Case report

Case study of 100 patients with intracranial lesions and evaluation of intracranial calcification's along with various intracranial space occupying lesions on multisliced computed tomographic scan (64 sliced)

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1. Introduction

Aquilion 64, CT scanner features a unique detector system that provides super-thin slices for crystal clear, comprehensive images. The scanner is engineered to generate the same high resolution in all three dimensions, allowing for multi-planar views of internal anatomical structures. In a single breath-hold of 6-10 seconds, it can capture superior, precise images. Computed Tomography was introduced in 1992.

The various space occupying lesions of the brain are classified as follows:

1. Tumors – benign and malignant.
2. Traumatic – contusion, intracerebral hematoma, arterial dissection.
4. Infective: brain abscesses by various microbes, granulomatous infection by mycobacterium, treponema, fungal infection by aspergillosis, candida, cryptococcus etc. parasitic infection by cysticercosis, toxoplasma, echinococcus.
5. Congenital lesions.

Tumors:

1. Gliomas (a) Astrocytomas: Circumscribed-juvenile pilocytic astrocytoma, pleomorphic xanthoastrocytoma, subependymal giant cell astrocytoma, diffuse, optic pathway glioma, anaplastic astrocytoma, glioblastoma multiforme (b) Oligodendrogliomas (c) Ependymomas (d) Choroid plexus tumors - papilloma or carcinoma.
2. Non-glial tumors: (a) Neuronal and mixed neuronal/glial tumors: Ganglioglioma, Ganglioctyta, Central neurocytoma. (b) Pineal parenchymal tumors: Pineoblastoma, Pineocytoma © Embryonal Tumors: Medulloblastoma
3. Tumors of cranial nerves (a) Schwannoma (b) Neurofibroma (c) Malignant peripheral nerve sheath tumors.
4. Tumors of the meninges: (a) Meningioma (b) Melanocytic tumor (c) Hemangioblastoma.
5. Tumors of hematopoietic system (a) Primary or secondary CNS lymphoma (b) Granulocytic sarcoma.
6. Germ cell tumor: (a) Germinoma (b) Teratoma.
7. Tumors of the Sellar region: (a) Pituitary adenoma (b) Craniopharyngioma (c) Rathke cleft cyst.
8. Metastases

Cystic lesions of Brain

1. Normal and/or variant - Choroid plexus cyst (xanthogranuloma), enlarged perivascular spaces, ependymal, neuroglial.
3. Traumatic and/or vascular infectious - neurocysticercosis, hydatid cyst.


Intracranial calcifications

I. Physiological

II. Pathological

1. Posttraumatic and dystrophic

2. Congenital disorders (Phakomatoses)

3. Vascular disorders

4. Infections

5. Inflammatory disorders

6. Tumors

7. Metabolic

   a) Age-related physiologic and neurodegenerative calcifications

Intracranial physiologic calcifications are unaccompanied by any evidence of disease and have no demonstrable pathological cause. The most common sites include the pineal gland, habenula, choroid plexus, basal ganglia, thalami, and hypophysis. The percentage of meningiomas that calcify ranges from 20% to 69%. The calcifications can be focal, diffuse, coarse, sand-like or even rim. There is a higher percentage of calcified meningiomas in children, which could be associated with more aggressive subtypes of meningiomas.

b) Acquired infections

Cysticercosis, tuberculosis, HIV and cryptococcus are the most common acquired intracranial infections typically associated with calcifications.

In cysticercosis, calcifications are seen in the dead larva (granular-nodular stage) and the typical appearance is that of a small, calcified cyst containing and eccentric calcified nodule that represents the dead scolex.

A "target sign" representing a central nidus of calcification surrounded by a ring of enhancement is strongly suggestive of a tuberculoma.

5. Inflammatory lesions

Sarcoidosis involves the leptomeninges, producing granulomas of the pituitary stalk and the optic chiasm. Calcified sarcoid granulomas can also be seen in the pituitary, pons, hypothalamus and the periventricular white matter.

