Annals of Nuclear Medicine Vol. 12, No. 3, 161–164, 1998

Single photon emission CT images in a case of intraventricular neurocytoma

Manabu OGUCHI, Kotaro HIGASHI, Mitsuru TANIGUCHI, Takahiro NISHIKAWA, Hiroyasu TAMAMURA, Tetsuro OKIMURA and Itaru YAMAMOTO

Department of Radiology Kanazawa Medical University

Although Tc-99m HMPAO uptakes in various brain tumors have been reported, SPECT images of neurocytoma have not been described. The authors report a patient with intraventricular neurocytoma (IN) who demonstrated significant uptake of Tc-99m HMPAO and Tl-201 Cl before brain biopsy. Residual tumor after biopsy showed significant uptake of I-123 IMP on early SPECT images, but this uptake was decreased on delayed images. The three radionuclides seem to have different uptake mechanisms.

Key words: Tc-99m HMPAO, I-123 IMP, Tl-201 Cl, neurocytoma, SPECT

INTRODUCTION

TECHNETIUM-99m-hexamethyl-propyleneamine-oxime (Tc-99m HMPAO) is a lipophilic agent that can penetrate the blood brain barrier (BBB) and is used for regional cerebral blood flow studies. Most brain tumors show a decreased uptake of Tc-99m HMPAO on brain SPECT images, although in some brain tumors such as meningioma and glioblastoma increased uptakes have been reported.[1,2] Intraventricular neurocytoma (IN), a recently recognized benign cerebral tumor of young adults, can be confused microscopically with oligodendroglioma. CT and MRI studies of IN have been reported.[3,4] Although positron emission CT (PET) studies of IN have been reported, SPECT images of IN have not yet been demonstrated.[5–7]

CASE REPORT

A 33-year-old woman had complained of occipitalgia for the last 6 months. She recently developed nausea, vomiting and muscle weakness. Severe memory disturbance was recognized on physical examination but there were no other neurological deficits. There was no history of epilepsy. MRI revealed a large intraventricular tumor with marked and homogenous enhancement with Gd-DTPA on a T1-weighted image (Fig. 1A, B). CT also revealed well enhanced intraventricular tumor (Fig. 2A, B). A brain SPECT study was performed to evaluate cerebral blood flow with a triple-headed camera SPECT system 20 min after the i.v. injection of 740 MBq of Tc-99m HMPAO. The Tc-99m HMPAO SPECT image showed noticeably increased tracer uptake in the intraventricular tumor (Fig. 3). Tl brain SPECT images were obtained with a single head camera 15 min and 3 hours after the i.v. injection of Tl-201 Cl 111 MBq. Both early and delayed images showed significant Tl-201 uptake in the tumor (Fig. 4A, B). About 2 weeks later, the tumor biopsy was performed through right occipital craniotomy. The pathological finding confirmed the presence of neurocytoma (Fig. 5). Four weeks later, IMP SPECT was performed 20 min and 3 hours after the i.v. injection of 111 MBq I-123 IMP to evaluate regional brain perfusion with a single head camera. Early SPECT images showed a significant tracer uptake in the residual tumor, although tracer uptake was decreased on the delayed images (Fig. 6A, B).

DISCUSSION

Intraventricular neurocytoma (IN) is a relatively rare and benign brain tumor of young adults. Radiologically, CT and MRI studies of intraventricular neurocytoma have been reported with the tumors demonstrating a characteristic attachment to the lateral and third ventricles. Calcification and intratumoral vessels have also been commonly

Received December 10, 1997, revision accepted March 9, 1998.

For reprint contact: Manabu Oguchi, M.D., Department of Radiology, Kanazawa Medical University, 1–1, Daigaku, Uchinada, Kahoku 920–0293, JAPAN.

