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SURGICAL MANAGEMENT OF SUPRASELLAR GERMINOMA: INSIGHTS FROM A CRANIOTOMY CASE

Monica Halim[1], **Andrea Valentino**[2], **Agustiawan**[3]

[1]Department of Surgery, Faculty of Medicine, University of Riau, A Achmad Regional General Hospital, Riau, Indonesia
[2]Neurosurgery Divison, Department of Surgery, University of Riau, A Achmad Regional General Hospital, Indonesia
[3]Faculty of Medicine, Helvetia Health Institution, Medan, Sumatera Utara, Indonesia

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ABSTRACT

Intracranial germinoma is a rare midline CNS tumor, most commonly arising in the suprasellar or pineal regions. Suprasellar lesions frequently cause hypothalamic–pituitary dysfunction, resulting in diabetes insipidus, endocrine abnormalities, and visual impairment. We report a 21-year-old man with a two-year history of progressive visual blurring and polyuria–polydipsia that culminated in acute loss of consciousness. Imaging revealed a suprasellar mass, and clinical deterioration required intensive care admission. Craniotomy was performed for tumor decompression and histopathological diagnosis, confirming germinoma. Postoperative radiotherapy led to recovery of consciousness after the third session and marked tumor regression to approximately 1 cm, demonstrating the tumor's high radiosensitivity. Despite favorable oncologic response, residual deficits persisted, including left-sided visual blurring, complete right-eye blindness, severe hypocortisolemia, and low prolactin levels requiring hormone replacement therapy. This case emphasizes the importance of early diagnosis, individualized treatment, and multidisciplinary management to achieve tumor control while addressing long-term neurological and endocrine sequelae. Survivorship-focused care integrating endocrinology, rehabilitation, psychosocial support, and adherence monitoring is essential, particularly in resource-limited settings, to improve treatment continuity, reduce complications, and enhance quality of life among young brain tumor survivors.

Corresponding Author:
Monica Halim
Department of Surgery, Faculty of Medicine,
University of Riau, Arifin Achmad Regional General Hospital, Pekanbaru, Riau, Indonesia
Email: monicahalim.sk@gmail.com

1. INTRODUCTION

Intracranial germinoma represents a malignant form of central nervous system germ cell tumors (CNS-GCTs) that primarily affects children, adolescents, and young adults. Despite being uncommon worldwide, its incidence shows marked geographic variation. [1] Epidemiological data consistently demonstrate a higher occurrence in East Asian populations compared with Western countries, indicating a possible contribution of genetic or population-specific susceptibility factors. The disease is more frequently observed in males, particularly when tumors arise in the pineal or suprasellar regions. Large cohort studies from Asia report a predominance of male patients, with a median age at diagnosis around early adolescence. Additionally, tumors located in non-midline areas such as the basal ganglia have been associated with poorer recurrence-free survival compared to those in typical midline locations [1], [2], [3].

Advances in molecular research have uncovered significant biological diversity within germinomas. Genomic and epigenetic studies have identified activation of key signaling pathways, including the MAPK and PI3K pathways, along with distinct DNA methylation profiles. [4] These findings contribute to more precise tumor classification, improved risk stratification, and the exploration of targeted therapeutic approaches. Although the exact cause of intracranial germinoma remains uncertain, patterns of ethnic predominance and familial clustering further support the role of genetic predisposition, particularly among individuals of Asian descent [5].

Clinically, suprasellar germinomas often present with endocrine and visual disturbances due to involvement of the hypothalamic–pituitary axis. Diabetes insipidus frequently appears as an early symptom and may precede imaging findings by a considerable period, while progressive visual decline occurs as the tumor compresses adjacent optic structures. Importantly, germinomas are highly responsive to radiotherapy and chemotherapy. [6] Contemporary studies involving large patient populations have reported excellent survival outcomes, with five-year overall survival rates exceeding 97% when appropriate treatment protocols are implemented. Nevertheless, therapeutic strategies must carefully consider long-term complications, including hormonal deficiencies, neurocognitive effects, and visual impairment, particularly given the young age of affected patients and their long life expectancy [5], [7].

