HYPNOS
Banja Luka 2025

4th INTERNATIONAL CONGRESS OF ANESTHESIA AND INTENSIVE CARE

19—21 September 2025, Banja Luka, Republic of Srpska, Bosnia and Herzegovina

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Book of Summaries

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WELCOME WORD

Dear colleagues, dear friends, guests, ladies and gentlemen,

It is a great honor and pleasure to welcome you to this extraordinary gathering - Hypnos IV - the Congress of Anesthesiologists of the Republic of Srpska with international participation, organized by the Association of Anesthesiologists, Reanimatologists and Intensivists of the Republic of Srpska, which brings us together to share knowledge, experiences and the latest achievements in the field of anesthesiology.

Anesthesiology is a profession that requires extreme precision, dedication and constant education. Meetings like these remind us of the importance of togetherness, cooperation and constant professional development for the benefit of our patients and the entire healthcare system.

This year, the Congress brings us a rich scientific program, numerous workshops and an opportunity to get to know each other better, but also moments to relax and exchange experiences in an informal environment.

I would like to thank all the lecturers, participants, organizers and sponsors who made it possible for this event to be at such a high level. I wish you all successful work, inspiring discussions and a pleasant stay.

Welcome to Banja Luka!

Dragan Milošević, MD, PhD,
President of UARIRS

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CONTENT

Mayo Clinic Session I

PERIOPERATIVE STROKE AFTER NON-CARDIAC AND NON-NEUROLOGIC SURGERY

Kirstin M. Erickson, MD

Department of Anesthesiology and Perioperative Medicine, Mayo Clinic, Rochester, Minnesota, USA

ABSTRACT:

Perioperative stroke is very rare outside of cardiovascular and neurologic surgery. Historically, much more attention and study has been given to perioperative stroke after neurologic and especially after cardiac surgery because the incidence in these settings ranges from 2.2–5.2%. Only recently has more light been shed on stroke occurring after more commonplace operations. Studies of large data sources have revealed a stroke incidence of 0.1–0.3% in this setting.

Although rare, this type of stroke deserves attention because outcomes are poor. Absolute mortality is 20–24% or more if a patient suffers a stroke after an operation compared to approximately 10% mortality rate after having a stroke without surgery. The mechanism is mostly thrombotic in the non-cardiac and non-neurologic setting, rather than embolic. In addition, stroke sets up a systemic inflammatory response in the body which is likely exacerbated by surgical inflammatory processes, leading to poor outcomes. Screening for risk factors is important. Intraoperative hypotension is unlikely to be a significant contributing factor. Greater attention to early diagnosis and rapid treatment of stroke in the post-surgical period is warranted.

ANESTHESIA CONSIDERATIONS FOR AORTIC STENOSIS IN NONCARDIAC SURGERY

Niki Dietz, MD

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ABSTRACT:

Aortic stenosis (AS) remains one of the most common cardiac valve pathologies worldwide. The prevalence increases with age and AS is present in approximately 2.8% of all adults over the age of 75. In people with severe AS, the probability of death if untreated is as high as 75% within five years. When data on outcomes of noncardiac surgery in patients with AS is analyzed, there is no difference in the mortality in patients with severe AS, but there is a significant increase in adverse outcome defined as myocardial infarction, heart failure, and stroke.

Transcatheter aortic valve replacement (TAVR) presents a less invasive mode of treatment of AS than traditional open cardiac surgery. Anesthesia for TAVR ranges from general anesthesia to local anesthesia with varying degrees of sedation. When recent data for anesthesia for TAVR have been reviewed, a significant advantage of minimal sedation has been realized, including lower 30-day mortality rates, shorter in-hospital stays, reduced bleeding leading to transfusion, and fewer respiratory complications. Neuraxial anesthesia has always been controversial in patients with AS. In meta-analyses of outcomes of patients with AS undergoing noncardiac surgery under neuraxial anesthesia, some complications have been more prevalent than with those experiencing general anesthesia. The most common of these is hypotension requiring vasopressors. However, data suggest that neuraxial anesthesia may not be contraindicated in carefully selected patients with AS. The relative risk of AS severity in this scenario remains unclear.

LIVER TRANSPLANTATION IN OBESE PATIENTS

Timucin Taner, MD, PhD
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ABSTRACT:
Obesity has become one of the most pressing global health challenges, with prevalence rates continuing to rise and significant implications for liver disease and transplantation. Metabolic dysfunction-associated fatty liver disease (MAFLD) now affects nearly one-quarter of the world's adult population and has emerged as a leading cause of cirrhosis, hepatocellular carcinoma, and liver transplantation. Patients with extreme obesity (BMI >45) pose unique challenges, including higher perioperative risks, increased cardiovascular and pulmonary complications, greater likelihood of disease recurrence, and frailty-related outcomes. These factors have led many centers to consider morbid obesity a relative contraindication to liver transplantation.
However, evolving data suggest that carefully selected patients can achieve acceptable outcomes, particularly when adjunctive strategies are used. Bariatric surgery—either before, during, or after transplantation—has demonstrated promise in optimizing weight control, improving metabolic risk factors, and reducing long-term complications. In particular, simultaneous sleeve gastrectomy at the time of liver transplantation has shown durable weight loss, improved comorbidity profiles, and survival rates comparable to standard recipients.
This presentation reviews the evidence regarding the feasibility and outcomes of liver transplantation in patients with a BMI >45. It highlights the technical aspects, comorbidity burden, and long-term survival, while also emphasizing innovative approaches such as combined transplant and bariatric surgery. Ultimately, extreme obesity should not be viewed as an absolute barrier to transplantation but rather as a call for individualized risk assessment, multidisciplinary management, and integration of metabolic therapies to improve both patient and graft outcomes.

UPDATE ON ROBOTIC SURGERY: WHAT ANESTHESIOLOGISTS NEED TO KNOW

Gurinder M. Vasdev, MD, FRCA, FRCSI, FASA

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ABSTRACT:

Robotic surgery offers significant surgical advantages but introduces unique challenges for anesthesiologists. Extreme patient positioning, high-pressure pneumoperitoneum, and limited patient access once the robot is docked can complicate ventilation, hemodynamics, and emergency management. Longer procedure times further increase anesthetic exposure and postoperative risks, particularly as many cases are performed in the outpatient setting.

Recent advances—including enhanced robotic platforms, real-time feedback systems, and the integration of enhanced recovery pathways—are improving perioperative safety and efficiency. Developments in same-day complex procedures, telesurgery, and artificial intelligence hold promise for expanding access while maintaining high standards of care. Anesthesiologists play a critical role in adapting protocols, optimizing comorbid patients, and ensuring safe, fast-tracked recovery as robotic surgery continues to evolve.

INTERSCALENE NERVE BLOCKS: IS IT TIME TO SAVE THE BEST FOR LAST?

Jason K. Panchamia, MD

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ABSTRACT:

The interscalene brachial plexus block remains the gold standard for analgesia in shoulder surgery, yet its near-universal incidence of hemidiaphragmatic paralysis limits its use in patients with compromised pulmonary function. With the aging surgical population presenting more frequently with COPD, obesity, and opioid tolerance, balancing optimal pain control with preservation of respiratory function is increasingly critical. This presentation reviews the evolving role of the interscalene block in modern shoulder surgery, highlighting current strategies for phrenic nerve–sparing, including reduced local anesthetic volume and concentration, extrafascial injection techniques, and alternative regional approaches.

Comparative data on suprascapular, axillary, supraclavicular, and infraclavicular blocks are discussed, with emphasis on analgesic efficacy, onset times, and pulmonary impact. Special attention is given to anterior suprascapular nerve blocks and periarticular infiltration as potential options in high-risk patients. By integrating anatomical insights, recent clinical trials, and practical experience, this session aims to provide a decision-making framework to optimize shoulder analgesia while minimizing respiratory compromise in vulnerable populations.

ECHOCARDIOGRAPHY IN CARDIAC ARREST (TTE VS TEE): APPLICATIONS & LIMITATIONS

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ABSTRACT:

Echocardiography plays a critical role in cardiac arrest management by enabling real-time cardiac assessment. Transthoracic echocardiography (TTE) is widely used for its noninvasive bedside accessibility but is often limited by poor acoustic windows, patient factors, and interruptions during chest compressions. In contrast, transesophageal echocardiography (TEE) offers continuous, high-quality imaging without interrupting resuscitation efforts. TEE allows better visualization of cardiac structures, facilitates identification of reversible causes of arrest, and guides procedural interventions. While TEE requires specialized training and equipment, its advantages make it a valuable tool for improving diagnostic accuracy and clinical decision-making in cardiac arrest scenarios.

Recent studies suggest that TEE can significantly enhance the ability to detect mechanical cardiac activity, optimize chest compression quality, and identify underlying etiologies such as tamponade, pulmonary embolism, or severe ventricular dysfunction. Furthermore, TEE provides crucial guidance during advanced procedures like extracorporeal membrane oxygenation (ECMO) cannulation or pericardiocentesis in unstable patients. Despite these benefits, challenges including limited availability, cost, and the need for operator expertise currently restrict widespread adoption. Ongoing research and training initiatives aim to address these barriers and integrate TEE more fully into cardiac arrest protocols to improve patient outcomes.

ECMO BASICS: KEY PRINCIPLES AND PRACTICAL CONSIDERATIONS

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ABSTRACT:

Extracorporeal Membrane Oxygenation (ECMO) has become a cornerstone in the management of severe respiratory and cardiac failure, yet its complexity demands a nuanced understanding of physiology, hemodynamics, and patient-centered goals. This presentation offers a practical and evidence-informed overview of ECMO basics. Key principles include optimizing oxygen delivery through careful modulation of ECMO flow, hemoglobin levels, and cardiac output, while avoiding the pitfalls of hyperoxia and tissue hypoxemia. Clinical markers such as lactate levels, urine output, and mental status are emphasized as accessible indicators of end-organ perfusion and metabolic balance.

The session also explores the interplay between ECMO settings and patient physiology, highlighting the importance of hands-on assessment and trend-based monitoring. Through case-based discussion—including a complex presentation of Guillain-Barré Syndrome in the context of respiratory illness—the talk underscores the need for individualized care and vigilance in ECMO management. Attendees will leave with actionable insights into ECMO troubleshooting, shock differentiation, and the critical role of bedside evaluation in guiding therapy.

MANAGEMENT OF OBSTETRIC HEMORRHAGE

Dennis C. Shay, MD

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ABSTRACT:

Obstetric hemorrhage is the leading cause of maternal mortality in both developed and developing countries. It is the most preventable cause of maternal death. The talk will illustrate the physiologic changes of pregnancy, the incidence of postpartum hemorrhage (PPH), and the risk factors associated with maternal hemorrhage. Diagnosis, prevention, and treatment strategies, both pharmacologic and surgical, will be discussed. Teamwork and availability of resources will be emphasized.

INTRODUCING POCUS: A NEW OB ANESTHESIOLOGIST PERSPECTIVE

Ivan Velickovic MD
FASA

ABSTRACT:
The integration of Point-of-Care Ultrasound (POCUS) into perioperative anesthesiology is transforming obstetric anesthesia practice worldwide.[1] POCUS provides anesthesiologists with a real-time, non-invasive tool to enhance diagnostic accuracy and clinical decision-making, ultimately improving maternal outcomes.[2] Traditionally, obstetric anesthesiologists relied on history taking, physical examination, and external monitoring. In contrast, POCUS allows rapid bedside assessment of cardiac function, volume status, neuraxial anatomy, gastric content, extravascular lung water, and even indirect intracranial pressure through ocular ultrasound. These capabilities are particularly valuable in high-risk pregnancies, where early recognition of hemorrhage, preeclampsia, or intra-abdominal fluid can be lifesaving.[3]
Despite its advantages, introducing new technologies into clinical practice is challenging. Barriers may include limited awareness, resistance to change, and inadequate training. Successful implementation requires a gradual, collaborative approach that engages key stakeholders—anesthesiologists, obstetricians, nurses, residents, and administrative staff. Educational initiatives such as lectures, workshops, and formal POCUS courses, often with support from external faculty, can accelerate adoption and build departmental expertise.
By fostering a culture of education and collaboration, POCUS supports a shift toward more individualized and dynamic anesthetic management strategies. As training programs continue to expand, obstetric anesthesiologists will be increasingly able to integrate POCUS into daily practice. Ultimately, POCUS stands for a new frontier in obstetric anesthesia, offering greater precision, improved safety, and more patient-centered care.

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Plenar Session

ANESTHESIA AND INTENSIVE CARE IN THE ERA OF TECHNOLOGICAL DEVELOPMENT: CHALLENGES AND PERSPECTIVES

Vojislava Nešković

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ABSTRACT:

Introduction: Technological innovation continues to transform anesthesiology and intensive care, not only by enhancing clinical skills and improving patient safety, but also by shifting long-term priorities. Two key directions expected to shape the future of the field are environmental sustainability and the integration of artificial intelligence (AI).

Summary: It is estimated that 13 million deaths annually are linked to avoidable environmental changes. While these changes burden public health, the healthcare sector paradoxically contributes approximately 5% of global greenhouse gas (GHG) emissions—ranking as the fifth-largest global emitter. Operating rooms and intensive care units are major contributors due to high energy consumption, single-use plastics, and inhaled anesthetics, some of which are potent GHGs and ozone-depleting agents. Additional environmental impact arises from pharmaceuticals, electricity use, and medical waste. In response, the European Society of Anaesthesiology and Intensive Care (ESAIC) has published two major policy documents: *The Glasgow Declaration* and the *Consensus Statement on Sustainability*, outlining four pillars of sustainable practice: reduction of inhaled anesthetics, energy optimization, waste management, and promotion of clinician well-being and self-care.

AI technologies are increasingly integrated into perioperative and critical care. Closed-loop drug delivery systems and advanced modes of mechanical ventilation are already in clinical use. Other areas, including predictive risk modelling, depth-of-anesthesia monitoring, ultrasound interpretation, pain management, and operating room logistics, are active fields of research and development. Mechanical assistance and robotics are also being explored. Beyond clinical applications, AI is expected to significantly influence education, documentation, research, and decision-making. The challenge is placed on ensuring ethical and effective integration that enhances safety and standards of care.

Conclusion: Anesthesiology and intensive care have always relied on technological progress. Future concerns will focus on the ethical use of AI and sustainable practices to support global health and environmental responsibility.

TECHNOLOGICAL ADVANCES IN PAIN THERAPY: AN INTEGRATIVE REVIEW (2015–2025)

Nebojša Lađević[1,2], Vesna Jovanović[1,2], Nataša Petrović[1,2], Jelena Jovićić[1,2], Miloš Lazić[1]

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ABSTRACT:
Pain therapeutics have undergone a decade of rapid innovation spanning neuromodulation, image-guided interventions, molecularly targeted pharmacology, regenerative strategies, and digital therapeutics. This review synthesizes high-quality evidence and recent regulatory milestones to appraise clinical efficacy, safety, and future directions. Highlights include closed-loop spinal cord stimulation (SCS) with evoked compound action potential (ECAP) feedback; dorsal root ganglion (DRG) stimulation for focal neuropathic pain; focused ultrasound for cancer pain palliation; the first-in-class NaV1.8 inhibitor suzetrigine (FDA approval 30 January 2025) for acute pain; consolidation of calcitonin gene–related peptide (CGRP)–pathway therapies in migraine; cautious optimism—and caveats—for sodium channel (NaV1.7/1.8) targeting and gene therapies; and growing roles for virtual reality (VR), wearables, and AI-assisted care pathways. We conclude with pragmatic guidance on patient selection, real-world implementation, and research priorities.

1. Introduction

Chronic pain affects >20% of adults and remains a leading cause of disability. Opioid-centric models have given way to mechanism-specific, multimodal approaches combining device-based, interventional, pharmacologic, behavioral, and digital tools. We review advances with emphasis on randomized trials, authoritative guidelines, and 2021–2025 developments.

2. Neuromodulation

2.1 Closed-loop spinal cord stimulation (SCS)

Closed-loop SCS measures spinal ECAPs to maintain target dorsal column activation despite postural changes. The ECAP-controlled "Evoke" system demonstrated superior and durable outcomes versus open-loop SCS in a randomized trial, with higher responder rates and sustained relief out to 36 months.

Clinical takeaways. Closed-loop control appears to reduce stimulation drift and may improve long-term consistency; evidence quality is high (multicenter RCT with long follow-up).

2.2 Dorsal root ganglion (DRG) stimulation

DRG stimulation targets segmental sensory ganglia and is particularly suited to focal neuropathic syndromes (e.g., CRPS). The ACCURATE RCT showed DRG stimulation was superior to traditional SCS for complex regional pain and causalgia at 3 and 12 months.

2.3 Peripheral nerve stimulation (PNS)

Modern percutaneous PNS systems enable temporary (e.g., 60-day) or permanent

leads. Evidence is strongest for focal neuropathic and musculoskeletal indications; randomized and pragmatic data show clinically meaningful reductions in pain and disability in selected cohorts (e.g., hemiplegic shoulder pain, chronic low back pain; restorative neurostimulation for multifidus dysfunction).

3. Image-Guided and Energy-Based Interventions

3.1 Radiofrequency ablation (RFA) for facetogenic pain

Guidelines from interventional pain societies support medial branch RFA for well-selected patients after confirmatory diagnostic blocks. Evidence syntheses show short-term to intermediate benefit (with variability across studies); patient selection and technique (parallel lesioning, meticulous block criteria) drive outcomes.

3.2 MR-guided focused ultrasound (MRgFUS)

For painful bone metastases refractory to standard care, a randomized, sham-controlled multicenter trial established MRgFUS as a safe, effective, noninvasive option; meta-analyses and guideline-style summaries corroborate efficacy and acceptable complication rates. Emerging work explores neuromodulatory (non-ablative) applications for neuropathic pain.

3.3 Photobiomodulation (low-level laser)

Cochrane reviews indicate small, uncertain benefits for neck pain with low-certainty evidence, underscoring a need for higher-quality trials and standardized dosimetry.

4. Pharmacologic Innovations

4.1 First-in-class NaV1.8 inhibition for acute pain

On **January 30, 2025**, the U.S. FDA approved suzetrigine (Journavx), an oral, peripherally acting NaV1.8 inhibitor for moderate-to-severe **acute** pain in adults—the first new analgesic class for acute pain in >20 years. Independent and agency reports emphasize opioid-sparing potential; effectiveness in chronic neuropathic conditions remains under investigation.

4.2 CGRP-pathway therapies for migraine

Monoclonal antibodies (erenumab, fremanezumab, galcanezumab, eptinezumab) and oral "gepants" (ubrogepant, rimegepant, atogepant) have transformed migraine prevention and acute treatment with favorable tolerability, now reflected in guideline statements and contemporary reviews.

4.3 Sodium channel (NaV1.7/1.8) targeting—promise and pitfalls

While human genetics implicate **SCN9A/NaV1.7** in pain, translation has been challenging. Recent reviews in *PAIN* and *Frontiers in Pharmacology* highlight discordance between preclinical success and clinical efficacy, citing selectivity, target engagement, and biological redundancy as barriers. NaV1.8 has proven more tractable clinically (e.g., suzetrigine).

5. Regenerative and Biologic Therapies

5.1 Platelet-rich plasma (PRP)

Meta-analyses suggest PRP may improve pain and function in chronic lateral epicondylitis and some tendinopathies, with heterogeneity in formulations and protocols; results are mixed and condition-specific.

5.2 Mesenchymal stromal cells (MSCs) for knee osteoarthritis

Systematic reviews and randomized trials report symptomatic improvement versus placebo in some studies, but durability, optimal dosing, and disease-modifying effects remain uncertain; regulatory pathways vary.

6. Targeted Drug Delivery and Nanomedicine

6.1 Intrathecal drug delivery systems (IDDS)

Intrathecal pumps provide low-dose, targeted analgesia (e.g., morphine, ziconotide, clonidine) for refractory cancer and non-cancer pain, with guideline-based algorithms for candidate selection, trialing, and long-term management of device/biologic risks.

6.2 Nanotechnology-enabled analgesia

Nanocarriers (e.g., liposomes, polymeric nanoparticles) show potential for targeted delivery and reduced systemic toxicity; current evidence is largely preclinical/early clinical, with translational challenges in stability, targeting, and manufacturing.

7. Digital Health, VR, and AI-Assisted Care

7.1 Virtual reality (VR)

VR reduces acute procedural pain and shows moderate effects for some chronic pain phenotypes. Notably, in **2021** the FDA granted De Novo authorization for **EaseVRx** (AppliedVR) for chronic low back pain. Recent meta-analyses quantify small-to-moderate analgesic benefits; adherence and personalization influence outcomes.

7.2 Wearables and pain prediction

Wearable sensors (e.g., activity, heart-rate variability, sleep) coupled with machine learning can forecast pain fluctuations and support just-in-time interventions; scoping and systematic reviews (2024–2025) highlight feasibility but call for larger, prospective trials with transparent models and external validation.

8. Gene and Epigenetic Therapies (Emerging)

Preclinical and early translational studies investigate CRISPR/dCas9, antisense oligonucleotides, and other modalities to modulate nociceptor ion channels (e.g., **SCN9A/NaV1.7**), neuroinflammation, and neurotransmission. Reviews in 2024–2025 outline progress and key barriers (delivery, specificity, durability, ethics). Clinical efficacy signals for chronic pain remain preliminary.

