CT BRAIN IMAGES IN CANCER PATIENTS WHO HAD NEUROLOGICAL PROBLEMS

Patchrin PEKANAN[1,2], Tarapong DUANGKAM[1]

ABSTRACT

A retrospective study of CT images of 154 cancer patients who were sent for CT scanning due to the presence of neurological abnormalities. About 34% of the studied patients had brain metastases. Carcinoma of the lung, the breast and the nasopharynx were the three most common types of cancers in patients who came for the investigations and they represented the three most common types of cancers that had metastases to the brains. Malignant melanoma, malignant mole, chorioCa and Ca lacrimal gland had highest tendency for brain metastases. Facial palsy/hemiparesis, headache, seizure and alteration of consciousness were among the most neurological manifestations. Parenchymal metastases were more common than the dural/ leptomeningeal types.

INTRODUCTION

Metastases to the central nervous system are among the most feared complications of systemic malignant disease. Once metastatic disease in the brain is discovered, the median survival without treatment is only one to two months[7] and only six months with treatment[8]. However, palliative therapy may be beneficial for some patients by controlling the progression of neurological deficits, headaches and dementia. In some patients treatment of brain metastases may result in prolonged periods of useful and relatively comfortable survival. Detection, diagnosis and localization of intracerebral lesions are important roles for these imaging methods, with the intent of determining prognosis as well as planning and assessing the results of treatment. Metastases must be distinguished carefully from benign brain tumors or brain abscesses to avoid critical errors in clinical management[2,13].

Studies to determine the incidence of brain metastases from different types of cancers by CT images were considered rare in our country.

PATIENTS AND METHODS

The retrospective study was performed in the Urupong Medical Center which was the center servicing the CT studies for patients from different parts of the country. The data collection included the CT brain images of cancer patients who had neurological problems, between the year 1984 and 1992. The clinical presentation was only obtained from the request forms and the follow up study was impossible.

The CT machine used were Somatom DRH (Siemens Co.,Germany) and GE9800 (GE Co.,USA). The standard cuts were parallel to the orbitomeatal line, 5 mm slice thickness at the posterior fossa and 10 mm slice thickness at the rest of the brain. Both noncontrast and intravenous contrast enhancement types of studies were routinely performed in the standard dose(40-80 gram of iodine). The scans were done immediately after the contrast injection. The

[1]Department of Radiology, Ramathibodi Hospital, Rama 6 Street, Bangkok 10400, Thailand.
[2]Urupong Medical Center,BKK.

interpretation was performed by the qualified radiologists.

The purpose of the study was (1) to obtain the incidence of brain metastases in different types of cancers in Thai population who had neurological problems; (2) to define the neurological manifestations in the positive brain metastatic group; (3) to determine the types of brain metastases.

The nodule or nodules with extensive brain edema was considered as parenchymal metastases. Nodule/nodules with less extensive brain edema in the steroid-treating patients was also counted as positive cases. Parenchymal hemorrhage in a high bleeding tendency cancer (chorioCa) in a young patient was classified as having brain metastases and parenchymal hemorrhage in less bleeding tendency cancers was set in a negative group. Dural mass with or without calvarial destruction and abnormally dense leptomeningeal enhancement was considered positive for metastases.

RESULTS

There were 154 cancer patients, age ranged from 11 to 89 years old; 74 patients were male and 80 cases were female. About 90% of cases belonged to age-group range of 31-80 years old. Twenty-seven varieties of cancers were presented; the three most common cancers were Ca lung, Ca breast and Ca nasopharynx in 36%, 18% and 10% respectively. Twenty-one clinical signs and symptoms were noted and the three most common complaints were facial palsy/ hemiparesis, headache and seizure/convulsion in 34%, 22% and 11% respectively. Eleven of 27 types of cancer were responsible for 52 positive brain metastases by CT scan; the three most common types of cancers were Ca lung, Ca breast and Ca nasopharynx in 50%, 17% and 9% respectively. All cases of melanoma, malignant mole, chorioCa and Ca lacrimal gland and 75% of lymphoma showed positive brain metastases. The three most common age-groups that had positive brain metastases were 51-60 years old, 41-50 years old and 61-70 years old in 33%, 19% and 19% respectively and the patients in age-group 11-20 years old showed 100% metastatic incidence. After the age 50 years old, the incidence of positive brain metastases decreased with the advancing ages. Facial palsy/ hemiparesis, headache and seizure/convulsion also represented the three most common signs and symptoms in the metastatic patients in 33%, 25% and 20% respectively.

