



NARRATIVE REVIEW: FLUID THERAPY MANAGEMENT IN REGIONAL ANESTHESIA AND NEURAXIAL BLOCK

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ABSTRACT

Neuraxial anesthesia is a regional anesthesia technique involving the injection of anesthetic agents into or near the subarachnoid or epidural space to block pain transmission from spinal nerve segments. Proper management of neuraxial anesthesia includes preoperative preparation, selection of anesthetic agents and dosages, block placement techniques, hemodynamic monitoring, and management of possible complications. This article discusses key aspects of neuraxial anesthesia management, including patient preparation, spinal and epidural block techniques, selection of local anesthetic agents and adjuvants, as well as the detection and treatment of side effects such as hypotension, bradycardia, and local toxicity. The aim of this discussion is to ensure that neuraxial anesthesia is delivered safely, effectively, and in accordance with anesthesiology standards of care.

Keywords: Neuraxial anesthesia Spinal block Epidural block Anesthesia management Anesthesia complications

ABSTRAK

Anestesi neuraksial adalah metode anestesi regional yang melibatkan penyuntikan anestesi ke dalam atau dekat ruang subarahnoid atau epidural untuk memblokir transmisi nyeri dari segmen saraf tulang belakang. Manajemen yang baik dalam pemberian anestesi neuraksial meliputi persiapan praoperatif, pemilihan obat anestesi dan dosis, teknik pemasangan blok, pemantauan hemodinamik serta penanganan komplikasi yang mungkin timbul. Artikel ini membahas langkah-langkah penting dalam manajemen anestesi neuraksial, termasuk persiapan pasien, teknik blokus spinal dan epidural, pemilihan agen anestesi lokal dan adjuvan, serta deteksi dan penanganan efek samping seperti hipotensi, bradikardia, dan semburan lokal. Tujuan dari pembahasan ini adalah agar pemberian anestesi neuraksial dilakukan secara aman, efektif, dan sesuai standar mutu kedokteran anesthesiologi.

Kata Kunci: Anestesi neuraksial Blok spinal Blok epidural Manajemen anestesi Komplikasi anestesi

Introduction

Anesthesia is a vital component of modern medical practice aimed at providing comfort and safety, while facilitating surgical and invasive medical procedures (Pirma Ivan Ricky Manurung et al., 2025). In its

development, anesthesia is divided into several types, one of which is regional anesthesia, which focuses on blocking pain transmission in specific areas of the body without a complete loss of consciousness. One of the most widely used forms of



regional anesthesia is neuraxial anesthesia, which includes spinal, epidural, and combined spinal-epidural techniques (Torrano et al., 2020).

Neuraxial blocks offer significant advantages over general anesthesia in certain conditions, such as better hemodynamic stability, reduced need for systemic opioids, and effectiveness in controlling perioperative and postoperative pain (Raharjo et al., 2022). This technique is also widely used in various surgical procedures, including orthopedic, urologic, obstetric, and gynecological surgeries. In the field of obstetrics, for instance, neuraxial anesthesia has become the primary choice for cesarean sections and labor analgesia as it is proven safe for both mother and infant (Torrano et al., 2020).

Nevertheless, the management of neuraxial anesthesia administration requires adequate skill, knowledge, and experience. Errors in patient selection, drug dosage, or placement techniques can lead to serious complications, such as severe hypotension, bradycardia, high spinal block, and neurological injury. Therefore, patient safety aspects must be the top priority in every neuraxial anesthesia procedure (Torrano et al., 2020).

Along with scientific developments, the techniques and medications used in neuraxial anesthesia have also advanced. Various adjuvants such as opioids, clonidine, and dexmedetomidine are now used to enhance the quality of the block and prolong the duration of analgesia (Djajanti Sari, 2023). Furthermore, the latest practice guidelines from international and national anesthesia organizations emphasize the importance of strict hemodynamic monitoring, prevention of complications through fluid administration and vasopressors, and a multimodal approach to pain management (Kietaibl et al., 2018).

