ISSN 1220-8841 (Print)
ISSN 2344-4959 (Online)

ROMANIAN
NEUROSURGERY

Vol. XXXIX | No. 4 December 2025

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DOI: 10.33962/roneuro-2025-063

Romanian Neurosurgery (2025) XXXIX (4): pp. 345-349
DOI: 10.33962/roneuro-2025-063
www.journals.lapub.co.uk/index.php/roneurosurgery

Psychiatric and neurobehavioral effects of posterior fossa surgery. A literature review

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ABSTRACT

The posterior fossa, housing the brainstem and cerebellum, has traditionally been viewed as exclusively responsible for motor functions. However, recent literature has highlighted the profound cognitive and psychiatric implications of lesions and surgery in this area. This literature review analyses case studies, clinical series, and systematic reviews regarding post-surgical neuropsychiatric sequelae in the posterior fossa. Relevant studies on cerebellar mutism, cerebellar cognitive affective syndrome, and emotional lability were included. Posterior fossa pathology is associated with a wide spectrum of disorders. Posterior Fossa Syndrome (PFS) is a common pediatric complication, characterised by mutism and irritability. In adults, although rarer, subtle personality changes, executive dysfunction, and severe emotional lability caused by brainstem compression can occur. Pathophysiological mechanisms involve the disruption of cerebello-cerebral circuits (diaschisis). Recognising postoperative psychiatric complications is essential. Neuropsychological assessment should be routine in posterior fossa surgery to optimise patient recovery and quality of life. This review may serve as a structured framework for future prospective and statistical studies that systematically evaluate psychiatric and cognitive outcomes after posterior fossa surgery.

Keywords
posterior fossa, cerebellum, emotional lability, cerebellar mutism, posterior fossa syndrome

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1. INTRODUCTION

The posterior fossa syndrome (PFS) is marked by a range of linguistic, cognitive, and behavioural-affective symptoms that may arise following cerebellar lesions of various causes [1]. Surgeries within the posterior fossa represent a major challenge in neurosurgery. Although historically the cerebellum was primarily associated with motor coordination, the "cerebellar revolution" of recent decades has demonstrated an intrinsic connection between posterior fossa lesions and neuropsychiatric manifestations. Studies have shown that the cerebellum modulates cognitive and affective processes through reciprocal connections with the cerebral cortex and limbic system [2].

The anatomical basis of psychiatric disorders in posterior fossa pathology lies in the connections of the cerebellum with supratentorial structures. Disruption of the balance of dopaminergic

ISSN 2344-4959 (online)
ISSN 1220-8841 (print)

First published
December 2025 by
London Academic Publishing
www.london-ap.uk

and serotonergic networks plays a central role. Cerebellar lesions can lead to a "deafferentation" of thalamo-limbic circuits or the interruption of cerebellar output to midbrain areas (locus coeruleus and raphe nuclei) [3]. Wickenhauser et al. emphasize the role of the dentato-thalamo-cortical tract; its injury causes cerebello-cerebral diaschisis, reducing metabolism in the contralateral frontal lobes, which explains the executive deficit and mutism [4]. This paper aims to synthesize the psychiatric effects of posterior fossa surgery, ranging from mutism and executive dysfunction to psychotic states and emotional lability.

In the pediatric population, PFS is a well-documented complication, affecting a significant percentage of children operated on for vermian tumors (especially medulloblastoma) [5]. Pollack (2001) describes this syndrome as a neurobehavioral complex including: transient mutism: Delayed onset (1-6 days postoperatively); severe emotional lability: uncontrolled crying, extreme irritability; personality changes: social withdrawal or bizarre behavior [5]. A systematic review conducted by Hanzlik et al. demonstrated that survivors present long-term neuropsychological deficits, including lowered IQ and attention problems, exacerbated by adjuvant treatment [6].

Emotional lability (pathological laughing or crying) is a disabling symptom associated with brainstem compression. In a recent case-control study, Prakash et al. (2023) showed that extra-axial tumors compressing the pons can trigger these involuntary manifestations [7]. Surgical decompression led to complete remission of symptoms in all study patients and improved quality of life [7].

Although less frequently reported than in children, posterior fossa syndrome also affects adults. Marien et al. (2013) and Wibroe et al. (2018) documented cases of transient mutism and affective disorders in adults following tumor surgery [1, 8]. Symptoms include: executive dysfunction (planning, working memory); personality changes (disinhibition or affective flattening); linguistic difficulties (agrammatism, dysprosody). Omar et al. (2014) draw attention to the difficulty of diagnosing CCAS in adults due to confounding factors such as anxiety and fatigue [9].

There is evidence linking structural posterior fossa abnormalities (e.g. Dandy-Walker cysts, megacicterna magna, tumors) to the onset of psychoses, bipolar disorders, and personality disorders, suggesting that the cerebellum is an essential modulator of mental state [3].

