COARCTATION OF THE WALLS OF THE LATERAL ANGLES OF THE LATERAL CEREBRAL VENTRICLES

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For many years my late colleague, Cornelius Dyke, and I have been intrigued by the asymmetrical appearance of the lateral ventricles of the brain in the anteroposterior encephalograms in a considerable number of cases (Fig. 1). The ventricles in these instances were usually normal in size and position, and no explanation in the clinical picture existed to account for the asymmetry. We decided, therefore, to watch the appearance of the corresponding portions of the ventricles in postmortem specimens, through the cooperation of Dr. Abner Wolf. Before anything could be done, Dr. Dyke's untimely death occurred, and the present writer undertook to make the investigation at the Jewish Hospital of Brooklyn. With the cooperation of Dr. Bernard Epstein of the Radiographic Department and Drs. Max Lederer and David Grayzel of the Pathological Department of that institution, about 64 brains, taken routinely from cases without brain tumor, and usually without any other known neurological disease, were studied.

MATERIAL AND METHOD

The brains were removed fresh and suspended in a 4 per cent formaldehyde solution in ample crockery jars, by passing a string through the basilar artery and tying the string to the lid, in order to avoid flattening or other distortion of the specimens. After a week of suspension, the specimens were removed and the fluid was allowed to drain off, after which anteroposterior roentgenograms were taken of the specimens. In many instances reasonably good pneumoventriculograms were obtained in this way. The brains were then sectioned coronally and the ventricles examined. Where asymmetry was found, sections were made for histological examination from the site where any abnormality was seen.

For the sake of objectivity, the roentgenographic and pathological studies were conducted quite independently. The result has been, however, that some of the specimens with positive roentgen evidence, if the brains were sectioned in the absence of the author, were not carefully observed, and contrariwise, some of the specimens that showed asymmetry of the ventricles on section had not had preliminary roentgen studies. Moreover, a number of the roentgen examinations were unsatisfactory in that the ventricles were inadequately visualized.

We thus ended up by having 6 cases with asymmetry of the ventricles as seen on the postmortem pneumoventriculograms, 10 cases in which devia-
tions of a similar nature were seen in the brain specimens on coronal sections; and 4 cases in which both positive roentgenographic changes and demonstrable, corresponding pathological changes were evident.

RESULTS

The Roentgenograms. The reason leading to this study was the observation that in certain clinical cases in which pneumoencephalography is done for various reasons, such as epilepsy or post-traumatic headache, the roentgenograms reveal an asymmetry of the two lateral ventricles. This consists of a

normal looking “butterfly wing” pattern of the ventricle on one side, and a truncated one on the other side (Fig. 1). Since, usually, the “normal” side is normal also in size, the asymmetry obviously could not be explained on the basis of unilateral dilatation of this side, and the obvious conclusion had to be reached that the smaller ventricle was the anomalous one. The possible causes for this appearance we believed could be: (1) inadequate filling of the ventricle with gas; (2) a filling defect produced by a tumor mass; (3) adhesions resulting from a healed inflammatory process; or (4) a congenital anomaly.
Fig. 2. Anteroposterior pneumoventriculogram of a postmortem brain specimen showing a truncated lateral angle of right lateral ventricle similar to Fig. 1.

Fig. 3. Section of brain showing coarctation of lateral angle of one lateral ventricle (arrow) resulting in appearance similar to Figs. 1 and 2.
COARCTATION OF CEREBRAL VENTRICULAR WALLS

To test the first possibility, the encephalograms in which the above deviation was noted were examined carefully in lateral, anteroposterior and posteroanterior views taken with the patient both in the horizontal and vertical positions. The asymmetry was always found in all positions, thus excluding the possibility of inadequate filling with gas as being responsible for the encephalographic appearance.

The second consideration, that a tumor may be present, was ruled out clinically by the absence of tumor symptoms and signs, and roentgenologically by the absence of displacement of the ventricular system as a whole.

The possibility that infection may have caused adhesions at these sites seemed unlikely in the absence of histories of meningitis, syphilis or diseases
of the nervous system that could be interpreted as infection by viruses.

This left the fourth explanation, namely, a congenital deformity, as the most likely one, but still unconfirmed. Confirmation was forthcoming, however, in that encephaloroentgenograms from patients dying from causes other than neurological, and, if neurological, other than brain tumors, became available. These showed changes in some of the cases analogous to those seen in some of the clinical pneumoencephalograms and led to the logical conclusion that they may be due to similar causes (Fig. 2).

The Gross Anatomy. As already stated, 10 brain specimens, out of a series of 64 cases, showed asymmetrical developments of the two lateral ventricles, which on cross section presented an appearance closely resembling the encephalographic picture (Fig. 3). On close inspection there appears to be a coarctation of the adjacent walls of the lateral ventricles on the side of the smaller ventricle. In some of the specimens,

Fig. 5. Section of brain from a patient with moderate dilatation of the ventricular system showing an area of coarctation similar to that of Fig. 4 in which the adhesion was stretched out.
the adhesions were incomplete so that beyond the truncated end of the ventricle and the site of adhesion was a small cavity—evidently the most peripheral portion of lateral ventricle cut off by the adhesion from the main cavity (Fig. 4). In some cases in which there existed any degree of dilatation of the ventricle, at least on the side of the coarctation, the appearance just described changed to an elongation of the adhesion into a pillar or column within the cavity of the ventricle (Fig. 5).

Microscopic Appearance. Under the microscope, the site of coarctation is characterized by an elongation of ependymal cells between the corpus callosum and the head of the caudate nucleus (Fig. 6). These seem to show no degenerative changes or any tendency to cellular proliferation. In the cases in which the adhesions occur before the terminal extent of the ventricle is reached, thus leaving a portion of the ventricle cut off by the adhesion, this cut-off portion forms what looks like an ependymal cell-lined cyst, but is probably a pocket with an outlet communicating with the general ventricular cavity (Figs. 7 and 8).

No evidence of inflammatory reaction, gliosis or fibrosis was found in any of the sections examined.

DISCUSSION

In discussing this problem with Dr. Abner Wolf, who first began to watch the routine postmortem brains for these lesions, he was found to be under the impression that they occur most commonly in people who died of cardiovascular-renal disease and are rarely seen in children. He wondered whether
cerebral edema in these cases may not cause an approximation of the ventricular walls and, in certain instances, adhesions at these sites. However, it is not seen commonly in cases of brain tumor in which the ventricle on the side of the tumor is often completely collapsed. Moreover, as we have seen in several of our specimens (Fig. 5), when dilatation of the ventricles exists the site of adhesion becomes elongated, indicating preexisting coarctation.

Finally, embryologically the lateral cerebral ventricles, which begin as rounded cavities, take on their mature shape as the basal ganglia on the floor and the fibres of the corpus callosum on the roof, develop. It is easily conceivable that the angle between these structures may form at a certain stage of development and be further sharpened as development continues to the point where occasionally coarctation of the walls takes place.

SUMMARY AND CONCLUSIONS

A certain form of asymmetry of the lateral ventricles on the pneumoencephalograms, especially in the anteroposterior views, was investigated. It was found to correspond to an area of coarctation of the ventricular walls usually at or near the extreme lateral angle of one ventricle. This was believed to take place during the developmental period of the brain.