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MRI EVALUATION OF INTRACRANIAL EXTRA-AXIAL LESIONS

Radiodiagnosis

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ABSTRACT

Background: During the last few years, the role of magnetic resonance imaging (MRI) as a diagnostic tool in neuroradiology is well-established. There are many kinds of intracranial extra-axial lesions, and definitive diagnosis is complicated in some cases. With advanced MRI techniques such as perfusion, diffusion and spectroscopy, it is now possible to differentiate between these lesions.

Materials and Methods: MRI brain of 140 patients with varying clinical symptoms was performed on 1.5-T MR system using a dedicated head coil.

Purpose: To illustrate imaging features of various intracranial extra-axial lesions using MRI.

Results: A total of 140 patients in a span of 2 years were studied in which majority of the patient's i.e. 72 % had extra-axial neoplasms. Tumours of the meninges (29%) were the most common extra-axial lesion followed by congenital/developmental cysts (26%). Meningioma (90%) was the most common meningeal tumour while arachnoid cyst (62%) was the most common extra-axial cystic lesion. The most common location of the extra-axial lesion was sellar region. Amongst the lesions of the sellar region, pituitary macroadenoma (50%) was the commonest.

Conclusion: MRI is an excellent modality for classifying and evaluating the different intracranial extra-axial lesions. Recent advanced MRI tests aids in characterization and narrowing the differential diagnosis, for definitive diagnosis, still histologic tissue evaluation is needed for uncommon and tumours with atypical presentation. Thus by providing complete information, MRI helps in better management and prognosis of these patients.

KEYWORDS

Extra-axial, Neoplasms And Magnetic Resonance Imaging (MRI)

INTRODUCTION

Extra-axial lesions account for approximately one-third of all intracranial primary neoplasms in adults and about one-quarter of intracranial tumours in children. The differential diagnosis of an extra-axial mass varies significantly with both patient age and geographic location [(1).]

Intracranial extra-axial pathologies arise from tissues other than brain parenchyma, such as meninges, dura, calvarium, ventricles, choroid plexus, pineal gland or pituitary gland. There are many kinds of extra-axial lesions, and their definitive diagnosis can often be made easily via imaging studies. However, conditions such as rarity, atypical localization or overlapping symptomatology may complicate the diagnosis. Once the extra-axial location of a lesion has been established, the enhancement characteristics of the lesion help differentiate non-enhancing lesions from various enhancing lesions.

CT scan and MRI are the most widely used neuroimaging modalities for evaluation of these lesions. The high morbidity and mortality associated with them necessitates their early diagnosis so as to plan any intervention if required [(2)].

MRI is a non-invasive diagnostic modality and it provides superior soft tissue contrast, high level of gray white matter contrast, high resolution information and thus provides anatomic details which are not provided by other techniques. Imaging with MRI is not limited to the study of static anatomic images, it also includes dynamic, physiologic, and chemical imaging - all of which can be used to focus a differential diagnosis [(3)].

Magnetic resonance spectroscopy (MRS) provides additional information over conventional study to differentiate extra axial tumours as meningioma with alanine peak.

AIMS AND OBJECTIVES

1. To study the characteristic MRI features of intracranial extra-axial lesions.
2. To identify and classify intracranial extra-axial lesions.
3. Delineate specific helpful imaging features in an attempt to differentiate extra-axial lesions.

MATERIALS AND METHOD

This study was carried out for a duration of 2 years, with due approval from the ethics committee. Total 140 patients were selected in the study who were sent to the Department of Radio diagnosis at Dr.Vasantrao Pawar Medical College, Hospital and Research Centre, Nashik with varying clinical symptoms and suspicion of an intracranial pathology. The demographic profile and clinical features were obtained after due consent to correlate the findings. The patients who underwent any previous intra-cranial surgery or had any history of trauma were not included in this study.

Follow up was obtained for histopathological diagnosis, laboratory investigations and follow up imaging studies wherever possible except for some cases where follow up could not be obtained due to migratory rural population and where diagnostic findings were confirmatory and additional supportive diagnostic test was not required.