This case report aims to illustrate the diagnostic and therapeutic challenges in managing a suprasellar germinoma presenting predominantly with endocrine dysfunction and progressive visual impairment. In addition, this report highlights the importance of early recognition and multidisciplinary management to optimize both oncological and functional outcomes. Considering its predilection for younger individuals, potential for lasting neurologic and endocrine consequences, and distinct geographic distribution, a comprehensive understanding of intracranial germinoma is crucial. Improved awareness of its epidemiology and clinical presentation facilitates earlier diagnosis, supports informed treatment planning, and enables the development of individualized management approaches that preserve quality of life while maintaining high survival rates. In selected cases, surgical intervention may also play an important role in establishing histopathological diagnosis and relieving acute mass effect or visual compromise when diagnostic uncertainty and rapid neurological deterioration are present

2. RESEARCH METHOD

A 21-year-old man presented with a two-year history of progressively worsening visual impairment. Initially, he experienced intermittent blurring of vision, which gradually progressed to severe bilateral visual loss. Approximately six months after the onset of visual symptoms, he developed persistent polyuria and polydipsia suggestive of diabetes insipidus. Over the following months, his family noted progressive behavioral changes, cognitive decline, emotional withdrawal, and excessive daytime sleepiness. His symptoms culminated in a sudden episode of loss of consciousness while driving, clinically resembling a narcoleptic attack, prompting emergency hospital admission.

Upon admission to the intensive care unit, the patient appeared somnolent and intermittently disoriented. Ophthalmologic examination demonstrated complete vision loss in the right eye (oculus dexter) and markedly reduced visual acuity in the left eye (oculus sinister), findings suggestive of optic chiasm compression. Formal perimetry could not be performed during the acute phase because of decreased consciousness and profound visual dysfunction. Serial ophthalmologic assessments were subsequently conducted during follow-up to evaluate residual visual function and monitor disease progression.

Brain magnetic resonance imaging (MRI) revealed a large suprasellar mass measuring $3.8 \times 4.0 \times 4.2$ cm with homogeneous contrast enhancement, thickening of the pituitary stalk, and restricted diffusion on diffusion-weighted imaging (DWI), findings strongly suggestive of intracranial germinoma. Differential diagnoses considered during the diagnostic workup included craniopharyngioma, pituitary adenoma, and Langerhans cell histiocytosis involving the hypothalamic–pituitary axis.

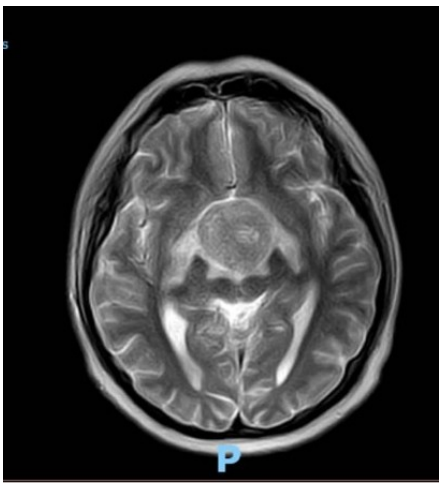

Figure 1. Axial T2-weighted brain MRI demonstrates a well-defined suprasellar mass with predominantly hyperintense signal intensity relative to the surrounding brain parenchyma. The lesion appears centered in the midline region, involving the hypothalamic–pituitary area, with extension toward the optic chiasm region. Mild surrounding edema and mass effect on adjacent structures are noted. The ventricles appear mildly prominent without evidence of acute hemorrhage or midline shift on this image. These imaging findings are suggestive of a suprasellar neoplasm, with intracranial germinoma included in the differential diagnosis

Comprehensive endocrine evaluation demonstrated severe panhypopituitarism. Laboratory testing revealed secondary adrenal insufficiency with serum cortisol levels below 1 μg/dL, central hypothyroidism, diabetes insipidus, and central hypogonadism with markedly reduced prolactin levels, indicating extensive hypothalamic–pituitary dysfunction. Hormonal parameters were monitored serially by the endocrinology team throughout hospitalization and follow-up visits to guide replacement therapy adjustments. Given the significant mass effect and imminent risk of irreversible visual loss, the patient underwent right frontotemporal craniotomy for tumor debulking and tissue biopsy. Intraoperatively, the lesion appeared as a solid and friable suprasellar tumor. Histopathological examination confirmed the diagnosis of germinoma. Postoperatively, hormone replacement therapy was initiated, including hydrocortisone, levothyroxine, and desmopressin.

