

SITES OF PRIMARY MALIGNANCIES IN PATIENTS WITH BRAIN METASTASES

Munir Ahmad, Zeenat Ayub, Yunas Khan

Department of Radiology and Department of Paediatric Surgery,
Hayatabad Medical Complex and Lady Reading Hospital, Peshawar

ABSTRACT

Objective: To know the frequency of different primary tumors having metastases in the brain.

Material and Methods: This descriptive study was conducted in the department of Radiology Postgraduate Medical Institute Hayatabad Medical Complex Peshawar from January 2003 to July 2004. The subjects were patients having established diagnosis of primary tumors who revealed metastasis in brain on CT scan examination. The frequency of various primary tumors with brain metastases was calculated in the study.

Results: Out of 49 cases, 29(59.2%) were male and 20(40.8%) female. The age ranged from 5 to 80 years while mean age was 55 years. Thirty four (69.39%) patients presented with multiple metastatic deposits in brain, 13(26.53%) patients showed single lesion while 2 (4.08%) showed leptomeningeal metastases. Cerebral metastases were seen in 29 (59.18%), cerebellar in 14(28.57%), while both supra and infra-tentorial deposits were detected in 6 (12.24 %). Bronchogenic carcinoma was the commonest primary, seen in 20 (40.82 %) patients followed by breast carcinoma in 9 (18.36 %) patients.

Conclusion: Bronchogenic carcinoma is the commonest primary tumor that metastatize to brain. The second common tumor that metastatize to the brain is carcinoma breast. Most metastases are multiple and cerebral hemispheres are the common location for metastatic deposits.

Keywords: Bronchogenic Carcinoma, Carcinoma Breast, Brain Metastases, CT, MRI.

INTRODUCTION

Metastases to the brain are the most feared complication of systemic cancer and are the common intracranial tumors in adults. Incidence is rising with improved survival of cancer patients¹. Approximately 40% of intracranial neoplasms are metastatic². Various autopsy series suggest that lung, breast, melanoma, renal, and colon cancers are the most common primary tumors to metastasize to the brain.^{3,4}

Intracranial metastases can be categorized by location as parenchymal and leptomeningeal. Lung carcinoma most often metastasizes to brain parenchyma, while lymphoma or leukemia most frequently involve the meninges.⁵ Parenchymal lesions are mostly commonly seen in cerebrum and less commonly in cerebellum and brain stem.⁶

Until recently, CT scan was the primary imaging method of evaluation of patients with intracranial metastases. Now contrast MRI is used for evaluation of intracranial metastases. MRI with its mutiplanar imaging capabilities, superior tissue

contrast, elimination of bony artifacts and versatile parameters is an effective tool in the evaluation of such patients.^{7,8} Intravenous administration of contrast material (30-40g iodine) increases the diagnostic accuracy of C.T. Most metastases enhance after a standard dose of intravenous contrast. Use of a higher dose of contrast (80-85g iodine) and scanning delayed 1-3hours after injection of the contrast agent does offer a further increase in the detection of multiple metastases, and is appropriate if MRI is not available.⁹ Radiological diagnosis of brain metastases in a patient with a known systemic cancer is easy. However, diagnosis in a patient with no known primary cancer elsewhere in the body is difficult. Metastatic disease should be strongly suspected in patients with multiple cranial lesions.¹⁰ Solitary intracranial lesions may prove to be metastatic in 15% of patients, with no known systemic cancer.¹¹

This study was conducted to find out the frequency of various primary tumors having metastasis in the brain.

FREQUENCY OF PRIMARY TUMORS HAVING BRAIN METASTASES

Primary tumors	No. of patients n = 49	Percentage
Bronchogenic carcinoma	20	40.82
Breast carcinoma	9	18.37
Carcinoma kidney	5	10.20
Gastrointestinal tract tumors	4	8.16
Melanoma	3	6.12
Carcinoma thyroid	2	4.08
Neuroblastoma	2	4.08
Miscellaneous (choriocarcinoma, lymphoma, leukemia, sarcoma)	4	8.16

Table 1

MATERIAL AND METHODS

Our study group consisted of patients having known primary cancer elsewhere in the body. These patients were referred from IRNUM, Hayatabad Medical Complex, Lady Reading Hospital, Khyber Teaching Hospital, other government hospitals and private clinics.

All patients both male and female having establish diagnosis of their primary disease who revealed metastatic deposits in brain after CT scan examination were included in the study. Patient age below 5 years and those patients in whom the primary diagnosis was not confirmed were excluded from the study.

After taking history and evaluating the record, CT scan was performed. The following protocol was used.

Using lateral scout image for planning, axial contiguous slices were taken parallel to orbito-meatal line. Slice thickness was 5mm from foramen magnum to petrous ridge and 8-10mm to vertex. Plain examination was performed followed by post contrast scans after administration of 100-140ml of intravenous contrast.