6. Tumors

a) Intra-axial tumors

Calcifications are present in the majority of subependymal giant-cell astrocytomas in the form of calcified chunks or nodules. Up to 25% of pilocytic astrocytomas have intratumoral calcification.

The oligodendrogliomas exhibit the highest frequency of calcification among all brain tumors, since up to 90% of them calcify. The calcifications in oligodendrogliomas can be central or peripheral, punctate or ribbon-like, usually located within walls of intrinsic tumor vessels.

b) Extra-axial tumors

The percentage of meningiomas that calcify ranges from 20% to 69%. The calcifications can be focal, diffuse, coarse, sand-like or even rim. There is a higher percentage of calcified meningiomas in children, which could be associated with more aggressive subtypes of meningiomas.

c) Intraventricular tumors

Intraventricular ependymomas typically calcify, ranging from punctuate to mass-like calcifications. Posterior fossa ependymomas exhibit small, round calcifications up to 50% and have the highest frequency of calcification among the posterior fossa tumors.

7. Endocrine/metabolic/idiopathic

Metabolic disorders affecting the calcium homeostasis are associated with intracranial calcifications that predominantly involve the basal ganglia.

Progressive and symmetric basal ganglia calcifications are the commonest radiological finding of MELAS syndrome.

Fahr disease: Fahr disease, also known as familial cerebral ferrocalcinosis, is a congenital disorder characterized by abnormal calcium deposition with subsequent atrophy involving the basal ganglia, cerebral and cerebellar cortical regions. Both autosomal dominant and autosomal recessive inheritance patterns have been proposed. CT findings of calcification are extensive and have a fairly typical distribution at, basal ganglia and thalami.
isodense lesions were seen in 7 cases (8.8%). Lesions and hypodense lesions were seen in 6 cases (7.6%). Well defined hypodense lesions were seen in 26 cases (32.9%) and ill-defined hyperdense lesions were seen in 35 cases (44.3%). Well defined 15% cases. Out of 79 supratentorial lesions, well defined cases was headache seen in 46% cases. Hyperdense lesions ratio was found to be 1.4:1. The commonest complaint of the that 58% were males and 42% were females. Male to female Peak incidence was observed in the age group of 21-30 years intra-axial and 15% were extra-axial.

AIMS AND OBJECTIVES:
1. To study the computed tomographic (CT) findings of various physiological and pathological intracranial calcification
2. To distinguish between the physiological from the pathological intracranial calcification.
3. To determine the role of Multisliced computed tomography in evaluation of space occupying lesions of the brain.

MATERIAL AND METHODS

SOURCE OF DATA:
The cases will be recruited from department of Radio Diagnosis, JNIMS.

INCLUSION CRITERIA:
1. Male and Female patients of age between 10yrs-80 yrs presenting with symptoms like fever, headache, vomiting, seizures, behavioral disorders, dizziness, neurological deficit of sudden onset.
2. Also asymptomatic patients where intracranial calcifications detected at time of routine computed tomographic (CT) scanning done for other diagnosis.

EXCLUSION CRITERIA:
Exclusion criteria: Trauma, Pregnant females, allergy to contrast.

SAMPLE SIZE:
It’s a 6 months study of approximately 100 cases. The total number of subjects will be those referred to Department of Radio diagnosis, JNIMS.

Toshiba CT Scanner -Toshiba aquilion 64 sliced.
5 mm cut in both supra and infratentorial structures.

RESULTS:
The space occupying lesions of the brain were broadly classified into two groups. 79% were in supratentorial compartment, 21% were seen in infratentorial compartment, 15% were intra-axial and 6% were extra-axial and 64% were intra-axial and 15% were extra-axial.

