Volume 3: Issue 2 2025

NEWS LETTER

Pakistan Association of Cardiothoracic Anaesthesiologists

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EDITORIAL

Assalam Alaikum,

It is my pleasure to present to you the **second issue of the PACTA Newsletter for the year 2025**, published under the banner of the **Pakistan Association of Cardiothoracic Anaesthesiologists (PACTA)**. We aim to share knowledge, highlight new developments, and create a platform for learning and collaboration within our specialty.

In this issue, we have compiled a range of diverse and thought-provoking topics, carefully chosen to be both informative and relevant to our readers. Alongside scientific updates, clinical insights, and academic discussions, we have also included social events in the photo gallery.

I remain deeply grateful to all those who contributed to this edition — the authors who shared their expertise, and the reviewers who ensured quality. Without their commitment and enthusiasm, this newsletter would not have been possible.

As always, your **feedback, suggestions, and active participation** are invaluable in helping us improve the quality and impact of this newsletter. We welcome contributions in the form of articles, case reports, updates, or even reflections from your professional experiences. Together, we can ensure that this publication continues to serve as a meaningful voice for our community.

Thank you once again for your interest and support. I hope you find this issue both engaging and enriching.

With best regards,

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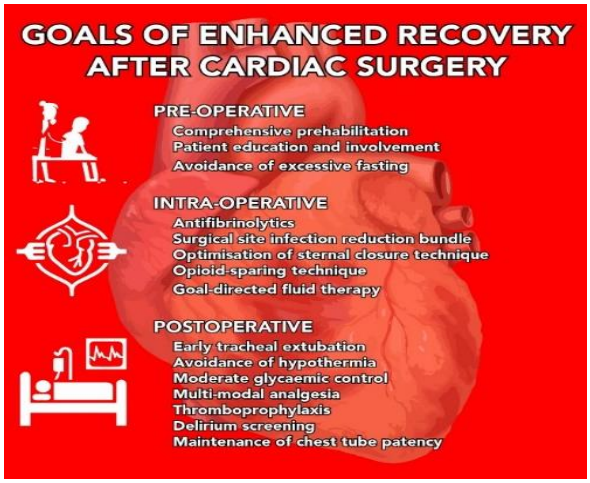
Enhanced Recovery after Cardiac Surgery: The Role of the Cardiac Anaesthesiologist

Enhanced recovery after cardiac surgery (ERAS) programs are designed to optimize postoperative recovery and improve patient outcomes. With increasing recognition of the need to minimize surgical stress and expedite the recovery process, the role of the cardiac anaesthesiologist has become pivotal in this multidisciplinary approach. This essay explores the essential contributions of cardiac anaesthesiologists within ERAS protocols, emphasizing their influence on patient management, intraoperative care, and postoperative recovery.

Cardiac anaesthesiologists are uniquely trained to manage the complex physiological demands associated with cardiac procedures. Their expertise allows them to assess and prepare patients preoperatively, identifying potential risks and optimizing them for surgery. This preoperative assessment is crucial, as it provides an opportunity to implement strategies that may reduce the incidence of postoperative complications. By employing risk stratification tools, such as the American College of Cardiology/American Heart Association (ACC/AHA) guidelines, anaesthesiologists can tailor their management plans according to individual patient profiles, thereby enhancing overall surgical outcomes.

During the surgical procedure, cardiac anaesthesiologists play a central role in monitoring and maintaining hemodynamic stability while ensuring adequate analgesia. This involves the administration of anesthetics and analgesics, which must be carefully balanced to contribute to a smooth recovery. A key aspect of ERAS protocols is the promotion of multimodal analgesia. This strategy employs various medications and techniques to minimize opioid use and its associated side effects, such as nausea and delayed recovery. Cardiac anaesthesiologists are instrumental in integrating regional anaesthesia techniques, such as thoracic epidurals or paravertebral blocks, which can significantly enhance pain control and facilitate early mobilization, a critical component of ERAS.
Moreover, the management of fluid therapy is another area where cardiac anaesthesiologists directly impact recovery outcomes. Studies have shown that optimizing fluid balance intraoperatively can reduce complications such as acute kidney injury and myocardial dysfunction. These anaesthesiologists utilize goal-directed fluid therapy guided by real-time hemodynamic monitoring, which enables individualized fluid resuscitation strategies. By anticipating fluid requirements and adjusting them throughout the procedure, they can ensure better postoperative recovery and reduced length of hospital stay.