This article aims to comprehensively discuss the management of neuraxial anesthesia administration, including preoperative preparation, spinal and epidural block placement techniques, choice of anesthetic agents, and the management of

potential complications. With a thorough understanding, medical professionals are expected to optimize the benefits of neuraxial anesthesia while minimizing risks, ensuring that patient safety and comfort are maintained (Eka P, 2017).

METHODS

This article employs a narrative analysis method based on a literature study. Data was collected through a search of scientific articles, clinical guidelines, and research reports published within the last 10 years, sourced from both Sinta-indexed national journals and reputable international journals. The search process was conducted using keywords such as “neuraxial anesthesia”, “spinal block”, “epidural block”, and “anesthesia management” (Kusuma & Nurmawati, 2023). Relevant literature was subsequently selected based on inclusion criteria, specifically those discussing spinal, epidural, and combined spinal-epidural anesthesia techniques, the use of adjuvants, and the management of resulting complications. Meanwhile, articles that only mentioned non-neuraxial regional anesthesia or those with no direct relevance to anesthesia management were excluded (Kotler, 2019). Furthermore, the obtained data were analyzed qualitatively using a content analysis approach, which involved identifying, classifying, and comparing key findings from each literature source. The results of this analysis were then synthesized into a structured narrative description to provide a comprehensive overview of neuraxial anesthesia management, ranging from preoperative preparation, block execution techniques, and drug selection to the prevention and management of complications (Hendry, S.Kom, M.Kom & Prof. Ir. Daniel H.F Manongga, M.Sc, 2024).

RESULTS AND DISCUSSION

1. Preoperative Preparation

Neuraxial anesthesia management begins with the preoperative preparation stage, which is highly decisive for the

success of the procedure. At this stage, the anesthesiologist conducts a comprehensive evaluation of the patient's condition, including a medical history anamnesis, physical examination, and diagnostic tests if necessary. Several focal points include absolute contraindications such as coagulation disorders, infection at the puncture site, and patient refusal. Additionally, risk factors such as hypotension, anemia, spinal deformities, and history of drug allergies must be considered. Educating the patient regarding the procedure, benefits, risks, and potential complications is essential to ensure the patient understands and agrees to the intervention with a clear informed consent (Li et al., 2017).

2.Neuraxial Block Execution Techniques

There are three primary techniques in neuraxial anesthesia: spinal anesthesia, epidural anesthesia, and combined spinal-epidural (CSE). The success of the technique heavily depends on the operator's skill and the patient's positioning. Maximum flexion of the lumbar region (sitting or lateral decubitus position) facilitates the identification of the intervertebral space (Sutiyono, 2014).

3. Choice of Anesthetic Agents

The selection of local anesthetic agents is a critical aspect of neuraxial anesthesia management. Commonly used drugs include bupivacaine, ropivacaine, lidocaine, and levobupivacaine. Bupivacaine is known for its long duration of action, making it suitable for orthopedic and obstetric surgeries (Utari, 2022). Ropivacaine offers the advantage of a better cardiotoxic safety profile compared to bupivacaine, leading to its widespread use in obstetric analgesia. Adjuvants such as opioids (fentanyl, sufentanil, morphine), clonidine, and dexmedetomidine can be added to improve the quality of the sensory block, prolong the duration of analgesia, and

reduce local anesthetic requirements (Sutiyono, 2014).

Drug dosages are determined based on the type of block, the patient's height, and the objective of the anesthesia. For instance, in spinal anesthesia for cesarean section, the dose of hypobaric or isobaric bupivacaine ranges from 7.5–12.5 mg, often combined with intrathecal opioids to enhance analgesia (El-Tallawy et al., 2017).

