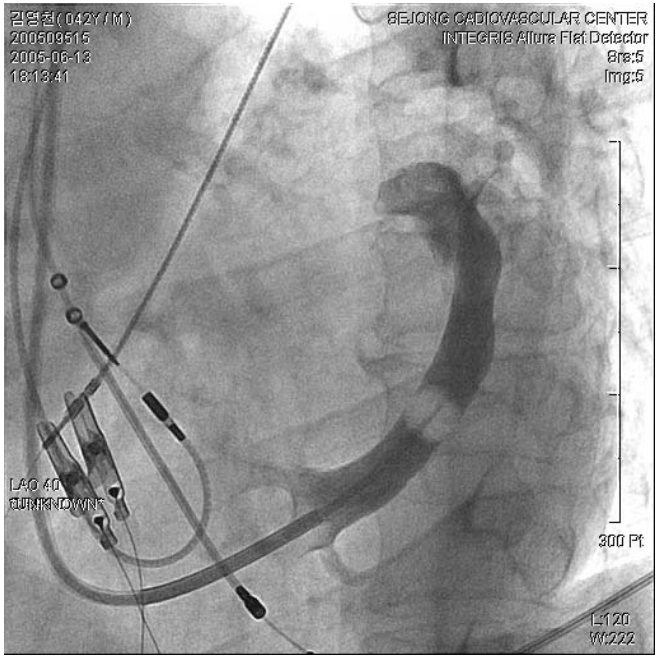


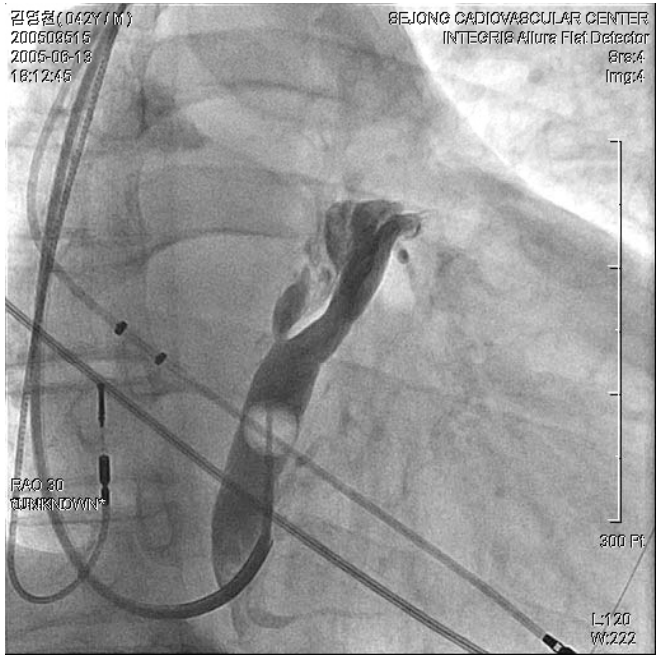




Cornary Sinus dissection during CS angiography –Ballooning in the small branch



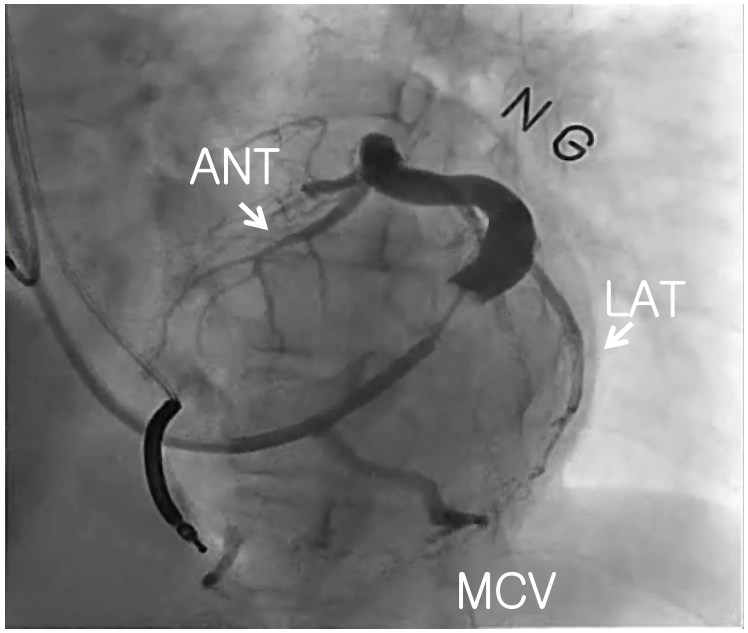




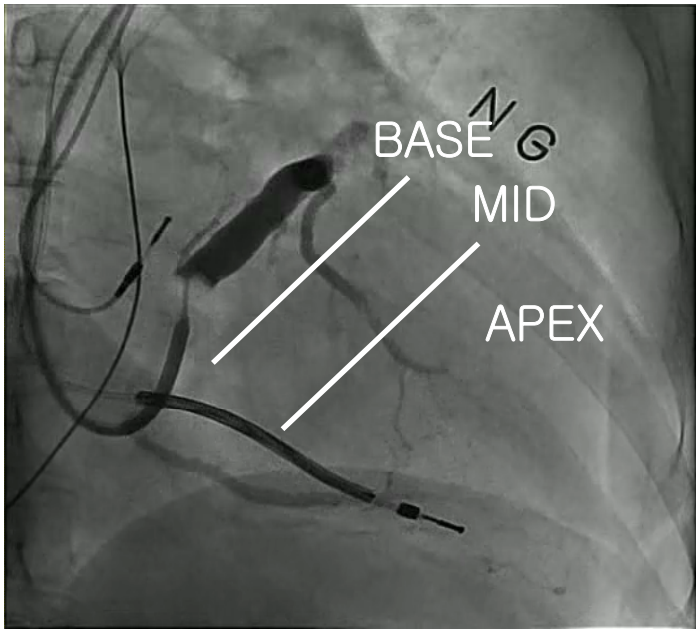
Perform venogram at LAO 25°–40° and RAO 30° to determine the target branch

LAO: to define the branch of coronary sinus to LV
(posterolateral or lateral > anterior or MCV)

RAO: to define the level of branch (base to apex)
(mid or apex for lead stability)



