REVIEW ARTICLE

INTRACRANIAL CYSTIC MASSES: A PICTORIAL REVIEW FROM TERTIARY CARE ONCOLOGY SETUP

Muhammad Omer Altaf, Mehreen Shafqat, Palwasha Gul, Hira Farooq, Kashif Siddique, Muhammad Atif Naveed

Department of Radiology, Shaukat Khanum Memorial Hospital and Research Centre, Lahore, Pakistan.

PJR April - June 2020; 30(2): 122-133

ABSTRACT

Cystic intracranial masses are one of the most common findings reported on routine imaging examination. These lesions can be neoplastic, non-neoplastic, infectious and related to congenital malformations in brain development. Most of these are benign and symptomless with no clinical outcomes but some can pose life threating risks to the patient and severe neurological symptoms needing an aggressive treatment approach. Hence the accurate diagnosis of such lesions is mandatory to predict the treatment approach and prognosis. Besides variable history and clinical presentation, intracranial cystic masses show discrete features on radiological imaging. This wide imaging spectrum of such lesions produces a challenging situation for a radiologist to make the accurate diagnosis. It is important to pay attention to characteristic findings of each lesion along with relation with age, gender and anatomic site thus helping to narrow down the differential diagnosis. We aim to discuss characteristic radiological features of some of the frequently occurring intracranial cystic lesions in order to improve the diagnostic approach encountered in medical practice.

Key words: Cystic lesions. Intracranial. Brain.

Introduction

Intracranial cysts are commonly encountered findings in imaging of the brain. The imaging spectrum of intracerebral cysts is very broad and includes developmental disorders and malformations, primary and secondary neoplasms, infectious etiologies, such as cerebral abscess formation.[1] Inflammatory central nervous system (CNS) diseases also cause intracerebral cystic defects whereas brain infarctions or encephalomalacic changes after severe traumatic brain injury is also one of the precursors.[1]

Usually the detection of the intracranial cysts is seen as incidental finding when an imaging is performed for nonspecific symptoms or may present with neurologic focal signs.[2,4] Diagnosis of the intracranial cystic lesions on the basis of imaging alone often challenging.[2] These lesions vary in prevalence from common to rare.[3] Once seen, these lesions need to be diagnosed since some of these lesions require an aggressive and more tailored treatment, whereas many others remain asymptomatic and do not require any intervention. Further prognosis is extremely variable from one type of lesion to another.[2,4]

Dermoid cyst:

Intracranial dermoid cyst are relatively uncommon lesions with characteristic appearances on both MRI and CT scan. It appears as a well-defined abnormality usually in the midline with relatively low density on CT and appears hyperintense on both T1 and T2 MR sequences. Very rarely it may represent a CT hyperdensity secondary to microcalcification or blood products or fat saponification. Usually it is not associated with contrast enhancement.[5] Dermoid cyst are more common in females and typically present before

Correspondence : Dr. Palwasha Gul
Department of Radiology,
Shaukat Khanum Memorial Hospital and
Research Centre, Lahore, Pakistan.
Email: gul_l123@yahoo.com

Submitted 17 February 2020, Accepted 7 April 2020

the age of 30 years.[6] Seldom it may present with rupture with associated fat constituents within the subarachnoid space and intraventricular compartments.[7] Usually dermoid cysts are asymptomatic; however if symptomatic ,this could be surgically removed. The recurrence is usually infrequent. Transformation into squamous cell carcinoma is extremely rare.

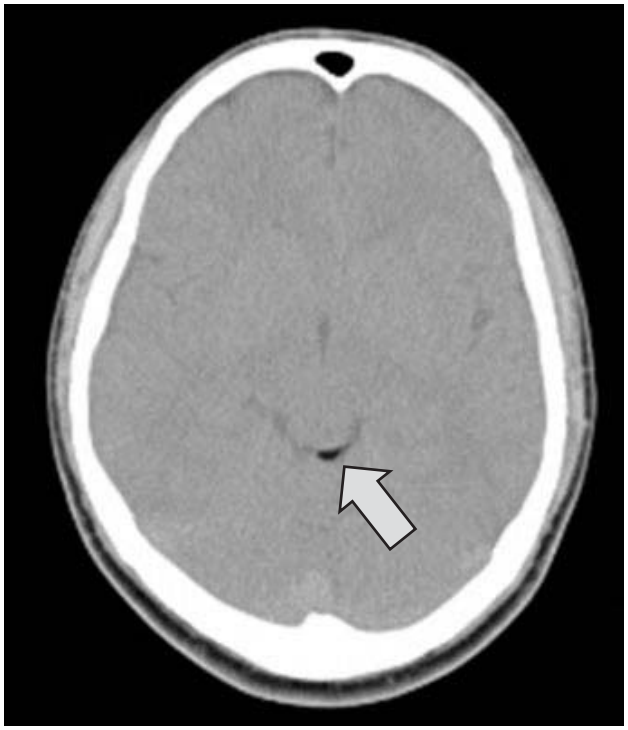
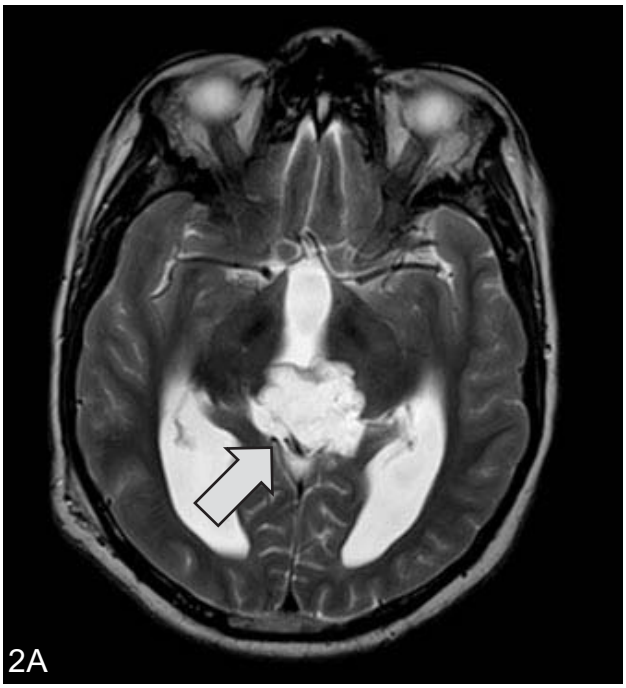
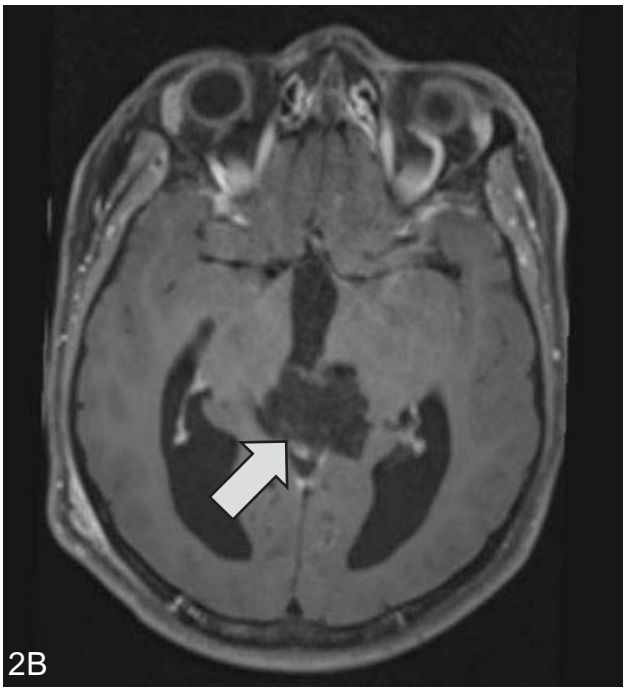


Figure 1: A case of a 24 year old male complaint of headache. CT head shows Incidental finding of fat attenuating small lesion dorsal to the midbrain (arrow). This is extra-axial at the cranial aspect of the ambient cistern. This measures 1.6 cm in CC dimension. The imaging features are suggestive of a dermoid cyst.