Postoperatively, the expertise of cardiac anaesthesiologists continues to be essential. Their involvement in the early postoperative phase, particularly in intensive care units (ICUs), enhances patient recovery trajectories. They collaborate with surgeons, nurses, and other healthcare professionals to monitor patients closely for potential complications, assess pain management strategies, and implement early extubation protocols. Early weaning from mechanical ventilation, supported by effective anaesthesia management, can lead to decreased ICU stay and improved overall recovery.



An often-overlooked aspect of the anaesthesiologist's role is patient education and engagement. In ERAS approaches, it is crucial to inform patients about postoperative expectations and pain management strategies. By demystifying the surgical experience and emphasizing the importance of participation in their recovery, cardiac anaesthesiologists can

significantly influence patient satisfaction and engagement in the rehabilitation process.
The integration of technology and data-driven practices also underscores the evolving role of cardiac anaesthesiologists within ERAS protocols. Utilizing evidence-based practices, including predictive analytics for risk assessment and recovery, allows for fine-tuning patient management. Moreover, embracing telemedicine for follow-up post-discharge has become increasingly important. This approach helps monitor patients' recovery and promptly addresses complications, ensuring continued support beyond the hospital setting.

In conclusion, the contributions of cardiac anaesthesiologists to enhanced recovery after cardiac surgery are multifaceted and critically important. Through comprehensive preoperative assessments, innovative intraoperative management strategies, and vigilant postoperative care, they play a significant role in optimizing patient outcomes. As the field of cardiac surgery continues to advance, the integration of anaesthesiology within ERAS protocols remains a cornerstone of effective patient management that not only enhances recovery but also improves the overall patient experience. The ongoing collaboration among surgical teams, anaesthesiologists, and post-operative care staff is vital in achieving the common goal of delivering superior care and advancing patient recovery in the realm of cardiac surgery.

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The Role of Artificial Intelligence in Cardiac Anaesthesia

Background

"Artificial Intelligence (AI) is broadly defined as the study of algorithms that enable machines to reason, solve problems, and make decisions."

The term AI was first introduced in 1950. The practice of cardiac anaesthesia has always been an intricate balance of physiological monitoring, pharmacological precision, and rapid decision-making. The increasing integration of artificial intelligence (AI) and machine learning (ML) is poised to fundamentally augment this practice, not by replacing the clinical expert, but by providing sophisticated tools for decision support. While there have been attempts to develop machines for anaesthesia based on AI principles, they were not successful due to the complexities of the practice. However, recent innovations in AI, especially machine learning, will continue to grow in importance and will significantly revolutionize anaesthesia along with surgical practice and perioperative medicine. AI's ability to analyse vast datasets, which is usually beyond human capacity, offers a new pathway for defining health states, predicting future events, hence delivering more personalized patient care. This has the promise to improve patient safety and outcomes by enhancing monitoring, prediction, and guidance in the data-intensive environment of the cardiac operating room and ICU.

Rationale of Using AI

The critical rationale for AI in cardiac anaesthesia lies in its ability to support clinicians in complex tasks. AI algorithms are excelling in event and risk prediction, such as identifying patients at risk for post-induction hypotension, dysrhythmias or other major adverse events. This proactive approach allows for timely intervention, decreasing adverse outcomes. A specific example is the concept of AI-assisted tailored cardiopulmonary resuscitation, which leverages data to optimize management during critical events. Furthermore, AI systems can serve as clinical decision support (CDS) tools. While traditional CDS tools have been effective for minor tasks, incorporating machine learning can enhance their analytical capacities to create personalized clinical pathways.
One of the most impactful applications for cardiac anaesthetists is in echocardiography, as AI can assist in image acquisition, interpretation, and quality assessment, which is particularly relevant for TEE. AI-based software can objectively assess cardiac function, such as LV Ejection Fraction, RWMAs, RV function/strain, providing standardized and reproducible data. In the critical care setting, AI can cut the clutter and improve workflow, reduce operator variability, and enhance diagnostic accuracy.