2. Methods

This article is a narrative literature review. We searched PubMed and Google Scholar using combinations of the terms "posterior fossa", "cerebellum", "cerebellar mutism", "posterior fossa syndrome", "cerebellar cognitive affective syndrome", "emotional lability", "pathological laughing and crying", and "brainstem" up to March 2025. We prioritised clinical case reports, case series, prospective cohorts, and systematic reviews that described psychiatric, cognitive, or behavioural outcomes after posterior fossa lesions or surgery in paediatric and adult populations. Reference lists of key articles were screened to identify additional relevant publications. Non-English papers without an English abstract and studies without clear neuropsychiatric data were excluded.

3. Psychiatric and neurobehavioral manifestations according to lesion location in the posterior fossa

For the neurosurgeon, it is clinically helpful to relate psychiatric and cognitive sequelae to the exact location of the posterior fossa lesion. The available literature indicates that midline vermian lesions, lateral hemispheric lesions, involvement of the cerebellar peduncles and dentato-thalamo-cortical pathways, intrinsic brainstem lesions, and developmental malformations of the posterior fossa are each associated with relatively characteristic neuropsychiatric profiles [1–7].

Cerebellar vermis and midline lesions

The cerebellar vermis is crucial for affect modulation and social behaviour and is the key structure implicated in posterior fossa syndrome. In children, midline tumours (especially vermian medulloblastoma) frequently lead to delayed-onset mutism, severe emotional lability and marked personality change in the early postoperative period [4,5]. Pollack describes a triad of transient mutism, severe irritability or pathological crying, and pronounced personality change or behavioural regression [5]. Adults with midline lesions may not develop a full PFS, but subtle combinations of reduced speech output, emotional instability and

personality change have been described [1,8,11]. These manifestations represent the affective–behavioural expression of cerebellar cognitive affective syndrome and can persist as long-term deficits in attention, executive function and social cognition [1,5,6].

Cerebellar hemispheric lesions

Lesions restricted to the cerebellar hemispheres, particularly the posterior lobules, more often present with the "cognitive" aspects of CCAS. Patients may show impaired planning and set-shifting, reduced verbal fluency, visuospatial disorganisation and slowed information processing, with only modest motor signs [1,2,9]. Right hemispheric lesions tend to predominantly affect language and verbal executive functions, whereas left hemispheric lesions more often impair visuospatial abilities. Personality changes are usually milder than in vermian damage, but apathy and irritability are not uncommon, and these deficits are easily overlooked without targeted questioning or formal neuropsychological testing.

Cerebellar peduncles and dentato-thalamo-cortical pathways

The cerebellar peduncles, especially the superior cerebellar peduncle and the dentato-thalamo-cortical tract, are critical for cerebello-cerebral communication. Wickenhauser et al. and other authors have shown that injury to these outflow pathways produces cerebello-cerebral diaschisis with reduced metabolism in contralateral frontal regions, explaining postoperative mutism and frontal-type executive dysfunction [4]. In paediatric series, involvement of the inferior cerebellar peduncle has been consistently associated with more severe and complex PFS phenotypes, including mutism, sleep-disordered breathing, cognitive regression and language disturbance [4,5]. Thus, peduncular damage can generate a full CCAS/PFS picture even when the cerebellar cortex appears relatively preserved.

Brainstem compression and intrinsic brainstem lesions

The brainstem, particularly the pons, plays a central role in emotional expression and arousal. Extra-axial posterior fossa tumours compressing the pons may cause pathological laughing or crying and emotional incontinence; in the series by Prakash et al., decompression led to complete remission of these symptoms and improved quality of life [7]. Intrinsic brainstem lesions can similarly produce emotional lability, rapid mood shifts and reduced initiative through disruption of corticobulbar and monoaminergic pathways [3,7]. In extensive lesions, disorders of consciousness and respiration dominate, but apparently "purely neurological" brainstem compression can be the principal driver of severe postoperative emotional dysregulation.

Developmental malformations and CSF-space abnormalities

Developmental anomalies such as Dandy-Walker malformation, megacisterna magna or large posterior fossa arachnoid cysts have been linked with major psychiatric syndromes. Pollak et al. described patients with such malformations who presented with psychotic disorders, bipolar illness or marked personality change in the absence of supratentorial lesions [3]. It is likely that longstanding distortion or hypoplasia of the vermis and cerebellar outflow pathways alters the maturation of cerebello-limbic circuits, predisposing to psychosis and mood instability. In some cases, psychiatric symptoms are the presenting complaint and posterior fossa pathology is discovered only after brain imaging.

Pediatric versus adult profiles

Although the underlying anatomy is the same, the psychiatric and cognitive sequelae of posterior fossa lesions differ in emphasis between children and adults. In children, vermian tumours and peduncular involvement most often produce the full PFS picture with mutism, striking emotional lability, behavioural regression and long-term reductions in IQ and attention [4–6]. Adjuvant treatments (radiotherapy, chemotherapy) further compound these deficits [6]. From a neurolinguistic perspective, early language acquisition depends on widely distributed cortico-subcortical networks in which the cerebellum has a modulatory role. In a recent review, Cîndea I.E. and Cîndea C. integrated neuropsychological and functional imaging data to show that language development is closely linked to the maturation of fronto-temporo-cerebellar circuits [10]. This framework helps explain why posterior fossa lesions in childhood can lead not only to transient mutism but also to persistent language and communication

disorders. In adults, posterior fossa surgery more commonly results in partial or attenuated syndromes: transient mutism or speech disturbance, subtle personality change, executive dysfunction and mood symptoms. Full-blown PFS is rare but well documented [1,8,9]. Omar et al. underline that in adults, fatigue, anxiety and premorbid psychiatric conditions can mask or mimic CCAS, making systematic cognitive and affective assessment essential [9].

Rare and atypical psychiatric presentations

Beyond the more common patterns of mutism, emotional lability and executive dysfunction, the literature also describes rarer psychiatric phenomena associated with posterior fossa pathology. Pollak et al. documented cases in which posterior fossa lesions were associated with psychotic syndromes, bipolar disorder and severe personality change, sometimes leading to an initial misdiagnosis of primary psychiatric illness [3]. Case reports outside the core series have also described manic episodes, catatonia-like states and vivid hallucinosis in the context of cerebellar or brainstem lesions. Although these presentations are uncommon, they are clinically important because psychiatric onset in mid-life with atypical features or neurological signs should prompt neuroimaging including the posterior fossa; and in neurosurgical patients, new-onset psychosis, mania or catatonia in the postoperative period may represent an extreme form of cerebellar cognitive affective dysfunction rather than a de novo primary psychiatric illness.

4. Clinical implications for neurosurgical practice

Posterior fossa surgery carries significant risks not only for motor function but also for neuropsychiatric integrity. The evidence reviewed confirms that the cerebellum and brainstem participate in distributed networks subserving cognition, affect and behaviour, and that disruption of these networks can produce a recognisable cerebellar cognitive affective syndrome in both children and adults [1–3,9]. In children, this syndrome frequently overlaps with posterior fossa syndrome, characterised by delayed mutism, severe emotional lability and behavioural regression after midline tumour resection [4–6]. In adults, similar circuits can be affected, but the clinical picture is usually more subtle, with partial mutism, personality change and executive dysfunction that are easily misattributed to nonspecific postoperative factors [1,8,9]. In line with previous analysis of surgical versus conservative management in supratentorial intracerebral hemorrhage, where neurosurgical decisions were closely tied to prognostic factors and long-term outcomes [11], similar structured decision frameworks are needed for posterior fossa lesions, explicitly integrating the risk of psychiatric and cognitive sequelae.

Anatomically, midline vermian lesions and developmental malformations of the posterior fossa are most strongly associated with affective dysregulation, personality change and, in some cases, psychotic or bipolar syndromes [3–5]. Lateral hemispheric lesions predominantly produce cognitive deficits—executive dysfunction, visuospatial impairment and language disturbance—with relatively modest motor signs [1,2,9]. Involvement of the cerebellar peduncles and dentato-thalamo-cortical pathways is a key determinant of severity, because disruption of these outflow tracts leads to cerebello-cerebral diaschisis with mutism and frontal-type deficits [3,4]. Compression or intrinsic involvement of the brainstem, especially the pons, may manifest as pathological laughing or crying and other forms of emotional incontinence, often reversible after decompression [3,7].

These findings have direct implications for neurosurgical practice. Pre-operative counselling should include specific information about potential cognitive and psychiatric sequelae, especially in paediatric patients with vermian tumours and in adults undergoing extensive midline or peduncular resections. Post-operative follow-up should incorporate simple, standardised screening for mutism, emotional lability, personality change and executive deficits. Where abnormalities are identified, referral to psychiatry, neuropsychology and rehabilitation services is essential. Paediatric series demonstrate that early recognition and structured cognitive and behavioural interventions can improve educational and adaptive outcomes in posterior fossa tumour survivors [5,6].

5. Conclusions

The cerebellum is not only a coordinator of movement but an essential modulator of the mind. Subtle postoperative changes in personality or executive function and severe emotional lability

should not be dismissed as transient or purely reactive phenomena; they often represent the clinical expression of a well-defined cerebellar syndrome. The literature reviewed, including studies on posterior fossa surgery and posterior fossa syndrome, strengthens the evidence that involvement of the cerebellar peduncles—particularly the inferior cerebellar peduncle—is consistently associated with mutism, cognitive and psychiatric disorders, sleep-disordered breathing and language impairment [3–5]. Systematically integrating lesion-location–based risk assessment, routine neuropsychiatric screening and early cognitive–behavioural rehabilitation into posterior fossa care pathways is therefore crucial to optimise not only survival but also long-term quality of life and social reintegration in these patients.

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