MRI TECHNIQUE

All the MRI scans were done on 1.5-T magnet MR system (Siemens Magnetom Essenza). Patients were made to lie supine for the scan and a dedicated head coil was used. The exact MR imaging pulse sequences vary among different institutions. MRI by multiplanar T1- and T2-weighted, FLAIR, diffusion, gradient images, using spin echo sequences, was obtained in all the patients. Proton magnetic resonance spectroscopy on single and multivoxels chemical shift imaging was done wherever indicated.

Usually, a field of view (FOV) of 200-300, 512 x 512 matrix sizes and 3-4 mm slice thickness was applied. For evaluation of tumours, administration of intravenous Gadolinium was given. Pre and post contrast images were taken in sagittal, axial and coronal orientation. Three-dimensional (3D) sequences with isotropic resolution were also taken that provided thinner sections and reduced partial volume averaging.

RESULTS

Total 140 patients referred to our department in a span of 2 years were examined and their MRI features were studied with the aim of describing extra-axial lesions. The salient observations are as follows:

- The study comprised of 66 males and 74 females, between age groups of 0 - 100 years. The peak incidence was observed in the age group of 41 – 50 years (n=35) of patients (Table 1).
- Majority of the patients had neoplastic lesions (n=103). The most common type of extra-axial lesion found was meningeal tumour seen in 41 patients followed by congenital/developmental cysts seen in 37 patients. 24 patients had tumours of sellar region, 16 had cranial nerve tumours and 10 had lipoma. Central neurocytoma& metastases were seen in 4 patients each. Pineal gland tumours and

musculoskeletal tumours were seen in 2 patients each (Table 2).

- Amongst meningeal tumours, majority of the patients, i.e. 37 had meningioma while 4 had hemangiopericytoma. Amongst the tumours of the sellar region, pituitary macroadenoma was the commonest seen in 12 patients. 6 patients had pituitary microadenoma, 4 had craniopharyngioma while 2 had Rathke's cleft cyst. Amongst cranial nerve tumours, 15 patients had acoustic neuroma while 1 had trigeminal schwannoma.
- Amongst the congenital/developmental cystic lesions, arachnoid cyst was the commonest seen in 23 patients followed by epidermoid cyst found in 9 patients. 2 patients each had colloid cyst and dermoid cyst while 1 had a pineal cyst (Diagram 1).
- Location wise, extra-axial lesions were seen to occur most commonly in the sellar region (n=25) followed by cerebello-pontine angle(n=24).

DISCUSSION-

Extra-axial is a descriptive term to denote lesions that are external to the brain parenchyma, in contrast to intra-axial which describes lesions within the brain substance.

Extra-axial masses of the intracranial compartment have a wide range of differentials, ranging from benign developmental cysts to malignant tumours.

Examples (non-exhaustive) of extra-axial lesions include:

- **NEOPLASMS**
  - **Tumours Of The Meninges**
    - **meningioma**
    - **solitary fibrous tumour**
    - **haemangiopericytoma**
  - **Tumours Of Sellar Region**
    - **pituitary region masses**
- **microadenoma**
- **macroadenoma**
- **craniopharyngioma**
- **rathke's cleft cyst**
    - **others**
- **meningiomas**
- **gliomas**
- **germinomas**
    - **Pineal Parenchymal Tumours**
- **pineocytoma**
- **pineoblastoma**
    - **Pineal Region Tumours**
- **germinoma**
- **teratoma**
    - **Cranial Nerve Tumours**
- **acoustic schwannoma**
- **trigeminal schwannoma**
- **neurofibroma**
- **Chordoma**
- **Choroid Plexus Papilloma/Carcinoma**
- **Central neurocytoma**
- **Lipoma**
- **Melanoma**
- **Musculoskeletal**
- **plasmacytoma**
- **primary bone tumour**
- **sarcoma**
    - **Metastatic tumours**
- **CONGENITAL/DEVELOPMENTAL CYSTS**
  - **Arachnoid cyst**
  - **Pineal cysts**
  - **Colloid cyst**
  - **Dermoid cyst**
  - **Epidermoid cyst**

TUMOURS OF THE MENINGES:

Meningioma:-

Meningiomas are benign, slow growing, well-localized lesions. They commonly occur after 5th decade, and are roughly twice more common in females [3][4].

