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Gamma knife radiosurgery for pediatric hypothalamic hamartoma: a case series illustrating delayed and heterogeneous clinical responses

Made Agus Mahendra Inggas[1,2], Kennytha Yoesdyanto[2,3], Edeline Samudra[2*], Nathan Muliawan[2], Prudence Wirajaya[2], Elia Soediatmoko[4], Irhas[4]

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ABSTRACT

Hypothalamic hamartoma (HH) is a rare congenital, non-neoplastic lesion of the hypothalamus, commonly presents with gelastic seizures, precocious puberty, or both. Gamma Knife radiosurgery (GKRS) has emerged as a minimally invasive treatment option, although long-term outcomes remain incompletely characterized. We report three pediatric patients with HH treated with single-session GKRS and evaluate their long-term clinical and radiological outcomes. All patients presented with gelastic seizures and precocious puberty, accompanied by varying degrees of cognitive, behavioral, or developmental impairment. Lesions were classified as Delalande type II-III, with target volumes ranging from 2.100 to 6.140 cm^3. Following GKRS, seizure outcomes were heterogeneous. The first patient achieved substantial seizure control (Engel class ID) nearly 4 years after treatment, accompanied by cognitive improvement and reduction in antiseizure medication burden. The second patient experienced marked seizure improvement, including 2 years of complete remission (Engel class IA), but developed late seizure recurrence approximately 5 years after treatment (Engel class IIIB). The third patient demonstrated transient early improvement followed by seizure recurrence at 6-month follow-up (Engel class IVB). Radiological changes included transient lesion enlargement, central necrosis, and cystic evolution, which did not consistently correlate with clinical outcomes. Although responses varied, seizure improvement in two patients occurred despite minimal long-term volumetric reduction, supporting the hypothesis that GKRS may exert its effects through delayed neuromodulatory mechanisms rather than direct lesion shrinkage. These cases highlight the heterogeneous and delayed nature of clinical responses following GKRS, underscoring the importance of long-term follow-up when evaluating treatment outcomes in pediatric HH.

Keywords: Hypothalamic hamartoma, gelastic epilepsy, gamma knife radiosurgery.

Type of Article: Case Report **Specialty:** Neurosurgery, Neurology

Correspondence to: Edeline Samudra
*Faculty of Medicine, Pelita Harapan University, Tangerang, Indonesia.
Email: edelinesamudra@gmail.com
Full list of author information is available at the end of the article.

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Background

Hypothalamic hamartoma (HH) is a rare developmental, non-neoplastic brain lesion composed of ectopic glial and neural tissue [1,2]. Most cases of HH occur sporadically, with an incidence of 1 in 50,000 to 100,000 and a slight male predominance [1,3]. The most common clinical presentations are seizures (61%), precocious puberty (66%), or both (25%). The characteristic seizure type is gelastic seizures, with up to 40% developing drug-resistant epilepsy (DRE) [4].

HH can be managed through both open and endoscopic surgical approaches. However, due to the deep anatomical location, surgical management can be complex and potentially catastrophic. The most frequently used minimally invasive options include stereotactic radiosurgery (SRS), radiofrequency thermocoagulation, and laser ablation. SRS is accepted as the first-line modality for Regis grade 1-3 lesions, with Gamma Knife radiosurgery (GKRS) being one of the main SRS techniques [1,3]. Although GKRS has shown promising outcomes for HH, its long-term efficacy remains under investigation. In developing countries, including Indonesia, access to GKRS for HH is limited, and its application remains uncommon. In this case series, we present three pediatric patients with HH who were treated with GKRS, which is still rarely performed in Indonesia. Seizure outcomes were assessed clinically according to the Engel Outcome Scale.

Case Presentation

Case 1

A 12-year-old boy presented with intractable gelastic epilepsy beginning at age 1, initially occurring 1-2 times per week and progressing to four times daily, later evolving to include blank stares, body stiffness, and

loss of consciousness. Symptoms were accompanied by throbbing frontal headaches, mood disorders, signs of aggressiveness in early childhood, and cognitive decline, particularly in executive function and short-term memory. The patient showed evidence of precocious puberty from age 5, and received hormonal therapy until age 9.

Laboratory examinations revealed hypothalamic-pituitary axis dysfunction, including recurrent hypocortisolism, low growth hormone level, and high testosterone, suggesting early pubertal onset, while thyroid function remained normal. Electroencephalography (EEG) showed no abnormal findings. Magnetic resonance imaging (MRI) revealed a non-enhancing retrochiasmatic suprasellar nodule consistent with Delalande type III HH.

Despite treatment with multiple antiseizure medications (ASMs), seizures remained refractory. GKRS was performed with a marginal dose of 17.0 Gy targeting a 2.100-cm³ lesion (Figure 1). At 6 months post-GKRS, cognitive performance improved, although seizure symptoms persisted, and sleep disturbance was noted. At 12 months, imaging showed enlargement of the lesion with central necrosis; however, laughing spells improved, and follow-up cognitive assessment showed slight improvement. At 18 months, MRI revealed lesion regression and continued neurocognitive improvement. Over the following years, seizure frequency gradually decreased, allowing a reduction of ASM use. Nearly 4 years post-treatment,

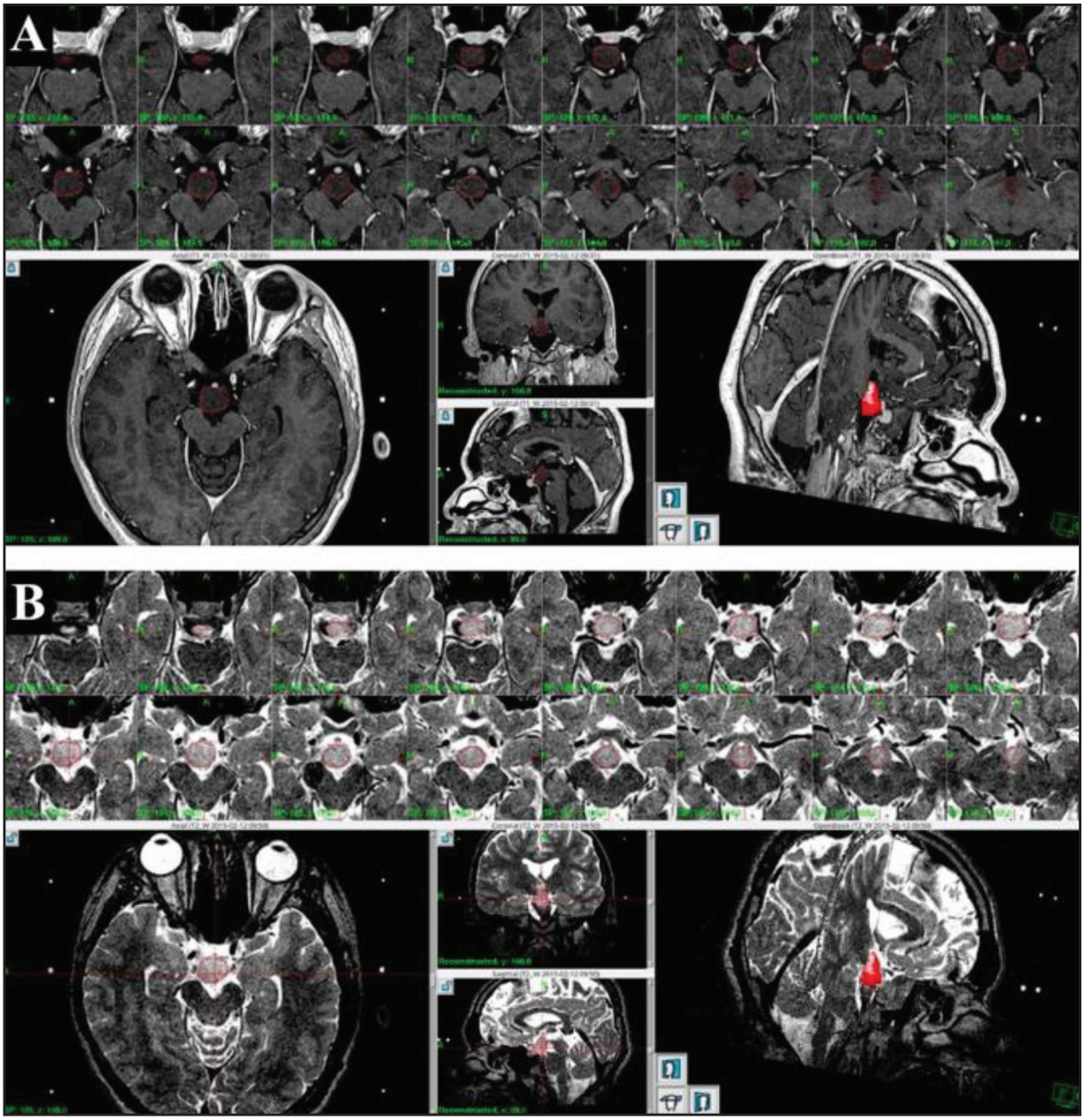

Figure 1. *Pre-treatment MRI of Case 1. Axial T1-weighted (A) and T2-weighted (B) images demonstrating a non-enhancing retrochiasmatic HH (Delalande type III) located in the suprasellar region. The lesion measured 2.100 cm³ and was selected as the target for GKRS.*

the patient achieved seizure control (Engel class ID) while continuing routine ASM therapy (Figure 2).

Case 2

A 5-year-old girl presented with gelastic seizures beginning at age 2, progressing to frequent daily episodes and occasional generalized myoclonic seizures, accompanied by rage attacks, mood disorders, and speech delay. She had previously undergone tumor resection but remained refractory to medical therapy.

EEG revealed multifocal epileptiform discharges, while examination revealed precocious puberty and developmental delay. Laboratory tests showed neuroendocrine abnormalities, most notably low morning cortisol, indicating central adrenal insufficiency, and a mildly elevated T3 level. Brain MRI revealed a hypothalamic mass involving the tuber cinereum, suggestive of an HH (Figure 3).

In November 2017, at age 5, the patient underwent GKRS with a target volume of 6.140 cm³ and a marginal dose of 18.0 Gy (Figure 4). An initial reduction in seizures was observed in the first month, followed by a transient worsening. However, by 5 months, seizures improved with the resolution of generalized seizures and controlled gelastic seizures. T3 and T4 hormone levels were elevated, and cortisol levels decreased. MRI revealed transient lesion enlargement with central necrosis.

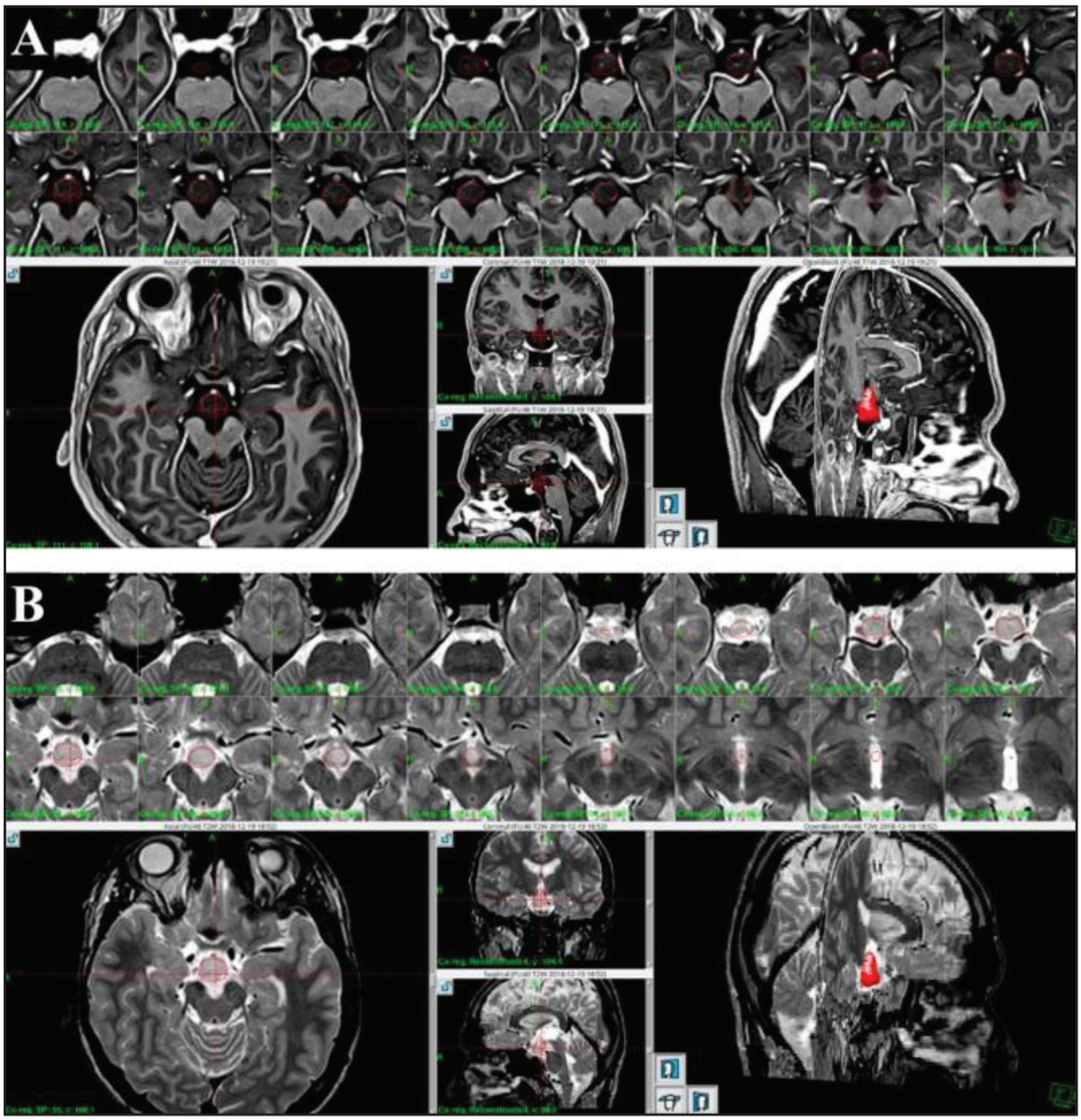

Figure 2. *Follow-up MRI of Case 1 at 46 months after GKRS. Axial T1-weighted (A) and T2-weighted (B) images demonstrating stable lesion volume (2.100 cm³) without significant mass effect. Despite minimal volumetric change, the patient achieved substantial clinical improvement with marked seizure reduction (Engel class ID).*

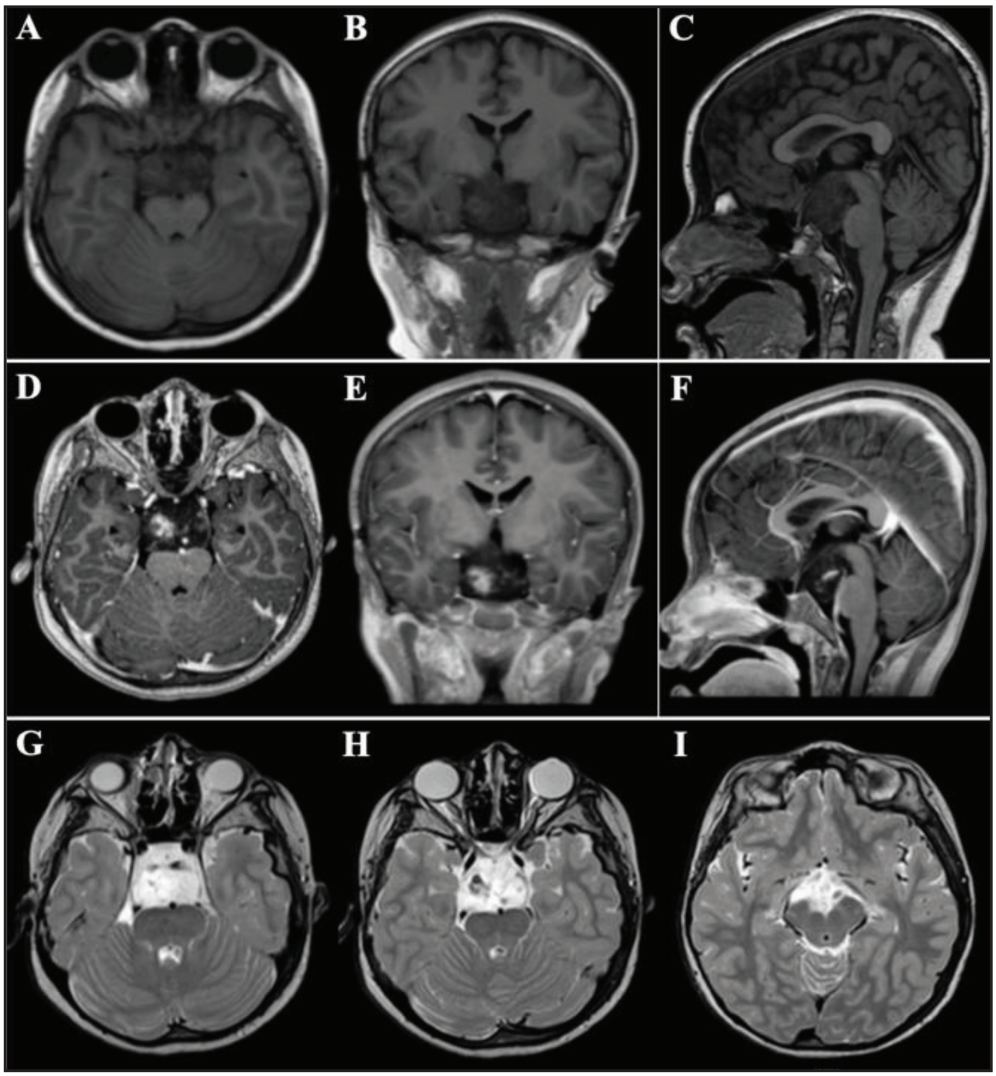

Figure 3. *Pre-treatment MRI of Case 2. T1-weighted MRI without contrast in axial (A), coronal (B), and sagittal (C) views; T1-weighted MRI with contrast in axial (D), coronal (E), and sagittal (F) views; and T2-weighted MRI in axial (G), coronal (H), and sagittal (I) views. MRI demonstrates a large HH (Delalande type III) extending from the tuber cinereum into the hypothalamus, measuring approximately 2.7 × 3.4 × 3.0 cm. The lesion is associated with mass effect on the midbrain, pons, optic chiasm, and third ventricle, and shows proximity to major intracranial vessels.*

The patient achieved prolonged seizure control, including 2 years of complete remission (Engel class IA), but experienced recurrence approximately 5 years after GKRS (Engel class IIIB). MRI demonstrated lesion enlargement with hemorrhagic and cystic components (Figure 5). Behavioral symptoms worsened, and she was subsequently prescribed aripiprazole and valproic acid. At age 11, she underwent repeat microsurgical resection. Postoperative MRI demonstrated a substantial reduction in lesion volume, with only minimal residual tissue attached to the hypothalamus and tuber cinereum, as well as a persistent cystic suprasellar lesion adjacent to the HH. It is still unclear whether the recurrent seizures were driven by residual HH tissue, the cystic lesion, or secondary epileptogenic changes. Currently, seizures persist but remain well-controlled with valproic acid.

Case 3

An 8-year-old boy presented with recurrent gelastic and dacrystic seizures beginning at the age of 1, occurring 2-3 times daily and accompanied by body stiffness despite levetiracetam and valproic acid therapy. He also developed early pubic hair, frequent penile erections, attention deficit, and had previously received leuprorelin acetate. Examination confirmed precocious puberty, most notably a deep, adult-like voice and increased stature. Laboratory evaluation showed borderline low morning cortisol, suggesting central adrenal dysfunction. MRI revealed a sessile hypothalamic mass consistent with type IIA HH (Figure 6).

The patient was treated with hormonal therapy and multiple ASMs. Although microsurgical resection was recommended, the family opted for GKRS. The lesion was irradiated with 15.0 Gy to its margin, delivered to the 40%

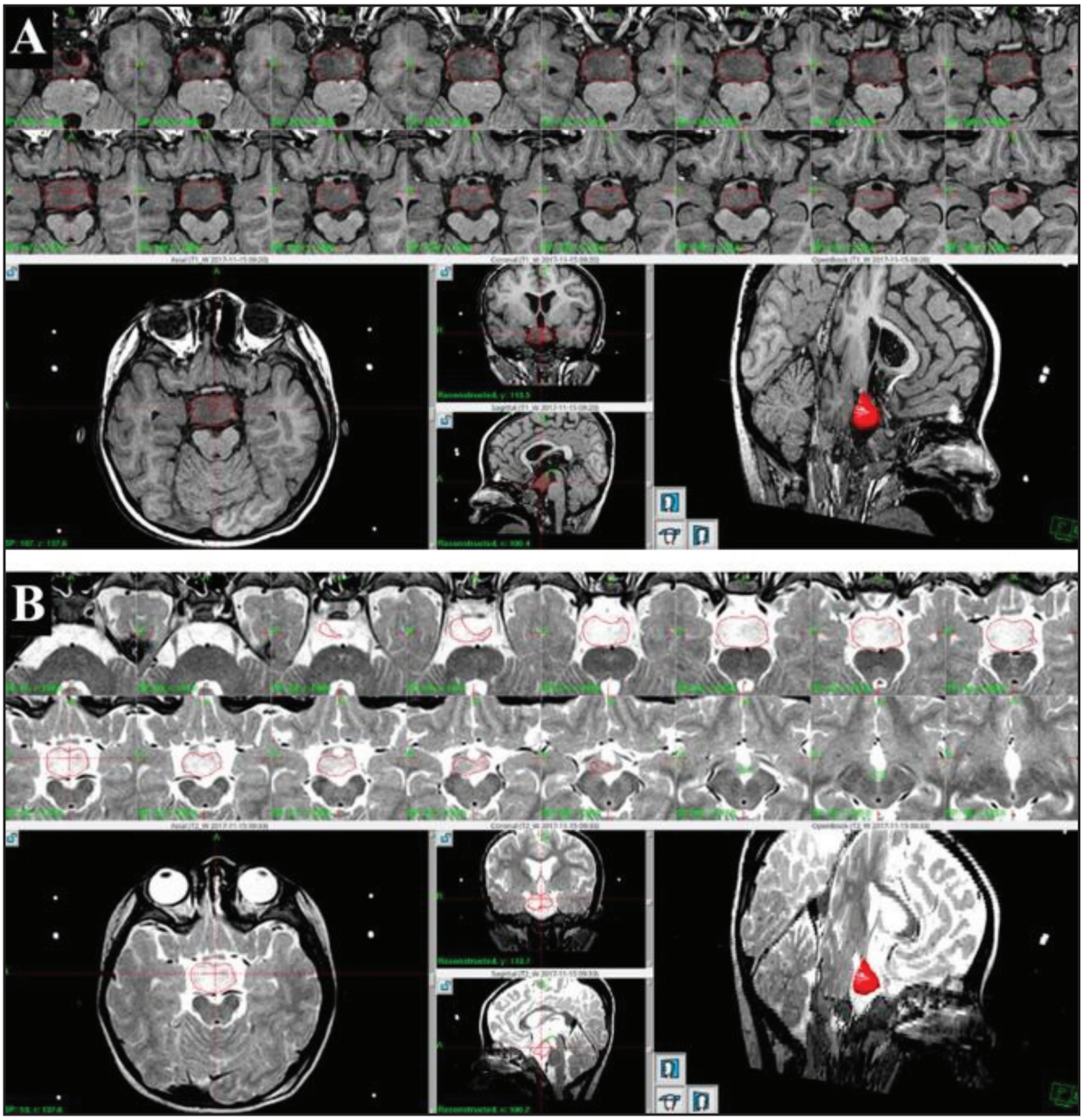

Figure 4. *Pre-GKRS MRI of Case 2. Axial T1-weighted (A) and T2-weighted (B) images demonstrating residual HH following prior microsurgical resection. Target volume at the time of GKRS was 6.140 cm³.*

isodose line with a target volume of 5.752 cm³ (Figure 7). At 6 months post-GKRS, there was transient seizure reduction during the first month, followed by recurrence (Engel class IVB). MRI demonstrated transient lesion enlargement following GKRS (Figure 8), an expected post-radiosurgical finding (Figure 9). The patient remains on valproic acid and is under ongoing follow-up.

Discussion

Hypothalamic hamartoma

HHs are congenital brain malformations that contribute to the development of intractable epilepsy syndromes, primarily due to the presence of a complex and dynamic cortical-subcortical ictal network that facilitates secondary epileptogenesis [1]. HHs present with a wide spectrum of clinical manifestations, which can be categorized into three major groups: endocrine, neurological, and psychiatric. The most common endocrine manifestation is precocious puberty, typically occurring when the lesion is situated near the infundibulum [3]. All three patients in this case series experienced precocious puberty, likely because the lesion was large enough to reach the infundibulum.

Neurological and psychiatric features are more frequently seen in tumors involving the mammillary bodies, and may include cognitive impairment, intellectual disability, mood disorders, behavioral problems, and epilepsy [3]. These features were noted in all three patients: the first patient had cognitive impairment, the second had developmental delay, and the third experienced attention deficit.

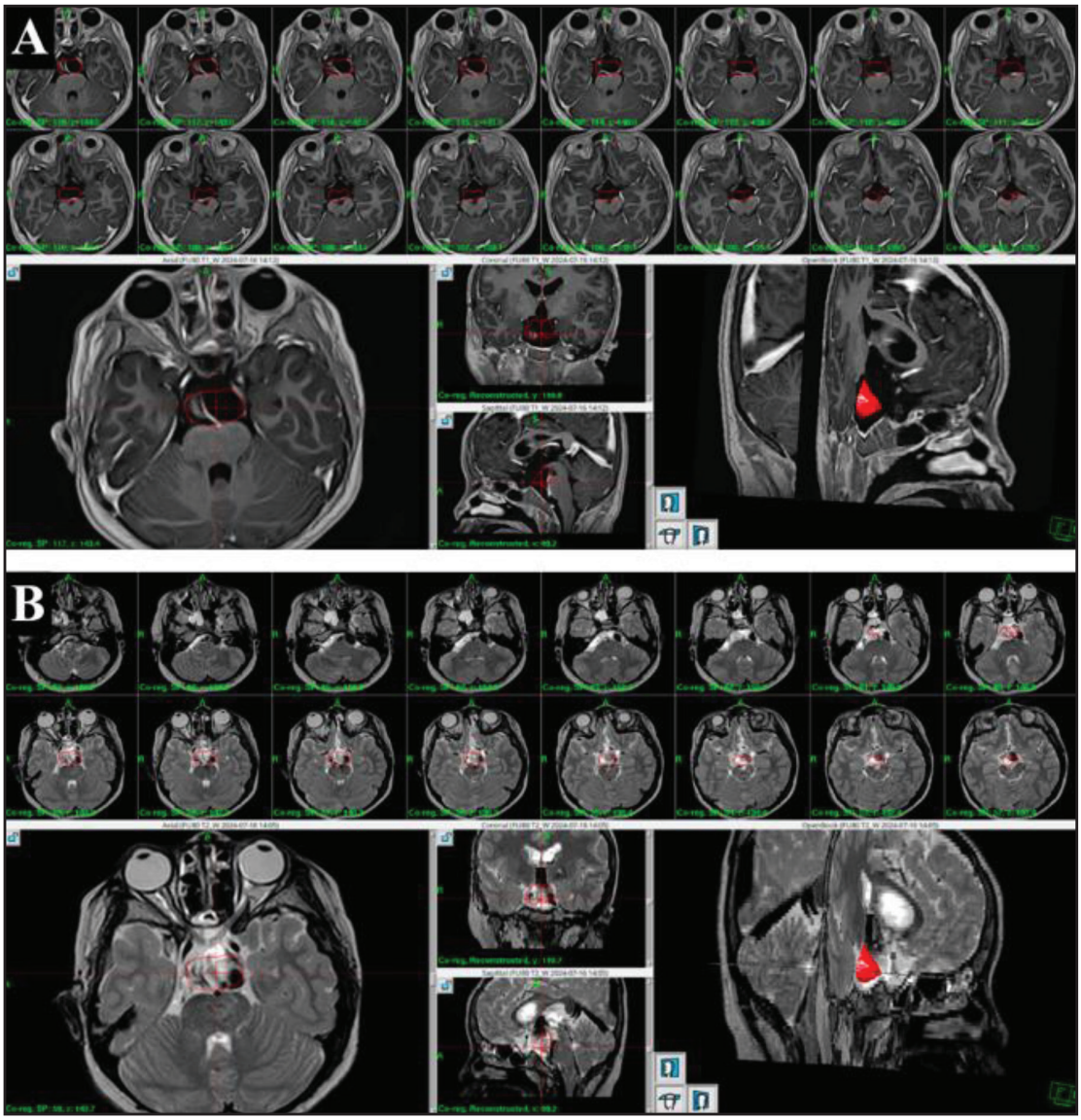

Figure 5. *Follow-up MRI of Case 2 at 80 months after GKRS. Axial T1-weighted (A) and T2-weighted (B) images demonstrating a persistent residual lesion measuring 7.790 cm³ with associated cystic and post-treatment changes. Clinical recurrence occurred approximately five years after GKRS despite an initial period of seizure remission.*

The first and second patients had more severe types of the condition compared with the third, resulting in more pronounced cognitive and developmental disturbances.

The HH is known to be intrinsically epileptogenic [5]. Among the seizure types, the hallmark manifestation is the gelastic seizure, characterized by repeated, brief seizures involving inappropriate, emotionless laughter or grimacing, or an uncontrollable urge to laugh [6,7]. Gelastic seizures are frequently resistant to antiepileptic drugs, and up to 68.4% of cases eventually evolve into other seizure types [3]. This explains why the seizure manifestations in the three patients in this case series were not controlled with prior ASMs. All of our patients experienced gelastic seizures originating from the hamartoma itself, suggesting activation of neuronal networks involving the insula and limbic system. The seizure evolution observed closely parallels previous HH cases and cohorts, in which gelastic seizures are often the earliest manifestation and may later evolve into more complex seizure semiology due to secondary epileptogenesis [2,4,5].

HH subtype was classified according to the Delalande classification based on the anatomical relationship between the lesion, hypothalamus, and third ventricle on MRI [7]. Case 1 and 2 were classified as type III because they demonstrated both horizontal attachment to the hypothalamus and vertical extension toward the third ventricle. Case 3 was classified as type IIA because the lesion was predominantly intrahypothalamic with a vertical attachment and limited suprasellar extension.

GKRS in HH

GKRS is most effective for Types I and III lesions and can even serve as a first-line therapy for patients with HH volumes <3 cm³. Type II lesions can be treated with either

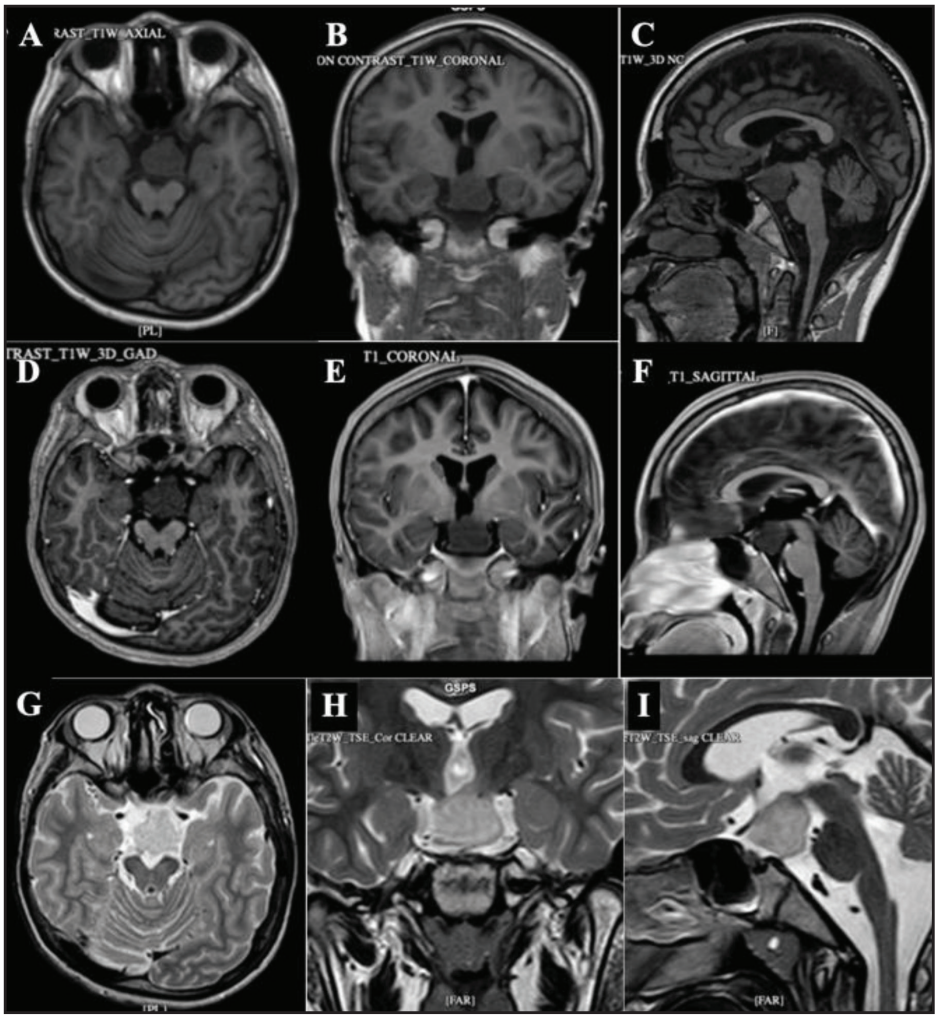

Figure 6. *Pre-treatment MRI of Case 3. T1-weighted MRI without contrast in axial (A), coronal (B), and sagittal (C) views; T1-weighted MRI with contrast in axial (D), coronal (E), and sagittal (F) views; and T2-weighted MRI in axial (G), coronal (H), and sagittal (I) views. MRI demonstrates a sessile HH (Delalande type IIA) measuring approximately 2.2 × 2.3 × 2.4 cm. The lesion occupies the suprasellar and interpeduncular cisterns and abuts the tuber cinereum, mammillary bodies, optic tracts, and cerebral peduncles.*

surgery or GKRS, whereas Type IV lesions or those >3 cm^3 are generally managed with initial surgical resection, followed by postoperative GKRS to target any residual tissue [8,9]. It is not recommended for large HHs to be treated with GKRS alone due to the potential biophysical deterioration associated with high radiation doses [10]. Therefore, the second and third patients, both of whom had lesions >3 cm^3 (Table 1), were indeed indicated for microsurgery first. This was performed in the second patient, but the family declined surgery in the third patient.

The exact mechanism by which GKRS treats HHs remains unclear, but it is believed to involve non-destructive neuromodulation and the induction of neural plasticity, rather than direct lesion ablation [8]. This is supported by the absence of overt target necrosis on follow-up MRI despite seizure improvement, suggesting that the effect is unlikely to result from direct tissue destruction alone. Instead, the neuromodulatory effect of GKRS is potentially driven by radiation-induced gliosis, subnecrotic radiation causing gradual neuronal degeneration, down-regulation of intrinsically firing neurons, and gradual alterations in vascular supply [1,11,12]. This mechanism explains the delayed therapeutic response, typically observed between 6 months and up to 3 years, as well as the early signs of seizure improvement, which are reflected in changes in semiology before a reduction in seizure frequency [1,11,13]. The ASM burden can also be reduced over time [14,15].

The temporal pattern of seizure control in our series is consistent with previously reported GKRS outcomes [1,11,13]. The first patient in this case series showed gradual improvement in neurological symptoms 6 months after GKRS, improvement in laughing spells at 12 months, and eventual seizure improvement after 3 years. The second patient experienced seizure improvement within the first month after GKRS, which lasted for approximately 5 years before seizure recurrence occurred. The mechanism underlying this late recurrence remains uncertain, as

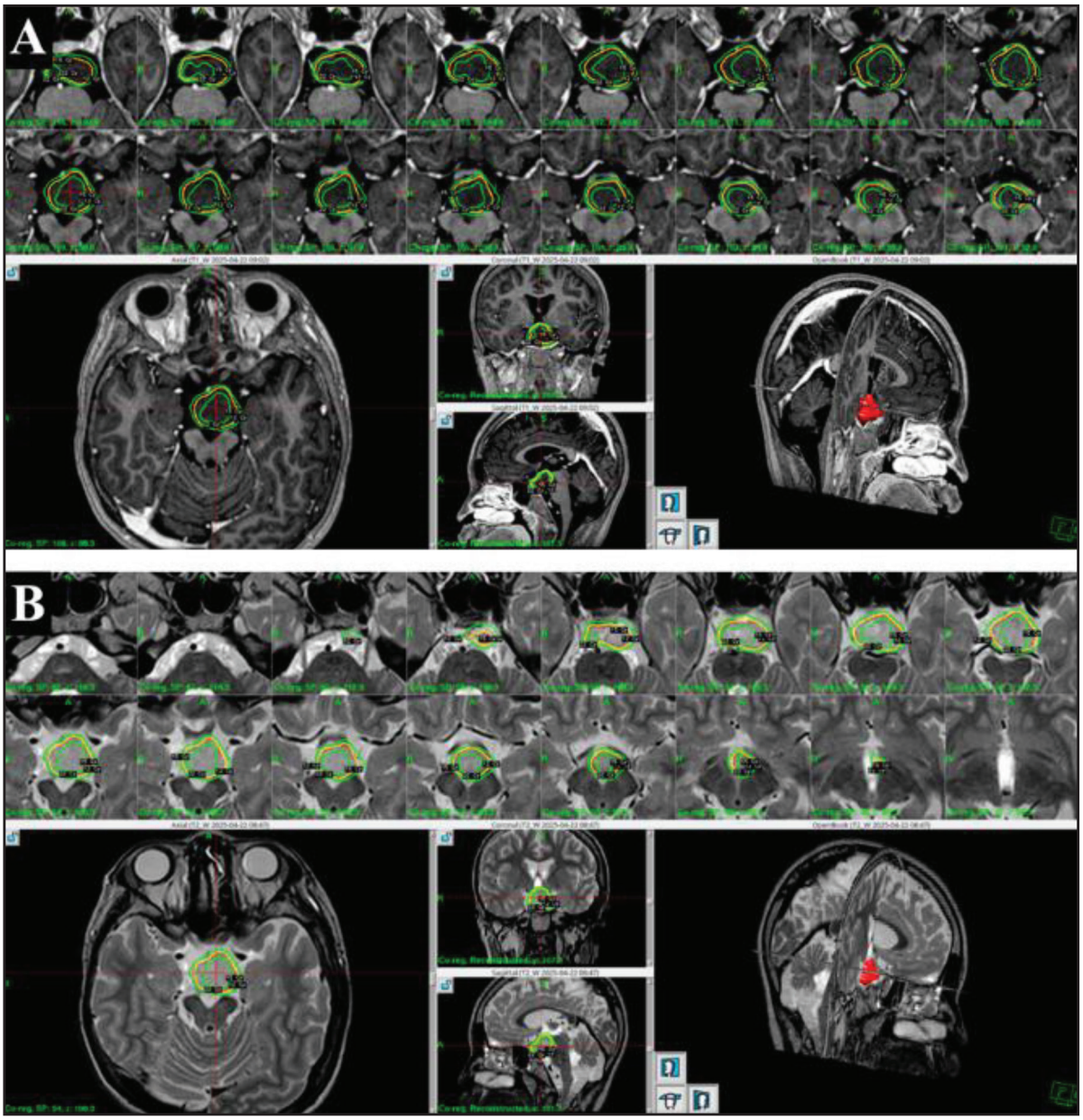

Figure 7. *Pre-GKRS MRI of Case 3. Axial T1-weighted (A) and T2-weighted (B) images demonstrating a HH with a target volume of 5.752 cm³ before radiosurgical treatment.*

several factors may have contributed, including residual epileptogenic hamartoma tissue, cystic transformation, hemorrhagic evolution, or secondary epileptogenesis independent of lesion volume. Because repeat surgery identified both residual HH and a suprasellar cystic lesion, the precise source of recurrent seizures could not be definitively determined. The third patient had only completed 6 months of follow-up and experienced only transient improvement in the first month, followed by seizure recurrence, suggesting a delayed response consistent with the expected treatment timeline. All three patients demonstrated clinical improvement despite minimal volumetric change after GKRS, which aligns with the neuromodulatory mechanism rather than direct lesion shrinkage. Although the Engel classification remains the primary clinical outcome measure for GKRS in HH, seizure semiology evolution, EEG changes, ASM burden, and imaging findings can serve as complementary markers reflecting clinical improvement [16,17]. In our series, seizure improvement was first reflected by changes in semiology, including a reduction in laughing spells and the disappearance of generalized seizure manifestations in the first and second patients, preceding achievement of Engel class I outcomes. While EEG follow-up data were limited and functional imaging findings were not significant, a reduction in ASM burden was observed in all three patients. Table 1 provides a detailed comparison of seizure outcomes in all three patients.

Lesion morphology may also have contributed to the variability in clinical outcomes. Previous studies have

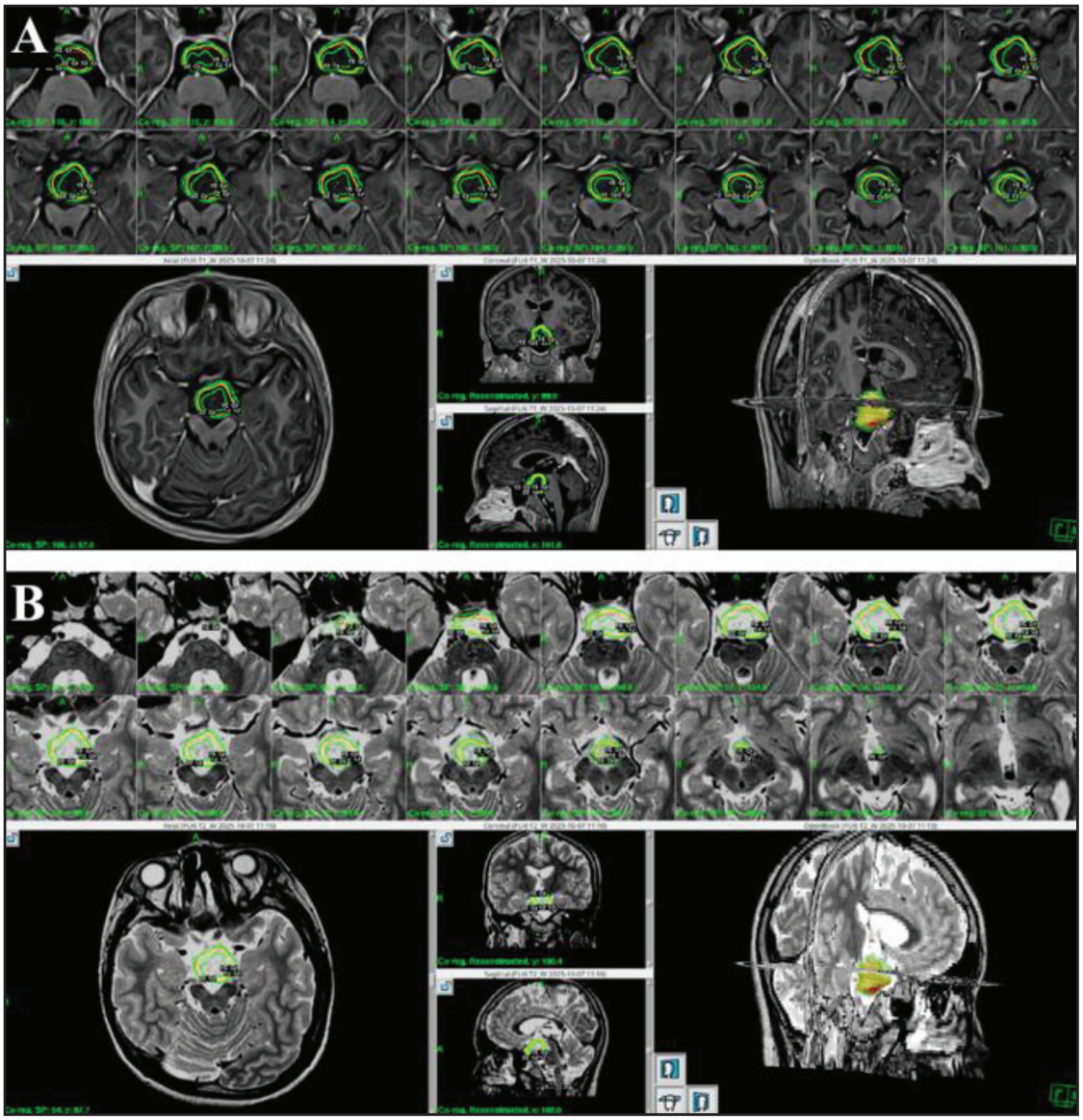

Figure 8. *Follow-up MRI of Case 3 at 6 months after GKRS. Axial T1-weighted (A) and T2-weighted (B) images demonstrating transient lesion enlargement to 8.602 cm³ following treatment. Radiological enlargement was not accompanied by sustained clinical improvement and was interpreted as a post-radiosurgical treatment-related change.*

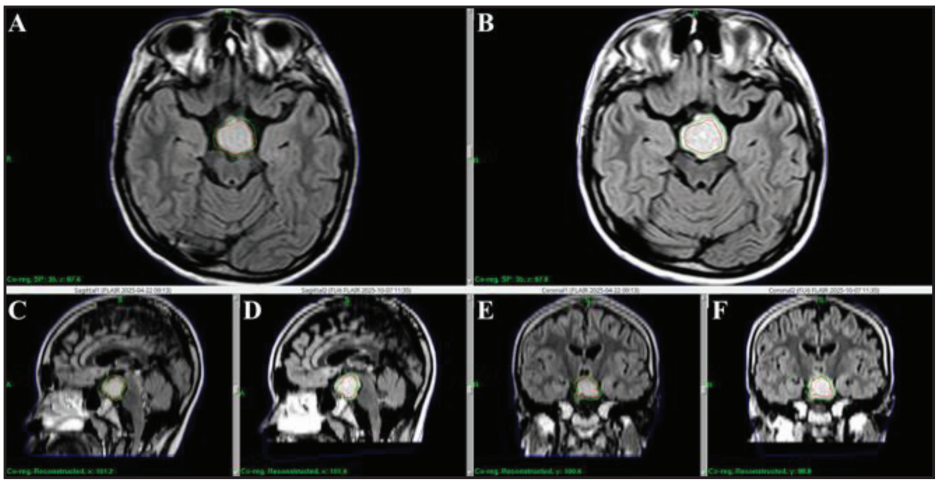

Figure 9. *Comparison of pre-treatment and 6-month follow-up MRI in Case 3. Axial, sagittal, and coronal T2-weighted FLAIR images obtained before GKRS (A, C, and E) and at 6 months after GKRS (B, D, and F). Images demonstrate an interval increase in lesion size and signal abnormality following radiosurgery, consistent with treatment-related radiological change.*

suggested that smaller lesions and Delalande type I-III hamartomas are generally associated with more favorable radiosurgical outcomes, whereas larger lesions often exhibit delayed or less complete responses [1,11]. In our series, the smallest lesion achieved the most favorable long-term seizure control, while the larger lesions demonstrated either delayed clinical benefit or seizure recurrence. Although larger HHs are often considered for surgical management before radiosurgery, both patients with lesion volumes >3 cm^3 had specific circumstances that influenced treatment selection. In the second patient, GKRS was performed following prior microsurgical resection because residual disease remained deeply seated within the hypothalamic region and was closely associated with critical neurovascular structures, rendering further aggressive resection less desirable. In the third

Table 1. *Parameters and outcome of HH patients treated with GKRS.*

	CASE 1	CASE 2	CASE 3
Age at onset of seizure	1 year old	2 years old	1 year old
Age at diagnosis	7 years old	2 years old	3 years old
Baseline seizure frequency	4/day	3-5/day	2–3/day
Prior surgery	No	Tumor resection	No
Prior hormonal therapy	Hormone injections	Levothyroxine + prednisone	Leuprorelin
Age at GKRS			
HH type	Type III	Type III	Type IIA
Size at GKRS		2.7 × 3.4 × 3.0 cm	2.2 × 2.3 × 2.4 cm
Volume at GKRS	0 mo: 2.100 cm^3 6 mo: 2.443 cm^3 12 mo: 2.100 cm^3 18 mo: 2.100 cm^3 27 mo: 2.100 cm^3 34 mo: 2.100 cm^3 46 mo: 2.100 cm^3	0 mo: 6.140 cm^3 8 mo: 10.664 cm^3 15 mo: 17.955 cm^3 56 mo: 14.656 cm^3 69 mo: 48.743 cm^3 73 mo: 4.781 cm^3 80 mo: 7.790 cm^3	0 mo: 5.752 cm^3 6 mo: 8.602 cm^3
Fraction of GK	1	1	1
Dose and target coverage	17.0 Gy @ 50%	18.0 Gy @ 45%	15.0 Gy @ 40%
Mean dose	0 mo: 22.7 ± 3.8 Gy 6 mo: 21.5 ± 4.7 Gy 12 mo: 15.3 ± 6.4 Gy 18 mo: 21.3 ± 4.7 Gy 27 mo: 21.8 ± 4.8 Gy 34 mo: 22.1 ± 4.8 Gy 46 mo: 23.5 ± 4.1 Gy	0 mo: 25.1 ± 4.5 Gy 8 mo: 20.6 ± 6.6 Gy 15 mo: 16.1 ± 7.8 Gy 56 mo: 17.6 ± 7.7 Gy 69 mo: 8.7 ± 7.9 Gy 73 mo: 16.1 ± 6.6 Gy 80 mo: 19.6 ± 8.3 Gy	0 mo: 22.0 ± 4.7 Gy 6 mo: 18.9 ± 6.0 Gy
Max dose	34.2 Gy	39.9 Gy	37.5 Gy
Max dose to optic chiasm	15.1 Gy	16.4 Gy	15.9 Gy
Max dose to pituitary	18.7 Gy	20.7 Gy	16.9 Gy
Time to improvement	6-12 mo	1-5 mo	1 mo
Time to best response	~4 years	~3 years	-
Follow-up duration	46 mo	80 mo	6 mo
Best seizure outcome	Engel class ID	Engel class IA → IIIB after 5 years	Engel class IVB
Seizure reduction (%)	>90%	>90% → relapse after 5 years	<50%
ASM reduction	Yes (3 → 2) **Initial**: Zonisamide 100 mg once daily, levetiracetam 250 mg twice daily, lamotrigine 25 mg twice daily **After 4 years**: Levetiracetam 25 mg twice daily and lamotrigine 25 mg twice daily	Yes (2 → 0 → 1) **Initial**: Levetiracetam 500 mg twice daily and topiramate 75 mg twice daily **After 3 years**: Complete remission without ASM **After relapse**: Valproic acid 500 mg twice daily	Yes (2 → 1) **Initial**: Levetiracetam 250 mg twice daily and valproic acid 500 mg twice daily **After 6 months**: Valproic acid 500 mg twice daily
Current status	Controlled on 2 AEDs	Controlled after repeat surgery	Ongoing follow-up
Endocrine outcome			
Cortisol	0.33-5.05 → 7.13	4.49 → decreased clinically	10.7 → NA
GH	1.7 → NA	0.8–2.1 → NA	NA
FT3	2.89 → 3.15	2.33 → elevated clinically	3.06 → NA
FT4	1.12 → 1.28	NA	1.44 → NA

patient, microsurgical resection was recommended based on lesion size and anatomical considerations; however, the family declined surgery and elected to proceed with GKRS as a less invasive alternative. These cases highlight how the management of HH often requires individualized decision-making beyond anatomical classification alone, particularly when balancing seizure control against the potential morbidity of open surgical intervention.

Available endocrine evaluations did not reveal clinically significant endocrine deterioration during follow-up. However, these findings should be interpreted with caution, as hormonal assessments were not performed uniformly throughout follow-up. Despite this limitation, no clinically documented new endocrinopathy attributable to GKRS during the observation period. Consistent with previous reports, GKRS appears to have a favorable endocrine safety profile, and improvement of precocious puberty has been described in selected patients with HH [1,9].

The recommended dose for HH ranges from 12 to 16 Gy [13]. Only one patient in this case series was treated within this range (15 Gy), while the other two patients received higher doses (17 and 18 Gy), which may enhance seizure control but also increase the potential risk of dose-dependent edema. However, previous systematic reviews have reported effective marginal doses ranging from 12 Gy to a maximum of 30 Gy for treating HHs [18]. In our series, maximum optic chiasm doses ranged from 15.1 to 16.4 Gy, while maximum pituitary doses ranged from 16.9 to 20.7 Gy. Despite these relatively high exposures, no patient developed clinically evident visual deterioration during follow-up. Formal ophthalmologic evaluation was performed in the first patient following transient lesion enlargement and demonstrated normal findings. The overall administered doses appeared to be well-tolerated in this small series, with no documented radiation-related visual complications or new endocrinopathies.

This study has several limitations. First, there was heterogeneity of patient characteristics, including variations in HH morphology and prior treatments received. Second, the timing of follow-up MRI examinations varied across patients, which may affect the comparability of radiological outcomes. Third, long-term follow-up data for the third patient were limited; therefore, additional findings from future follow-up may need to be reported in a separate publication. Finally, endocrine data were retrospectively collected from available clinical records and were not obtained according to a standardized follow-up protocol.

Conclusion

HH is a rare but clinically significant cause of DRE, often accompanied by endocrine and neurobehavioral disturbances. Early seizure control remains an important therapeutic goal. In this case series, GKRS appeared clinically beneficial in two patients, resulting in meaningful seizure reduction and improved quality of life, while the third patient demonstrated only transient improvement during short-term follow-up. Clinical responses were heterogeneous and appeared delayed, supporting the proposed neuromodulatory effects of GKRS rather than direct lesion reduction. No clinically significant endocrine deterioration attributable to GKRS was observed during the study period, and the administered radiation doses were well-tolerated in this small series. These findings highlight the importance of long-term monitoring when evaluating treatment outcomes in HH, as clinical improvement may continue to evolve. Although follow-up duration and HH morphology varied among patients, this case series contributes additional data regarding the long-term clinical and radiological outcomes of GKRS for HH. Larger studies with standardized follow-up protocols are needed to better define treatment indications, optimal dosing strategies, long-term clinical outcomes, and prognosis.

What is new?

Although GKRS has shown promising outcomes for HH, its long-term efficacy remains under investigation. In developing countries, including Indonesia, access to GKRS for HH is limited, and its application remains uncommon. This case series provides new insights by presenting one of the first written reports from Indonesia, offering detailed long-term clinical follow-up, serial volumetric and radiological assessments, and endocrine profiling. It highlights the dynamic radiological evolution following GKRS, including pseudoprogression and delayed regression, and demonstrates clinical-radiological dissociation, where seizure improvement occurs despite minimal volumetric change.

Acknowledgments

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List of Abbreviations

ASM	Antiseizure medication
DRE	Drug-resistant epilepsy
EEG	Electroencephalography
GKRS	Gamma knife radiosurgery
HH	Hypothalamic hamartoma
MRI	Magnetic resonance imaging
SRS	Stereotactic radiosurgery

Conflicts of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Funding

None.

Consent to participate

Written informed consent was obtained from the patients' parents for participation in this report and for the publication of anonymized clinical information and imaging data.

Consent for publication

Written informed consent was obtained from the patients' parents for the publication of anonymized patient information and imaging data. All authors have read and approved the final manuscript and agree to its submission and publication.

Ethical approval

Ethical approval is not required at our institution to publish an anonymous case report.

Author contributions

Made Agus Mahendra Inggas and Kennytha Yoesdyanto developed the initial concept for this study. Edeline Samudra developed the methodology with guidance from Made Agus Mahendra Inggas, Kennytha Yoesdyanto, Prudence Wirajaya, and Nathan Muliawan. Edeline Samudra, Elia Soediatmoko, and Irhas conducted the investigation. Edeline Samudra, Prudence Wirajaya, and Nathan Muliawan drafted the original manuscript. Made Agus Mahendra Inggas and Kennytha Yoesdyanto reviewed the manuscript, and the manuscript was revised by Edeline Samudra. All authors contributed study resources, participated in manuscript preparation, and reviewed the final version. Made Agus Mahendra Inggas and Kennytha Yoesdyanto supervised the study.

Data availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Author details

Made Agus Mahendra Inggas[1,2], Kennytha Yoesdyanto[2,3], Edeline Samudra[2], Nathan Muliawan[2], Prudence Wirajaya[2], Elia Soediatmoko[4], and Irhas[4]

1. Department of Neurosurgery, Siloam Hospitals Lippo Village, Tangerang, Indonesia
2. Faculty of Medicine, Pelita Harapan University, Tangerang, Indonesia
3. Department of Neurology, Siloam Hospitals Lippo Village, Tangerang, Indonesia
4. Gamma Knife Center Indonesia, Tangerang, Indonesia

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Summary of the case 1.

1	Patient (gender, age)	12 years, male
2	Final diagnosis	HH (Delalande type III) with DRE
3	Symptoms	Gelastic seizures, cognitive decline, precocious puberty, behavioral disturbances
4	Medications	Zonisamide, levetiracetam, lamotrigine, citicoline
5	Clinical procedure	GKRS
6	Specialty	Neurosurgery/Neurology

Summary of the case 2.

1	Patient (gender, age)	5 years, female
2	Final diagnosis	HH (Delalande type III) with DRE and central adrenal insufficiency
3	Symptoms	Gelastic seizures, generalized seizures, rage attacks, speech delay, developmental delay, precocious puberty
4	Medications	Levetiracetam, topiramate, valproic acid, aripiprazole, levothyroxine, prednisone
5	Clinical procedure	Tumor resection followed by GKRS and repeat microsurgery
6	Specialty	Neurosurgery/Neurology

Summary of the case 3.

1	Patient (gender, age)	8 years, male
2	Final diagnosis	HH (Delalande type IIA) with DRE
3	Symptoms	Gelastic and dacrystic seizures, precocious puberty, attention deficit
4	Medications	Levetiracetam, valproic acid, oxcarbazepine, phenytoin, leuprorelin acetate
5	Clinical procedure	GKRS
6	Specialty	Neurosurgery/Neurology