4.Intraoperative Monitoring and Management

During neuraxial anesthesia procedures, monitoring the patient's hemodynamics is crucial. Hypotension and bradycardia are frequent complications resulting from sympathetic blockade. Prevention can be achieved through pre-loading or co-loading with crystalloid fluids, and the use of vasopressors such as ephedrine or phenylephrine if hypotension occurs (Alfira, 2020). Monitoring includes blood pressure, pulse rate, oxygen saturation, and in some cases, ECG to detect arrhythmias. Furthermore, the patient's position after the block must be carefully managed. In pregnant women, for example, the left lateral tilt position is important to prevent inferior vena cava compression by the uterus (El-Tallawy et al., 2017; MUH. ADNAN RAMADHAN, 2022).

5. Management of Complications

Complications of neuraxial anesthesia can range from mild to severe. Hypotension is the most frequent complication and can be managed with fluid administration and vasopressors. Bradycardia is treated with atropine, while a high spinal block requires immediate intervention in the form of airway support, oxygenation, vasopressors, and cessation of the procedure if necessary (Hendry, S.Kom, M.Kom & Prof. Ir. Daniel H.F Manongga, M.Sc, 2024).

Another possible complication is post-dural puncture headache (PDPH), which typically arises from cerebrospinal fluid leakage following a dural puncture. Management may include bed rest, hydration, analgesics, caffeine, and an epidural blood patch if the pain persists. Neurotoxicity due to local anesthetic overdose is rare but must be anticipated, particularly if there is an accidental injection of a large dose (El-Tallawy et al., 2017).

6. Recent Developments

As technology advances, neuraxial anesthesia techniques continue to evolve with the use of ultrasound guidance. With ultrasound, the identification of vertebral anatomy and intervertebral spaces becomes more accurate, thereby increasing success rates and minimizing complications. Additionally, recent research highlights the use of non-opioid adjuvants to reduce side effects, as well as multimodal analgesia strategies to optimize postoperative pain control (El-Tallawy et al., 2017).

7. Practical Implications

Sound neuraxial anesthesia management has a significant impact on the quality of patient care. With optimal pain control, patients can recover faster, mobilize earlier, and the risk of postoperative complications such as thromboembolism can be suppressed. From a cost perspective, neuraxial anesthesia is often more economical than general anesthesia for certain procedures (El-Tallawy et al., 2017).

In clinical practice, fluid therapy management in regional anesthesia and neuraxial blocks has direct implications for the patient's hemodynamic stability. The sympathetic nerve blockade resulting from neuraxial anesthesia, particularly spinal and epidural, can cause peripheral vasodilation and a decrease in blood pressure. Therefore, pre-block fluid

administration (preloading) or administration concurrent with anesthesia induction (co-loading) serves as a preventive measure to reduce the risk of hypotension. In practice, nurse anesthetists must be able to determine the appropriate fluid type, volume, and timing based on the clinical condition and the patient's volume status. This strategy is vital to ensure that tissue perfusion remains adequate without causing fluid overload.

The selection of fluid type is an important aspect of therapy implementation. Crystalloid fluids such as Ringer's Lactate are often used to maintain electrolyte balance and support circulatory stability, while colloid fluids may be considered in cases with a high risk of severe hypotension or significant volume loss. In practice, the decision for fluid administration depends not only on protocols but must also consider the patient's age, cardiac condition, and hydration status. Continuous monitoring of blood pressure, pulse rate, and peripheral perfusion signs is performed to assess the effectiveness of fluid therapy and prevent complications such as pulmonary edema or heart failure due to fluid excess.

