

Clinical Review: Cerebral Metastases - Variable Appearance on MRI

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Abstract :

Cerebral metastases can have a variable pattern of appearance on magnetic resonance imaging (MRI). This along with a site predilection may even provide a clue to the primary tumor type. We hereby show case of different patterns of cerebral metastases on MRI with a view to provide a clinical implication on the basis of their distribution pattern and location.

Introduction :

Intracranial metastases are one of the most common causes of the neurological disorder in patients with systemic malignancy. Headache and motor symptoms are the presenting symptoms, followed by seizures. Cerebral metastases can have a variable pattern of appearance on magnetic resonance imaging (MRI). Based on these and site predilection they may even give clue to primary tumor type. Contrast enhanced Magnetic resonance imaging (CEMR) is most sensitive imaging method for the detection of intracranial metastases. We show case here our experience with various intracranial metastases in terms of distribution and MR appearance of the lesions.

Materials and Methods :

All patients with suspected intracranial metastases were subjected to CEMR for diagnostic or screening purposes. Standard MRI protocol was performed with T1 weighted, T2 weighted, fluid attenuated inversion recovery sequence (FLAIR) and post contrast sequences after intravenous injection of Gadolinium contrast. Prospective analysis of patients was made and history was taken in terms of primary malignancy. MRI scans were evaluated in terms of T1, T2 signal intensity, pattern of contrast enhancement and location and number of lesions. A note was also made for any calcification or hemorrhage within the lesions. A brief description of the cases that we came across is given below.

CASE 1

Forty five years old man presented with headache since two months. There was no history of fever, convulsions or loss of consciousness.

MRI showed a well-defined T1 hypointense and T2 hyperintense cystic lesion with enhancing mural nodule and perilesional edema. Another nodular enhancing lesion was noted in right temporal lobe in perisylvian cortex (Fig.1a). Frontal hyperostosis was also noted. Provisional diagnosis of atypical meningioma was considered. But it proved to be well differentiated metastatic carcinoma from squamous cell carcinoma on biopsy correlation. Chest radiograph then performed showed a spiculated right hilar mass but the patient had no symptoms pertaining to that lesion (Fig 1b).

CASE 2

Forty two years old woman, with known history of Carcinoma breast, post operative and post chemotherapy status before two years, came with a complaint of headache and giddiness since ten days. MRI revealed plaque like homogeneously enhancing lesions along anterior falx and left frontal region with convex margins suggesting dural location of the lesion (Fig. 2a, 2b). Indentation was noted over the cerebral cortex by the dural lesion. Thus diagnosis of dural metastases was considered and patient was again put on chemotherapy.

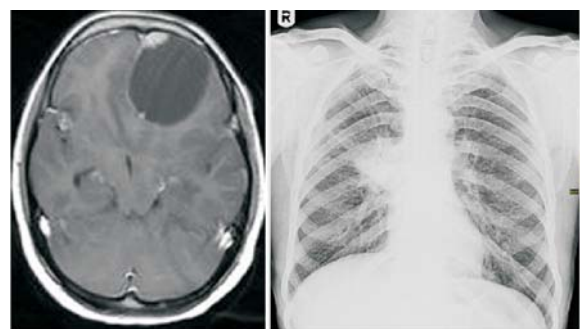


Fig 1a: CEMR showing cystic lesion with enhancing mural nodule in left frontal lobe. Another enhancing nodule is noted near right sylvian fissure

Fig 1b: Plain radiograph of Chest shows spiculated mass in right hilar region

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Fig 2a,2b: Contrast enhanced T1W axial and coronal MRI shows enhancing dural lesion along anterior falx and left frontal lobe

CASE 3

An eighty years old man with history of carcinoma parotid was referred for MRI to evaluate his complaints of dimness in vision in left eye with sixth nerve palsy gradually increasing since 6 months. MRI revealed choroidal soft tissue intensity bulge in left eye (Fig. 3a). A well-defined homogeneously enhancing nodular lesion was noted on left side obliterating left cerebello-pontine angle cistern and indenting left cerebral peduncle, suggestive of dural based extra axial lesion (Fig. 3b, 3c). It was inferred to be a dural based metastatic lesion with compression of cerebral peduncle at origin of sixth nerve with choroidal metastasis in left eye and the patient was switched on to chemotherapy.