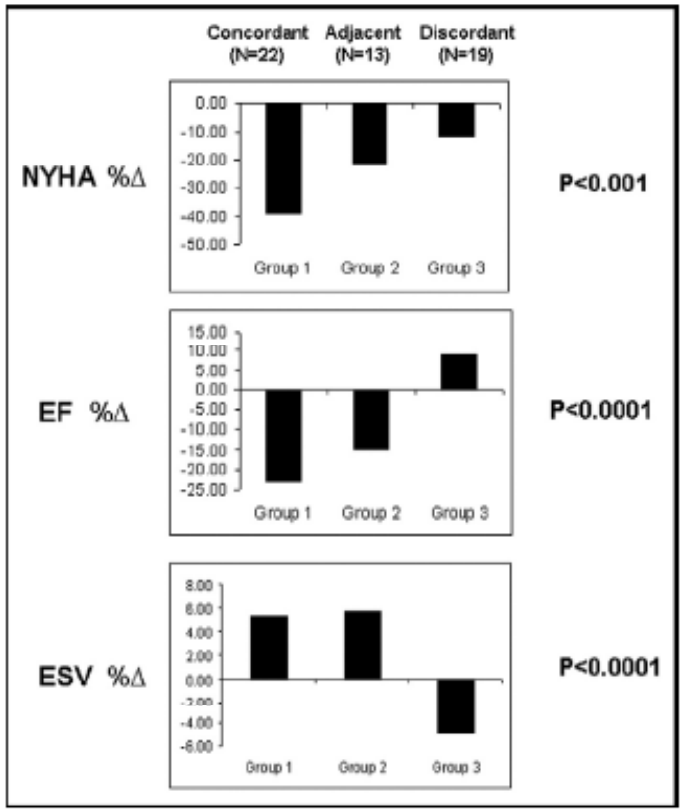
LAO 30

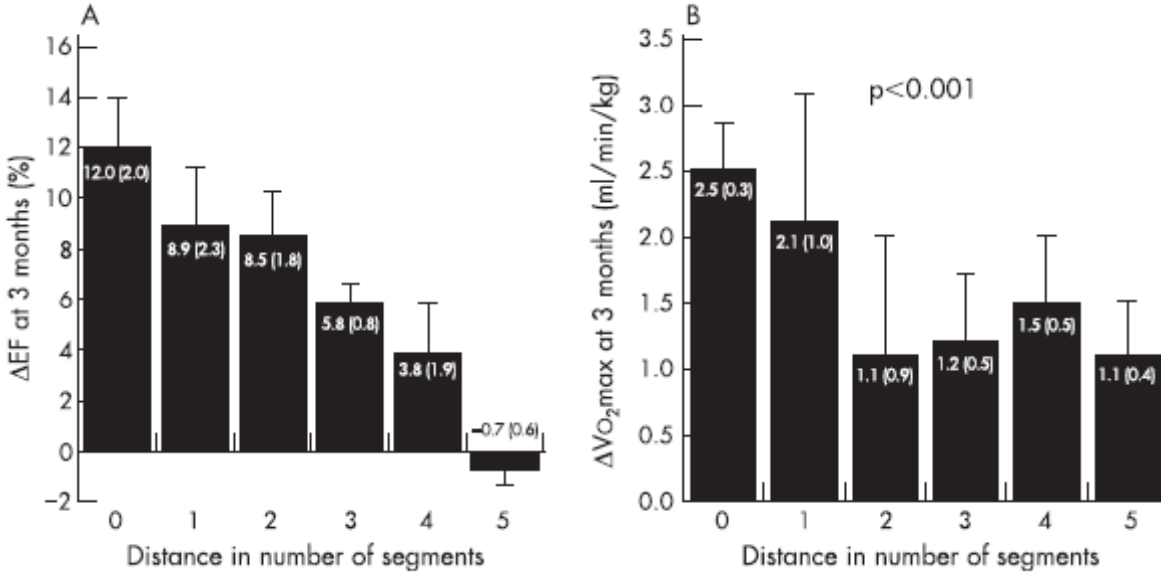


RAO 30

Selection of optimal branch of CS

- In recent study, concordance of the LV lead site and location of the latest systolic contraction on echocardiography results in greater improvement of LV function.