9. Implementation: Patient Selection and Pathway Design

Match mechanism to phenotype (e.g., DRG stimulation for focal CRPS; migraine-specific CGRP therapies). 2) **Use diagnostic blocks and stringent criteria** before denervation. 3) **Leverage closed-loop or feedback-controlled systems** when available. 4) **Integrate digital tools** (VR, wearables) to augment self-management. 5) **Monitor safety** (device complications, biologic risks, neuropsychiatric effects) and **collect real-world outcomes** to refine selection.

10. Future Directions

Adaptive/closed-loop neuromodulation beyond SCS (DRG, PNS) with biomarker-guided control.

Next-gen channel modulators (selective NaV1.8/combination channel strategies) and **post-approval effectiveness** of suzetrigine in opioid-sparing pathways.

Gene/epigenetic editing for nociceptor targets with nonviral delivery.

Validated digital phenotyping and AI-assisted prediction to trigger timely interventions.

Conclusion

From closed-loop stimulation and MRgFUS to CGRP antagonism and NaV1.8 inhibition, the last decade has diversified the pain-therapy toolkit while shifting away from opioids. The strongest evidence supports mechanism-targeted interventions for carefully phenotyped patients, coupled with multimodal rehabilitation and digital supports. Continued emphasis on rigorous randomized trials, transparent real-world data, and equitable access will be essential to translate these advances into population-level relief.

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ARTIFICIAL INTELLIGENCE (AI) IN ANESTHESIA AND INTENSIVE CARE

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ABSTRACT:
AI is a branch of computer science focused on developing systems and software that execute tasks typically associated with human intelligence. These tasks include language processing, pattern recognition, data-driven learning, decision-making, and problem-solving. AI technologies incorporate concepts from disciplines such as mathematics, computer engineering, cognitive science, and neuroscience to design algorithms and models that allow machines to learn from experience, adapt to new inputs, and achieve performance levels comparable to humans in select areas.
Artificial intelligence (AI) is being examined for use in anesthesia and intensive care units (ICUs), with the potential to assist clinicians in decision-making and patient management. The following is an overview of general AI applications in anesthesia and intensive care:
1) Predictive Analytics and Risk Scoring
• Patient Deterioration Prediction
• Length of Stay & Readmission Risk: Predictive modelling methods can identify patients who may require extended ICU admissions or face a higher risk of readmission, supporting clinical management and resource allocation.
2) Decision Support Systems
• Treatment Guidance: AI-based tools can generate recommendations for treatment plans or medication dosages (e.g., sedation, antibiotics, vasoactive drugs) based on individual patient data, aiming to reduce variability and error in care.
• Ventilator Management: Machine learning approaches can inform ventilation strategies by adjusting parameters for lung-protective ventilation, which may impact complication rates and the duration of mechanical ventilation.
• Medication and Fluid Management: AI can contribute to determining fluid management strategies and dosing for critically ill patients, with the goal of minimizing both fluid overload and under-resuscitation.
3) Automated Monitoring and Alarms
• Continuous Surveillance: AI-enabled systems can monitor patient metrics—such as heart rate, blood pressure, oxygen saturation, and laboratory values—to reduce alarm fatigue and enhance anomaly detection.
• Early Sepsis Detection: AI algorithms can analyze data from various sources (e.g., vital signs, biomarkers, clinical notes) to identify sepsis at earlier stages compared to traditional methods, which may influence patient outcomes.

ICU - Session II

MICROBIOLOGICAL SURVEILLANCE

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ABSTRACT:

The appearance of antimicrobial resistance during the past several decades has been a major challenge in the treatment of infections among hospitalized patients, carrying the risk of increased morbidity, mortality, prolonged hospital stays and treatment costs. The greatest challenge are intensive care units and the resistance development has been attributed to the severity of illness, use of invasive devices, inappropriate use of broad-spectrum antimicrobials, multiple drug combinations, prolonged treatment and lack of de-escalation. One of most effective strategy to minimize the development of resistance is strict infection control measures, optimizing empiric and therapeutic antibiotic use, establishing the protocol, education and stewardship. Antimicrobial resistance is not just a problem in healthcare institutions, but increasingly being detected in community-acquired infections.

In Europe antimicrobial resistance is established primarily through the European Center for Disease Control and Prevention (ECDC), the European Antimicrobial Resistance Surveillance Network (EARS-Net) and national institutions or networks. Some of the most common problems that healthcare providers are facing with are vancomycin-resistant enterococci (VRE) and methicillin-resistant Staphylococcus aureus (MRSA).

Surveillance provides the necessary information for the development and monitoring of antibiotic therapy guidelines, antibiotic stewardship prorammes and infection control policies. The surveillance begins with the development of algorithms for empiric antibiotic therapy and stewardship programmes. For effective antibiotic stewardship programme, active monitoring of antimicrobial resistance is essential, which supports adequate antimicrobial use that is best for the patient's outcome, while minimizing side effects of antibiotics, including toxicity an emergence of resistance. Data from global surveillance systems provide information on emerging and worrisome trends in antimicrobial resistance and enables development of new strategies for its prevention and management at national and international levels.

Inadequate and delayed reporting of surveillance data leads to suboptimal empiric prescribing and overprescribing, which compromises individual outcomes and increases the risk of transmission between hospital and community-based patient. New molecular assays should also be included to better understand the possibility of monitoring and spreading new threats of antimicrobial resistance. Surveillance data should be readily available, continuously updated and detect the emergence and spread of previously uncommon or entirely new types of resistance

Some of a long-terms plan should include implementation of a surveillance system that links European clinical, epidemiological, radiological and epidemiological data, creation of a platform in which representatives from public health and the pharmaceutical industry can collaborate and connection among surveillance systems in human beings, animal and food chain. It will be almost impossible to reduce medical costs and economic burdens without urgent need for surveillance improvement to optimize empirical therapy, drive antimicrobial stewardship and infection control measures.

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PERSONALIZED HEMODYNAMIC MANAGEMENT APPROACHES IN CRITICALLY ILL AND SURGICAL PATIENTS

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ABSTRACT:

Introduction. Perioperative and critically ill patients share similarities in hemodynamic management, particularly in the use of inotropes and vasopressors, as well as in the need for continuous monitoring of tissue perfusion and fluid balance. ***Aim.*** Hypotension has been extensively associated with adverse events. Meta-analyses of observational studies highlighted this association in both the intensive care unit (ICU) and in the perioperative settings, prompting guidelines to advise against hypotension in perioperative setting. Traditionally, hemodynamic management focused on achieving precise blood pressure targets. Contemporary hemodynamic management often finds clinicians focused on numerical targets, overlooking subtle changes in organ function or adverse outcomes over extended periods. ***Analysis.*** While hypotension does not imply a superior state over normotension, maintaining normotension despite challenging circumstances can entail significant risks. From a cost-benefit perspective, every intervention carries potential adverse effects. Minimal or short-term vasopressor use to restore arterial pressure is likely not harmful, the adverse effects of high doses or long-term catecholamines are well known. Increasing vasopressor doses to maintain higher MAP targets may necessitate reevaluating and lowering these targets, accepting hypotension in certain patients. Use of muiltimodal vasopressor approach is advisable in order to limit catecholamines. Personalized targets might improve patient outcomes. This strategy recommends monitoring tissue perfusion during surgery through tools like near-infrared spectroscopy or the peripheral perfusion index, both of which correlated with postoperative outcomes and provided an estimation of organ perfusion. ***Conclusion.*** Flow is optimal hemodynamic target, defined as the dynamic maintenance of adequate tissue perfusion and oxygenation at the microcirculatory level, moves beyond numerical targets of MAP and focusing instead on ensuring sufficient blood flow to meet the evolving metabolic needs of individual organs.

Key words: hemodynamic management, hypotension, flow, monitoring, personalized medicine

INTENSIVE CARE UNIT-ACQUIRED WEAKNESS

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ABSTRACT:

Intensive care unit-acquired weakness (ICU-AW), is a common neuromuscular complication associated with patients in the ICU, is a type of skeletal muscle dysfunction that commonly occurs following sepsis, mobility restriction, hyperglycemia, and the use of glucocorticoids or neuromuscular blocking agents. Depending on the presence of neuropathy or myopathy, a distinction can be made between critical illness polyneuropathy (CIP), critical illness myopathy (CIM), and critical illness neuromyopathy (CINM), which involves elements of both neuropathy and myopathy. The incidence of ICU-AW is estimated to be around 25–30%, even higher up to 70% in surgical ICUs. It depends on the age, sex, primary diseases and treatment. ICU-AW is a significant complication that can lead to extended hospitalization, limited mobility, reduced quality of life, prolonged morbidity, and increased healthcare costs. Currently, its pathogenesis is uncertain, with unavailability of specific drugs or targeted therapies. Modifiable risk factorsfor ICU-AW are hyperglycaemia, drugs (neuromuscular blocking agents, glucocorticoids), parenteral nutrition and immobilization, while non-modifiable risk factors are premorbid health status, multiple organ failure, sepsis and septic shock, mechanical ventilation, high lactate level.

The diagnosis of ICU-AW is based on clinical findings (Medical Research Council score, MRC), electrophysiological assessments, radiological techniques, and if necessary muscle biopsies.

Prompt recognition of neuromuscular dysfunction in a critically ill patient is a crucial step in management, as it allows early intervention to halt the pathogenic mechanisms underlying this condition. It should be emphasize that comprehensive patient management is crucial in this clinical process. Two cornerstones of the treatment of ICU-AW are patient mobilization and adequate nutrition are. Also, we have to pay attention on early treatment of sepsis, aiming for normoglycaemia, judicious use of inotropes/vasopressors, corticosteroids and muscle relaxants cannot be over emphasized. A key element in preventing ICU-AW is reducing the length of stay in the ICU.

Conclusion: An awareness of the condition, its early recognition and predisposing risk factors are essential in its prevention. The management of ICU-AW requires a comprehensive, multidisciplinary approach. This involves coordination between intensivists, physiotherapists, nutritionists, and nursing staff to develop and implement individualized care plans for each patient.

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PROTEKTIVNA MEHANIČKA VENTILACIJA PLUĆA KOD PACIJENATA U JEDINICAMA INTENZIVNOG LIJEČENJA

Sanja Šušnjar Rakanović

SAŽETAK:
Protektivna ventilacija pluća predstavlja strategiju mehaničke ventilacije osmišljenu s ciljem smanjenja ventilatorom indukovanog oštećenja pluća (VILI). Iako je prvobitno razvijena i upotrebljavana kod pacijenata sa akutnim respiratornim distres sindromom (ARDS), danas se protektivni principi sve češće primjenjuju i kod kritično oboljelih bez ARDS-a, uključujući pacijente nakon velikih hirurških zahvata, politraumatizovane bolesnike i one s drugim oblicima akutne respiratorne insuficijencije. Osnovne komponente protektivne ventilacije uključuju primjenu nižih tidalnih volumena (6–8 ml/kg idealne tjelesne mase), održavanje plato pritiska <30 cmH_2O, individualizirani nivo PEEP-a radi prevencije alveolarne deregrutacije, te pažljivo ograničavanje FiO_2 u cilju smanjenja oksidativnog stresa. Brojne studije ukazuju da ovakav pristup smanjuje rizik od volutraume, barotraume i biotraume, poboljšava ishode liječenja i može imati dugoročne benefite u smislu smanjene morbidnosti i mortaliteta. Protektivna mehanička ventilacija pluća se danas posmatra kao univerzalni koncept u intenzivnom liječenju, a ključ uspjeha leži u individualizaciji ventilacijskih parametara u skladu s plućnom mehanikom i kliničkim stanjem pacijenta.

Ključne riječi: protektivna mehanicka ventilacija pluca, jedinica intenzivnog liječenja

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OB Anesthesia - Session II

TIPS AND TRICKS IN LABOR ANALGESIA

Dr. E. Guasch

ABSTRACT:
During this lectura we'll afford several aspects that may help the anesthesiologist to afford a challenging situation as it is an epidural failure, and even better, how to prevent it. We'll go through current and often spread myths and disinformation about labor analgesia and which are the sources of that information for parturients in our countries, trying to focus on what is the ideal technique and considering that one size does not fit all. Different techniques will be described for initiation and maintenance, mainly base don current literatura evidence. Regarding maintenance, the advantages and disadvantages Will be discussed. The epidural failure Will be clearly defined, and different strategies Will be discussed when affording a problematic neuraxial block for labor analgesia, including how to suspect and solve failure in case of abnormal blocks. By the end of the lectura, some practical points Will be offered to the fellows, in order to make easier to adapt neuraxial blocks to the parturient needs.

IMPACT OF THE KYBELE PROGRAM ON REGIONAL ANESTHESIA FOR CESAREAN DELIVERY: A 13-YEAR EVALUATION OF ANESTHESIOLOGIST PROFICIENCY AT UCCV

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ABSTRACT:

Introduction: A decade ago, the use of regional anesthesia (RA) for cesarean delivery (CD) and labor analgesia in Serbia was historically low, with general anesthesia (GA) being the predominant choice in nearly all hospitals across the country. However, in 2012, anesthesiologists at the University Clinical Center Vojvodina (UCCV) started a multi-year collaboration with the Kybele program, a partnership focused on improving maternal and neonatal health through education and training, which would revolutionize Serbian anesthesiology. The goal was to increase the adoption of RA for CD and labor analgesia. This program, which included annual visits from the Kybele team and innovative, hands-on training, became a beacon of hope for the future of obstetric anesthesia in Serbia. The most valuable component of these Schools of Obstetric Anesthesia was the intensive workshops, which provided a unique hands-on experience in obstetric anesthesia.

During the years of collaboration, UCCV has been recognized as a leading teaching hospital in Serbia and the surrounding countries (former Yugoslavia). The hands-on training sessions, a key part of the collaboration, attracted participants from Serbian hospitals at both secondary and tertiary levels, as well as Croatia, Bosnia and Herzegovina, Romania, North Macedonia, Montenegro, and Slovenia. This collaborative effort has united us in our goal of improving obstetric anesthesia practices.

Methods: Data were collected from the UCCV delivery database covering 2011 to 2024, focusing on using GA and RA for elective and non-elective CD. Additionally, data on each anesthesiologist within the department were gathered, and the trend of their RA use was compared between 2011 and 2024.

Results: During the Kybele program, the number of RA for CD significantly increased, from 13.81% in 2011 to 73.85% in 2024 (CHISQ: $p<0.001$). A more prominent increase was observed in RA for emergency CD (5.26% in 2011 – 62.14% in 2024) than elective CD (20.07% in 2011 – 84.64% in 2024). All 13 anesthesiologists in the department improved their skills. In 2024, only 2/13 had RA rates below 50%, whereas in 2011, none had RA rate greater than 50%. In 2024, 84.61% of anesthesiologists had an RA rates above 50% (60-94%), with 38.46% having RA in more than 80% of all CDs.

Conclusion:

The more significant increase in RA use among non-elective cases is an unsurprising result because all faculty already increased the number of elective CDs, suggesting that more effort

should be placed into the education of anesthesiologists on the benefits/risks of RA among those with lower usage of RA and trend for use over time. The need for continued education and skill improvement in this area is crucial for further enhancing RA adoption across diverse clinical settings.

Literature:
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This abstract was previously presented as a poster at the SOAP 2025 Annual Meeting (USA), where it received an award.

WHAT TO DO WHEN THE LABOR EPIDURAL FAILS? ESAIC FOCUSED GUIDELINES 2025

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ABSTRACT:

Introduction: Failed labor epidural analgesia remains a significant clinical challenge with reported failure rates of 10%–25%. Secondary failure is defined as inadequate pain relief from a previously effective catheter despite one manual top-up. Ineffective epidural analgesia compromises maternal comfort, and causes breakthrough pain and, in the context of emergency cesarean delivery, increases the risk of intraoperative pain, unplanned conversion to general anesthesia, and perioperative complications. Early recognition and structured intervention are essential to maintain maternal safety and high standards of care. **Aim:** To present an algorithmic approach to the prevention, recognition, and management of failed labor epidural analgesia, integrating the ESAIC Focused Guidelines 2025 with current evidence. **Discussion:** The ESAIC 2025 Focused Guidelines recommend a stepwise, algorithmic approach, structured around four principles. 1. Early detection: Proactive monitoring of sensory and motor block enables timely recognition and correction before labor progression complicates intervention. 2. Classification of failure: Epidural failure should be categorized as complete block (absence of sensory block), incomplete block (insufficient level, typically below T10; patchy block; or inadequate intensity), or unilateral block (lateralized distribution). This classification directs management. 3. Algorithmic intervention: Recommended measures include verifying catheter position, optimizing bolus dose and concentration, maternal repositioning, and, if needed, timely catheter replacement. 4. Corrective steps: Withdrawing the catheter to 3–4 cm may improve unilateral block; one or two rescue boluses of higher-concentration local anesthetic may address incomplete block; or replacement with a combined spinal–epidural (CSE) may be indicated. The dural puncture epidural (DPE) technique may also be considered in high-risk patients. Persistent failure requires prompt abandonment of the ineffective epidurals, with an alternative neuraxial block or general anesthesia based on urgency and maternal–fetal condition. Standardized protocols, effective team communication, and simulation training enhance block reliability and support timely corrective action. Adoption of the ESAIC 2025 algorithm, supported by continuous monitoring and team training, promotes safer and more effective obstetric anesthesia. **Conclusion:** A failing labor epidural should not be managed with improvisation but through structured, guideline-based intervention.

Keywords: labor epidural, failed epidural, obstetric anesthesia, ESAIC guidelines, neuraxial block, troubleshooting.

GASTRIC EMPTYING IN PREGNANCY

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ABSTRACT:
Pulmonary aspiration remains a serious risk during anesthesia for Caesarean delivery and labor, often due to delayed gastric emptying. Traditional fasting guidelines are based on the assumptions that delayed gastric emptying is expected in the whole pregnancy, especially in the third trimester. On the contrary, women have delayed gastric emptying only in labor and early pregnancy. Gastric emptying is actually unpredictable in pregnancy, especially in labor. Systemic opioids slow gastric emptying, while epidural analgesia helps but does not restore it completely. This means some fasting guidelines may need reassessment according to recent published data (1).
Gastric ultrasound could be a useful tool to assess individual aspiration risk. Carbohydrate drinks and tea with milk do not significantly increase gastric volume, suggesting potentially more liberal preoperative fluid intake, as a safe alternative. A more individualized approach to fasting and aspiration risk should be introduced in obstetrics.
The new approach to fasting policies in obstetrics should consider use of gastric ultrasound to assess individual aspiration risk, rather than relying on universal fasting guidelines. Epidural analgesia should be preferred choice over systemic opioids in labor to reduce gastric stasis. For emergency cases, delayed gastric emptying should be always assumed and rapid-sequence induction, should be performed for Cesarean section.

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Circulation and Breathing - Session I

THE RISK OF CARDIOVASCULAR EVENTS AFTER NON-CARDIAC SURGERY

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ABSTRACT:

Surgery and anesthesia induce a stress response that provokes increased sympathetic stimulation, secretion of cortisol, hypercoagulability and systemic inflammatory response. All these homeostatic deteriorations, especially systemic inflammation (secretion of proinflammatory cytokines and activation of neutrophils), represent a risk for organ damage, also cardiac injury. The extent of perioperative inflammation depends on surgical factors (type of surgical procedure, magnitude of surgical trauma - invasiveness, prolonged surgical time, blood loss, presence of infection), type of anesthesia, transfusion of blood components, utilization of extracorporeal support and perioperative mechanical ventilation. Risk for perioperative cardiovascular events is additionally increased in patients with increased inflammatory markers before surgical procedure, in patients with obesity and diabetes. Elevated levels of certain inflammatory markers preoperatively are associated with increased risks of infections, delayed wound healing, cardiovascular events, and overall morbidity and mortality following surgery. Systemic inflammatory biomarkers increase in the first days after surgical procedures and decline in some weeks. Besides contemporary traditional biomarkers (CRP, IL-6, BNP), the newer biomarkers, like galectin-3, TNF-alpha, MiRNA, neutrophil/lymphocyte ratio and platelet/lymphocyte ratio can predict inflammatory response and related cardiac injury. Determination of inflammatory markers in perioperative period could therefore help to identify patients at risk for cardiovascular events and provide a predictive measure of postoperative outcomes. Despite the relevance of inflammatory markers, routinely used scoring systems for perioperative risk assessment (ACS NSQIP, P-POSSUM, CR-POSSUM, EuroSCORE II, ASA, RCRI) do not include preoperative levels of any inflammatory markers. Myocardial injury after non-cardiac surgery has an estimated incidence of 20% and has a significant impact on morbidity and mortality in the perioperative period (about 4% of patients with myocardial injury after surgery will die within 30 days after procedure). In non-cardiac surgery the most frequent CV events are myocardial damage, infarction and atrial fibrillation.

For patients at high risk for postoperative CV complications, it is important to reduce inflammatory response and related risks and optimize underlying cardiac conditions. Many preventive and therapeutic strategies have been studied recently. Optimization of surgical procedures with the minimization of tissue trauma (laparoscopic and robot-assisted procedures), shorter procedures, lower inflammatory response and related perioperative adverse events. Also, anesthetic regimen (propofol vs. sevoflurane, ventilation strategies) and pharmacological agents, especially interleukin inhibitors (colchicine) and steroids have been studied. Some drugs used in secondary prevention of atherosclerosis like statins with their pleiotropic anti-inflammatory properties may reduce perioperative CV events.

