

## Active Chest Tube Clearance Added to an ERAS Program Improves Outcomes and Reduces Resource Utilization

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### Background

The authors of this article had already implemented an **ERAS (Enhanced Recovery After Surgery)** program for cardiac surgery starting 2019, fully protocolized by 2020. In 2022, they added **active chest tube clearance (ATC)** as a component of the ERAS protocol. The study's goal was to compare patient outcomes before and after ATC implementation, specifically evaluating whether active clearance would reduce complications and resource use.

### Methods

The study population was 1,334 patients in total:

- **Control group** (historical, no ATC): 650

patients (Jan–Oct 2020 and Jan–Oct 2021)

- **Intervention group** (with ATC): 684 patients (Jan 2022 – Aug 2023)

Preoperative and procedural characteristics were similar between the two groups.

Outcomes measured included incidence of **retained blood syndrome (RBS)**, **postoperative atrial fibrillation (POAF)**, **intensive care unit (ICU) stay**, **ICU readmissions**, and other resource metrics.

### Key Findings & Results

Patients in the ATC group had fewer complications, shorter ICU stays, and lower rates of returning to ICU after transfer to a lower-acuity unit. The authors interpret these improvements as evidence that ATC enhances outcomes and reduces resource

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## Improving Cardiac Surgical Outcomes in Safety-Net Hospitals Through ERAS-C and Perioperative Optimization

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Safety-net hospital (SNH) systems deliver healthcare to low-income and underserved populations, who often face significant barriers to care.<sup>1</sup> Including late-stage disease diagnoses, transportation challenges, language barriers, and limited health literacy. Such barriers complicate the delivery of complex interventions like cardiac surgery.

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## Ventilator Acquired Pneumonia

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Ventilator-associated pneumonia (VAP) is defined by both the Infectious Diseases Society of America (IDSA) and the Centers for Disease Control and Prevention (CDC) as occurring more than 48 hours after endotracheal intubation. IDSA criteria require new or progressive infiltrates on imaging plus at least two of the following: temperature  $>38^{\circ}\text{C}$  or  $<36^{\circ}\text{C}$ , leukocytosis  $\geq 12,000$  cells/mm<sup>3</sup> or leukopenia  $\leq 4,000$

cells/mm<sup>3</sup>, and purulent respiratory secretions, along with positive respiratory cultures<sup>1</sup>. The CDC's surveillance-based definition categorizes VAP within the Ventilator-Associated Event (VAE) algorithm as "Possible VAP" (PVAP), requiring sustained increases in FiO<sub>2</sub> ( $\geq 20\%$ ) or PEEP ( $\geq 3$  cm H<sub>2</sub>O) for  $\geq 2$  days, clinical signs of infection, and microbiologic evidence (Figure 1)<sup>2</sup>. While objective and

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## Following Cardiac Surgery, Do Digital Drainage Systems Versus Underwater Seal Impact Postoperative Outcomes?

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### Objective

The objective of this article was to compare postoperative outcomes in cardiac surgery patients managed with digital drainage systems versus the conventional underwater seal (analogue) drainage after surgery. The key outcomes of interest: new-onset atrial fibrillation, need for reoperation (for bleeding or tamponade), pleural effusion requiring intervention, and drainage volumes/duration.

### Methods

The study population included patients  $>16$  years undergoing cardiac surgery (single surgeon at one centre) between August 2017 and August 2018 for underwater seal group and between August 2022 and August 2023 for digital drainage group.

Propensity score matching was used to balance the two groups on baseline covariates (age, sex, BMI, antiplatelet use,

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## Active Chest Tube Clearance Added to an ERAS Program Improves Outcomes and Reduces Resource Utilization

utilization when integrated into an ERAS framework.

Patients in the ATC group had fewer complications, shorter ICU stays, and lower rates of returning to ICU after transfer to a lower-acuity unit. The authors interpret these improvements as evidence that ATC enhances outcomes and reduces resource utilization when integrated into an ERAS framework.

### Interpretation & Limitations

The findings support the notion that actively maintaining chest tube patency (i.e., preventing clogging) helps reduce blood retention, which is linked to complications after cardiac surgery (e.g., inflammation, tamponade, atrial fibrillation). However, the authors acknowledge some limitations. The study was not randomized or blinded. Since the control group is retrospective, it is possible that the improvements associated with the implementation of the ERAS protocol may confound the outcomes attributed to ATC. Additionally, evidence in the benefit of ATC is not uniformly consistent.