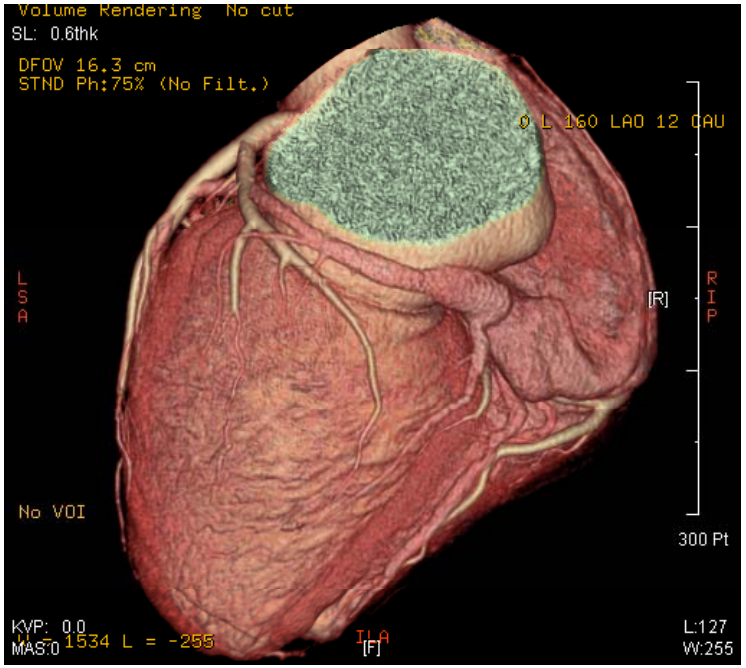


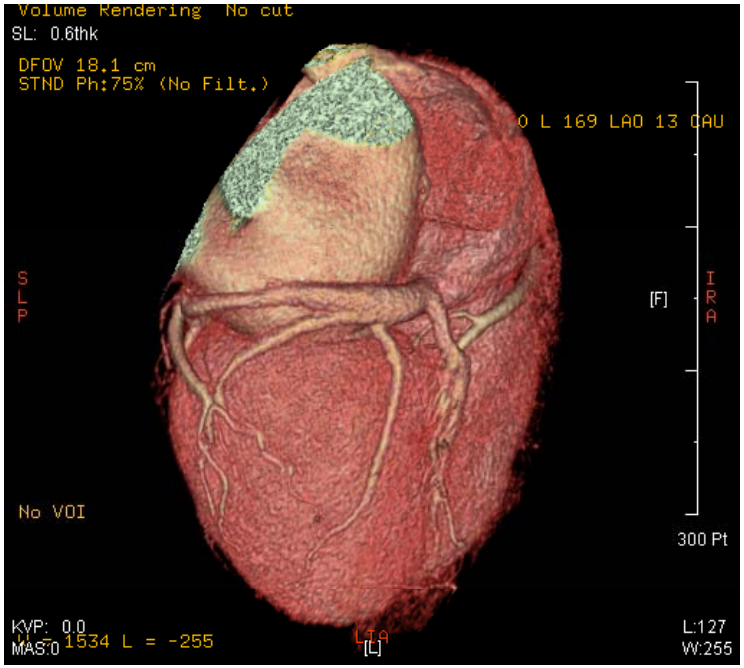
Am J Cardiol 2006;97:1615–1621

Heart 2007;93;1197–1203

Selection of optimal branch of CS

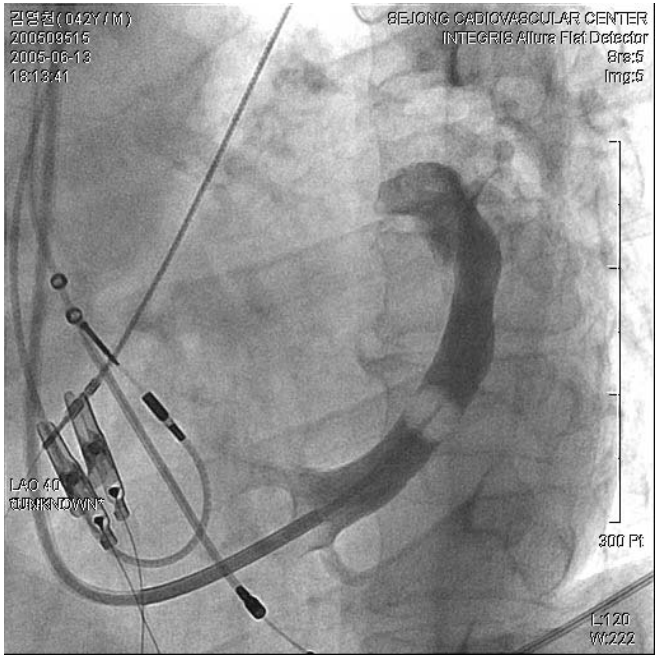
- Recognition of precise CS anatomy before procedure might be helpful by levo-phase coronary angiography or MDCT (if possible) to match the pacing site and the latest contraction.