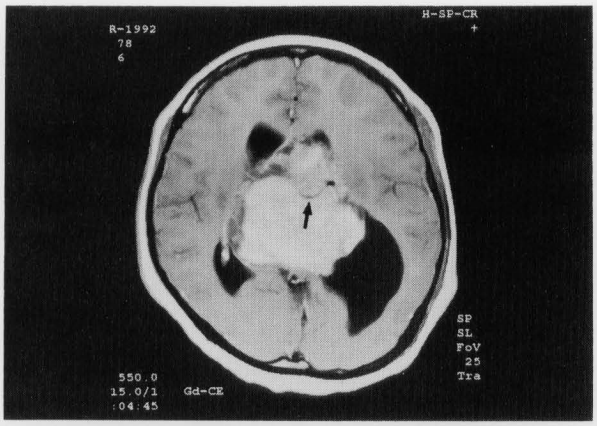
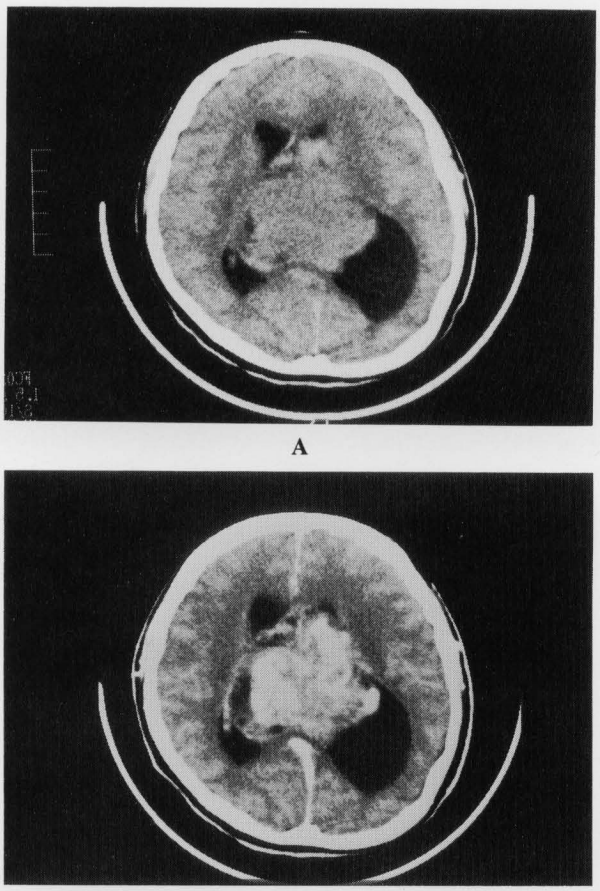


Fig. 1 Gd-DTPA enhanced brain MR image. There was homogenous enhancement in the large intraventricular tumor. Blood vessels within the tumor can be seen (arrow).



A

B

Fig. 2 (A) Pre- and (B) Post-contrasted brain CT images. The attenuation of the tumor was similar to the cortical gray matter, and the tumor demonstrated a marked enhancement.

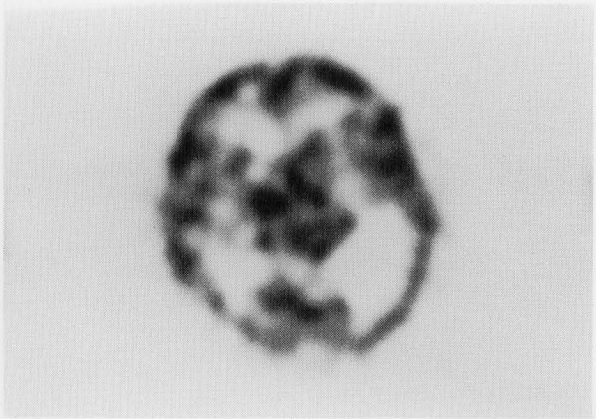
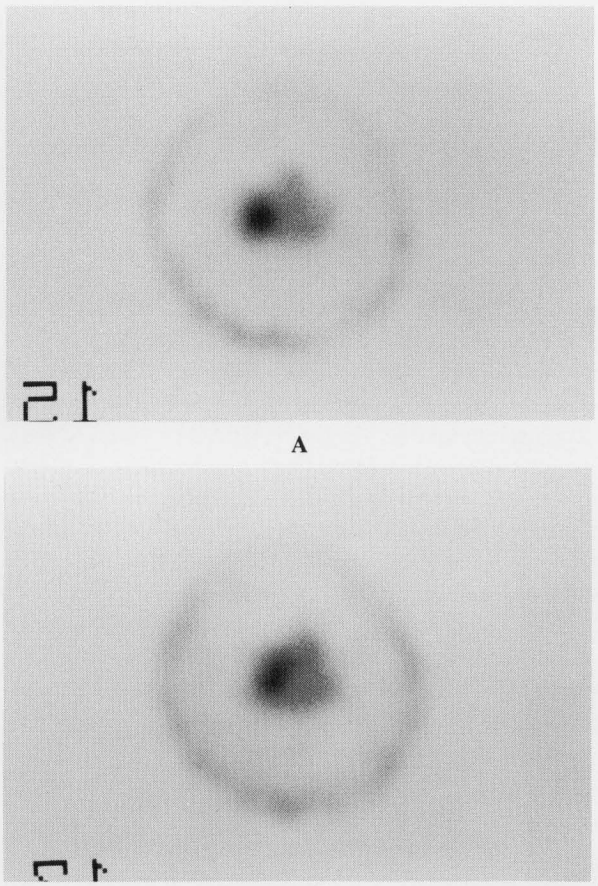


Fig. 3 Technetium-99m HMPAO SPECT image (axial). Increased accumulation in the intraventricular tumor was visible compared to normal brain cortex.



A

B

Fig. 4 Thallium-201-Cl SPECT images (axial). Both early (A) and delayed (B) images showed significant Tl uptakes in the tumor. The early ratio (tumor count/normal brain count) was 2.00 and the delayed ratio was 2.00.

seen.[3,4]

Mineura et al. reported blood flow and metabolism of central neurocytoma by using $C^{15}O_2$, $C^{15}O$, and ^{18}F-fluorodeoxyglucose (FDG). They reported that tumor regional cerebral blood flow (r-CBF) and regional cerebral blood volume (r-CBV) were higher than comparable values in the contralateral gray matter but the oxygen extraction fraction (r-OEF), the cerebral metabolic rate of

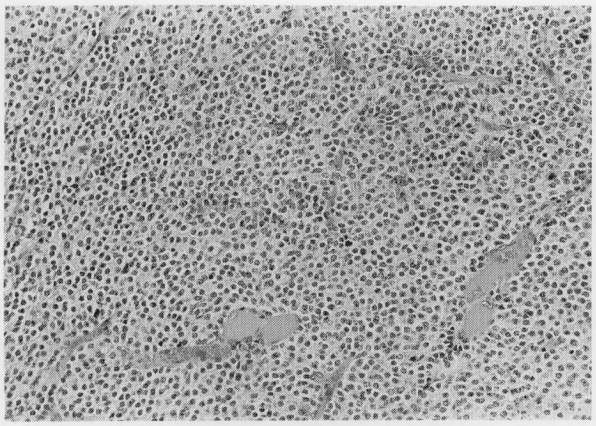
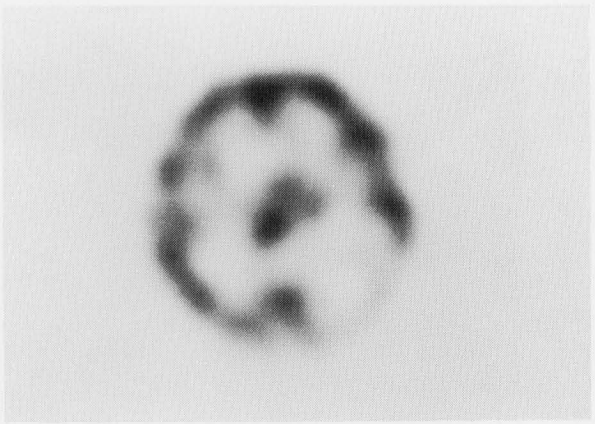
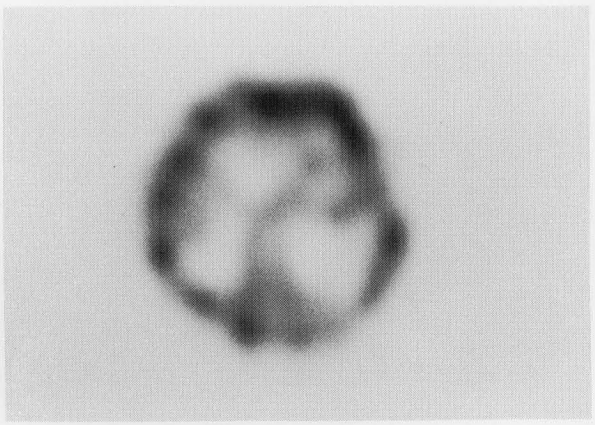


Fig. 5 Histology of the intraventricular tumor showed a central neurocytoma with capillary dilatation. Hematoxylin Eosin staining.



A



B

Fig. 6 N-isopropyl-p-I-123 iodoamphetamine SPECT images (axial). The early image (A) showed a significant IMP uptake for the residual tumor but delayed image (B) showed a decreased uptake for the tumor.

oxygen (r-$CMRO_2$) and the cerebral metabolic rate of glucose (r-CMRGl) are significantly lower than those of the gray matter.[5] Perfusion of brain tumors has been studied extensively with SPECT and I-123 IMP, Tc-99m HMPAO, and Tc-99m ECD. Most brain tumors show a low uptake or defect on SPECT images, although some such as meningioma and glioblastoma have been reported to show a high uptake.[1,2,8,9] Recently, low-grade gliomas have been reported to show increased Tc-99m HMPAO or Tc-99m ECD uptake.[10,11] The mechanism of Tc-99m HMPAO uptake is not known, but hypervascularity is thought to be one of the important factors. Suess et al. have demonstrated a correlation between the glutathione content of brain tumor and Tc-99m HMPAO uptakes.[12] Winchell et al. have reported that I-123 IMP uptake is dependent on amine binding sites and that decreased uptake is due to a deficiency of binding sites in the brain tumors.[13]