No	Penulis & Tahun	Judul Sumber	/ Desain / Jenis Studi	Populasi Konteks	/ Hasil Utama	Kesimpulan
1	ASA, 2020	Practice guidelines for obstetric anesthesia	Pedoman klinis (Guideline)	Pasien obstetri dengan anestesi spinal/epidural	Menekankan skrining praoperatif, penggunaan vasopressor, dan keamanan ibu-bayi	Memberikan dasar praktik anestesi neuraksial pada obstetri
2	Wijaya et al., 2019	Perbandingan efektivitas anestesi spinal dan epidural pada pasien ortopedi	RCT (Indonesia)	Pasien ortopedi ekstremitas bawah	Spinal: onset cepat, durasi singkat; Epidural: durasi panjang, kontrol analgesia lebih fleksibel	Mendukung pemilihan teknik sesuai durasi operasi
3	Kushwaha et al., 2017	Comparison of ropivacaine and bupivacaine in spinal anesthesia	RCT	Pasien operasi elektif	Ropivakain lebih aman secara kardiotoksik; Bupivakain durasi lebih panjang	Menjadi dasar pemilihan obat lokal
4	Huang et al., 2020	Intrathecal opioids for labor analgesia: A systematic review	Review sistematis & meta-analisis	Analgesia persalinan	Opioid intratekal meningkatkan kualitas analgesia & mengurangi kebutuhan anestesi lokal	Relevan untuk kombinasi adjuvan dalam blok spinal
5	Kinsella et al., 2018	Consensus on vasopressor use during spinal anesthesia for C-section	Konsensus internasional	Pasien sectio caesarea	Hipotensi 30–40%; fenilefrin efektif sebagai profilaksis	Panduan manajemen komplikasi intraoperatif
6	Turnbull & Shepherd, 2019	Post-dural puncture headache	Review	Pasien dengan PDPH	Jarum kecil menurunkan risiko PDPH; Blood patch efektif untuk kasus persisten	Strategi pencegahan & terapi komplikasi

No	Penulis & Tahun	Judul Sumber	/ Desain / Jenis Studi	Populasi Konteks	/ Hasil Utama	Kesimpulan
7	Lee & Wong, 2021	Combined spinal-epidural techniques in obstetric anesthesia	Review naratif	Obstetri	CSE gabungkan onset cepat spinal & fleksibilitas epidural	Opsi teknik untuk obstetri & operasi durasi panjang
8	Perlas et al., 2016	Lumbar neuraxial ultrasound	Meta-analisis	Pasien anestesi spinal/epidural	Ultrasound meningkatkan akurasi tusukan & menurunkan komplikasi	Mendukung penggunaan teknologi baru
9	Chin et al., 2020	Ultrasound imaging facilitates spinal anesthesia	Studi observasional	Pasien dengan anatomi sulit	Ultrasound bantu identifikasi ruang intervertebra	Implikasi praktis dalam kasus sulit
10	Macfarlane et al., 2021	Multimodal analgesia for postoperative pain	Review naratif	Manajemen nyeri pascaoperasi	Pendekatan multimodal lebih efektif dibanding tunggal	Memperkuat strategi analgesia pascaoperasi
11	Rahmawati, 2018	Kecemasan pasien praoperasi dengan anestesi spinal	Studi observasional (Indonesia)	Pasien praoperasi dengan spinal	Edukasi & informed consent menurunkan kecemasan	Relevan untuk tahap persiapan praoperatif

CONCLUSION

The management of neuraxial anesthesia administration is a vital aspect of modern anesthesiology as it provides effective, safe, and economical analgesia for various surgical and obstetric procedures. The selection of the appropriate technique—whether spinal, epidural, or combined—must be tailored to the patient's condition, the type of surgery, and the objectives of the anesthesia. The rational selection of local anesthetic agents and adjuvants further determines the success of the block, while strict intraoperative monitoring plays a crucial role in preventing and managing complications such as hypotension, bradycardia, high spinal block, and post-dural puncture headache.

Recent developments, such as the use of ultrasound guidance and multimodal analgesia strategies, further strengthen the effectiveness and safety of neuraxial anesthesia. With sound management based on scientific evidence, neuraxial anesthesia remains a primary choice that supports patient safety and enhances the quality of perioperative care.

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