Mobile sediment of CaCO$_3$ grains inside the cyst of an intraventricular teratoma

Case report

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The case of a 40-year-old woman with a mature cystic teratoma in the lateral ventricle is reported. An unusual mobile sediment of radiopaque material in the cyst was identified as grains of calcium carbonate. It was considered to have precipitated from the cystic fluid under specific chemical conditions.

Key Words • calcium carbonate • intraventricular teratoma • cystic tumor

Fluctuating radiolucent fat-fluid levels have been reported in intracranial cystic tumor or in the ventricle on plain skull films in several cases of epidermoid and dermoid tumors and teratoma.$^{1,2,4}$ To our knowledge there has been no previous report of an intracranial tumor presenting with mobile radiopaque material in the cystic fluid. We report here the first case of a mature cystic teratoma showing mobile radiopaque material in the cyst on plain skull films. The material gravitated downward with change in the position of the patient's head. The radiopaque substance was identified as grains of calcium carbonate (CaCO$_3$). A proposed mechanism of formation of these grains is discussed.

Case Report

This 40-year-old woman presented with a 2-week history of progressively worsening headache and vomiting. She had undergone radical mastectomy for breast cancer on the right side 2 months previously. There was no history of intracranial illness or surgery.

Examination. The general examination disclosed nothing abnormal other than the operative scar on the chest. Neurological examination revealed right homonymous hemianopsia, anisocoria (right > left), and papilledema. Routine laboratory studies, including the serum calcium level, were normal. Some biochemical tumor markers in the serum were measured; alphafetoprotein (AFP) and human chorionic gonadotropin (HCG) were within normal limits, while the carcinoembryonic antigen level (CEA) was high (15.9 ng/ml). Plain lateral skull films showed two areas of radiopaque fluid material and two high-density spots. With changes in the patient's head position, the radiopaque material gravitated downward (Fig. 1). A computerized tomography (CT) scan demonstrated a cystic mass, 7 cm in diameter, in the left trigone of the lateral ventricle. In the wall of the cyst an area of fat density and two spots of very high density were seen. There was little enhancement of the cyst wall on the CT scans after infusion of contrast medium (Fig. 2). The cyst mass was pendulous in the enlarged ventricle and contained high-density material that settled to the bottom of the cyst as the patient's head position was changed. On magnetic resonance imaging the sediment showed a signal-void area, suggesting calcium or another mineral. Cerebral angiography revealed an avascular mass and a small aneurysm arising from the origin of the pericallosal artery, with an azygous anterior cerebral artery.

Operation. Following a diagnosis of teratoma, surgery was performed on May 11, 1992, and the tumor was totally removed via a parietal craniotomy. A yellowish cystic tumor, composed in part of lipoma and containing fine hairs, was found in the left trigone of the lateral ventricle. The cyst was punctured and 30 ml of milky white fluid was aspirated. On inspection of the cyst a group of small round particles was found at
Mobile CaCO₃ grains in intraventricular teratoma

Fig. 1. Plain skull films obtained with the patient’s head in different positions showing two mobile sediment-fluid levels (arrows) and two calcified spots (arrowheads). The radiopaque material-fluid level gravitates downward with changes in the patient’s position.

Fig. 2. Preoperative computerized tomography (CT) scans. A: Plain CT scan showing a cystic mass in the left trigone of the lateral ventricle, with a high-density fluid at the bottom. B: The wall of the cyst shows slight enhancement after infusion of contrast medium; it contains a fat-density area anterolaterally.

the bottom, admixed in uniform fashion in the white fluid (Fig. 3A).

Postoperative Course. The patient suffered transient weakness of the lower right extremity and underwent a second operation for clipping of the aneurysmal neck on June 15, 1992. She made an uneventful recovery. The serum CEA level became normal postoperatively and she was discharged soon after the second surgery.

Pathological Examination. Microscopically, the sediment from the cyst consisted of small oval grains and larger round ones (Fig. 3B). In general, calculus composed of CaCO₃ is morphologically oval or round. Both grain shapes were identified as being composed of CaCO₃ by analysis with a double-beam recording infrared spectrophotometer.* Chemical study of the aspirated fluid showed a pH of 8, a calcium level of 8.2 mg/dl, AFP and HCG levels within normal limits and a remarkably high CEA level (10,066.1 ng/ml).

Histological features of the cyst specimen included stratified squamous epithelium resembling oral mucosa, glandular structures resembling salivary gland, ciliated epithelium with goblet cells resembling bronchial mucosa, cartilage, bone with marrow tissue, and mature fat cells. Although a few small irregularly formed calcifications were found in a selected cyst wall, uniformly round or oval calcifications seen on microscopic examination of the sediment from the cyst were not observed in or on the cyst wall. Histologically, the tumor was diagnosed as a mature teratoma (Fig. 4).

Discussion

Teratomas are the most common neoplasms among neonatal intracranial tumors, comprising more than one-third of all tumors. They frequently occur in the frontal lobe and lateral ventricle in this age group. However, teratomas are uncommon in adults and those originating in the lateral ventricle are extremely rare.**

On radiological examination of intracranial teratomas, radiopaque regions on plain skull films usually suggest calcifications, teeth, and bones. In our case, plain skull films showed not only two heavily dense calcifications, suggestive of teeth, or bones, but also two radiopaque material-fluid levels which moved to-
Fig. 3. A: Operative photograph showing numerous round particles at the bottom of the cyst. They appear to be transparent in the milky white fluid. B: Photomicrograph of the sediment showing large round grains and small oval ones. The larger grains correspond to the transparent particles in A. × 30.

Fig. 4. Photomicrographs of the tumor, diagnosed as a mature teratoma. A: Glandular structures resembling salivary gland and cartilage are shown. H & E, × 100. B: A few small irregularly formed calcifications are seen on the cyst wall (arrow). H & E, × 100.

ward the bottom of the cyst with changes in the position of the patient’s head. This radiographic image is unique and as far as we know has not been reported previously.

What was the mobile sediment in the cyst? At operation the cyst was entered and found to contain a milky white fluid with numerous small round particles at the bottom. Microscopic examination of this sediment disclosed two kinds of grains, small oval and larger round ones, which must have been the mobile radiopaque material seen on radioimaging.

By what mechanism were these grains formed in the cyst? Three different mechanisms are possible: 1) intracystic exfoliation of calcifications formed in the cyst wall; 2) intracystic extravasation of stones formed in the duct of teratomatous organs which may create calculi; or 3) precipitation from the cystic fluid under specific chemical conditions. In the present case, there were too few histological calcifications in or on the cyst wall to be deposited in the cystic fluid. Furthermore, there was almost no calculus in or around the glandular structures (salivary and other glands may pathologically manufacture calculi). Thus it is less likely that the grains were formed by the first or second mechanism.

Because calcium carbonate is a weak base salt, it is apt to precipitate easily under alkaline conditions, in the following chemical reaction:

\[ \text{Ca(HCO}_3\text{)}_2 \rightleftharpoons \text{CaCO}_3\downarrow + \text{H}_2\text{O} + \text{CO}_2. \]

A chemical analysis of the cystic fluid taken at operation showed a pH of 8 and a calcium content of 8.2 mg/dl. The pH of the cystic fluid was alkaline and the grains in the cyst were relatively uniform, so we propose that the grains were formed by precipitation from the cystic fluid under the specific chemical conditions mentioned above.
Mobile CaCO₃ grains in intraventricular teratoma

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References


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