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Removal of pineal region teratomas using occipital transtentorial approach (OTA) technique: Case report and literature review

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ABSTRACT

INTRODUCTION: The development of improved micro-surgery techniques and neuroanesthesia has become increasingly sophisticated makes open-microsurgery tumor resection a choice for the management of the pineal region.

CASE PRESENTATION: An 11-year-old male with a pineal body tumor post ventriculo-peritoneal (VP) shunt, underwent tumor resection. Patients complain of headaches, relieve with medication but often recurrent, and often experience a decrease in consciousness. One month before the procedure, the patient experienced blurred vision, staggering, nausea, vomiting, and decrease of consciousness. The operation is performed with an occipital transtentorial approach (OTA) technique. During surgery, hemodynamics was relatively stable. Postoperatively, the patient underwent controlled ventilation in the intensive care room, and recover significantly within one week.

DISCUSSION: Various surgical approaches have been proposed for pineal region tumors. We review the available literature (PubMed) with 11 reported cases of pineal tumor therapy with the occipital transtentorial approach and evaluate general symptoms in clinical manifestations, histopathological features, radiological findings, and survival times to demonstrate therapeutic effectiveness. Several cases of the pineal tumor were also reported using tumor extraction by occipital transtentorial approach.

CONCLUSION: The choice of approach is influenced by the location of the tumor, pathology findings, the neurosurgeon's comfort and consideration of the risk of complications.

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1. Introduction

Improvement micro-surgery techniques during the decades, as well as the development of neuroanesthesia and critical care. Increasingly sophisticated instruments make tumor resection a choice for the management of pineal region tumors [1]. Although various approaches to pineal region tumors have been introduced, only three approaches are frequently used, including infratentorial-supracerebellar, and supratentorial approaches including intrahemisphere-transcallosal and occipital-transtentorial approach [2]. Determining the optimal surgical approach depends on the anatomy of the tumor and the neurosurgeon's preference and experience. Improved surgical techniques also have an impact on the results of surgery for this rare tumor.

This work has been reported in line with the SCARE criteria [3].

2. Presentation of case

An 11-year-old patients came to the emergency unit with the decreased consciousness. On the previous month, the patient started complaining of dizziness, nausea, vomiting, and had fainted and even seizures, but the patient have normal daily activities. The patient has no family history of tumors. History of allergies and other diseases is denied. On physical examination: 3 mm/3 mm round isochoric pupil. Light reflexes +/- Papilledema (+/+), physiological reflexes (+). Other neurological deficits: decreased hearing and consciousness. On head CT Scan were found isodense area of the ventricular III region with left and right lateral ventricular dilatation, no midline shift. Impression: solid mass with hydrocephalus. The patient was diagnosed with hydrocephalus, and underwent VP Shunt procedure, then planned for tumor removal surgery one week later. On MRI with contrast (post VP-Shunt); was found solid mass of 5,5 × 4,5 × 3 cm in the pineal body area (Fig. 1). Patient