In the case presented here, the neurocytoma showed significant uptake of Tc-99m HMPAO compared to normal brain parenchyma. Since the tumor was well enhanced by contrast media on CT and MRI images, it is more likely that hypervascularity or increased blood flow to the tumor is responsible for the phenomenon than other uptake mechanisms. PET study also demonstrated a relatively high r-CBF and r-CBV of IN.[5] Histological finding for the biopsy specimen demonstrated that the tumor was composed of small, and uniform cells and that capillary dilatation contained red blood cells. A similar pattern has been reported in the case of meningioma.[1] I-123 IMP SPECT also demonstrated high accumulation in the tumor on early images, though low radioactivity (washout from the tumor) was observed on the delayed images. This could be explained by the difference between the tumor and normal brain tissue in amine binding sites. Tl-201 Cl uptake is thought to reflect the viability of the tumor, and the degree of TlCl uptake has been repoted to correlate with cell growth rate and to represent tumor malignancy.[11] Intraventricular neurocytoma is believed to be biologically benign. This seems to correlate with the cellular viability of the tumor and perfusion of the tumor.

REFERENCES

1. Hoshi H, Jinnouchi S, Watanabe K, Nakano S, Kinoshita K. Mismatch between Iodine-123 IMP and Technetium-99m HM-PAO Brain Perfusion Imaging in a Patient with Meningioma. *Clin Nucl Med* 12: 737–740, 1987.
2. Babich JW, Keeling F, Flower MA, Repetto L, Whitton A, Fieding S, et al. Initial experience with Tc-99m-HM-PAO in the study of brain tumors. *Eur Nucl Med* 14: 39–44, 1988.
3. Goergen SK, Gonzales MF, McLean C. Intraventricular Neurocytoma: Radiologic Features and Review of the Literature. *Radiology* 182: 787–792, 1992.
4. Chang KH, Han DG, Kim JG, Chi DC, Suh SJ, Kim SH, et al. MR Appearance of Central Neurocytoma. *Acta Radiologica* 34: 520–526, 1993.
5. Mineura K, Sasajima T, Itoh Y, Kowada M, Tomura N, Uesaka Y, et al. Blood flow and metabolism of central neurocytoma: a positron emission tomography study. *Cancer* 76: 1224–1232, 1995.

6. Shioya H, Mineura K, Sasajima T, Kowada M, Iida H, Ogawa T, et al. Kinetics of glucose metabolism in central neurocytomas. *Nou to Shinkei* 47: 981–987, 1995.
7. Fukahori T, Tahara T, Kato A, Masumoto H, Kudo S, Tsuji T, et al. Diagnostic value of high N-isopropyl-p-[^{123}I] iodoamphetamine (IMP) uptake in brain tumors. *Nippon Igaku Houshasen Gakkai Zasshi* 56: 53–59, 1996.
8. Nishimura T, Hayashida K, Uehara T, Imakita S, Hashimoto K, Naruo Y, et al. Two patients with meningioma visualized N-isopropyl-p-iodoamphetamine (I-123). *Neuroradiology* 30: 351–354, 1988.
9. Lindegaad MW, Skretting A, Hager B, Watne K, Lindegaard KF. Cerebral and cerebellar uptake of Tc-99m(d,l)-hexamethyl-propyleneamine oxime (HM-PAO) in patients with brain tumor studied by single photon emission computerized tomography. *Eur J Nucl Med* 12: 417–420, 1986.
10. Grünwald F, Menzel C, Pietsch T, Pavics L, Hufnagel A, Biersack HJ. Increased Technetium-99m-HMPAO Uptake Grade II Astrocytoma. *J Nucl Med* 36: 804–806, 1995.
11. Hirano T, Suzuki H, Higuchi T, Watanabe N, Oriuchi N, Shibazaki T, et al. Grade II Astrocytoma Visualized by Technetium-99m-ECD SPECT. *J Nucl Med* 37: 273–275, 1996.
12. Suess E, Ungersbock K, Kitz P, Podreka I, Heimberger K, Deecke L. Technetium-99m-d,l-Hexamethlpropyleneamine Oxime (HMPAO) Uptake and Glutathione Content in Brain Tumors. *J Nucl Med* 32: 1675–1681, 1991.
13. Winchell HS, Horst WD, Oldendorf WH, Hatter R, Parker H. N-Isopropyl-[^{123}I] p-Iodoamphetamine: Single-Pass Brain Uptake and Washout; Binding to Brain Synaptosomes; and Localization in Dog and Monkey Brain. *J Nucl Med* 21: 947– 952, 1980.
14. Oriuchi N, Tomiyoshi K, Inoue T, Ahmad K, Sarwar M, Tokunaga M, et al. Independent Thallium-201 Accumulation and Fluorine-18-Fluorodeoxyglucose Metabolism in Glioma. *J Nucl Med* 37: 457–462, 1996.