HIRURŠKO ZBRINJAVANJE INTUBACIONIH LEZIJA DISAJNOG PUTA – SERIJA SLUČAJA

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SAŽETAK:

Uvod: Iako učestalost intubacionih lezija disajnog puta prema podacima iz literature nije veliki, njihov klinički značaj je ogroman jer mogu kompromitovati ventilaciju, lako se komplikuju i utiču na morbiditet i mortalitet. Učestalost lezija, njihova lokalizacija i težina zavise od tehnike izvođenja intubacije, i individualnih karakteristika bolesnika.

Cilj: Cilj rada je prikaz serije slučajeva različitih intubacionih lezija traheje i bronha, koje su uspješno zbrinute hirurškim putem uz primjenu različitih hirurških pristupa, uključujući i minimalno-invazivni, i različitih rekonstruktivnih tehnika.

Materijal i metode: U našoj ustanovi u periodu od jula 2022. do maja 2024. godine hirurškim putem su liječena četiri pacijenta sa intubacionim lezijama disajnog puta. Kod svih je analizirana klinička prezentacija, lokalizacija lezije, dijagnostička procedura, hirurški pristup, rekonstruktivna tehnika i postoperativni tok.

Rezultati: Prvi slučaj je lezija distalnog cervikalnog segmenta traheje kod pacijenta podvrgnutog gornjoj desnoj UVATS lobektomiji, zbrinuta primarnim šavom uz pleuralni flap. Drugi slučaj je lezija srednje trećine traheje zbrinuta desnom anterolateralnom torakotomijom sa rekonstrukcijom defekta vaskularizovanim interkostalnim mišićnim režnjem. Treći slučaj je lezija na spoju cervikalne i torakalne traheje, tretirana cervikotomijom i rekonstrukcijom membranoznog zida traheje sternohioidnim mišićnim režnjem. Četvrti slučaj je lezija lijevog glavnog bronha tokom desnostrane VATS dijagnostičke operacije pluća, uspešno rekonstruisana istim pristupom primarnim šavom i pleuralnim flapom. Kod svih bolesnika postignuta je potpuna prohodnost disajnog puta, bez intraoperativnih i postoperativnih komplikacija. Kontrolne bronhoskopije pokazale su uredan endoskopski nalaz.

Zaključak: Hirurško zbrinjavanje intubacionih lezija disajnog puta moguće je izvesti uspješno različitim pristupima i tehnikama, u zavisnosti od lokalizacije i obima oštećenja. Upotreba vaskularizovanih mišićnih i pleuralnih režnjeva omogućava sigurnu rekonstrukciju, obezbjeđuje stabilnu prohodnost disajnog puta i donosi odlične funkcionalne rezultate. Pravovremeno prepoznavanje i upućivanje pacijenata u specijalizovane centre presudni su za povoljan ishod liječenja.

Ključne riječi: intubacione lezije, traheja, bronhus, rekonstrukcija disajnog puta.

SIGNIFICANCE OF ELEVATED TROPONIN IN NON-CARDIAC SURGERY

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ABSTRACT:

Introduction: Elevated troponin levels after noncardiac surgery, often referred to as Myocardial Injury after Non-cardiac Surgery (MINS) are common and should not be ignored. Troponin is a cardiac biomarker that is highly specific for myocardial injury. Elevated levels postoperatively suggest that some degree of cardiac muscle damage has occurred, even if the patient has no symptoms. Patients with troponin elevation are at higher short-term and long-term risk of morbidity and mortality.

AIM: Many factors can contribute to troponin elevations after noncardiac surgery like anesthesia and surgical trauma, perioperative hemodynamic fluctuations, tachycardia, bradycardia, hypoxemia, anemia and severe obstructive sleep apnea. A literature review is conducted to analyze the underlying causes of elevated troponin levels and their clinical implications.

Conclusion: Elevated troponin after non-cardiac surgery is a strong and independent predictor of short and long-term mortality. It likely reflects myocardial injury (MINS), often silent, and requires careful clinical evaluation and consideration of further cardiac risk management.

Pediatric Anesthesia - Session II

COMPLICATIONS OF PROCEDURAL SEDATION IN CHILDREN

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ABSTRACT:
Children present for procedural sedation with complex medical issues including congenital malformation, congenital heart diseases, neurologic disabilities, respiratory diseases, feeding dysfunction, and developmental delay. These comorbidities require diagnostic examination that cannot be completed without sedation or anesthesia. Also, there is growing evidence for the need for deep sedation for many pediatric therapeutic procedures. Sedation should only be performed in an environment where staff, facilities, equipment and drugs meet requirements to manage emergencies in children.

Key words: sedation, complication, child

APSTRAKT:
Deca kod koje je potrebno uraditi proceduralnu sedaciju najčešće imaju složene medicinske probleme, uključujući kongenitalne malformacije, kongenitalne srčane mane, neurološke smetnje, respiratorne bolesti, poremećaje u ishrani i kašnjenje u razvoju. Ovi komorbiditeti upravo i zahtevaju dijagnostički pregled koji se ne može obaviti bez sedacije ili anestezije. Takođe, sve je više dokaza o potrebi za dubokom sedacijom za brojne pedijatrijske terapijske procedure. Sedaciju treba izvoditi samo u okruženju gde osoblje, objekti, oprema i lekovi ispunjavaju zahteve za zbrinjavanje hitnih stanja kod dece.

Ključne reči: sedacija, komplikacija, dete

Introduction

Paediatric sedation has expanded, over the past decade, in volume and demand. With a limited selection of sedatives and few new sedatives to market over the past decade, some providers utilize agents that formerly were considered exclusive for administration by anaesthesiologists. Worldwide there is not consistent agreement on sedation practice and delivery. Many of the sedatives used today were first described over a century ago. In a retrospective review, drug overdosage, drug interactions, and administration of three or more sedatives were major contributors to critical incidents (death or permanent neurological injury). Overall, even today some sedatives are used off-label in the paediatric population. New routes and methods of delivery, using either new or existing sedatives, might also offer benefits.[1] Pediatric sedation is a clinical activity with potential for rare but serious adverse events (AEs). To perform safe and effective procedural sedation, one must be knowledgeable of the nature, frequency, and timing of AEs during the sedation encounter. Early recognition of an AE during sedation is critical because most sedation-related AEs begin as respiratory events, which may progress to serious AEs without appropriate intervention by an attentive practitioner.

Without such intervention, serious AEs may result in death or permanent neurologic injury. Respiratory AEs are the most common sedation-related AEs.[2] Procedural sedation and analgesia (PSA) performed in the ED is distinctive from other settings in that the procedures performed are likely to be more painful and urgent in nature.[3] Due to the nature of the pediatric intensive care unit (PICU), children frequently undergo more painful and stressful medical procedures and traumatic treatments than children who are hospitalized in general wards. Complications could be acute as e.g. desaturation or laryngospasm[4] or manifest as prolonged recovery.[5] They also depend on many factors such as underlying condition, e.g. hematological malignancy[6], age of a child[7] or different kind of emergency e.g. foreign body removal.[8] Apostolidou et al.[9] found female sex and each increase of propofol bolus by 1 mg/kg to be independent risk factors for AEs.Pre-sedation checklist could reduce the number of serious adverse events (SAE) by improving the adherence to sedation protocols, and by positively affecting the safety culture of the ED team, but the results of Librov and Shavit[10] clearly suggest that administration of pre-sedation checklist was not associated with a reduction in SAE rate. Drug selection should be tailored to each specific patient encounter with consideration given to drug allergies, current cardiopulmonary status, co-administered medications, and the patient's prior experiences with procedural sedation, if applicable.[11]

Risk to pediatric patient safety

Various research and clinical studies have been conducted to explain the terminology and definitions so that sedation-related adverse events can be easily identified (i.e. ranging from minimal to severe).[12,13]

Adverse events may be categorised as follows, according to clinical importance:

• Lesser adverse events (i.e. a short period of oxygen desaturation)

• Standard or moderate adverse events (i.e. lowest oxygen saturation at 75% or lasting longer than 60 seconds)

• Critical adverse events (i.e. permanent neurological injury, admission to hospital, CPR and tracheal intubation, or death)

Environment and clinical setting

Treatment areas must be large enough to enable adequate access for the sedation team. Furthermore, sedation should only be performed in an environment where staff, facilities, equipment and drugs meet requirements to manage emergencies in children. There must also be enough room for managing medical emergencies. Resuscitation equipment suitable for children must be available, maintained and regularly checked, especially before the start of the procedure. The equipment must be in working order and the drugs within their expiry date. Records of the maintenance of equipment must be retained and be made available for formal inspections.

The recovery facility may either be a dedicated recovery area or a treatment area that is used as such. Children must be continually monitored in the recovery area until they have completely recovered from the effects of the sedation. The recovery area must be equipped to facilitate the management of any sedation-related adverse events.

Clinical assessment

Assessment should be done in accordance with the ASA physical status classifica-

tion system. However, while anaesthesia and sedation providers use the ASA classification to indicate a child's overall preoperative status for anaesthesia and sedation, it may be misinterpreted as a classification to predict risk. It is important to realise that this is not a risk classification, but an evaluation of clinical status only. Only children in ASA Class I, II and fragile ASA II well-controlled, should be considered for sedation outside of a hospital operating theatre.

Children at an increased risk for complications include, but is not limited to:

• Children younger than 3 years of age.

• Children with a history of prematurity with residual pulmonary, cardiovascular, gastrointestinal or neurological problems, or significant anaemia.

• Children with congenital syndromes.

• Children with obesity (> 95th percentile body mass index (BMI) for their age).

*The association between obesity and obstructive sleep apnoea (OSA) limits the use of sedatives and opioids and increases risk in light of early discharge requirements. Children with restrictive lung disease are prone to desaturation – they must be evaluated on a case-by-case basis.

• Children with previous failed sedation.

• Children with any known adverse reactions (hyperactive or paradoxical response) or allergy to any of the sedation drugs.

• Children who display severe behavioural problems or hyperactivity, or who are mentally challenged.

• Children whose parents are reluctant.

Principles of safe sedation practice

Knowledge of the pharmacokinetics and pharmacodynamics of drugs, relating to children.

• Administration of the minimal dose of drug necessary to ensure the child's safety and comfort. This dose must have taken full effect before any additional dose is administered. The use of fixed doses or boluses is not recommended.

• SPs trained and experienced in paediatric sedation, support staff who understand the special issues relating to paediatric sedation, and facilities that meet the requirements for safe practice.

• SPs must be able to recognise and manage complications, and rescue and recover a child who enters a deeper-than-intended level of sedation.

Conclusion

Although procedural sedation is considered a safe and effective practice when performed by experienced providers and healthcare teams, well-known risks exist. Complications associated with procedural sedation include apnea, hypoxia, vomiting, aspiration, laryngospasm, cardiovascular collapse, and adverse behavioral reactions (e.g., emergence reaction). The sedation technique should be tailored to the demands of the procedure. Considerations include whether the procedure is painless or painful; whether pain can be relieved by local or regional analgesia and whether systemic analgesics are needed; whether complete immobility is required and what the expected duration of the procedure is. Since airway obstruction and depression of ventilation are common negative effects of sedation, attention

should be paid to positioning of the head and neck before the start of the sedation. A small pillow under the shoulders to extend the head and neck may minimise airway obstruction. The drugs selected for PSA should have a duration of action appropriate for the duration of the procedure. Sufficient time for peak brain effect (the target site) must be allowed to prevent overdose of sedatives. Titration of administered drugs is deemed to be one of the single most important layers of safety.

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PAIN IN NEONATES

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ABSTRACT:
Introduction: Pain is a multidimensional phenomenon that includes not only nociception but is also a personal experience. Exposure to untreated pain in neonatal age leads to development of chronic pain, anxiety and depression in following years of growth. The aim of this review is to look over the developmental issues of pain, its recognition and treatment in neonatal population.
Discussion: Pain receptors develop in first trimester of intrauterine life and by 30th gestational week pain pathways are formed. This means that premature and term neonates can feel pain early in their lives. Response to pain stimuli in neonates is equal as in adults and has three phases: instant pain, persistent pain and prolonged pain. Neonates can exhibit hypersensitivity as a result of exposure to repeated pain stimuli. Estimation of pain in neonates can be done using appropriate tools like nonverbal pain scales and more objective tools that quantify changes in the autonomic nervous system (ANS) activity (pulse wave amplitude, pulse beat interval, heart rate variability, skin sweating, and pupillary changes). Once pain is recognized it must be treated. Pain therapy can be pharmacological and nonpharmacological. Most effective nonpharmacological method is per oral administration of glucose solution. Pharmacological pain therapy requires thorough understanding specific neonatal pharmacokinetics. Medications in use are acetaminophen, opioid analgetic, local anesthetics and ketamine.
Conclusion: Like any other index of clinical status, pain in neonates requires everyday evaluation and adjustment of analgetic therapy according to pain level documented. Pain has to be preveneted and Eževery pain episode must be treated. Unrecognized and unterated pian imaptcs on course of treatment, prolongs hospital stay and has long teram negative cocequences on futur qualty of life.

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PERIOPERATIVNA NADOKNADA TEČNOSTI KOD PEDIJATRIJSKIH PACIJENATA-NOVI STAVOVI

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SAŽETAK:

Perioperativna terapija tečnostima kod dece predstavlja izazov zbog njihove specifične fiziologije, većeg ekstracelularnog volumena, bržeg metabolizma i sklonosti ka brzim gubicima tečnosti. Neadekvatno vođenje terapije tečnostima može dovesti do poremećaja elektrolitne i acidobazne stabilnosti, hemodinamske nestabilnosti kao i multiorganskog disbalansa. Hipovolemija je jedan od vodećih uzroka mortaliteta perioperativnog srčanog zastoja u ovoj populaciji.

Cilj perioperativne terapije je održavanje ili uspostavljanje normalne fiziološke ravnoteže, uključujući euvolemiju, adekvatnu perfuziju tkiva, oksigenaciju i stabilnost acidobazne i elektrolitske homeostaze. Savremene preporuke naglašavaju upotrebu izotoničnih, po mogućstvu izbalansiranih rastvora kao standarda za održavanje i nadoknadu tečnosti, uz individualno prilagođavanje brzine infuzije prema tipu operacije, stepenu dehidracije i intraoperativnim gubicima. Na početku se nadoknada proračunava na osnovu Holidej Segarove formule, a nakon toga se rukovodimo biohemijskim rezultatima i hemodinamskim parametrima. Posebno se razmatra uloga glukoze jer hipoglikemija kao i hiperglikemija mogu izazvati neurološke poremećaje kod dece. Rutinska primena rastvora sa visokim sadržajem glukoze se više ne propisuju tokom perioperativnog perioda. Preporučuje se primena izotonih balansiranih rastvora sa 1–2,5% glukoze kod pedijatrijskih pacijenata.

Diskutuje se i upotreba koloida u stanjima hipovolemije kada kristaloidi nisu dovoljni, uzimajući u obzir rizike i regulatorna ograničenja. Prezentacija sumira aktuelne međunarodne smernice (AAP, NICE, ESPNIC) i rezultate najnovijih studija, osvrćući se na problem ograničene dostupnosti optimalnih rastvora u pojedinim regionima i na značaj dodatnog skraćivanja preoperativnog i postoperativnog gladovanja. Naglasak je na praktičnim preporukama za anesteziologe i pedijatrijske timove sa ciljem smanjenja komplikacija i poboljšanja perioperativnih ishoda kod dece.

Ključne reči: perioperativno, nadoknada tečnosti, pedijatrijska anestezija

CHALLENGES AND PERSPECTIVES OF PEDIATRIC ANESTHESIA IN BOSNIA AND HERZEGOVINA

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ABSTRACT:
Rad govor o tome šta je zapravo pedijatrijska anestezija, te koliko je važan i značajan njen udio u zbrinjavanju ove senzitivne populacije za razne vrste hirurških, dijagnostičkih i terapijskih procedura. Značaju anesteziologa, treniranog i edukaovanog u pedijatrijskoj anesteziji kao članu multidisciplinarnog tima za izvođenje različitih anesteziooloških procedura. Analiziraju se izazovi u vidu specifičnosti, anatomskih, fizioloških i farmakoloških od strane pedijatrijskih pacijenata, kao i izazovi edukacije anesteziologa, te opreme i prostora potrebnih za ove procedure.
Rad potom prezentuje stanje u Bosni i Hercegovini dobijeno anketiranjem dva anesteziološka strukovna udruženja o vremenu i načinima edukaciji anesteziologa u pedijatrijskoj anesteziji, kao i stanje kadrova, opreme, mogućnosti i ograničenja izvođenja anesteziooloških procedura kod pedijatrijskih pacijenata. Iz ovih podataka analizira izazove i perspektive.
U zaključku naglašava se važnost ulaganja u edukaciju kadrova, opremu i prostor za povećanje bezbjednosti anesteziooloških procedura kod pedijatrijskih pacijenata.

Circulation and Breathing - Session II

AIRWAY MANAGEMENT TEACHING AND PRACTICE: OLD SCHOOL VS. HIGH TECH – OUR EXPERIENCE

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ABSTRACT:

Background: Airway management remains a cornerstone of anesthesiology and emergency medicine, with techniques evolving from traditional, "old school" methods of intubation with direct laryngoscopy to highly sophisticated, technology-driven solutions. Recent decades have seen the rise of videolaryngoscopy (VL), supraglottic devices (SGA) with integrated imaging (3rd generation of SGA), robotic intubation prototypes, and artificial intelligence (AI)–based tools for assessment, training, and clinical decision-making. However, high-tech solutions are often unavailable in resource-limited regions or can fail in austere environments, reinforcing the importance of mastering traditional skills.

Methods: This presentation draws on historical review, literature analysis, and our institutional experience in teaching airway management to students, residents, and practicing clinicians. We observed changes in learning behaviors across generations, particularly in response to technological innovations, pandemic-driven remote education, and the integration of simulation, virtual reality (VR), and AI-assisted training tools.

Results: Video-chip technology based devices (e.g. VL) enhance glottic visualization, first-pass success, and training feedback. AI-enabled platforms and virtual simulation offer individualized learning and real-time performance assessment. Nevertheless, competence in direct laryngoscopy and basic airway maneuvers remains critical for safety during equipment failure or in disaster settings. A hybrid model, blending traditional and modern approaches, optimizes skill acquisition and patient outcomes according to the author's experience.

Conclusion: Technology should augment—not replace—fundamental airway skills. Future-proof airway management education requires a balanced, hybrid approach that integrates advanced tools with the traditional principles of manual expertise, teamwork, and crisis readiness.

Keywords: Airway management; airway devices; videolaryngoscopy; artificial intelligence; airway education; simulation training;

PROACTIVE HAEMODYNAMIC MANAGEMENT IN PERIOPERATIEVE PERIOD

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ABSTRACT:

Introduction. Hemodynamic instability is not a specific diagnosis but a final common pathway resulting from different hemodynamic mechanisms that can coexist or act independently. The aim of hemodynamic management is to optimize perfusion pressure and oxygen delivery to maintain adequate cellular metabolism. Mean arterial pressure, the mean pressure over the cardiac cycle, is the inflow pressure for most organs and therefore a main determinant of organ perfusion pressure. However, organ perfusion pressure is also influenced by venous outflow pressure and extravascular pressure in the relevant tissue. The rationale to monitor CO during surgery thus is to avoid organ injury by maintaining oxygen delivery.

Discussion. Early goal-directed therapy uses treatment protocols based on fixed targets to normalize blood flow. Individualized hemodynamic therapy aims at a maximization of blood flow based on individual targets defined after assessment of fluid responsiveness by functional hemodynamic monitoring. Personal hemodynamic management tries to achieve optimal/adequate blood flow using personal targets and adaptive multiparametric approaches. 2022 ESC/ESA Guidelines on perioperative management of patients with cardiac diseases for noncardiac surgery have recommended avoidance (as opposed to correction) of intraoperative hypotension (IOAH). The term avoidance was chosen because there are very few (if any studies) that demonstrated that correction of intraoperative arterial hypotension improves outcome. Treatment of low cardiac output (CO) and/or hypotension situations is usually reactive, which means treatment is generally initiated when the episode of hypotension, low CO, or the combination of both has already occurred. The emergence and integration of the so-called goal-directed hemodynamic therapy (GDHT) algorithms into clinical practice have allowed for more proactive management of patient hemodynamics. Hypotension treatment should be based on underlying causes including vasodilation, hypovolemia, bradycardia, and low cardiac output. (strong recommendation, high-quality evidence). There are various endotypes of intraoperative hypotension characterised by different underlying hemodynamic alterations. Hypotension prediction index (HPI; Edwards Lifesciences, Irvine, CA, USA) algorithm is based on a machine learning algorithm with the complex analysis of the arterial pressure waveform as an input and the occurrence of hypotension with MAP <65 mmHg for at least 1 min as an output. The HPI algorithm gives the clinician an unitless number, ranging from 0–100, informing about the likelihood that within 5–15 min a hypotensive event will occur despite the patients being still hemodynamically stable. Intraoperative hypotension, however, might be just the tip of the iceberg that we see because arterial pressure is measured ubiquitously during surgery. Intraoperative hypotension is one of many signs reflecting profound alterations in cardiovascular dynamics, with some other signs rarely recognised because they are not monitored or simply ignored. Changes in cardiovascular dynamics are complex and include impaired myocardial contractility, relative or absolute intravascular hypovolemia, bradycardia, low afterload and thus eventually impaired blood flow (i.e. cardiac output).

