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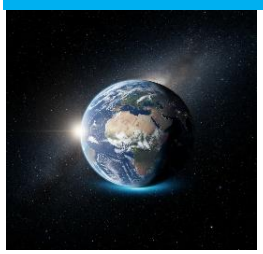

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Postoperative neurological symptoms after anesthesia - diagnostic challenges, pathophysiology and a review of uncommon cases

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Abstract

Introduction: Postoperative neurological symptoms following anesthesia are uncommon but may pose significant diagnostic challenges in the perioperative period. These manifestations can range from transient focal deficits to delayed or atypical neurological syndromes, and may occur in the absence of clear structural pathology. Diagnostic uncertainty is frequently compounded by residual anesthetic effects, perioperative physiological disturbances, and overlap with surgical or systemic complications.

Material and methods: A review of selected literature was conducted using the PubMed database. The search was performed using keywords including “postoperative neurological symptoms,” “anesthesia,” “neurological complications,” “delayed emergence,” “functional neurological disorders,” and “case reports”.

Summary: Reported postoperative neurological presentations include focal neurological deficits mimicking acute cerebrovascular events, movement disorders, cranial nerve dysfunction, visual and sensory disturbances, alterations in consciousness, functional neurological presentations, and delayed-onset symptoms emerging after initial recovery. These cases highlight the heterogeneity of postoperative neurological phenomena and suggest that multiple interacting mechanisms, rather than a single causative pathway, may contribute to their development.

Conclusions: Uncommon postoperative neurological symptoms associated with anesthesia remain diagnostically challenging and are primarily documented through isolated case reports and targeted reviews. Awareness of atypical presentations and careful clinical evaluation may assist in avoiding misdiagnosis and unnecessary interventions. Further systematic investigation may help clarify contributing factors and inform perioperative management strategies.

Keywords: Postoperative neurological symptoms; anesthesia; diagnostic challenges; case reports; uncommon complications.

1. Introduction

Postoperative neurological symptoms occurring after anesthesia represent a challenging and often concerning clinical situation in perioperative practice [24,25]. Although such manifestations are relatively uncommon, their appearance in the postoperative period may resemble serious neurological conditions, including acute cerebrovascular events or structural central nervous system injury. Symptoms such as focal weakness, sensory disturbances, abnormal movements, visual changes, or altered levels of consciousness may prompt urgent diagnostic evaluation [16,24].

Neurological assessment following anesthesia is inherently complex. Residual effects of anesthetic agents, sedatives, and opioids may interfere with neurological examination and delay recovery of normal cognitive and motor function [16,24]. Perioperative physiological disturbances and patient vulnerability factors may further influence neurological status [30,31]. As a result, postoperative neurological symptoms do not always follow classic patterns, and their interpretation may remain uncertain despite extensive diagnostic testing [25]. While many postoperative neurological abnormalities are transient and resolve without specific intervention, atypical or persistent symptoms may lead to prolonged hospitalization or unnecessary investigations [20,21].

The literature addressing postoperative neurological symptoms in relation to anesthesia is largely based on case reports, small case series, and narrative or systematic reviews across general, regional, and local anesthesia contexts [20,22,24]. The aim of this review is to summarize diagnostic challenges, discuss pathophysiological considerations, and present uncommon postoperative neurological manifestations reported in association with anesthesia, with emphasis on cautious interpretation and practical clinical relevance [19,25].

2. Diagnostic Challenges in Postoperative Neurological Assessment

Neurological assessment in the postoperative period is frequently complicated by the pharmacological effects of anesthetic and analgesic agents. Residual sedation, drug redistribution, and medication interactions may alter consciousness, motor responses, and sensory perception, making early examination difficult to interpret [16,24]. Delayed emergence

and atypical re-sedation syndromes further complicate attribution when recovery deviates from the expected trajectory [14,17].

