Neuroradiology (1987) 29: 366-370

Neuroradiology

Computed tomography of germinomas in basal ganglia and thalamus

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Summary. CT findings of 6 cases with germinoma originating in the basal ganglia and thalamus are reported. The early finding of germinoma in this region on plain CT, was an irregularly defined, slightly high density area without mass effect. Repeated CT scanning showed enlarging iso- density lesion accompanied by mass effect to high. Intratumorous cysts and calcifications were frequently observed. The tumor showed mild to moderate and inhomogeneous enhancement by intravenous injection of contrast medium. A tendency to ipsilateral hemicerebral atrophy was found in one case. These findings were somewhat different from those of germinomas in the pineal and suprasellar regions. This phenomenon may be related to the anatomical difference of the brain where the tumor originated.

Key words: Computed tomography - Germinoma - Basal ganglia - Thalamus

It is well known that the preferential locations of intracranial germinoma are the pineal and suprasellar regions. The germinomas, though rare, develop in other sites of the brain than these two preferential sites [1-3]. The incidences of germinoma originating in the basal ganglia and thalamus are estimated to be 5 to 10% of all the intracranial germinomas [2-4]. It is important to recognize that germinoma can arise in this region, since the tumor is radiosensitive and potentially curable [2], as are those of the pineal and suprasellar regions [5-9]. Because of the rarity of germinoma arising in this region, there are only a limited number of case reports on this tumor studied by computed tomography (CT) [2, 4, 10, 11]. The purpose of the present paper is to describe detailed CT findings of germinoma in this special region to aid in earlier detection and decision of treatment.

Patients and methods

Six patients with germinomas originating in the basal ganglia and thalamus were admitted to the neurosurgical departments of Kyushu University and University of Occupational and Environmental Health after introduction of CT scanner in 1976 in the former and 1979 in the latter institutions. All the patients were examined by CT, both before and after the injection of contrast medium. Their plain skull x-rays and cerebral angiographies were also studied. Pathological examination was performed on surgical specimens obtained by stereotaxic needle biopsy or partial removal of tumor via craniotomy, and a characteristic histology of two-cell pattern germinoma was obtained in all the tumors. Radiation therapy of about 50 Gy was given focally and to the whole brain for 6 patients and also 20 Gy of irradiation was added to the spinal axis for 3. All the patients recovered to attend school but with some residual neurological deficits. In follow up periods from 2 to 8.6 years, one patient died from mediastinal tumor (case 3), which was found 1 year before his death. There was no evidence of recurrent tumor in the central nervous system of case 3. The other five have been doing well and without any signs of recurrence on clinical and CT findings. Clinical presentations are summarized in table 1.

Results

The CT findings of 6 patients are summarized in table 2.

In all the cases, the tumors showed irregular, inhomogeneous and iso-to slight high density on plain CT, and slight to moderate enhancement after an intravenous injection of contrast medium, at the

Table 1. Clinical features in six patients with germinomas in basal ganglia and thalamus.

patient	Age, Sex	Location of Tumors	Duration of Symptoms	Clinical Findings	Follow-Up Period and Outcome
1. Y.M.	11, M	lt B & Th	1 yr 4 mos	Pp, Mo	8.6 yrs: alive
2. O.M.	9, M	lt B & Th	2 yrs	Pp, Mo, Co	7.6 yrs: alive
3. H.T.	11, M	lt B & Th	1 yr 6 mos	Pp, Ch, Mo Dy, Ep	6.6 yrs: died from mediastinal tumor
4. H.H.	7, M	lt B	2 mos	Mo, Se	4.6 yrs: alive
5. N.K.	15, M	rt B & Th	1 yr 1 mos	Ch, Mo, Se Dy, Ep	3 yrs: alive
6. N.H.	12, M	rt B & Th	1 yr 2 mos	I, Mo, Pp	2 yrs: alive

B = basal ganglia; Ch = changes of character and behavior; Co = impaired consciousness Dy = dystonic movement; Ep = epilepsy; I = impaired intelligence; Mo = hemiparesis Pp = precocious puberty; Se = hemihypesthesia; Th = thalamus

