Cardiovascular Implantable Electronic Devices (CIEDs) and Hemodialysis Access

Vascular Access Society of the Americas Meeting
Haimanot (Monnie) Wasse, MD, MPH
Emory University School of Medicine
Renal Division/Interventional Nephrology
May 3, 2014
Then and Now....

2012

2014
CV Implantable device use increasing in ESRD patients

- Cardiovascular implantable electronic devices (CIED’s) are used to treat cardiac rhythm disorders in ESRD patients
  - Pacemakers and implantable cardioverter-defibrillators (ICD’s)

- Between 1996-2006, ~9500 US Medicare-insured ESRD patients underwent ICD implantation
  - 88% occurred after year 2000
  - CIED prevalence in ESRD estimated at ~10%

Charytan et al, AJKD, 2011
Saad T, Sem in Dial, In Press
CIEDs Confer Mortality Benefit in ESRD

- Similar to that of general population
- Despite competing risks, ICD’s confer significant survival benefit to ESRD patients with ventricular fibrillation, sudden cardiac death syndrome compared to ESRD patients without an ICD
- ICD use in ESRD patients associated with a 42% reduction in mortality
  - Similar to ICD benefit conferred to non-ESRD patients

Herzog C et al, KI, 2005
Desai AS et al, JAMA 2004
Considerations for HD patients with CIEDs

- Central venous stenosis
- High rate of infections
Central venous stenosis with CIEDs in ESRD patients

- Traditional CIED lead insertion route is transvenous
  - subclavian, cephalic veins
- Can occur at vein puncture site or any point in contact with CIED leads
  - Well described in non-ESRD patients
- CIED can be complicated by presence of AV access with $Q_a$ 1-2 L/min
  - Risk of symptomatic venous hypertension, especially if CIED is ipsilateral to AV access
Central Stenosis and CIED

- Teruya et al: Pacemaker and ipsilateral AV access led to symptomatic subclavian vein stenosis/occlusion in 10 or 14 patients

- Superior vena cava is susceptible to lead-induced injury, subsequent symptomatic SVC stenosis and occlusion
  - Estimated in as many as 18% of ESRD patients with CIED’s

Asif A et al, Semin Dial, 2009
Left subclavian vein CIED leads ipsilateral to AV access with left subclavian and brachiocephalic occlusion associated with severe venous hypertension.

86x86mm (300 x 300 DPI)

 Courtesy of TSaad from Sem Dial, 2014, In press

Left subclavian vein CIED leads ipsilateral to a left arm AV access with no associated central vein stenosis.

81x77mm (300 x 300 DPI)
Management of CIED-related symptomatic central stenosis

- Primary approach is angioplasty without stent placement
  - Primary patency 12-50% at 12 months
  - CIED + Ipsilateral AV access time to intervention is shorter and can require more interventions vs. contralateral access

- Stents have been used, yet no proven benefit that they result in superior long-term outcomes vs. PTA
  - Remove CIED, implant stent, reinsert CIED leads
  - Stent over CIED leads
    - Resultant lead entrapment could be highly problematic in setting of infection
    - May require thoracotomy to extract leads

Saad T, Sem in Dial, In Press, Kundu S, JVIR, 2010
Planning for CIED Placement: Lead Location

- Traditional CIED lead insertion route is transvenous
  - subclavian, cephalic veins

- Internal jugular vein CIED insertion is reported
  - Patients remain at risk for brachiocephalic or SVC stenosis from leads
  - May lose opportunity to use IJ for future dialysis access due to resultant stenosis

- Femoral vein use is rare
  - Risk damage to IVC, may compromise future lower extrem AV access

Varma N, PACE, 2008; Mathur G et al, Europace, 2001
CIED Lead Options: Endocardial vs. Epicardial CIED

Endocardial (transvenous) approach

Epicardial (surgical) approach
Alternate CIED Lead Options: Epicardial and Subcutaneous Approaches

- Epicardial Approach
  - More common in children
  - Leads traverse through subcutaneous tissue, avoiding central veins
  - Studies in children find epicardial lead survival comparable to transvenous endocardial leads

- Subcutaneous ICD’s
  - Highly sensitive at detecting V fibrillation and tachyarrhythmia's
  - Preliminary nonrandomized results encouraging

Beaufort-Krol GC et al, J Thorac Cardiovasc Surg, 1999
Bardy G et al, NEJM, 2010
CIED and Infection

- Retrospective case series reviewing Mayo Clinic Heart Rhythm Device Database, 1991-2008
  - 415 admitted with CIED infection; 17 ESRD patients

- Among ESRD, 41% had infected vegetations on CIED leads or cardiac valves
  - 82% required device removal

- Device infection associated with significant 90-day mortality in HD patients compared with non-HD patients (76% vs. 92%).

