

Key: Evidence-based Practice Recommendations

R= Research-Based

N= National Practice Guideline/Protocol

L= Literature

E= Expert Opinion/Consensus

## UCLA Department of Nursing Pediatric Cardiothoracic ICU

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### PCTU Guidelines: Admission, Care, Discharge

#### Scope

This guideline applies to patients admitted to the PCTU after open heart surgery which includes but not limited to: Tetralogy of Fallot repair, ventricular septal defect repair, atrial septal defect repair, coarctation of the aorta repair, single ventricle repairs, ventricular assist device placements, and heart transplant.

#### PATIENT GOALS / OUTCOMES

1. Maintain adequate cardiac output:
  - Stable heart rate & rhythm
  - Stable blood pressure
  - Urine output within normal limits
  
2. Maintain adequate tissue perfusion:
  - Warm and dry skin
  - Presence of peripheral pulses
  - Adequate urine output
  - ScvO<sub>2</sub> (Central Venous Oxygen Saturation) within set limits
  - Qp:Qs results as close as possible to 1:1 ratio
    - Qp:Qs=SaO<sub>2</sub>-SvO<sub>2</sub>/PVsat-PA<sub>sat</sub>
    - Normal=1:1
    - L to R shunt >1
    - R to L < 1
  - Omega Factor ( $\Omega$ ) as close as possible to 2 to 4  
(Qp:Qs and Omega Factor ( $\Omega$ ) are calculated based on blood gas readings)
  
3. Maintain adequate fluid and electrolyte balance:
  - Intake and output within set limits
  - Electrolytes within normal limits
  
4. Maintain adequate blood-gas exchange:

- Breath sounds clear for both lungs
- ABG and SvO<sub>2</sub> (Mixed Venous Oxygen Saturation) within set limits
- Pulse oximeter readings within set limits
- Cerebral / Somatic Oximeter readings within set limits

5. Maintain adequate pain control:

- Vital signs within set limits
- Pediatric Pain Management Guideline Nur-HS 1006
- Able to move around / ambulate
- Able to take deep breaths

### Admission Room Set-Up

- Cables are for: EKG, Temp. toe and skin (for Infant Warmer), 2 Pressure cables for Art, CVP and splitter needed if Transthoracic Lines, NBP ( or infant NBP cable), Pulse Ox, ETCO<sub>2</sub>

\* Note: Send to OR: Hypafix tape, Pacemaker box + 2 disposable extension cables.  
Verify that they come up with patient after surgery

- 12-lead EKG
- 3 suction heads (one each for: NGT, ETT, CT), may use 2 extension tubing for Pleur-evac suction. Use Y Connector to connect both pleur-evac suction
- Emergency Drug Sheet according to weight (Check with OR for weight Anesthesiologist used)
- Emergency Drugs from Pharmacy as ordered along with 5% Albumin
- Maintenance IV: Check MD's order for IV solution and Total IV Fluid, prepare and have ready in IV pump
- Med Line primed and on syringe pump.
- Heparinized NS for Art and CVP lines as ordered by MD/designee
- Have prepared Lab Tubes( 2 green BDs, 1 blue, 1 grey, 1 purple BD, ACT), 2 Blood gas syringes (for ABG and VBG), and 2 lab draw set-ups
- Additional monitoring equipment as needed (SvO<sub>2</sub>, cerebral sat monitoring, CCO)
- Graduated Cylinder (empty all urine in the bag)
- Catheter tip syringe (check NG placement)
- Appropriate size diapers
- PCTU Off-pump report sheet
- Accu Check machine –QCs done

**“Off Pump” report** (OR to PCTU Report Sheet Forms portal#14018)

1. Notify the following:
  - a) Charge Nurse/Flex RN

- b) PCTU Fellow/Attending MD
- c) Respiratory Therapist
2. Check for MD/designee admission orders:
  - a) Post-op PCTU Order Set
  - b) CXR Order
  - c) Antibiotic Order (AOF) for open chest
  - d) Care Connect Vasoactive drip order set for PCTU (for Downtime: Forms Portal #11313)
3. Note patient's temperature. Order warming blanket if core temp.  $<36.0^{\circ}\text{C}$ .
4. Double check room set-up.
5. Check hallway, clear if obstructed.
6. Review anesthesia record in care connect

