GLIOMAS INVOLVING THE SPLENIUM OF THE CORPUS CALLOSUM
A ROENTGENOLOGIC STUDY
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According to Ostertag, gliomas of the splenium, like other gliomas of the corpus callosum, originate in the region of the superomedial angle of the lateral ventricle. Further growth of the lesion is either systematized or irregular. Systematized growth takes place along the fibers of the corpus callosum, commissura hippocampi and fornix, which may become markedly thickened. Early infiltration of the cingular gyri appears to be the rule. Unsystematized growth may involve the thalamus, the caudate nucleus and the choroid plexus of the lateral ventricles. Sooner or later the lesions may infiltrate most of the posterior portion of both cerebral hemispheres, tumefaction of the splenium being a common property of the entire group.

The roentgenologic features are largely determined by the systematized spread of the neoplasm which, following injection of air into the ventricles or subarachnoid fluid spaces, may permit visualization of characteristically altered parts of their ventricular surfaces.

CASE REPORTS


Following air injection into the atrium of the right lateral ventricle the lateral views showed a downward displacement of the pineal body, but were otherwise non-contributory, as was the AP view.

The PA view (Fig. 1) showed the basolateral segment of the posterior portion of the right lateral ventricle only, its superomedial portion being absent. The shadow of the ventricle appeared to be displaced to the right of the median plane, and to be bounded medially by a vertical line. Due to the rotation of the head, which favoured

Fig. 1. Case 1. PA view.
the right side of the skull, the degree of displacement was not fully reflected by this view. For the same reason, the pineal shadow, although displaced to the right, appeared to lie in the median plane. A soft tissue mass, possibly representing the proximal portion of the hippocampus, seemed to protrude into the lower medial portion of the ventricle. On the whole, the image of the ventricle appeared to be enlarged in spite of the absence of its superomedial portion.

At operation, a glioma occupying the depth of the left parietal lobe was found. Autopsy revealed spread of the lesion into the opposite hemisphere through the splenium of the corpus callosum.

Comment. The air outlined only that part of the neoplasm that had extended from the left into the right hemisphere but gave no direct informa-

![Figs. 2 and 3. Case 2. Lateral and PA views.](image)

tion as to the location of the lesion in the former. However, the seemingly unsatisfactory ventriculogram confirmed and amplified the clinical diagnosis, as the roentgenologic findings suggested the presence of a tumor of the left occipitoparietal lobe which infiltrated the posterior portion of the corpus callosum and displaced the pineal body downward. Failure of the air to enter the third and the lateral ventricle opposite the site of air injection was attributed to marked swelling of the brain, which narrowed the interventricular foramen.

Case. 2. Large glioma of splenium involving both parietal and occipital lobes. Downward and forward displacement of pineal body. Unsuccessful ventriculography, followed by lumbar air injection. Filling defect on medial side of vestibule of both lateral ventricles.

Cannulation of the brain on the left on attempted posterior parietal ventriculography yielded a few cc. of grossly hemorrhagic CSF. Lumbar encephalography was performed a few days later.

The AP views showed a slight symmetrical dilatation of both frontal horns and the ascending portions of the bodies of both lateral ventricles.
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Right lateral stereos taken in the recumbent position (Fig. 2) showed, in addition to the enlargement of both anterior horns: (a) sharp depression of the descending portion of the body and the vestibules of the lateral ventricles, more so on the left; (b) slight dilatation of the temporal horns; (c) depression and forward displacement of the pineal gland, which appeared to be projected upon the junction of the temporal horn and the vestibule of the lateral ventricle; and (d) depression of the posterior portion of the roof of the flattened 3rd ventricle. The aqueduct and the floor of the 4th ventricle formed an obtuse angle rather than a curve. A number of elongated shadows converging toward the left vestibule evidently represented needle tracts filled with air.

Lateral views taken in the erect position showed the posterior portion of the 3rd ventricle and the pineal gland to be depressed.

The PA view (Fig. 3) revealed a separation of the posterior portion of the left lateral ventricle by a soft tissue mass, apparently extending into the left vestibule from its medial wall. Above the mass, the previously described composite shadow corresponding to the multiple needle tracts could be seen. The inward and downward slant of the roofs of the lateral ventricles appeared to be increased.

The 4th ventricle appeared to be dilated in both lateral and PA views.