Table 2. CT findings of six patients

Case no.	Duration to Exam. after Onset of Symptoms	Precontrast Study				Contrast Enhancement of Tumor	Perifocal Low Density	Hemicerebral Atrophy	Ca. of Pineal Body
		High Density of Tumor	Low Density in Tumor	Ca. in Tumor	Mass Effect				
1	16 mos	+	+	+*	+	+	-	-	+
2	2 yrs	+	+	+	+	+	-	-	+
3	13 mos	+	-	-	-	n.d.	-	-	+
	18 mos	+	++	-	+	+	-	-	+
4	2 mos	+	+	+*	-	+	-	-	+
5	10 mos	+	+	+	-	+	-	±	+
	13 mos	+	+	+	+	+	+	±	+
6	14 mos	+	++	+	+	+	+	-	+

n.d. = not done, * = visualized on plain skull X-ray films. Ca. = calcification

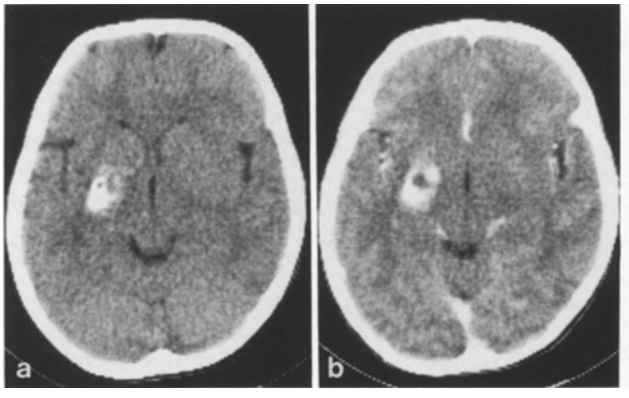

Fig. 1. **a** Precontrast CT of case 4 showing an extreme to slight high density area with central iso-to low density in the left basal ganglia. There were no shift and deformities of ventricular system and subarachnoid spaces. The calcification was also seen on plain skull x-ray films in this case. **b** Postcontrast CT of the same case showing moderate and inhomogeneous enhancement of the tumor

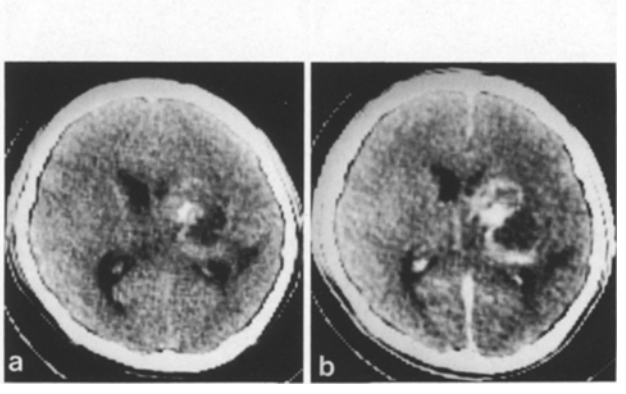

Fig. 2. **a** Precontrast CT of case 6 showing inhomogeneous mass with extreme high, iso- and low densities in the right basal ganglia and thalamus. There was a slight perifocal low density in the temporal lobe. **b** Postcontrast CT showing moderate to marked and inhomogeneous enhancement of the tumor. There was xanthochromic fluid in the cyst found at surgery

time of admission (Figs. 1 to 4). Five of 6 tumors in the present series had calcification visualized on CT (Figs. 1 to 3), and in two, the calcifications were so dense that they were seen on plain skull x-ray films (Fig. 1 a). On CT, calcification of the pineal body was present in all cases, within normal size and without surrounding enhancement. There were some areas of low density in all the tumors. In two