A major diagnostic challenge is distinguishing delayed emergence from pathological neurological states. Prolonged unresponsiveness, impaired responsiveness, or abnormal motor activity can reflect residual anesthetic effect, metabolic causes, or acute intracranial pathology, and bedside differentiation is often limited without further evaluation [16]. Case-based literature highlights that delayed awakening may occasionally be the presenting feature of an intracranial event, reinforcing the need for structured escalation when red flags are present [15]. Individual risk factors and perioperative physiological instability also contribute to postoperative cognitive phenotypes and delirium risk, increasing diagnostic ambiguity [30].

Postoperative neurological symptoms may overlap with metabolic, systemic, and surgical complications, including electrolyte abnormalities, hypoxemia, hypotension, and broader perioperative stress responses [31]. Diagnostic uncertainty may lead to unnecessary investigations or delayed recognition of time-sensitive conditions. A cautious, structured approach is therefore essential to balance timely intervention with avoidance of premature diagnostic closure [25]. In procedure-specific neuroanesthesia contexts, altered signals from intraoperative neuromonitoring and anesthetic effects on monitoring fidelity can add further complexity to interpretation of neurological function and risk signaling [43].

3. Pathophysiological Considerations

The pathophysiology underlying postoperative neurological symptoms following anesthesia is likely multifactorial and remains incompletely characterized. Proposed contributors include transient alterations in cerebral perfusion, oxygenation, and metabolic balance during or after anesthesia, particularly in physiologically vulnerable patients. Systemic inflammatory and post-infectious states, including post-acute sequelae of COVID, may further modify perioperative neurological vulnerability and recovery patterns [45].

Neuropharmacological effects of anesthetic agents and adjunct medications may also contribute to postoperative neurological phenotypes. The literature describes diverse neurological sequelae after general anesthesia, including altered cognition and sensory disturbances, with variability across patient populations and procedures [23,24]. In some settings, perioperative medication interactions may contribute to neurochemical syndromes with prominent neurological manifestations, reinforcing the need for careful medication review when

symptoms are atypical [13]. Overall, mechanistic plausibility supports cautious interpretation, but the evidence base is often observational, and causality is rarely established [25].

4. Risk Factors and Modifying Variables

Patient-related vulnerability factors may influence the likelihood and expression of postoperative neurological symptoms. Comorbidities and physiological reserves may modify susceptibility to transient neurological dysfunction, and specific risk considerations have been synthesized for neuraxial anesthesia and spinal anesthesia practice [27]. Broader perioperative vulnerability factors also contribute to postoperative delirium risk and cognitive phenotypes in noncardiac surgery populations [30].

Procedure-related and management-related modifiers may include bleeding risk, anticoagulation status, and hemostatic thresholds relevant to neuraxial techniques, which require individualized risk assessment [29]. Nutritional and metabolic vulnerability may also be relevant, with vitamin deficiencies proposed as an under-recognized contributor to postoperative complications in selected contexts [28]. Perioperative fluid administration and goal-directed strategies have been associated with postoperative outcomes, emphasizing the role of systemic physiology as a modifier rather than a single-cause explanation.

5. Uncommon and Atypical Postoperative Neurological Presentations

Uncommon postoperative neurological symptoms are primarily described through isolated case reports and small case series across regional, general, and local anesthesia settings. These reports illustrate atypical clinical presentations that may not follow expected recovery patterns and are often associated with diagnostic uncertainty. Although such evidence does not establish causality, case-based descriptions remain valuable for recognizing unusual neurological phenomena and contextualizing postoperative neurological findings when structural pathology is not evident [20,24].

5.1 Acute Focal Neurological Deficits Mimicking Stroke

Acute focal neurological deficits in the postoperative period may resemble ischemic or hemorrhagic cerebrovascular events and often trigger urgent stroke evaluation. Case reports describe transient aphasia and hemiparesis following regional anesthesia or surgery, with

imaging excluding acute infarction and symptoms resolving over time [1,2]. These presentations can be diagnostically challenging because time-sensitive treatment pathways exist for true ischemic stroke, and perioperative sedation may confound neurological assessment.

5.2 Movement Disorders and Motor Control Abnormalities

Uncommon postoperative movement disorders have been described during emergence or early recovery, including myoclonic movements following general anesthesia. Case reports and accompanying reviews describe variable onset, fluctuating clinical features, and often unrevealing diagnostic workup, with many cases improving with observation or supportive care [10,11].

5.3 Cranial Nerve and Brainstem-Related Dysfunction

Cranial nerve and airway-related neurological dysfunction has been reported after anesthesia and surgery, including vocal fold paralysis, recurrent laryngeal nerve palsy, transient facial nerve palsy, and pupillary abnormalities after regional blocks near the head and neck [5-8]. These deficits may overlap with airway instrumentation-related injury, and systematic review evidence highlights that endotracheal intubation can be associated with laryngeal injury and upper airway symptoms, complicating attribution in the postoperative period [42]. Neuroanesthesia airway management considerations, including escalation planning and airway rescue, are particularly relevant when airway dysfunction is suspected [41], and rare post-infectious neuromuscular crises may present with airway compromise requiring emergent tracheostomy [46]. Cranial nerve symptoms may also occur after local anesthesia in dental and procedural contexts, further underscoring that postoperative cranial neuropathies can have diverse mechanisms [22].

5.4 Visual and Sensory Perceptual Disturbances

Visual disturbances have been described as rare postoperative neurological presentations, ranging from transient changes to severe postoperative vision loss. Case-based literature includes postoperative vision loss following bariatric surgery and emphasizes the need for prompt evaluation when visual symptoms occur postoperatively [9]. Broader reviews also describe sensory and olfactory disturbances after general anesthesia, supporting cautious interpretation and structured assessment when perceptual symptoms are reported [23].

5.5 Altered Consciousness and Cognitive Phenotypes

Altered consciousness and cognitive phenotypes include delayed awakening, prolonged unresponsiveness, or fluctuating responsiveness beyond expected anesthetic recovery. Case reports describe delayed awakening influenced by physiological and psychological factors and emphasize that delayed awakening may occasionally signal intracranial pathology, including hemorrhage, even when initial recovery appears typical [14,15]. Reviews of delayed emergence emphasize a differential diagnosis approach and describe atypical re-sedation patterns with specific agents such as remimazolam [16,17]. Neurochemical syndromes with neurological manifestations, including serotonin syndrome related to perioperative medication interactions, may also present with altered mental status and should be considered when clinical features are compatible [13]. Perioperative delirium risk factors, synthesized from large patient-level analyses, further contribute to interpretive complexity in susceptible populations [30].

5.6 Functional and Psychogenic Neurological Presentations

Functional and psychogenic neurological presentations have been reported after anesthesia, including functional weakness, sensory loss, abnormal movements, or psychogenic coma in the absence of structural pathology. Perioperative-focused reviews highlight diagnostic uncertainty, emphasize that such presentations often mimic organic neurological disease, and support cautious assessment after exclusion of time-sensitive etiologies [19]. Case reports of psychogenic coma after general anesthesia further illustrate the diagnostic challenge and the importance of avoiding premature labeling while maintaining patient-centered management [18].

5.7 Delayed-Onset Neurological Syndromes

Delayed-onset neurological symptoms may emerge hours to days after an initially unremarkable recovery and can complicate attribution because immediate anesthetic effects are no longer prominent. Case literature includes acute paraplegia after neuraxial anesthesia due to hemorrhage within an undiagnosed spinal cord tumor and highlights the potential for rare structural causes presenting in the postoperative period [3]. Other reports describe severe neurological complications related to misplaced devices in the epidural space, illustrating that technical and procedural factors may present with delayed or evolving neurological signs [4].

Postpartum neurological events, including late seizures after cesarean section with challenging differential diagnosis, further emphasize that delayed-onset syndromes may have obstetric-specific and neuraxial-related considerations [12,35].

6. Management Principles and Preventive Considerations

Management of postoperative neurological symptoms requires timely recognition, structured evaluation, and escalation based on symptom severity, progression, and clinical context. Reviews of neurological complications after regional anesthesia and pain interventions emphasize careful neurological assessment, appropriate imaging when indicated, and early specialist involvement for suspected neuraxial hematoma or other time-sensitive diagnoses [20,21]. Prevention strategies for regional nerve injury emphasize technique, risk stratification, and mitigation of mechanical and physiological contributors [26]. When neuraxial techniques are considered in patients with bleeding disorders or anticoagulation concerns, evaluation of hemostatic thresholds and individualized risk assessment are essential [29]. Broader perioperative physiology, including fluid management strategies, may influence postoperative outcomes and should be contextualized during evaluation and prevention planning [31].

Preventive considerations also include approaches to delirium risk reduction and neurocognitive protection in vulnerable populations. Systematic evidence addresses anesthesia selection and pharmacologic strategies to reduce postoperative delirium, supporting individualized planning rather than protocol-level overreach [32]. Meta-analytic evidence comparing regional versus general anesthesia for neurocognitive outcomes in elderly hip fracture patients provides additional context for technique selection when neurocognitive vulnerability is a concern [33]. Practical perioperative strategies also include opioid-sparing and multimodal analgesia, supported by systematic review evidence for opioid-free anesthesia and consensus guidance for intravenous lidocaine, as well as evidence syntheses for nonopioid analgesics and regional techniques in specific surgical settings [36-38]. Technique-focused reviews address ultrasound-guided interfascial plane blocks and ankle blocks, providing context for regional anesthesia selection and safety in appropriate settings [39,40]. In procedure-specific neuroanesthesia contexts, airway management principles and laryngeal injury risk after intubation remain relevant, particularly when cranial nerve or airway symptoms occur postoperatively [41,42]. Reviews of anesthesia effects on neuromonitoring during scoliosis surgery highlight how anesthetic technique can influence intraoperative signal interpretation and downstream neurological decision-making [43]. Vascular emergency anesthesia reviews

provide context for high-risk hemodynamic environments where neurological vulnerability may be amplified [44]. In neurosurgical settings, evidence-based reviews of postoperative nausea and vomiting after craniotomy support targeted perioperative management and symptom control as part of comprehensive neuroanesthesia care [34]. For special populations, perioperative considerations in long COVID and post-COVID neuromuscular crises reinforce the need for individualized perioperative planning and vigilance [45,46]. Procedure selection considerations in functional neurosurgery, such as anesthesia choice for deep brain stimulation, further illustrate how anesthetic technique intersects with neurological outcomes and monitoring needs [47]. When stroke is suspected postoperatively, awareness of procedural sedation contexts in acute ischemic stroke thrombectomy contributes to clinical understanding of sedation-related tradeoffs in neurovascular care pathways.

7. Summary and Conclusions

Postoperative neurological symptoms following anesthesia represent a heterogeneous group of uncommon clinical presentations that may pose significant diagnostic challenges [24,25]. As illustrated by case-based literature, these symptoms can manifest as focal deficits, movement disorders, cranial nerve and airway dysfunction, perceptual disturbances, altered consciousness phenotypes, functional neurological presentations, and delayed-onset neurological syndromes [1-4,10,14,18]. The variability in timing, clinical course, and diagnostic correlates underscores the importance of cautious interpretation and structured evaluation, particularly when early recovery deviates from expected patterns [16,20].

Awareness of atypical postoperative neurological presentations may assist clinicians in navigating diagnostic uncertainty and avoiding premature conclusions once time-sensitive etiologies have been addressed [19]. A structured approach to assessment, informed by patient vulnerability factors and perioperative context, may help balance timely investigation with avoidance of unnecessary intervention [30,31]. Preventive considerations should remain individualized and evidence-aligned, drawing on available reviews and consensus where applicable, while acknowledging that much of the evidence for rare phenomena remains case-based [20,26,32].

Disclosure

Author's contribution

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