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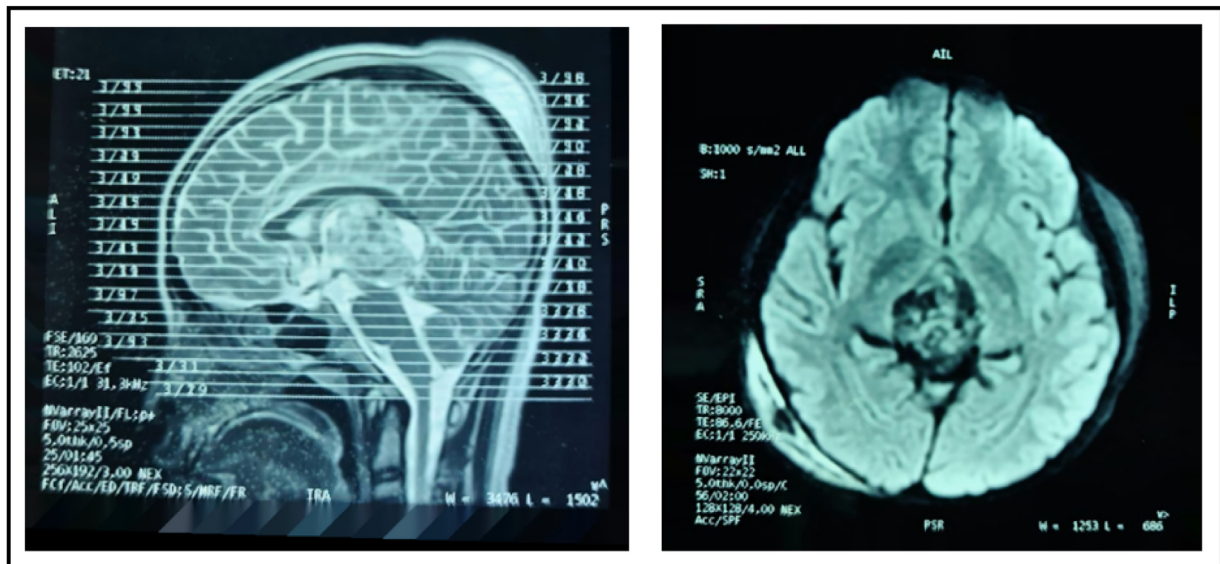


Fig. 1. MRI of the patient in emergency unit admission.

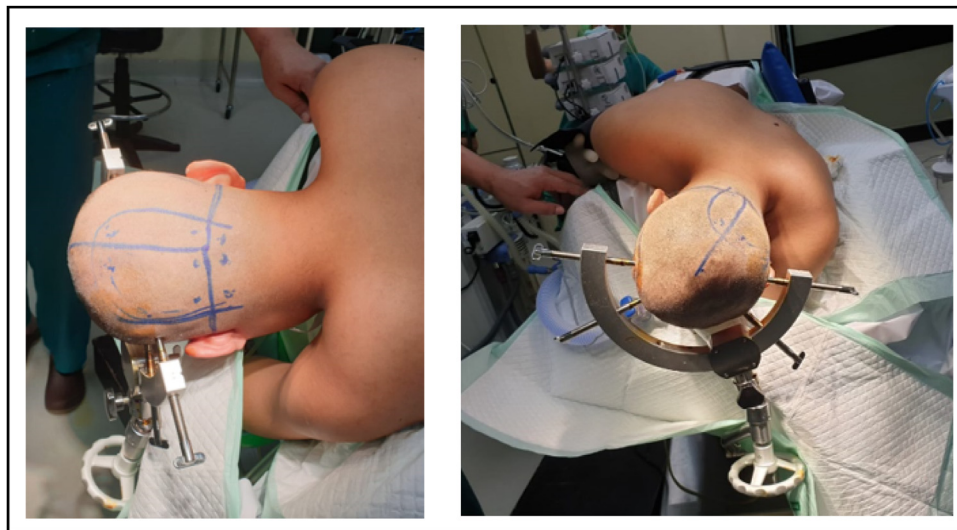


Fig. 2. Lateral semi-prone position for the OTA.

was diagnosed with Pineal Body Tumor post VP-shunt *et causa* non-communicating hydrocephalus. Tumor extraction was carried out using the *Occipital Transtentorial Approach* (OTA) technique at a secondary referral hospital (Figs. 2–4). The patient underwent tumor resection using an open-microsurgery occipital transtentorial approach, with histopathological assessment stated as an immature teratoma.

The occipital transtentorial approach was performed by occipital craniotomy on superior sagittal sinus and torcula. C-shaped pattern in open the dura on the superior sagittal and transverse sinus. Tumor resection reduces the effect of mass and increases the response to adjuvant therapy for malignant lesions, for benign tumors, total resection can be performed.

