Editorial

Sedation in Regional Anaesthesia: Balancing Comfort, Safety, and Efficacy

The practice of regional anaesthesia has significantly advanced in recent days, offering targeted pain relief and often an improved recovery profile compared to general anaesthesia. The judicious use of sedation with different drugs and techniques is integral to the success and patient acceptance of many regional techniques. The evolving landscape of sedative agents and delivery methods necessitates on optimizing sedation in regional anaesthesia, focusing on a delicate balance between patient comfort, procedural success, and safety. Current protocols are rightly guided by these principles, though they vary based on surgery type, patient condition, and institutional practices[1].

The primary objectives of sedation in this context are to alleviate preoperative anxiety, which can affect up to half of the patients undergoing regional anaesthesia[1,2], ensure patient comfort and immobility during intricate procedures; improve acceptance of the regional technique[3], and enhance overall patient satisfaction. The goal is to achieve moderate (conscious) sedation, where the patient remains responsive to verbal or light tactile stimulation, maintains spontaneous ventilation and protects airway reflexes, particularly when the airway is not secured. This is vital for preventing recall of the procedure and managing discomfort associated with needle fear.

The cornerstone of safe sedation practice is a thorough preoperative assessment. This includes evaluating the patient's psychological and developmental status, as cooperation is key for conscious sedation, alongside a detailed review of systemic diseases. Informed consent, which explains and discusses the procedure and sedation, with patients and family members is required.

Specific considerations are crucial for vulnerable populations. Elderly or frail patients, for instance, exhibit increased sensitivity to sedatives, face a higher risk of desaturation or hemodynamic instability. These types of patients often require lower doses, with a general recommendation to avoid benzodiazepines. Similarly, patients with significant comorbidities such as COPD, obstructive sleep apnea (OSA), or cardiac issues benefit from agents like dexmedetomidine, which have minimal respiratory or hemodynamic impact[4]. Pediatric sedation presents unique challenges due to cooperation and cognitive abilities, often necessitating sedation or general anaesthesia for successful regional block[5]. Multimodal strategies, frequently employing combinations of dexmedetomidine, ketamine, and midazolam, are increasingly favored in children to optimize conditions while ensuring airway protection and cardiorespiratory stability in addition or in combination with general anaesthesia. Intranasal dexmedetomidine is also a valuable option[6], which is under trial.

The pharmacology for sedation in regional anaesthesia is diverse, with no single agent being universally ideal. Propofol, a GABAA agonist, offers rapid onset and offset, providing hypnosis and amnesia, but carries risks of respiratory depression and cardiovascular instability, including hypotension and bradycardia[7]. Incremental bolus of Propofol is frequently used but associated with unstable blood and effect site concentration with variability of sedation score and hemodynamic parameters. Propofol 10–20 mg per increment, titrated to effect, is recommended for sedation in adults receiving regional anesthesia. This dose should be administered slowly[8]. For pediatric group Propofol 1 mg/kg over 30 seconds then 0.5 – 1 mg/kg every 3 – 5 minutes as needed can be used[9]. A continuous infusion has the potential to eliminate these side effects of incremental bolus doses but repeated adjustment of rate of infusion is required to adjust the level of sedation according to the stage of surgery. Propofol infusion at 25 – 75 mcg/kg/min has been used successfully with peripheral nerve blocks[3].

Dexmedetomidine, an α2 agonist, emerged as an excellent alternative[10], promoting a physiological sleep state while preserving spontaneous respiration and providing moderate analgesia. Its favorable profile, including reduced postoperative delirium, makes it particularly suitable for geriatric patients, and it can prolong the sensory block of local anaesthetics[11]. For conscious sedation Dexmedetomidine 1 μg/kg IV infusion over 10 – 15 minutes avoids acute hemodynamic fluctuations, then continuous infusion of 0.2 – 0.5 μg/kg/hour titrated to achieve a Ramsay Sedation Scale (RSS) score of 3 – 4 (responsive to commands, tranquil, and cooperative). Lower Maintenance Doses (0.2 – 0.3 μg/kg/hr) are equally effective as higher doses for sedation, with fewer hemodynamic side effects like hypotension and bradycardia.

Remimazolam, a novel ultra-short-acting benzodiazepine, offers rapid hydrolysis in liver and is independent of cytochrome P450 enzymes, reaches a quick peak sedation. Recovery from Remimazolam is quick with full alertness and with less cardiorespiratory depression than older agents[12]. This makes it a promising option for high-risk patients. For infusion, in adults < 65 years, initial loading dose of 0.1 – 0.2 mg/kg IV administered over 1 minute, then 0.5 – 1 mg/kg/h for moderate sedation, with adjustments based on patient response and procedural requirements.