Those patients who showed no brain metastases, the three most common CT findings were normal, ischemic areas and brain atrophy in 41%, 38% and 13%. The other findings considered negative for metastases but actually metastatic process could not be totally excluded were hydrocephalus, intracerebral hematoma, pituitary mass and thickened pituitary stalk (see discussion). The negative group presented slightly more percentage than the positive group. The brain parenchymal hemorrhage was noted in a case of Ca cervix (53/F), a case of leukemia (30/M) and a case of Ca liver (49/M). The pituitary mass was seen in a case of Ca breast (61/F), mildly thickened pituitary stalk was noted in a case of Ca prostate (85/M).

Positive brain metastases in the case of chorioCa (24/F) was a parenchymal hematoma. Combined leptomeningeal metastases and parenchymal nodules were seen in a case of Ca lung (40/F). A combined dural/calvarial and adjacent parenchymal deposit was noted in a case of Ca breast (62/F).

(Age of patient / Sex) M = Male, F = Female

The history of acute or chronic onset could not be obtained in all patients so that it was not used for the information.

Table 1. Numbers of the cancer patients in the study vs age group

Age group	No. of patients (%)	
0-10	0	(0)
11-20	2	(1.3)
21-30	5	(3.3)
31-40	11	(7.1)
41-50	20	(13)
51-60	42	(27.3)
61-70	34	(22)
71-80	32	(20.8)
81-90	8	(5.2)
Total	154	(100)

Male = 74, Female = 80

Table 2. Number of studied patients in each type of cancers

Type of Cancers		No. of patients (%)
Ca lung	56	(36.35)
Ca breast	28	(18.17)
Ca nasopharynx	10	(6.49)
Ca cervix	8	(5.19)
Ca colon	6	(3.9)
Ca prostate	6	(3.9)
Lymphoma	4	(2.6)
Ca stomach	4	(2.6)
Ca thyroid	3	(1.95)
Ca kidney	3	(1.95)
Ca tongue	3	(1.95)
Adenocarcinoma	2	(1.3)
Ca ovary	2	(1.3)
Malignant melanoma	2	(1.3)
CholangioCa	2	(1.3)
Ca pancreas	2	(1.3)
Ca liver	2	(1.3)
Leukemia	2	(1.3)
ChorioCa	1	(0.65)
Ca uterus	1	(0.65)
Ca bladder	1	(0.65)
Ca larynx	1	(0.65)
Leiomyosarcoma	1	(0.65)
Ca rectum	1	(0.65)
Ca mouth	1	(0.65)
Malignant mole	1	(0.65)
Ca lacrimal gland	1	(0.65)
Total	**154**	**(100)**

Table 3. Clinical signs and symptoms vs number of patients

Signs and symptomas	**No. of patients (%)**
Facial palsy and hemiparesis	59 (34.3)
Headache	39 (22.68)
Seizure or convulsion	20 (11.64)
Alteration of consciousness	18 (10.47)
Nausea/ vomiting	6 (3.49)
Vertigo	4 (2.33)
Dizziness	4 (2.33)
Blindness	3 (1.74)
Fainting	3 (1.74)
No history about symptoms	3 (1.74)
Aphasia	2 (1.16)
Ataxia	2 (1.16)
Hallucination	1 (0.58)
Decreased mental status	1 (0.58)
Dementia	1 (0.58)
Dysarthria	1 (0.58)
Dysphagia	1 (0.58)
Hoarseness of voice	1 (0.58)
Stifffneck	1 (0.58)
Fever	1 (0.58)
Leg pain	1 (0.58)
Total	**172 (100)**