After surgery, post-operative complaints in patients only difficulty glancing to the right. There are no significant motor and sensory weaknesses, although the patient standing still needs help. At that time, the patient was aware and was able to communicate actively. One month after surgery, patient control and CT scan

examinations found VP-Shunt function is still proper, and there are no abnormalities (Fig. 5).

3. Discussion

The Pineal Gland is a small endocrine gland in the brain. Located near the midpoint of the brain between two hemispheres in the gap between the two thalami. The pineal gland is located in the middle of the brain, which functions to regulate the body's biological clock, especially in the normal cycle between waking and sleeping [4]. Atypical pineal tumors (germ cell tumors) occur most often in childhood. These tumors can damage the flow of fluid around the brain, resulting in enlargement of the brain and skull (hydrocephalus) and serious brain function abnormalities [5].

Pathological tumors originating purely from the pineal gland are very rare. They mainly found in children and adolescents [6]. Most of them are originating from germ-cell tumors, accounting for 31–85% of tumors [7]. Tumors of the pineal region show

Table 1
Summary of Published Cases Who Underwent Occipital Transtentorial Approach for Pineal Region Tumors.

| Study | Age | Sex | Time to diagnosis | Clinical Presentation | Radiological findings | Hydro cephalus | MRI size | Biopsy | Pathology | Extent of resection | Complications | VPS/TVS | Chemotherapy | Radiotherapy | Survival |
|------------------------------------|-------|-----|-------------------|---|---|----------------|---------------------------|---------------------|-----------------------------------|-------------------------------|--------------------------------|---------|--------------|--------------|----------|
| Mallucci, et al./1995. [15] | 32 | M | 72 weeks | Parinaud syndrome, blindness, personality change | CT: large enhancing mass, hydrocephalus | 1 | NA | NA | meningioma | partial resection | no new deficit | VPS | NA | NA | NA |
| Mallucci, et al./1995. [15] | 30 | M | 28 weeks | headache, homonymous hemianopia, parinaus syndrome and gait disturbance | CT: large enhancing mass, hydrocephalus | 1 | NA | NA | meningioma | gross total resection | no new deficit | VPS | NA | NA | NA |
| Moon, Kyung-Sub, et al./2006. [16] | 68 | M | 8 weeks | headache, vomiting and gait disturbance | CT: HDC, hypodense mass MR: irregular heterogeneously ringenhanced mass with central necrosis | 1 | 40 × 30 × 40 mm | frozen biopsy | anaplastic astrocytic tumor cells | partial resection | hydrocephalus | VPS | NA | NA | 2 mo |
| Inoue et al., 2015. [17] | 37 | F | 24 weeks. | gradually worsening headache, altered mental status | Brain computed tomography (CT) and gadolinium (Gd)-enhanced magnetic resonance imaging (MRI) showed a homogeneously enhanced and welldefined tumor in the pineal region | 1 | 30 × 30 × 25 mm | NA | meningioma | “Simpson Grade III” resection | no postoperative complications | NA | NA | NA | NA |
| Inoue et al., 2015. [17] | 67 | M | 24 weeks | gradually progressing dizziness. No neurological deficits | Gd-enhanced MRI demonstrated a large mass in the pineal region. | 0 | 30 mm in maximal diameter | NA | meningioma | total resection | no postoperative complications | NA | NA | NA | NA |
| Radoi et al., 2012 [18] | 67 | M | 52 weeks | headache and deficits in memory, diplopia, spontaneous tremor in the right hand | Cerebral CT-scan examination showed a well circumscribed tumor located periventricular in the pineal region | 1 | 6 × 5 × 4 cm | stereotactic biopsy | Meningioma | gross total resection | NA | NA | NA | Yes | NA |
| Tanikawa et al., 2019. [19] | 10 | M | NA | Headache | NA | 1 | 35 mm | Biopsy | immature teratomas | gross total resection | None | NA | Yes | Yes | NA |
| Tanikawa et al., 2019. [19] | 66 | F | NA | Gait disturbance | NA | 1 | 30 mm | Biopsy | immature teratomas | gross total resection | Transient upper gaze palsy | NA | Yes | Yes | NA |
| Tanikawa et al., 2019. [19] | 7 | M | NA | Somnolence, diplopia | NA | 1 | 38 mm | Biopsy | pineocytoma | gross total resection | Transient upper gaze palsy | NA | Yes | Yes | NA |
| Tanikawa et al., 2019. [19] | 9 mo. | F | NA | Macrocephaly | NA | 1 | 48 mm | Biopsy | atypical teratoid rhabdoid tumor | partial resection | Asymptomatic subdural hygroma | NA | Yes | Yes | NA |
| Tanikawa et al., 2019. [19] | 21 | M | NA | Diplopia | NA | 1 | 15 mm | Biopsy | yolk sac tumor | gross total resection | None | NA | Yes | Yes | NA |
| Present case | 11 | M | 4 weeks | Somnolence | CT: HDC, a well circumscribed tumor located in the pineal region MR: welldefined tumor in the pineal region | 1 | 5,5 × 4,5 × 3 cm | Biopsy | Immature teratoma | gross total resection | parinaud syndrome | VPS | 0 | 0 | 0 |