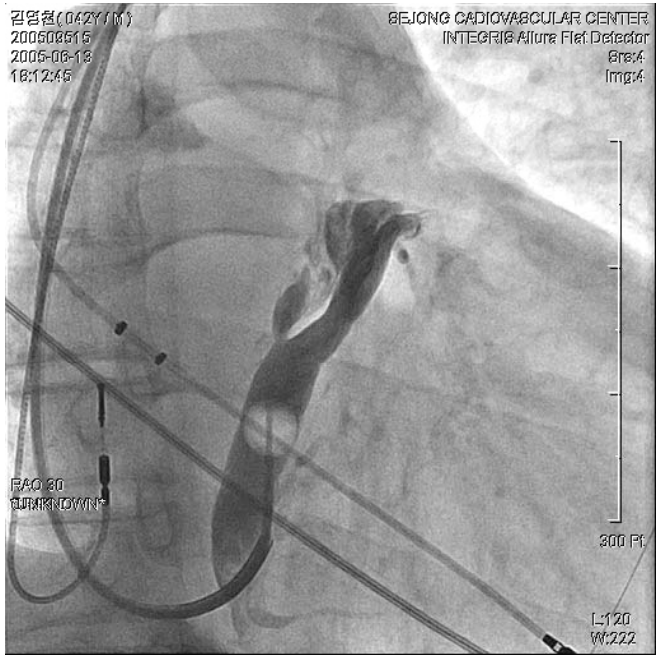




Selection of optimal branch of CS

- If there is no available branch at posterolateral area, it is better to implant LV lead under open thoracotomy rather than anterior branch or middle cardiac vein.





Transseptal endocardial left ventricular pacing: An alternative technique for coronary sinus lead placement in cardiac resynchronization therapy

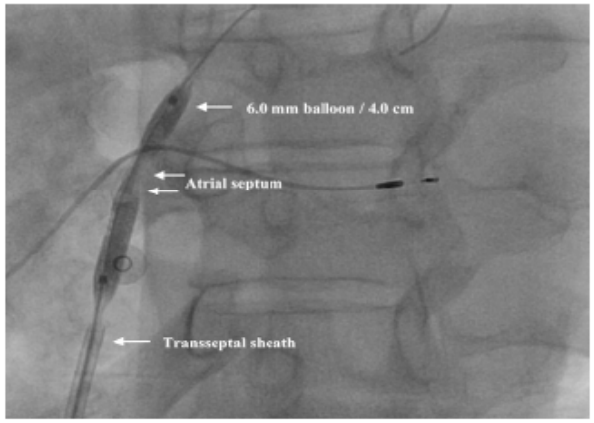


Figure 2 Anteroposterior view during inflation of the 6-mm balloon showing indentation at the level of the atrial septum.

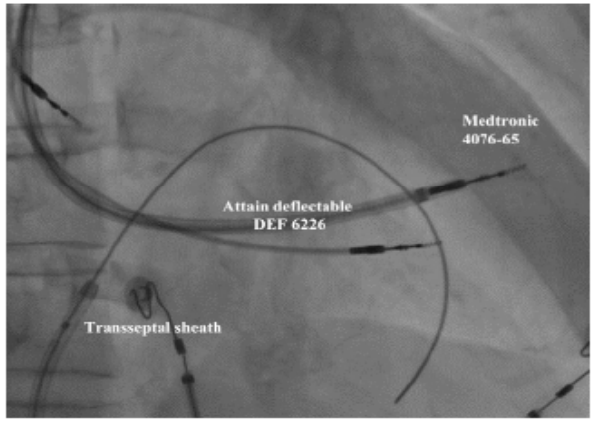


Figure 4 Anteroposterior view showing the Medtronic deflectable sheath in the LV. The right Judkins catheter and Terumo guide wire are removed, and the Medtronic 4076 is positioned in the basal part of the posterolateral wall of the LV.