Peak incidence was observed in the age group of 21-30 years (18 cases) followed by 11-20 years (17 cases). Table III shows that 58% were males and 42% were females. Male to female ratio was found to be 1.4:1. The commonest complaint of the cases was headache seen in 46% cases. Hyperdense lesions were the most common finding on non-contrast CT studies, seen in 45% cases, hypodense lesions in 40% and isodense lesions in 15% cases. Out of 79 supratentorial lesions, well defined hyperdense lesions were seen in 35 cases (44.3%). Well defined hypodense lesions were seen in 26 cases (32.9%) and ill-defined hypodense lesions were seen in 6 cases (7.6%). Well defined isodense lesions were seen in 7 cases (8.8%) lesions and irregularly defined isodense lesions were seen in 5 cases (6.3%). About 58 cases (73.4%) showed a mass effect, perilesional edema was seen in 41 cases (51.8%), calcification in 2,5 cases bone changes in 14 cases (17.7%). Ring-enhancement of supratentorial lesions was them ost common pattern of contrast enhanced studies seen in 23 cases (38.9%). Homogenously enhancing lesions were seen in 11 cases (18.6%) and heterogeneously enhancing lesions were seen in 8 cases (13.5%).

No enhancement was seen in 3 lesions (5%) and rim enhancement of the lesion was seen in 2 cases (3.4%). Out of 21 infratentorial lesions, well defined hyperdense lesions were seen in 10 cases (47.6%) followed by well-defined hypodense lesions in 8 cases (38%) and well defined isodense in 3 cases (15.7%) lesions. About 15 cases (71.4%) showed a mass effect with perilesional edema in 12 cases (57.4%), bone changes in 2 cases (9.5%) and calcification in 1 case (4.7%). Homogenously enhancing infratentorial lesions were seen in 7 cases (11.8%) while ring enhancing lesions were seen in 5 cases (5%). Rim and mural nodule enhancement was seen in 2 lesions (3.4%). Table I shows that among congenital lesions, there was one case of mega cistern magna, two cases of arachnoid cysts and two cases of dermoid/epidermoid cysts, one case of tuberous sclerosis and Dandy Walker malformation.

Among vascular lesions, there were sixteen cases of acute ICH, three cases of arteriovenous malformation, three cases of acute SDH, two cases of subacute SDH, three cases of chronic SDH and one case of prominent intrasosseous arachnoid granulations which are projections of the arachnoid membrane into the dural sinuses that allow csf entrance from the subarachnoid space to the venous system.

Among infectious lesions, there were nine cases of tuberculomas, six cases of abscesses and twelve cases of neurocysticercosis.

Among tumors and tumor like lesions, there were four cases of low grade astrocytomas and six cases of high grade astrocytomas and, four cases of Sellar region masses five cases of meningioma, three cases of Oligodendroglioma, two cases of schwannomas, one case of Ependymoma, one case of medulloblastoma, nine cases of metastases, two cases of colloid cysts and one case of lymphoma.

1. Most of the cases of hyperdense lesions (27%) showed blood attenuation, suggestive of intracerebral and subdural hemorrhages. 5 cases of meningioma and a case of lymphoma and medulloblastoma were also hyperdense.
2. Hypodense lesions with heterogenous/ring enhancement, irregular margins, associated perilesional edema and mass effect in the older age group were suggestive of high grade astrocytomas seen in 6 cases (6%) in the present series. Low grade astrocytomas with minimal/rim and mural nodule enhancement were seen in 4 cases (4%).
3. The majority of the lesions, i.e. 26 cases (44%) showed ring enhancement on contrast enhanced study done in 59 cases. Homogenous enhancement was seen in 18 cases (30.5%), while heterogenous enhancement was seen in 8 cases (13.5%). No enhancement was seen in 3 cases, two arachnoid cysts and a low grade glioma.
4. Ring enhancing or nodular enhancing hyperdense or isodense lesions suggestive of intracranial tuberculosis were seen in 9 cases. Headache and seizures were the most common complaint in these patients. Most of the lesions were located supratentorially.
5. Hypodense lesions with ring enhancement and scolex were seen in 7 out of 12 cases of neurocysticercosis with seizures as presenting complaint in most of the cases. 6 cases of hypodense lesions with ring enhancement, medial wall being thinner, perilesional edema and fever were suggestive of brain abscesses.