Process of Implementation in Clinical Settings

Implementing AI requires a structured and deliberate approach. AI models are only as good as the data they are trained on, needing good and calibrated datasets and collaboration between clinicians and data scientists. If any AI system is planned to be implemented, it must undergo rigorous, standardized evaluation, including external validation using different patient populations. A significant challenge is the lack of public access to large healthcare databases due to legal and commercial barriers; therefore, it is the responsibility of clinicians to ensure that the evaluation of AI moves beyond technical metrics and proves genuine clinical benefit to the patient.

Advantages in Low-Resource Settings

AI holds immense promise for improving care in low-resource settings, where access to experienced specialists may be limited. The ability of AI to enhance diagnostic accuracy and standardize clinical data or echocardiographic interpretation can help bridge training gaps and lack of advanced techniques. The integration of AI into tele-ultrasound systems, for example, allows expert-level diagnostics to be extended to remote and underserved areas. By providing decision support, AI can help clinicians with less experience provide a higher standard of care, ensuring quality is not solely the domain of specialized centers.

Possible Disadvantages

Despite the advantages, AI integration is not without limitations. A significant challenge is bringing together experts from medicine, data analytics, and computer science to develop these systems in harmony. Furthermore, the "black-box" nature of many algorithms, where the reasoning behind a recommendation is opaque, makes it difficult for clinicians to trust and accept the technology. There is also the risk of algorithmic bias, where models trained on non-diverse datasets may perform poorly or unfairly in certain patient groups. Another pitfall is cybersecurity; the threat of hacking medical devices connected to the internet is a serious hindrance to the development of AI systems. AI systems also currently lack proper situational awareness and cannot extrapolate beyond their training data, a key aspect of clinical practice.

Conclusion

AI represents a transformative tool for cardiac anaesthesia, offering new opportunities for enhancing patient safety and personalized care. Its true value lies in its ability to augment, not replace, our clinical expertise. While challenges related to data quality and its validation must be addressed, the path forward is clear. As clinicians, we must take responsibility to harness this technology for good use and remain involved in its evolution, guiding the development and responsible implementation. We can ensure that AI becomes a trusted partner in the operating room, ultimately leading to better outcomes for the patients.

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References

1. Khan FH, Fazal M. Artificial intelligence--- Future of Anesthesiology!! Anaesth pain & intensive care 2019;23(3):247-249.
2. Pinsky, M. R., et al. (2024). Use of artificial intelligence in critical care: opportunities and obstacles. *Critical Care*.
3. Bowness, J. S., et al. (2024). Leading in the development, standardised evaluation, and adoption of artificial intelligence in clinical practice: regional anaesthesia as an example. *British Journal of Anaesthesia*.

Non-Operating Room Anaesthesia (NORA): Challenges for Cardiac Anaesthesiologists in Low- and Middle-Income Countries (LMICs)

Non-Operating Room Anaesthesia (NORA) refers to the provision of anaesthesia services outside the traditional operating theatre. With the expansion of diagnostic and therapeutic procedures across radiology, cardiology, gastroenterology, and interventional specialities, the demand for anaesthesia support in non-operating environments has grown significantly. NORA plays a crucial role in ensuring patient safety and procedural success, especially for high-risk populations such as those with cardiac comorbidities.

In high-income countries, the transition to delivering anaesthesia services in these settings has been supported by technological advancements and infrastructure development. However, in low- and middle-income countries (LMICs), unique challenges make NORA a far more complex undertaking, particularly for cardiac anaesthesiologists dealing with patients who are already hemodynamically vulnerable.