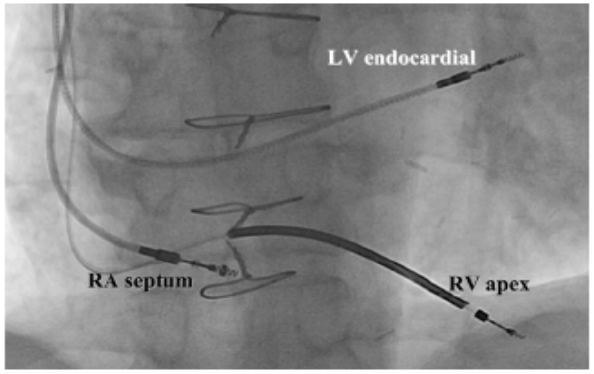


Figure 5 Example of an anteroposterior view showing the position of the three leads, with the LV lead transseptal and endocardial in the posterolateral area.

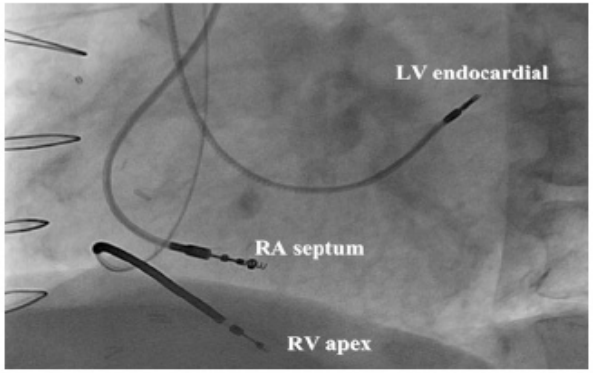
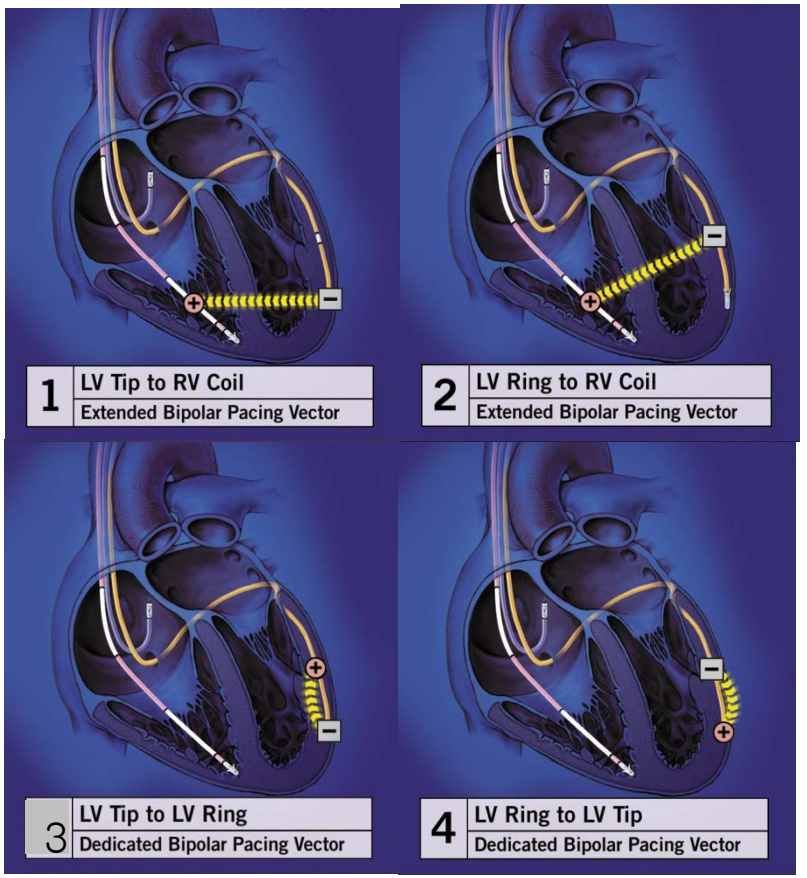


Figure 6 Example of a left anterior oblique view showing the position of the three leads with the LV lead transseptal in the posterolateral area.

