Pacemaker, ICD and CRT Lead-induced Central Venous Stenosis: What is the right approach?

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Evolution of ICD Therapy: 1980 to 2002

Number of Worldwide ICD Implants Per Year (Ref: Corporate Market Share Database)

USRDS 2006

USRDS - 2007
**Cardiovascular Implantable Electronic Devices - CIEDs**

- **Pacemakers**
- **Implantable Cardioverter-Defibrillators (ICD)**

**Cardiac Resynchronization Therapy (CRT)**

- Right Atrial Lead
- Right Ventricular Lead
- Left Ventricular Lead

**Cardiac Rhythm Device Lead Complications**

- Tricuspid Regurgitation
- Infection
- Venous Stenosis

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*Carrillo RG, Garisto JD, Salman L, Merrill D, Asif A. AJKD, 2010*
I. Tricuspid Valve Regurgitation

- Severe Tricuspid regurgitation can happen in 26.2% of patients with cardiac rhythm devices (NYHA III & IV).
  - Lead adherence.
  - Lead induced valve perforation.
  - Lead induces impingement of the valve.
  - Lead entanglement.


Becker et al. Circulation 1972;46;409-412
Vecht et al. British Heart Journal, 1976, 38, 1359-1362


II. Cardiac rhythm devices lead infection

- Rate of lead infection in the general population ranges from 0.8% to 5.7%.

- Patients with chronic kidney disease are at an increased risk of infection.
  - Fontenaille C et al. Septicema 1993;64:95-100
  - Jaber BL et al. Kidney Int. 2000;58:1758-1764

- Infection is the second leading cause of death in end stage renal disease patients.
  - US Renal Data System, USRDS 2009 annual data report

- Annual percentage of mortality secondary to sepsis can be 100 to 300 fold higher in dialysis patients compared to general population.

- Device infection is a potentially life-threatening complication of cardiac device implantation.
  - UpToDate 2009

- Staphylococcus continues to be a major culprit (60%) causing lead-induced endocarditis.

- Multivariate predictors of cardiac device infection

  - CHF = congestive heart failure.
  - High creatinine is defined as Cr ≥ 1.5 mg/dL and low GFR as CrCl ≤ 60 mL/min/1.73 m².


  - Lekkerkerker J C et al. Heart 2009

Certain Realities

- Lekkerkerker J C et al. Heart 2009

- Ishani et al. The USRDS Wave 2 study, Kidney Int 68 (2005)
Logical Points to Consider

Arteriovenous Access

Tunneled Dialysis Catheter

Arteriovenous dialysis access-associated transvenous pacemaker infection

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Abstract: Pacemaker (PM) and other cardiovascular distribution and cardiac rhythm disturbance therapy devices also provide support to chronic dialysis patients with cardiac rhythm abnormalities. However, these devices can get infected. In general, device infection is either primary or metastatic spread from a distant source. Arteriovenous grafts are commonly used to provide dialysis therapy. Compared to a fistula, an arteriovenous graft has a higher risk of infection. In this analysis, the skin overlying the graft usually shows signs of infection (tenderness, erythema). The process of blood can be successfully removed by the flow, but removal of the graft is usually required to completely get rid of the infection. However, if other factors are present in the body, the bacteria can cause metastatic spread of infection to these devices. Indeed, antibiotics targeting a transvenous procedure.

Carrillo RG, Garisto JD, Salman L, Asif A. Clinical Nephrology, July 2010

CASE REPORT

Contamination of Transvenous Pacemaker Leads Due to Tunneled Hemodialysis Catheter Infection: A Report of 2 Cases

Roger G. Carrillo, MD, Juan D. Garisto, MD, Leon Salaman, MD, Donna Merrill, RN, and Asif Asif, MD

Carrillo et al. report two patients with tunneled hemodialysis catheters and pacemaker-related bacteria. In both cases, the pacemaker-related bacteria were isolated from the patients' bloodstream during hemodialysis therapy. The patients were treated with antibiotics and therapies, but the pacemaker-related bacteria persisted. In one case, the pacemaker-related bacteria were isolated from the bloodstream during hemodialysis therapy. The patients were treated with antibiotics and therapies, but the pacemaker-related bacteria persisted.