Epidermoid cyst:

Intracranial epidermoid cysts are fairly common lesions accounting approximately 1% of all the intracranial lesions.[8] Typically represent in the between 20-40 years secondary to symptoms arising related to the mass-effect from this lesion. A relatively infrequent association is also seen with currarino triad.[9] Mostly these present in intradural location out of which almost 90% of cases in cerebellar pontine angle is most common. On CT scan it present as fluid density and could mimic the arachnoid cyst. Calcifications can also present in such lesions (10-25%).[8] On the MRI scan these can represent iso-to hyperintense to CSF on T1 sequences and are usually isointense on T2 sequences. Relatively thin peripheral enhancement on post contrast sequences are seldom seen. These can be differentiated from the arachnoid cyst on the basis of diffusion-weighted imaging which is positive in the lesion. These are excised only in symptomatic patients with recurrence is usually uncommon.[10]





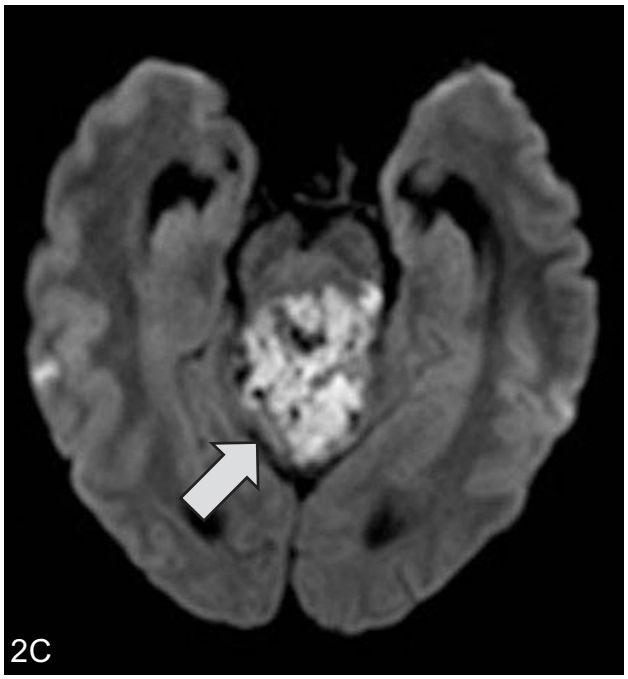


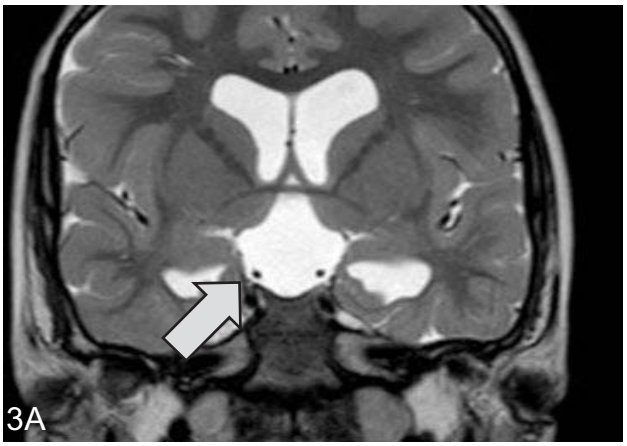
Figure 2A, B & C: show a case of a 41 year old male with history of RTA. On MRI brain there is an irregular extra-axial lesion showing T2 high **(Figure 2A)** and T1 low signal intensity **(Figure 2B)**. On Diffusion weighted images, It showed restriction **(Figure 2C)**; however is not associated with post contrast enhancement. Tumor is applied to the undersurface of the tentorium cerebelli, cranially tumor extends into the trigone of the left lateral ventricle.

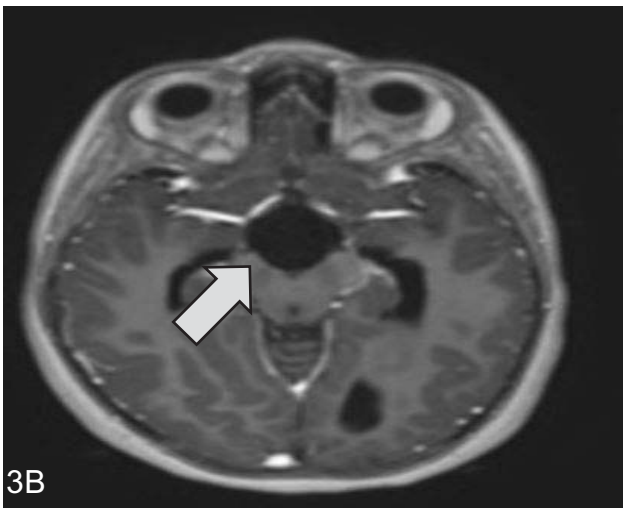
Arachnoid cyst:

These are usually common benign intracranial lesions which are asymptomatic is most of the cases. These are present in both intracranial as well as within the spinal canal. Usually the arachnoid cyst are present in the subarachnoid space and contain CSF. On imaging these are typically seen as well marginated cystic structure with indiscernible walls showing mass-effect; remodelling of the adjacent bones may also be appreciated. The most frequent location for presentation is middle cranial fossa and usually present as widening of the sylvian fissure.[11] The next common location of its presentation is retrocerebellar.[12] These are not associated with diffusion restriction and follow the CSF characteristics on all the sequences. The important differential diagnosis includes enlarged CSF space for example cisterna magna.[13]

Colloid cyst:

These are usually asymptomatic epithelial lined cysts characteristically identified as increased attenuation





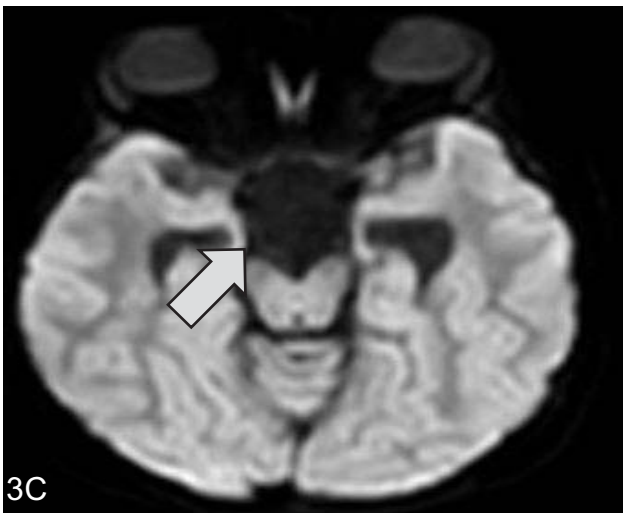
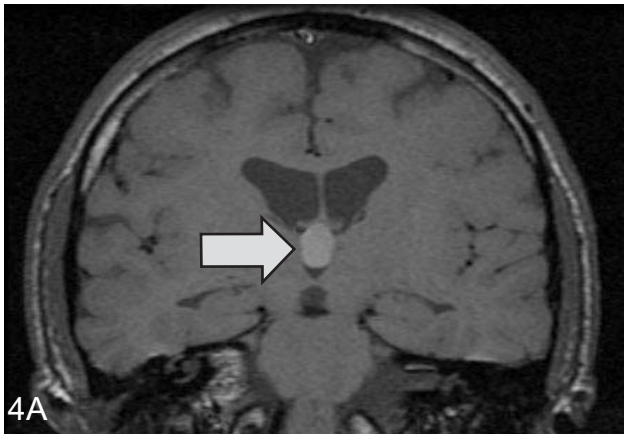


