بسم الله الرحمن الرحيم
Implantation of Cardiac Resynchronization Therapy device (CRT-P)

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Results: CRT-P
Results: All CRT-D/CRT-P
Results: CRT-D as percentage of all CRT
Cardiac resynchronization Therapy

- Cardiac resynchronization: Optimization of AV delay + pre-exciting the lateral LV wall:
  - Improves CO
  - Increase hemodynamic performance
  - Reduction of symptoms
  - Reverse remodeling

ECG depicting IVCD

ECG depicting cardiac resynchronization
Desynchronized
Desynchronized
Synchronized
Synchronized
CRT rational: COMPANION

- COMPANION (Comparison of Medical Therapy, Pacing, and Defibrillation in Chronic Heart Failure)

**Overview:** Conducted to determine if the implantation of a low or high voltage device could help achieve resynchronization therapy in patients not indicated for either device.

**Results:** Demonstrated that CRT and CRT-D devices reduced **morbidity and mortality** in the most symptomatic HF patients.
CRT rational: CARE-HF

- CARE-HF (Cardiac Resynchronization in Heart Failure Study)
  - **Overview:** Studied the effects of CRT-only (no defibrillation capability) on morbidity and mortality.
  
  - **Results:** 36% reduction in all cause mortality and 52% reduction in unplanned cardiovascular hospitalizations in the CRT arm.
ICD/CRT Trial Summary: Reduction in All Cause Mortality\textsuperscript{1-6} or Heart Failure Event\textsuperscript{6}

- MADIT\textsuperscript{1}: 54%
- MUSTT\textsuperscript{2}: 55%
- MADIT-II\textsuperscript{3}: 31%
- SCD-HeFT\textsuperscript{4}: 23%
- COMPANION\textsuperscript{5}: 36%
- MADIT-CRT\textsuperscript{6}: 29%

ACC/AHA/HRS Recommendations for CRT Implantation

- **Class I:**
  - LVEF $\leq 35\%$, QRS $\geq 0.12$ seconds, NYHA III or IV and sinus rhythm

- **Class IIa:**
  - LVEF $\leq 35\%$, QRS $\geq 0.12$ seconds, NYHA functional Class III or ambulatory IV and AF
  - LVEF $\leq 35\%$, NYHA functional Class III & ambulatory IV symptoms
  - and frequent dependence on ventricular pacing
Case presentation
Three Wires introduction through subclavian vein puncture
Shock lead insertion
Shock lead insertion
Shock lead insertion
Shock lead fixation
Transvenous LV lead placement

Transvenous via CS, to the left side of the heart, using a branch of it, to position the LV lead.
Anatomy of Coronary venous system

- Coronary Sinus
- Posterior vein
- Postero-lateral vein
- Antero-lateral vein
- Anterior vein
- Middle cardiac vein
- Small cardiac vein
X-ray Projections

RAO

LAO

Asirvatham 2004
Where to pace the LV? sites

- BV pacing: Lead Position
  - Latest LV activation
  - Lateral or posterolateral LV base
  - Target location: lateral or posterolateral CS vein

**Pulse Pressure (%) ↑**

- ANT: 9
- LAT: 18*
- POST: 10

**LV +dP/dt (%) ↑**

- ANT: 17
- LAT: 30*
- POST: 24

- BASE
- MID
- APEX

Coronary Sinus Target Veins for CRT

- Anterior Vein
- Lateral Vein
- Postero-lateral Vein
- Posterior Vein
- Middle Vein
LV lead introducer preparation
Coronary Sinus Anatomy

CS os and Tebesian valve

• At the CS os a valve is present;

• This valve usually consist of a very small leaflet

• In some individuals it may close most of the os, thus creating an obstacle to the entrance in.
Probing the Ostium
Guiding catheter

- 3 models well-suited for approaching CS from below
- 2 models well-suited for approaching CS from above
- 2 models to support right-sided implants
How to locate the CS Os?

- Use LAO projection 30°
- Use guiding catheter +
  - Diagnostic catheter (Multi purpose, amplatz II)
  - EPS catheter (Josephson curve, CSL deflectable, ablation)
  - Specialized cannulation inner catheters
  - Luminary catheter (deflectable inner catheters with lumen)
- Atrial angiograms
  - Through guiding catheter
  - Pigtail power injection
  - Consider coronary angiography
Probing with Steerable EP Catheter
Cannulation of CS os using Ep Catheter
Cannulation of CS os using Ep Catheter
Coronary Sinus angiography

Several observations support the need to perform CS angiography before advancing and placing the lead into a CS branch:

- Anatomical variants
- Chamber dilatation
- Venous valve, tortuosity, compression

- Long runs to look for collateral filling
- Obtain images in at least 2 views
- Ensure full visualization of CS branches
- Store images
Coronary Sinus angiography
Venogram in LAO projection
Vein target selection:

- Position:
  - Best: Lateral or posteriolater vein
  - Other options: posterior, middle cardiac vein, anterior

- Diameter:
  - not too small not too large

- Pacing threshold:
  - < 1.5 - 2 V

- Phrenic nerve stimulation:
  - Not present when pacing at 10 V
Different target vein off-sets
PTCA wire introduction & branch selection (OTW technique)
PTCA wire in target vein
PTCA wire in target vien
Lead advancing over the PTCA wire to target vein
Lead advancing over the PTCA wire to target vein
Lead advanced over the PTCA wire to target vein
Electrical testing: Phrenic nerve stimulation solution:

1. little movements

2. Change polarity: Bipolar, unipolar, LV tip to RV ring, LV ring to RV ring (change the course of the electrical depolarization wave away from the Phrenic nerve)

3. Change vessel

- Bipolar
- Common Ring
- Ring-Ring
Problem: CRT Pacing Complications

- Incidence rates for high pacing thresholds are between 10-20% \(^1\)
- A recent study documented Phrenic nerve stimulation in 37% of CRT patients at implant or follow-up \(^2\)

Solution:

- Only St. Jude Medical offers quadripolar pacing with more options to manage common pacing complications

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2: Biffi et al. CIRCEP. Aug.2009:402-10
3. B. Thibault et al. Pacing electrode selection in a quadripolar left heart lead determines presence or absence of phrenic nerve stimulation; EUROPACE; advance access Jan 15, 2010
Peeling the introduction sheath
Pealing the introduction sheath
PTCA wire withdrawal
LV lead fixation
Atrial lead insertion
Atrial lead fixation
Battery connection
Final view of the system in AP
Final view of the system in AP projection
Final view of the system in RAO projection
Final view of the system in LAO projection
Final view of system in lateral projection