CASE 4

Eighteen years old man, a known case of carcinoma rectum, post-operative and post radiotherapy status presented with severe headache and giddiness since 20 day and was referred for MRI. It revealed hyper intense signal on FLAIR and T2W sequences along the cerebral convexity (Fig. 4a) which homogeneously enhanced on post contrast study (Fig. 4b). No evidence of any enhancement was noted along the leptomeninges. No parenchymal lesion was noted. In a known case of primary metastases with history correlation, the disease was inferred to be pachymeningeal metastases and the patient was subjected to radiotherapy.

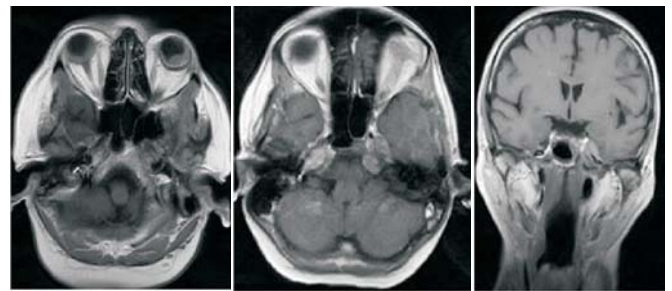


Fig 3a: Contrast enhanced T1W axial scan shows left choroidal metastases

Fig 3b, 3c: Contrast enhanced T1W axial and coronal MRI scan shows dural metastases at left Cerebello-pontine angle cistern indenting pons near origin of sixth nerve.

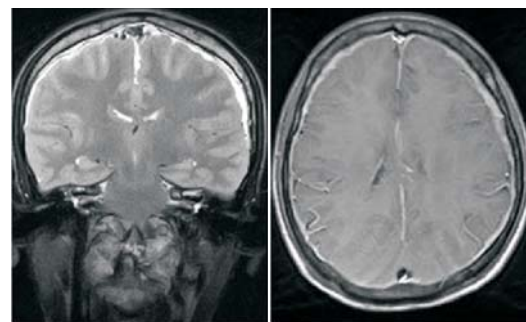


Fig 4a and 4b: T2W coronal scan shows diffusely hyperintense pachymeninges along cerebral cortex Contrast enhanced T1W axial scan shows diffuse enhancement of pachymeninges with normal enhancement of leptomeninges

CASE 5

Fifty two years old woman with a known history of carcinoma breast presented with complaints of headache and was subjected to MRI. There was a hyper intense lesion noted on FLAIR sequence in right temporal region and in right hippocampus (Fig. 5a). On post contrast study multiple homogeneously enhancing lesions were noted in both temporal lobes and in right hippocampus region, suggestive of multiple metastases (Fig. 5b). It needs to be emphasized here that in every patient with suspected cerebral metastases a contrast study should be performed as it may reveal more number of lesions as compared to other sequences.

CASE 6

In a known case of carcinoma breast with chemotherapy taken, there was a faint hyper intensity noted in right frontal region on FLAIR (Fig. 6a) and T2W sequences. On Gradient Echo MRI sequence there was a signal void noted (Fig. 6b) and it showed homogeneous enhancement on contrast enhanced study (Fig. 6c). The lesion was inferred to be calcified metastases which remained static as compared to previous scans.

CASE 7

A seven years old boy presented with fever, malaise and lethargy since three months with multiple swellings in groin, calf and wrist. He was markedly anemic with hemoglobin 5 gm% and with very low platelet count of 26,000. He was referred for CT scan brain due to the complaint of drowsiness. CT scan revealed multiple hyper dense lesions situated peripherally with interdigitations along the inner table of skull vault. Marked white matter edema was present (Fig. 7a,7b). Subsequently MRI was performed which showed multiple hypo intense lesions in both parietal lobes on T1W and T2W sequences. Perilesional hyperintense signal was noted on T1W sequence which was inferred to be subacute haemorrhage (Fig. 8a,8b). Peripheral hypo intense rim was seen on gradient sequence possibly due to cortical vessels suggesting extra axial nature of the lesions (Fig 8c). On post contrast examination there was moderate homogeneous contrast enhancement of surface lesions associated with diffuse dural enhancement (Fig 8d). Significant white matter edema was noted with mass effect on the ventricles. Skeletal survey revealed marked generalized coarsening of the bones with widening of sutures in skull vault, suggesting sutural metastasis. Diagnosis of lymphoma or leukemia with generalized involvement of skeletal system, soft tissue lesions and dural based lesions with sutural metastasis was inferred. Histopathological examination revealed high grade small cell Non-Hodgkin's lymphoma.