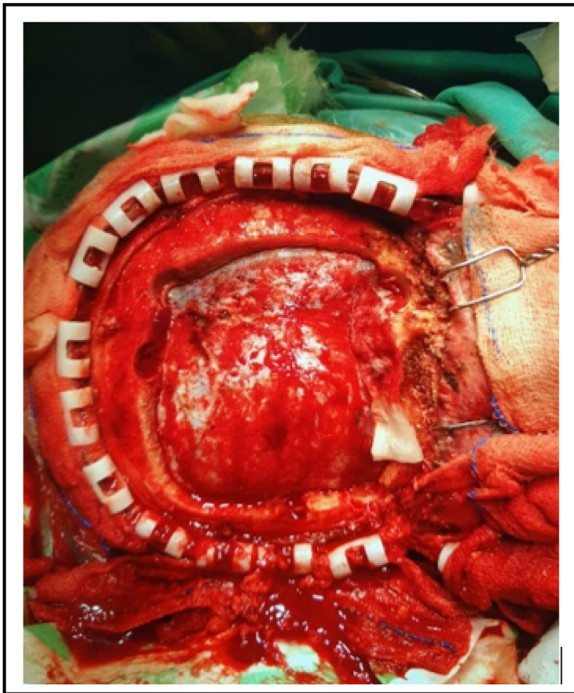


Fig. 3. Skin incision and craniotomy for the occipital transtentorial approach.

histopathological heterogeneity. Distribution of the main histological types of tumors of the pineal region are germ cell tumors, glial neoplasms, and pineal parenchymal tumors [8]. Posterior pineal and ventricular III glandular tumors, including thalamus astrocytoma, ependymoma, choroid plexus tumor, craniopharyngioma and meningioma originating from velum interpositum, etc.

Pineal tumors can suppress the superior colliculus and the dorsal area of the midbrain, causing Parinaud's syndrome. Suppressing cerebral aqueduct causes hydrocephalus [9]. Clinical manifestations are a consequence of the effects of suppression in the form of visual impairment, headaches, and a decrease of cognitive and consciousness. Most patients present with hydrocephalus. It is recommended to install VP-shunt several days before definitive tumor surgery for ventricular decompression. Although the installation

