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# NEWSLETTER

Pakistan Association of Cardiothoracic Anaesthesiologists

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## Editorial

Assalam Alaikum, this is the fifth edition of the Newsletter published under the Pakistan Association of Cardiothoracic Anaesthesiologists (PACTA) banner. Please also visit our website for messages from PCTA leadership and relevant information. Newsletters are also available on the PACTA website (www.pacta.pk).

The current newsletter's theme is critical care management in cardiac intensive care, and we have received essential topics related to this theme. I am grateful to all who contributed, including the writers, reviewers, and editors. We try to involve different authors from various institutes. We have also limited the word count for the newsletter article to 500 words and only two references. Anyone interested in writing an article for this Newsletter can contact me at mohammad.hamid@aku.edu or mhamid92@gmail.com.

Please keep sending your feedback to improve the quality of this Newsletter.


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## Strategies to prevent and manage delirium. Is there any role of Dexmedetomidine?

Delirium is the sudden change in mental state marked by altered consciousness, fragmented thought patterns, and/or inattention. The impairment of thinking, memory, and learning is known as cognitive dysfunction. They are frequently observed in the intensive care unit (ICU) and, more commonly, in the post-surgical elderly patient. It can lead to long-term cognitive impairment, longer hospital stays, increased expenses, and rate of morbidity and mortality, thus making preventive strategies imperative.

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Non-pharmacological interventions such as establishing sleep schedules, reducing noise, ensuring enough light, promoting early mobilization, and physiotherapy can lower the prevalence of delirium. On the other hand, good pain management using multimodal analgesia and management of sedation by implementing sedation protocols and taking regular sedation vacations can also help prevent delirium and cognitive dysfunction in the ICU.

Haloperidol and Dexmedetomidine are commonly used for the treatment of delirium and cognitive dysfunction in the ICU. Haloperidol, a typical antipsychotic, is limited due to potential side effects. Whereas Dexmedetomidine, a selective α2-adrenergic agonist having sedative, analgesic, and anti-sympathetic effects, is FDA-approved for use in peri-procedural/operative sedation of non-intubated patients and sedation of intubated and mechanically ventilated patients in the ICU. Its off-label uses have grown over time, such as treating insomnia, alcohol withdrawal, prevention and management of delirium in the ICU, and providing supplementary analgesia. Its indications have broadened because it frequently results in a sedative condition that makes patients comfortable and compliant during mechanical ventilation. In addition, it does not require to be stopped to accomplish extubation and is safe to use in non-intubated patients because it does not produce significant respiratory depression. Furthermore, unlike most sedatives that lack natural analgesic effects, Dexmedetomidine has an opioid-sparing effect as well.
The use of Dexmedetomidine as an adjuvant to avoid emerging agitation, postoperative delirium, and postoperative cognitive impairment has generated some interest with mixed results. However, some studies prove that emerging agitation can be avoided after non-cardiac surgeries in both adults and children. But few studies found that Dexmedetomidine may increase the risk of other adverse outcomes.
The Dexmedetomidine dose range is 0.2 to 0.7 mcg/kg per hour for ICU sedation. However, the dose can be increased up to 1.5 mcg/kg per hour to achieve the desired sedation level, beyond which adverse effects occur. The most frequent side effects that occur are bradycardia and hypotension, which can be prevented by avoiding the loading dose or administering it slowly. The mechanism behind this is the reduction in central sympathetic outflow and presynaptic alpha receptor stimulation, resulting in a decreased release of norepinephrine.
To cover the 'D', *D*elirium: assess, prevent, and manage in the ICU ABCDEF bundle, and to enhance the short- and long-term outcomes of critically ill patients with delirium, research is currently needed to further develop therapeutic choices from medications to rehabilitation. Based on a few studies, such as that of Hamouda et al. on the safety of Dexmedetomidine in postoperative cardiac patients, Dexmedetomidine is being used after cardiac surgery and TAVR procedures in adult surgical ICU patients at NICVD hospitals, also without adverse effects, but studies are still lacking to prove the claim. This article is intended to serve as a resource to support future therapeutic practice and stimulate more research.