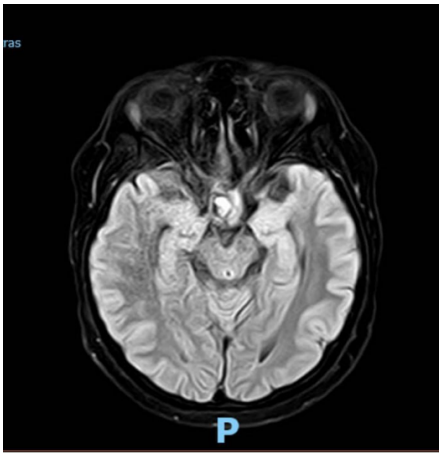

Figure 2. Axial T2-weighted/FLAIR brain MRI demonstrates a suprasellar lesion centered in the hypothalamic–pituitary region with heterogeneous hyperintense signal intensity. The mass extends superiorly toward the optic chiasm and adjacent basal cisterns, producing mild compression of surrounding structures. No acute intracranial hemorrhage is identified on this image. Mild perilesional edema is present without significant midline shift. The imaging appearance is consistent with a suprasellar neoplasm, and intracranial germinoma should be considered among the leading differential diagnoses

Following surgery, the patient received platinum-based chemotherapy followed by radiotherapy under the supervision of the neuro-oncology and radiation oncology teams. Serial MRI evaluations demonstrated marked tumor regression, leaving only a residual cystic lesion measuring $7 \times 10 \times 7$ mm. Neurologically, the patient improved substantially, achieving a Glasgow Coma Scale score of 15 with resolution of hypersomnolence episodes. Radiological response was monitored by serial neuroimaging, whereas endocrine outcomes were followed through repeated hormonal assessments and clinical evaluation by endocrinology specialists.

Despite favorable oncologic control, the patient subsequently developed severe hypothalamic obesity. His body weight increased from 75 kg at presentation to 130 kg within six months after treatment. Weight trajectory, metabolic parameters, and cardiovascular risk factors were monitored through multidisciplinary follow-up involving endocrinology, internal medicine, nutrition, and rehabilitation services. During the same period, the patient also developed symptoms consistent with peripheral neuropathy, likely related to metabolic imbalance and treatment-related complications. Blood pressure and glycemic profiles remained within acceptable limits during follow-up.

Long-term follow-up was complicated by poor adherence to hormone replacement therapy. Approximately one year after treatment completion, the patient independently discontinued hydrocortisone and other hormonal medications for nearly eleven months because he believed his condition had improved and underestimated the importance of lifelong endocrine therapy. This non-adherence resulted in recurrent adrenal insufficiency with progressive weakness, fatigue, and clinical deterioration, necessitating re-evaluation by the endocrinology team. Re-initiation of hydrocortisone at a dose of 20 mg twice daily resulted in clinical stabilization and improvement of symptoms.

From the patient's perspective, restoration of consciousness and improvement in daytime alertness after treatment were perceived as major improvements in quality of life. However, he expressed significant emotional distress related to permanent visual impairment and rapid weight gain after therapy, both of which substantially affected daily activities and social interactions. The patient and family also acknowledged difficulties in maintaining long-term adherence to complex hormone replacement regimens.

