Nursing Care of the Post Cardiac Transplant Extracorporeal Membrane Oxygenation Patient: A Case Study

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Who we are

Staff nurses of Cardiac Surgery Intensive Care (CSICU) at the University of Ottawa Heart Institute

- UOHI performs approximately 1450 surgeries per year
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Introduction

• Overview of ECMO
• Case Study
  ● Patient
  ● Post-op period
  ● Complications
  ● Nursing Interventions
  ● Family considerations
• Conclusion
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What is ECMO?

• Extracorporeal Membrane Oxygenation (ECMO)
• Derived from cardiopulmonary bypass (CPB)
• First used in paediatric and neonatal populations
• Used in adults for support of reversible cardiac or respiratory failure
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ECMO

- ECMO circuits at UOHI are monitored by a perfusionist.
  - Monitors and adjusts parameters of ECMO machine.
- Nurse responsible for close monitoring of patient
  - Hemodynamics, hygiene, wound care, family support, coordinating. interdisciplinary team.
- Monitor for early signs of deterioration.
  - Being proactive
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Components of ECMO circuit
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Oxygenation in ECMO

- Oxygenation occurs in the membrane lung (oxygenator) of the ECMO circuit.
- Oxygenation of patients can be affected by:
  - Oxygenator parameters
  - Rate of flow
  - Native lung and heart function
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Oxygenator Parameters

• Oxygenation in the membrane lung is affected by
  • Type of membrane lung
  • FiO₂
  • Time blood spends in membrane lung
  • Hemoglobin
  • Oxygenation of blood before entering the ECMO circuit
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CO₂ Removal

- Removal rates dependent on
  - Type of membrane lung chosen
  - Patient’s blood CO₂ level
  - ECMO flows and sweep gas flows
- Rates of CO₂ removal can be adjusted by increasing the surface area of the membrane lung or by adjusting sweep gas flows
ECMO Modalities

- 2 kinds of ECMO
  - Veno-venous (VV)
  - Veno-arterial (VA)
- VV is used to treat refractory respiratory failure
- VA is used for complete cardiopulmonary support in cardiogenic shock and cardiac arrest
What is VA ECMO?

- VA oxygenator and pump replaces some or all lung and heart function
- Oxygenated blood is returned to aorta and combined with blood which has passed through the native cardiac circulation
  - Results in mixing of $O_2$ and $CO_2$ from each source which is delivered to organs
  - Forward flow is combination of native cardiac output and ECMO flows
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“Stan Plant”

59 year old male with ischemic cardiomyopathy

- Heartmate II Left Ventricular Assist Device (LVAD) inserted in March 2012
- Recurrent GI bleeds
  - On Coumadin for LVAD
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Donor

60 year old post head trauma - subdural hematoma

- Echocardiogram showed normal right and left ventricle ejection fraction
- Cardiac catheterization showed normal coronary arteries
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Case Study Timeline

- **Post-op Day 0**
  - Heart Transplant
  - ECMO started

- **Post-op Day 1**
  - Reopened x 2
  - Open Chest
  - Right arm hyperperfusion

- **Post-op Day 2**
  - Reopened 4th time
  - ECMO weaning not tolerated

- **Post-op Day 3**
  - Reopened
  - IAPB inserted

- **Post-op Day 4**
  - Bronchoscopy
  - Nitric Oxide started
  - ECMO weaned!
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“Stan Plant’s” Surgery

- Redo-sternotomy
- Removal or automated implantable cardioverter-defibrillator (AICD)
- Removal of Heartmate II
- Orthotopic cardiac transplantation (Bicaval)
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Intraoperative

- Massive bleeding and hemodynamic instability requiring massive transfusions
- Dobutamine at 10 mcg/kg/min
- Mirinone at 0.5 mcg/kg/min
- Vasopressin at 4 units/hr
- Norepinephrine at 0.7 mcg/kg/min
- Epinephrine at 0.15 mcg/kg/min
- Insulin at 16 units/hr
- Heparin at 250 units/hr
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Post-op Day 0

- Cardiac transplant completed at 0500
  - Stan too unstable to leave cardiac operating room
    - Nursed by 2 CSICU nurses in cardiac operating room (COR)
  - Decided by CSICU physicians/surgeon that patient required ECMO and procedure started at 0730
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Post-op Day 0

- Right femoral vein and right axillary artery
- Transferred to CSICU at 1330 from COR
- Transesophageal echo (TEE)
- Right arm beginning to blister from hyperperfusion of ECMO
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Catch-22 of Anticoagulation and ECMO