Meningiomas are extra axial lesions seen along the external surfaces of the brain as well as within the ventricular system. Parasagittal aspect of the cerebral convexity, lateral hemispheric convexity, sphenoid wing, middle cranial fossa, and the olfactory groove are the common sites. They are the second most common CP angle masses. Less common sites include the optic nerve sheath, the lateral ventricles and the sella turcica [4].

On imaging they are lobular, well defined extra- axial masses with well circumscribed margins and broad dural attachment. On T1 it is iso to slightly hypointense, on T2 it is iso to slightly hyperintense. On CEMR they show avid, homogeneous enhancement (Fig. 1 & Fig. 2). Occasionally they may have areas of necrosis and calcific foci [4].

On CEMR imaging an interesting finding: the dural tail or "dural flair" can be demonstrated. The dural tail is a curvilinear region of dural enhancement adjacent to the bulky hemispheric tumour (Fig.1).

It is now well known that though specific for meningioma, dural tail sign can also be seen in many other lesions [5-7].

Another imaging finding is a "CSF cleft", which is seen as a cleft of CSF between tumour and adjacent brain cortex, which is suggestive of extra-axial nature of the lesion (Fig. 1 & Fig. 2). Cortical vessels can be seen within the CSF cleft. Bony changes like hyperostosis can be seen in approximately 20% of cases.

Solitary fibrous tumours and Hemangiopericytoma

Solitary fibrous tumours are mesenchymal tumours with increased cellularity. Hemangiopericytomas are the most malignant end of solitary fibrous tumours and known as cellular solitary fibrous tumours [8]. Hemangiopericytoma is a tumour of pericytes that originate in the meninges. They represent less than 1% of all CNS tumours [9].

These aggressive lesions occur at an earlier age as compared to other meningeal tumours, and have a tendency to recur with high frequency, usually metastasizes to bone, lung, kidney, liver, pancreas, and adrenals [9].

SFTs are dural based tumours arising from falx cerebri and tentorium cerebelli [8].

HPC most commonly occur in the occipital region [8]. On MRI, low grade SFTs are well circumscribed dura based mass that are isointense on T1WI, variable on T2WI with avid enhancement on CEMR [8].

HPC are heterogeneous, predominantly hypointense on T1WI and hyperintense on T2WI. Flow voids within the tumour are almost always seen [8]. There is no calcification or reactive skeletal hyperostosis [8] as in meningioma.

TUMOURS OF SELLAR REGION:

Pituitary region tumours

Common neoplasms include pituitary adenomas, craniopharyngiomas, Rathke's cleft cysts, meningiomas, optic nerve gliomas etc.

Pituitary adenomas:

Pituitary neoplasms are the commonest sellar region neoplasms.

Adenomas having size up to 10 mm are known as microadenomas, while those larger than 10 mm are known as macroadenomas[10].

Pituitary microadenomas are not uncommon. Dynamic contrast enhanced MRI is the investigation of choice for the detection of microadenomas.

They usually enhance late and/or to a lesser degree than normal pituitary tissue.

Pituitary macroadenomas are centered in the sella and thus they cause enlargement or ballooning of the pituitary fossa.

They are usually isointense on T1WI images. Administration of IV contrast may show uniform or heterogeneous enhancement (Fig. 3) and facilitates the detection of cavernous sinus invasion [10].

Macroadenomas may contain cystic or haemorrhagic components. Acute haemorrhage into a pituitary macroadenoma can lead to rapid expansion of the gland resulting in acute compression of the optic chiasm (pituitary apoplexy). Haemorrhage appears hyperintense on non-enhanced T1W images and, in the acute stage, hyperdense on CT [10].

Craniopharyngiomas

Craniopharyngiomas are suprasellar tumours that occur most frequently in childhood. They probably arise from Rathke's pouch, from which anterior pituitary also develops. Unlike pituitary macroadenoma, they do not cause enlargement of sella unless they are large enough.