6. Calcification was seen in tuberous sclerosis, neurocysticercosis, meningiomas, oligodendrogliomas, arteriovenous malformations, dermoid cyst and in a case of Fahr disease.

7. Incidental note was made of a case of tuberous sclerosis and Dandy Walker malformation.

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<tr>
<th>CT Diagnosis</th>
<th>No. of cases</th>
<th>Percentage</th>
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<tr>
<td>Congenital (7 cases)</td>
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<tr>
<td>Tuberous sclerosis</td>
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<tr>
<td>Dandy Walker Malformation</td>
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</tr>
<tr>
<td>Mega cistern magna</td>
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<td>1%</td>
</tr>
<tr>
<td>Dermoid cysts</td>
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<td>1%</td>
</tr>
<tr>
<td>Arachnoid cysts</td>
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<td>2%</td>
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<td>Vascular (28 cases)</td>
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<td>Acute ICH</td>
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<td>Infective (27 cases)</td>
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<td>Tuberculomas</td>
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<tr>
<td>Abscesses</td>
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TABLE II: PROBABLE CT DIAGNOSIS OF SPACE OCCUPYING LESIONS OF BRAIN (n=100)

<table>
<thead>
<tr>
<th>PT Age (Years)</th>
<th>Supratentorial (No. of cases)</th>
<th>Infratentorial (No. of cases)</th>
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<td>3</td>
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<td>13</td>
<td>4</td>
<td>17</td>
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<td>2</td>
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<td>31-40</td>
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<td>2</td>
<td>13</td>
</tr>
<tr>
<td>41-50</td>
<td>12</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>51-60</td>
<td>11</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>60-80</td>
<td>12</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>79</td>
<td>21</td>
<td>100</td>
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<tr>
<td>Male</td>
<td>58</td>
<td>58%</td>
</tr>
<tr>
<td>Female</td>
<td>42</td>
<td>42%</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100%</td>
</tr>
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</table>

TABLE III: SEX WISE DISTRIBUTION (n=100)

Figure 1. Axial NCCT brain image showing a well-defined extra-axial hypodense lesion with CSF density in the right temporal region-Arachnoid cyst

Figure 2 Axial NCCT brain image of a 36 yrs female presenting with headache showing a hyperdense lesion near the third ventricle most likely a colloid cyst.
Fig. 3 Axial NCCT brain image showing a well-defined hypodense epidermoid cyst.

Fig. 4 Axial CT brain image showing Closed lip schizencephaly on left fronto temporal lobe.

Fig. 5 (a,b)-Axial NE CT brain images showing osteolytic lesions in the occipital bone due to prominent intraosseous Arachnoid granulations or Foveolae granulations.

Fig. 6 (a,b,c) Axial NCCT brain images showing a multiple calcification Fahr disease.

Fig. 7a. Axial CECT brain image showing multiple ring enhancing lesions in both cerebral lobes with perilesional edema, most likely tuberculomas.
Figure 7b. Axial CECT image of brain in a known case of tuberculosis showing ring enhancing lesions with marked perilesional edema s/o tuberculoma.

Figure 8a Axial CECT brain image of 6 and half month baby with history of TORCH positive mother showing small calcification in brain parenchyma.

Figure 8b Axial CECT brain image of 2 month baby with history of toxoplasma positive mother born at 7 month pregnancy showing multiple calcification in brain parenchyma.

Fig 18b-Axial ct brain image of a 17 yrs boy showing ring enhancing lesion in the temporoparietal region, with a small central hypodensity likely representing a scolex of neurocysticercosis.
Figure 9: Axial CECT brain image showing left occipital arteriovenous malformation with multiple calcified phleboliths with surrounding hyperdensity.

Figure 10: Axial NECT brain images showing multifocal lesion rounded thick wall lesions with central hypodensity and surrounding vasogenic oedema along with a tumoural bleed on left frontal region.....Multifocal glioma .......