### **Admission Primary nurse**

1. Position yourself on the side of the bed opposite ventilator.
2. Assess EKG rhythm and Blood Pressure when X3 docked
3. Assess patient and verify air entry (ETT may have moved). Confirm position of ETT with anesthesiologist and respiratory therapist.
4. Identify all transducers according to the invasive lines where they are connected and correctly label each on the cable and on the monitor and zero.
5. Zero, assess waveform (RA and LA lines may move down to RV and LV, respectively), check for blood return and flush all lines (LA/RA/PA do with charge RN). If unable to flush, notify MD's/designee immediately.
6. Check all drips and infusions and verify pumps are set correctly with same weight, concentrations and rate.
7. Intervene for abnormal Vitals as set by MD/designee.
8. Once VS stable obtain report from anesthesiologist and surgeon  
Obtain:
  - Last lab values
  - Last time IV antibiotics given
  - Last time sedation/pain medication given
  - Last time any blood products given
  - Identify and label chest tubes/drains

### **Secondary nurse**

1. Position yourself opposite Primary Nurse's side of the bed
2. Connect X3 and CO2 extension
3. Connect chest tube set-ups to suction. Note quality and amount of drainage.  
Communicate output with Primary RN. (bleeding is CT output  $>3\text{ml/kg}$ ). Empty JP drains.
4. Obtain non-invasive BP.

5. Plug in bed, IV pumps and all syringe pumps
6. Raise Head of Bed to 45-50°. Promotes CT drainage and prevents SVC syndrome for Glenn Shunt patients.
7. Empty urine in Foley bag. Note quality and amount. Communicate with Primary RN (Pink urine may indicate Hemoglobin damage during CP Bypass. Large amount may cause hypovolemia)
8. Place Temperature Probes on Toe (use rectal only if necessary)  
Normal Toe temp. is 32.0°C to 34.0 °C. Toe temp correlates to Cardiac Output. Hypothermic patients may bleed. Warm patient with warm blankets.
9. Check and give Blood and Blood Products as ordered by MD/designee. (Blood Products: Ordering, Storage, Administration, and Documentation, ORS105)
10. Note expiration time on blood cooler. Blood may be stored in Blood refrigerator on unit or returned with cooler prior to expiration date/time.
11. Check ECMO standby order if needed
12. Record Vital Signs in EHR every 15 minutes until hemodynamically stable, then every hour
13. Draw admission labs as ordered by MD/designee. Complete ACT(2 ml), Hemocue and Accucheck.  
Notify Primary RN of Results (Normal ACT is <150 secs).  
Cyanotic Heart Defects may need higher Hct  
( \*\*Except for shunt patients, heparin is fully reversed in the OR. )  
(Protamine should only be given after careful consideration with MD at the bedside and for shunt patients, with the surgeon at the bedside\*\* )  
Correct hypoglycemia/hyperglycemia as ordered.
14. Connect NGT/OGT to Low Intermittent Suction. Check correct placement.
15. Monitor patient while Primary RN gets report from Anesthesiologist/Surgeon.
16. Obtain 12-Lead EKG and AEG; Transmit and print a copy of 12 Lead EKG/AEG
17. Record all invasive lines and pacing wires in EHR.
18. Connect pacemaker. Check settings to order. Have PCTU fellow/attending check wires.

(Note: Pediatric MD/designee sets up the initial pacing and sensitivity thresholds. The settings are communicated to the Primary Nurse and documented in EHR.)

19. If not paced, connect AEG for monitoring for 24 hours post-op.
20. Call for CXR.

**After report :**

1. Set monitor for alarm limits and volume.
2. Saline lock extra IVs and central line if able
3. Change IV dressings if needed.
4. Diaper patient and cover with warm blanket.
5. Document EKG strip, 12-lead, AEG in chart.