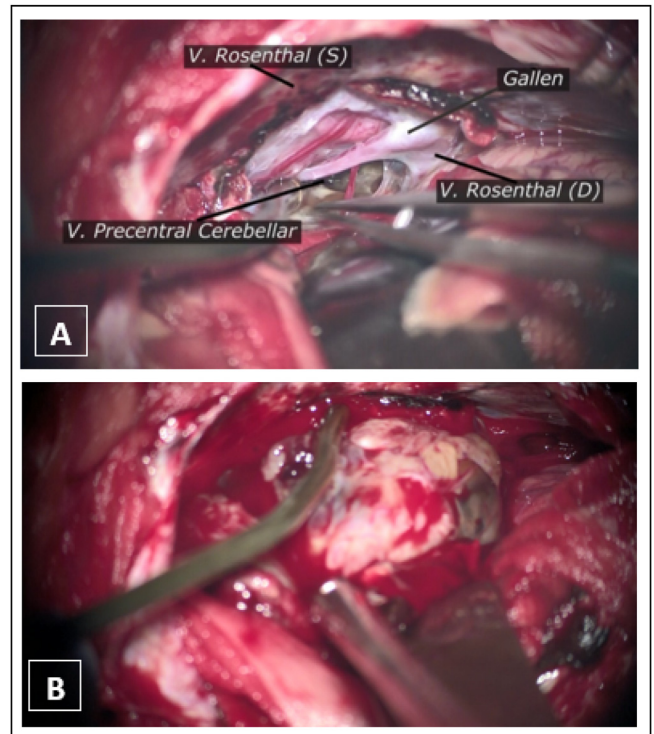


Fig. 4. (A) Topographic anatomy of the operative field; (B) Removal of pineal region tumor.

of a VP-shunt can cause spread to the peritoneum in malignant tumors, it is infrequent [10]. Tumor resection reduces the effect of mass as definitive therapy.

Surgical Approach Techniques have been tried and introduced by clinicians for cases of lesions in the pineal gland, posterior ventricles III and dorsal midbrain. Everything requires precision and good anatomical knowledge. Horsley was the first to perform surgery for pineal region lesions, but successful surgery was first performed by Krause in 1931 using the supracerebellar infratentorial approach, which was later updated by Stein in 1971. Another alternative approach was carried out by Jamieson and Poppen (transtentorial occipital approach) [11]. Advantages of that approach to reach