The diagnosis of a bilateral tumor occupying the depth of both parietal lobes was made. It was assumed that the lesions were hemorrhagic and friable, possibly metastatic in character, and that the cannulation of the brain on attempted ventriculography had established a communication between the left lateral ventricle and the interior of the lesion, which became visible following encephalography.

Autopsy of the Brain. There was a moderate degree of arteriosclerosis of the blood vessels at the base of the brain. Both hemispheres were flabby and the convolutions slightly flattened. Palpation revealed an area of definitely decreased resistance occupying the right upper parietal region.

There was evidence of a mild bilateral pressure cone in both the region of the uncus and the cerebellar tonsils. On sectioning the brain an enormous tumor was found involving the posteromedial portion of both hemispheres (Fig. 4). It extended from about the beginning of the crura of the fornix backward to replace the white matter almost completely, and to undermine the gray matter. The tumor was hemorrhagic and the needle tracts, done on attempted ventriculography, and corresponding to the converging shadows visible on the ventriculograms, could be clearly identified in the disintegrated tumor tissue close to the atrium of the left lateral ventricle. The anterior horns of the lateral ventricles were moderately and symmetrically dilated, their bodies narrow and their posterior horns reduced to slit-like cavities.
Histologic examination proved the lesion to be a typical spongioblastoma multiforme.

Comment. Except for the fact that the posterior portion of the body of the lateral ventricle was invisible in Case 1, the images of the lateral ventricles in both cases were quite similar, because (a) the medial border of the shadow representing the posterior portion of the lateral ventricle was displaced away from the midline; and (b) the normal wing-like form of the ventricular image was converted into a triangle.

Case 3. Large glioma replacing splenium of corpus callosum, and extending into both occipitoparietal lobes. Frontal ventriculography. Downward displacement of pineal shadow. Widening of shadow of splenium of corpus callosum in transverse diameter.

AP views revealed a mild symmetrical dilatation of both anterior horns and the adjacent portions of the body of the lateral ventricles. The PA view (Fig. 5) showed

![Fig. 5. Case 3. PA view.](image1)

![Fig. 6. Cramer's Case 6, for comparison with Fig. 5.](image2)

the posterior portions of both lateral ventricles, the 3rd ventricle, and part of the body of the left lateral ventricle. A soft tissue mass which occupied the region of the midline could be seen to protrude into both the right and the left vestibule. Due to the superimposition of air present in the body of the left lateral ventricle, the mass could be more clearly visualized on the right. On close inspection some air appeared to be present in the body of the right lateral ventricle, too, but this part of the ventricular system did not contain enough gas to obscure the image of the intraventricular protrusion of the neoplasm.

The 3rd ventricle was in the midline and there was no lateral displacement of the pineal body. The 4th ventricle, as seen in one of the lateral views, was normal.

The pineal gland, as seen in lateral views, was shifted downward and forward, although to a lesser degree than in Case 2.

A preoperative diagnosis of a tumor of the splenium extending into the right parietal lobe was made. At operation, the atrium of the right lateral ventricle was
opened, and the wall of the ventricle found to be pathologically altered. No tumor tissue was removed.

**Autopsy of the Brain.** The choroid plexuses of the lateral ventricles were displaced laterally by a soft fleshy pinkish-white tumor mass which incorporated the entire splenium of the corpus callosum, more so on the right. The neoplasm extended into the frontoparietal region and as far caudad as the parieto-occipital junction.

On microscopic examination the tumor showed the structure of a highly cellular glioma.

**Comment.** Since the superomedial portion of the shadows on either side of the midline (representing the posterior portion of the body of the lateral ventricle on either side) were inconspicuous as compared to the shadows of the inferolateral portion, the images of the posterior parts of the lateral ventricles appeared, for all practical purposes, to be represented by the prominent shadows only. The distance between the two vestibules, as seen in PA views, was markedly increased.

**DISCUSSION**

I. **The Mechanism of Ventricular Distortion in Gliomas of the Splenium of the Corpus Callosum.** As mentioned in the introduction, systematized spread of the lesions under consideration takes place by infiltration of the forceps posterior on either side. The portion of the posterior forceps which sweeps backwards along the medial wall of the atrium and the posterior horn, narrowing its cavity, is known as bulbus cornu posterioris. Studies of coronal sections show that spread of the glioma into the adjacent calcar avis is a very frequent occurrence and that the entire medial wall of both the atrium and the posterior horn is infiltrated. The cavity of the ventricle in the involved region is therefore narrowed (Figs. 4 and 6). If the films are taken in the brow-down position the laterally protruding walls indicating the abnormal separation of the posterior portions of both lateral ventricles are outlined by air. The medial boundary of the narrowed ventricle appears to be altered on account of its vertical course, as in Case 1 or its oblique course, as in Cases 2 and 3. The hydrocephalus of both the anterior and temporal horns is due to narrowing of the foramina of Monro, incident either to edema of the hemispheres, neoplastic infiltration of the fornices or both. If the lesion extends forward toward the midportion of the corpus callosum, the inward and downward slant of the roof of the descending portion of the lateral ventricle appears to be greatly increased, as in Case 2.