Note; One patient might have more than one sign or symptom
total studied patients = 154

Table 4. Types of cancer vs number of patients with positive brain metastases by CT scan

Types of Cancer	**Number of patients (%) who have positive brain metastases by CT scan**
Ca lung	26 (50)
Ca breast	9 (17.30)
Ca nasopharynx	5 (9.62)
Lymphoma	3 (5.77)
Melanoma	2 (3.86)
Ca cervix	1 (1.92)
Ca kidney	1 (1.92)
Malignant mole	1 (1.92)
Ca ovary	1 (1.92)
Ca colon	1 (1.92)
Ca lacrimal gland	1 (1.92)
ChorioCa	1 (1.92)
Total	**52 (100)**

Table 4a. Percentage of types of cancers who had brain metastases by CT scan and number of total patients of the group

Type of Cancer	**% of the total group**	
Ca lung	26/56	(46.43)
Ca breast	9/28	(32.14)
Ca nasopharynx	5/10	(50)
Lymphoma	3/4	(75)
Melanoma	2/2	(100)
Ca cervix	1/8	(12.5)
Ca kidney	1/3	(33.33)
Malignant mole	1/1	(100)
Ca ovary	1/2	(50)
Ca colon	1/6	(16.67)
Ca lacrimal gland	1/1	(100)
ChorioCa	1/1	(100)
Total	**52/122**	**(42.62)**

Table 5. Age group of the patients who have positive brain metastases by CT scan vs number of patients in each age group and percentage of the whole studied patients

Age group	**Number of patients**		**% of total patients in the same age group**	
0-10	0	(0)	0/0	(0)
11-20	2	(3.92)	2/2	(100)
21-30	2	(3.92)	2/5	(40)
31-40	4	(7.84)	4/11	(36.36)
41-50	10	(19.61)	10/20	(50)
51-60	17	(33.33)	17/42	(40.48)
61-70	10	(19.61)	10/34	(29.41)
71-80	5	(9.8)	5/32	(15.63)
81-90	1	(1.92)	1/8	(12.5)
Total	**51**	**(100)**	**51/154**	**(33.12)**

Table 6. Signs and symptoms in the positive group of brain metastases by CT scan vs number of patients and percentage of the total patients who had that sign and symptom

Signs and symptoms	No. of patients (%) with brain metastases		% of total patients with that sign and symptom	
Facial palsy and hemiparesis	20	(32.78)	20/59	(33.9)
Headache	15	(24.59)	15/39	(38.46)
Seizure or convulsion	12	(19.67)	12/20	(60)
Alteration of consciousness	5	(8.20)	5/18	(27.78)
Nausea/vomiting	2	(3.28)	2/6	(33.33)
Aphasia	2	(3.28)	2/2	(100)
Dizziness	1	(1.64)	1/4	(25)
Blindness	1	(1.64)	1/3	(33.33)
Ataxia	1	(1.64)	1/3	(33.33)
Vertigo	1	(1.64)	1/4	(25)
Fever	1	(1.64)	1/1	(100)
Total	**61**	**(100)**	**61/172**	**(35.47)**

Note;One patient might have more than one sign and symptom

Table 7. Findings in the brains in the patients with negative brain metastases by CT scan

CT findings	No. of patients (%)	
No abnormality detected	41	(39.04)
Ischemic areas	38	(36.19)
Brain atrophy	13	(12.38)
Hydrocephalus	5	(6.01)
Intracerebral hematoma	3	(2.86)
Calcified cysticercosis	3	(2.86)
Pituitary mass	1	(0.95)
Thickened pituitary stalk	1	(0.95)
Total	**105**	**(100)**

Table 8. Number of patients in age group who had negative brain metastases by CT scan