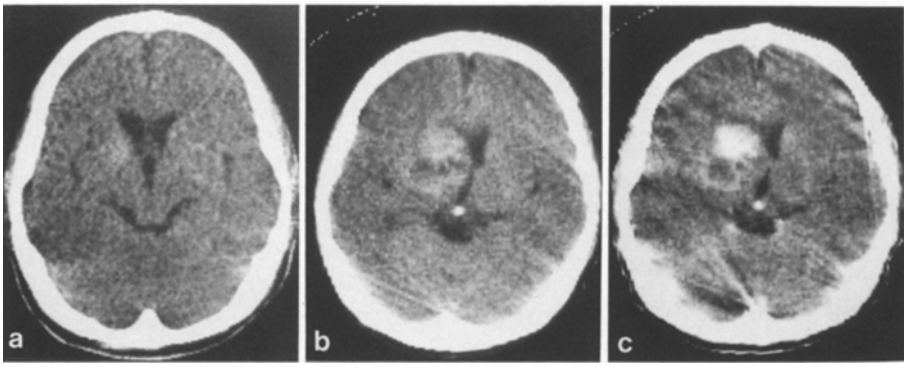

Fig. 3. **a** Precontrast CT of case 3 examined 5 months before admission. There was a small and faint high density in the head of the left caudate nucleus without mass effect. Enhancement was not done at this time. **b and c** Pre and postcontrast CTs of the same case examined at the time of admission. **b** Inhomogeneous low, iso- and slightly high densities in the left basal ganglia and thalamus. There were moderate deformities of the ventricular system. **c** shows slight to marked enhancement of the tumor. There was no indication of the presence of a tumor around the calcified pineal body

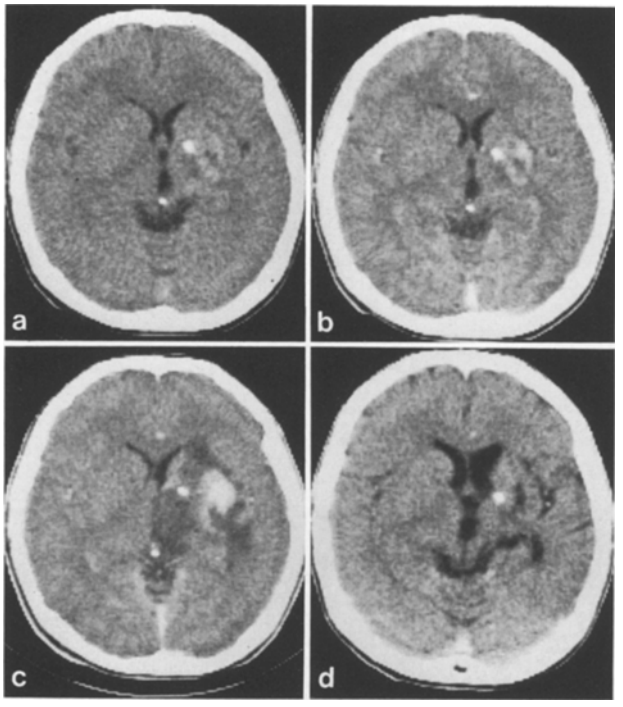

Fig. 4a–d. CTs of case 5. **a and b** Pre and postcontrast studies 3 months before admission, showing calcification and inhomogeneous density without mass effect. Only a slight enhancement of the tumor was obtained by intravenous contrast medium. **c.** Postcontrast CT of the same case taken at the time of admission showing slight to marked enhancement of the tumor with surrounding low density. The ipsilateral anterior horn of the lateral ventricle was slightly larger than that of the left. There was no abnormal enhancement of the calcified pineal body. **d.** Postcontrast CT 2 years after the treatment showing residual small calcification and low density, where the tumor had been present. Hemicerebral atrophy ipsilateral to the tumor is seen

cases, the low densities were large, and xanthochromic fluid was found in a cyst at surgery (Fig. 2).

In two patients, repeated CTs were examined before admission. In case 3, initial plain CT, taken in another hospital, was reported to be normal in spite of the presence of spastic hemiparesis and precocious puberty. The second CT, taken 13 months after the onset of symptoms, showed only a homogeneous and slightly high density area in the head of the left caudate nucleus without signs of mass effect (Fig. 3a). This absence of mass effect was also observed in another two tumors accompanied by calcification and low density (Figs. 1 and 4a). The follow-up CTs, examined after 4 to 6 months, revealed the enlarged and imhomogeneous high density areas with mass effect (Figs. 3b, c and 4c).

Perifocal low density area was present only in two cases (Figs. 2 and 4c). CT in one case showed a slightly larger lateral ventricle on the tumor side than the other side, in spite of an extensive perifocal low density area, suggesting the presence of hemicerebral atrophy (Fig. 4c).