Hemorrhagic and thromboembolic complications

- Bleeding is most common of all ECMO complications
- Primary- surgical and cannulation site
- Secondary - Mucous membranes, gastrointestinal system, pulmonary hemorrhage, intracranial bleed
Nursing implications of Anticoagulation

- Cannulation site bleeding
- Close monitoring
- Transfusions and monitoring for hypovolemia
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Post-op Day 0

At 1630 Stan exhibited hemodynamic decline and bleeding from the chest tubes

- Chest reopened and cleaned out at bedside
- Ruled out tamponade and investigated source of bleeding
- Chest closed afterwards
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Post-op Day 1

- Still requiring 2:1 nursing
- TEE done
- Reopened again at 1500 to rule out tamponade
  - Chest left open covered with Vi-drape
- Blisters on right arm becoming worse due to hyperperfusion
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Assessment of Risk Factors

- Severity of illness/length of stay in ICU
- Exposure to moisture
- Vasopressors shunting blood from periphery to vital organs
- Inability to physically turn patient
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Nursing Interventions

- Regular skin assessment
- Regular and prn sheet changes
- Begin feeding
- Absorbent dressings to collect drainage from wounds
- Wean vasopressors as tolerated
- Continue lateral rotation therapy
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Post-op Day 1 (cont’d)

- Vidrape bulging
  - It’s an OR in the ICU
- Bleeding from multiple sites
  - Platelets transfused
  - IV heparin has to be continued for ECMO circuit patency
- 37 kg of fluid overload!
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Post-op Day 2

- Second ECMO weaning attempt
- “Renal function stable! Miraculously!”
- Fourth bedside OR
- Right arm hyperperfusion worsening
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Post-op Day 3

- How high can you go?
  - Patient still requiring large doses of vasoactive meds
- Intra-aortic balloon pump (IABP) inserted
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Post-op Day 3

- Did the IABP work?
- Patient converted from normal sinus rhythm to atrial fibrillation

![ECG Image]

- Third ECMO weaning attempt
  - ECMO flow to 1 L/min - not tolerated
  - Overall vasopressor requirements decreasing
  - Right arm hyperperfusion
    - Managed with frequent dressing changes
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Post-op Day 3 (cont’d)

- PRBC 7 units
- Albumin 1000 mL
- FFP 2 units
- Platelets 2 adult doses
- Cryoprecipitate 30 units
- Cell saved 4 times
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Post-op Day 4
Morning

- Bronchoscopy at bedside
- How is the arm?
- Fourth ECMO weaning attempt
  - Doesn’t tolerate initial ECMO weaning - MAP 45
- Inhaled nitric oxide administered
Why are ECMO patients prone to infection?

Multiple Risk Factors

- Duration of ECMO
- Illness severity pre-ECMO
- Steroid use
- Prolonged ventilation
- Open chest/surgery/cannulation
- Inability to move/hygiene
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Monitoring for signs of infection

ECMO skews objective measures like body temperature and white blood cell count (WBC)

- Thorough nursing assessments
  - How does the patient look and feel?
  - What has changed?
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Infection prevention

Nurses are first line workers in preventing infections

- Apply transparent dressing to cannula insertion sites
- Use ventilator-associated pneumonia (VAP) prevention measures
- Meticulous hand hygiene
- Catheter care
- Antibiotics
- Stress ulcer prophylaxis
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Post-op Day 4 (cont’d)

Afternoon

- Fifth ECMO weaning attempt - SUCCESS!
- Stan remains critically ill
  - Large doses vasoactive drugs
  - Secretions improved post-bronchoscropy
  - Patient continues to diurese
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A look back

Norepinephrine doses

Epinephrine doses

presented by the University of Ottawa Heart Institute  September 27, 2015
Final tally of blood products received during ECMO

- **PRBCs** 49 units
- **FFP** 21 units
- **Platelets** 23 doses
- **Cryo** 40 units
- **Albumin**
  - **5%** 5500 mL
  - **25%** 300 mL
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How did it end for Mr. Plant?

- Long-term CSICU patient
- Hospitalized for 281 post-op days
  - CSICU 171 days
  - Ward 62 days
  - Rehab 48 days
- Walked into his home
Caring for the family of the ECMO patient

- Family-centered model of care
- Kubler-Ross model of five stages of grief
  - Denial, anger, bargaining, depression, and acceptance
- Therapeutic relationships with family
  - Families want clear, understandable, and honest information
- Challenge making connection
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In Conclusion

- What is ECMO and how does it work?
- Case Study
- Challenges of ECMO
- Families and ECMO
- Looking back
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Thank you! Any questions?
References


References


References