Age group	No. of pts (%)		% of total pts in the same gr.	
0-10	0	(0)	0/0	(0)
11-20	0	(0)	0/2	(0)
21-30	2	(1.97)	2/5	(40)
31-40	7	(6.87)	7/11	(63.64)
41-50	10	(9.80)	10/20	(50)
51-60	25	(24.5)	25/42	(59.52)
61-70	24	(23.53)	24/34	(70.59)
71-80	27	(26.47)	27/32	(84.38)
81-90	7	(6.86)	7/8	(87.5)
Total	**102**	**(100)**	**102/154**	**(66.23)**

DISCUSSION

Metastases to the brain are relatively common, occuring in 12% of autopsied cancer patients[1]. Prolonged patient survivals and the increasing prevalence of lung cancer is a factor that increases the incidence of metastatic disease in the brain, in addition to the recent use of computed tomography and magnectic resonance imaging. Lung carcinoma is the most common primary tumor to give rise to clinically evident brain metastases, followed by breast carcinoma and malignant melanoma; together comprise 70%-80% of clinically evident cerebral metastases[9-10]. Approximately 60% for melanoma, 50% for all types of lung cancer, and 30% for breast cancer were found to have brain metastases at autopsy [12]. Next in order of frequency are genitourinary and gastrointestinal cancers[9]. The remaining cases come from a wide variety of primary cancer sites such as bladder, prostate, thyroid, lymph glands, salivary gland, testis, endometrium, and ovary. The primary tumor site for brain metastases may remain undetermined after diagnostic studies in as many as 14% of cases[9]. Most cancer patients who have brain metastases also have metastases to other organs, particularly the lungs. Malignant cells entering the venous blood stream are filtered out first by the lungs; spread to the brain and other organs may then occur as tumor emboli break off into the pulmonary veins from the metastatic lung lesions. Metastases may pass first by way of the portal circulation to the liver and, subsequently, to the lungs and other organs. In accordance with these concepts of tumor spread, it is rare for a cure to be effected in a patient with brain metastases, even if the brain lesions can be controlled. When the primary cancer is in the lung, embolic spread may sometimes occur directly to the brain without involving other organs. This may explain why there seems to be a tendency for lung carcinomas to spread to the brain earlier than they do with other malignancies.

Another route by which cancers are thought to metastasize to the cranial contents is Batson's venous plexus, a network of valveless paravertebral veins. This route is implicated often in metastases to the intracranial dura. The cranial dura may be involved alone, or there may be concurrent metastases to the brain substance also. In some of these patients there are also metastases to the dural venous sinuses.

The most frequent symptoms of brain metastases are headache, motor weakness, and disordered mentation. Other common symptoms are ataxia, cranial nerve dysfunction, seizures, sensory disturbances, and speech problems. Although the symptoms caused by cerebral metastases tend to evolve progressively over days or weeks, their onset is sometimes sufficiently acute to resemble a stroke. This type of clinical presentation is particularly likely when there has been bleeding into a brain metastases[2]. Approximately 10 to 30% of brain metastases that are evidence on imaging studies or at autopsy may remain neurologically silent for an indefinite period[8].

Approximately 80% of brain metastases are located supratentorially and involve the cerebrum. Any intracranial structure may harbor a metastatic lesion. Certain carcinomas may be linked with neurological symptoms only as remote (paraneoplastic) manifestations, without direct central nervous system involvement by the tumor. Paraneoplastic neurologic syndromes are most commonly associated with carcinomas of the lung. Some cancer patients have vague neurologic symptoms that may be related to metabolic imbalances. Agitaion, irritability, impaired mentation, and somnolence may be associated with low serum sodium, high serum calcium, elevated BUN, or blood ammonia levels; hypoxial hypercarbia or sepsis (with or without accompanying renal or hepatic disease).