Ketamine, which is a NMDA receptor antagonist and has sympathomimetic properties, produces a "dissociative state" and enhances hemodynamic stability. Ketamine is usually used in combination with midazolam[13]. If ketamine is used alone, it can produce hallucinations and bad dreams which although are not typically reported at sedative doses. For infusion an initial loading dose for ketamine is 0.15 – 0.35 mg/kg IV over 1 – 2 minutes is used to achieve the initial sedation, then 0.1 – 0.5 mg/kg/hour to maintain moderate sedation (Ramsay Sedation Scale 3 – 4)[13].

Opioids can be used for moderate sedation in patients receiving regional anesthesia despite its lack of strong hypnotic effects because they provide sedation through mechanisms beyond simple hypnosis. Specifically, opioids act as agonists at mu and kappa opioid receptors in the central nervous system, producing a sedative effect that is less intense and more unpredictable than classical sedative-anxiolytics although their action is clinically significant. Their primary role is analgesia, which reduces discomfort and noxious stimuli during procedures, contributing indirectly to sedation by diminishing patient anxiety and restlessness. Moreover, opioids have a synergistic sedative effect when combined with benzodiazepines or other sedatives, lowering the dose of hypnotics needed and enhancing overall sedation quality. In practical clinical settings, fentanyl is usually administered as incremental boluses (25 –100 μg IV) during regional anesthesia to supplement analgesia rather than as a continuous infusion[14]. Opioids like remifentanil are also used and it offers rapid onset and offset but lack amnestic properties and can cause respiratory depression.

Advances in administration techniques have further refined sedation practices. While incremental boluses are common, continuous infusions can offer more stable blood and effect-site concentrations. Target-Controlled Infusion (TCI) systems represent a significant step forward, utilizing pharmacokinetic models to maintain stable plasma or effect-site concentrations, potentially leading to lower total drug consumption[15], faster recovery, and fewer hemodynamic disturbances[16]. The optimal target concentration of propofol for conscious sedation during regional anesthesia is generally in the range of 0.9 to 1.8 μg/ml plasma concentration when administered via target-controlled infusion (TCI). This range produces safe and effective sedation without severe complications, as demonstrated by Kim and Sohn in a study using bispectral index (BIS) monitoring to maintain an Observer's Assessment of Alertness/Sedation (OAA/S) score of 3 during local or regional anesthesia[17]. Remifentanil can be used for sedation in both continuous infusion and TCI techniques. But it is more precise to use this drug in TCI method as this results in more controlled and optimized drug delivery, leading to better sedation conditions, reduced propofol requirements, and a lower incidence of respiratory side effects such as hypopnea and apnea compared to manually controlled continuous infusion (MCI)[18]. The recommended dose with Remifentanil TCI for ASA I/II, is 2.0 – 3.0 ng/ml, for ASA III/IV is 1.5 – 2.5 ng/ml (reduce initial dose by 50% in elderly >65 years). But a much lower dose has been implemented successfully for sedation in regional anesthesia at 0.5 – 1.0 ng/ml. Low dose midazolam (0.02 – 0.03 mg/kg) for anxiolysis and amnesia should be used with Remifentanil. For continuous IV infusion, an infusion rate 0.1 mg/kg/min has been suggested as an optimal balance between side-effects and sedative effects[1].
In conclusion, sedation during regional anaesthesia is an evolving and critical component of perioperative care that significantly enhances patient comfort, procedural success, and overall satisfaction. The selection of sedative agents and techniques must be meticulously individualized, considering patient-specific factors such as age, comorbidities, and the nature of the procedure. Recent pharmacological innovations, particularly with agents like dexmedetomidine and remimazolam, alongside sophisticated delivery systems like TCI, offer safer and more effective sedation options with minimal physiological disruption. For specialized populations, such as pediatric or elderly patients, tailored strategies are essential to navigate their unique physiological considerations.

The medical community must continue to drive progress in this field. This involves advocating for individualized sedation plans, encouraging the adoption of advanced and evidence-based techniques, and fostering continuous education and training in sedation practices. Future research should be directed towards developing novel sedative agents with even better safety profiles, refining dosing protocols for diverse patient groups, and exploring the integration of personalized medicine approaches, such as pharmacogenomics and AI-driven sedation systems. Non-pharmacological adjuncts may also play an increasing role. The most important factors while performing sedation are patient evaluation, patient preparation, appropriate drug choice, best drug delivery system and managing emergencies. The ultimate aim remains steadfast: to achieve safe, effective, and patient-centered sedation that maximizes the benefits of regional anaesthesia while rigorously minimizing risks, paving the way for superior patient outcomes.

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