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# Cardiac Arrest Protocols in Cardiac Surgical Patients

## Introduction

Cardiac arrest in the general population may happen in a hospital or outside the hospital and requires immediate resuscitative measures to revive the patient. It is, however, crucial to perform a simultaneous rapid assessment and identify the cause to increase the potential for a successful outcome. These management strategies of resuscitations are now well established in the form of advanced cardiac life support (ACLS) protocols as per AHA (American Heart Association) guidelines. ACLS protocols are mandatorily taught to hospital staff members involved in patient care, allowing them to manage such incidents with vigilance and confidence as a team.

Cardiac arrest in cardiac surgical patients in the hospital, as in other patients, though rare but not uncommon, and successful resuscitation depends on the rapid assessment of the cause and prompt action. The application of the ACLS protocol may partly be used. Still, it could be counterproductive in cardiac surgical patients because AHA guidelines recommend "pushing hard and fast," and this action of external cardiac massage may be avoided or minimized. External cardiac massage may subject the underlying recently operated heart to the danger of damage to the myocardium, grafts, chambers, prosthetic valves, etc. One of the essential resuscitative measures in cardiac surgical patients is prompt sternotomy, which is not part of ACLS protocol. This led the leaders in the field to construct a protocol for cardiac surgical patients, considering that the sternotomy is a life-saving action in such patients.

**Construction of Cardiac Surgical Unit Advanced Life Support (CALS or CSU-ALS)**

The CALS protocol was developed by a team of cardiothoracic surgeons and Anaesthetist to manage critically ill cardiac surgical patients. Although based on ACLS guidelines, at the same time, taking into account the surgical complications, chest opening and focusing on the next step of reversing the aetiology of the arrest. These protocols were then converted into a structured teaching course to be taught to the cardiac surgical team, ICU nurses and anaesthesiologists. The course is further reinforced by scenarios like bleeding and ischemia. This course, in turn, improves the quality of care given to patients by the candidates in similar real scenarios and enhances their confidence (1).

The above modified protocol for cardiac surgical patients has been approved by the European Association of Cardio Thoracic Surgery (EACTS) and the Society of Thoracic Surgeons. The STS recommends the use of CALS instead of ACLS in cardiac surgical patients in a consensus statement and additionally suggests that the successful treatment of a patient who arrests after cardiac surgery is a multidisciplinary activity with at least six key roles that should be allocated and rehearsed as a team on a regular basis, **Fig.1**. patients who arrest with ventricular fibrillation should immediately receive three sequential attempts at defibrillation before the external cardiac massage, and if this fails, emergency re-sternotomy should be performed; patients with Asystole or extreme bradycardia should undergo an effort to pace if sternal wires are available before the external cardiac massage, then optionally external pacing followed by emergency re-sternotomy; Pulseless electrical activity should receive prompt re-sternotomy after exclusion of quickly reversible causes **Fig 2**. A full dose of epinephrine should not be routinely given owing to the danger of extreme hypertension if a reversible cause is rapidly resolved (2).

**The way forward**

The fundamental teachings of Cardiac arrest protocols for post-cardiac surgery patients prioritize rhythm analysis and immediate defibrillation followed by basic life support, rapid assessment of reversible causes like cardiac tamponed and preparation for emergency sternotomy within 5 minutes of arrest, to facilitate removal of clots, internal cardiac massage and pacing via epicardial wires whenever needed. However, in the recent literature, Yang and colleagues have rationalized the modernization of CALS protocol by referring to the changing landscape of cardiac surgery in terms of the progressive increase in the number of procedures performed by sternal sparing approach, making sternotomy less quick and friendly (3). They suggest resuscitation may include the use of echocardiography to help identify the cause of arrest and guide corrective measures. Furthermore, they encourage the use of Extra Corporeal Resuscitation in the form of veno arterial extracorporeal membrane oxygenation (VA ECMO) in selected patients leaving emergent resternotomy for patients with bleeding and cardiac tamponed.

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## Recognition and management of SIRS in post-cardiac surgical patients: Role of methylene blue

Vasoplegia in cardiac surgery accounts for <5% of the shock. It occurs in 5-50% of patients who have cardiac surgery. Mortality rate as high as 25%. The risk factors are preoperative antihypertensive use, low ejection fraction, diabetes, recent myocardial infarction, long duration of cardiac bypass, and warm core temperature while on cardiac bypass.
Clinically, **vasoplegia presents** as a high-output shock state, low systemic vascular resistance, normal cardiac output, dysfunction or dysregulation of vasculature, and hypoperfusion.
Vasoplegia has **no standard definition**. It is a shock occurring within 24 hours of cardiopulmonary bypass, cardiac index > 2.2 L/kg/m2, and SVR < 800 dynes/cm2.
Normally, the vasculature responds to hypotension by activating G-protein-coupled receptors, which leads to an increase in intracellular calcium and causes vascular smooth muscle cell contraction and vasoconstriction.

There are **multiple mechanisms of vasoplegia described in the literature**. The first one is during CPB. The contact of blood with the CPB circuit leads to the release of IL-1, IL-6, and TNF-α, which induce nitric oxide synthase, leading to increase NO production. The NO causes inhibition of calcium influx in the smooth muscle cells and activation of soluble guanylate cyclase, which leads to vasodilation. The second mechanism is through the adrenergic system. The inflammatory cytokines that induce NO synthase also cause hormone depletion and desensitization of adrenergic receptors. This leads to the loss of effect of catechol amines, which causes resistant hypotension. Thirdly, vasoplegia can be mediated by Hydrogen Sulphide, which L-cysteine produces. This leads to smooth muscle cell hyperpolarization and causes vasodilation.

The **first line of management** of vasoplegia includes fluid boluses, pressers, steroids, and ascorbic acid. Different agents are used to treat it, including **Methyl Blue (off-label), Hydroxycobalamine, and Angiotensin II**.

**Methylene blue has been used for multiple purposes**. These include treating methemoglobinemia, vasoplegic syndrome, hypotension, plasmodium falciparum, ifosfamide encephalopathy, urinary tract infections, and surgical staining. It **inhibits guanylate cyclase, which decreases cGMP production** and inhibits vasodilation. It is given as 1-2 mg/kg over 20-60 min. The contraindications to use are G6PD and serotonergic medications. The adverse effects are limb pain, blue-green urine discoloration, skin discolouration, dysgeusia, nausea, dizziness, hyperhidrosis, and decreased pulse oximetry readings with normal PaO2.

A **randomised controlled trial** was conducted for the role of methylene blue in vasoplegic patients in cardiac surgery **(Recardo Levin, 2004)**. 56 patients undergoing elective cardiac surgery and meeting the vasoplegic criteria (Hypotension, MAP <50 mmHg, Low filling pressures, CVP <5mmHg PCWP <10mmHg, High/normal cardiac index >2.5 L/min/m2, low peripheral resistance, SVR <800 dynes/s/cm2) were enrolled in a RCT and were given Methylene Blue 1.5 mg/kg over 1 hour vs placebo. The exclusion criteria were off-pump CABG, patients with bacterial endocarditis, aortic dissections, and urgent /emergent procedures. The trial showed that the patients receiving Methylene Blue had lower mortality compared to those who did not, 0/28 (0%) vs. 6/28 (21.4%) (p=0.01). **The patients who received Methylene Blue had a shorter duration of vasoplegia, approximately 2 hours vs >48 hours (p=0.002)**. The limitations were

that it had a small sample size and was not applicable to all cardiac surgery patients, given the exclusion criteria.

Another retrospective cohort study **(J. Hunter Mehaffey, 2017)** included 3608 patients who underwent CPB. One hundred eighteen patients received methylene blue within 72 hours of bypass (2mg/kg IV bolus followed by 12-hour infusion at 0.5mg/kg/hour. The primary outcome was adverse events, which included operative mortality, stroke, renal failure, reoperation, sternal wound infection and prolonged ventilation. **The study looked at patients who received Methylene blue vs. those who did not, the patients who got it earlier in the OR, and the late group who received it in the postop period in the ICU**. The methylene blue group was preoperatively younger, had more heart failure with low EF, more ventricular assist devices, and had more chronic lung disease, more preoperative amiodarone use and more prior cardiac surgeries. The methylene blue group had higher rates of major adverse outcomes, higher rates of operative mortality and was sicker, which prompted the use of Methylene blue**. Another comparison was early vs late administration of methylene blue**. Methylene blue administration was associated with decreased vasopressor requirement and increased MAP and SVR. However, early administration was associated with a reduced risk of major adverse events. The limitations of this study was that it was retrospective, had a smaller sample size and had many cofounders that could affect the outcome.

A systematic review of meta-analyses of methylene blue included six studies, which compared 317 patients who had cardiothoracic surgery (CABG, valve replacement, endocarditis) and received Methylene blue to those who did not **(Perdhana, 2021)**. There was no difference between the groups when they compared MAP, SVR, HR, and length of stay. Compared to adverse events like renal failure, multi-organ failure, and mortality, the Methylene blue group showed better outcomes.

The **limitation of its use is that the data we have for methylene blue is** limited. However, the existing data suggest that it does have mortality benefits in cardiothoracic surgeries for vasoplegia, and its earlier administration is more beneficial.

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## Artificial Intelligence Use in Pediatric Cardiac ICU: Prospects and Challenges

Artificial Intelligence (AI) has become a defining force today, with growing applications across various sectors, including healthcare. The medical field, particularly specialties such as radiology, has embraced AI to enhance workflow efficiency and decision-making (1). Among these, the intensive care unit (ICU) stands out as a data-dense environment where patient conditions fluctuate rapidly, and clinical decisions must be made in real-time. This constant influx of physiologic and clinical data offers an ideal foundation for AI integration. Its application in pediatric cardiac intensive care units (CICUs) marks a pivotal advancement in how we understand, monitor, and respond to the needs of critically ill children (2). As the field of pediatric cardiac critical care continues to grapple with high patient acuity, data overload, and variability in care delivery, AI-driven tools are increasingly showing promise in transforming clinical decision-making, particularly in low- and middle-income countries (LMICs) (3).

Central to this innovation is AI's capacity to process large volumes of complex data in real time, helping clinicians extract actionable insights that might otherwise be overlooked. Our team has shown that AI-based risk analytics could support goal-directed therapy even in resource-constrained environments (4). The tool was able to aggregate and analyze continuous physiologic variables, offering a snapshot of oxygen delivery adequacy, one of the most critical parameters in cardiac critical care.

Building on this, a more recent study by Asfari et al. showed that a near-real-time AI algorithm could predict elevated lactate levels, a surrogate marker for poor perfusion and evolving shock in pediatric cardiac

patients (5). Similarly, another study confirmed the accuracy and feasibility of using AI tools to predict acute kidney injury following cardiac surgery in the pediatric population (6). This predictive capability—using high-frequency data streams from the bedside—provided an opportunity to intervene earlier than conventional monitoring would allow. Importantly, the algorithm was validated across multiple centers, emphasizing its generalizability and the value of AI in identifying silent deterioration.