Metastases to the brain are readily detected on CT scans because of the extensive brain edema that metastases cause and because they nearly always enhance strongly after intravenous infusions of contrast medium. Cerebral metastases with diameters of less than 0.5 cm often are shown readily. Using a high-dose contrast infusion technique and waiting an hour after the infusion

to begin CT scanning improve detection rates even further[3]. Because the imaging characteristics of brain metastases can vary so greatly, descriptions of typical appearances on CT scans are hazardous[2]. They are more likely to occur in the territory of the middle cerebral artery than in other regions of the cerebrum. The typical brain metastasis has a distinct enhancing rim on CT scan and a low - density central region. The rim may be thick or thin, irregular or smooth. The smaller ones may have a homogenous solid appearance. It is common to see metastases of different appearances within the same brain. Peritumoral edema may spread along the white matter fiber tracts for considerable distances, but it does not cross the corpus callosum nor does it involve the cortical gray matter. When systemic steroids are administered, cerebral edema may be reduced and the enhancement of metastatic lesions by intravenously administered contrast media may become less obvious on CT scans. In some patients with intracerebral bleeding, the metastatic tumor nodule from which the bleeding originated may be obscured by blood.

On CT scans, differentiating cerebral metastases from other types of brain lesions usually is not difficult because metastases are usually multiple and occur in patients who have known primary tumor elesewhere. However, the diagnosis may be more difficult when a symptomatic brain metastasis is the initial or presenting clinical problem, as it is with 10% of lung carcinoma[12]. Because cerebral abscesses often have smooth, thin margins and low-density centers seen on infusion CT scans, they may be similar in appearance to metastases.The degree of perifocal brain edema also tends to be comparable in both conditions. Early brain abscesses may resemble small tumors. Some patients with brain abscesses may not have systemic signs of infection, and there may be no abnormal CSF findings. A cerebral biopsy or a follow up study might be helpful, because brain abscesses may change in appearance more rapidly than metastases.[2]

Dural metastases may be missed by CT scans when erosion of the endosteal surface of the cranium is not apparent. Leptomeningeal tumor spread is also difficult to detect on cranial CT scans. The positive CT findings observed with leptomeningeal metastases included contrast enhancement of the subarachnoid space and/or obliteration of the quadrigeminal cistern. Communicating hydrocephalus frequently was present.

In conclusion: (1) The patients with Ca lung and Ca breast were the first two most common groups who were sent for CT scan to rule out brain metastases and were found to be the two most common group that showed positive studies. (2) The third most common type was Ca nasopharynx which was dissimilar to reports from non-Asian patients; melanomas were the third rank in those patients. The reason was that we have much more patients with Ca nasopharynx. Facial palsy/ hemiparesis, headache, seizure/ convulsion and alteration of consciousness were the dominant manifestations of both positive and negative brain metastasis and were agreeable to other reports. (3) Melanoma, malignant mole, chorioCa, Ca lacrimal gland and lymphoma were among the groups that gained high percentage of positive results. (4) The most common age groups that showed brain metastases were between 41-70 years old but the positive percentage decreased with the advancing age, probably due to high incidence of cerebrovascular disease among those patients. (5) Leptomeningeal or dural deposits were found much less than the parenchymal metas-tases.(6) More negative results for brain metastases indicated that images-investigations were needed to exclude the other possibilities.