Table 1: Chronological Timeline of Clinical Course

Time Course	**Clinical Events**
2 years before admission	Progressive intermittent visual blurring began.
18 months before admission	Development of polyuria and polydipsia.
12 months before admission	Behavioral changes, cognitive decline, and hypersomnolence.
At presentation	Sudden loss of consciousness while driving, requiring ICU admission.
Initial hospitalization	MRI revealed a suprasellar mass; endocrine evaluation confirmed panhypopituitarism.
Early treatment phase	Right frontotemporal craniotomy and biopsy were performed.
Postoperative period	Histopathology confirmed germinoma; hormone replacement therapy was initiated.
Subsequent months	Platinum-based chemotherapy and radiotherapy were completed.
6 months after treatment	Significant tumor regression was observed on MRI; severe hypothalamic obesity developed.
Approximately 1 year later	Hormone therapy was discontinued by the patient for approximately 11 months.
Follow-up after non-adherence	Recurrent adrenal insufficiency occurred; hydrocortisone therapy was restarted.
November 2025	MRI confirmed sustained remission without evidence of recurrence.

At the latest follow-up in November 2025, serial MRI demonstrated sustained remission without evidence of tumor recurrence. Clinical outcomes continued to be monitored through multidisciplinary follow-up involving neurosurgery, neuro-oncology, endocrinology, ophthalmology, and rehabilitation medicine.

3. RESULT AND ANALYSIS

Intracranial germinoma is among the most frequently encountered subtypes of central nervous system germ cell tumors (CNS-GCTs) and is characterized by distinct epidemiological patterns, including notable racial predilections. [1], [8] Its incidence differs markedly between populations, with consistently higher rates reported in Asian countries compared to Western regions, as demonstrated in epidemiological studies such as those by Poynter et al. This distribution aligns with the demographic profile observed in our case, involving a young adult male, which is consistent with the well-documented male predominance and peak incidence during adolescence and early adulthood [9].

The clinical manifestations in this patient closely reflect the typical presentation of suprasellar germinoma. Gradual visual deterioration and early endocrine abnormalities, particularly diabetes insipidus (DI), are hallmark features resulting from tumor involvement of the optic chiasm and hypothalamic–pituitary axis. [9] Endocrine dysfunction is often one of the earliest indicators, with hypopituitarism, adrenal insufficiency, and gonadal hormone deficiencies commonly reported. In this case, the presence of severe hypocortisolism ($< 1\mu$g/dL) and markedly suppressed prolactin levels strongly indicates hypothalamic–pituitary axis impairment and is in line with findings reported in previous studies. [1], [10], [11], [12].

Table 2: Clinical Course, Interventions, and Outcomes

Category	Findings
Baseline characteristics	A 21-year-old male with a 2-year history of progressive visual blurring, polyuria–polydipsia, hypersomnolence, behavioral changes, and cognitive decline.
Initial neurological status	Somnolence, intermittent disorientation, and acute loss of consciousness resembling a narcoleptic episode.
Baseline ophthalmologic findings	Complete right-eye blindness and decreased left-eye visual acuity consistent with optic chiasm compression.
Baseline endocrine findings	Severe hypocortisolemia (< 1 μg/dL), low prolactin levels, diabetes insipidus, and panhypopituitarism.
MRI findings	Suprasellar mass measuring $3.8 \times 4.0 \times 4.2$ cm with homogeneous enhancement, pituitary stalk involvement, and restricted diffusion.
Differential diagnoses	Germinoma, craniopharyngioma, pituitary adenoma, and Langerhans cell histiocytosis.
Surgical intervention	Right frontotemporal craniotomy with subtotal tumor debulking and biopsy.
Extent of resection	Subtotal resection was performed to relieve mass effect and preserve optic and hypothalamic structures.
Histopathology	Confirmed intracranial germinoma.
Chemotherapy	Platinum-based regimen consisting of carboplatin and etoposide.
Radiotherapy	Fractionated external-beam radiotherapy according to the institutional neuro-oncology protocol.
Perioperative management	Steroid replacement, electrolyte monitoring, diabetes insipidus management, and multidisciplinary care.
Oncologic outcome	Significant tumor regression with a residual lesion measuring $7 \times 10 \times 7$ mm.
Visual outcome	Persistent right-eye blindness with partial stabilization or improvement in left-eye vision.
Endocrine outcome	Persistent adrenal insufficiency and hypopituitarism requiring long-term hormone replacement.
Complications	Hypothalamic obesity, with body weight increasing from 75 kg to 130 kg within 6 months; no cerebrospinal fluid leak or postoperative infection was observed.
Follow-up status	Ongoing remission without recurrence on serial MRI through November 2025.