Filming: Soft tissue window (Posterior fossa: 170/40. Above: 100/30)

Films were viewed under optimal viewing conditions and looked for presence, number, site, characteristic and pattern of enhancement of metastatic deposits. The primary site was also noted. After compiling the data and results the frequency of different primary tumors was calculated.

RESULTS

Our study consisted of 49 patients with known primary cancer elsewhere in the body. 29(59.2%) were male and 20 (40.8%) female. The age ranged from 5 to 80 years while mean age was 55 years. Out of 49 patients, 34 (69.39%) patients presented with multiple metastatic deposits in the brain, 13(26.53%) patients showed single lesion while 2 (4.08%) showed leptomeningeal metastases. Cerebral metastases was seen in 29 (59.18%), cerebellar in 14(28.57%), while both supra and infra-tentorial deposits were detected in 6 (12.24 %). The commonest site was the parietal lobe. Bronchogenic carcinoma was the commonest primary and was seen in 20 (40.82 %) patients. The second common primary was breast carcinoma and was seen in 9 (18.36 %) patients. Other primary tumors were carcinoma kidney in 5 (10.2%) patients, gastrointestinal tract tumors in 4 (8.16%) patients, melanoma in 3 (6.12%) patients, carcinoma thyroid in 2 (4.08 %) patients,

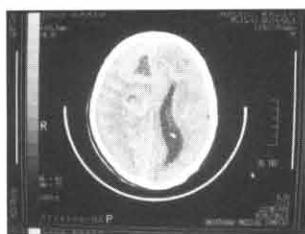


Figure 1a:
Precontrast image showing multiple brain metastases.

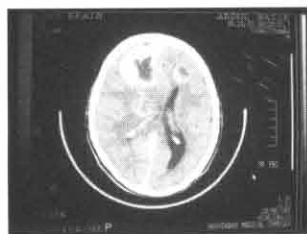


Figure 1b:
Postcontrast image showing multiple enhancing brain metastases

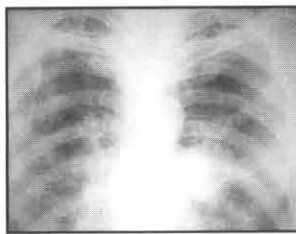


Figure 2:
X-Ray chest of a patient of bronchogenic carcinoma who also revealed brain metastases

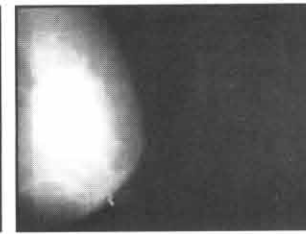


Figure 3:
Mammography shows carcinoma breast in a patient who presented with brain metastases after one year.

neuroblastoma in 2(4.08%), choriocarcinoma, lymphoma, leukemia and sarcoma in 1 (2.08%) cases each (Table 1).

DISCUSSION

Brain metastases accounts for about 40% of brain tumors. The incidence is rising with improved survival of patients due to better treatment. Majority of brain metastases occur in adult patients aged 35-70 years.¹ Six tumors account for 95% of all brain metastases i.e bronchial carcinoma, breast carcinoma, gastrointestinal tract tumors, hypernephroma, melanoma and choriocarcinoma, in decreasing order of frequency. In childhood the most common tumors that metastasize to the brain are leukemia / lymphoma and neuroblastoma.¹²

In our study, 80% of patients were adults. 59% patients were male and 41% patients were female. Taddei et al¹³ reported 66% brain metastases in male and 34% in female patients. The site of metastatic deposits also varies. Wolfgang Dahnert¹² in his Radiology review manual reported 57% brain metastases in cerebral hemisphere, 29% in cerebellum, and 32% in brain stem. Delattre et al¹⁴ reported the following sites in his study. Cerebrum (80-85%), cerebellum (10-15%), and brain stem (3-5%). Only 4% showed simultaneous extra-axial metastasis in his study. In our study cerebral metastases was seen in 60% patients, cerebellar in 28% patients, while both supra and infra tentorial locations were detected in 12% patients. The commonest site was the parietal lobe. Metastatic lesions may present as single or multiple lesions. Multiple deposits occur in two third of patients while single deposits in one third patients. 15% deposits occur in subarachnoid space.¹² Stephen Chapman¹⁵ claims that approximately 80% of brain metastases are multiple. In our study 70% of patients presented with multiple metastatic deposits, 26% patients showed only single lesion while 4% patients had leptomeningeal deposits. Anil khosla et al and Sawaya et al¹⁰ reported that 50% of patients present with a single metastatic lesion. In our study we placed emphasis on the frequency of different primary tumors, which revealed brain deposits. Brain metastases from bronchogenic carcinoma was seen in 40 % patients. The second common primary tumor that metastasized to brain was breast carcinoma (18 %). Other primary tumors were carcinoma kidney (10%), gastrointestinal tract tumors (8 %), carcinoma thyroid (4 %), melanoma (6%), neuroblastoma (4%), choriocarcinoma, lymphoma, leukemia and sarcoma in 2% cases each. Sawaya et al¹⁰ reported brain metastasis from lung cancer in 32%, breast cancer 21%, melanoma 48%, colon cancer 6%, and

renal cell cancer 11%.