They are of two types: Admantinomatous- which is more common type (90%) and papillary type which is a less common type and MRI features vary according to the type of craniopharyngioma [8][10]

The adamantinomatus type, more commonly occurring in children, and has multiple cysts with squamous epithelium and cholesterol rich fluid in the cyst and so they tend to have T1 hyperintense cystic components or may have variable appearance on T1WI. On post-contrast imaging solid components usually enhance (Fig. 4). They are commonly calcified and on GRE images they usually show blooming [8][10].

The papillary type, which occurs mostly in adults, is more likely to be predominantly solid. The solid components of craniopharyngiomas show intense contrast enhancement and may be partially calcified [8][10].

Rathke's cleft cysts: They usually lie within the pituitary gland, although others are found adjacent to the infundibulum, above the sella [10].

In 77% of Rathke's cleft cysts, MRI will show T1 hyperintense intracystic nodules, which are better seen as hypointense structures relative to the surrounding hyperintense cystic fluid on T2WI [11].

Rathke's cysts do not usually enhance following IV contrast medium, although enhancement of the cyst wall is possible [10].

Rathke's cleft cysts are mostly hyperintense on FLAIR imaging [8].

Other sellar region tumours

Meningiomas, gliomas, germinomas are other tumours seen in this region.

PINEAL PARENCHYMAL TUMOURS:

Pineal parenchymal tumours are rare lesions, accounting for less than 0.2% of intracranial neoplasms.

Pineocytomas are benign tumours that expand and obliterate pineal architecture, “exploding” the normal pineal calcification toward the periphery. On MRI, they are well-circumscribed lesions that are iso to hypointense on T1WI and hyperintense on T2WI. They show avid, homogenous enhancement. [10][12].

Pineoblastomasare highly malignant lesions that account for approximately 40% of pineal parenchymal tumours. They are described as primitive neuroectodermal tumours (PNETs) of pineal gland, and behave like cerebellar medulloblastomas, with frequent seeding via the CSF. They tend to be of low signal intensity on T2W images and can appear bright on DWI [10][12].

PINEAL REGION TUMOURS:

Pineal region tumours account relatively uncommon tumours, which are relatively common in children.

More than half of all pineal region tumours are of germ cell origin. They include germinoma, teratoma, yolk sac tumours and choriocarcinoma [12].

TUMOURS OF CRANIAL NERVES:

Cranial nerve sheath tumours

Cranial nerve sheath tumours account for 6-8 % of primary intracranial tumours [10][13].

Primary intracranial nerve sheath tumours are nearly always schwannomas and don't have malignant potential. Neurofibromas have malignant potential [14].

Vestibular schwannoma / Acoustic neuroma:-

They are benign nerve sheath tumours arising most frequently from vestibular portion of vestibulocochlear (VIII) nerve and account of majority (approx. 90%) of cerebellopontine angle masses in adults [15][16].

Classically they resemble an ice cream cone, with the IAC portion representing the cone and the CP angle cisternal portion representing the ice cream [15].

On MRI imaging, they are iso/ hypointense on T1WI and hyperintense on T2WI. Larger schwannomas often contain areas of cystic degeneration. They show strong enhancement with IV contrast administration (Fig. 5). When they are large enough, they cause dilation of IAC. MRI is much more sensitive than CT for the detection of small vestibular schwannomas. It can detect small tumours causing focal nerve thickening [10].

There may be difficulty in differentiating schwannomas from meningiomas; however, several clues help in differentiating them. Calcifications or dural tails should strongly favour meningioma over schwannoma while dilation of the internal auditory canal is suggestive of schwannomas [15].

Gradient echo sequences can show focal hypointense punctate areas of microhemorrhage; however, these can have an appearance similar to that of punctate calcifications seen in meningiomas [15].

Other nerve sheath tumours are MPNST (malignant peripheral nerve sheath tumours), perineuroma, solitary fibrous tumours, neurofibrosarcomas, all of them are rare [8].

CENTRAL NEUROCYTOMA:

Central neurocytomas are slow-growing, relatively benign tumours of purely neuronal origin. It presents as intra-ventricular mass near the foramen of Monro, centered on septum pellucidum and sometimes involving the third ventricle [17].

