Evaluation of various intracranial cystic lesions using CT and MRI at a tertiary hospital in central Gujarat.

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ABSTRACT:
BACKGROUND: Various cystic lesions in the intracranial lesions are enumerated and their imaging appearances have been described. Mainly, Cyst of developmental origin, Cyst of parasitic and infective origin, and Cyst of degenerative lesions that could be primary or metastatic. Aims: To enumerate and describe the various cystic lesions in literature and to diagnose cysts by CT and MRI. MATERIAL AND METHODS: 100 patient visiting SSG hospitals, suspected to have intracranial sign and symptoms were studied for a period of 15 months. Patient age group range 5-85 years were subjected to CT scan and MRI scan using standard intracranial protocols. RESULTS AND CONCLUSION: Out of 100 cases, 48 were simple cysts, 52 were complex cysts. 11 complex cysts turned out to be malignant. True cysts were 27% of total and rest being cyst like appearing lesions. 62% cases were symptomatic and remaining 38% were incidentally detected cystic lesions.

INTRODUCTION

By definition, a true cyst is an abnormal closed epithelium lined cavity in the body, containing liquid or semisolid material.¹ It is also a stage in the life cycle of certain parasites, during which they are enveloped in a protective wall, such as in neurocysticercosis.¹ A cyst is a closed sac, having a distinct membrane and division compared to the nearby tissue. Basically, a cyst is a cluster of cells that have grouped together to form a sac (not unlike the manner in which water molecules group together, forming a bubble); however, the distinguishing aspect of a cyst is the cells forming the "shell" of such a sac, are distinctly abnormal (in both appearance and behavior) when compared to all surrounding cells for that given location. It may contain air, fluids, or semi-solid material. A pseudo cyst is a cystic lesion that may appear as a cyst on scans, but lacks epithelial or endothelial cells. Pseudo cysts may form in a number of places, including the pancreas, abdomen, adrenal gland, and eye. An acute pancreatic pseudo cyst is made of pancreatic fluids with a wall of fibrous tissue or granulation.²,³ A simple cyst is a spherical space that is filled with liquid and the lining or wall of the cyst is very thin and has no irregularities in it. Inside the simple cyst there is nothing but fluid, which when removed is usually yellow or clear. It has no internal septae or solid components.⁴ Complex cysts have irregularities both in the wall and the internal components. The walls may be thick and irregular. Septae may be very fine and thin or quite thick and coarse and the cyst may also have tissue inside of it that enhances.⁴ On High Resolution Computed Tomography (HRCT), the term lung cyst is used to refer to a well-defined, round, and circumscribed lesion, with a wall that may be uniform or varied in thickness but which is usually thin (less than 2–3 mm thick). A cyst usually contains air but may also contain liquid, semisolid, or solid material. Lung cysts are also defined as having a wall composed of one of a variety of cellular elements, usually fibrous or epithelial in nature.⁵ Cysts form from a proliferation of epithelium, the tissue making up the skin and the linings of the blood.
vessels and body cavities, and may become detached from surrounding structures so that they move freely. The material inside can consist of natural body secretions, abnormal products from the breakdown of natural secretions and structural proteins, or, in case of infection, bacteria, larval parasites, and microbial products. Several organs, including the kidney, liver, and breast, are particularly susceptible to cyst formation and may become filled with numerous cysts of various sizes. In some cases, these cystic diseases are themselves dangerous, or they may obscure more serious, underlying diseases. Cysts are one of the most commonly detected lesions in radiology. Patients may present with a wide variety of clinical manifestations, and may even be asymptomatic. Importance of imaging lies in the characterization of these cysts to aid in further management. An asymptomatic small, simple cyst may be left alone where a large complex cyst with features of malignancy will require surgical removal and histopathological evaluation. This thesis enumerates the cystic lesions of the body, and describes the various imaging features.

1. Intracranial cystic Lesions

1.1.1 Choroid plexus cysts (CPCs)
CPC are non neoplastic epithelial-lined cysts of the choroid plexus & are the most common of all intracranial neuroepithelial cysts. Most are bilateral & located in the lateral ventricular atria & are found incidentally, typically in neonates & older adults. CPCs occur when lipid accumulates in the choroid plexus from degenerating or desquamating choroid epithelium. Most are small, measuring 2–8 mm in diameter. Peripheral calcification is common.