Figure 3A, B & C: show a case of a 5 year old male with history of seizers. MRI scan shows a large extra-axial CSF signal intensity suprasellar cystic structure. Appearing high of T2 coronal sequences **(Figure 3A)** There is no postcontrast enhancement **(Figure 3B)** or diffusion restriction **(Figure 3C)**. The morphological appearances and MRI signal intensity characteristics are suggestive of a large arachnoid cyst. There is mass effect on the floor of third ventricle resulting in moderate obstructive hydrocephalus.

lesion on the unenhanced CT brain. They make up to 2% of all primary brain tumors.[8] These are attached to the anterosuperior region of the third ventricle. On MRI it usually present as well defined rounded lesion with hyperintense signal changes on T1 sequence, while on T2-weighted images, this shows low central and higher peripheral signals occasionally it is isointense to the rest of the brain parenchyma. Many of the times peripheral enhancement is also seen.14 These are slowly growing lesions and are surgically resected when symptomatic. The common differentials include hyperdense meningioma, hemorrhage component the foreman of Monro possibility of pilocytic or giant cell astrocytomas.



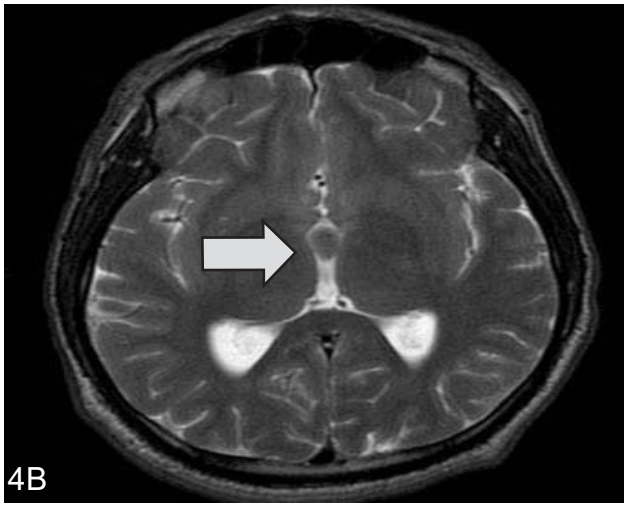
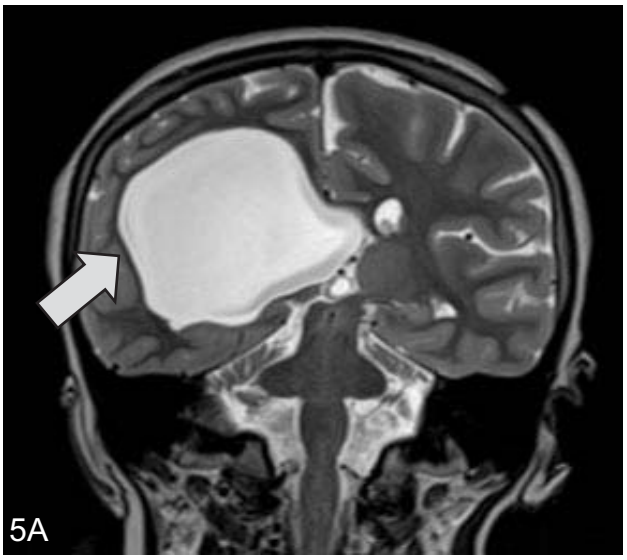
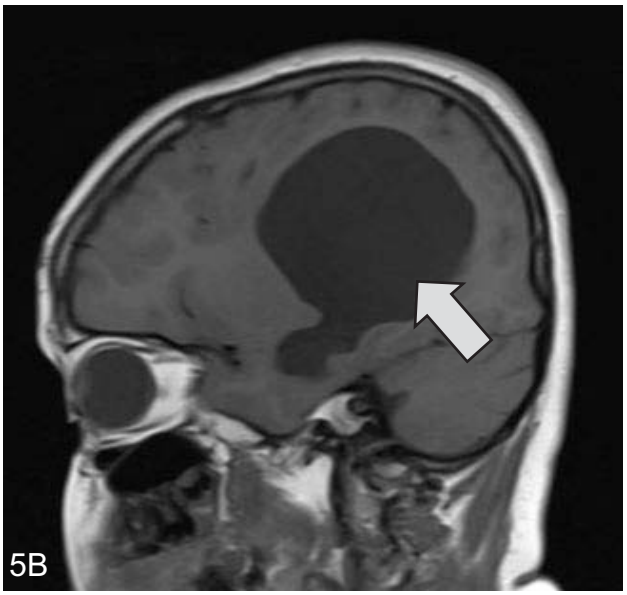


Figure 4A & B: Show a case of a 26-year-old male with history of poor memory. No neurological deficit or history of trauma/surgery. MRI scan shows homogeneous T1 hyper intense non-enhancing relatively well-circumscribed lesion in the anterior third ventricle at the level of foramen of Monro **(Figure 4A)**. This shows isointense signal intensity on T2 weighted imaging **(Figure 4B)**. There is no associated obstruction on this scan. The findings are compatible with colloid cyst, while the patient is still at risk of obstructive hydrocephalus.

Porencephaly:

Usually porencephaly is described as focal cystic region of encephalomalacia which communicates with either the subarachnoid space or ventricular system. This could be likely related to perinatal cerebral ischaemia, secondary to trauma or infection or possibly as a sequelae of antenatal intraparenchymal haemorrhage.[15] When it doesn t communicate with the adjacent ventricle it is called porencephalic cyst. On CT it appears as intracranial cyst with attenuation as that of the CSF. Usually it is not associated with surrounding mass-effect and show no significant contrast enhancement or solid component. MR scan characteristically shows CSF signal intensity changes within the abnormality.[16]