Calcification and cystic changes are common [17].

On MRI these lesions appear as heterogeneously enhancing mixed signal intensity mass containing septated cysts (Fig. 6). On GRE images blooming/ signal drop out due to susceptibility artefact from calcification can be seen. Obstructive hydrocephalus is a common association [10][17].

INTRACRANIAL LIPOMAS:

Intracranial lipomas are uncommon congenital lesions which probably have meningeal origin [8].

They account for less than 0.5% intra-cranial masses. They are of two types – curvilinear and tubule-nodular. Calcification occurs in both types more commonly in tubule-nodular [8].

Midline cerebral structures, including pericallosal cistern is the commonest site. Ambient and quadrigeminal cistern, CP angle, superior cerebellar cistern, interpeduncular cistern, supra sellar cistern, and sylvian cisterns are the other locations [18].

On CT scan imaging lipomas have low CT attenuation values ranging between -39 to -80 HU.

On MRI, they are fat signal intensity lesions on all sequences (Fig. 7). They are hyperintense on T1WI and T2WI fast spin echo images [8][18]. Lipomas are hypointense on STIR and hyperintense on FLAIR [8].

Associated corpus callosum anomalies are common [8].

Metastatic tumours

The primary neoplasms that most commonly metastasize to the brain are carcinoma of the lung, breast, adenocarcinoma of colon, etc. (Fig. 8). Metastasis should be considered when there are multiple lesions in various compartments. Parenchymal edema tends to be less pronounced in extra-axial metastasis compared to intra-axial one. Imaging based differentiation between meningioma and metastasis may be challenging. Most metastatic lesions are solid. In rare occasions, cystic metastasis can be seen with enhancing solid component.

CONGENITAL/DEVELOPMENTAL CYSTS:

Arachnoid cyst:

Arachnoid cysts are benign, extra-axial, congenital lesions within the intra arachnoid space which contain clear CSF. Communication with the ventricular system is not seen. They possibly occur secondary to "splitting" or a diverticulum of the developing arachnoid [17][19].

They comprise of approx. 1% of all intracranial masses. They are unilocular, smoothly marginated expansile lesions [19].Mostly they are supratentorial and approximately 50-60% are detected in the middle cranial fossa, anterior to the temporal lobes. Suprasellar cistern, CP angle cistern and posterior fossa are the other common locations. Cerebral convexity, interhemispheric fissure, choroidal fissure and cistern magna are the other common sites [19].

On MRI, arachnoid cysts typically have the same signal intensity as CSF at all sequences. They show no enhancement on CEMR imaging. They displace or deform the adjacent brain and cause scalloping of the adjacent calvarium [19].

The most difficult lesion to distinguish from the arachnoid cyst is an epidermoid cyst Arachnoid cysts typically suppress completely on FLAIR images and do not restrict on diffusion-weighted images (Fig. 9). They tend to displace the adjacent arteries and cranial nerves, while epidermoid cysts engulf them [19].

Pineal Cyst:

Pineal cysts and cystic degeneration of the pineal gland with some residual pineal parenchyma are common; they are seen in up to 10% of cases at routine imaging and in 20%–40% of cases at autopsy [19]. Most of the cysts are smaller than 1.5 cm. Cysts larger than 1.5 cm may result in hydrocephalus by causing compression of the tectum and aqueduct [19].They appear as unilocular fluid- filled mass within the pineal gland. Signal intensity on MRI varies with cyst content. They may have rim or nodular cyst wall calcification. Rim or nodular enhancement is also common [19]. On T1WI, they appear slightly hyperintense to CSF. They do not suppress completely on FLAIR images. They may have rim or nodular enhancement of the wall [19] (Fig. 10).

Colloid cyst:

They are rare benign lesions related to anterior 3rd ventricle. They occur at the posterior lip of the foramen of Monro, between the third and lateral ventricle. On sagittal images, they appear between the columns of the fornices[10].

They cause symptoms only when they occlude the foramen of Monro and cause hydrocephalus.