6. All neonates < 30 days or < 44 weeks gestation age will be monitored by CEEG within 6 hours of admit. If no seizures after 48 hours, then it will be d/c'd. If seizure, then will monitor until 24 hours without seizure activity. Head U/S may be performed.
7. Allow family to visit.

### **Assessment and Care: L<sup>1-4</sup>**

#### 1. Assess for S& S decreased cardiac output:

- Hypotension
- Low CVP or LA pressures
- Arrhythmias
- Decreased urine output
- Cool, clammy, dusky skin
- Change in mental status
- Decreased SvO<sub>2</sub>

A. Assess for Signs & Symptoms of cardiac tamponade: Usually observed in the first 24 to 48 hrs when the chest tubes become occluded or clogged.

#### B. Early signs:

- hypotension
- JVD
- muffled heart sounds
- elevated RA/CVP
- increased heart rate from baseline

#### C. Late signs:

- equalization of filling pressures
- pulsus paradoxus (drop > 10 mmHg)
- widened mediastinum on CXR
- PEA

#### Possible causes of cardiac arrest:

- Acute massive mediastinal bleeding
- Myocardial ischemia/infarction (intraop and / or postop)
- Fluid and electrolyte imbalance
- Arrhythmia
- Hypoxia

#### 2. Assess for Signs & Symptoms of respiratory failure:

- Adventitious breath sounds (crackles, rhonchi, wheezing)
- Accessory muscles, intercostal retraction, paradoxical breathing
- Thick, viscous secretions
- High peak airway pressure on ventilator, loss of tidal volume
- Abnormal ABG's as set by MD/designee
- Increased or decreased respiratory rate
- Hypercapnia
- dyspnea
- Altered LOC

Possible causes of respiratory failure:

- pulmonary interstitial edema
- atelectasis, pneumothorax, hemothorax, pleural effusion
- sedative-induced respiratory depression
- pain
- aspiration

### 3. Open Sternum/Chest Exploration/Chest Closure

- Assemble Equipment: Bovie, fluid warmer, head lamp, step stool, chest bleeder ECMO tray, ECPR/Chest closure pack
- Order for: Sedation, paralytic, antibiotic, Duobiotic solution, sterile mineral oil, blood in cooler in room
- Recognize limits on positioning
- Skin care precautions

### 4. Chest Suspension Care

- Chest suspension sign on bed
- Monitor vital signs not limited to blood pressure and central venous pressure; cardiovascular compromise especially when releasing sutures
- Monitor insertion site of suspension sutures and surrounding skin for infection
- Ensure sutures remain clamped and chest suspended during procedures and repositioning. Notify MD if sutures need to be released at any time
- Recognize limits to repositioning
- Clean suspension sutures insertion sites daily with chlorhexidine
- Document suture sites in assessment-wound

## **Interventions: L1-4**

### **1. Hemodynamics:**

#### **• Vital Signs:**

- A. Check vital signs every 15 min. until stable, then every hour, unless indicated otherwise
- B. RAP, LAP, PAP (S/D), and Respiratory Rate every hour.
- C. Monitor pulse ox continuously, record every hour and PRN.

- D. SvO<sub>2</sub> every hour if present. Note: Initial calibration is needed and every 24 hours thereafter.
- E. Cerebral Oximeter(NIRS): All ECMO and postop hypoplast patients document readings every hour
- F. For patients who have PA catheter record CO/CI and calcs every hour and PCWP prn as ordered
- G. Continuous EEG x 48hrs for all neonates having bypass and on ECMO patients for the duration of ECMO

\*\*If numbers are questionable on CCO monitor, recalibrate machine.