1.1.2 Enlarged Peri Vascular spaces (PVS)
Also known as Virchow-Robin spaces are pial-lined interstitial fluid-filled structures that accompany penetrating arteries & veins & dont communicate directly with the subarachnoid space. They frequently appear in the inferior basal ganglia, clustering around the anterior commissure & surrounding the lenticulostriate arteries as they superiorly course through the anterior perforated substance. Prominent PVSs are considered a normal variant. Most appear as smoothly demarcated fluid-filled cysts, typically less than 5 mm in diameter, & often occur in clusters in the basal ganglia or midbrain.

1.1.3 Ependymal cysts
Ependymal cysts are rare, benign, ependymal-lined cysts of the lateral ventricle or juxtaventricular region of the temporoparietal region & frontal lobe. These cysts are thought to arise from sequestration of developing neuroectoderm during embryogenesis. They are thin walled & filled with clear serous fluid secreted from ependymal cells. On imaging it is a 2mm-2cm sized nonenhancing thin-walled cerebro spinal fluid (CSF)-containing cyst of the lateral ventricle.

1.1.4 Neuroglial (glioependymal) cysts
They are benign epithelial-lined lesions that occur anywhere in the neuraxis. Intraparenchymal neuroglial cysts are congenital lesions, arising from embryonic neural tube elements that become sequestered within the developing white matter. They are round, smooth, unilocular & contain clear fluid that resembles CSF. A neuroglial cyst on imaging is a non enhancing CSF-like parenchymal cyst with minimal to no surrounding SI abnormality.

1.1.5 Pineal cysts & cystic degeneration of the pineal gland
They are unilocular , fluid filled masses within the pineal gland. Attenuation or SI varies with cyst content. One-fourth have rim or nodular calcium in the cyst wall on nonenhanced CT (NECT) scans. On T1 weighted images (T1WI), 55%–60% are slightly hyperintense to CSF. Most do not appear hypointense on Fluid attenuation inversion recovery (FLAIR) images, & 60% enhance with use of contrast material.

1.1.6 Dandy–Walker Malformation (DWM)
This encompasses a spectrum of cystic posterior fossa malformations from the complete DWM to persistent Blake's pouch & mega cisterna magna, all of which have in common an apparently focal extra-axial CSF collection which is continuous with the fourth ventricle.
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variable cerebellar hypoplasia. The classical DWM is characterized by cystic dilatation of the fourth ventricle, which almost fills the entire enlarged posterior fossa; the cerebellar vermis is hypoplastic & rotated or aplastic, & the tentorium & venous confluence of the torcula are elevated. At the mildest end of the spectrum, the mega cisterna magna is seen as an incidental finding of doubtful clinical significance & consists of an infracerebellar CSF collection, occasionally with an enlarged posterior fossa but a normal cerebellum & fourth ventricle.

1.2.1 Arachnoid cysts
They are benign, congenital, intraarachnoidal space-occupying lesions that are filled with clear CSF, which do not communicate with the ventricular system. The cysts tend to be unilocular, smoothly marginated expansile lesions that are molded by the surrounding structures. Most are supratentorial, found in the middle cranial fossa, anterior to the temporal lobes. The mechanism for the formation is secondary to splitting of the developing arachnoid. They appear as sharply demarcated, extraaxial cysts that can displace or deform adjacent brain. Scalloping of the adjacent calvarium is often seen. The classic arachnoid cyst has no identifiable internal architecture & does not enhance. The cyst typically has the same signal intensity (SI) as CSF on all sequences.

1.2.2 Colloid cysts
They are benign mucin-containing cysts & most common location is in the foramen of Monro. The cysts are smooth & spherical, with mean size 1.5 cm. They are filled with viscous gelatinous material that consists of mucin, blood degradation products, foamy cells, & cholesterol crystals. The classic colloid cyst appears as a well-delineated hyperattenuated mass on nonenhanced CT scans. On T1WI, two thirds of colloid cysts are hyperintense. The majority are isointense to brain on T2 weighted images (T2WI). Some demonstrate peripheral rim enhancement.

1.2.3 Epidermoid cysts
They are congenital inclusion cysts. The most common location is the cerebellopontine angle cistern. All are located off the midline. On imaging, it is a CSF-like mass that insinuates within cisterns, encasing adjacent nerves & vessels, & they do not enhance. They do not suppress completely on FLAIR images & show restricted diffusion on Diffusion Weighted Images (DWI).