Conclusions. Perioperative hypotension and hypotensive events in critically ill patients are common and associated with hypoperfusion and organ failure. Arterial pressure is not the

sole determinant of organ perfusion pressure and, although coupled to blood flow, is not a surrogate of blood flow or tissue perfusion. Low blood pressure values occur late in the development of hemodynamic instability, i.e., when global cardiovascular dynamics are already markedly altered and compensatory mechanisms are exhausted. The use of artificial intelligence (machine learning) gives us the opportunity to predict hypotensive events and might enable pre-emptive rather than reactive treatment strategies to be used.

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INTELLIVENT-ASV – BENEFITS OF CLOSED LOOP VENTILATION IN CLINICAL PRACTICE

Matija Jurjević, MD

ABSTRACT:

Despite the fact that applying simple principles of lung protection in mechanical ventilation like "low-tidal volume" ventilation and lowering plato pressure, studies have shown that in real life at least 25-30% of patients are ventilated with too high tidal volumes or too high pressures [(1)]. Furthermore, the same study has shown that less then 50% of patients have plato pressure measured, meaning driving pressure is rarely measured [(1)]. Applying lung protective individualized mechanical ventilation from intubation to extubation can be easier using modern technology tool readily available bedside.

After the initial PEEP optimization used as a starting point for setting up mechanical ventilation, choosing the adequate individualized settings can be challenging in any mode especially in ARDS patients.

INTELLiVENT-ASV (I-ASV) is a closed-loop ventilation mode based on the ASV mode of breathing designed to provide minimal work of breathing as well as minimal force of breathing[(2)]. Furthermore, using the integrated volumetric CO_2 sensor and pulse oximeter the mode I-ASV has an integrated algorithm for constantly targeting the user defined $ETCO_2$ and SpO_2 [(3)]. This is achieved by automation of the amount of minute ventilation delivered by ASV as well as automation of PEEP and inspired oxygen fraction (FiO_2) using ARDSNet PEEP-FiO_2 tables.

Studies have shown that I-ASV provides lung protective ventilation in terms of low tidal volume as well as driving pressure breath by breath. Even in severe ARDS driving pressure is kept as low as possible [(4)].

Furthermore, in another study comparing I-ASV to conventional ventilation, I-ASV was superior in terms of applying lung protective ventilation in the first 7 days as well as delivering lower mechanical power when compared to conventional ventilation [(5)].

Closed-loop ventilation using I-ASV offers more breath by breath protection when compared to conventional modes by applying low tidal volume and driving pressure ventilation as well as low mechanical power.

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VALIDATION OF THORACOSCORE IN PREDICTING RISK IN THORACIC SURGERY

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ABSTRACT:

Introduction. Thoracic surgery is lacking a broadly accepted and dependable risk model that could be used prospectively to make objective decisions and retrospectively to enable fair comparison of outcomes. Thoracoscore is the first multivariate model for the prediction of in-hospital mortality after general thoracic surgery. It is incorporated in the new British Thoracic Society and National Institute of Health and Clinical Excellence guidelines. Thoracoscore is the first model with multiple variables developed for predicting in-hospital mortality following pulmonary resections. However, additional evaluation of Thoracoscore is considerably advised in order to demonstrate its validity and potentially make it a dependable tool for thoracic surgeons across the world. Our study assesses the accuracy of Thoracoscore scoring system in estimating in-hospital mortality in patients under-going pulmonary resections. However, further external evaluation is necessary in order to establish its validity and potentially make it a dependable tool for thoracic surgeons across the world. Objective of our study was to evaluate accuracy of Thoracoscore in predicting perioperative mortality in patients undergoing high-risk pulmonary resections. **Matherial and metods**. Between 2020 and 2025 data was retrospectively collected on 6 patients operated on at the Urgent Center, Clinical Center of Vojvodina, Srbia. The procedures performed were pneumonectomies or lobectomies. The Thoracoscore was calculated based on the following variables: age, sex, American Society of Anaesthesiologists' class, performance status classification, dyspnea score, priority of surgery, procedure class, diagnosis group and comorbidities score. Thoracoscore was divided into four risk groups: low (0-3), moderate (3.1-5), high (5.1-8) and very high (>8). **Results**. Four of 6 (67%) patients had pneumonectomy for malignancy. The observed death rates in the test set were compared with the predicted death rates by category of risk: the correlation of observed to expected mortality was 0.99. This scoring system had excellent discriminatory ability with a ***C*** statistic (0.78, 95% CI). **Discussion nad conclussion**.Advanced age, male sex and malignancy proved to be strong predictors of perioperative mortality in this study. Thoracoscore showed to be a good and useful clinical tool for preoperative prediction of perioperative mortality among patients undergoing high-risk surgical procedures like pulmonary resections.

Keywords. Thoracoscore, scoring system, thoracal surgery

Poster Presentations

OSMJEH KOJI KRIJE PRIČU: PERIOPERATIVNE STRATEGIJE ANESTEZIJE U HIRURGIJI RASCJEPA USNE I NEPCA

More than just a smile: Perioperative Anesthesia Strategies for Lip and Cleft Surgery

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SAŽETAK:

Uvod: Anestezija za operativni zahvat rascjepa usne i nepca kod djece predstavlja značajan izazov za anesteziologe. Ovi pacijenti su podložni riziku od otežane intubacije i raznih perioperativnih komplikacija zbog svoje dobi i prisutnih kraniofacijalnih anomalija. Anesteziološka tehnika prilagođava se stanju pacijenta i procjeni složenosti uspostavljanja disajnog puta. U Kliničkom Centru Univerziteta u Sarajevu, multidisciplinarnim pristupom nastoji se postići optimalno stanje pacijenta za operativni tretman.

Cilj: Cilj ovog rada je istaknuti faktore koji mogu uticati na anesteziološke i hirurške komplikacije tokom operativnog tretmana rascjepa usne i nepca kod djece, kao i prikazati primijenjene metode rada u našoj ustanovi.

Materijal i metode: Retrospektivnom studijom analizirani su podaci 46 pedijatrijskih pacijenata operisanih zbog rascjepa usne i nepca u periodu od 2019. do 2023. godine u KCUS-u. U okviru anesteziološke pripreme evidentirane su operativna dijagnoza, preoperativne kliničke dijagnoze, radiološka i laboratorijska dijagnostika, kao i mikrobiološki nalazi. Posebna pažnja posvećena je perioperativnim komplikacijama.

Rezultati: U ukupnoj grupi od 46 pacijenata, 21,7% imalo je pridružene bolesti. Radiološki pregled pluća otkrio je promjene u plućnom parenhimu kod 15% pacijenata. Postoperativni laringealni stridor zabilježen je kod 2,1% pacijenata. Anemija je evidentirana kod 4,3% ispitanika. Ultrazvučni pregled srca otkrio je srčane mane kod 19,5% pacijenata, ali bez značajnog uticaja na anesteziološki plan. Nisu zabilježene komplikacije prilikom uspostavljanja disajnog puta. U postoperativnom periodu febrilnost je zabilježena kod 4,3% pacijenata, a mikrobiološkim brisom grla i nosa kod 13,04% otkriveni su patogeni, što je rezultiralo adekvatnom primjenom antimikrobne terapije.

Zaključak: Anestezиološki pristup treba biti individualiziran u zavisnosti od stanja pacijenta i težine uspostavljanja disajnog puta. Pažljiva preoperativna priprema ključna je za smanjenje rizika perioperativnih komplikacija i sigurnu realizaciju operativnog zahvata.

Ključne riječi: anestezija, rascjep usne i nepca, disajni put

MENINGEOM STRAŽNJE LOBANSKE JAME OTKRIVEN NAKON CARSKOG REZA KOD PACIJENTICE LIJEČENE POD DIJAGNOZOM PREEKLAMPSIJE – PRIKAZ SLUČAJA

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SAŽETAK:
Uvod: Preeclampsija i intrakranijalni tumori imaju slične simptome : glavobolju, poremećaje vida, konvulzije,kognitivne promjene,konfuziju, hipertenziju,mučninu, povraćanje , što može odgoditi postavljanje adekvatne dijagnoze. Meningeomi su benigni tumori ovojnica mozga.U trudnoći mogu rasti brže zbog hormonalne stimulacije.Cilj prikaza ovog slučaja je ukazati na potrebu za širim diferencijalno dijagnostičkim pristupom trudnici sa neurološkom simptomatologijom. Prikaz slučaja: Pacijentica stara 29 godina, četvrta trudnoća neredovno kontrolisana - 32. sedmica gestacije, premještena na Kliniku za ginekologiju i akušerstvo zbog pogoršanja neurološkog statusa , glavobolje i povišenog krvnog pritiska. Predhodno liječena na Klinici za ortopediju zbog celulitisa lijeve potkoljenice. Zbog dalje progresije neuroloških simptoma izveden carski rez, nakon kojeg se neurološki status pacijentice i dalje pogoršava. Uradi se CT kranijuma koji pokaže tumorsku masu u stražnjoj lobanjskoj jami i hidrocephalus.Pacijentica se odmah podvrgne ventrikulostomiji a potom se učini i resekcija tumora; histološki potvrđen meningeom WHO I.Pacijentica postoperativno liječena u Intenzivnoj njezi Klinike za neurohirurgiju, potom u Palijativnoj njezi sa smrtnim ishodom. Novorođenče (na rođenju TT 1950/44, APGAR score 9/10) otpušteno iz bolnice treći dan po rođenju na dalju brigu porodici. Zaključak: Kod trudnica s neuobičajnim ili perzistentnim neurološkim simptomima je važno u diferencijalnoj dijagnozi razmotriti postojanje intrakranijalnih lezija, naročito kada klinički tok odstupa od tipične slike preeclampsije.

PATIENT SATISFACTION WITH EPIDURAL COMPARED TO COMBINED SPINAL EPIDURAL ANALGESIA DURING LABOR – RETROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT:

Background: Epidural analgesia and combined spinal-epidural analgesia are widely used techniques in labor analgesia. This study aimed to compare patient satisfaction and side effects between epidural (E) and combined spinal-epidural (CSE) analgesia during labor.

Methods: Data was collected retrospectively thorough electronic hospital medical records and interviewing the patients after delivery during their hospitalization. The study included sixty-five patients allocated into groups: Group E (n = 24) and Group CSE (n = 41). Patient satisfaction was measured using five-point Likert scale. Pain scores were measured with visual analogue scale (VAS). Data on episodes of fetal bradycardia and Apgar scores in neonates, along with itching, postdural puncture headache (PDPH), nausea, vomiting, and pain scores in mothers, were analyzed. The Mann-Whitney U test and Chi-square test were applied where appropriate. Statistical significance was determined at a p-value threshold of 0.05.

Results: The data on patient satisfaction showed high satisfaction that exceeded 95% in both groups ($p > 0,05$). Itching was reported to be higher in CSE group (70.7% vs 29.1%, $p< 0.001$). Pain scores were lower in CSE compared to E group (0.93 ± 1.68 vs. 2.5 ± 2.3; $p <0.001$). There were no statistically significant differences among other measured variables (PDPH, nausea and vomiting, fetal bradycardia, Apgar scores). More than 95% of patients in both groups expressed that they would opt for labor analgesia in their next delivery.

Conclusion: There were no significant differences in overall patient satisfaction between the groups. CSE group experienced less pain but more side effects such as itching. These findings highlight the need to balance analgesic efficacy with potential side effects when selecting the most appropriate method for labor analgesia.

Keywords: epidural analgesia, combined spinal epidural analgesia, patient satisfaction, visual analogue pain scale, analgesia side effects.

ANESTEZIOLOŠKI PRISTUP DJETETU PRI OPERATIVNOM TRETMANU CT-OM VERIFIKOVANE OBOSTRANE EHINOKOKOZE PLUĆA

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SAŽETAK:

Uvod: Ehinokokoza je parazitska bolest koja pogađa čovjeka, ali i životinje. Izaziva je mala pantljičara, koja živi u crijevima, a njena jajašca se izbacuju iz crijeva životinja stolicom. Čovjek se zarazi direktnim kontaktom sa životinjama ili preko hrane i vode. Embrioni iz želuca čovjeka kroz crijevni zid, putem krvi dospijevaju u pluća, jetru, mozak, bubrege, slezenu i druge organe.Tu se razvijaju vezikule koje mogu biti mnogobrojne multilokularne ciste zavisno od vrste ehinokoka. Ciste imaju oko sebe hitinsku membranu, a oko nje organizam stvara vezivnu ovojnicu. Simptomi koji se javljaju kod cistične ehinokokoze pluća su kašalj, iskašljavanje krvi, alergijske promjene na koži, poremećaj pri disanju, atelektaze. Dijagnoza se postavlja na osnovu pregleda, Rtg pluća, UZ, CT-a, magnetne rezonance, labaratorijskih nalaza (povećan broj eozinofila u krvi). Liječenje se vrši hirurškim tretmanom ukoliko lokalizacija ciste dozvoljava ili višemjesečnom terapijom lijekom abendazololom. **Cilj** je nakon pravovremene odluke konzilija obezbjediti siguran disajni put i adekvatan hemodinamski monitoring djeteta prilikom izvođenja hirurškog tretmana. **Prikaz slučaja** je dijete (Š.E.), starosti deset godina. Bolest počela mjesec dana prije prijema u bolnicu sa febrilnošću, kašljem i bolom u grudnom košu. Dijete liječeno antibioticima bez zdravstvenog poboljšanja. Auskultatorno oslabljen disajni šum obostrano, a nakon urađene dijagnostike (Rtg pulmo i CT-a) verifikuju se desno okruglasta zona konsolidacije sa zonama zraka (37x53x51) i lijevo kolekcija (65x78x123) sa zonama atelektaze i kompresivnim ponašanjem. Uradi se adekvatna preoperativna priprema djeteta od strane anesteziologa, dječijeg hirurga, pedijatra pulmologa, infektologa i dermatologa. Nakon konzilijarne odluke na osnovu veličina obostranih plućnih formacija, uradi se operativni zahvat sa lijeve strane grudnog koša. Plasira se desni karlens tubus, op. zahvat protekne sa hemodinamskom stabilnošću i adekvatnom ventilacijom djeteta. Postoperativni tok se nastavi u Jedinici Intenzivne Pedijatrijske klinike, te nakon kontrolnog Rtg-a pluća odluči za konzervativnu terapiju ehinokokoze desne strane pluća abendazololom. Po otpustu iz bolnice pacijentica se naručuje na redovne kontrolne preglede. **Zaključak** ehinokokoza pluća kod djece zahtijeva studiozan i brižljiv timski pristup ljekara koji vodi najčešće uspješnom terapijskom efektu. Ključne riječi : ehinokokoza pluća, anestezija, tim.

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GIGANTSKA MULTINODOZNA STRUMA SA TRAHEALNOM KOMPRESIJOM – IZAZOV ZA ANESTEZIOLOGA: PRIKAZ SLUČAJA

Neda Tomaš

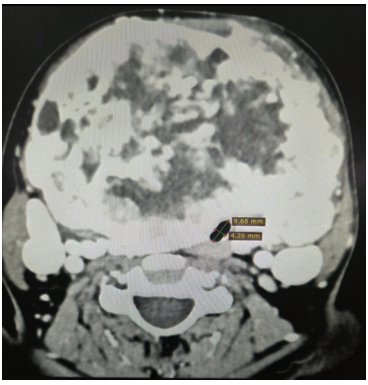
ABSTRACT:
Uvod: Hirurško zbrinjavanje pacijenata sa gigantskom strumom često predstavlja anestezиološki izazov zbog kompresije traheje i distorzije anatomije gornjih disajnih puteva. U ovim situacijama, izbor anesteziološke tehnike je ključan za bezbjednost pacijenta.
Prikaz slučaja: Prikazujemo pacijentkinju staru 59 godina sa gigantskom multinodoznom strumom i infiltracijom traheje. U cilju izbjegavanja opšte anestezije i potencijalno nemogućeg osiguravanja disajnog puta, zahvat je izveden u bilateralnom površinskom cervikalnom bloku. Za blok je korištena kombinacija lidokaina 2% (5 ml) i levobupivakaina 0,5% (7 ml) po strani. Tokom intervencije pacijentkinja je bila u potpunosti obezboljena i hemodinamski stabilna, očuvanog spontanog disanja i bez intraoperativnih komplikacija.
Zaključak: Regionalna anestezija, u ovom slučaju cervikalni pleksus blok, može biti adekvatna alternativa opštoj anesteziji kada se procijeni visok rizik od otežane ili nemoguće endotrahealne intubacije.

Uvod

Hirurško liječenje pacijenata sa gigantskom multinodoznom strumom predstavlja veliki izazov za anesteziologa, prije svega zbog izražene kompresije i devijacije traheje, što značajno komplikuje obezbjeđivanje disajnog puta. U takvim okolnostima, opšta anestezija sa endotrahealnom intubacijom može biti visokorizična ili neizvodljiva. Regionalna anestezija, u vidu cervikalnog pleksus bloka, nudi bezbijednu alternativu, omogućavajući očuvanu spontanost disanja i izbjegavanje manipulacije kompromitovanim disajnim putem.

Prikaz slučaja

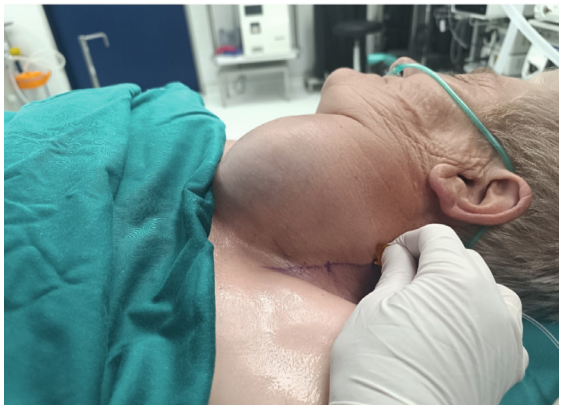
Pacijentkinja, 59 godina sa gigantskom multinodoznom strumom i simptomima disajne opstrukcije, primljena je radi planirane totalne tireoidektomije. Preoperativni CT vrata i grudnog koša pokazao je izraženu kompresiju traheje, sa luminalnim suženjem na svega 4,26 mm, kao i devijaciju u desnu stranu (slika 1). Zbog procijenjenog izuzetno otežanog i potencijalno nemogućeg obezbjeđivanja disajnog puta, nakon informisanog pristanka, odlučeno je da se procedura sprovede u regionalnoj anesteziji.



Slika 1. Preoperativni CT vrata/grudnog koša: izražena kompresija traheje sa minimalnim lumenom 4,26 × 9,68 mm.

Anesteziološka tehnika

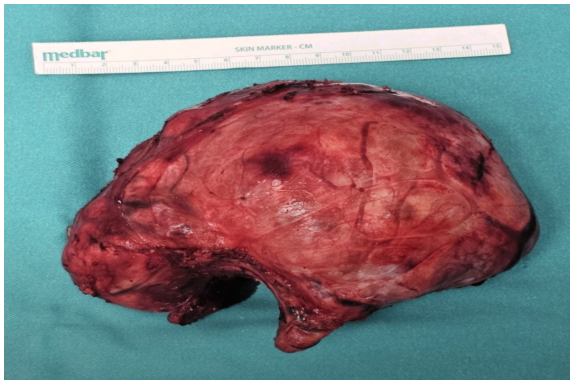
Monitoring je uključivao EKG u tri odvoda, neinvazivni krvni pritisak i pulsnu oksimetriju. Obezbijeđen je periferni venski pristup i kontinuirani niskoprotočni nazalni O_2. Primijenjen je bilateralni površin-



ski cervikalni blok. Na svakoj strani infiltrisano je 5 ml lidokaina 2% i 7 ml levobupivakaina 0,5%. Blok je izveden pod aseptičnim uslovima, uz aspiracione probe radi izbegavanja intravaskularne aplikacije (slika 2). Ukupna doza iznosila je ~ 200 mg lidokaina i 70 mg levobupivakaina.

Slika 2. Priprema i orijentiri za bilateralni površinski cervikalni blok

Tokom operacije pacijentkinja je bila budna, svjesna i u stalnom verbalnom kontaktu sa anesteziološkim timom. Vitalni parametri (EKG, SpO_2, NIBP) ostali su stabilni tokom operativnog zahvata. Nije bilo desaturacije niti znakova lokalno-anestetičke toksičnosti. Nije bilo potrebe za dodatnom analgezijom niti sedacijom. Operativni tok je protekao uredno i bez intraoperativnih komplikacija. Preparat je makroskopski odgovarao gigantskoj multinodoznoj strumi značajnih dimenzija (Slika 3).



Slika 3. Preparat gigantske multinodozne strume nakon totalne tireoidektomije

Postoperativno, pacijentkinja je praćena u PACU, a potom i na odjeljenju. Pacijentkinja je bila hemodinamski stabilna, sa urednim disanjem i bez potrebe za opioidima. Nije bilo znakova hipokalcemije niti oštećenja glasnica; fonacija očuvana. Takođe, nije bilo znakova respiratornog distresa, a oporavak je protekao bez neuroloških ili lokalnih komplikacija vezanih za primijenjeni blok. Otpust sa odjeljenja izvršen je trećeg postoperativnog dana.

Diskusija

Kod pacijenata sa gigantskom strumom i značajnim kompromitovanjem disajnog puta, opšta anestezija može nositi rizik od nemogućnosti ventilacije i intubacije. U takvim situacijama, cervikalni pleksus blok predstavlja racionalan izbor jer omogućava izvođenje tireoidne hirurgije uz očuvanu spontanu ventilaciju.