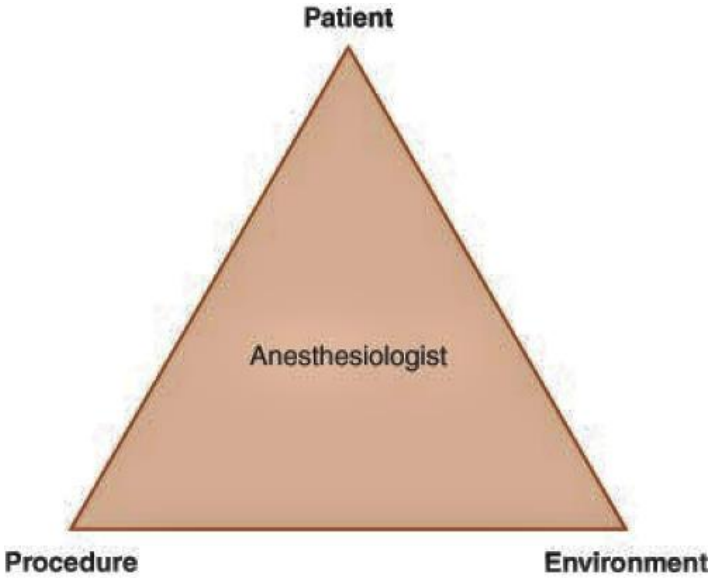
Inadequate Infrastructure and Equipment:
In LMICs, a major challenge in NORA is inadequate infrastructure, especially for cardiac patients who require continuous monitoring, resuscitation equipment, and ventilatory support. Facilities like catheterization labs often lack essential resources such as oxygen supply, suction, reliable power, and temperature control. According to WFSA, 35% of facilities lack oxygen, and 74% operate without pulse oximetry. The absence of end-tidal CO_2 monitoring, ECG leads, and defibrillators significantly increases risks for cardiac patients undergoing procedures outside the operating room.

Poorly Designed NORA Environments:
Most NORA sites in LMICs are not built with anaesthesia needs in mind. Cardiac catheterization labs or radiology suites often have poor lighting, limited access to the patient during procedures, and insufficient room for anaesthesia equipment. Providers are forced to transport critical supplies themselves, increasing delays during emergencies

Lack of Standardised Protocols and Safety Systems:
Safety protocols in operating rooms, such as WHO Surgical Safety Checklists and structured time-outs, are standard. Such systems are rarely implemented in non-OR settings in LMICs, where the emphasis may still be on procedural throughput rather than safety. Cardiac patients, who are especially prone to arrhythmias, myocardial ischemia, and hypotension, are at higher risk when such checks are not in place.

Communication Barriers with Procedural Teams:
Cardiac anaesthesiologists often work alongside interventional cardiologists, radiologists, or gastroenterologists during NORA. In LMICs, poor interdisciplinary communication, lack of pre-procedural assessment, and absence of joint decision-making can hinder patient care. A clear understanding of anaesthetic risks, procedural demands, and patient-specific vulnerabilities is essential.

Emergency Preparedness and Recovery Limitations:
The ability to manage anaesthetic emergencies, especially in high-risk cardiac patients, is significantly impaired in resource-limited NORA environments. Resuscitation carts may be incomplete, airway equipment inadequate, and access to emergency drugs delayed. Furthermore, post-procedure recovery spaces are often under-equipped, with insufficient monitoring or staffing, which can compromise patient safety in the critical post-anaesthetic period.



A three step paradigm for non-operating room Anaesthesia

Way Forward:
Addressing these challenges requires a multi-tiered approach: investment in infrastructure, capacity-building through training and simulation, and development of context-specific safety protocols. Advocacy for NORA-specific guidelines that account for cardiac patients in LMICs is essential. Interdisciplinary collaboration and telemedicine can also help bridge the expertise gap. International partnerships may play a role in mentorship and policy development.

Conclusion
Cardiac anesthesiologists in LMICs face daunting challenges when delivering NORA, balancing resource limitations with the need for safe care in complex cardiac patients. Addressing infrastructure gaps, workforce shortages, and communication failures is essential. With innovation, advocacy, and global collaboration, NORA can be made safer and more accessible, transforming cardiac care even in resource-limited settings.