1.2.4 Dermoid cysts
They are congenital ectodermal inclusion cysts that tend to occur in the midline sellar, parasellar, or frontonasal regions & their origin is strictly ectodermal. Unruptured cysts have the same imaging characteristics as fat because they contain liquid cholesterol. They appear hypointense on CT with a negative Hounsfield Unit (HU) between -60 to -170. All are hyperintense on T1WI & do not enhance.

1.2.5 Neurenteric cysts
They are congenital, benign, malformative endodermal lesions in the central nervous system. Most intracranial neurenteric cysts are found in the posterior fossa. On imaging, neurenteric cyst is a round or lobulated, nonenhancing, slightly hyperintense mass in front of the medulla. The SI characteristics vary depending on the protein content of the cysts. Neurenteric cysts are hyperintense on FLAIR images & may show mild restriction on DWI.

1.2.6 Rathke cleft cysts (RCC)
They are congenital nonneoplastic cysts arising from remnants of the embryonic Rathke cleft. They are common incidental intra- &/or suprasellar lesions. On imaging, there is a nonenhancing noncalcified intra- &/or suprasellar cyst with an intracystic nodule. A small nonenhancing intracystic nodule is considered a virtually pathognomonic sign of a RCC. These nodules show high SI on T1WI & low SI on T2WI, & they do not enhance. RCC do not enhance after contrast material administration.

1.3.1 Cystic leucomalacia
Periventricular leucomalacia secondary to infarction, is seen as increased echogenicity on ultrasonography (US). In extreme cases of hypoxic ischemic encephalopathy in preterm neonates, cystic
encephalomalacia may be seen. The damaged tissue undergoes cystic degeneration 10–20 days after the insult. Small, often confluent, cysts form in the periventricular white matter; these are usually transient & subsequently collapse. As the cysts collapse, atrophy of the damaged brain tissue follows with secondary ventricular dilatation.

1.3.2 Porencephalic cysts
They are congenital or acquired cavities within the cerebral hemisphere. Congenital ones originate from a fetal or perinatal encephaloclastic process. Acquired cysts are secondary to injury later in life & are usually secondary to trauma, surgery, ischemia, or infection. They are typically CSF-filled cavities with a smooth wall, & are lined with gliotic or spongiotic white matter. The typical porencephalic cyst is a cystic space in the brain parenchyma that communicates with an enlarged adjacent ventricle. The cysts have the same appearance as CSF on imaging.

CHOROID PLEXUS CYST
Case 1. Antenatal US shows a well defined, round, anechoic choroid plexus cyst surrounded by echogenic choroid plexus.

Case 31. US head shows a well defined, round, anechoic choroid plexus cyst surrounded by right echogenic choroid plexus.

Case 22. Coronal non contrast CT head shows a well defined fluid density lesion in right parietal region which is seen to communicate with right lateral ventricle.

PERIVASCULAR SPACES
Case 13. Axial T2WI of multiple tiny hyperintense PVS in bilateral ganglio capsular region which appear hypointense on coronal FLAIR images.

1.4.1 Brain abscess
Brain abscesses arise by haematogenous dissemination, penetrating trauma or direct spread from contiguous infection. On CT, it appears as an ill-defined low attenuation area & shows thick ring enhancement surrounded by low attenuation vasogenic oedema. On MRI, the signal of the abscess centre is hypointense on T1WI, & hyperintense on T2WI. On T2WI the abscess rim is relatively hypointense with rim enhancement on post contrast T1WI. Surrounding vasogenic oedema is of low signal on T1W & high signal on T2WI. The abscess centre is high signal on diffusion-weighted imaging (DWI) & low signal on maps of apparent diffusion.
coefficient (ADC), because of restricted diffusion in the viscous pus.