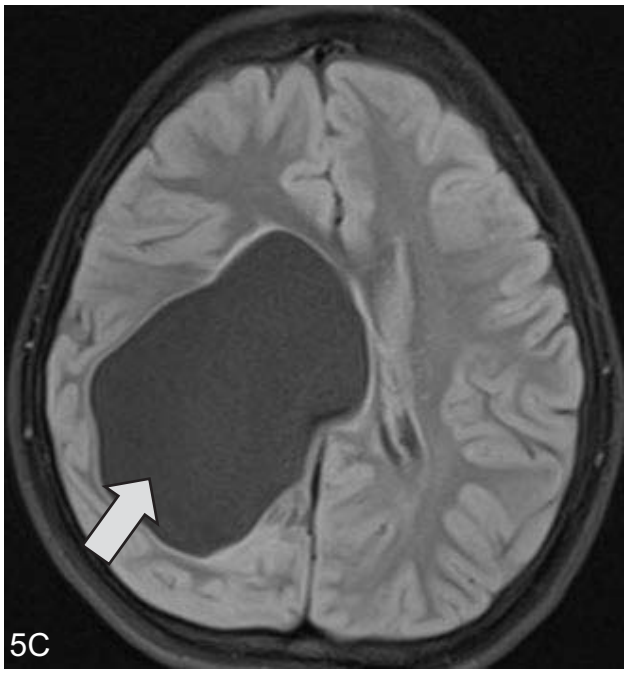
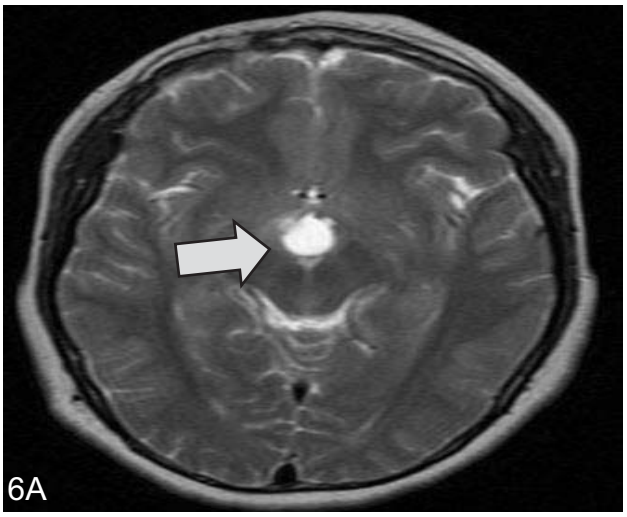
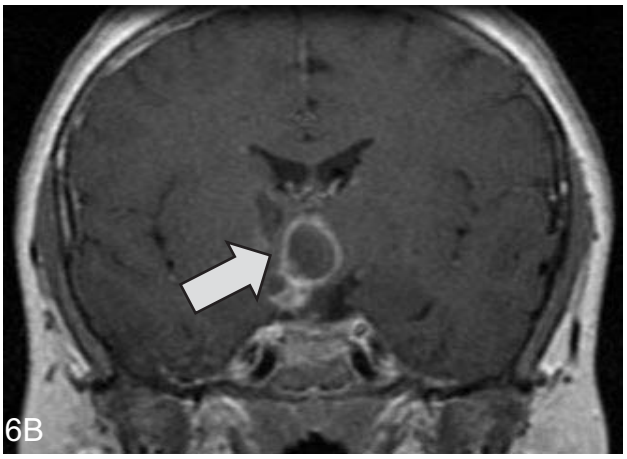


Figure 5A, B and C: Shows Known case of epilepsy. MRI brain showing T2 coronal, T1 sagittal and Flair axial sequences showing a large well circumscribed T2 high and T1 low signal intensity lesion in the right cerebral hemisphere, this has low signal intensity on FLAIR sequences suggesting CSF contents. This is communicating with the body and trigone of the right lateral ventricle. There is no diffusion restriction seen. This lesion is lined by the white matter tracts. Imaging features are suggestive of a porencephalic cyst.

Craniopharyngioma:

These are WHO grade 1 intracranial neoplasms making approximately 5% of the primary brain tumors.[17] Typically these are presented as sellar/suprasellar lesions and are frequently associated with headaches and intracranial raised pressures. Hormonal imbalance and visual symptoms are also seen associated with it. Histologically these are divided into 2 types i.e. adamantinomatous and papillary, the former is more common. Craniopharyngiomas have bimodal age of presentation i.e. from 5-15 years of age and over 40 years of age. 90% of cases present with cysts and calcifications.18On MRI T1 sequence it manifests as the T1 iso-to hyperintense sellar/suprasellar lesion with variable T2 sequence presentation.[18] MR spectroscopy also has its roll in diagnosis. The pain is mostly surgical followed by radiotherapy if there is residual disease. Possible differentials include Rathke cleft cyst, pituitary macro adenoma and intracranial teratoma.





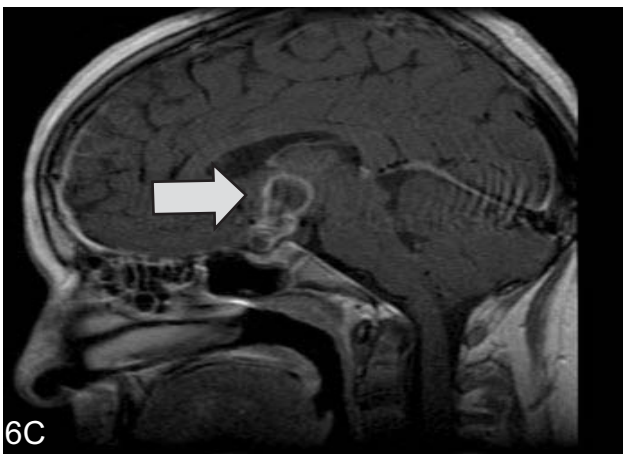
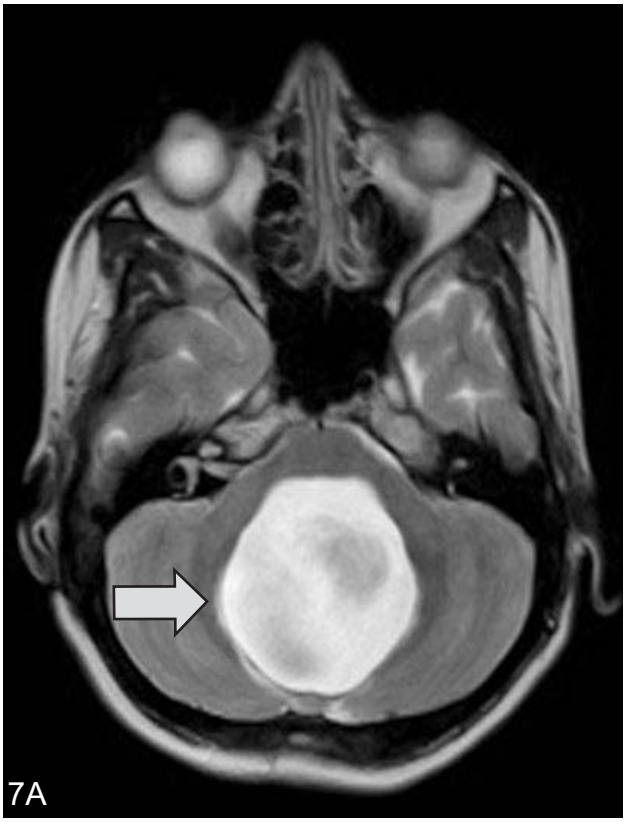


Figure 6A, B & C: Show a case of a 19 years old male with pan-hypopituitarism. On MRI, there is a multiloculated complex cystic mass in the suprasellar region extending upward adjacent to the inferior margins of third ventricle causing its compression. This shows T2 hyperintense signals **(Figure 6A)** with peripheral enhancement as noted on coronal and sagittal post contrast T1 sequences **(Figure 6B and Figure 6C)** This is projecting towards the right of the midline and apparently causing involvement/compression effect on the right optic tract. These radiological features are suggestive of craniopharyngioma.

Cystic dilatation of 4th ventricle in background of Arnold Chiari malformation:

Encysted fourth ventricle or isolately enlarged fourth is relatively rare condition in which there is obstruction to either exit or entry path of CSF. These are associated with subsequent compression of adjacent cerebellum and brainstem structures.[19] Rarely it is also associated with Chiari malformations type VI. Arnold-Chiari syndrome is characterized by caudal descent of the cerebellar tonsils through the foramen Magnum more frequently encountered in females. It is characterized by brainstem compression syringomyelia and scoliosis. 30% of the cases as seen with hydrocephalus and skeletal anomalies.[20] Syrinx formation is commonly seen with these patients. Other causes of focally dilated fourth ventricle could also include choroid plexitis, infection, intraventricular cysts or masses.[21] Treatment options include related to cause focal dilatation as well as based on the patient's symptoms.