Figure 11: (a, b) Axial NCCT & CECT images of brain showing an irregular isodense ring enhancement lesions with marked edema .....cerebral metastasis in a known case of carcinoma breast.

Figure 12: Axial CT brain image showing hyperdense mass in the posterior fossa giving rise to obstructive hydrocephalus.......Medulloblastoma
Fig 13: Axial CT brain image showing a calcified meningioma on the right parietal lobe.

Fig 15: Axial CECT brain image showing a well-defined hyperdense lesion in the right centrum semiovale with minimal perilesional oedema. Primary CNS Lymphoma.

Fig 14: Axial CT brain image showing a well-defined hypodense lesion with mural nodule and surrounding minimal perilesional oedema. On contrast study, the mural nodule is enhanced suggestive of pleomorphic xanthoastrocytoma associated with an old depressed fracture at the right parietal bone.

Fig 16: Axial CT brain image showing a pituitary mass with patchy enhancement suggestive of haemorrhage in a pituitary adenoma.

Fig 17: Axial NECT brain image of a 41-year-old man with left-sided weakness showing a mixed-attenuating lesion with calcification in the right temporal lobe. Post-contrast show minimal enhancement most likely oligodendroglioma.
In the present study, out of 100 cases, supratentorial lesions were seen in 79 cases (79%) and infratentorial lesions were seen in 21 cases (21%). This corresponds to the study carried out by Irfan A et al9 on 386 cases in which 77% were supratentorial lesions and 23% were infratentorial and another study conducted by Alabedeen10 on 192 cases in which 76.6% were supratentorial lesions and 23.4% were infratentorial.

In the present study, the age ranged from 2 to 80 years. The age incidence of our study corresponds with the study carried
out by Irfan A et al9 where mean age was 33 years and in another study carried out by Alabedeen Z et al4, the mean age was 34.1. In the present study most of the cases (35%) were in the age group 11 to 30 years and this also corresponds with the maximum age incidence in the study carried out by Irfan A et al9 which was a second and third decade.

In the present study, out of the 100 cases, 58 cases were male and 42 cases were female with male to female ratio of 1.4:1 corresponding with the study done by Irfan A et al9 where male to female ratio of 1.5:1 and Mahmoud5 who reported male to female ratio of 1.7:1.

In the present study, headache was the most common clinical presentation seen in 46% cases, altered sensornium in 24% cases, focal neurological deficit in 19% cases, seizures in 15% cases and fever in 15% cases. Our study corresponds with the study conducted by Mahmoud11 in which headache was seen in 43% cases, altered sensornium in 21% cases, focal neurological deficit in 14% cases and seizures in 11% cases.

Out of 45 hyperdense lesions, 35 were supratentorial and 10 were infratentorial in location. Thirteen hyperdense intra-axial lesions showing attenuation value corresponding to blood with perilesional edema and mass effect in the form of effacement of lateral ventricle and midline shift were intracerebral hemorrhages. Eight extra-axial lesions with crescentic shape had features of subdural hemorrhage. Most patients with intracerebral hemorrhage were of older age group with hypertension being the commonest risk factor in 70% cases. In 3% of all cases, arteriovenous malformation related hemorrhage was seen in young males. These findings are in accordance with a study done by Chiewvit et al27 showed similar findings in their study on medulloblastoma. Chang, et al26 in their study of 56 cases of supratentorial astrocytomas appeared as ill-defined masses with a ring or heterogeneous enhancement, present in midline in 11 year male was stated that medulloblastomas are primarily childhood tumors, appearing as hyperdense lesions pushing fourth ventricle anteriorly and surrounded by cerebrospinal fluid with moderate enhancement. Zimmerman et al23 reported similar findings in their study on medulloblastoma.

One elderly immunocompromised patient with homogenously enhancing hyperdense mass involving both frontal lobes had features of lymphoma. On CT, the lesion typically had high attenuation and virtually showed enhancement after administration of contrast material. The findings in the present study corresponds with that done by Jack Jr, et al24 on 32 cases of intracranial lymphomas in which 63% lesions were hyperdense and 100% showed homogenous enhancement.