Adding **active chest tube clearance** into an established ERAS protocol for cardiac sur-

***"We appreciate the opportunity to share our findings with the ERAS community. Please share back your findings as you evaluate the technology in your centers."***

**-Dr. Marc Gerdisch**

gery was associated, in this nonrandomized observational comparison, with lower rates of retained blood complications, reduced atrial fibrillation, shorter ICU stays, and fewer ICU readmissions. However, the results

should be interpreted cautiously given the study design, and further controlled trials are needed to validate these benefits more definitively.

Outcome	Control (no ATC)	ATC Group	Relative Difference/P-value
Retained blood syndrome (composite)	8.2%	4.8%	41% reduction, <b>P = 0.014</b>
Postoperative atrial fibrillation (POAF)			~17% reduction, <b>P = 0.049</b>
Median ICU hours	51.6 h	36.3 h	~30% reduction, <b>P &lt; 0.001</b>
ICU readmissions	3.2% (21 patients)	1.17% (8 patients)	<b>P = 0.013</b>

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## Ventilator Acquired Pneumonia

suitable for automated tracking, the CDC definition may exclude cases clinically consistent with VAP that fall outside strict criteria.

VAP commonly complicates cardiac surgery, affecting 6–13% of patients, with rates between 17.1 and 34.5 per 1,000 ventilator-days<sup>3</sup>. In a cohort study of 1,709 post-cardiac surgery patients, 9.7% developed VAEs, with 57.2% classified as PVAP (4). Patients with VAP experience significantly prolonged ICU stays (median 20.5 vs. 3 days), extended mechanical ventilation (22 vs. 1 day), and higher mortality rates both in-hospital (31.6% vs. 6.7%) and at one year (49.1% vs. 8.1%) compared to matched controls<sup>3</sup>. Post-cardiac surgery VAP are more prone to multi-drug resistant organisms (40.7% in one study), with *Pseudomonas aeruginosa* being the most frequent isolate<sup>3</sup>.

Prevention relies on bundled strategies. High-impact measures from the 2022 SHEA/IDSA/APIC guidelines, supported by extensive high-quality evidence, include daily sedation interruptions or

protocol-driven sedation management, daily spontaneous breathing trials, early extubation to noninvasive ventilation, and subglottic secretion drainage tubes<sup>5</sup>. Moderate-impact interventions like head-of-bed elevation ( $\geq 30$  degrees), routine tooth brushing, and early enteral nutrition offer modest but consistent benefits. Conversely, strategies such as chlorhexidine oral care, probiotics, and selective digestive tract decontamination have limited or inconsistent evidence and are not routinely recommended. Tailored interventions in high-risk patients (e.g., congestive heart failure, pulmonary hypertension, prolonged ventilation) further enhance prevention<sup>5</sup>.

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## Improving Cardiac Surgical Outcomes in Safety-Net Hospitals Through ERAS-C and Perioperative Optimization

A 2023 study by Frankel et al. analyzed over 525,000 patients undergoing coronary artery bypass grafting (CABG) in SNHs compared to non-SNHs.<sup>2</sup> After propensity score matching, mortality and major morbidity were comparable across systems.<sup>2</sup> However, SNH patients had longer hospital stays and incurred higher total costs.<sup>2</sup>

To address these disparities, cardiovascular surgery and anesthesia teams at Baylor College of Medicine and Ben Taub Hospital—a level 1 trauma and safety-net hospital in Houston—are developing a perioperative optimization service tailored for the SNH environment. The initiative integrates Enhanced Recovery After Surgery for Cardiac Surgery (ERAS-C) protocols—proven to reduce ICU and hospital lengths of stay—with the American Society of Anesthesiologists' Perioperative Surgical Home (PSH) model, which integrates anesthesiologists as the collaborative leaders of multi-disciplinary perioperative care.<sup>3</sup> A key feature is

the integration of patient advocates into the care team. Advocates will support patients through preoperative and postoperative phases by providing education, enhancing communication, and promoting adherence to care plans. Once a patient is identified as a surgical candidate, system-based optimization per ERAS-C protocols will begin, coordinated by the advocate and the multidisciplinary team.