Their MR appearance varies depending on the cyst content, some colloid cysts can have similar signal to CSF, but most of them have high signal intensity on both T1W and on T2W images [10] (Fig. 11).

Dermoid cyst:

Like epidermoid cysts, dermoid cysts are congenital ectodermal inclusion cysts [19].

They are extremely rare tumours comprising less than 0.5% of primary intracranial tumours [19].

They are usually extra-axial lesions and are most commonly seen in midline, most commonly occur in supra-sellar cistern followed by posterior fossa [8][19].

They usually grow slowly. Rapid enlargement with cyst rupture can occur. On imaging, the signal intensity varies with the fat content of the cyst and mostly they are heterogeneously hyperintense on T1WI [8][19].

Rupture in cases of ruptured dermoid cyst, disseminated fat droplets can be seen in sub-arachnoid space [8].

Fat suppression techniques help in the diagnosis. Dermoid cysts appear heterogeneously hyperintense on FLAIR images [8][19].

Ruptured dermoid cyst shows blooming on GRE images with subtle hyperintensity on FLAIR images [8][19].

Calcification of capsule is seen in 20% of cases [8].

Epidermoid Cyst:

They are congenital inclusion cysts. They comprise 0.2%-1.8% of primary intracranial tumours [19].

The commonest location is the cerebellopontine angle cistern and they are the third most common CP angle masses. They also occur in the fourth ventricle and the sellar and/or parasellar region. Cerebral hemispheres or brainstem are the less common locations. All epidermoid cysts are located off the midline [19].

On imaging they are CSF like mass that encases adjacent nerves and vessels and insinuates along the CSF cisterns [19].

They are mostly isointense to slightly hyperintense to the CSF on T1WI and T2WI and do not suppress completely on FLAIR images which differentiates them from arachnoid cyst. On DWI, they show diffusion restriction which also differentiates them from arachnoid cyst and other extra-axial cysts (Fig. 12). Calcification may be seen. "White epidermoids" which are rare lesions have high protein content. They show reversed signal intensity on MR images, with high signal intensity on T1WI and low signal intensity on T2WI [19].

CONCLUSION

We have briefly reviewed the imaging characteristics of various intracranial extra-axial lesions. Familiarity with these lesions and increased awareness of their imaging findings and differential diagnosis should improve the interpretation of the images, leading to reduced errors and increased diagnostic value in reporting.

Detailed information of these lesions by MRI aids in diagnosing and management. Moreover, non-invasive recent advanced MRI techniques plays a major role in characterization and narrowing differential diagnosis for these lesions, still for definitive diagnosis histologic tissue evaluation is needed for uncommon and lesions with the atypical and overlapping presentation.

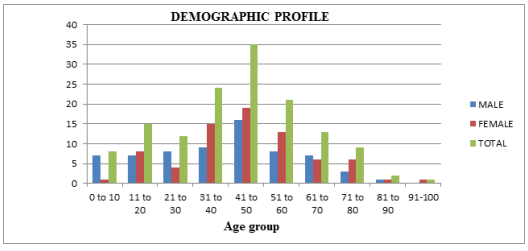

Table 1: Demographic Profile.

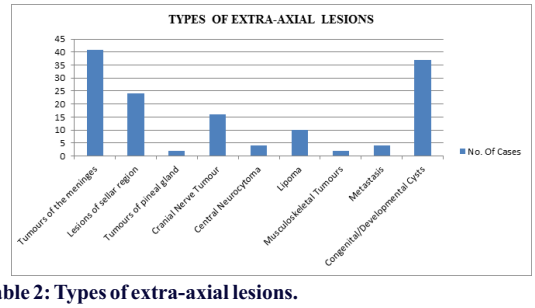

Table 2: Types of extra-axial lesions.

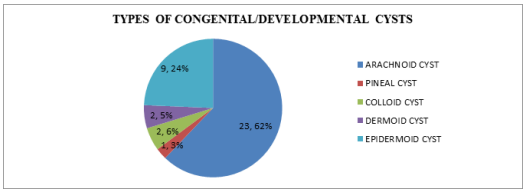

Diagram 1: Types of congenital/developmental cysts.