1.4.2 Neurocysticercosis (NCC)

It occurs in 60%–90% of all cases of systemic cysticercosis. Most are found in the subarachnoid spaces, typically the basal cisterns & deep within the sulci. Inflammatory reaction provoked by the cyst may cause adhesion of the adjacent gyral surfaces, giving the mistaken impression that the cyst is intraparenchymal. Imaging findings in neurocysticercosis vary with the stage of cyst development. The early vesicular stage is typified by a smooth thin-walled cyst that is CSF-like. A mural nodule is often present that represents the viable larval scolex, the “cyst with a dot” appearance. When cyst degeneration begins (colloidal-vesicular stage) & host inflammatory response ensues, pericystic edema & cyst wall enhancement are present. In the healing, or granular nodular, stage, NECT scans show

**BRAIN ABSCESS**

Case 33. Axial T1WI shows multiple well-defined hypointense lesions in right parietal region, peripheral thin ring enhancement on post contrast T1WI, and which appear hyperintense on T2WI with perilesional edema on FLAIR. The lesions show central RD on DWI with low ADC values.

**an isoattenuated cyst with a calcified scolex & surrounding edema. Nodular or micro-ring enhancement is common at this stage. In the residual stage, small calcified nodules without mass effect & usually without enhancement are seen. Multifocal lesions & lesions in different stages of development are common.**

1.4.3 Intracranial hydatid cysts

They are parasitic infections caused by the larval stage of Echinococcus granulosus. The most common location is the hemispheric parenchyma. It is a single, large, thin-walled, spherical, nonenhancing CSF-attenuation cyst in the parietal region of the brain. Perilesional edema is usually absent. While MR imaging is more sensitive in demonstrating the pericyst, CT is more sensitive in depicting cyst calcification. Multilocular or multiple lesions occur, but are rare.

1.4.4 Cryptococcosis

Cryptococcosis, the most common mycotic infection of the central nervous system, primarily manifests as meningitis. Several reports have described extension of the meningeal infection along perivascular spaces giving rise to small cysts, termed gelatinous pseudocysts, in the PVSs and adjacent basal ganglia. Punctate hyperintensities, representing dilated PVSs or cryptococcomas, are frequently seen in the basal ganglia, thalami, and midbrain on T2WI. Larger gelatinous pseudocysts tend to give a “soap bubble appearance”, with hypointensity on T1WI and FLAIR and hyperintensity on T2WI. Case 30 sagittal T2WI show a small round well-defined hyperintense lesion with hypointense dot within (cyst with dot sign) in the left parietal region. The lesion shows ring enhancement on post contrast sagittal T1WI and perilesional edema on coronal FLAIR images.
1.5.1 Metastatic Cysts
Detection of an intracerebral mass in patients with known malignant tumour strongly suggests the presence of brain metastases. They are multiple in most cases, & the most common sources of intracranial metastases in order of decreasing frequency are carcinomas of the lung, breast, malignant melanoma, carcinomas of the kidney, & carcinomas of the gastrointestinal tract. On MRI, most intracerebral metastases show diminished signal on T1WI & increased signal on T2WI. On T1 post contrast images, lesions show ring enhancement. On NECT, they are difficult to be detected due to their discrete appearance as rounded homogeneously isodense nodules, surrounded by extensive vasogenic oedem.

1.5.2 Pilocytic Astrocytoma
Cerebellar astrocytomas account for 30% of all posterior fossa tumors in children, with the most common histologic subtype being Juvenile Pilocytic Astrocytoma. The classic imaging appearance is of a large cyst with a solid mural nodule. Enhancement patterns may vary, but most commonly appears as a cyst with an enhancing wall & an intensely enhancing mural nodule.

1.5.3 Hemangioblastoma
Hemangioblastomas account for 1–3% of all intracranial neoplasms, & most occur in middle-aged adults. Most common site is in the cerebellum, & 25–40% are associated with Von Hippel Lindau (VHL) syndrome. Hemangioblastomas may present as a enhancing mural nodule within a large cyst cavity (45%) or a purely solid enhancing tumor (45%). The cyst wall most commonly does not enhance unless lined by neoplasm. Large feeding & draining vessels in the periphery & within the solid component appear as tubular flow voids on T2WI.

CRYPTOCOCCAL CYSTS
Case.38 Multiple tiny well defined lesions in bilateral gangliocapsular region, which appear hyperintense on T2WI, hypointense on T1WI and bright on FLAIR.

CYSTIC BRAIN METASTASES
CASE 23. Axial post contrast T1WI shows a well defined hypointense lesion with thin ring enhancement. The lesion appears bright on T2WI and dark on FLAIR with minimal perilesional edema, and does not show RD on DWI.
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mural nodule with secondary cystic changes within. Sagittal post contrast image shows enhancement of the mural nodule with hypointense cyst and mild enhancement of the cyst wall.

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