Magnetic resonance imaging (MRI) plays a central role in the detection and characterization of intracranial germinomas. In this patient, MRI revealed a well-defined, homogeneously enhancing suprasellar mass measuring approximately 3.6–4.3 cm, with typical midline localization [4], [13]. These imaging characteristics are highly suggestive of germinoma and help distinguish it from other sellar and suprasellar lesions such as pituitary adenoma or craniopharyngioma [6], [8], [9]. Standard MRI protocols for CNS-GCTs include T1-weighted, T2-weighted, FLAIR, contrast-enhanced T1, and diffusion-weighted imaging (DWI) sequences in multiple planes, consistent with contemporary imaging recommendations [4], [10]. Following surgical intervention and radiotherapy, the marked reduction in tumor size to approximately 1 cm further supports the well-known radiosensitive and chemosensitive nature of germinomas [1], [11].

Management of intracranial germinoma follows well-established international guidelines, including those from SIOP and ESCP, which advocate a multimodal approach combining radiotherapy with platinum-based chemotherapy. [6] Surgical intervention is generally limited to obtaining tissue diagnosis or relieving mass effect, given the tumor's excellent response to non-surgical treatments. In the present case, subtotal tumor debulking rather than biopsy alone was performed because of significant mass effect, progressive visual compromise, and acute neurological deterioration. Surgical debulking was performed to reduce tumor burden while preserving surrounding critical neurovascular structures. Because proton therapy was not available locally, the patient subsequently received conventional fractionated external-beam radiotherapy combined with platinum-based chemotherapy using carboplatin and etoposide, in accordance with institutional neuro-oncology protocols and current standards of care for intracranial germ cell tumors. Beyond oncologic treatment, long-term management in this patient required extensive multidisciplinary coordination involving pediatric endocrinology, neurosurgery, oncology, rehabilitation, nutrition, and family counseling services. Persistent endocrine dysfunction following suprasellar tumor treatment necessitated ongoing hormone replacement therapy and regular monitoring for treatment adherence, metabolic complications, and neurocognitive impairment. In resource-constrained settings, maintaining adherence to endocrine replacement therapy may be challenging because of limited access to medications, transportation barriers, and fragmented follow-up systems. Therefore, structured health education for patients and caregivers plays an important role in improving understanding of lifelong hormonal treatment needs, recognizing early signs of adrenal crisis or electrolyte imbalance, and encouraging continuity of care. Strengthening multidisciplinary collaboration and caregiver-centered education may help optimize long-term outcomes and quality of life in pediatric patients

with complex neuroendocrine tumors, particularly in middle-income healthcare systems [9], [14].

Perioperative management involved multidisciplinary collaboration among neurosurgeons, neuro-oncologists, endocrinologists, neuroradiologists, radiation oncologists, ophthalmologists, and intensive care specialists through coordinated case discussions and longitudinal follow-up. [9], [14]. Postoperatively, corticosteroid replacement was initiated with gradual tapering according to endocrine response and hemodynamic stability. Fluid balance, urine output, serum sodium, and electrolyte levels were closely monitored to manage central diabetes insipidus and prevent perioperative electrolyte disturbances. No postoperative infection, acute hypothalamic injury, or persistent cerebrospinal fluid leakage was identified [15].

Although survival outcomes for germinoma are highly favorable, long-term endocrine complications remain a significant concern. Persistent hypopituitarism, diabetes insipidus, and adrenal insufficiency are frequently observed following treatment, resulting from both tumor-related damage and therapeutic effects on the hypothalamic–pituitary axis [2], [6], [7]. In this patient, continued cortisol deficiency and low prolactin levels during follow-up reflect these chronic sequelae and emphasize the importance of lifelong endocrine monitoring and hormone replacement therapy, as recommended in the literature [15]. Visual function partially stabilized following treatment; however, complete visual recovery was not achieved. Right-sided blindness persisted, while left-eye visual acuity showed partial improvement on serial ophthalmologic evaluations. Formal quantitative perimetry was unavailable during the acute phase because of the patient's neurological condition.

Overall prognosis in intracranial germinoma is excellent, with large cohort studies reporting long-term survival rates exceeding 90–97% when treated according to established protocols [16]. Favorable outcomes are closely associated with early diagnosis, accurate staging, and adherence to combined therapeutic strategies [17], [18]. In the present case, the patient demonstrated significant radiological regression, improved clinical status with full consciousness (GCS 15), stabilization of visual function, and gradual endocrine recovery with appropriate hormone replacement, findings that align with outcomes reported in previous studies [12]. Current literature suggests that biopsy-only strategies are generally preferred for lesions with classic radiological and tumor marker profiles because of the high radiosensitivity of germinomas, whereas subtotal debulking may be considered in selected patients with severe mass effect, hydrocephalus, or rapidly progressive visual impairment. Minimally invasive approaches such as endoscopic endonasal biopsy are increasingly utilized and may reduce operative morbidity in appropriately selected suprasellar tumors [17], [18].

Long-term management of hypothalamic obesity in this patient included nutritional counseling, endocrine optimization, weight monitoring, and rehabilitation support, although sustained metabolic control remained challenging. This study has several limitations inherent to a single case report. First, the retrospective nature of this report and the possibility of selection bias may limit interpretation of clinical outcomes. Second, the findings may have limited generalizability, as they represent the clinical course and management of a single patient and may not fully reflect the heterogeneity of intracranial germinoma presentations across different populations. Third, the absence of long-term follow-up data restricts the ability to evaluate sustained oncological control, late recurrence, and long-term endocrine outcomes. Treatment decisions were also influenced by local resource availability, including limited access to advanced modalities such as proton therapy, which may affect comparability with outcomes reported in centers with more comprehensive facilities. Additionally, the lack of formal quantitative visual field testing limited objective assessment of visual recovery.

Fluctuations in hormone levels during follow-up may not solely reflect treatment failure or individual nonadherence, but also broader systemic challenges commonly encountered in resource-constrained healthcare settings. Limited medication availability, inconsistent follow-up infrastructure, transportation barriers, financial constraints, variable caregiver health literacy, and insufficient psychosocial support may all contribute to interruptions in long-term endocrine replacement therapy. These challenges are particularly relevant in survivors of pediatric neuroendocrine tumors who require lifelong multidisciplinary monitoring. Public health-oriented strategies such as caregiver-centered education programs, digital reminder and telemonitoring systems, integrated survivorship clinics, and task-shifting of stable endocrine follow-up to primary care providers may help improve treatment continuity and early detection of complications. Strengthening coordination between tertiary referral centers and community-based healthcare services may further support long-term adherence, reduce preventable metabolic decompensation, and improve quality of life among pediatric brain tumor survivors in middle-income settings.

4. CONCLUSION

This case highlights the importance of early diagnosis and multidisciplinary management in suprasellar germinoma to preserve neurological, visual, and endocrine function. Surgical intervention should be limited to tissue diagnosis or acute decompression, while definitive treatment primarily relies on radiotherapy and platinum-based chemotherapy. Lifelong endocrine surveillance and structured adherence support are essential, as treatment discontinuation may lead to significant clinical deterioration despite good oncologic control.

Written informed consent was obtained from the patient for publication of this case report and accompanying clinical images. Patient identity and personal information were anonymized to ensure confidentiality. According to institutional policy, ethical approval was not required for a single-patient case report. This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. This manuscript was prepared and reported in accordance with the CARE (CAse REport) guidelines to ensure completeness and transparency in case report reporting. A completed CARE checklist is recommended for submission as supplementary material.

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