- **Administration of vasoactive and inotropic agents**

- a) Check rate/dose every hour and PRN. All adjustments need 2<sup>nd</sup> RN
- b) Evaluate response continuously (vital signs, etc.).
- c) Wean gradually, continuously evaluating and charting response (Notify MD if weaning not tolerated i.e. change in perfusion)

- **Hemorrhage:**

- a) Check CT drainage every hour. If patient bleeding, milk clots from the tubes and connections.  
Empty JP drains Q 1 hour. (check with MD prior to stripping)
- b) Check coagulation profile as ordered
- c) Check Hbg on drainage if increased blood

- **Arrhythmia:**

- A. Continuous EKG

- Document rhythm and ectopy every hour.
- Document and print rhythm strips and EKG measurements every 12 hours and PRN.
- Notify MD/designee of any arrhythmia

- B. Administration of antiarrhythmic agents:

- Monitor response of antiarrhythmic agents.
- Check Potassium levels before administering Digoxin. (K<sup>+</sup> level of >3.5 is needed)
- Check PR Interval prior to administration of amiodarone
- Check iCa, Mg, K – keep on high end of normal
- If cardiac pacing needed, obtain MD/designee order with pacemaker settings

## 2. ECMO standby (Discussed QD with MD/surgeon)

- A. ECMO order set & consult to perfusion
- B. Blood is kept in the blood refrigerator if <10kg
- C. Over 10 kg-“wet circuit” (primed without blood) is present on unit
- D. Once on ECMO, all patients should have 2 units of blood in refrigerator

E. Clot sent to blood bank every 3 days unless < 4 months of age

**3. Open chest:**

- A. Monitor for bulging of loban dressing-have Fellow/NP assess all bulging dressings
- B. Ensure chest tubes remain patent by gently milking or tapping the tube, not stripping them. Milk JP drain tubing.
- C. Place red, open chest signage on door of room
- D. No home linen/toys until chest closed
- E. Monitor visitors for infection & maintain room cleanliness
- F. Daily CHG bath
- G. Day of closure: prior to closure: ensure an extra cleaning of the room and top of warmer, bathe patient and place new linens.

**4. Hypothermia (<36.5°C):**

Use warming equipment to maintain core temperature of 36.5°C to 37.5°C If core Temperature is <35° C, warm patient gradually, one degree / hour).

If baby on infant warmer, set temperature to 36 and on auto heat

**5. Chest Tubes, Pacing wires, IV lines and IV Admixtures**

Chest Tubes

- A. Chest tubes are mediastinal, pleural, or both.
- B. Maintain chest tube patency.
  - \*\* Chest Tube drainage system or is set to (-) 20 cm H2O for adults and (-) 10 to (-) 15 cm H2O for pediatrics
- C. Check CT system for leaks. Check water seal chamber for air leaks every hour if using Atrium.
- D. If JP fills with air 3 x after emptying, notify MD/NP and attach to atrium system.
- E. Note CT output. Notify MD/designee if <1ml/kg in 24 hrs. (CT's are usually removed when output <1ml/kg in 24 hrs.) Notify if > 3ml/kg bleeding in 1 hour
- F. CT removal:
  - A. Patient must have been OOB or HOB elevated 45 degrees for at least 1 hour prior
  - B. Chest Tubes are removed by MD/designee
  - C. CXR may be ordered to R/O pneumothorax after removal

Pacing Wires:

- a) Clean site with betadine every day. Close caps or place in finger cot. Wrap with 2 x 2 gauze and tape securely to the chest.
- b) All wires must be labeled, (A, V or G)
- c) If pacing is needed, tape pacer cables securely to chest.



Pacing Wires Removal:

- a) Send Coagulation studies to lab. INR should be <2.5
- b) Keep patient on bed rest for 1 hour after removal. Check vital signs q15 min x 4
- c) Observe patient for 3 hrs before discharging from hospital

IV Lines and Line Care:( IV &TPN Therapy, Nur-HS 116;CVC Care,Nur-HS 104)

- a) All primary and continuously infusing IV tubing is changed every 96 hours.  
Exception: TPN/IL tubing change Q24 hours.
- b) All intermittent IV lines are changed Q 24 hours.
- c) All tubing must be labeled with dates.
- d) Don clean gloves prior to entering the side port or stopcock of a central line or A-line. Clean caps and & IV tubing ports according to hospital policy #104
- e) RN's may discontinue peripheral lines, femoral lines, and radial arterial line.
- f) RN's who have competency may discontinue PA catheters, high CVC lines, and PICC lines.

#### 4. Pulmonary

- a) RN's and RT's maintain patent airway.
- b) Ventilator setting changes are done by RT's, RN's can wean  $FiO_2$ .
- c) Ventilator setting changes and respiratory treatments are recorded in EHR.

Weaning and Extubation (Requires MD/designee order):

- a) Weaning and extubation are initiated after hemodynamic / pulmonary stability.
- b) ABG limits shall be interpreted according to patient's cardiac physiology.
- c) RN and RT will extubate patient with the supervision of MD/designee.

Blood gases:

- a) Blood gases are drawn as per MD/designee order
- b) Arterial blood gases are drawn via the arterial line. VBG via most central line

Endotracheal (ETT) and Tracheostomy (Trach) care :(Management of the Patient Needing Mechanical Ventilation, Nur-HS G1023, Tracheostomy Care Nur-HS 129)

Pulmonary Hygiene:

- a) Chest physical therapy (CPT) is the responsibility of nursing staff along with MD/designee order.
- b) CPT q2h when patient is awake as per order beginning POD#1 or post-extubation.
- c) After extubation, encourage patient to do Incentive Spirometry (IS) q1h

Oxygen Therapy:

- a) Humidified O<sup>2</sup> is given to keep O<sup>2</sup> saturations at MD/designee order for limits depending on patient's cardiac physiology.
- b) O<sup>2</sup> saturations are continuously monitored and recorded.

### **5. Renal and Foley catheter care**

Intake and Output:

- a) All IV Fluid intakes are recorded hourly. Including arterial and CVC flushes, manual CO, vasoactive drips, PO/NGT meds, IV medication bolus.
- b) Output is measured and recorded hourly. Including urine output, chest tubes, and CVVH UF, also NGT, Jackson Pratt bulb suction, Hemovac drains and Hemodialysis.
- c) Foley catheter site cleaning is done every 4 hours and PRN.
- d) Foley catheter presence is addressed daily during rounds for early removal

### **6. Wound and CVC care**

Wound site care:

- a) Pleural and mediastinal CT dressings are changed every other day. Use betadine to clean sites. Dress with gauze and tape.
- b) Follow MD/NP order for surgical site care
- c) Assess all wound / drain sites. Notify MD/NP if drainage is noted.
- d) Delayed chest closure – follow MD/NP standard at bedside
- e) Always cover sternal incision when patient is eating or having pulmonary toilet

CVC Dressing Change:

- a) Follow CVC HS 104

### **7. Suction Canisters**

- a) Suction canisters are changed q 72 h and PRN.
- b) Oral aspirators should be changed daily and PRN

### **8. Nutritional status**

- a) Total Parenteral Nutrition (TPN) should be initiated as ordered by MD/designee.
- b) If there is risk of aspiration, may use Dobhoff or NGT.
- c) Keep HOB at 45-50<sup>0</sup> to prevent aspiration of gastric contents.

- **\*\*\*Note:** Keep patients' HOB at 45-50<sup>0</sup> angle even if on NPO. (Patients can aspirate gastric contents while NPO.)

- d) Notify MD and consult with Dietician if patient is not tolerating enteral feeding (e.g. large volume, increased abdominal girth or diarrhea)

### 9. Skin integrity

- a) Bathe patient when hemodynamically stable, not within the first 4 hours post OR, ecmo decannulation, or chest closure. Pay particular attention to folds in the neck, armpits and groin. Betadine can cause skin burn.
- b) Assess skin integrity every shift. Turn every 2 hours and elevate heel off mattress.
- c) For patients with severely compromised cardiopulmonary function, e.g. patients on ECMO or VAD, tilt body or head every 2 hours with help of perfusionist to relieve pressure on skin. Consider light massage to bony prominences.
- d) To determine if specialized bed is needed, refer to Neonatal Pediatric Skin and Wound Care Pressure Ulcer Prevention Standard Nur-HS G1027

### 10. Ambulation/Mobilization: (Progressive Patient Mobility, Nur-HS G1030; PICU BMAT Suggestions, Forms Portal #16909)

- a) Day of Surgery: Post-Extubation: may dangle feet over the side of bed. Ask patient to do plantar flexion and dorsiflexion.
- b) Sit-up on chair for meals, 20 - 30 minutes as tolerated. Encourage patient to stand and walk in place for 1 min as tolerated. The third time patient is out of bed; encourage him/her to ambulate 20 to 30 feet.
- c) POD #1-2: May ambulate around the unit for 2 to 3 minutes 3 x.
- d) POD #2-33: Ambulate in the hall four times a day with assistance.
- e) Record BMAT level daily

### Patient / Family Education: PCTU discharge checklist Forms Portal #16242; PCTU discharge Packet Forms Portal #16243

1. The patient/family will review and understand home care instructions prior to discharge.
2. The patient/family will perform incision care and demonstrate cleaning of skin
3. Prior to discharge, the patient/family understands (will verbalize) the importance of calling the physician when the following signs and/or symptoms occur:
  - a. Fever ( $>101^{\circ}$  F or  $>38.5^{\circ}$  C)
  - b. Chills
  - c. Extreme Fatigue
  - d. Difficulty breathing, shortness of breath
  - e. Excessive swelling of feet or ankles
  - f. Dizziness or feeling faint
  - g. Weight gain ( $>2$  lbs/day x2 days or 4 lbs in 1 week)
  - h. Palpitations, fast or irregular heart beats
  - i. Signs of poor wound healing (increased tenderness, redness, swelling, drainage or open incision)
  - j. Chest pain that is different from incisional pain
  - k. Unrelieved nausea
4. The patient/family will verbalize and demonstrate the following as it relates to his/her home medication therapy prior to discharge:
  - a. Take medication as ordered by the MD/designee.

- b. If the patient forgets to take a dose, he/she will take it as soon as possible.  
\*\*\*However, if it is almost time for the next dose, skip the missed dose and go back to the regular dosing schedule. DO NOT DOUBLE THE DOSE.
  - c. Do not stop taking medications without checking with the doctor.
  - d. Store medications in the original container away from extreme temperatures.
  - e. Always keep medications away from children.
5. The patient/family will understand, and acknowledge understanding, home care referrals prior to Discharge.

## RELATED REFERENCES

Nur-HS104 Central Venous Catheter Care

UCLA Nur HS116 IV & TPN Therapy – Adults / Peds / Neonate / Perinatal

UCLA HS Policy 1450 Medication Administration

UCLA NurHS-G1023 Management of the Patient Needing Mechanical Ventilation

UCLA Nur-HS 129 Tracheostomy Care (in the Non-Head and Neck Patient)

UCLA HS Nur-G1009 Skin and Wound Care, Pressure Ulcer Prevention Standard UCLA

UCLA Nur HS 165 Oxygen Therapy

UCLA Nur-HS G1024 Arterial Catheter Management and Monitoring

UCLA Nur-1031 Hemodynamic Monitoring in Adults and Pediatrics

ORS105 Blood Products: Ordering, Storage, Administration,

UCLA HS 1338 Documentation Transfusion Policy

## FORMS

Forms Portal 16242: PCTU discharge checklist

Forms Portal 16243: PCTU discharge Packet

## REFERENCES:

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L<sup>1</sup> Caverly, L, Rausch, CM, daCruz, E, Kaufman, J. Octreotide treatment of chylothorax in pediatric patients following cardiothoracic surgery. *Congenital Heart Disease*. 2010. Nov 5(6) 573-8.

L<sup>2</sup> Conte, J., Baumgartner, W. Owens, S, Dorman, T. 2<sup>nd</sup> edition. 2008. *The Johns Hopkins Manual of Cardiac Surgical Care*. Mosby-Elsevier. Philadelphia.

L<sup>3</sup> Lehrer, S., 2003. *Understanding pediatric Heart Sounds*. 2<sup>nd</sup> edition. Saunders. New York.

L<sup>4</sup> Nichols, D., et al. 2<sup>nd</sup> Edition 2006. *Critical Heart Disease in Infants and Children*. Mosby-Elsevier. Philadelphia.