Cerebral angiography revealed mass lesions with a faint vascularity in the capillary to venous phases in four cases and avascular masses in two. There were no characteristic findings suggesting germinoma.

Radiation therapy produced rapid regression of tumor size in all the patients, and there was no evidence of residual tumor on CT examined at the end of treatment. Follow-up CT of 5 patients, taken 1 to 6 years after the treatment, revealed enlarged lateral and third ventricles and subarachnoid space over the ipsilateral cerebral hemisphere, which indicated hemicerebral atrophy (Fig. 4d). Cerebral atrophy did not develop in one patient (case 4), whose tumor was restricted to the putamen. There were relatively small residual low density areas and a high density spot at the previous tumor site. There was no evidence of local recurrence and subarachnoid dissemination of the tumor examined by follow-up CTs in the present series.

Discussion

The CT findings of germinomas in the pineal and suprasellar regions have been well documented [5, 7, 8, 12]. On plain CT, the tumor shows well defined, round and homogeneous areas of iso- to slightly higher density than that of the surrounding normal brain tissue. Abnormal calcification in the tumor itself is rare [8, 12]. After intravenous administration of contrast medium, the tumor is homogeneously enhanced without central lucency in most cases. When the tumor is large, the margin of the high density area becomes irregular suggesting infiltration. Germinoma in these regions occasionally shows single or multiple low densities, indicating the presence of cysts [8].

When CT shows both cystic pattern and abnormal calcification in a pineal tumor, the tumor is usually said to be a teratoma [7, 8, 12]. In five of 6 tumors in the basal ganglia and thalamus in our series, plain CT revealed calcification. The calcifications were also visualized on plain skull x-ray films in two cases. All the tumors had low densities indicating the presence of cysts. In the surgical specimens we examined, the tumor tissues were composed of only germinomas. Previous some case reports also describe the presence of cysts and occasional calcifications in germinomas in this region [2, 4, 10, 11]. Germinomas in the cerebral hemisphere are also reported to be cystic [1, 13]. When compared to the structures of basal ganglia and thalamus, the pineal body, pituitary stalk and chiasm are small and restricted and defined by narrow connexions to the surrounding brain. This anatomical difference may influence the mode of progression of the tumor.

In the early stage of the disease, plain CT was reported to be normal in case 3. Kobayashi [2] also reported normal CT findings in initial examination of germinoma cases of this region. The first abnormal finding on CT was a slightly high density area without mass effect in case 3. Judging from the presence of spastic hemiparesis, when the initial and second CT were done, the tumor must have been bigger than the lesion localized to the head of caudate nucleus shown on plain CT. Postcontrast study might be necessary. With further progression of symptoms, CT showed an enlarged, inhomogenous high density area with mass effect.

In the early reports of germinomas in the basal ganglia and thalamus, radiological and pathological findings were characterized by the presence of ipsilateral hemicerebral atrophy [14, 15]. In the present series, the tendency to hemicerebral atrophy was seen only in one case before treatment, but became definite after the disappearance of the tumors in all patients except for one, whose tumor was restricted to the basal ganglia. Yamada's case also showed a tendency to cerebral atrophy in the advanced stage. Thus, hemicerebral atrophy may be a result of long-standing destructive lesions in the thalamus.

Cerebral angiography did not differentiate germinoma from other tumors in this region [2]. Some showed faint tumor stain in the capillary to venous phases but the others showed no vascularity, as in glioma. In a larger series of tumors in thalamus and basal ganglia, the majority are gliomas [16–18], some being cystic and some having calcification. But germinoma is more likely when plain CT shows slight high density of the tumor tissue as compared to iso- to low density of the glial tumor [7]. Increased level of tumor marker, such as HCG, in serum and CSF and the presence of precocious puberty will allow a firm diagnosis of germinal cell tumor. The final diagnosis ismade by histological examination.

In spite of the high radiosensitivity and potential curability of germinoma of this region, the residual neurological condition of the patient after treatment is not satisfactory due to incomplete recovery of hemiparesis and impaired intelligence [4, 10]. Early detection of the tumor is essential for better outcome.