U literaturi je opisano više slučajeva uspješne primjene cervikalnog bloka kao glavne anesteziološke tehnike kod visokorizičnih tireoidnih pacijenata. Regionalna anestezija ima dodatne prednosti: smanjen rizik od postoperativne respiratorne insuficijencije, manju potrebu za opioidima, brži oporavak i kraći boravak u intenzivnoj njezi. Međutim, tehnika zahtijeva visok nivo iskustva i striktno praćenje vitalnih funkcija, budući da neuspjeh blo-

ka može ugroziti bezbijednost pacijenta. Važno je voditi računa o ukupnoj dozi lokalnih anestetika, izvoditi injekcije frakcionisano uz aspiraciju i kontinuirani monitoring, kao i imati spreman plan konverzije u opštu anesteziju (oprema za otežan disajni put, mogućnost hitne traheostome) – iako u ovom slučaju konverzija nije bila potrebna. Rijetke, ali moguće komplikacije uključuju intravaskularnu aplikaciju, toksičnost lokalnog anestetika, parcijalni blok n. phrenicusa ili n. vagusa i insuficijentnu analgeziju; nijedna nije zabilježena.

Naš slučaj potvrđuje da pažljivo planiran bilateralni površinski cervikalni blok može obezbijediti pouzdanu i sigurnu anesteziju, čak i kod pacijenta sa ekstremno suženim trahealnim lumenom. Naš ishod je u skladu s tim nalazima: stabilna ventilacija, izostanak potrebe za sedacijom/opioidima i uredan postoperativni tok.

Zaključak

Bilateralni površinski cervikalni blok može biti efikasna i bezbijedna anestezioloska alternativa kod pacijenata sa gigantskom multinodoznom strumom i suženim disajnim putem, kada je opšta anestezija kontraindikovana ili rizična. Ovaj pristup omogućava uspješno izvođenje hirurške procedure uz minimalan rizik od respiratornih komplikacija i maksimalnu bezbijednost pacijenta. Pažljivo planiranje, doziranje i intraoperativni nadzor ključni su za bezbijedan ishod.

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Taking Care of Brain

MODERATE AND SEVERE TRAUMATIC BRAIN INJURY: PROGRESS AND CHALLENGES IN CLINICAL CARE AND RESEARCH

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ABSTRACT:
Moderate and severe traumatic brain injury (TBI) remains one of the most devastating forms of neurological trauma, and contributes significantly to global morbidity, mortality, and long-term disability. Despite advances in neurocritical care, surgical techniques, and neuroimaging, outcomes for patients with TBI remain suboptimal. This review summarises recent advances and current challenges in the clinical care and research of TBI. We begin with an examination of the evolution of TBI classification systems, including the limitations of the Glasgow Coma Scale and the emergence of multidimensional systems that incorporate imaging, biomarkers, and clinical trajectories. The pathophysiological cascade following TBI — from primary mechanical injury to secondary biochemical and inflammatory processes— - will be explored in the context of therapeutic targets and neuroprotective strategies. Diagnostic advances, including high-resolution imaging and fluid biomarkers, will be discussed, as well as the importance of early referral to specialist centres, which has been shown to reduce mortality and improve functional outcomes for certain subgroups. Surgical treatment strategies, including decompressive craniectomy and intracranial pressure (ICP) control, will be discussed with consideration of patient selection and timing. In the intensive care unit, sedation protocols, daily wake-up attempts and the integration of multimodal neuromonitoring are critical to optimising outcomes. We highlight the latest SIBICC (Seattle International Brain Injury Consensus Conference) guidelines, that emphasise individualised goals for ICP and brain tissue oxygenation ($PbtO_2$) and autoregulation-based management. The new therapies are highlighted. Finally, we discuss prognostic models and outcome prediction tools.

Keywords: classification of traumatic brain injury, fluid biomarkers, neuromonitoring, ICU management, precision medicine

Introduction

Traumatic brain injury (TBI) remains one of the leading causes of death and long-term disability worldwide, particularly among young adults and older people in low-income countries. The epidemiology of traumatic brain injury has changed considerably in recent decades. Older adults (≥75 years) now represent the highest risk group for TBI-related hospitalisations and deaths due to falls, which have overtaken other mechanisms of injury. Men consistently have higher rates and mortality rates compared to women. The age-standardised incidence worldwide is 259 per 100,000, with Eastern Europe and Central Asia having the highest rates. The proportion of moderate/severe TBIs has increased worldwide, especially outside high-income regions (1,2). Over the past two decades, significant progress has been made in understanding the pathophysiology of TBI, refining diagnostic tools, and improving acute care. However, clinical management and clinical trials of traumatic brain injury continue to face significant challenges due to heterogeneity in injury severity, limitations in classification and diagnosis, various pre-injury factors (e.g., age, gender, comorbidities),

patient response and social determinants of health. Advances in classification, neuroimaging, and fluid biomarkers, have the potential to enable earlier and more accurate diagnosis, while innovations in high-resolution neuromonitoring, surgical techniques and targeted intensive care protocols have led to a move away from a one-size-fits-all approach towards more personalised treatment strategies (3). Standardised protocols can overlook crucial individual differences, leading to suboptimal outcomes. Yes, there is growing evidence that personalised management of traumatic brain injury (TBI) can improve patient outcomes, although the field is still evolving and more high-quality studies are needed. The Seattle International Brain Injury Consensus Conference (SIBICC) has played a critical role in standardising care through updated recommendations on intracranial pressure (ICP) management, brain tissue oxygenation ($PbtO_2$), and cerebral autoregulation (4). These developments aim to optimise neuroprotection and reduce secondary brain injury in the intensive care unit (ICU). Despite these advances, long-term outcomes remain highly variable, and many survivors suffer from persistent cognitive, emotional, and physical impairment. This review aims to summarise the current state of knowledge and recent advances in classification, pathophysiology, diagnosis, surgical and intensive care management, neuromonitoring, and new therapies for moderate and severe TBI.

Classification systems

The classification of TBI has traditionally based on the Glasgow Coma Scale (GCS), which categorises the severity of the injury into mild (13–15), moderate (9–12), and severe (≤8). While the GCS remains a cornerstone of initial assessment, its limitations in capturing the complexity of brain injury — particularly in cases involving sedation, intubation, or extracranial trauma — have necessitated the development of more comprehensive classification systems. One of the most promising advances is the Clinical-Biomarker-Imaging-Modifier (CBI-M) model, which comprises 4 domains. The clinical domain includes GCS, pupils, motor responses, and clinical context (e.g., intoxication, seizures). The biomarker domain utilises serum markers such as glial fibrillary acidic protein (GFAP), ubiquitin carboxy-terminal hydrolase L1 (UCH-L1), neurofilament light chain (NfL), and tau proteins to assess neuronal and glial injury. The imaging section uses advanced neuroimaging techniques such as CT, MRI, and diffusion tensor imaging to detect structural damage, haemorrhage and diffuse axonal injury (DAI). The modifiers section takes into account patient-specific factors such as age, comorbidities, anticoagulant use, and extracranial injuries that influence outcome (5). This model enables better stratification in clinical trials, more personalised treatment planning, and a better prognosis. The model is currently being tested in trauma centres and is not yet widely used. It is currently being validated in large-scale, prospective cohort studies to assess its clinical utility and feasibility. In addition to the CBI-M framework, recent efforts have focused on the development of machine learning-based classification systems that analyse large datasets from electronic health records, imaging, and biomarker profiles to predict outcomes and guide therapy (3).

Pathophysiology: molecular and cellular mechanisms

The pathophysiology of moderate and severe TBI is characterised by a complex interplay of molecular and cellular events that evolve over time. These mechanisms extend beyond the initial mechanical insult and contribute to secondary injury cascades that exacerbate

neuronal damage and influence long-term outcomes. The primary injury results from mechanical forces such as acceleration/deceleration, rotational stress, and direct impact. These forces disrupt neuronal membranes, axonal integrity, and vascular structures, resulting in immediate cell death, haemorrhage and DAI. The mechanical deformation of brain tissue triggers mechanotransduction pathways that activate intracellular signalling cascades, creating the conditions for secondary injury. Secondary injury develops over hours to days and involves a series of interrelated processes: (1) excitotoxicity – excessive release of glutamate leads to over-activation of NMDA and AMPA receptors, resulting in calcium influx, mitochondrial dysfunction, and neuronal apoptosis; (2) oxidative stress – reactive oxygen species (ROS) and reactive nitrogen species (RNS) accumulate, and damage lipids, proteins, and DNA; (3) neuroinflammation – activation of microglia and astrocytes leads to the release of pro-inflammatory cytokines (e.g., IL-1β, TNF-α, IL-6), chemokines, and complement proteins; (4) apoptosis – cell death is triggered by mitochondrial dysfunction, DNA damage, and inflammatory signalling; (5) cytoskeletal dysfunction – axonal injury is accompanied by microtubule and neurofilament degradation, which impairs axonal transport and leads to uncoupling and degeneration (6). The dysfunction of the blood-brain barrier in TBI leads to infiltration of peripheral immune cells and plasma proteins into the brain parenchyma. This exacerbates oedema, inflammation, and neuronal injury. The complex changes are regulated not only by genes but also by epigenetic mechanisms. Recent studies have emphasised the role of epigenetic modifications — including DNA methylation, histone acetylation, and non-coding RNAs — in modulating gene expression after TBI. Trauma to the brain can trigger long-term changes similar to those seen in Alzheimer's disease and other neurodegenerative disorders. One of the key players in this process is the tau protein. Hyperphosphorylation of the tau protein and its aggregation into neurofibrillary tangles (toxic aggregates inside neurons) have been observed in chronic traumatic encephalopathy and neurodegeneration following TBI. These tangles disrupt normal cell function and eventually lead to cell death. These changes mirror those observed in Alzheimer's disease and suggest a link between TBI and long-term cognitive decline (6).

Diagnosis

Diagnostic strategies have evolved considerably. They go beyond clinical assessment and incorporate advanced imaging techniques and fluid biomarkers that provide deeper insights into the extent and nature of brain injury. **Clinical assessment.** Initial diagnosis begins with a neurological examination, including the Glasgow Coma Scale (GCS), pupillary response, motor function, and vital signs. While the GCS remains a useful tool for triage, its limitations — particularly in intubated or sedated patients — necessitate additional diagnostic measures. The clinical context, such as the mechanism of injury and associated extracranial trauma, is also important for early decision making. **Neuroimaging.** While CT remains the cornerstone of acute assessment, advanced magnetic resonance imaging (MRI) techniques offer greater sensitivity in the detection of non-haemorrhagic lesions, DAI, and microvascular damage. Advanced MRI techniques include: (1) diffusion tensor imaging (DTI) quantifies white matter integrity by measuring fractional anisotropy (FA) and mean diffusivity; (2) susceptibility-weighted imaging (SWI) detects microbleeds and venous abnormalities common in DAI; (3) MR spectroscopy measures concentrations of brain metabolites such

as N-acetylaspartate (NAA), choline, and lactate, and in research only (4) functional MRI assesses network connectivity and recovery potential. These advanced MRI modalities are increasingly used in subacute and chronic phases to assess injury load and recovery potential. **Blood and CSF biomarkers** have revolutionised TBI diagnostics. Current evidence supports the use of GFAP, UCH-L1, and S100B protein for reclassification of TBI at acute time points (0–24 hours), particularly in the emergency department, while NfL, GFAP, and S100B are useful at subacute time points (1–30 days) in the hospital and intensive care unit. New evidence suggests that NfL and phosphorylated tau may have a potential role at chronic time points (>30 days) in the future (REF 29). GFAP and UCH-L1 levels within 12 hours of injury are now included in recognised platforms such as the Banyan Brain Trauma Indicator (BTI), which helps to rule out the need for CT in mild TBI in the emergency department. The BTI has demonstrated high sensitivity and negative predictive value for the detection of intracranial lesions in mTBI and is currently being under investigation for its potential applicability in moderate and severe TBI (7,8).

Tertiary referral

Timely referral of patients with moderate and severe TBI to tertiary centres has an impact on survival and functional recovery. Specialised centres provide advanced neurocritical care and access to neurosurgical expertise. According to the American College of Surgeons (7) and NICE (9) guidelines, the ambulance service is instructed to transport all patients to the highest level trauma centre if severe TBI is suspected and one of the following high-risk criteria is present: mGCS <6, decreasing GCS, skull deformity, evidence of skull base fracture or CSF leak, penetrating head injuries, post-traumatic seizures, and the presence of significant extracranial injuries. Primary care in hospitals without neurosurgery may occasionally be appropriate in rural areas with long transport times, provided there is telemedicine support and predefined air/ground transfer protocols. Interestingly, in seven countries, including Slovenia, referral to centres with neurosurgery was found to be beneficial, but only for the subgroup of patients with severe TBI. Conversely, treatment of patients with minor TBI in non-neurosurgical hospitals was associated with a higher rate of good recovery and lower mortality when patients were treated in non-neurosurgical hospitals rather than tertiary centres. This unexpected result may be partly due to the negative effects of more aggressive neuro-oriented therapies in tertiary centres (10).

Surgical management

Surgical intervention in TBI is often life-saving and plays a central role in the treatment of intracranial hypertension, the removal of mass lesions, and the prevention of secondary brain injury. Timely surgical intervention can prevent herniation syndromes and irreversible brain damage. The decision to operate is based on clinical presentation, imaging findings and ICP dynamics, although there is wide variation between centres (7,11). Numerous guidelines and consensus statements have been developed in emergency and critical care medicine in collaboration with neurosurgical experts. The only guidelines specifically developed by neurosurgeons date from 2006. There are very few studies on neurosurgical management with a high level of evidence, so in 2025 the French Neurosurgical Society issued “Recommendations for professional practise” with the following wording: “It is probably advisable”

for level 2 recommendations and "The experts recommend" for expert opinions. No level 1 recommendations were issued (12). The most common indications for surgical intervention are extra-axial haematoma (EDH, SDH), depressed skull fractures with dural tear, gross contamination and signs of infection, acute obstructive hydrocephalus and high ICP unresponsive to medical treatment. The treatment of traumatic intracerebral haematoma (TICH) remains controversial. In patients with mass effects and neurological deterioration, the decision in favour of surgical intervention is easier to make. However, in patients with smaller lesions, the decision in favour of early surgery to avoid secondary damage is controversial. The STITCH trial showed improved survival in the early surgery group and a trend towards better functional outcomes, but only in the subgroup with GCS 9–12. However, surgery was harmful even in small lesions or patients with very low or high GCS scores (13). Recently, the CENTRE-TBI trial found that early surgery was associated with a better outcome compared to no surgery in a subgroup of patients with TICH and a GCS score of 9-12, similar to the STITCH trial. (11,14). The RESCUE-ASDH RCT trial compared two surgical approaches — craniotomy and decompressive craniectomy — for the evacuation of acute SDH. If the bone flap can be replaced without compressing the brain, craniotomy is preferred over craniectomy to avoid the need for subsequent skull reconstruction and its associated complications (15). Primary decompressive craniectomy is indicated in acute SDH and possibly in TICH when the brain protrudes beyond the inner table. Secondary decompressive craniectomy is indicated to control brain swelling in refractory intracranial hypertension when the primary injury is compatible with an acceptable recovery (12).

ICU management

The aim is to prevent secondary brain injury and maintain physiological homeostasis. The complexity of TBI requires a multidisciplinary approach involving neurointensive care physicians, neurosurgeons, nurses, and rehabilitation specialists.

Sedation strategies. Sedation is essential to control agitation and temperature, suppress seizures, reduce cerebral metabolic demand and ICP, and facilitate mechanical ventilation to alter cerebral blood flow by blood gases. Preferred agents for sedation include propofol, dexmedetomidine, and ketamine in a controlled environment only (may reduce unwanted cortical spreading depolarisations), barbiturates (for refractory high ICP only). Benzodiazepines are generally avoided as they are associated with increased delirium and prolonged ICU stay. Analgesics include fentanyl, remifentanil and sufentanyl, depending on patient-specific factors and institutional protocols. Excessive sedation can mask neurological deterioration and delay recovery. Where clinically possible, light to moderate sedation is recommended to allow neurological assessment and reduce the risk of delirium and prolonged ventilation. Neurological wake-up tests (NWTs) allow serial neurological assessments (motor function, pupils and level of consciousness) that serve as the gold standard for neuromonitoring. NWTs may cause a transient increase in ICP and CPP, but do not impair neurochemistry or cerebral oxygenation (16-17). The decision to temporarily discontinue sedatives is sometimes not easy. However, a recent expert consensus has established heat maps for the safety of a sedation break in patients whose ICP is controlled under different therapeutic intensity levels, taking into account the following factors: initial mGCS, pupil status, CT findings, and degree of treatment required for intracranial hypertension (none, tier 1, or tier 2 or 3 therapies) (18). The fact is that an increase in ICP and ischaemic changes on CT are a

very late sign of neurological deterioration, when the brain damage is already irreversible. A brain herniation is not always associated with an increase in ICP, especially in patients with temporal contusions and after decompressive craniectomy. As sedation blurs neuroworsening in these patients, NWTs are the gold standard for detecting neurological deterioration, although the patient is monitored by multimodal neuromonitoring.

Basic care for severe TBI – Tier 0 (not ICP- or PbtO2-directed) includes intubation, mechanical ventilation, serial assessment of neurological status, positioning of the head at least 30°, optimisation of venous return from the head (e.g. head in the midline, ensuring cervical collars are not too tight), analgesia to treat pain symptoms (not ICP directed), sedation (not ICP directed) to prevent agitation and ventilatory asynchrony, anti-seizure prophylaxis for 1 week, maintenance of an initial CPP of 60-70 mmHg (transducer at earlobe level), maintenance of normothermia, avoidance of hyponatraemia and discontinuation of antihrombotics. Only mechanical thromboprophylaxis is given until the follow-up CT shows no signs of progression of the haemorrhage. Enteral nutrition is preferable to parenteral nutrition (blood glucose 7-10 mmol/L). Gastric ulcer prophylaxis and laxatives are administered daily. Antibiotic prophylaxis in case of penetrating head injury (18).

Multimodal Neuromonitoring

Multimodal neuromonitoring has become a cornerstone of modern neurocritical care for severe TBI, enabling detection of secondary damage, the management of therapeutic interventions, and the personalisation of care. By integrating physiological, biochemical, and imaging data, multimodal monitoring provides a dynamic picture of cerebral homeostasis and injury progression.

In contrast to the Brain Trauma Foundation, the Milan Consensus Statement does not recommend routine **invasive ICP monitoring** in comatose TBI patients if the initial CT scan is normal (e.g. diffuse axonal injury). Instead, it is recommended to repeat the CT scan and initiate monitoring only if the radiological situation worsens on follow-up. This approach reflects a more selective and individualised strategy, aimed at avoiding unnecessary invasive interventions and possible overtreatment of patients without radiological signs of intracranial hypertension (19). The most accurate and reliable method of measuring ICP is invasive measurement using external ventricular drainage (EVD) or intraparenchimal sensors. ICP readings should always be correlated with imaging and clinical findings. Elevated ICP is associated with increased mortality and poor neurological outcome. When interpreting an elevated ICP, the physician should always check the position of the sensor, consider intercompartmental differences in ICP, and note the shape and pattern of the ICP waves. Both the intensity and duration of ICP insults are independently associated with poorer outcomes. The threshold of 18 ± 4 mmHg for initiating treatment is supported by robust data, but its application must take into account patient-specific factors (elderly, women) and cerebrovascular autoregulatory status. Fixed thresholds such as 20 or 22 mmHg may be too simplistic and could overlook critical nuances in patient care. The calculated CPP values, recommended in the guidelines, to ensure adequate perfusion without exacerbating oedema or ischaemia, should initially be between 60-70 mmHg initially and then individually adjusted according to autoregulation status – see below. Tolerance to intracranial pressure insults is reduced when cerebral autoregulation is impaired (20). The randomised BEST TRIP trial, published in 2012, involving patients with severe TBI from South American centres, showed no benefit of treatment based

on ICP monitoring compared to treatment based on clinical examination and serial imaging (21). In contrast, the more recent SYNAPSE-ICU study, published in 2021, and involving 1287 patients with TBI in 146 ICUs, showed that the use of ICP monitoring was associated with higher treatment intensity (more frequent use of hyperosmolar agents, sedation, and surgical interventions), lower mortality (34% vs. 49%), and better functional outcome at 6 months compared to patients without ICP monitoring (22). When invasive monitoring is unavailable or contraindicated, the following non-invasive tools are available: transcranial Doppler ultrasound (TCD), ultrasound measurement of the optic nerve sheath diameter (ONSD) and automated pupillometry. The main tools for the non-invasive estimation of ICP should be: the neurogenic pupillary index (NPi) from the automated pupillometer, the pulsatility index from the TCD, the non-invasive ICP formula from the TCD, and the ONSD. The Brussels Consensus on non-invasive ICP monitoring was published in 2025 (23). In severe TBI patients with radiological evidence of intracranial hypertension, invasive ICP should always be preferred to non-invasive methods, if available and not contraindicated.

Cerebral autoregulation (AR) refers to the ability of the cerebral vasculature to restore cerebral blood flow (CBF) after significant changes in CPP and is considered an essential intrinsic brain protective mechanism. In acute TBI care, AR capacity is assessed by evaluating the response of ICP to (1) intermittent MAP challenge (a vasopressor is titrated by 10 mm Hg for up to 20 minutes and the interaction between MAP, ICP, and possibly PbtO2 is monitored during the challenge), as emphasised in the recent SIBICC guidelines, or (2) by assessing ICP responses to spontaneous fluctuations in arterial blood pressure. The latter can be quantified by the pressure reactivity index – PRx (i.e. a correlation coefficient between ICP and CPP/MAP), with a negative PRx indicating intact AR and a positive PRx (>0.3) indicating impaired AR. The optimal cerebral perfusion pressure (CPPopt) represents the CPP at the lowest PRx level (best preserved vascular reactivity) for a given patient, thus minimising the risk of hyperaemia or ischaemia. Treatment of patients with CPPopt was associated with a better outcome in retrospective studies (REF 23). TBI patients are more vulnerable to CPP reductions below as compared to elevations above personalised CPP thresholds. In clinical practise, CPPopt should be used as the lower CPP limit, and it is optimal to keep CPP within ± 5-10 mmHg of CPPopt. Increasing CPP above CPPopt may not be as detrimental to brain physiology as decreasing CPP below CPPopt (24).

ICP monitoring is increasingly being supplemented by monitoring the **partial pressure of oxygen in brain tissue (PbtO2)** and (less frequently) by microdialysis. $PbtO_2$ monitoring provides information on cerebral oxygen supply and utilisation. Values below 20 mmHg are associated with ischaemia and poor outcomes. Normal ICP values are no guarantee of adequate brain oxygenation, and cerebral hypoxia can still occur (in 20-30% of TBI patients). $PbtO_2$-guided therapy includes optimisation of oxygenation, ventilation, and perfusion. It complements ICP/CPP monitoring by identifying hypoxia even when global perfusion appears adequate (2). Two large ongoing trials, BOOST-3 in the US and BONANZA in Australia, are expected to provide robust evidence for the clinical efficacy of PbtO2 (11). Interestingly, the European OXY-TC trial, the only randomised trial comparing a dual strategy of ICP and PbtO2 monitoring with a strategy of ICP monitoring alone, found no significant difference in functional outcomes at 6 months between patients with combined ICP and PbtO2 monitoring and those monitored with ICP alone. However, post-hoc results, suggest that an ICP- and PbtO2-guided strategy could reduce the number of patients with poor neu-

rological outcomes in the case of high ICP (>20 mmHg) on admission, so there was a signal for a positive effect of PbtO2-guided strategies in patients with high ICP (25). A recent meta-analysis showed that the group with PbtO2 monitoring had a significantly higher proportion of favourable 6-month outcomes (OR 1.39; 95% CI: 1.01–1.92), but no lower mortality (26).

Cerebral microdialysis (CMD) measures the extracellular concentrations of substrates and metabolites such as glucose, lactate, pyruvate, glutamate and glycerol. An elevated lactate/pyruvate ratio (LPR) with low pyruvate concentrations indicates cerebral hypoxia, while an elevated LPR with preserved or even high pyruvate levels may indicate mitochondrial dysfunction. Increased LPR has been observed to precede critical events such as intracranial hypertension and a reduction in CPP in TBI patients. Observational studies show that elevated LPR and low glucose concentrations in brain tissue are associated with poor outcome after severe TBI, but there is not yet robust evidence to target these parameters to improve outcomes (11). **Near-infrared spectroscopy (NIRS)** is a non-invasive monitoring of regional cerebral oxygenation. However, it is not a stand-alone tool, but is best used as part of a multimodal neuromonitoring. **TCD** measures cerebral blood flow velocities, detects hypoperfusion, hyperaemia, traumatic vasospasm, increased ICP (pulsatility index >1,3) and failure of autoregulation (i.e., CBF velocity changes linearly with MAP). **Electroencephalography (EEG)** reflects global cerebral function after TBI and is a valuable tool for assessing severity, diagnosing non-convulsive status epilepticus or vasospasm, guiding treatment (antiepileptic drugs, degree of sedation) and prognosis, in moderate to severe TBI. Alternatively, an EEG system designed for use in the operating theatre or in ICU (e.g. Masimo SedLine) displays continuous raw EEG signals (to detect seizure patterns), and processed EEG parameters (Patient State index - PSi, suppression ratio, EEG power over frequency bands – DSA and asymmetry). Like all functional brain monitors, both methods require trained personnel for set-up and interpretation.

Despite extensive evidence supporting the role of multimodal, invasive neuromonitoring-guided therapy in improving cerebral physiology, there is a paucity of high-quality data demonstrating a direct link to improved clinical outcomes. Neuromonitoring can only have an impact on patient outcomes if the physiological changes detected trigger timely and appropriate treatment to correct abnormalities, which in turn contribute significantly to outcomes. The rationale is that ICP monitoring is only beneficial if it leads to timely and appropriate therapeutic interventions that address intracranial hypertension, a key determinant of outcome. However, large studies such as that of the CREACTIVE consortium (1,448 patients from 7 countries) suggest that while ICP monitoring is widely used, its impact on long-term functional outcomes remains uncertain, and its effectiveness may vary depending on how the data are used to guide treatment (27). In 2019, consensus-based protocols were published for the treatment of severe TBI based on the presence and type of neuromonitoring device. A detailed description of the three different protocols is beyond the scope of this overview:

1. A treatment algorithm (CERVICE protocol) for severe TBI in patients without an ICP device (based on neuro-exam and CT scan only). Please refer to paper no. 28.
2. A treatment algorithm for severe TBI in patients with ICP device (based on neuro exam, CT scan, and ICP values). Please refer to paper no. 18.
3. A treatment algorithm for severe TBI in patients with cerebral oxygen and intracranial pressure monitoring (based on neuro exam, CT scan, ICP and PbtO2 measurement). See article no. 4.

Clinical trials and novel therapies

Despite advances in surgical and critical care, no pharmacological therapy has shown consistent efficacy in improving long-term outcomes in moderate and severe TBI. However, in recent years there has been an increase in clinical trials and experimental therapies targeting the molecular and cellular mechanisms of secondary injury. **Stem cell-based therapies** are one of the most promising options in regenerative medicine for TBI. Mesenchymal stem cells (MSCs) have been investigated for their ability to promote neurogenesis and synaptic plasticity, modulate neuroinflammation, enhance angiogenesis and blood-brain barrier repair, and replace lost or damaged neurons. Two European RCTs are currently being conducted in patients with moderate and severe TBI to investigate the safety and efficacy of i.v. administration of allogeneic mesenchial stromal cells in the early phase (within 48 hours) and in the subacute phase (2-3 weeks) (29). The STEMTRA study investigated the efficacy and safety of stereotactic implantation of allogeneic modified MSCs in patients with chronic motor deficits following TBI. The study showed a significant improvement in motor function compared to sham treatment, with the benefit being maintained after 12 months (30). **Several neuroprotective agents** that mitigate secondary injury cascades, such as excitotoxicity, oxidative stress, neuroinflammation, mitochondrial dysfunction, and apoptosis, are currently under investigation. Pharmacological therapies aimed at restoring consciousness after severe TBI, especially in patients with disorders of consciousness such as coma, vegetative state, or minimal consciousness, are also an active area of research. The main pharmacological agents under investigation are NMDA receptor antagonists (esketamine, amantadine, magnesium), zoldipem, dopaminergic agents (bromocriptine, levodopa), apomorphine (potent D1/D2 agonist), neuroprotective peptides (cerebrolysin), citicoline, statins, erythropoietin, progesterone, cyclosporin A, dexanabinol, minocycline, IL-1 Rc antagonists, antioxidants (N-acetylcysteine, resveratrol), and lactate-based therapies. Various sensory stimulation modalities are used to restore consciousness with promising results. Electromagnetic therapies aimed at modulating brain activity and restoring connectivity in disrupted neural networks, especially in chronic TBI, include repetitive transcranial magnetic stimulation (rTMS), transcranial direct current stimulation (tDCS), deep brain stimulation and vagus stimulation (6).

Prognosis for acute TBI

The prognosis in the acute phase following TBI remains a complex endeavour. Numerous studies have investigated the relationship between clinical, radiological, and laboratory parameters and neurological outcome after moderate to severe TBI. The most commonly validated prognostic models, CRASH and IMPACT, have identified several independent predictors of outcome: age, mGCS, pupillary reactivity, CT findings, and presence of hypoxia, hypotension, and coagulopathy. Care should be taken when counselling surrogate decision-makers and family members, particularly with regard to treatment restrictions and decisions to withdraw life-sustaining treatment (WLST). Discontinuation of life-sustaining treatment after traumatic brain injury varies widely, ranging from 45 to 87% in North American centres and from 0 to 96% in European centres. To improve prognostic accuracy, an individualised approach could incorporate additional variables such as basic and advanced imaging, electrophysiological findings, physiological monitoring variables, biochemical markers, and genetic polymorphisms. A new paradigm in this field is comparative effectiveness research, which aims to identify optimal clinical interventions based on real-world data. International TBI

registries — including CREACTIVE, CENTER-TBI, TRACK-TBI, and ADAPT — are actively collecting extensive datasets on imaging biomarkers, blood-based markers, and clinical outcomes, to refine evidence-based treatment pathways. Although functional recovery is typically assessed six months post-injury, when approximately 85% of neurological recovery has occurred, data on long-term outcomes, particularly neurocognitive function and quality of life, remains limited. The most commonly used measurement tools include the Glasgow Outcome Scale (GOS) for functional neurological status and the Quality of Life after Brain Injury (QOLIBRI) scale for health-related quality of life. Possible long-term consequences include motor deficits (hemiparesis, spasticity, and coordination problems), cognitive impairments (memory loss, attention deficits, executive dysfunction), neuropsychiatric symptoms (depression, anxiety, irritability, and post-traumatic stress disorder) and social and occupational challenges (difficulty returning to work or school, strained relationships, and reduced independence). Importantly, a history of TBI is also associated with a significantly increased risk of developing ischaemic and haemorrhagic strokes, Parkinsonism, post-traumatic epilepsy, dementia, and progressive neurocognitive decline (2,31).

Conclusion

Traumatic brain injury remains a major challenge to global health and has a significant impact on mortality, long-term disability, and utilisation of healthcare resources. The introduction of a new classification system such as CBI-M, reflects the increasing recognition of the heterogeneity of TBI and the need for a personalised approach. Over the past two decades, significant progress has been made in understanding the complex pathophysiology of TBI, refining diagnostic tools, and improving acute and surgical treatment. The integration of advanced imaging, fluid biomarkers, and multimodal neuromonitoring methods has enabled more precise and personalised treatment. Although significant progress has been made towards individualised treatment, clinicians are not yet sufficiently able to tailor therapies to subgroups of patients. The future of TBI care lies in precision medicine - the use of molecular diagnostics, AI-driven monitoring, and regenerative therapies to tailor interventions to individual patients.

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INTENSIVE CARE MANAGEMENT OF ANEURYSMAL SUBARACHNOID HEMORRHAGE

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ABSTRACT:

Introduction: Aneurysmal subarachnoid hemorrhage (aSAH) is a life-threatening neurological emergency characterized by bleeding into the subarachnoid space, most often due to rupture of an intracranial aneurysm. Intensive Care Unit (ICU) management is critical to improving outcomes and reducing morbidity and mortality associated with this condition.

Objective: The aim of the paper is to present the most important issues about intensive care treatment of patients with aSAH.

Elaboration: The ICU treatment of aSAH focuses on early aneurysm securing (via surgical clipping or endovascular coiling), prevention and management of secondary complications, and meticulous neurocritical care. Key components include the prevention and treatment of delayed cerebral ischemia (DCI), typically associated with cerebral vasospasm, through the use of nimodipine and maintenance of euvolemia and appropriate cerebral perfusion. Intracranial pressure (ICP) monitoring, blood pressure control, seizure prophylaxis, and management of hydrocephalus are also essential. Additionally, ICU care must address systemic complications such as neurogenic pulmonary edema, cardiac dysfunction, electrolyte disturbances, and infection risk. Multimodal monitoring and a multidisciplinary approach are essential to optimize outcomes.

Conclusion: Despite advances in treatment, aSAH remains associated with significant long-term disability, underscoring the importance of timely intervention and comprehensive ICU care.

HOW TO IMPROVE BRAIN OXYGENATION IN THE ICU!

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ABSTRACT:

Introduction: Optimizing cerebral oxygenation in critically ill patients remains a cornerstone of neurocritical care and is essential for improving neurological outcomes across a wide range of acute brain injuries. This complex and dynamic process necessitates a multifaceted approach aimed at maximizing oxygen delivery, preserving adequate cerebral perfusion, and minimizing cerebral metabolic demand. Concurrently, interventions must address the primary etiology of neurological injury to effectively mitigate the risk of secondary brain damage.

Systemic Oxygen Delivery: The foundation of cerebral oxygenation lies in ensuring sufficient systemic oxygenation. Arterial oxygen tension (PaO_2) should be maintained above 100 mmHg to prevent hypoxemia, which can exacerbate secondary brain injury. Maintaining arterial oxygen saturation (SpO_2) above 94% is typically targeted in clinical practice. Hemoglobin concentration plays a critical role in the oxygen-carrying capacity of blood; transfusion thresholds should be individualized, with a general target of maintaining hemoglobin levels above 7–9 g/dL, depending on comorbidities and overall clinical context. Cardiac output, a determinant of global oxygen delivery, should be optimized through volume resuscitation, vasoactive agents (e.g., norepinephrine), and inotropic support when necessary.

Cerebral Perfusion Optimization: Cerebral perfusion pressure (CPP), defined as the difference between mean arterial pressure (MAP) and intracranial pressure (ICP), is a key determinant of cerebral blood flow and, by extension, brain oxygenation. CPP should generally be maintained above 60–70 mmHg, although individualized targets may be required based on pathology and autoregulatory status. Strategies to maintain MAP include vasopressor therapy and judicious fluid administration. Simultaneously, ICP must be controlled through a combination of head-of-bed elevation, adequate sedation, osmotic agents such as mannitol or hypertonic saline, cerebrospinal fluid (CSF) drainage via external ventricular drain (EVD), and in some cases, decompressive craniectomy. Regular neuromonitoring of ICP and CPP is essential to guide interventions and avoid both ischemia and hyperemia.

Reduction of Cerebral Metabolic Demand: Minimizing cerebral metabolic rate of oxygen consumption ($CMRO_2$) helps align oxygen supply with demand, especially in the context of impaired perfusion. Normoglycemia should be maintained to avoid both hypoglycemia and hyperglycemia, which are associated with worse outcomes in brain-injured patients. Normothermia is critical, as fever increases metabolic demand and exacerbates neuronal injury. Targeted temperature management (TTM) may be considered in specific contexts. Adequate sedation and analgesia help control agitation and prevent metabolic surges. Seizure control, through both prophylaxis in selected cases and prompt treatment, is another cornerstone of metabolic demand reduction.

Advanced Neuromonitoring Techniques: Advanced neuromonitoring allows for real-time assessment of cerebral oxygenation and guides personalized therapeutic strategies. Brain tissue oxygen tension ($PbtO_2$) monitoring offers direct insights into local oxygen availability, with values below 20 mmHg typically prompting intervention. Jugular venous oxygen saturation ($SjvO_2$) provides a global estimate of cerebral oxygen extraction, with low values suggesting supply-demand mismatch. Additional modalities such as near-infrared spectroscopy (NIRS) offer noninvasive monitoring of regional cerebral oxygenation, particularly useful in operating rooms or during transport. Cerebral micro dialysis, which measures extracellular metabolites

such as lactate, pyruvate, and glutamate, may provide deeper insights into cellular metabolism and ischemic thresholds, though its application remains limited to specialized centers.

Addressing Underlying Etiologies: Optimization of cerebral oxygenation should be closely integrated with the treatment of the underlying neurological condition. In traumatic brain injury, controlling intracranial hypertension and avoiding hypoxia are priorities. In ischemic stroke, restoration of perfusion via reperfusion therapies must be accompanied by oxygenation support. In intracerebral hemorrhage, prevention of hematoma expansion, management of ICP, and blood pressure control are essential. Other conditions—such as subarachnoid hemorrhage, encephalitis, or post-cardiac arrest syndrome—each require a tailored approach grounded in the principles of oxygenation optimization.

Conclusion: Optimizing brain oxygenation in critically ill patients requires a comprehensive and individualized strategy. By securing systemic oxygen delivery, maintaining adequate cerebral perfusion, reducing metabolic demand, and integrating advanced neuromonitoring technologies, clinicians can better tailor interventions to the dynamic needs of each patient. As understanding of cerebral physiology and monitoring capabilities evolve, this multifaceted approach remains pivotal in minimizing secondary injury and promoting neurological recovery.

Case Report: On June 24, 2025, a 62-year-old female was found collapsed in the morning. She reported severe headache and neck pain, accompanied by involuntary defecation, likely secondary to an epileptic seizure. Emergency Medical Services transported her to the Infectious Disease Hospital at QSUT with a presumptive diagnosis of gastroenteritis. While in the emergency department, she experienced a second episode characterized by loss of consciousness, prompting her transfer to the Infectious Disease ICU. Following initial cardiac evaluations, the patient was transferred the same day to the Cardiology ICU. Due to the persistence of severe headache, a cranial CT scan was performed, which revealed a subarachnoid hemorrhage (SAH). She was subsequently transferred to the Neurosurgery ICU. Her medical history was notable for a 27-year history of rheumatoid arthritis with severe deformities of the small joints in the hands and feet and a fixed posture. Additional comorbidities included a trophic ulcer on the left lower extremity. There was no known history of diabetes mellitus or hypertension. Her chronic medications included aspirin 100 mg/day. She had a left eye enucleation due to arthritis-related complications. On objective examination, the patient was somnolent with a right-sided motor deficit (strength 4/5), minimal neck rigidity, and bilaterally diminished deep tendon reflexes (1+). Assessment of upper motor neuron signs, including Hoffmann's, Rossolimo's, and Babinski's reflexes, was not feasible due to joint deformities. She was transferred to the Stroke Unit, where a diagnosis of SAH (Fisher Grade 4) was confirmed. Endovascular embolization was performed, and the patient was returned to the ICU. No vasospasm was observed, but cerebral oximetry readings remained low. Despite maintaining normal blood pressure and cardiac output, the clinical team initiated supportive measures including Dobutamine, blood transfusion, and increased FiO_2. Subsequent reassessment showed: hemoglobin >10 g/dL, cardiac output >4 L/min, mean arterial pressure 80–90 mmHg, and PaO_2 >100 mmHg. Under these conditions, cerebral oximetry improved to acceptable levels.

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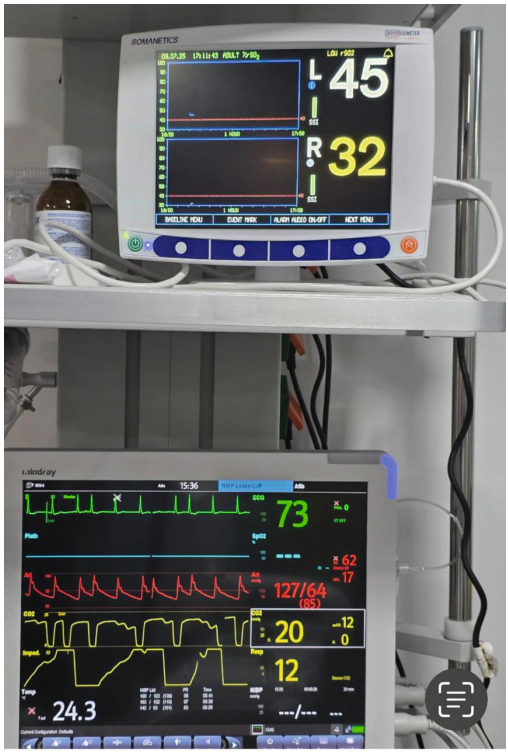

Figure 1. First moments of brain oxygenation, monitoring.

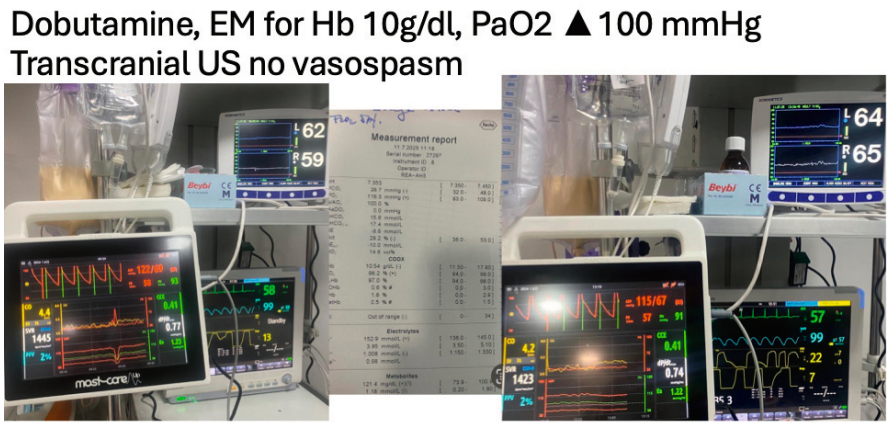

Figure 2. Brain oxygenation improvement after specific therapy.

NEUROMONITORING IN CAROTID SURGERY

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ABSTRACT:
Objective: To evaluate and compare the effectiveness of neuromonitoring techniques during carotid endarterectomy (CEA), with emphasis on the role of the awake patient as a monitoring tool under regional anesthesia, versus instrument-based monitoring under general anesthesia.
Methods: A prospective randomized clinical trial included 70 patients undergoing CEA, randomized into two groups of 35 patients each: Group N1 underwent surgery under superficial cervical plexus block (regional anesthesia) with intraoperative neurological assessment using a modified Scandinavian Stroke Scale (SSS), while Group N2 received general endotracheal anesthesia with cerebral oximetry (rSO_2) monitoring. Intraoperative and postoperative neurological status was recorded and analyzed in both groups.
Results: In Group N1 (awake patients), intraoperative SSS remained stable in 94.2% of cases, except during carotid clamping, when 51.4% experienced a transient decrease, mostly attributed to sedation. Only one patient developed a transient ischemic attack intraoperatively. In Group N2, no patients achieved full SSS score upon awakening, with most recovering to preoperative levels within 120 minutes. Cerebral oximetry had limited sensitivity (44%) and specificity (82%) in detecting ischemia.
Additional neuromonitoring modalities discussed include:
- Electroencephalography (EEG): Allows indirect real-time monitoring of cortical ischemia, but is limited to superficial layers, with potential delay in detecting ischemia and susceptibility to artifacts and anesthetic interference.
- Somatosensory evoked potentials (SSEP): Effective in detecting subcortical ischemia, especially in the brainstem, but less sensitive for cortical areas. Demonstrated high specificity (up to 100%) but variable sensitivity.
- Transcranial Doppler (TCD): Offers dynamic assessment of cerebral blood flow velocity and embolic events, but with mixed results in predicting the need for intraoperative shunt placement. Sensitivity and specificity vary depending on study design.
- Retrograde "stump" pressure: Provides crude assessment of collateral flow, but lacks standardized cutoff values for shunt indication (values ranging from 20–70 mmHg reported).
- Bispectral index (BIS): Primarily used for anesthetic depth monitoring under general anesthesia; its utility in detecting cerebral ischemia is still under investigation.
Conclusion: Awake neurological monitoring under regional anesthesia remains the most straightforward, sensitive, and cost-effective method for intraoperative detection of cerebral ischemia. While general anesthesia ensures patient comfort and airway control, it necessitates reliance on adjunctive neuromonitoring modalities that vary in sensitivity, specificity, and practicality. No single technique matches the immediacy and reliability of direct neurological examination in an awake patient. Optimal monitoring during CEA should be tailored based on patient condition, anesthetic plan, and surgical factors.

Keywords: carotid endarterectomy, cerebral ischemia, neuromonitoring, regional anesthesia, general anesthesia, EEG, SSEP, BIS, TCD, stump pressure, cerebral oximetry

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Regional Anesthesia

REGIONAL ANESTHESIA AND NERVE DAMAGE - EVIDENCE AND PREVENTION STRATEGIES

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ABSTRACT:

Introduction: Nerve injuries associated to regional anesthesia are very rare. Permanent nerve injury (PNI), defined as persisting longer than 1 year, as a consequence of neuroaxial RA has an incidence of < 0,04% and it appears to be even rarer after PNB (1).
In children undergoing neuroaxial and peripheral blocks in GA, the risk of transient neurological deficits was 1,6- 3,6: 10000 and 0 - 0,4: 10000 for permanent neurological deficits (2).
Early persistent paresthesias after peripheral nerve blocks, so-called postoperative neurological symptoms (PONS), are found in up to 15% but they resolve quickly in the vast majority of cases (3).

Key words: Regional anesthesia, transient nerve injury, permanent nerve injury, risk factors, ultrasound, dual guidance, triple protection, local anesthetics, adjuncts

Material and Methods

Review of literature, according to the international standards of scientific work (https://www.dfg.de/resource/blob/173732/4166759430af8dc2256f0fa54e009f03/kodex-gwp-data.pdf) in Cochrane Database, EMBASE, Google Scholar, PubMed / MEDLINE.

Results and findings

Ultrasound is the superior method of choice to locate nerves, prevent LAST and damage to neighbouring structures (4). Till 2024 no evidence existed, that US prevents permanent nerve injuries as compared to nerve stimulation (5). US often fails to accurately distinguish between intra- and extraneural needle position (6,7). A recent review by Lemke et al. reported a lower incedence of neurological incidence when using ultrasound- guidance (8).

If nerve damage occurs, it is more often related to patient factors and surgical factors (type of surgery, positioning, traction, Tourniquet, postsurgical inflammation) than to RA (9). Careful patient selection is important, as preexisting comorbidities like alcohol and tobacco abuse or diabetic neuropathy increase the risk of PNI 10fold („double or triple crush theory“) (3).

A study by Welch et al. failed to link PNB as an independent risk factor for nerve damage, unlike neuroaxial anaesthesia (10). While mechanisms of PNI are described as mechanical, pressure- related, vascular and chemical, eventual damage to the perineurium („blood- nerve- barrier“, Sunderland 1965) is crucial (3). Intrafascicular high- pressure injection leads to mechanical and ischemic PNI. Current US- imaging is not always and reliably able to distiguish between intraneural- extrafascicular and intraneural- intrafascicular needle positions (6,7,11). As even intraneural- **extra**fascicular injections may lead to histological, subclinical damage, nerve expansion („swelling“) seen on US during injection should always prompt needle repositioning to extraneural (12).

„Dual Guidance“ is supported to minimize nerve injuries (3,9,13,14). Combining ultrasound with nerve stimulation to avoid nerve- needle contact („protective nerve stimulation“, 15) improves patient safety. Nevertheless, the safety threshold of 0,5mA without motor response or paresthesia, to correctly predict nerve contact, has been questioned (16-19). Most of these data comes from animal or cadaver models and the clinical significance remains unclear.

No comparitive studies on the incidence of permanent (> 1 year) nerve injury with USGRA vs. nerve stimulation vs. dual guidance have been published yet.

As pressure-related and ischemia- related damage are closely linked, limiting injection pressure has been suggested (20-25). Subjective pressure evaluation („syringe feel“) is unreliable, even with experienced anesthesiologists (26).

Literature tells that pressure monitoring is very sensitive but not specific for intrafascicular injections (needle contact to tendons, fascia etc.) whereas nerve stimulation is very specific for intraneural needle positions at low currents, but not sensitive enough (3,11).

ASRA guidelines (27) and textbooks (28) advocate for combining ultrasound, nerve stimulation and pressure monitoring as so called „Triple Guidance“ or „Triple Protection“. These techniques are complemetary and no single best practice to avoid nerve injury is evidence-based. Redundant needle manipulations close to a nerve should be avoided. Circumferential LA spread is not always mandatory for successful blocks (29,30).

A recent ESAIC guideline (31) gives detailed advice on how to avoid nerve damage due to impaired coagulation (no neuroaxial blocks, no deep peripheral nerve blocks, time intervals to anticoagulants, role of impaired renal clearence).

All local anesthetics are neurotoxic to different degrees, reduce neural blood flow and induce inflammation, leading to chemical injury (3,32). As this effect is dose-dependent, reducing the concentration and the volume reduces the risk of nerve injury. This is a significant advantage of ultrasound-guided regional anesthesia, since studies found very low volumes and doses required for successful blocks, as compared to the practice of landmark- or nerve-stimulation only guided blocks (33,34).

Amide LAs are less toxic than Ester- LAs. Ropivacaine has the least neurotoxicity and causes less vasoconstriction than (Levo)bupivacaine (3). It has long been known that adrenaline as adjunct worsens the reduction of nerve blood flow (35) while recent findings emphasize that perineural dexmedetomidine attenuates perineural inflammation caused by local anesthetics (36).

Most guidelines and textbooks advocate for nerve blocks in awake, conscious adults. Nevertheless, findings in children challenge this paradigm (2,37) and lead to debate on the necessity, advantages and disadvantages of doing so (38,39). Pain during injection does not reliably indicate nerve injury. Nevertheless, if pain or dysesthesia occurs during injection, it absolutely must prompt cessation of the injection and needle repositioning.

Sharp, long bevelled needles penetrate the perineurium more easily than short bevelled needles (45°), which, by consequence, reduce the risk of injury (3,11). However, if a „blunt“ needle penetrates the perineurium, mechanical trauma and axonal damage are more pronounced (40). Intrafascicular degree of trauma also depends on the needle diameter (41).

Finally, for desinfection and infection prevention, preparations with remanence effect (alcohol with chlorhexidine or octinedine, prefarable to iodine) are preferable to alcohol alone, especially when using catheter techniques (42,43). Nevertheless, it is crucial not to transfer disinfectant containing chlorhexidine or octinidine to the neuronal structures,

as cases of abacterial, chronic adhesive arachnoiditis with subsequent paraplegia linked to chlorhexidine have been published (44,45).

Conclusion

Finally, most of the evidence and knowledge on regional anesthesia and (permanent) nerve damage results from cadaver or animal models and from case reports and non randomized case series or retrospective register data.

Causality and clinical consequences and outcomes are often much more complex and not fully understood (46,47).

In the absence of better clinical data and comparative trials, we should use the above mentioned and available patient safety mesures to further reduce the risk of permanent nerve damage when performing regional anesthesia.

„Primum non nocere, secundum cavere, tertium sanare".

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REGIONAL ANESTHESIA IN HIGH-RISK PATIENTS: INDICATIONS, BENEFITS, AND RISKS

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ABSTRACT:
Introduction: Regional anesthesia represents a valuable option in the management of high-risk surgical patients, particularly those with significant cardiovascular, respiratory, or metabolic comorbidities. In such cases, general anesthesia is associated with increased risks of hemodynamic instability, respiratory complications, and prolonged recovery.
Objective: The aim of this review is to evaluate the role of regional anesthesia in the perioperative management of high-risk patients, focusing on its indications, potential benefits, and possible risks, and to highlight key considerations for optimizing clinical outcomes.
Discussion: When carefully selected and expertly performed, regional anesthesia can provide a safer alternative to general anesthesia by avoiding airway manipulation, preserving spontaneous ventilation, and minimizing systemic drug exposure. Indications include surgical procedures where targeted peripheral nerve blocks or neuraxial techniques can provide complete surgical anesthesia or form part of a multimodal analgesic strategy. The benefits encompass improved perioperative hemodynamic stability, reduced incidence of postoperative delirium, enhanced pain control, and facilitation of early mobilization. However, these advantages must be weighed against potential risks such as block failure, nerve injury, bleeding in anticoagulated patients, and local anesthetic systemic toxicity. Optimal outcomes require comprehensive preoperative assessment, individualized block selection, and vigilant intraoperative and postoperative monitoring.
Conclusion: Regional anesthesia is an effective and often underutilized technique that, when applied with meticulous planning and strict adherence to safety protocols, can significantly reduce perioperative morbidity and accelerate recovery. It should be considered a method of choice in selected high-risk patients.

Keywords: regional anesthesia, high-risk patients, comorbidities, perioperative management, patient safety, anesthesia risk reduction

REGIONALNA ANESTEZIJA KOD VISOKORIZIČNIH PACIJENATA: INDIKACIJE, PREDNOSTI I RIZICI

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SAŽETAK:

Uvod: Regionalna anestezija predstavlja vrijednu opciju u zbrinjavanju visokorizičnih hirurških pacijenata, posebno onih sa značajnim kardiovaskularnim, respiratornim ili metaboličkim komorbiditetima. U takvim slučajevima, opća anestezija povezana je s povećanim rizikom od hemodinamske nestabilnosti, respiratornih komplikacija i produženog oporavka.

Cilj: Cilj ovog preglednog rada je procijeniti ulogu regionalne anestezije u perioperativnom zbrinjavanju visokorizičnih pacijenata, s naglaskom na njene indikacije, potencijalne prednosti i moguće rizike, te istaknuti ključne aspekte za optimizaciju kliničkih ishoda.

Diskusija: Kada je pažljivo odabrana i stručno izvedena, regionalna anestezija može pružiti sigurniju alternativu općoj anesteziji izbjegavanjem manipulacije disajnim putem, očuvanjem spontanog disanja i smanjenjem sistemske izloženosti lijekovima. Indikacije uključuju hirurške zahvate kod kojih ciljani periferni nervni blokovi ili neuraksijalne tehnike mogu obezbijediti potpunu hirurišku anesteziju ili biti dio multimodalne analgetske strategije. Prednosti obuhvataju bolju perioperativnu hemodinamsku stabilnost, smanjenje učestalosti postoperativnog delirija, unaprijeđenu kontrolu bola i olakšanu ranu mobilizaciju. Međutim, ove prednosti treba pažljivo odmjeriti u odnosu na potencijalne rizike, poput neuspjelog bloka, ozljede nerava, krvarenja kod pacijenata na antikoagulantnoj terapiji i sistemske toksičnosti lokalnog anestetika. Optimalni ishodi zahtijevaju sveobuhvatnu preoperativnu procjenu, individualiziran izbor bloka i pažljivo intraoperativno i postoperativno praćenje.

Zaključak: Regionalna anestezija je efikasna i često nedovoljno korištena metoda koja, kada se primjenjuje uz temeljito planiranje i striktno poštivanje sigurnosnih protokola, može značajno smanjiti perioperativni morbiditet i ubrzati oporavak. Treba je razmatrati kao metodu izbora kod selektovanih visokorizičnih pacijenata.

Ključne riječi: regionalna anestezija, visokorizični pacijenti, komorbiditeti, perioperativno zbrinjavanje, sigurnost pacijenta, smanjenje anesteziološkog rizika

REGIONAL ANESTHESIA IN KNEE SURGERY

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ABSTRACT:
Regional anesthesia is a fundamental component of modern perioperative management in knee surgery, offering superior analgesia, reduced opioid consumption, and improved functional recovery compared with general anesthesia alone. Central neuraxial techniques such as spinal and epidural anesthesia remain widely used, while peripheral nerve blocks—including the femoral nerve block, adductor canal block, and sciatic nerve block—provide effective targeted analgesia with varying motor effects [1,2]. The introduction of ultrasound guidance has significantly enhanced the precision and safety of these techniques [3]. Within enhanced recovery after surgery (ERAS) pathways, regional anesthesia has been shown to facilitate early mobilization, shorten hospital stay, and improve patient satisfaction [4,5]. Recent evidence highlights the value of motor-sparing approaches, particularly the adductor canal block, which maintains quadriceps strength while achieving adequate pain control [6]. Furthermore, multimodal strategies combining regional blocks with local infiltration analgesia and systemic agents demonstrate additive benefits [2,7]. Despite these advances, risks such as local anesthetic systemic toxicity and motor blockade necessitate careful patient selection and dosing [8]. Ongoing randomized controlled trials and meta-analyses continue to refine best practices, emphasizing the role of regional anesthesia as a cornerstone of effective and safe perioperative care in knee surgery.

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NERVE BLOCKS AND COMPARTMENT SYNDROME

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ABSTRACT:

Introduction: Acute compartment syndrome (ACS) is a critical, potentially reversible, surgical emergency caused by rising pressure within a confined muscle compartment, typically following trauma. This pressure increase reduces blood flow, leading to muscle and nerve ischemia and potential cell death. While rare, ACS can be life-threatening, demanding urgent diagnosis and surgical fasciotomy to prevent irreversible damage. Disproportionate pain is the hallmark early symptom, with pain during passive muscle stretching being highly sensitive. As ischemia progresses, the limb hardens; late signs (pulselessness, pallor, paralysis, paresthesia, and coolness) indicate severe vascular compromise (1). The use of peripheral nerve blocks (PNBs) in patients at high risk for ACS has been controversial for years.

Literature Review: Critical risk factors for ACS include: male gender, age <35, diaphyseal long bone fractures, high-energy trauma, polytrauma, and clotting disorders. ACS can also occur post-elective surgery. Notably, 30% of ACS cases occur without a fracture, supporting trauma as the primary cause (2). Early surgical stabilization may reduce ACS risk in trauma patients (1).

Continuous PNBs may benefit trauma patients by improving limb perfusion (via sympathectomy), aiding in the clearance of acidosis byproducts, and potentially reducing unnecessary fasciotomies, especially in patients with low pain tolerance (3). However, deep neuraxial analgesia (e.g., epidural) can mask ischemic pain, delaying ACS diagnosis (3). In patients at high ACS risk, distal PNBs using low-concentration local anesthetic are preferred. Continuous catheter techniques provide stable analgesia, making breakthrough pain (indicating ACS) easier to recognize than the fluctuating levels from intermittent boluses (2-6).

Patient education and effective communication among the anesthesiologist, orthopedic surgeon, and nursing team are essential for the early recognition of ACS in patients receiving PNBs (7). Compartment pressure monitoring should be reserved for cases with uncontrolled pain (particularly under a block) or new-onset pain despite a functional block. Furthermore, recent studies show that crush injury followed by elevated levels of neutrophils, creatine kinase MB, and prolonged prothrombin time are strong predictors of muscle necrosis, enabling individualized risk assessment and early targeted interventions (8).

Conclusion: Evidence suggests that vigilance, maintaining a high index of suspicion, and effective communication within the multidisciplinary team (anesthesiologist, orthopedic surgeon, and nursing staff) are far more critical for timely recognition than the choice of analgesia itself. Appropriate patient monitoring and prompt surgical intervention are crucial for preventing adverse outcomes. Continuous regional anesthesia techniques provide significant analgesic and physiological benefits for trauma patients. To mitigate the risk of masking ischemic pain, PNBs should be performed using low-concentration local anesthetics and placed as distally as possible.

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OPTIMIZING BLOCK ROOM EFFICIENCY: ADVANCING ANESTHESIA WITH PERIPHERAL NERVE BLOCKS

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ABSTRACT:
Peripheral nerve blocks (PNBs) are an essential component of modern multimodal anesthesia, offering superior postoperative analgesia, reduced opioid requirements, and improved patient satisfaction. The implementation of a dedicated ***Block Room***—a space designed specifically for the performance of regional anesthesia—has emerged as a best practice in many institutions, helping to streamline perioperative workflow and improve operating room efficiency.
This presentation explores the clinical and organizational aspects of establishing and optimizing a Block Room for regional anesthesia procedures. Topics will include an overview of commonly used peripheral nerve blocks, the role of ultrasound guidance in enhancing safety and accuracy, and the impact of block rooms on surgical case turnover and overall hospital efficiency. Practical guidance will be offered on staffing models, workflow coordination, and quality assurance. Real-world case studies will highlight the benefits and challenges associated with block room integration.
Attendees will gain a deeper understanding of how a well-structured block room can improve outcomes, reduce delays, and support the expanding role of regional anesthesia in modern perioperative care.
Keywords: Peripheral nerve blocks, regional anesthesia, block room, operating room efficiency, ultrasound-guided anesthesia, perioperative workflow

PowerPoint Slide Structure (10–12 slides)
Here's a suggested slide-by-slide breakdown for your presentation:

Slide 1: Title Slide
- Presentation title
- Your name and credentials
- Institution
- Date and event

Slide 2: Learning Objectives
- Clear list of 3–5 objectives
- "By the end of this presentation, you will be able to..."

Slide 3: What is a Block Room?
- Definition
- Purpose
- Why it matters

Slide 4: Clinical Indications for PNBs
- Common surgical procedures requiring PNBs
- Table or diagram of block types and surgical applications

Slide 5: Techniques & Equipment
- Brief overview of ultrasound-guided block techniques
- Essential equipment and safety tools
- Image of ultrasound machine in use

Slide 6: Workflow in the Block Room
1. Who does what: roles of anesthesiologist, resident, nurse
2. Preop assessment, consent, time-out, and documentation
3. Sample flow diagram

Slide 7: Benefits of a Block Room
- Reduced OR delays
- Improved patient flow
- Better outcomes and satisfaction
- Bullet points with quick stats if available

Slide 8: Challenges & Solutions
- Scheduling conflicts
- Staff training
- Space limitations
- Proposed solutions or case examples

Slide 9: Case Study / Institutional Experience
- One or two real examples
- Before/after metrics (e.g., turnover time, patient satisfaction)
- Lessons learned

Slide 10: Key Takeaways
- Summary of key points
- Reinforce the value of a block room in modern anesthesia practice

Slide 11: Discussion / Q&A
- "Questions?"
- Invite audience to share experiences or ask about implementation

Slide 12 (Optional): References / Acknowledgements
- Key sources or contributors
- Include your contact info for follow-up

Would you like me to prepare a **PowerPoint file** for this presentation with all the content filled in, or would you prefer just the editable text so you can build it yourself?

General Topics

ENHANCING ANESTHESIA PATIENT SAFETY: STRATEGIES AND CHALLENGES

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ABSTRACT:

Patient safety in anesthesia represents a cornerstone of modern perioperative care, focusing on minimizing risks and preventing adverse events during surgical interventions. Historical developments, such as the introduction of anesthesia monitoring in the 1960s, the establishment of the Anesthesia Patient Safety Foundation in 1984, and the adoption of safety models from aviation and high-reliability organizations, have significantly reduced anesthesia-related mortality from 1 in 10,000 to 1 in 200,000 cases. Despite this progress, unsafe care continues to affect 1 in 10 patients globally, with medication errors, surgical complications, healthcare-associated infections, and patient misidentification being leading contributors.

The Helsinki Declaration on Patient Safety in Anaesthesiology, launched in 2010 by the European Society of Anaesthesiology and the European Board of Anaesthesiology, provided standardized recommendations for perioperative safety, including the use of checklists, incident reporting, and continuous professional education. Furthermore, initiatives such as the WHO Surgical Safety Checklist and the establishment of World Patient Safety Day underscore the importance of global collaboration in reducing preventable harm.

Contemporary challenges persist, particularly in low- and middle-income countries, where the burden of unsafe care contributes significantly to morbidity, mortality, and economic loss. Recent advancements, including simulation-based training, artificial intelligence for early risk detection, and smart monitoring systems, offer promising solutions. However, achieving sustainable improvement requires not only technological innovation but also fostering a culture of safety characterized by effective communication, teamwork, and non-punitive error reporting.

In conclusion, patient safety in anesthesia demands a multidisciplinary approach integrating historical lessons, global guidelines, modern technologies, and continuous education to ensure safer surgical care and better patient outcomes worldwide.

Kez words: patient, safety, anesthesia

“THE VALUE OF STRATEGIC PLANNING AND SWOT ANALYSIS IN ANESTHESIA“

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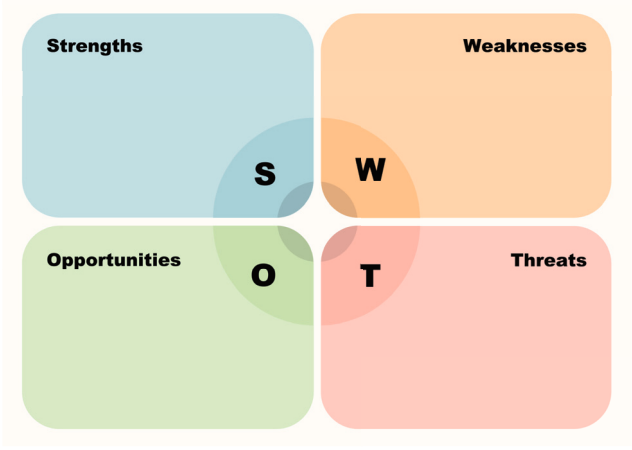
ABSTRACT:

The framework, using the acronym SWOT, focuses on the present (Strengths and Weaknesses) and the future (Opportunities and Threats), and is a strategic planning tool for organisations and individuals.

Strategic planning in anaesthesia involves a formal, forward-looking process for anesthesiology groups and organisations to define goals, assess their environment, and create actionable plans to achieve long-term success and viability.

The fact is that most anaesthesia practices are exclusively focused on their core mission: consistently providing high-quality anaesthesia care to patients scheduled by the facility. Especially in the current environment where so many practices are short-staffed, the idea of devoting valuable clinical time to strategic planning seems like the ultimate luxury. Nothing could be further from the truth. The very fact that so many providers feel trapped in an environment over which they have no control is exactly why they need to take time to step back, take time to assess how their current situation evolved and explore alternatives.



EVIDENCE-BASED NOVELTIES IN BASIC AND ADVANCED LIFE SUPPORT – 2025 UPDATE

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ABSTRACT:
Introduction: The 2025 updates to Basic and Advanced Life Support (BLS and ALS) guidelines represent a significant advancement in resuscitation science, reflecting the latest evidence and consensus from leading international organizations, including the International Liaison Committee on Resuscitation (ILCOR), the American Heart Association (AHA), and the European Resuscitation Council (ERC). These guidelines are the product of systematic reviews, scoping reviews, and expert consensus, and they emphasize high-quality resuscitation, early intervention, and individualized post-arrest care.

1. Methodology and Scope

The 2025 guidelines were developed through a rigorous, continuous evidence evaluation process. ILCOR's task forces conducted systematic reviews, scoping reviews and evidence updates to address 33 critical questions in BLS and ALS. Public comments were solicited and incorporated into the final recommendations, ensuring transparency and broad expert input. The guidelines address both in-hospital and out-of-hospital cardiac arrest scenarios, with an emphasis on adaptability for varied resource settings.

2. Basic Life Support (BLS) – 2025 Key Updates

Early Recognition and Emergency Activation

Immediate activation of emergency medical services (EMS) is recommended for any unresponsive individual, without delaying for detailed breathing assessment. Dispatcher-assisted recognition of abnormal breathing is prioritized to minimize delays in CPR initiation, as rapid EMS notification is linked to improved survival.

Chest Compression Quality

High-quality chest compressions remain fundamental. The guidelines reaffirm a compression rate of 100–120/min and a depth of 5–6 cm for adults, with a compression fraction above 60% associated with better outcomes. Interruptions should be minimized, and full chest recoil ensured.

Compression-to-Ventilation Ratio

The recommended compression-to-ventilation ratio for single rescuers is 30:2, balancing oxygenation and perfusion. This is supported by recent systematic reviews and remains unchanged from prior guidelines.

Dispatcher-Assisted CPR

Enhanced dispatcher-assisted protocols are emphasized, as evidence demonstrates

increased bystander CPR rates and improved outcomes when dispatchers provide real-time guidance.

AED Use and Early Defibrillation

Early use of automated external defibrillators (AEDs) is strongly recommended. The guidelines advocate for expanded AED access in public spaces and highlight the importance of early defibrillation in both adult and pediatric populations. Special considerations are provided for use in pregnancy and children.

Cardiac Arrest in Pregnancy

A notable update is the recommendation to consider perimortem cesarean delivery at 5 minutes if return of spontaneous circulation (ROSC) is not achieved, based on evidence of improved maternal and fetal outcomes.

Monitoring Rescuer Fatigue

Monitoring for rescuer fatigue is now a good practice statement, especially for those performing CPR while wearing personal protective equipment (PPE), as fatigue can compromise CPR quality.

3. Advanced Life Support (ALS) – 2025 Key Updates

Early and High-Quality ALS

ALS interventions should be started as early as possible, integrating advanced airway management, manual defibrillation, and effective drug administration with ongoing high-quality BLS.

Airway Management

A stepwise approach to airway management is recommended. Only rescuers with high intubation success rates should perform tracheal intubation; otherwise, supraglottic airway devices are preferred. Front-of-neck access (FONA) is newly included for "can't intubate, can't oxygenate" scenarios.

Oxygenation and Ventilation

Effective oxygenation and ventilation must be maintained. Oxygen saturation targets are now 94–96% to avoid hyperoxemia, and capnography is essential for confirming airway placement and monitoring ventilation.

Vasopressor and Antiarrhythmic Drugs

Epinephrine remains the first-line vasopressor for cardiac arrest (1 mg IV/IO every 3–5 min).

Vasopressin or methylprednisolone may be considered as alternatives, but high-dose epinephrine is not recommended.

Amiodarone or lidocaine may be used for refractory ventricular fibrillation/pulseless ventricular tachycardia, with no clear superiority between agents.

Routine use of calcium, sodium bicarbonate, and magnesium is not recommended except for specific indications

Defibrillation

Correct pad placement (apical-lateral) and minimizing pre-shock pauses are emphasized. Charging the defibrillator during compressions is recommended to reduce time to shock delivery.

Extracorporeal Cardiopulmonary Resuscitation (ECPR)

ECPR is now recognized as a reasonable option for selected patients with refrac-

tory cardiac arrest, provided that equipment and trained personnel are available. This is supported by recent trials demonstrating improved survival and neurological outcomes in appropriate settings.

Post-Cardiac Arrest Care

Temperature Control

A deliberate strategy for temperature control (32°C to 37.5°C) is recommended for all adults who do not follow commands after ROSC. The term "targeted temperature management" has been replaced by "temperature control," reflecting evidence that both hypothermia and normothermia are acceptable if fever is avoided.

Coronary Angiography

Coronary angiography should be performed emergently for patients with suspected cardiac cause and ST-segment elevation, or considered in those without ST-elevation but at high risk of coronary artery disease.

Neuroprognostication

A multimodal approach is recommended, utilizing clinical examination, EEG, imaging (MRI), somatosensory evoked potentials (SSEP), and blood biomarkers (e.g., neuron-specific enolase, GFAP, Tau, NfL) to guide prognosis and decisions regarding withdrawal of care.

Seizure Management

Empirical trials of non-sedating antiseizure medications are suggested for adults with post-arrest EEG findings on the ictal-interictal continuum, as uncontrolled seizures are associated with poor neurological outcomes.

Glucose Control and Antibiotics

Moderate glucose control is recommended, avoiding both hyper- and hypoglycemia. Routine prophylactic antibiotics post-ROSC are not recommended due to insufficient evidence.

Monitoring and Technology Integration

Waveform capnography is essential for confirming airway placement and monitoring CPR quality.

Point-of-care ultrasound (POCUS) is increasingly used to identify reversible causes and aid in neuroprognostication, but should not interrupt compressions.

Mechanical chest compression devices may be considered where manual compressions are impractical.

Brain monitoring (NIRS, EEG) is recommended for assessment during and after resuscitation.

Special Considerations

Pediatric and Neonatal Life Support: Compression-to-ventilation ratios and defibrillation energy doses are age-appropriate, with early intervention crucial for survival.

Trauma-Related Cardiac Arrest: Immediate identification and correction of reversible causes are prioritized.

Resource-Limited Settings: ALS guidelines may need adaptation based on available resources; prevention, early first aid, and BLS are emphasized where ALS is not feasible.

Conclusion

The 2025 BLS and ALS guidelines underscore the primacy of high-quality chest compressions, early defibrillation, and individualized post-arrest care. Major changes include updated drug recommendations, new approaches to airway management, expanded use of ECPR, and a broader, evidence-based approach to temperature and seizure management. These updates are designed to improve survival and neurological outcomes across diverse healthcare settings, reflecting the most current and robust scientific evidence available.

Summary Table: Key 2025 Updates in Basic and Advanced Life Support (BLS & ALS)

Topic	2025 Update Highlights	Scientific Basis / Evidence Source
Basic Life Support (BLS)		
Early EMS Activation	Immediate EMS call for any unresponsive person without first confirming abnormal breathing; dispatcher assists breathing assessment	ILCOR 2025 Adult BLS CoSTR; ERC 2025 BLS Guidelines
Chest Compression Quality	Compression rate 100-120/min, depth 5-6 cm; minimize interruptions; maintain compression fraction >60%	Systematic reviews reaffirm optimal compression parameters, emphasizing uninterrupted high-quality CPR
Dispatcher-Assisted CPR	Enhanced dispatcher protocols improve bystander CPR initiation and quality; dispatcher coaching critical	Multiple RCTs and observational studies show dispatcher assistance increases survival
Automated External Defibrillator (AED) Use	Early defibrillation remains critical; expanded AED access recommended; use in special populations with modifications	Evidence supports AED use in adults, children, and pregnant women; early defibrillation improves outcomes
Cardiac Arrest in Pregnancy	Perimortem cesarean delivery recommended at 5 minutes if ROSC not achieved (updated from 4 minutes)	Observational data indicate improved maternal and fetal outcomes with this timing
Head-Up CPR	Preliminary evidence suggests potential benefit but insufficient for routine use; further research needed	Limited studies bundled with other interventions; no definitive recommendation yet
Advanced Life Support (ALS)		
Antiarrhythmic Drugs	Amiodarone and lidocaine show no significant survival difference; choice based on availability and experience	ILCOR 2025 ALS Evidence Update; systematic reviews show equivalence
Steroids During and After CPR	Some evidence suggests hemodynamic and neurological benefits; data remain insufficient for strong recommendation	Ongoing studies; cautious consideration pending further trials
Post-Resuscitation Care	Strong recommendation for targeted temperature management (TTM); multimodal neuroprognostication combining clinical exam, EEG, MRI, SSEP, and blood biomarkers (NSE, GFAP, Tau, NfL)	ILCOR 2025 Evidence Updates detail improved prognostic accuracy with combined modalities

Percutaneous Coronary Intervention (PCI) After ROSC Without STEMI	Early PCI considered beneficial in selected patients without STEMI but suspected coronary disease	Emerging evidence supports early coronary angiography improving outcomes in this group
Glucose Control	Avoid both hyperglycemia and hypoglycemia post-resuscitation to optimize outcomes	Observational data link glucose extremes to worse prognosis; guidelines recommend moderate control
Prophylactic Antibiotics	Insufficient evidence to recommend routine use post-ROSC	Current evidence inconclusive; use individualized based on clinical scenario
Point-of-Care Ultrasound (POCUS)	Useful for identifying reversible causes (tamponade, pneumothorax) and aiding neuroprognostication; avoid prolonged CPR interruptions	ILCOR 2025 reviews emphasize POCUS benefits and caution against delays in compressions
Airway Management	Stepwise approach recommended; only providers with high intubation success should perform tracheal intubation	ERC 2025 ALS Guidelines stress skill-based airway management for best outcomes
Early Adrenaline Use	Emphasized for non-shockable rhythms to improve survival	Supported by recent trials and meta-analyses
Removal of Calcium and Sodium Bicarbonate	No routine use during CPR except for specific indications	Evidence shows no benefit in routine use; removed from standard protocols
Precordial Thump	Removed from guidelines due to lack of evidence for benefit	Consensus based on systematic reviews

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PERIOPERATIVE QUALITY INDICATORS - HOW ACHIEVABLE THEY ARE?

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ABSTRACT:
Different stakeholders in the healthcare system measure the quality of healthcare using different quality indicators. For patients, safety indicators are the most important, for healthcare administration, efficiency and cost-benefit indicators, and for scientists, indicators that have been validated and for which there is scientific evidence. When this is added to the classic requirement that an indicator contains three aspects, structure, process and outcome, the question of the sustainability of measurements in routine clinical practice, which is what they are basically intended for, is raised.

The perioperative period is extremely dynamic and of great interest to all stakeholders in the healthcare system. Therefore, it is not surprising that there are numerous initiatives and activities in the field of defining quality indicators in the perioperative period. Large professional anesthesiology societies have their proposals for general quality indicators in the perioperative period publicly available on the Internet. In addition, there are numerous publications on specific quality indicators for certain surgical procedures, anesthesia procedures or certain surgical groups of patients. Unfortunately, the number and heterogeneity of proposals for intraoperative quality indicators does not contribute to uniformity and only complicates harmonization in their routine application.

An additional problem is the definition of stakeholders that standardize perioperative quality indicators. It is believed that national professional societies, and not individual clinicians or state agencies, should be the site of quality data collection and initiatives for perioperative quality indicators, as they combine both research and close collaboration with clinicians. However, the latest research proves that currently only a few European national anesthesiology societies have recommendations for the use of perioperative quality indicators, which are mostly structural and not related towards patients.

Despite numerous attempts, there is still a need for a clearer and more specific definition of perioperative quality indicators that would be applicable in routine clinical practice. National anesthesiology societies have an open space to take an active role in the standardization of perioperative quality indicators.

Keywords: quality of healthcare; quality indicators, healthcare; perioperative care; anesthesia

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TEAM BASED PERFORMANCE - KEY FOR GOOD AIRWAY MANAGEMENT IN CHILDREN

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ABSTRACT:

Patient safety has become an essential component in quality healthcare. Securing an airway is undoubtedly the most important lifesaving skill and knowledge any prehospital and hospital emergency medical service provider owns and it is a vital task for the anesthetists. Anesthetized children, especially toddlers and neonates, have a high risk of critical airway incidents. Delayed management of compromised pediatric airway still causes significant perioperative morbidity and mortality.

Reviewing data shows us that the real progress in the management of pediatric airway, and changes in pediatric anetshesia altogether, started in the first decade of the 21st century (EXIT procedure, fiberoptic and videolaryngoscopy intubation as a gold standard) then, over the following years, the guidelines were, at first, a modification of adult based approaches, and only later on were the guidelines made specially for pediatric patients, then, the neuromuscular blocker was added to the guidelines, the ultrasound and apneic oxygenation started being used in airway management and now the ECMO is incorporated in airway management guidelines in pediatric patients.

Framework to guide in practicing safe and secure control of the pediatric airway could be good knowledge of anatomical and physiological pediatric airway specificity, good airway assessment, planning, minimum standard of equipment, accepted difficult airway algorithms combine with personnel dedicated teaching, training and practice. Ultimately and always the primary goal is to provide child's oxygenation and ventilation.

The human being may err and scientific training is not enough to ensure the desired outcomes; hence, there is a need to develop non-technical skills such as teamwork capabilities. Collaborations play a vital role in increasing the capacity of pediatric anesthesiology educators and training the pediatric anesthesia workforce.

Key words: Team working; Airway management; Children; Anesthesia

Introduction

Promoting teamwork in the operating theater has been associated with lower mortality according to publications[1-8]. Working as a team requires sharing common goals and specific roles for each team member[1-8].The complexity of surgical interventions demands increasing technical skills[7,8]. Scientific, technical skills training is not enough to ensure the desired outcomes there is a need to develop non-technical skills such as teamwork capabilities[7,8].

Methods

I used MEDLINE to search the English language literature from 2010 to 2024 for articles using the following search terms: "teamwork in operating theatre", "airway management in children", "component of perioperative efficience", "patient safety", "human factor as a key in event response during anesthesia". I focused on the team based per-

formance - key for good airway management in children. All sources were screened and selected for inclusion to determine their relevance in the framework of the current report.

Results

Emphasis is placed on the importance of simulation as part of the anesthetist training for developing experience and proper attitudes to solve problems during a crisis, for developing leadership abilities and above all, to be a team player. Primary goal is delivering oxygen and optimizing oxygenation in the management of difficult pediatric airway.

Discussion

Patient must be at the core of our activities and patient safety has to be our number one concern[1]. The medical practice is changing; technical skills must go hand in hand with proper teamwork[1,2]. Hospitals will be evaluated not just in terms of production, but also in terms of quality and outcomes[3,4]. Approximately 50% of hospital errors occur in the OR or in the Resuscitation suites[1]. Most of them are due to poor communication[1]. In order to improve teamwork, simulation, standardization of information, specific training and adequate role definition are required[7,8]. A positive attitude towards other team members, sound communications, leadership, understanding and learning about the different roles, ability to assist, feedback to learn, and finally coordination, are all needed[5,6]. There is a lot of studies as a valuable tool to train the OR staff in non-technical skills and to assess the impact of such training[1-8]. Simulation, training workshops, online modules, briefings and debriefings training programs, timeout and effective WHO checklist utilization as part of the anesthetist training for developing experience and proper attitudes to solve problems during a crisis, for developing leadership abilities and above all, to be a team player are recommended[1-8]. Surgical checklist is the best example of using "briefings" in the operating room[7,8]. The first two phases, "sign-in" and "time-out" must be completed before the surgical procedure begins. The WHO surgical checklist has proven to reduce perioperative morbidity and mortality, with particular impact on laterality errors, wrongful identification, antibiotic prophylaxis, preoperative evaluation check, and the need for blood by-products[7,8].

Conclusion

The aim of this review is to discuss recent scientific literature and provide a comprehensive approach to the team based performance as a key for good airway management in children. Primary goal is always to provide proper child oxygenation. Because of the anesthesiologist's technical training and his/her non-technical skills, including the development of leadership and communication abilities with the OR staff, the anesthesiologist plays a key role in achieving the desired outcomes.

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PERIOPERACIJSKI INDIKATORI KVALITETE - KOLIKO JE DOSTIŽNO?

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SAŽETAK:

Različiti dionici zdravstvenog sustava mjere kvalitetu zdravstvene zaštite različitim indikatorima kvalitete. Za pacijente su najvažniji indikatori sigurnosti, za zdravstvenu administraciju indikatori učinkovitosti i odnos koristi i troškova, a za znanstvenike indikatori koji su validirani i oni za koje postoje znanstveni dokazi. Kada se tome pridodaju i klasični zahtjev da indikator u sebi sadrži i tri aspekta, strukturu, proces i ishod, postavlja se pitanje održivosti mjerenja u rutinskoj kliničkoj praksi, čemu su u osnovi i namijenjeni.

Perioperacijsko razdobolje je izrazito dinamično i od velikog interesa za sve dionike zdravstveng sustava. Stoga ne čudi da su inicijative i aktivnosti u području definiranja indikatora kvalitete u perioperacijskom razdoblju brojne. Velika profesionalna anesteziološka društva imaju javno dostupne na internetu svoje prijedloge općih indikatora kvalitete u perioperacijskom razdobolju. K tome postoje brojne publikacije o specifičnim indikatorima kvalitete za određene kirurške zahvate, anesteziološke postupke ili određene kirurške skupine pacijenata. Nažalost, brojnost i heterogenost prijedloga perioperacijskih indikatora kvalitete ne pridonosi ujednačavanju i samo otežavaju harmonizaciju u njihovoj rutinskoj primjeni.

Dodatni problem je i definiranje dionika koje standardizira perioperacijske indikatore kvalitete. Smatra se da bi nacionalna profesionalna društva, a ne individualni kliničari niti državne agencije, trebala biti mjesta kvalitetnih prikupljanja podatka i inicijativa za perioperacijeke indikatore kvalitete jer objedinjuju i istraživanja i blisku suradnju s kliničarima. Međutim, najnovija istraživanja dokazuju da trenutno svega nekolicina europskih nacionalnih anesteziooloških društva ima preporuke za primjenu perioperacijskih indikatora kvalitete, koji su najčešće strukturalni i nisu usmjereni prema pacijentima.

Usprkos brojnim pokušajima i dalje postoji potreba za jasnijim i specifičnijim definiranjem perioperacijskih indikatora kvalitete koji bi bili primjenjivi u rutinskoj kliničkoj praksi. Nacionalna anesteziološka društva imaju otvoreni prostor za preuzimanje aktivne uloge u standardizaciji perioperacijskih indikatora kvalitete.

Ključne riječi: kvaliteta zdravstva; indikatori kvalitete, zdravstvo; perioperacijsko liječenje; anestezija

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