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References:
1. Muir, A.; Hart, R. Non-operating room anaesthesia: General considerations. Anaesth. Intensive Care Med. 2023, 24, 412–415.
2. Goudra B, Alvarez A, Singh PM. Practical considerations in the development of a nonoperating room anaesthesia practice. Curr Opin Anaesthesiol. 2016 Aug;29(4):526-30. doi: 10.1097/ACO.0000000000000344. PMID: 27054415.

Opioid Sparing Cardiac Anaesthesia: The Role of Erector Spinae Plane Block in Open Heart Surgery

Opioid-free anaesthesia (OFA) is gaining popularity in cardiac surgery due to its potential to reduce opioid-related side effects such as respiratory depression, nausea, and prolonged ICU stay. Regional techniques, particularly the erector spinae plane (ESP) block, have shown promising results in open cardiac procedures.

Benefits of ESP Blocks

- Reduced Opioid Consumption: ESP blocks have been shown to significantly reduce intraoperative and postoperative opioid use in patients undergoing coronary artery bypass grafting (CABG) and other cardiac surgeries.

- Improved Recovery: Patients who received ESP blocks were extubated earlier and had shorter ICU stays, supporting enhanced recovery protocols.
- Safety and Efficacy: ESP blocks are safe and effective across age groups, including children and adults.

Comparison with Other Regional Techniques

- Thoracic Epidural Analgesia (TEA): While TEA is considered the most effective in pain control, ESP blocks provide similar opioid-sparing benefits with a better safety profile, making them a strong alternative when TEA is not feasible.
- Other Regional Blocks: ESP blocks have been compared to other regional blocks, such as pectoral nerve block 2 (PECS 2), and have shown promise in reducing opioid consumption and improving patient outcomes.

Procedure-Specific Benefits

- Open Sternotomy-Based Procedures: ESP blocks have been found to be more effective in open sternotomy-based procedures, such as CABG, compared to minimally invasive direct coronary artery bypass (MIDCAB) surgery.

Enhanced Recovery after Surgery (ERAS) Protocols

- Faster Extubation: Incorporating ESP blocks into ERAS protocols has led to faster extubation, better respiratory function, and shorter hospital stays.
- Multimodal Analgesia: ESP blocks support a shift toward multimodal, opioid-sparing strategies in cardiac anaesthesia.

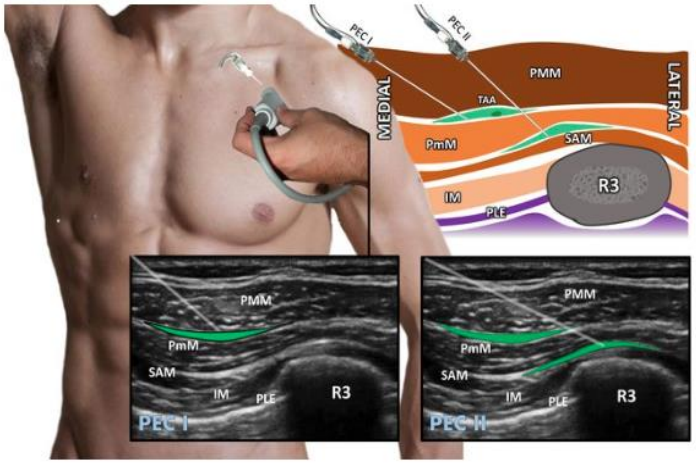
Cost-Effective Solution

- Limited Resources: In resource-limited settings like Pakistan, ESP blocks offer a cost-effective solution with just ultrasound and local anaesthetics.
- Training Programs: Training programs in ultrasound-guided blocks can further promote adoption and improve perioperative outcomes.

