Percutaneous Management of VenoArterial (VA) Extracorporeal Membrane Oxygenation

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Disclosures

- None
Background

• Veno-arterial extracorporeal membrane oxygenation (VA-ECMO) is an increasingly used strategy for temporary support in cases of refractory cardiac or cardiopulmonary failure
• Use is increasing and indications are expanding
In adults, there are two possible ECMO configurations: central (cannulation of right atrium and ascending aorta) or peripheral pV-A ECMO (femoral cannulation).
• Peripheral is more common given emergent nature of the shock with ability to cannulate at bedside

• Large bore cannulation of femoral vessels 15-17 fr CFA 23-27fr CFV
Background - Vascular

• Limb ischemia and local bleeding complications are significant and have reported incidence ranging from 10-70%\(^1\)
  • Even with use of distal perfusion catheter*

• Complications often require acute and time-consuming management

Why should I care?

• Cardiac specialists may not have a complete understanding of the peripheral arterial system and its physiology, less experience managing iliac and femoral complications

• As indications expand, vascular specialists will increasingly be involved in management, especially of more difficult cases or complications.

• A complete understanding of both open and percutaneous solutions for management and prevention of bleeding and ischemia will lead to the most optimum outcomes
Goals from vascular perspective

• #1 Decrease mortality
  • Case selection
  • Good initial cannulation, rapid assessment of bleeding and ischemic complications with percutaneous interventions preferred early on.

• #2 Decrease amputation, fasciotomy and limb ischemia
  • Early/prophylactic placement of antegrade cannula

• #3 limit new emergencies (and nighttime calls)
  • Emphasis on technique, ensure proper catheter placement early on with imaging if necessary (ultrasound). Fem-stop for early bleeding control

• #4 conserve resources
  • Avoid OR when unnecessary
    • Is surgical decannulation necessary?
Surgical decannulation

• pVA-ECMO has previously been associated with higher rates of bleeding and ischemia after percutaneous decannulation compared to surgical (14.7% vs. 3.4% p<0.01)\(^1\)

• Surgical decannulation may avoid risk of psuedoanuerym, compression time associated with local thrombosis, allow examination of distal flow and allow for vessel repair\(^1\)

HOWEVER...

• Cannula site is often inflamed leading to increased blood loss, larger wounds with inherent wound complications, longer operative times and cumbersome patient transport
  • Not good Add-on cases

• IS THERE ANOTHER VIABLE OPTION?
Objective

• To examine vascular complications related to nonoperative removal of pVA ECMO compared to surgical removal
Methods

• Retrospective review of a prospectively maintained database of all VA-ECMO recipients who received pVA-ECMO at a single institution

• January 2014-May 2017

• Primary endpoints:
  • Extremity vascular complications
    • Cannulation site bleeding, limb ischemia, compartment syndrome, fasciotomy and amputation
  • Survival to discharge
pVA-ECMO technique

• Cannulation performed percutaneously by CT surgery or experienced cardiologist with ultrasound guidance
• Arterial cannula 15-17 fr into CFA
• Venous cannula 23-27fr into CFV, advanced to atrium
• Antegrade perfusion cannula into SFA 6-7fr
Percutaneous Decannulation

- If on anticoagulation, stopped 2h prior to removal
- Manual compression applied for minimum of 45 minutes
- If no bleeding a Femstop applied to complete hemostasis
  - 10-20mmHg above systolic blood pressure for 1-3min
  - Between systolic and diastolic for 15 min
  - 30-40 mm Hg for 60-180 min
  - Surgical revision if there was ongoing bleeding, recurrent bleeding, or loss of pulse
- Covered stent placement over cannulation site as well as closure devices also used in some cases
Results

- 204 patients received placement of pVA-ECMO
- 85 (42%) expired prior to removal
- 14 (7%) developed critical ischemia requiring intervention
  - SFA cannula, relocation of cannula, or surgical intervention
- 6 (3%) developed compartment syndrome requiring fasciotomy and/or amputation
- 4(2%) had hemorrhagic complications requiring operative intervention
Results

• 119 patients survived to decannulation (58%)
• 77/119 (65%) were removed percutaneously
• 42/119 (35%) removed surgically
• Comparing surgical to non-operative removal, there was no significant difference in survival to discharge (71% vs 79%; P=0.37) or extremity vascular complications (5% vs 6%; P=1.00)
• Length of stay was significantly shorter with non-operative removal
  • 26.2 days vs 38.3 days; P=.008
Results

- Most common reason for surgical removal was comfort level of intensivist with percutaneous removal
- Other causes were suspected low or high stick, body habitus, or suspected traumatic cannulation
- 4/77 (5%) of percutaneous decannualtion had persistent or recurrent bleeding requiring operative closure
ECMO complication Case example

• Called during clinic by structural heart cardiologist
• “We are having some trouble with a vascular patient, can you come take a look?...Now.”
• Patient had been undergoing mitral clip procedure with perforation of the L atrium, emergent sternotomy, femoral cannulation with repair, converted to VA-ECMO

• Called for expanding R thigh hematoma

• 77 yo male with COPD on O2, H/o of remote AFB, right limb down and now with left to right fem-fem bypass
• Sheath placed through ECMO tubing
• Viabahn placed across SFA
- Arterial cannula had been placed into the fem-fem bypass graft instead of the femoral artery
- Removed and closed with perclose
- Transitioned to central ECMO
Conclusion

• VA-ECMO mortality rates remain high, >40% in our series

• Non-operative removal of pVA-ECMO has a significantly shorter length of hospital stay with equivalent rates of in hospital mortality and extremity vascular complication compared to surgical removal.

• Percutaneous removal is safe in the majority of patients and associated with improved outcomes while conserving operating room resources

• Limitations: single center study, retrospective, inconsistent methodology (manual pressure, closure device, stent)
Background- Vascular

• Peripheral ECMO will change perfusion pathways
  • North-south syndrome
  • Ischemic upper extremities with warm lower extremities
  • Monophasic flow