Srikanth SG et al¹⁶ has reported primaries as follows: lungs 33%, gastrointestinal tract 25%, ovary 10%, 3% from breast, cervix and esophagus each and 2% from kidney, thyroid and larynx each. The site of primary tumor was not known in 16%. Taddei GL et al¹³ selected brain metastases through a review of specimens from the department of pathology. He found Lung tumors in 47%, breast in 9% while in 17%, primary was unknown. Wolfgang Dahnert¹² revealed that six tumors accounts for 95% of all brain metastases in which bronchogenic carcinoma accounts for 47%, breast carcinoma 17%, gastrointestinal tract tumors 15%, hypernephroma 10%, melanoma 8% and choriocarcinoma 2%. The frequency of different primaries vary in different studies, however, bronchogenic and breast carcinomas are the common tumor that metastasis to the brain. In our study bronchogenic carcinoma was the commonest tumor among the brain metastasis followed by breast carcinoma which correlates with other studies. In the less common metastasis some primary tumors were not found in our study which were reported in other studies. This is likely due to small number of patients in our study.

CONCLUSION

Bronchogenic carcinoma is the commonest primary tumor that metastasis to the brain. The second common tumor that metastasis to the brain is carcinoma breast. Most metastatic deposits are multiple and cerebral hemisphere is the common location for metastatic deposits.

REFERENCES

1. Khosla A, Creasy JL, Coombs BD, DeLaPaz R L . Brain metastases . www.eMedicine.com/radiology/brain. August 2004.
2. Magilligan DJ Jr, Duvernoy C, Malik G Yagnik Pm. Surgical approach to lung cancer with solitary cerebral metastasis: Twenty years experience. *Ann Thoracic Surg* 1986; 42: 360-4.
3. Mandel L, Hilaris B, Sullivan M, Geremia GK. The treatment of single brain metastasis from non-oat cell lung carcinoma. *Cancer* 1986; 58: 641-649.
4. Hardy J, Smith I, Cherryman G, Johnson CE. The value of computed tomography (CT) scan surveillance in the detection and management of brain metastases in patients with small cell lung cancer. *Br J Cancer* 1990; 62: 684-6.
5. Akesson P, Larsson EM, Kristoffersen DT. Brain metastases-comparason of gadolinium

- enhanced MR imaging at standard and high dose, contrast-enhanced CT and non-contrast enhanced MR imaging. *Acta Radiol* 1995; 36: 300-6.
6. Posner JB, Chernik NL: intracranial metastases from systemic cancer. *Adva Neurol* 1978; 19: 579-92.
 7. Sze G, Shin J, Knol G, Kinkel WR, Vincent RG. Intraparenchymal brain metastases; MRI versus contrast-enhanced CT. *Radiology* 1988; 168: 187-94.
 8. Sze G, Milano E, Johnson C, Gosen A. Detection of brain metastases. Comparison of contrast enhanced MR with un-enhanced MR and enhanced CT. *Am J Neur Rad* 1990; 11 : 785-91.
 9. Hayman LA, Evans RA, Hink VC. Delayed high iodine dose contrast computed tomography in cranial neoplasms. *Radiology* 1980; 136: 677-84.
 10. Sawaya R, Bindal RK: Metastatic brain tumors. Edinburgh, Churchill Livingstone 1995: 923-46.
 11. Voorhies RM, Sundaresan N, Thaler HT. The single supratentorial lesion. An evaluation of preoperative diagnostic tests. *J Neurosurg* 1980; 53: 364-8.
 12. Dahnert W, *Radiology review manual*. 5th edit, Lippincott William & Wilkins, 2003: 302-3.
 13. Taddei GL, Moncini D, Raspollini MR, Mennonna P, Boddi V, Dini M, Boccoliero AM. Metastatic brain tumors. *Pathologica* 1999; 91: 3-7.
 14. Delattre JY, Krol G, Thaler HT: Distribution of brain metastases. *Arch Neurol* 1988; Vol no.2: 4-8.
 15. Chapman S, Nakielny R. *Aids to radiological differential diagnosis*. 4th ed. W.B. Saunders, 2003: 427-33.
 16. Srikanth SG, Jauakumar PN, Chaandrashekar HS. CT features of intracranial metastases of unknown primaries. *Neurol India* 2002; 50: 282-5.

Address for Correspondence:

Dr Munir Ahmad
 Senior Registrar
 Dept. of Radiology
 Hayatabad Medical Complex
 Peshawar
 E-mail: bajaur@yahoo.com