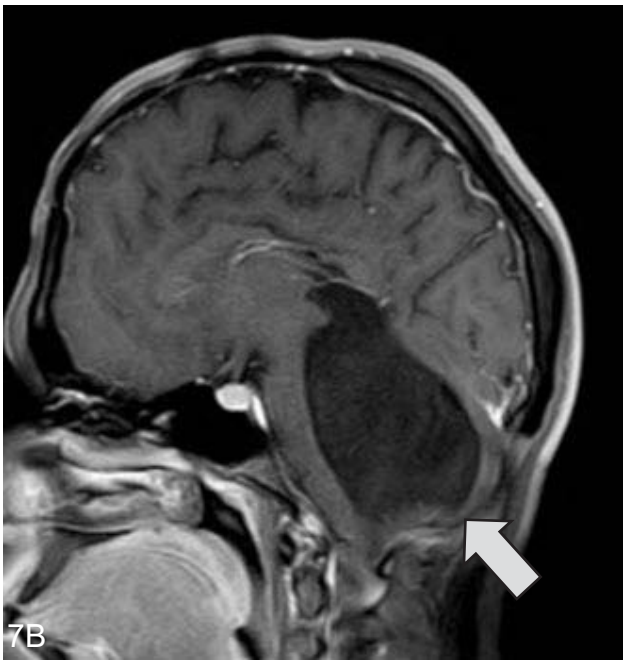
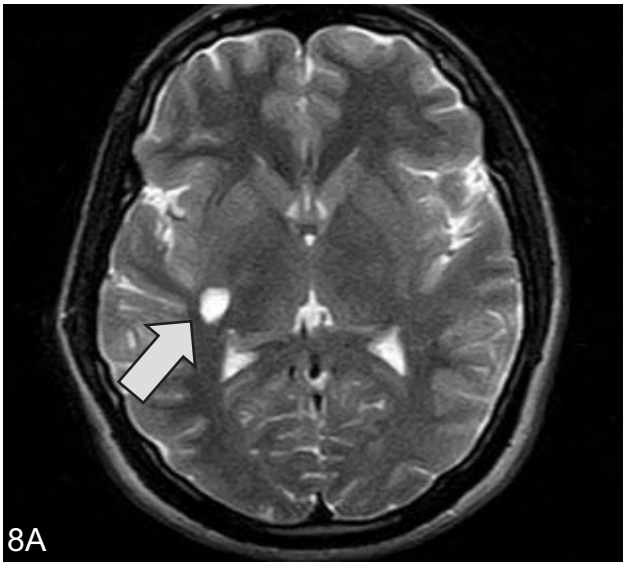
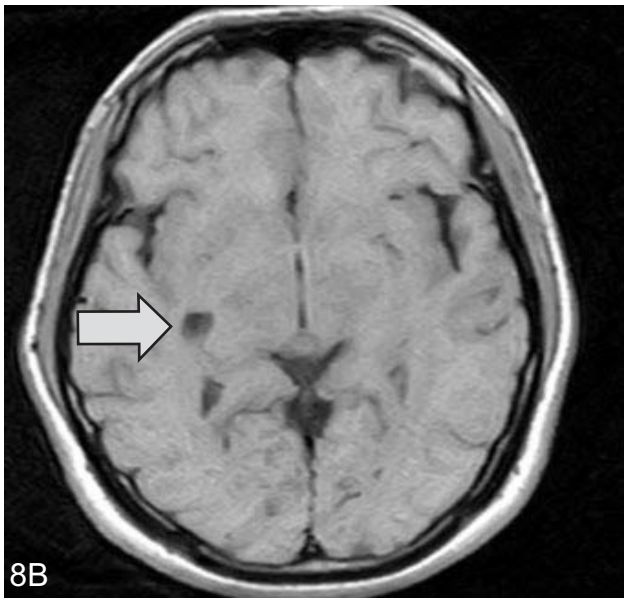


Figure 7A & B: Showing MRI images with axial T2 **(Figure 7A)** and sagittal post contrast T1 sequences **(Figure 7B)** a case of a 30 years male patient has suspected history of Arnold chiari malformation patient with complaints of weakness in left leg and arm. Last MRI cervical spine shows syrinx formation in spinal cord starting from the cranio-vertebral junction extending down to the visualized lower limit. Dilated fourth ventricles is compression upon cerebellum. This follows the CSF intensity. There is mild atrophy of the body and splenium of the corpus callosum.

Choroidal fissure cyst:

Also known as choroid fissure cyst is benign intracranial entity appearing within the choroidal fissure. Mostly these are asymptomatic and are seen inciden-





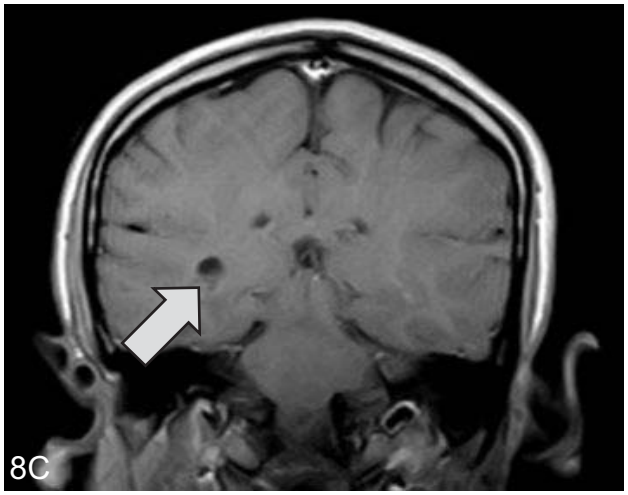
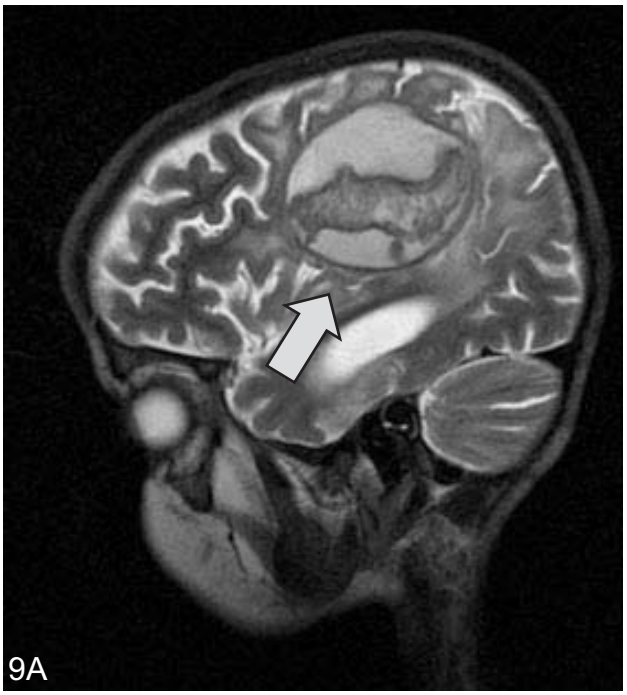