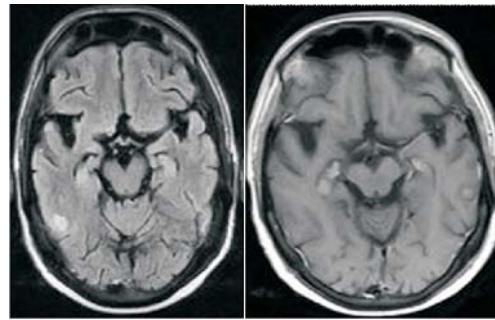


Fig 5a: FLAIR axial scan shows hyperintense foci in right temporal lobe, right hippocampal region.
Fig 5b: Contrast enhanced T1W axial scan shows multiple enhancing lesions in both temporal lobes and both hippocampal regions

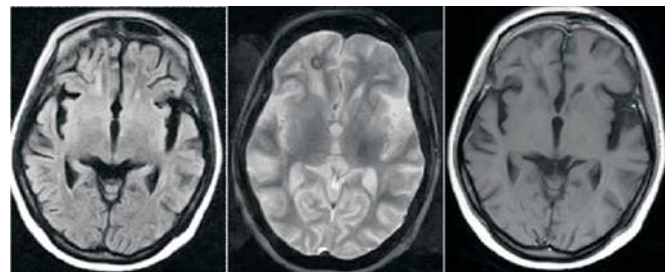


Fig 6a: MRI Brain with FLAIR axial scan shows mild hyperintense signal in right frontal lobe
Fig 6b: MRI Brain with Axial Gradient echo sequence shows signal void in right frontal lobe suggesting calcified focus.
Fig 6c: Contrast enhanced T1W sequence shows faint ring enhancement in right frontal lobe.

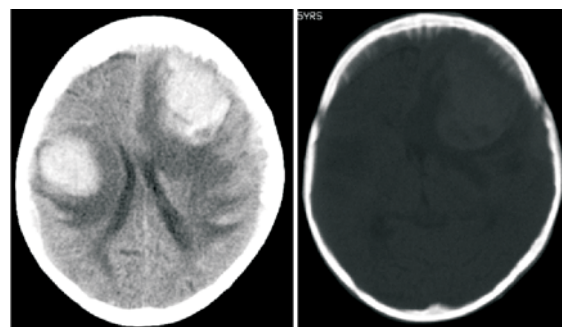


Fig 7a: Plain CT shows hyperdense multiple lesions with perilesional edema and serrated inner skull vault.
Fig 7b: Bone window in CT scan show widening of sutures with inter-digitations along the inner vault of the skull.

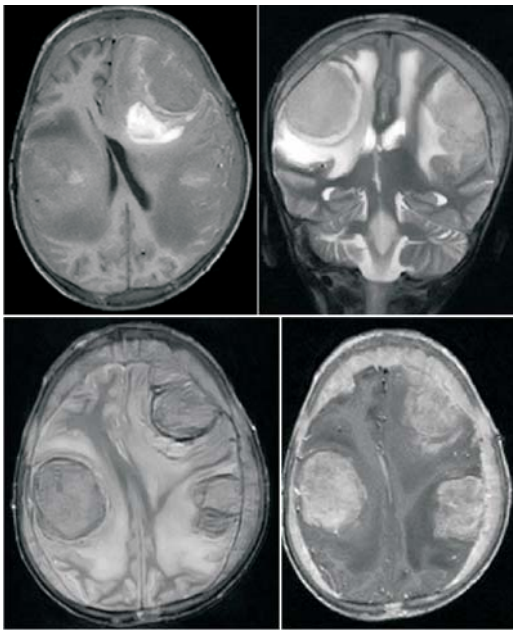


Fig 8a: T1W axial scan shows hypointense solid lesions with dural thickening. Hyperintense area in subcortical white matter suggests subacute hemorrhage.

Fig 8b: T2W coronal scan MRI brain showing hypointense lesions situated peripherally with perilesional edema and with thickened dura

Fig 8c: Gradient sequence MRI shows solid lesions with peripheral hypointense rim suggesting displaced cortical vessels along the margins

Fig 8d: Post Contrast T1W axial scan MRI shows homogeneously intensifying lesions in cerebral cortex and thickened homogeneously diffusely enhancing duramater.