In the inpatient phase, patients will be followed by a perioperative team that includes critical care, cardiology, CV surgery, anesthesia, and advocacy. Postoperatively, advocates will ensure continuity of care by collaborating with surgical and cardiology teams and facilitating formal handoffs to primary care.

The objective is to reduce length of stay and readmissions while improving patient outcomes and satisfaction. This model represents a scalable solution for delivering high-quality, patient-centered surgical care in resource-limited settings.

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## Following Cardiac Surgery, Do Digital Drainage Systems Versus Underwater Seal Impact Postoperative Outcomes?

surgical urgency, procedure type, ejection fraction, bypass time, preoperative cardiac rhythm). After matching, outcomes were compared using regression techniques (logistic for binary, linear/mixed effects for continuous) adjusting as needed.

Primary outcomes included postoperative atrial fibrillation (AF), reoperation for bleeding/tamponade, and pleural effusion needing intervention. Secondary outcomes included hourly and cumulative drain output in first 24 h, duration of drainage, and length of stay.

### Results

Total eligible cohort included 347 patients (190 in underwater seal, 157 in digital). After propensity score matching, 314 patients (157 per group in effect) were compared.

#### Atrial fibrillation:

- Unmatched: underwater seal group had 50/190 ( $\approx 26.3\%$ ) vs digital 26/157 ( $\approx 16.5\%$ )  $\rightarrow P = 0.03$ .

- After matching: the odds of postoperative AF in the digital group were  $\sim 0.57$  (95% CI 0.32–0.99) times that in the underwater seal group ( $P = 0.046$ ).

**Reoperation for bleeding/tamponade:** No statistically significant difference between groups after matching (OR  $\sim 2.4$  but wide confidence interval,  $P = 0.219$ )

**Pleural effusion requiring intervention:** No significant difference (OR  $\sim 2.1$ ,  $P = 0.378$ )

#### • Drainage volumes over first 24 h: No

statistically significant difference in cumulative output ( $P = 0.09$ )

• **Drain duration & length of stay:** Median durations were similar (digital: 12 h vs underwater seal: 13 h,  $P = 0.51$ ) and length of stay showed no significant difference ( $P = 0.34$ )

• **Mortality:** 3 deaths (1 %) in the digital group vs none in the underwater group (not statistically addressed)

### Discussion

The main finding of this study concluded the use of digital drainage systems was associated with a **lower risk of postoperative atrial fibrillation** compared to conventional underwater seal drainage. However, for the other key outcomes (reoperation, pleural effusion, drainage amount, drain duration, length of hospital stay), there was **no clear**

**advantage** of digital over underwater seal in this study. The mechanism by which the digital system might reduce AF is speculative: possibilities include more efficient removal of retained blood, more consistent intrapleural suction regulation, or reduced pericardial irritation/effusion.


Limitations of the study include the retrospective design, single centre, use of non-contemporaneous time periods for the two groups (possible calendar/time bias), and relatively low event rates for some outcomes limiting statistical power.

The authors conclude that digital drainage systems may be safely used after cardiac surgery and are associated with lower odds of postoperative atrial fibrillation compared to underwater seal systems, but they did **not** find significant differences in other postoperative outcomes in their matched cohort. They suggest that digital drains could be integrated into an Enhanced


After Surgery (ERAS) protocol for cardiac surgery, while acknowledging that further prospective, ideally randomized, larger-scale studies are needed to confirm their findings.




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## RECENT PUBLICATIONS:

[The left atrial appendage exclusion for prophylactic stroke reduction \(LEAAPS\) trial: Rationale and design.](#) Whitlock RP, McCarthy PM, Gerdisch MW, Ramlawi B, Alexander JH, Sultan I, Rose DZ, Healey JS, Sharma YA, Belley-Côté EP, Connolly SJ. *Am Heart J*. 2025 Jun;284:94-102. doi: 10.1016/j.ahj.2024.10.006. Epub 2024 Oct 11. PMID: 39395566

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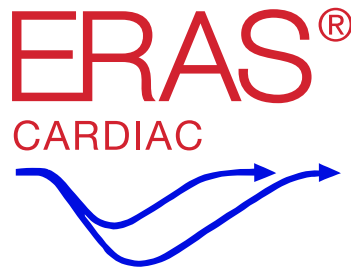
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