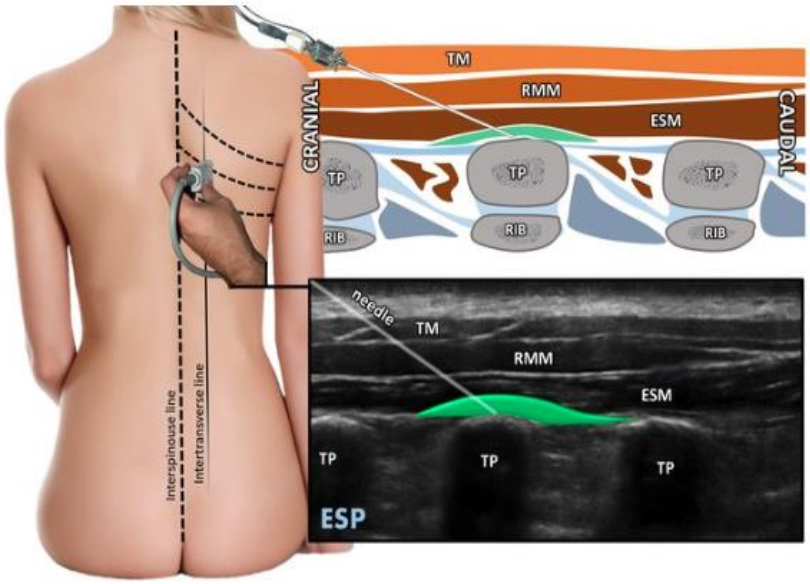
In conclusion, the ESP block is a safe, effective, and versatile option in opioid-free cardiac anaesthesia. Its role in multimodal analgesia can enhance recovery and modernize cardiac care, especially in resource-limited settings.

References:

1. Rahimzadeh, P., et al. (2023). Effect of ultrasound-guided erector spinae plane block on recovery after on-pump CABG: a randomized controlled trial. Ain-Shams Journal of Anesthesiology.
2. Iliev, I., et al. (2024). Erector spinae plane blocks for opioid-sparing multimodal pain management after pediatric cardiac surgery. PubMed.



Anatomical location of PEC I and PEC II block and distribution of local anesthetic seen on ultrasound. IM, intercostal muscle; PlE, pleura; PMM, pectoralis major muscle; PmM, pectoralis minor muscle; R3, third rib; SAM, serratus anterior musclel; TAA, pectoral branch of thoracoacromial artery



Anatomical location of ESP block and distribution of local anesthetic seen on ultrasound. ESM, erector spinae muscle; RIB, Rib; RMM, rhomboid muscle; TM, trapezius muscle; TP, transverse process

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Paediatric Thoracic Anaesthesia: An Update

Pediatric thoracic anaesthesia presents several challenges for anesthesiologists, which include several anatomical and physiological differences from adults, which make them prone to hypoxemia, limited availability of lung isolation devices, the emergence of new techniques for thoracic surgery pain, and the trend towards early discharge.

One Lung Ventilation (OLV)
There are various techniques available for OLV, but the preferred methods are endobronchial intubation for neonates and infants aged 0-6 months, Bronchial blockers for children aged 6 months to 8 years, and Double-lumen tube (DLT) for children aged 8 years and older. Univent tubes can also be used for children more than 4-6 years of age, and commonly used blockers are the Arndt blocker and the EZ endobronchial blocker.

Non-intubated VATS (NIVATS)
This technique is gaining popularity mainly due to the avoidance of complications associated with intubation, mechanical ventilation and OLV. The most common technique is general anaesthesia with LMA in a spontaneously breathing patient.

Perioperative pain management
Multimodal analgesia is still the mainstay of pain control and includes narcotics, NSAIDS, paracetamol analgesics and regional analgesia techniques. Other adjuncts used are ketamine, dexamethasone and gabapentin.
Newer facial plane blocks have been introduced in recent years to minimize complications associated with narcotics and thoracic epidural anesthesia. **Erector spinae plane Block** (ESP block) is considered an easy and efficient block with fewer complications and less haemodynamic alterations. **The serratus anterior plane block** is gaining popularity for VATS procedures. It also reduces perioperative opioid consumption. Traditional Intercostal and Paravertebral blocks are still commonly practised for pain management.

Robot-assisted thoracic surgery (RATS) is another developing area for pediatric patients. Its challenges include narrow intercostal spaces and a small thoracic cage. Thymectomies, Lobectomies, congenital diaphragmatic hernia and

surgery for pulmonary sequestration have been done through the RATS, but still there is no consensus on the minimal age for these surgeries.