II. **Differential Diagnosis.** (1) Pinealomas give rise to a separation of the ventricular shadows similar to that seen in gliomas of the splenium but produce a more marked hydrocephalus, including the front end of the third ventricle, whose caudal extremity is indented by the neoplasm. The roof of the fourth ventricle, if visible, is displaced downward.

(2) Meningiomas of the falx arising in the region of its junction with the tentorium cause depression of the roofs of both lateral ventricles which, however, do not appear to be separated as seen in PA views.
(3) The tip of the superior vermis of the cerebellum lies but a short distance from the lower surface of the splenium of the corpus callosum. Tumors of the superior vermis may produce a pressure cone extending from the infratentorial into the supratentorial space, and a forward shift of the midbrain, which encroaches upon the third ventricle from below and backward. The comma-shaped outline of the third ventricle resulting from this pressure, and the increased distance between the posterior elongated extremity of the third ventricle and the temporal horn are characteristic of this type of lesion. The mechanism of ventricular distortion in tumors of the superior vermis was clarified by Vincent and Le Beau.⁴

(4) Deep lying gliomas of the inferior parietal lobule approaching the splenium cause a marked midline shift, flattening of the entire wing-shaped image of the lateral ventricle as seen in PA views, or indentation of its superolateral wall.⁵

(5) Deep lying gliomas of the occipital lobe approaching the splenium of the corpus callosum produce kinking of the ascending toward the descending portion of the lateral ventricle as seen in lateral views, and marked forward shift on the involved side.

(6) Gliomas of the midportion of the corpus callosum protrude into the ventricle from the junction of the ascending and descending portion of its body.² Due to replacement of a large part of the body of the ventricular cavity by a tumor mass, its image may appear to be faint on both AP and PA views, but the separation of the lateral ventricles in PA views is absent.

(7) Poor filling of both lateral ventricles may give the impression of an apparent separation of the images as seen in PA views. However, the size and shape of the posterior horns is quite different from that of the narrowed ventricles, and there are, of course, no changes in the region of the posterior portion of the third ventricle.

CONCLUDING REMARKS

While it appears that the lesions under consideration can be more readily diagnosed by air studies than by clinical methods, the x-ray films do not necessarily tell the whole story. It is true that the location of the lesion is disclosed by its systematized spread as mentioned above, but the irregular spread into caudate nucleus and thalamus may well escape detection. A marked midline shift indicates infiltration by the neoplasm of the opposite hemisphere, as in Case 1. Gliomas of the splenium are no exception to the rule that pathologically altered cerebrospinal fluid spaces made visible by air injection, permit the identification of what may be termed the roentgenologically active part of the lesion but do not preclude the extension of the tumor into adjacent parts of the brain.

The size and extent of gliomas of the splenium, the majority of which are quite vascular, could probably be more accurately determined by bilateral angiography provided both posterior cerebral arteries can be filled. Widening of the arch of the great vein of Galen, or local compression of this
vessel, described by Moniz, may be important diagnostic clues. Displacement of the calcified glomus of the choroid plexus due to encroachment by the enlarged splenium is probably a rare occurrence.

In association with other findings the downward and forward displacement of the pineal body may be a danger signal indicating the presence of vulnerable gliomatous tissue in the posterior portion of the cerebral hemispheres, and should discourage posterior ventriculography by the posterior route.

**SUMMARY**

1) Roentgenologically, gliomas of the splenium of the corpus callosum appear to be characterized by downward and forward displacement of the shadow of the pineal gland and, following air injection, widening of the distance between the shadows representing the medial walls of the vestibule of the lateral ventricles. The adjacent part of the roof of the lateral ventricles may be sharply depressed on either side of the median plane.

2) The differential diagnosis of the lesions under consideration is discussed.

**REFERENCES**