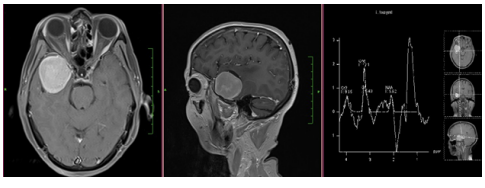

Figure 1: Sphenoid wing meningioma: lesion is showing dense homogeneous contrast enhancement. CSF cleft sign suggestive of extra-axial lesion is seen. MRI spectroscopy shows elevated choline peak with elevated alanine peak.

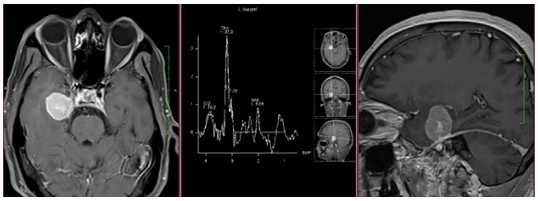

Figure 2: Parasellar meningioma showing CSF cleft sign, dural tail sign and MRS shows elevated choline peak with alanine peak.

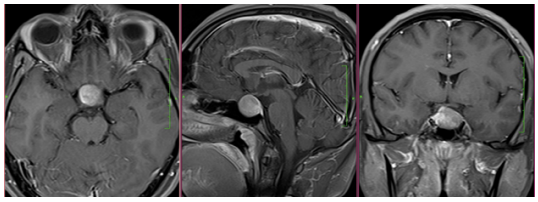

Figure 3: Pituitary macroadenoma: lesion is in the suprasellar region, causing widening of the pituitary fossa with heterogeneous contrast enhancement.

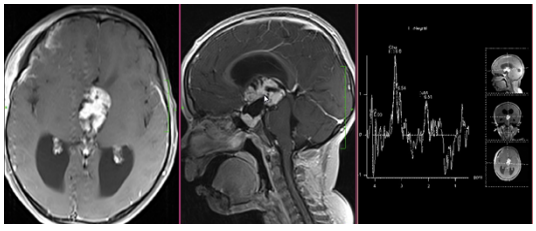

Figure 4: Craniopharyngioma: lesion is supra sellar in location. It shows heterogeneous contrast enhancement and on MRS, it shows predominant choline peak with small lipid peak.

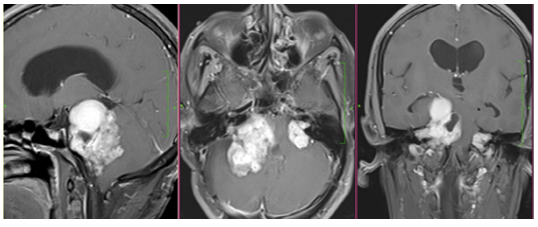

Figure 5: Bilateral vestibular schwannomas: larger on right side and smaller on left side - major diagnostic criteria and pathognomonic feature for neurofibromatosis type 2. Both of the lesions showed ice cream cone appearance due to their intracanalicular enhancing portions.

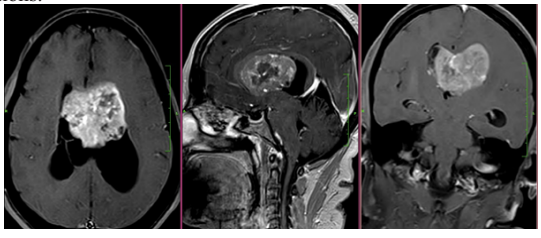

Figure 6: Central neurocytoma: lesion is seen as an intraventricular mass in the left lateral ventricle. The lesion showed diffusion restriction with corresponding hypointensity on ADC map. Cystic non-enhancing areas can be seen at the periphery of the tumour.