Carrillo RG, Garisto JD, Salman L, Asif A. AJKD, 2010


INDEX WORDS: Hemodialysis, pacemaker, tunneled dialysis catheter, catheter-related bacteremia.


End-Stage Disease in the Kidney

Carrillo RG, Garisto JD, Truex M, Merrill D, Asif A. AJKD, 2010


INDEX WORDS: A73.14, A73.15, A73.16, A73.17, A73.18, A73.19


INDEX WORDS: A73.14, A73.15, A73.16, A73.17, A73.18, A73.19

III. Central Venous Stenosis

What is the Incidence of CRD lead induced Central Venous Stenosis?
Venous lesions are frequent (64%) 6 months after transvenous PM implant. Severe and occlusion occurred in one of three cases.

Even though venous lesions are frequent, the population of symptomatic patients is small (5.2%). (Edema 2.6%, PE 2.6%)

10 of the total 14 patients with dialysis access ipsilateral to the PMs developed symptoms in a period of 2 weeks – 38 months.

The 4 patients who did not develop symptoms died within 6 months of dialysis access placement or transvenous pacemaker placement.

All symptomatic patients eventually underwent ligation of the dialysis access to control symptoms. After AV access ligation, all patients had resolution of arm symptoms.

Treatment:
Lead induced central venous stenosis

Historic perspective

Treatment:
Lead induced CVS
I. Access ligation

- 10 of the total 14 patients underwent ligation of the dialysis access to control symptoms. After AV access ligation, all patients had resolution of arm symptoms.

- After AV access ligation:
  - Four of these patients had subsequent contralateral extremity access.
  - Four patients had catheters as their long-term access.
  - Two patients had lower extremity access.


II. Planning

- There was a statistical difference in the rate of symptoms of the group with ipsilateral pacemakers and dialysis access (10/14) compared with the group that had contralateral pacemakers and access (0/6) (p = 0.015).

May be eliminating other side as an option.
SVC is a common path.

Asif A, Salman L et al. Semin Dial. 2009 Nov-Dec

Q. What percent of your hemodialysis patients have multiple vascular accesses?
Q. What percent of your hemodialysis patients have exhausted one upper extremity and gone to the other upper extremity for vascular access creation?

Data from Sharon Funk: Biotrend research

III. Angioplasty and Stent placement while leads in place

- Saad TF, Myers GR, Cicone J.
  Central vein stenosis or occlusion associated with cardiac rhythm management device leads in hemodialysis patients with ipsilateral arteriovenous access: A retrospective study of treatment using stents or stent-grafts.
  J Vasc Access. 2010 Jul 22

- Konner K, Vorwerk D:
  Permanent pacemaker wires causing subclavian vein stenosis in the presence of AV fistula – is it ever wrong to try angioplasty and stenting?
**Lead associated infection is relatively a common complication of CRDs.**

**Entrapped leads may require a complicated procedure.**

**Most of our patients are high risk patients.**

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**Treatment:**

**Lead induced CVS**

- Access ligation
- Planning
- PTA + Stent
- Lead retrieval
- PTA + Stent
- Lead placement

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### IV. Lead retrieval, PTA with stent placement followed by new lead placement

**Problems:**

1. This procedure might need to be repeated frequently in ESRD patients.
2. Add Two extra procedures.
3. Need to be done by (or with) a CT surgeon.
4. Reason for stenosis still exist.
5. Infections complicate treatment significantly if transmitted to stent.
How about angioplasty alone?

- Chronic hemodialysis patients with PM/ICD devices presenting with signs and symptoms of CVS were included in this analysis (06/2001-03/2009).
- Primary patency was defined as that time period during which no procedure or intervention was required to maintain patency.
- Secondary patency after intervention was defined as patency until the access was surgically revised, clotted, abandoned or lost to follow-up.
- The data for this retrospective cohort study were derived from eight Interventional Nephrology laboratories from the United States.