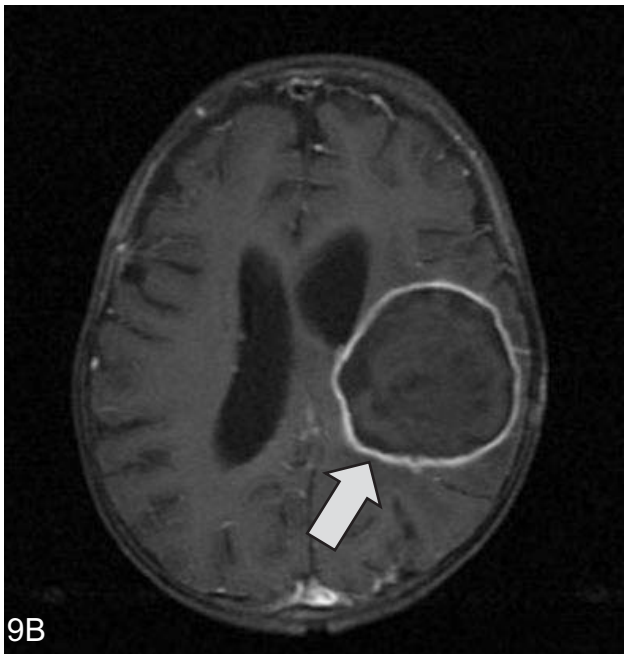
Figure 8A, B and C: Show a case of 28 years male complaining of ongoing severe headache since1 day, radiating to back with throbbing sensation at occipital region. T2 axial, T1 axial pre contrast and T1 post contrast coronal sequences show a CSF signal intensity cystic lesion is noted in the right temporal lobe sited just superior to the atrium/temporal horn of the right lateral ventricle (arrow). This has no postcontrast enhancement or solid component and appearances are characteristic of a choroidal fissure cyst.

tally. Rarely if in the temporal lobe is associated with seizures.[22] Mainly 2 types of choroidal fissure cysts are seen including neuroepithelial cyst or arachnoid cyst. Radiologically the signals are similar to that of CSF on all sequences of MRI with thin walls. There is no surrounding oedema or wall enhancement seen.[23] Usually no treatment is required and imaging follow up is mostly enough. Usually the differential includes enlarged perivascular space.

Brain abscess:

Brain infection require prompt treatment as it can lead to potential abscess formation which is a relatively life - threatening condition. The most common etiology for intra-cranial infection is via hematological spread, while other include direct spread from the outside trauma/ from para nasal sinuses or lymphangitic spread.[24] MRI scan remains the modality of choice to differentiate between the abscess and other forms of ring enhancing lesions.[25] The lesions could present with atypical features; in many of the cases have no convincing acute symptoms in the background. Abscess formation usually takes place after 10 days of cerebritis. Early abscess formation are associated with a peripherally enhancing discrete lesion with additional daughter collections or accompanying ventriculitis/ventricular expansion which leads to necrosis and reduced surrounding oedema on later phase. On MRI this is hypointense on T1 still relatively hyperintense to CSF, while central high signal intensity changes are appreciated on T2 and flair sequences. There is a central restriction on DWI/ADC sequences. Spectroscopy also shows its role in abscess diagnosis with elevation of the succinate peak. Neurological intervention with drainage is the treatment of choice in most of the cases. The possible differentials still include metastasis or high-grade glioma (GBM).[25]





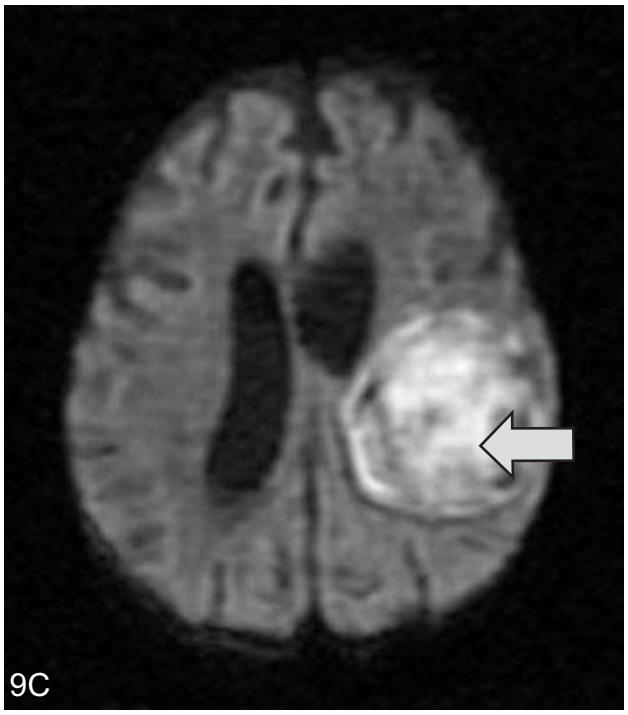
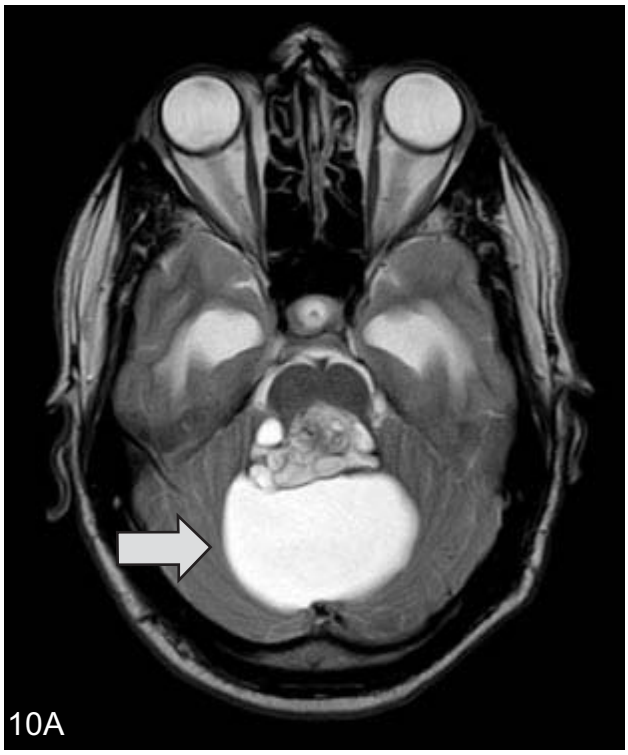


Figure 9A, B & C: Show a case of a 4 year old female with background of ALL presented with seizures. MRI scans shows a relatively well-circumscribed lesion in the left parieto-occipital lobe showing surrounding mass-effect and vasogenic oedema. It shows hyperintense signal intensity changes on T2-weighted images **(Figure 9A)**, and has low signals on T1 sequence and is associated with peripheral rim enhancement **(Figure 9B)**. On diffusion weighted imaging the lesion shows central restriction **(Figure 9C)**. On biopsy it turned out to be intracranial, intra axial aspergillosis. Background CT paranasal sinuses was also positive for fungal sinusitis.