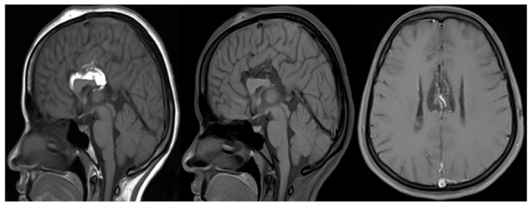

Figure 7: Lipoma: lesion is located in pericallosal cistern. It is hyperintense on T1WI and suppressed on T1 fat sat image with no post contrast enhancement. Associated corpus callosum agenesis is seen in posterior body and splenium region.

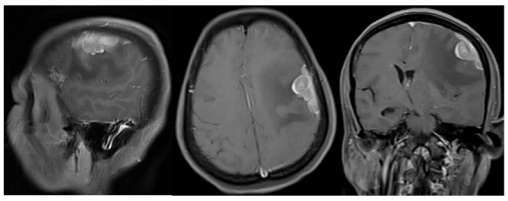

Figure 8: Metastasis in a known case of carcinoma of breast: dural based lobulated lesion is seen in left fronto-parietal region with surrounding disproportionate white matter edema. The lesion show moderate inhomogeneous contrast enhancement. Mass effect is seen in the form of compression of left lateral ventricle with subfalcine herniation and midline shift to right side.

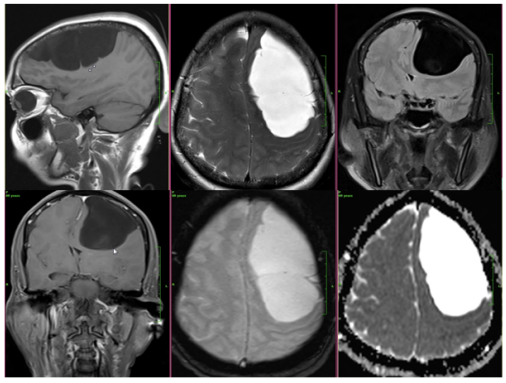

Figure 9: Arachnoid cyst: slesion is similar to CSF signal intensity on all imaging sequences. The cyst shows complete suppression on FLAIR images. No contrast enhancement can be seen. There is no diffusion restriction. On ADC map, the lesion shows hyperintense signal similar to CSF. Mass effect is seen in form of subfalcine herniation.

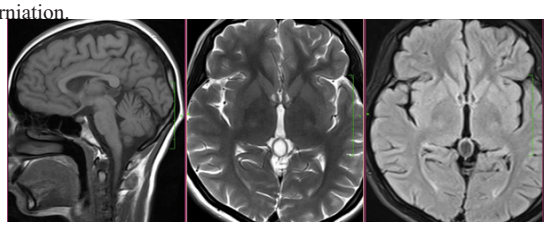

Figure 10: Pineal cyst: cystic lesion seen in pineal region showing incomplete suppression on FLAIR images due to proteinaceous fluid content within.The lesion showed thin rim enhancement.

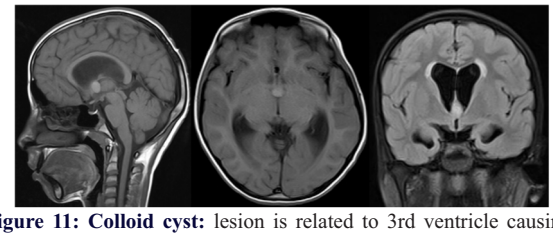

Figure 11: Colloid cyst: lesion is related to 3rd ventricle causing obstructive hydrocephalus. It showed high signal intensity on T1WI and iso to intermediate signal intensity on T2WI.

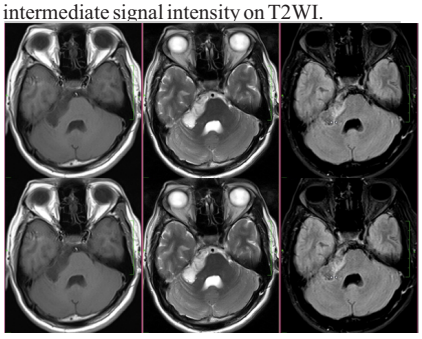

Figure 12: Epidermoid cyst: lesion is hyperintense on T2WI and hypointense on T1WI and shows characteristic features of diffusion restriction and incomplete suppression on FLAIR images.

DECLARATIONS
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