Recently, **Artificial intelligence** and **enhanced recovery after surgery** programs have been introduced in pediatric thoracic surgery, but they are still in their infancy; more studies are needed to assess their utility.

Conclusion

Recent advancements in the field of paediatric thoracic anaesthesia have focused on refining techniques of OLV, introducing new facial plane blocks and ERAS programs.

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References:

- Templeton, et al. An Update on One-Lung Ventilation in Children. Anesthesia & Analgesia 132(5):p 1389-1399, May 2021.
- Glasbey J, et al. *Enhanced recovery pathways in paediatrics: a systematic review*. Paediatr Anaesth, 2022.

Commonly used Bronchial Blockers

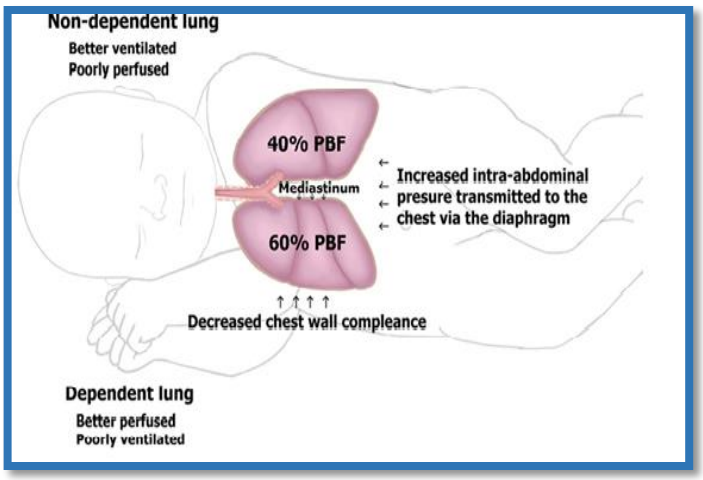

Figure 1: Pulmonary blood flow (PBF) in lateral position when both lungs ventilated.

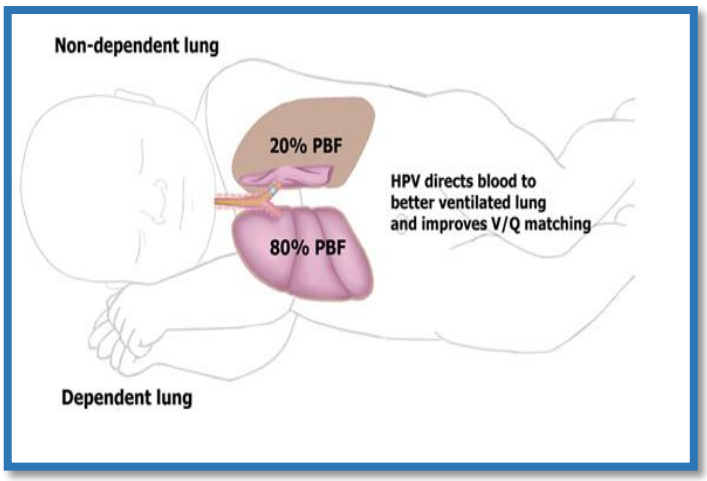

Figure 2: Pulmonary blood flow reduced further in non-dependent collapsed lung.

Teaching and Training in Cardiothoracic Anesthesia

Cardiothoracic anesthesia (CTA) has evolved internationally into a highly specialized subspecialty that integrates advanced perioperative management, hemodynamic monitoring, echocardiography, and critical care for patients undergoing complex cardiac and thoracic surgery. With the global rise in cardiovascular disease and increasingly sophisticated surgical interventions, structured fellowship training in CTA has become essential. While training programs in developed countries follow standardized, competency-based models, Pakistan's landscape remains variable—marked by resource limitations but also significant growth and potential.

International Benchmarks in CTA Training

In the United States, cardiothoracic anesthesia fellowships are accredited by the Accreditation Council for Graduate Medical Education (ACGME). These one-year programs, pursued after anesthesiology residency, are structured around six core competencies: patient care, medical knowledge, practice-based learning, interpersonal skills, professionalism, and systems-based practice. Training is milestone-based, ensuring fellows progress through defined levels of competence.