Discussion

Metastasis to the brain is the most feared complication of systemic cancer and the most common intracranial tumor in adults. Approximately 40% of intracranial neoplasms are metastases. Multiple, large autopsy series suggest that, in order of decreasing frequency, lung, breast, melanoma, renal, and colon cancers are most common primary tumors to metastasize to the brain. The metastatic lesions may be direct result of microscopic foci acquired via haematogenous route or they may be component of localized metastatic calvarial or dural membrane involvement. Majority of the metastatic lesions are multiple, however solitary metastases is not uncommon, especially in melanoma, lung and breast carcinoma. MRI with contrast study is

the investigation of choice for detection and characterization of metastases. Metastatic foci may be separated from surrounding edema on T2W sequence as metastases is typically a focus of variable intensity (depending on such factors as cellularity, necrosis, hemorrhage, and mucin content and calcification rarely) amidst high intensity oedema. However, cortical metastases would not produce edema due to paucity of interstitium and hence contrast examination is necessary for detection of cortical metastases.⁽¹⁾

Calcifications in metastatic neoplasms to the brain are rare, but must be considered in the differential diagnosis of intracranial calcified lesions.⁽³⁾ It can commonly be seen with metastatic mucinous adenocarcinoma, osteosarcoma, and chondrosarcoma. Treated metastasis with radiotherapy or chemotherapy can lead to calcification within the metastasis.^(4,5) Dural metastases can occur from tumors like lung, breast and prostate in adults and in rhabdomyosarcoma, Ewing's sarcoma, neuroblastoma and lymphoma in pediatric age group.⁽⁶⁾ Dural metastases are found at autopsy in 8–9% of patients with advanced systemic cancer. They arise either by direct extension from skull metastases or by hematogeneous spread. Unless they are aggressive metastatic tumors, they generally do not transgress dural boundaries. Consequently they do not involve brain parenchyma. Similarly they do not cross the falx to invade the contra lateral hemisphere. Dural metastases are often clinically asymptomatic but they may produce progressive neurological deficits and sometimes subdural hematomas. MRI may be misleading when the metastasis simulates a meningioma or when a subdural hematoma masks the underlying tumor. Whenever possible, surgical removal is the most appropriate treatment. The prognosis is poor because of the progressive systemic cancer but prolonged survival has been reported in operated patients, when the systemic cancer was controlled.⁽⁷⁾ In one study,⁽⁸⁾ the expected cases of breast cancer (n = 5) occurred, but more examples of prostate cancer (n = 7) or unusual malignant neoplasms (cervical = 3, laryngeal = 1, gallbladder = 1, Ewing sarcoma = 1, intravascular lymphomatosis = 1, ocular melanoma = 1) were identified.⁽⁸⁾

Hemorrhage is classically synonymous with choriocarcinoma, melanoma, as well as renal cell and thyroid carcinomas. However due to higher prevalence of lung and breast cancer they are more common

malignancies to produce hemorrhagic metastatic lesions on CT. Hyper dense lesions are frequently seen on NCCT in lesions arising from the gastrointestinal tract or small round cell tumor due to increased cellularity or with haemorrhagic metastases such as melanoma or choriocarcinoma. Increased cellularity, as with small cell, renal cell, and certain intestinal carcinomas, can be isointense to gray matter. Melanin content in melanoma appears hyper intense on T1WI and dark on T2WI due to paramagnetic effects. Lack of melanin or hemorrhage results in mixed signal intensity patterns. Metastases can account for leptomeningeal, dural, subependymal, and intraventricular masses, as well as nerve root masses on cranial nerve exiting to the extracranium.⁽⁹⁾

Conclusion :

CEMR is the choice of investigation in detection of cerebral metastases. Contrast enhancement improves detection of metastatic foci with MR imaging and that the findings indicate broader implications for the detection of multiple lesions from other causes. Metastases may have a varied range of appearances on MRI depending on its intrinsic characteristics like calcification, hemorrhage, necrosis and cellularity and has propensity for different sites which vary with the primary histology of the tumor. They can be solitary or multiple and when solitary needs to be differentiated from primary neoplasms of cerebral parenchyma or meninges certain newer techniques like perfusion MR and MR spectroscopy may be more useful.

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