Conclusion

CT-findings of germinoma arising in the basal ganglia and thalamus are somewhat different from those of the pineal and suprasellar regions. In the early stage, plain CT may not show any abnormality in spite of the presence of neurological abnormality. The early appearance of the tumor on plain CT is only a homogeneous or inhomogeneous iso- to slightly high density area without mass effect. Later, the tumor is seen as a space-occupying lesion on CT. Cysts and calcification develop at a relatively early stage of the disease. With intravenous injection of contrast medium, the tumor shows slight to moderate enhancement as also reported in germinomas of other intracranial regions. Ipsilateral hemicerebral atrophy may rarely develop early, but is frequently seen in the advanced stage and after treatment. Because of the potential curability of tumor and incomplete neurological recovery of the patient with advanced germinoma in this region, early detection and treatment of the tumor are desirable.

References

1. Tanaka R, Ueki K (1979) Germinomas in the cerebral hemisphere. Surg Neurol 12: 239-241
2. Kobayashi T, Kageyama N, Kida Y, Yoshida J, Shibuya N, Okamura K (1981) Unilateral germinomas involving the basal ganglia and thalamus. J Neurosurg 55: 55-62
3. Sano K (1982) Pineal region tumors: Problems in pathology and treatment. Clinical Neurosurg 30: 59-91
4. Mabuchi S, Abe H, Nakagawa Y, Aida T, Tashiro K, Tsuru M (1982) Germinoma originating in the basal ganglia - Report of 2 cases. Neurol Surg (Tokyo) 10: 977-982
5. Takeuchi J, Handa H, Nagata I (1978) Suprasellar germinoma. J Neurosurg 49: 41-48
6. Ueki K, Tanaka R (1980) Treatments and prognosis of pineal tumors - Experience of 110 cases. Neurol Med Chir (Tokyo) 20: 1-26 (in Jpn)
7. Zimmerman RA, Bilaniuk LT, Wood JH, Bruce DA, Schult L (1980) Computerized tomography of pineal, parapineal and histologically related tumors. Radiology 137: 669-677
8. Jooma R, Kendall BE (1983) Diagnosis and management of pineal tumors. J Neurosurg 58: 654-665
9. Rich TA, Cassady JR, Strand RD, Winston KR (1985) Radiation therapy for pineal and suprasellar germ cell tumors. Cancer 55: 932-940
10. Yamada H, Imamura K, Sasaki N, Ando T, Hirata T, Misao H, Sakata K, Shimokawa K (1980) Intracranial germinoma developing in the right basal ganglia - Report of a case followed up by CT scan and review of the literature. Brain Nerve (Tokyo) 32: 387-392 (in Jpn)
11. Moriyama T, Teramoto S, Kitajima H, Yonekura M, Nakamura M, Matsumura H (1983) Primary intracranial germ cell tumor in the right basal ganglia and its vicinity area. Neurol Surg (Tokyo) 11: 73-80 (in Jpn)
12. Tanaka R, Takeda N, Ueki K, Itoh J, Honda H (1980) Computerized tomography in the diagnosis and management of pineal region tumors. Neurol Med Chir (Tokyo) 20: 1103-1114 (in Jpn)
13. Ellis SJ, Crockard A, Barnard RO (1986) Klinefelter's syndrome, cerebral germinoma, Chiari malformation, and syrinx: A case report. Neurosurg 18: 220-241
14. Nakagawa Y, Hamajima I, Iwasaki Y, Yada K, Kunita H (1973) Ipsilateral cerebral atrophy caused by ectopic pinealoma. Report of a case. Brain Nerve (Tokyo) 25: 69-75
15. Kwak R, Saso S, Suzuki J (1978) Ipsilateral cerebral atrophy with thalamic tumor of childhood. J Neurosurg 4: 443-449
16. Arsenic C (1958) Tumors of the basal ganglia. Arch Neurol Psychiatr 80: 18-24
17. Cheek WR, Taveras JM (1966) Thalamic tumors. J Neurosurg 24: 505-513
18. Bernstein M, Hoffman HJ, Halliday WC, Hendrick EB, Humphreys RP (1984) Thalamic tumors in children. Long-term follow-up and treatment guidelines. J Neurosurg 61: 649-656

Received: 1 December 1986

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