Fellows receive rigorous exposure to adult and pediatric cardiac anesthesia, perioperative transesophageal echocardiography (TEE) with mandatory certification, advanced hemodynamic monitoring, extracorporeal support (ECMO/VAD), and postoperative ICU care.

In Europe, the European Association of Cardiothoracic Anaesthesiology and Intensive Care (EACTAIC) provides harmonized curricula that emphasize mentorship, research engagement, and mobility across centers. Graduates of these international programs report strong preparedness for independent practice, high employability, and job satisfaction, supported by resource-rich environments that offer advanced equipment and simulation-based training.

Teaching and Training Pathways in Pakistan

In Pakistan, cardiothoracic anesthesia is recognized as a subspecialty under the College of Physicians and Surgeons Pakistan (CPSP). Two main pathways exist:

1. **Primary fellowship track** – entered after two years of general anesthesiology training, involving three additional years in CTA.
2. **Secondary fellowship track** – pursued after completing FCPS in anesthesiology.

Training includes clinical rotations in cardiac operating rooms and ICUs. Assessment involves logbooks, mini-CEX, DOPS, and final examinations. However, unlike the milestone-based model of the ACGME, CPSP assessments remain less standardized, with variability across training centers.

Challenges in Pakistan's CTA Training

Despite progress, several challenges persist:

- **Equipment and Monitoring:** Limited availability of TEE, pulmonary artery catheters, and advanced cardiac output monitors (e.g., PiCCO).
- **Mentorship:** Many trainers lack formal fellowship training, resulting in variability in expertise and teaching quality.
- **Cardiac ICUs:** Under-resourced infrastructure, with limited nursing staff and monitoring capacity.
- **Pediatric Exposure:** Inconsistent training opportunities, depending on surgical case volume at individual centers.

- **Standardization:** Lack of harmonization across CPSP programs, leading to differences in fellow competencies.
- **Workload and Budgets:** Fellows face heavy patient loads, often with advanced disease, while underfunding of government-supported schemes further strains services.

Strengths and Opportunities

Despite these limitations, CTA training in Pakistan has important strengths. The high burden of cardiovascular disease in South Asia ensures the subspecialty's ongoing relevance and demand. Multiple centers nationwide perform large volumes of cardiothoracic surgeries, creating excellent opportunities for clinical exposure and hands-on training.

A new generation of anesthesiologists—many influenced by international standards or trained abroad—is steadily enhancing the quality of mentorship. Growing recognition of perioperative echocardiography, ECMO, and advanced hemodynamic monitoring further supports program development. By progressively incorporating competency-based assessments, simulation training, and structured mentorship, CPSP can align more closely with international benchmarks and ensure greater uniformity in trainee expertise.

Conclusion

Internationally, cardiothoracic anesthesia training is standardized, resource-rich, and competency-driven, producing fellows who are well-prepared for global practice. In Pakistan, while resource limitations, inconsistent mentorship, and lack of standardization remain barriers, the specialty is expanding rapidly. With structured reforms, investment in infrastructure, and competency-focused training, CTA in Pakistan has strong potential to match international standards—ultimately improving perioperative cardiac care and patient outcomes.

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References

1. Schreiber JU, El-Tahan MR, Erdoes G. European Association of Cardiothoracic and Vascular Anesthesiology and Intensive Care Fellowship Program: The Graduates' Experience. *J Cardiothorac Vasc Anesth.* 2021 Nov;35(11):3176-3182. doi: 10.1053/j.jvca.2021.05.043. Epub 2021 May 25. PMID: 34183253.

2. Mittnacht AJC, Garcia CSR, Cadwell JB, Shams P, Augoustides JGT, Neuman MD, et al. Global cardiac anesthesia workforce assessment – a cross-sectional observational survey study. *J Cardiothorac Vasc Anesth.* 2025 Mar;39(3):[Epub ahead of print]. doi: 10.1053/j.jvca.2025.02.042.

Photo Gallery

Hands on Workshop on Point of Care Ultrasound at NICVD

PACTA Brunch at Karachi Club

K&H HEALTH CARE