Hickson LJ et al, AJKD, 2014
Contaminated Pacemaker leads due to Tunneled CVC Infection with MRSA

3-D Color CT of patient with tunneled catheter in RIJ, central venous line in LJ inserted in ER. Pacemaker-chronic resynchronization therapy device in left chest with leads extending through subclavian, brachiocephalic and SVC. Note fibrous tissue wrapping catheter and leads together. Carillo RG et al, AJ KD, 2010
Prevention of central venous stenosis is key for ESRD patients with vascular access who receive a CIED.

Important to weigh benefits vs risks (including impact on current or future AV access).

Careful selection of veins for CIED leads, with avoidance of ipsilateral subclavian vein to existing or planned AV access will reduce likelihood of central stenosis.

Epicardial CIED leads may provide a solution for ESRD patients in certain circumstances.
ASDIN Recommendations

1. Preserve peripheral/central veins of advanced CKD (Stage 4-5) and ESRD patients receiving all forms of renal replacement therapy.

2. Collaborative review of benefits/risks/vascular access needs/overall prognosis prior to CIED placement.

3. In CKD or ESRD patients, conduct thorough venous assessment (duplex doppler, venography) prior to CIED or new AV access placement. Place on contralateral side of anticipated or existing AV access or CIED, respectively.

Saad T et al, Semin Dial, 2013
4. Consider epicardial leads among patients requiring new CIED or replacement of CIED leads.

5. PTA without stent placement should be utilized as preferred treatment of symptomatic central vein stenosis associated with transvenous CIED leads.

6. Avoid entrapment of CIED leads by stent. If necessary, first extract CIED leads and replace with alternative transvenous or epicardial route.
7. Avoid combination of long-term venous CVC’s + CIED’s due to risk of infection and central stenosis, and prioritize AV access creation in these patients.

8. Consider wearable cardioverter-defibrillators in those at risk for sudden cardiac death in patients with infection, with a CVC awaiting AV access creation, or when CIED indication hasn’t been established.
Wearable Cardioverter-Defibrillator Device

- Personal defibrillator effective for primary and secondary prevention of sudden cardiac death
- Continuous monitoring and delivery of treatment shock if needed
- Serves as bridge to CIED or transplantation
- Useful in early post-MI/revascularization setting or setting of infection when patient can’t receive a CIED
ASDIN Recommendations (cont.)

9. Preserve central veins in PD patients for future AV access; consider epicardial leads in PD; consider PD in hemodialysis patients with AV access complications from CIED lead-associated central vein stenosis
Acknowledgments

American Society of Diagnostic and Interventional Nephrology Clinical Practice Committee Workgroup

Ted Saad, MD
Dirk Hentschel, MD
Bruce Koplan, MD
Monnie Wasse, MD
Arif Asif, MD
Daniel Patel, MD
Loay Salman, MD
Roger Carrillo, MD
Jeff Hoggard, MD, Chair
CIED Implantation in ESRD or CKD Stage 4-5 Patients (GFR < 30)

ESRD or CKD 4-5 with indication for CIED

CIED collaboratively recommended by nephrologist, cardiologist, implanting physician, and primary care physician

Established AV Access
- Consider epicardial leads
  - Transvenous CIED contralateral to existing AV access, if epicardial leads not feasible

No Current AV Access
- Consider for peritoneal dialysis

Venous catheter access
- Avoid CIED implantation. Consider wearable cardioverter-defibrillator pending creation of AV access
  - Consider for peritoneal dialysis
  - Contract AV access ASAP and remove venous catheter prior to CIED implantation
- Venography and/or ultrasound vein mapping if PD not feasible
  - Consider epicardial leads
  - Transvenous CIED contralateral to expected AV access, if epicardial leads not feasible
- Consider epicardial leads
AV Access Creation in Patient with Existing CIED

Existing tranvenous CIED and need for AV hemodialysis access

Peripheral vein mapping for AV access planning: Contralateral peripheral vessels suitable for AV access?

YES
- Consider central venography if risk or clinical suspicion for contralateral central vein or SVC stenosis
- Proceed with contralateral AV access if peripheral & central veins suitable

NO
- Perform complete central venography
- Consider AV access ipsilateral to CIED leads if peripheral and central vessels suitable