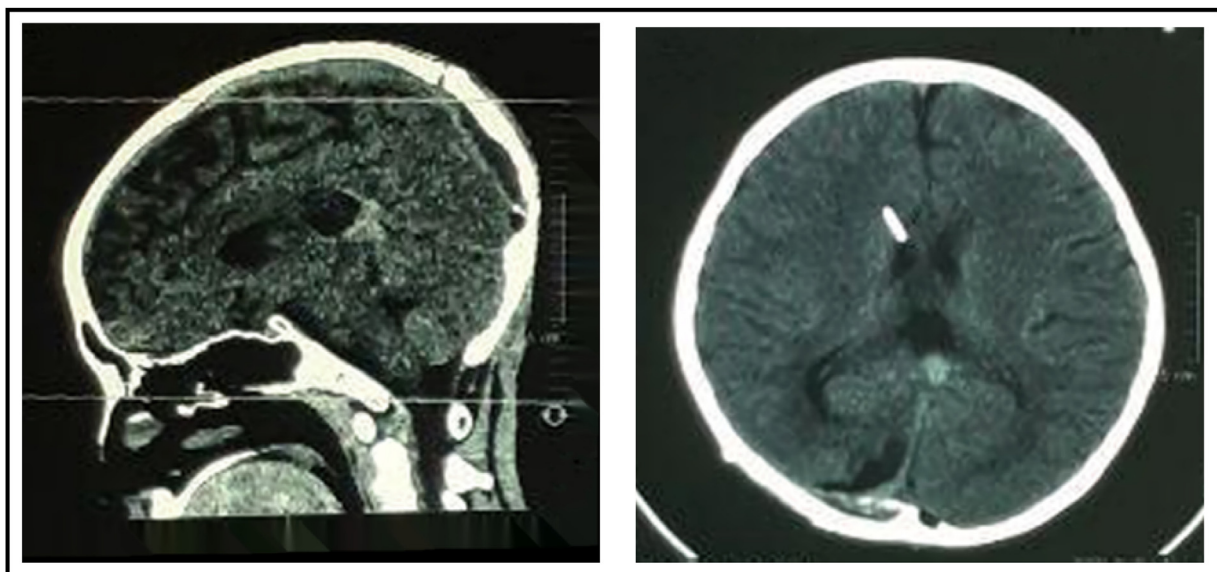


Fig. 5. CT Scan one month post-operation.

the tumor avoids injury to the deep venous canals (internal cerebral veins which lead to the Galen veins which lead to the sinuses and Rosenthal basal veins) which are usually located superior to the lesion. This approach provides good exposure with minimal damage.

Occipital transtentorial approach (OTA) in pineal region tumors, in which the occipital part is elevated and the bone flap is rotated more easily than in an approach where the patient is positioned horizontally. This approach allows an excellent view of the pineal region and access to the midline, superior vermis, and ventricle III. It also allows access to the splenium corpus callosum and lateral ventricles in cases of arteriovenous malformations or thalamic tumors [1].

The occipital transtentorial approach provides the wider field of view of the supratentorial and infratentorial compartments. This approach was chosen due to flexibility in exposing tumors with inferior extension into the cistern cerebellomesencephalic. The blind angle which experienced in the infratentorial supracerebellar approach, or tumor with significant lateral or supratentorial level, can be anticipated. Splitting the tentorium gives suprapanoramic fields of view, midbrain collicular plates, and deep vein structures [12].

Some disadvantages that can be found in the occipital transtentorial approach include: the risk of damage to the occipital lobe or internal occipital vein; risk of damage to deep vein structures; variations in the anatomy of the tentorial notch; Poor visualization of the contralateral half of the quadrigeminal region and the ipsilateral thalamus; may need to split splenium [13]. The morbidity rate associated with pineal region tumor extraction is 3–6.8%, with a permanent minor morbidity rate of 3–28% [14].

Based on the literature review [15–19], the age of patients with a mass in the pineal region varies from 7 to 68 years. In the literature findings (Table 1), 5 out of 11 case reports indicate headache complaints, whereas somnolence complaints are only found in 2 of 11 cases. It was found that most of the reports stated that hydrocephalus was a complication in the pineal region mass, which need further treatment. The literature found 5 out of 11 reports stated the histopathological results as meningiomas, whereas only 3 out of 11 reports (including our case report), stated the histopathological results as immature teratomas. Another study states that pineal meningiomas constitute 6–8% of tumors in the pineal region [20]. Based on the World Health Organization (WHO) classification and germ cell theory, intracranial germ cells tumor are divided into five histological subtypes: teratomas, embryonal carcinomas, germinomas, choriocarcinomas, and yolk sac tumors. Treatment depends on the histological characteristic; germinomas are treated with chemotherapy and radiotherapy, mature teratomas are treated with gross total resection, and immature and malignant teratomas are treated with gross total resection with adjuvant chemotherapy and radiotherapy. Pineal adult teratomas have a better prognosis, than immature or mixed types [21].

4. Conclusion

The occipital transtentorial approach provides an excellent field of view and workspace above and below the tentorial notch. This approach allows more extensive tumor removal for large pineal area tumors.

Declaration of Competing Interest

The authors report no declarations of interest.

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Ethical approval

Ethical Approval from the Health Research Ethics Committee at the Dr Soebandi General Hospital.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

Novan Krisno Adji: person who made the diagnosis, had direct patient contact, and designing of the work. **Achmad Romy Syahril Rozidi:** writing manuscript, and administrative needs. **Rahmat Sayyid Zharfan:** writing manuscript, editing, and, layouting.

Registration of research studies

N/A.

Guarantor

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