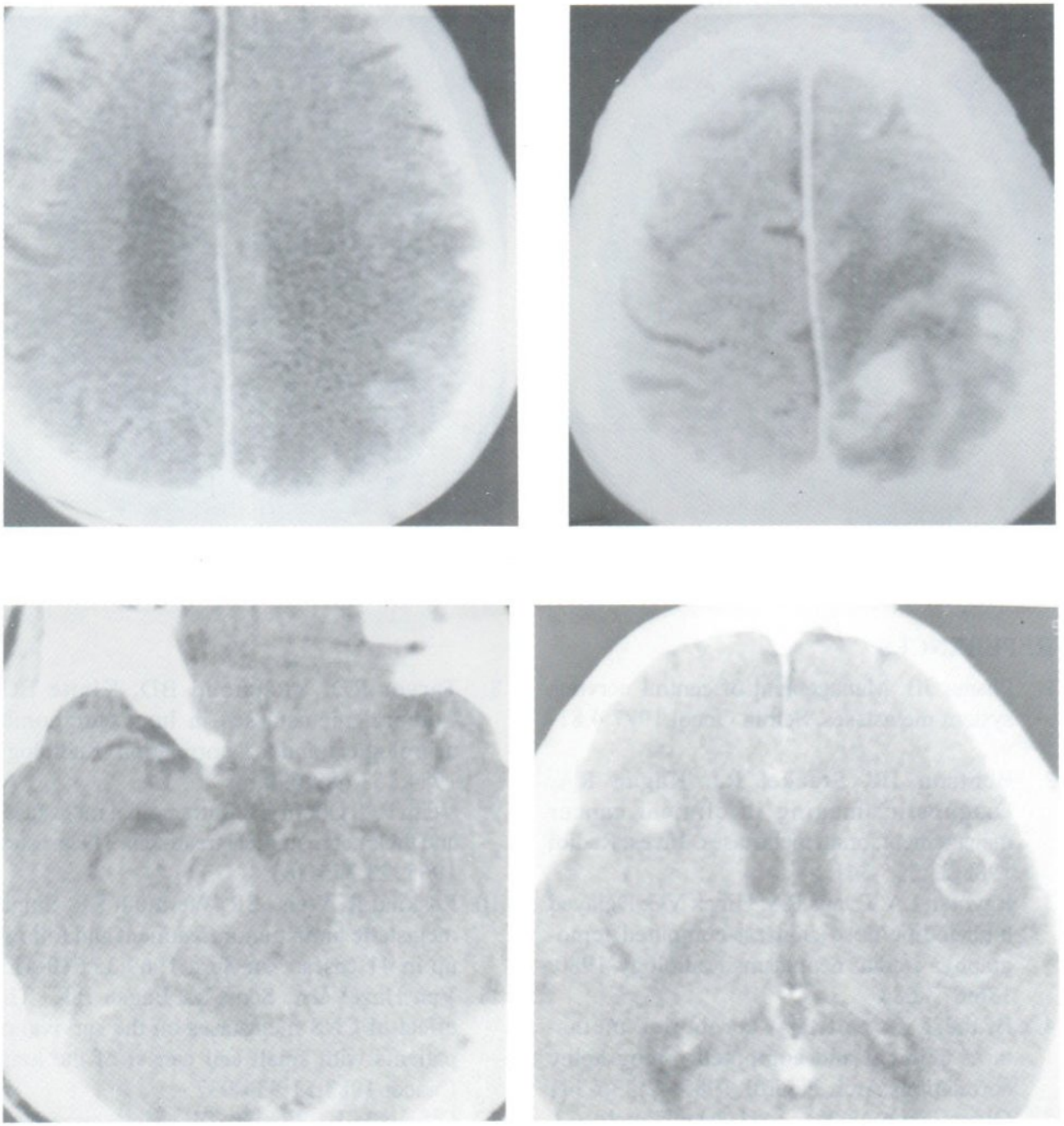

Fig. 1A Parenchymal metastatic lesions

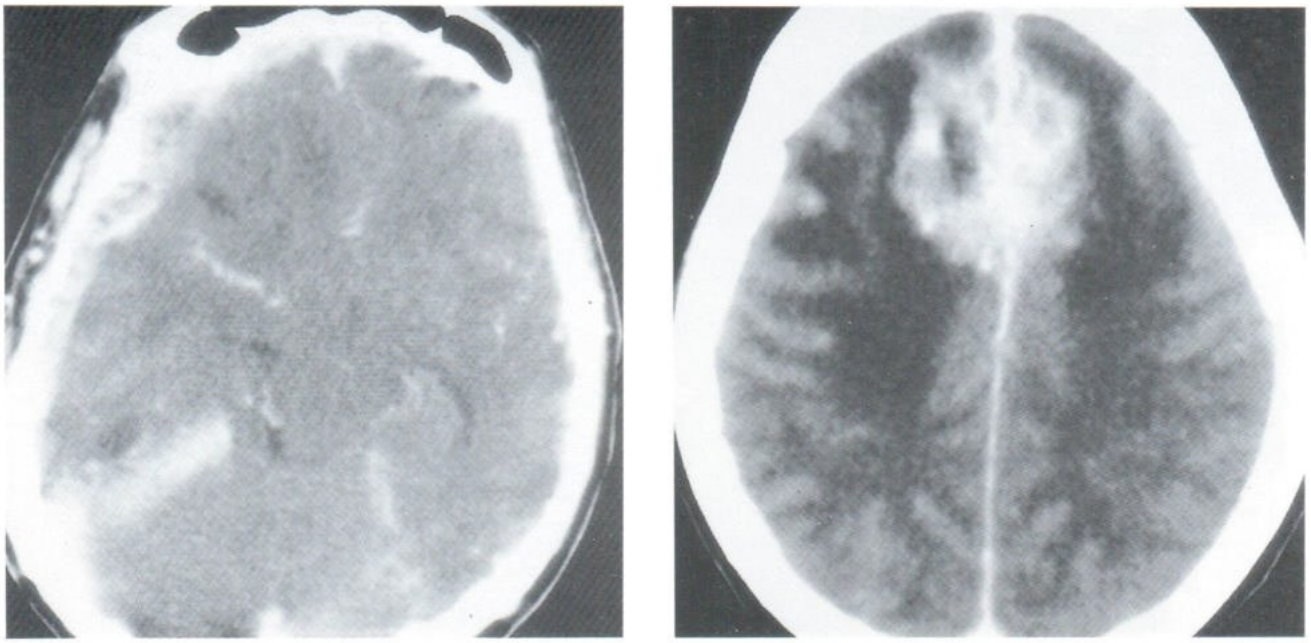

Fig. 1B Leptomeningeal/dural metastatic deposits.

REFERENCES

1. Posner JB. Management of central nervous system metastases. Semin Oncol 1977;4:81-91.
2. Bentson JR, Steckel RJ, Kagan RA. Diagnostic imaging in clinical cancer management: brain metastases. Invest Radiol 1988;23:335-341.
3. Rayman LA, Evans RA, Hinck VC. Delayed high iodine dose contrast computed tomography: cranial neoplasms.Radiology 1980; 136:677-684
4. Braberg L. Solitary cerebellar metastases.Clinical and computed tomographic correlations.Arch Neurol 1985;42:336-341
5. Oldersleeve N, Koo AH, MacDonald CJ. Metastatic tumor presenting as intracerebral hemorrhage.Radiology 1972;124:109-112
6. Tarmann DR, Krikorian J, Yorke C, et al. Computd tomography in leptomeningeal pread of tumors. J Comput Assist Tomogr 1978;2:448-455.
7. DiStefano A, Yap HY, Horobagyi GW, Blumen-schein GR.The natural history of breast cancer patients with brain metastases. Cancer 1979;44: 1913-1918.
8. Tarver RD, Richmond BD, Klatte EC. Cerebral metastasses in lung carcinoma: neurological and CT correlation. Radiology 1984;153:689-692.
9. Veith RG, Odom GL. Intracranial metastases and their neurosurgical treatment. J Neurosurg 1965; 23:375-383.
10. Raskind R, Weiss SR, Wermuth RE. Single metastatic brain tumor treatment and follow-up in 41 cases. Am Surg 1969;35:510-515.
11. Van Hazel GA, Scott M, Eagan RT. The effect of CNS metastases on the survival of patients with small cell cancer of the lung. Cancer 1983;51:933-937.
12. Cifuentes N, Pickren JW. Metastases from carcinoma of mammary gland: an autopsy study. J Surg Oncol 1979;11:193-205.
13. Davis JM, Zimmerman RA, Bilaniuk LT. Metastases to the central nervous system. Radiologic Clinics of North Americ 1982;20:417-426.