Six hypertensive supratentorial lesions in adults had ill-defined margins involving the white matter with heterogenous enhancement in 4 cases and ring enhancement in 2 cases showing mass effect and perilesional edema with areas of hemorrhage appearing as probable cases of high grade astrocytomas. The above morphological CT appearance and enhancement pattern parallels to the features observed by Rees et al25 Two cases who presented with headache had well defined hypodense lesions with one of them showing mild enhancement and the other showing no enhancement, appearing as probable cases of low grade astrocytomas. T Chang, et al26 in their study of 56 cases of supratentorial gliomas stated the same that low grade gliomas appear as well-defined hypodense masses with little or no enhancement and high grade gliomas appear as ill-defined masses with a ring or heterogeneous enhancement.

Five hyperdense extra-axial lesions appeared as well margined, homogenous, dural based masses, four located supratentorially and one at the cerebellopontine angle, causing buckling of white matter having high attenuation and strong contrast enhancement. Calcification was seen in three cases (60% of all cases), perilesional edema in four cases (80% of all cases) and hyperostosis in two cases (40% of all cases), so with them the probable diagnosis was meningioma.

These findings correlate with a study done by Kendall B, et al19 in which 90% lesions were hyperdense and showed intense enhancement. The above features of meningiomas also correspond with the study done by Amundsen et al20 in which 72.2% lesions were hyperdense, 93.7% showed strong homogenous enhancement, calcification was seen in 45%, perilesional edema in 80.9% and hyperostosis in 23-44%.

Two hyperdense well defined round to oval masses in third ventricle were colloid cysts. Colloid cysts appear as homogenous, rounded, hyperdense masses at the foramen of Monro showing minimal contrast enhancement. In the present study, CT features correspond well with features described by Ganti et al21.

One hyperdense infratentorial lesion with homogenous enhancement, present in midline in 11 year male was considered to be medulloblastoma. Koeller et al22 in their study stated that medulloblastomas are primarily childhood tumors, appearing as hyperdense lesions pushing fourth ventricle anteriorly and surrounded by cerebrospinal fluid with moderate enhancement. Zimmerman et al23 reported similar findings in their study on medulloblastoma.

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Two cases in children showed rim enhancing infratentorial hypodense lesion with a solid enhancing mural nodule. These features were probably due to pilocytic astrocytoma. Koeller et al27 showed similar findings in their study, in which pilocytic astrocytomas appeared as homogenous hypodense masses with an isodense enhancing mural nodule. An isodense fourth intraventricular lesion in a male child with homogeneous
Calcification on CT window width and level may affect the detectability of radiography. A number of factors including slice thickness; computed tomography (CT) than with plain skull and localization of intracranial calcifications. Intracranial calcifications in all age groups. Assessment of intracranial physiological and pathological detection of these calcifications. The aim of this study was the assessment of intracranial physiological and pathological calcifications in all age groups.

The intracranial calcifications may have no clinical importance or they may be critical findings in diagnosing the underlying pathology. Intracranial physiological calcifications are unaccompanied by any evidence of disease and have no demonstrable pathological cause. They are often due to calcium and sometimes iron deposition in the blood vessels of different structures of the brain.

Thus, it is noteworthy that several pathologic conditions involving the brain are associated with calcifications and the recognition of their appearance and distribution by computed tomography (CT) helps narrow the differential diagnosis. Knowledge of physiologic calcifications in the brain parenchyma is essential to avoid misinterpretations.

CONCLUSION

In our state CT scan is accessible as a potent diagnostic tool and with low cost throughout the country. The technical ease, speed and patient comfort are much more in Toshiba (64 SLICED) as compared to MRI. When the cost benefit is evaluated, CT imaging remains as a major diagnostic modality in our state like manipur, within the reach of common man as with low cost specially in our department, JNIMS/IMPHAL.

References:
