Recommendations and Best Practices for Early Extubation Following Cardiac Surgery

BACKGROUND

Prolonged mechanical ventilation after cardiac surgery is associated with increased ICU length of stay, higher morbidity (including pneumonia, atelectasis, and intrapulmonary shunting), and increased costs. Enhanced Recovery After Surgery (ERAS) cardiac guidelines and Society of Thoracic Surgeons (STS) quality benchmarks now strongly encourage early extubation, with a common target of ≤6 hours postoperatively. Evidence consistently shows that structured early-extubation protocols decrease ventilator hours safely and effectively.

Studies demonstrate:

- Early extubation as part of fast-track cardiac pathways reduces ICU and hospital LOS and supports earlier mobilization and recovery [(2)].
- Extubating within 6 hours is safe and effective across patient risk groups, including high-risk STS cohorts, when supported by a multidisciplinary protocol [(3)].
- Delays >22 hours sharply increase morbidity and mortality, reinforcing the importance of minimizing time on mechanical ventilation [(4)].

Collectively, these findings support the ongoing QI focus on timely, coordinated extubation as an evidence-based practice that improves patient outcomes and aligns with national cardiac surgery performance expectations.

PURPOSE

This document synthesizes all MSTCVS participating hospital interventions, strategies, barriers, and improvements implemented across 2024–2025 to support improved performance. While these practices reflect successful approaches used across multiple institutions, not all interventions may be appropriate or feasible for every hospital. Each site should use these examples as guidance and adapt or tailor them to fit their local resources, workflows, patient populations, and organizational culture.

Phase I: Preoperative Optimization

A. Respiratory Risk Screening & Preparation

- RT completes bedside FEV1 testing and provides pre-operative respiratory teaching for all open-heart patients.
- If FEV1 < 50%, the surgeon is notified for potential pulmonology consult or full pulmonary function testing.
- Early identification of respiratory impairment helps anticipate weaning challenges and tailor postoperative ventilation planning.

B. Pre-Operative Team Alignment

- ICU, CTS, anesthesia, and RT teams educated on the 6-hour extubation goal and patient selection criteria with ongoing reinforcement.
- RT meets with each patient pre-op to reinforce expectations and optimize lung recruitment strategies.

Phase II: Intraoperative Practices

A. Anesthetic Strategy for Rapid Emergence from Anesthesia

- Use balanced anesthesia minimizing long-acting sedatives to support early neurologic recovery.
- Incorporation of Precedex for smoother emergence and reduced opioid requirements.
- Intraoperative opioid reduction as the case concludes.

B. Respiratory and Ventilation Preparation

- FiO_2 is reduced toward the end of the surgery when clinically safe, preparing for early spontaneous ventilation.

C. OR-Based Extubation Pathway

- Selective OR extubation considered only when:
  - Hemodynamics are stable
  - Neurologic assessment is reliable
  - No prohibitive bleeding, temperature, or device-related barriers exist

D. Multidisciplinary Decision Framework

- Early extubation candidacy is assessed immediately after coming off cardiopulmonary bypass.
- Decision requires agreement between anesthesia, surgery, perfusion, and ICU.
- Clear communication of extubation plan to ICU prior to transport.

Phase III: ICU Arrival (First 1-3 Hours)

A. Sedation & Pain Control

- All sedation discontinued upon ICU arrival.
- IV Tylenol established as first-line analgesic to reduce opioid needs.
- Fentanyl preferred over hydromorphone due to shorter half-life and faster neurologic recovery.
- RN/APP titrate remaining sedatives per RASS targets.

B. Early Ventilator Weaning

- Standardized CVICU Extubation Protocol utilized.
- Reinforcement of rapid wean protocol.
- RT conducts early and frequent readiness evaluations.

C. Hemodynamic and Respiratory Optimization

- ABG assessment.
- Adjustment of vasoactive infusions to reduce shunting physiology and improve gas exchange.
- Active temperature management to maintain ≥ 36°C, including use of heated humidity when appropriate.

D. Communication and Handoff

- Increased RN–RT collaboration during shift changes to prevent delays.
- RNs empowered to notify CTS team of borderline ABGs or clinical parameters.
- Critical Care team engaged for extubation decision-making as needed.

Phase IV: Extubation Readiness (2-6 Hours)

A. Readiness Criteria

- Consciousness appropriate to protect airway.
- Hemodynamic stability without escalating support.
- Adequate gas exchange on minimal ventilator settings.
- Temperature ≥ 36°C.
- Chest tube output <100 mL/hr (or reassessed hourly).

B. Operational Tools Supporting Timely Extubation

- OR exit time written on the whiteboard to ensure accurate time tracking.
- Expected extubation time documented on ICU arrival.
- Real-time tracking and documentation by RT/ICU staff.
- Clear documentation of reasons for any extubation beyond 6 hours for QI review.

C. Proactive Management of High-Risk Time Windows

- Special attention given to patients expected to reach readiness during shift changes.
- Micro-huddles conducted to ensure continuity and prevent workflow gaps.

D. Correction of Reversible Barriers

- Pain management adjustments.
- Warming measures for hypothermia.
- Hemodynamic and ventilatory optimization.
- ABG correction as required.

Phase V: Extubation and Post-Extubation Care

A. Safe Extubation Execution

- Extubate immediately once all protocol readiness criteria are met.
- Utilize standardized fast-track extubation order sets to streamline the process.

B. Immediate Monitoring

- Continue multimodal analgesia to avoid oversedation and respiratory depression.
- Monitor closely for respiratory fatigue, instability, or signs of deterioration.
- Maintain a low threshold for intervention in patients with significant comorbidities.

C. Post-Event Documentation and Feedback

- RT documents extubation time and any factors contributing to delay.
- Brief interdisciplinary debrief (RT, CTS, RN) conducted when extubation exceeds the target timeframe.

Program-Level Systems to Sustain Early Extubation

A. Education and Culture

- Ongoing education for ICU and CTS staff regarding early extubation goals and accurate identification of OR exit time.
- Formal open-heart training and orientation programs for new staff.

B. Performance Monitoring and Recognition

- Post monthly scorecards to display performance against goals.
- Share monthly compliance data with clinical and administrative leadership.
- Provide recognition to staff achieving consistent <6-hour extubations.
- Regular multidisciplinary meetings to review:
  - Extubation performance
  - Fallouts and trends
  - Opportunities for improvement

C. Workgroups Driving Quality Improvement

- Establish multidisciplinary workgroups to identify gaps, review cases, and drive system-level improvement in ventilator management and extubation processes.

D. Staffing and Workflow Improvements

- Implement strategies to address RT staffing variability and anesthesia turnover.
- Strengthen APP coverage across all hours.
- Focus on ensuring consistent RT availability during peak workflow times.

REFERENCES

1. Grant, M. C., Crisafi, C., Alvarez, A., Sander, M., Zarbock, A., Engelman, D. T., & the ERAS Cardiac/ERAS International/STS Expert Panel. (2024). *Perioperative care in cardiac surgery: A joint consensus statement by the Enhanced Recovery After Surgery (ERAS) Cardiac Society, ERAS International Society, and The Society of Thoracic Surgeons (STS)*. The Annals of Thoracic Surgery, 117(4), 669–689.
2. McCarthy, C., & Fletcher, N. (2020). *Early extubation in enhanced recovery from cardiac surgery*. Critical Care Clinics, 36(4), 663–674.
3. Flynn, B. C., He, J., Richey, M., Wirtz, K., & Daon, E. (2019). Early extubation without increased adverse events in high-risk cardiac surgical patients. *The Annals of Thoracic Surgery, 107*, 453–459.
4. Etchill, E. W., Wu, X., Alejo, D., Likosky, D. S., Whitman, G. J. R., & the IMPROVE Network. (2025). A retrospective multicenter study of operating room extubation and extubation timing after cardiac surgery. *The Journal of Thoracic and Cardiovascular Surgery, 170*(2), 606–615.e1.
5. Goeddel, L. A., Hollander, K. N., & Evans, A. S. (2018). Early extubation after cardiac surgery: A better predictor of outcome than metric of quality? *Journal of Cardiothoracic and Vascular Anesthesia, 32*(2), 745–747.
6. Luo, R., Fan, Y. Y., Wang, M. T., Yuan, C. Y., Sun, Y. Y., Huang, T. C., & Jing, J. Y. (2025). Different extubation protocols for adult cardiac surgery: A systematic review and pairwise and network meta-analysis. *BMC Anesthesiology, 25*, Article 104
7. Tanner, D., Insler, S., Toennes, B., Ziegman, G., Sobol, T., & Conley, B. (2017). Early extubation following cardiac surgery. *Chest, 152*(4), A225.
8. Landoni, G., et al. (2010). "Early Extubation After Cardiac Operations: A Prognostic Factor for Lower Costs?" *The Annals of Thoracic Surgery*, 89(5), 1551-1556.
9. Harrois, A., et al. (2014). "Early Extubation Combined with Multimodal Analgesia as Part of a Fast-Track Cardiac Anesthesia and Surgery Program is Associated with Reduced Postoperative Morbidity and Mortality." *Journal of Cardiothoracic and Vascular Anesthesia*, 28(6), 1621-1627.