In LMIC settings, the use of AI has extended beyond prediction to include advanced data visualization and risk stratification tools. Inam et al. described a novel data visualization and risk analytic platform that operationalized real-time risk scoring and trend monitoring for bedside clinicians in a tertiary care center in Pakistan (7). The model was not only feasible but also led to improvements in identifying high-risk patients. Its success underscores that AI is not just the domain of high-income countries; with the right partnerships and infrastructure, it can be adapted and deployed in environments where the need for decision support is arguably even greater.

Despite these advances, successful AI integration in CICUs requires more than sophisticated algorithms. Local context, data governance, and clinician trust are critical to adoption. Algorithms must be interpretable and aligned with clinical intuition to gain widespread acceptance. Moreover, challenges remain in integrating AI into current workflows, especially in systems where electronic health records are either absent or underdeveloped. While AI offers substantial support, it does not replace the human workforce. An efficient and adequately trained ICU team remains central to delivering safe and effective patient care. The value of human judgment, compassion, and real-time decision-making cannot be overstated.

The future of AI in pediatric CICUs will likely evolve toward more personalized, dynamic models that incorporate genomics, imaging, and other 'omics data alongside physiologic parameters. However, the foundational work being done in LMICs—like the studies cited above—is crucial to get there. They demonstrate that with clinical leadership, collaborative spirit, and a commitment to innovation, AI can serve not only as a decision-support tool but also as a bridge to more equitable and consistent care delivery.

In conclusion, AI is rapidly becoming a cornerstone of modern pediatric cardiac critical care. It offers the potential to detect deterioration earlier, personalize therapy, reduce cognitive load, and, most importantly, improve outcomes for some of the most vulnerable patients. As our experience deepens, particularly through locally led innovation and validation, the integration of AI in pediatric CICUS will move from novelty to necessity.

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## Cone repair for Ebstein anomaly- early postoperative outcomes

Cone repair for Ebstein anomaly can achieve good anatomical correction of the Tricuspid valve and Right Ventricular geometry. We present our initial results of more than 20 Cone repairs done in our unit over the last 3 years.

A total of 21 patients who underwent cone repair (mean age, 5.5 years) between March 2022 and December 2024 are included. Echocardiography was our mainstay of pre-operative assessment. Only 2

Patients were GOSE Score 1. The majority of the patients were decompensated with shortness of breath and presented late.

Twenty-one patients with Ebstein anomaly were operated on for cone repair at our Centre during the study duration of 3 years. Their ages range from 2 to 21 years, with a mean age of 5.5. Patients were classified preoperatively into four groups according to their GOSE ratio with 12 patients of GOSE 2 score. All patients underwent cone repair. Four patients needed a Glenn shunt for severe RV dysfunction. The mean cardiopulmonary bypass time was 84 minutes, and the mean cross-clamp time was 61 minutes. Intraoperative epicardial echo showed no or trivial TV regurgitation in 5 patients, mild in 14 patients and 2 with moderate regurgitation. None of the patients had severe TV regurgitation. There were 2 mortalities not directly related to cone repair. 1 patient had a stroke, and 3 had AKI, for which one required dialysis, and reversible hepatic dysfunction in 5 patients. 2 patients needed reintubation. One patient had a heart block, but none required a permanent pacemaker.

The cone repair has satisfactory outcomes at our institution, with a low incidence of greater than mild tricuspid valve regurgitation at short-term follow-ups. Longer follow-up is underway to assess the late outcome of Tricuspid valve repair and the symptomatic status of the patients.

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# PHOTO GALLERY


**Examiners FCPS-II (Cardiothoracic Anesthesia) Exam at Regional Center Islamabad (3-5-25)**


**CEEA CME Course and hand on workshop on Transesophageal echocardiography at AKUH (Faculty and Participant)**


**Pakistan Association of Cardiothoracic Surgeons Conference at PC Karachi (Joint Session of Cardiac Anaesthesia, Emergency, Medicine and infectious Diseases)**


**Targeted Intensive Care Echocardiography course at Fazaia Postgraduate Medical Institute Islamabad**

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