Pilocytic astrocytoma:

These are seen as tumors of relatively good prognosis and are counted as WHO grade 1 astrocytomas in pediatric age group. Characteristically these present as large cystic lesions with eccentric enhancing mural nodule. One in five of cases show calcifications. The most common location in the posterior cranial fossa and has strong association with neurofibromatosis type I.[26] On the T1 MRI sequences in the solid component appears iso-to hypointense in comparison with the adjacent brain parenchyma, while the 50% of the cases there is also noted enhancement in the cyst wall. On T2 sequences the solid component appears hyperintense to the adjacent brain parenchyma. Pilocytic astrocytoma usually have good prognosis with 10 years survival of more than 95%.[27] Curative surgical resection is a treatment option frequently opted. It is important to understand its imaging characteristics to differentiate it from haemangioblastoma, medulloblastoma and ependymomas.[28]



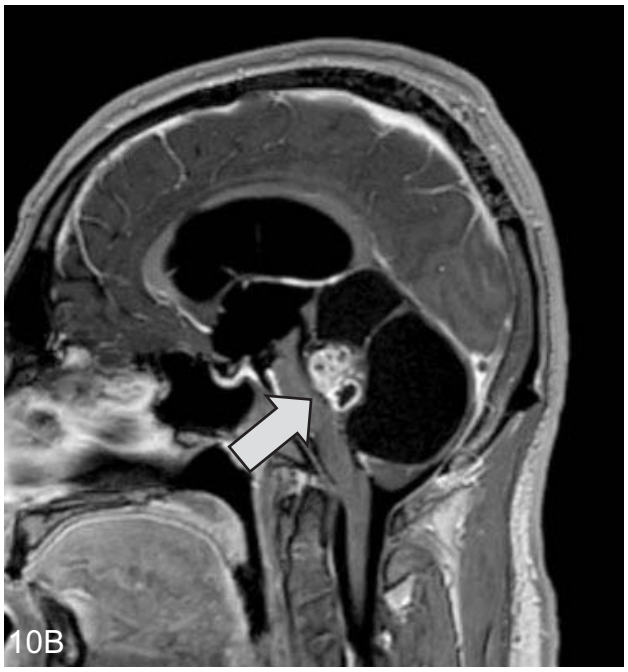
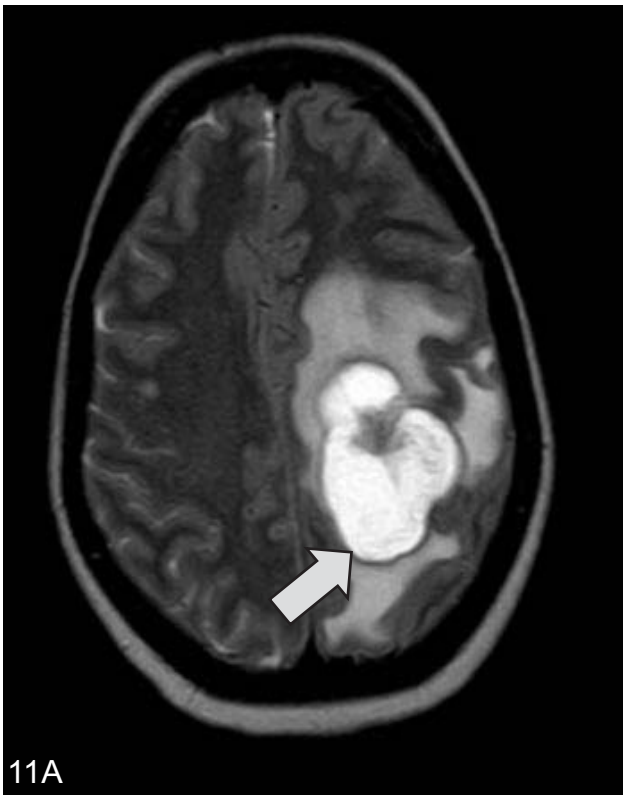
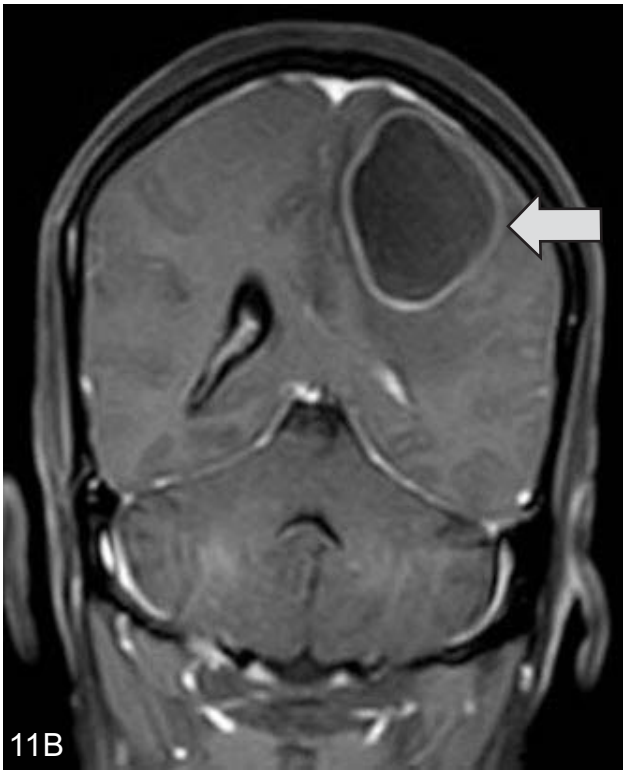


Figure 10A & B: Show a case of 9 year old male with bulbar symptoms. On MRI scan there is a large predominantly cystic lesion in posterior cranial fossa midline. This is hyper intense on T2 axial sequence **(Figure 10A)** Eccentric solid enhancing component is also seen showing post contrast enhancement as seen on sagittal T1 sequence **(Figure 10B)**. There is mass effect on the fourth ventricle resulting in moderate to severe supratentorial obstructive hydrocephalus. There is transependymal CSF seen due to hydrocephalus.





Metastatic Breast intracranial cystic lesion:

Presence of an intracranial cystic lesion in the background of a known malignancy is highly suspicious for brain metastasis until unless proven otherwise. Brain metastasis accounts for 25-50% of the intracranial tumors.[29] Most common intracranial metastases are from and lung carcinoma, renal cell carcinoma, breast carcinoma and melanoma.[30] Colorectal carcinoma to commonly leads to brain metastases. Mostly the brain metastatic lesions are presented as marked vasogenicoedema and mass-effect and are usually multiple in numbers.[31] Occasionally central necrosis within the tumor produces peripheral enhancement with cyst like morphology.[32] In old age patients brain metastasis can also present as first abnormality from an unknown primary malignancy. Usually the brain metastases is not resectable are treated with chemoradiation.

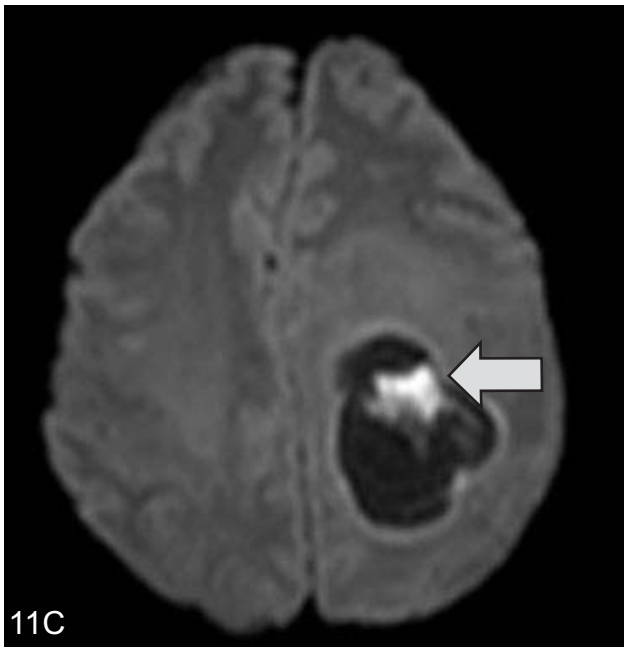


Figure 11A, B & C: Show a case of a 40 years female of treated CA breast on tamoxifen for last 2 years presented with right sided weakness 2 weeks. MRI scan shows A lobulated cystic lesion in left frontoparietal region seen as hyperintense abnormality on T2 axial image **(Figure 11A)**, This shows ring enhancement **(Figure 11B)** with a mural solid nodule showing DWI restriction **(Figure 11C)**. There is associated peri-lesional edema with significant midline shift. Features are suggestive of a metastatic deposit.