Heart Rhythm 2007:4:454–460

LV lead delivery

- Select LV lead
  - Bipolar or unipolar lead
  - Curved or straight
- Select delivery system
  - Stylet driven
  - Over the wire
  - Inner guide catheter with contrast puff



LV lead delivery (some tips)

- Similar technique as PCI
- Position the guide wire as distal as possible
- exchange more stiff wire if more support is needed
- Advance sheath for added support
- Buddy wire technique for acute anguation

Evaluating Sensing and Pacing Thresholds

- Optimal threshold values should be below 2.5V (@0.5ms), however, values up to 4 V could be acceptable if there is no other choice
- Phrenic nerve stimulation or direct diaphragmatic stimulation should be absent upon the maximal output in the pulse generator

Removal of guide catheter

- Place the finishing wire or stylet in the lead for stable position during removal
- Keep camera in RAO view and watch the LV lead tip during removal

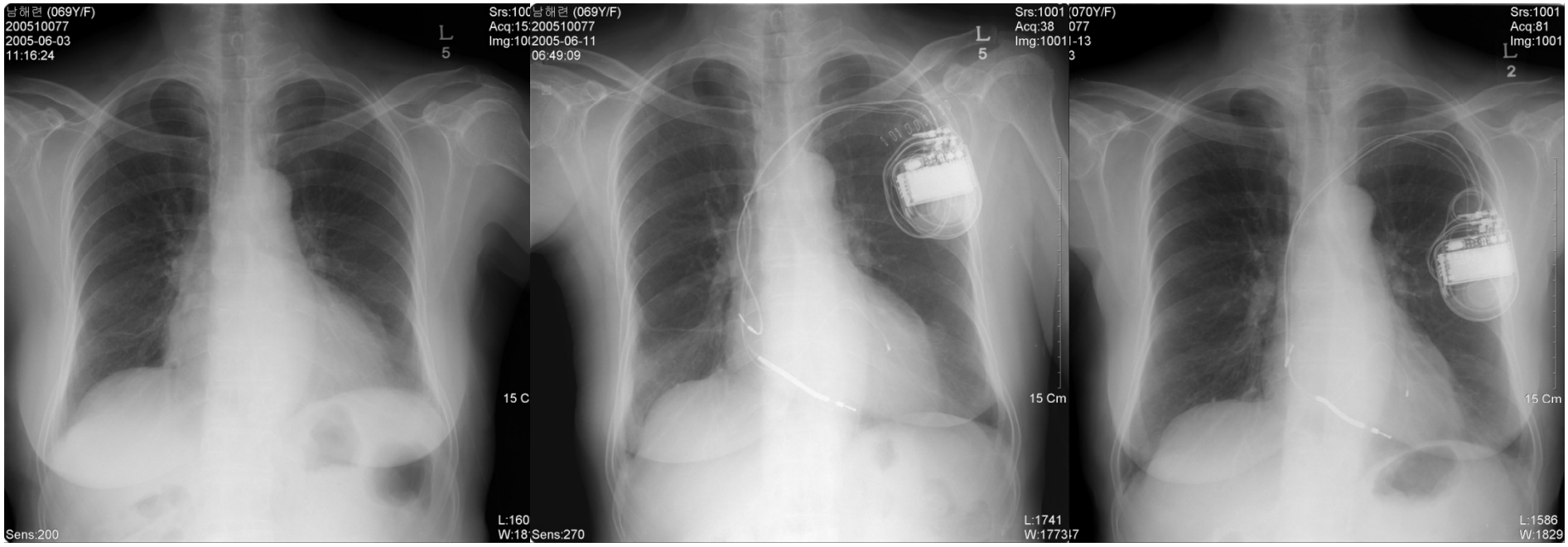
Securing the lead

- Recheck the electrical parameters of leads
- Sew in the lead
- Attach leads to can
- Check connection
- Subcutaneous and skin closure

When to stop

- Beginner (<50 cases)= 5 hours
- Experienced (>100 cases)= 3 hours
- Failure to impland LV lead (10-15%)
  - Implant BiV Can
  - Retry or send for epicardial LV lead

Thank you for attention



Before CRT

CRT 1 day

CRT 7 months