Leads safety post angioplasty!
ASDIN 8th Annual Scientific Meeting
PreCourse

Cardiac Rhythm Device Lead Complications

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PreCourse

Epicardial CIED

Heart Rhythm, May 2010

Surgically placed left ventricular leads provide similar outcomes to percutaneous leads in patients with failed coronary sinus lead placement

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POSTER BOARD Cardiac resynchronization therapy using a left ventricular (LV) lead placed via the coronary sinus (CS) increases symptomatic improvement vs. standard LV leads in patients with severe left heart failure (LHF). However, the efficacy of this procedure in patients with prior CS lead placement is unknown. The goal of this study was to determine the outcome of patients who have previously had an LV lead placed via the coronary sinus and subsequently undergo cardiac resynchronization therapy (CRT) using a CS lead placed via the transapical approach.

METHODS: A total of 31 patients underwent CRT using the transapical approach. Cardiac resynchronization therapy (CRT) was performed using a CS lead placed via the transapical approach.

RESULTS: No patients in the cohort had prior CS lead placement, and 13 patients who had prior CS lead placement were excluded from the study. The average age of the study population was 65 years (range: 36–82 years).

CONCLUSIONS: The transapical approach for CRT is an effective and safe method for patients with previous CS lead placement.

Tunel cardiac pacing in pediatric patients

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INTRODUCTION: There has been an increase in the number of pediatric patients who undergo cardiac surgery for congenital heart defects. One of the most common complications after surgery is atrioventricular (AV) valve regurgitation, which can lead to severe valve dysfunction and eventual heart failure.

METHODS: A total of 521 patients underwent 299 surgical procedures for congenital heart defects. The transapical approach for CRT was used in 31 patients who had prior CS lead placement, and the transapical approach was used in 21 patients who had prior CS lead placement.

RESULTS: The transapical approach for CRT was associated with lower rates of device-related complications and shorter hospital stays compared to the standard approach.

CONCLUSIONS: The transapical approach for CRT is a safe and effective method for patients with previous CS lead placement.

Preservation of central venous real estate


CONCLUSION: Our study demonstrates that the transapical approach for CRT is an effective and safe method for patients with previous CS lead placement.

Epicardial Cardiac Rhythm Devices for Dialysis Patients: Minimizing the Risk of Infection and Preserving Central Veins

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Abstract

Epicardial Cardiac Rhythm Devices (CIEDs) are a safe and effective treatment option for patients with advanced heart disease. However, the risk of infection and preservation of central venous access remains a concern for patients undergoing dialysis.

Methods: A total of 10 patients underwent epicardial CIED implantation. All patients had undergone previous attempts at percutaneous lead placement, which resulted in infection. The transapical approach was used in all patients. The epicardial leads were placed using a transapical approach, and the pacemaker was connected to the leads through a transapical approach.

Results: All patients had successful implantation of the epicardial CIED system. There were no episodes of infection or other complications related to the epicardial lead placement or pacemaker implantation.

Conclusion: The transapical approach for epicardial CIED implantation is a safe and effective method for patients with previous percutaneous lead infection.

References:

Laser lead extraction: Complications

- 2,561 pacing and defibrillator leads were treated. Major perioperative complications (tamponade, hemothorax, pulmonary embolism, lead migration, and death) were observed in 1.9% of patients with in-hospital death in 13 (0.8%).

- 975 chronic endovascular leads were removed. Major complications occurred in 2 (0.4%) patients. Only one patient required cardiac surgery. No deaths occurred.
  Jones et al. Heart Rhythm. 2008 April

A modest proposal

I. Angioplasty...

II. If stenosis or symptoms reoccur in less than 3 months consider referral for lead retrieval and epicardial device placement.

III. Stent should only be considered in a palliative therapy situation.

IV. Patients with ESRD or progressive CKD who need CRD, consider an epicardial device as those patients are expected to need vascular access.

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