Conclusion

Intracranial cystic lesions are mostly benign lesions that commonly encountered in daily practice. However a few of the primary brain tumors as well as some metastatic lesions may present as intracranial cystic lesions, thus require detailed knowledge regarding various presentations on imaging. A proper evaluation provides diagnostic accuracy in exceptional cases that have clinical importance. Radiologists must equip themselves to better differentiate between common Benign and malignant cystic lesions. It does not only help in the proper diagnosis but also assists in proper patient management.

References

1. Ahlhelm F, Shariat K, G tschi S, Ulmer S. Intracranial cystic lesions. Der Radiologe. Feb 2018; **58(2):** 120.

2. Taillibert, S., Le Rhun, E. & Chamberlain, M.C. CurrNeurolNeurosci Rep (2014) 14: 481. Epelman M, Daneman A, Blaser SI, Ortiz-Neira C, Konen O, Jarr n J, Navarro OM. Differential diagnosis of intracranial cystic lesions at head US: correlation with CT and MR imaging. Radiographics. Jan 2006; **26(1):** 173-96.

3. Popescu BO. Intracranial cysts: an imagery diagnostic challenge. Scientific World Journal. 2013; **2013:** 172154.

4. Oprisan A, Popescu BO. Intracranial cysts: an imagery diagnostic challenge. The Scientific World Journal. 2013; 2013

5. Brown JY, Morokoff AP, Mitchell PJ, Gonzales MF. Unusual imaging appearance of an intracranial dermoid cyst. American journal of neuroradiology. Nov 2001; **22(10):** 1970-2.

6. Brown JY, Morokoff AP, Mitchell PJ, Gonzales MF. Unusual imaging appearance of an intracranial dermoid cyst. American journal of neuroradiology. Nov 2001; **22(10):** 1970-2.

7. Jack w J, Tse G, Martin A, Sasiadek M, Romanowski C. Ruptured intracranial dermoid cysts: a pictorial review. Polish journal of radiology. 2018; **83:** e465.

8. Osborn AG. Michael T. Preece. Intracranial Cysts: Radiologicpathologic Correlation and Imaging approach. Radiology; 239.

9. Hota P, Chadaga H, Patwari S. Case 15611 Bilateral optic pathway glioma in Neurofibromatosis type1.

10. Andica C, Hori M, Kamiya K, Koshino S, Hagiwara A, Kamagata K, Fukunaga I, Hamasaki N, Suzuki M, Feiweier T, Murata K. Spatial restriction within intracranial epidermoid cysts observed using short diffusion-time diffusion-weighted imaging. Magnetic Resonance in Medical Sciences. 2018; **17(3):** 269.

11. Baron CA, Beaulieu C. Oscillating gradient spin-echo (OGSE) diffusion tensor imaging of the human brain. Magnetic resonance in medicine. Sep 2014; **72(3):** 726-36.

12. Al-Holou WN, Terman S, Kilburg C, Garton HJ, Muraszko KM, Maher CO. Prevalence and natural history of arachnoid cysts in adults. Journal of neurosurgery. Feb 2013; **118(2):** 222-31.

13. Bosemani T, Orman G, Boltshauser E, Tekes A, Huisman TA, Poretti A. Congenital abnormalities of the posterior fossa. Radiographics. Jan 2015; **35(1):** 200-20.

14. Manjunath MN. Multiple ring enhancing lesions in brain: Neurocysticercosis or tuberculoma? An extremely unusual/uncommon radiological presentation of a common disease: Central nervous system tuberculosis. British Journal of Medical Practitioners. Mar 2016; **9(1):** 39-42.

15. Roessmann U, Gambetti P. Pathological reaction of astrocytes in perinatal brain injury. Acta neuropathologica. Sep 1986; **70(3-4):** 302-7.

16. Oommen AT, Sethy G, Minz NT, Patra J, Panda SS. Unusual presentation of porencephalic cyst in an adult. Journal of clinical and diagnostic research: JCDR. Feb 2017; **11(2):** OD12.

17. Zacharia BE, Bruce SS, Goldstein H, Malone HR, Neugut AI, Bruce JN. Incidence, treatment and survival of patients with craniopharyngioma in the surveillance, epidemiology and end results program. Neuro-oncology. Aug 2012; **14(8):** 1070-8.

18. Sartoretti-Schefer S, Wichmann W, Aguzzi A, Valavanis A. MR differentiation of adamantinous and squamous-papillary craniopharyngiomas. American journal of neuroradiology. Jan 1997; **18(1):** 77-87.

19. Zimmerman RA, Bilaniuk LT, Gallo E. Computed tomography of the trapped fourth ventricle. American Journal of Roentgenology. Mar 1978; **130(3):** 503-6.

20. Elster AD, Chen MY. Chiari I malformations: clinical and radiologic reappraisal. Radiology. May 1992; **183(2):** 347-53.

21. Scotti G, Musgrave MA, Fitz CR, Harwood-Nash DC. The isolated fourth ventricle in children: CT and clinical review of 16 cases. American Journal of Roentgenology. Dec 1980; **135(6):** 1233-8.

22. Morioka T, Nishio S, Suzuki S, Fukui M, Nishiyama T. Choroidal fissure cyst in the temporal horn associated with complex partial seizure. Clinical neurology and neurosurgery. May 1994; **96(2):** 164-7.

23. de Jong L, Thewissen L, van Loon J, Van Calenbergh F. Choroidal fissure cerebrospinal fluid-containing cysts: case series, anatomical consideration, and review of the literature. World neurosurgery. May 2011; **75(5-6):** 704-8.

24. Kastenbauer S, Pfister HW, Wispelwey BR, Scheld WM. Brain abscess. Infections of the central nervous system. 2004: 479-507.

25. Holmes TM, Petrella JR, Provenzale JM. Distinction between cerebral abscesses and high-grade neoplasms by dynamic susceptibility contrast perfusion MRI. American Journal of Roentgenology. Nov 2004; **183(5):** 1247-52.

26. Hota P, Chadaga H, Patwari S. Case 15611 Bilateral optic pathway glioma in Neurofibromatosis type1.

27. Louis DN, Perry A, Reifenberger G. von DA, Figarella-Branger D., Cavenee WK, Ohgaki H., Wiestler OD, Kleihues P., Ellison DW The 2016 World Health Organization classification of tumors of the central nervous system: A summary. Acta Neuropathol. 2016; **131:** 803-20.

28. AlRayahi J, Zapotocky M, Ramaswamy V, Hanagandi P, Branson H, Mubarak W, Raybaud C, Laughlin S. Pediatric brain tumor genetics: what radiologists need to know. Radiographics. Nov 2018; **38(7):** 2102-22.

29. Barnholtz-Sloan JS, Sloan AE, Davis FG, Vigneau

FD, Lai P, Sawaya RE. Incidence proportions of brain metastases in patients diagnosed (1973 to 2001) in the Metropolitan Detroit Cancer Surveillance System. Journal of clinical oncology. Jul 2004; **22(14):** 2865-72.

30. Radu R, Nago A, Buruian M. Radiological Diagnosis of Multifocal Hepatocellular Carcinoma. European Congress of Radiology 2015.

31. Greenberg MS, Arredondo N. Cerebral metastases. Handbook of Neurosurgery. New York, Thieme. 2001: 463-9.

32. Sharma V, Prabhash K, Noronha V, Tandon N, Joshi A. A systematic approach to diagnosis of cystic brain lesions. South