VENTRICULOGRAPHIC DIAGNOSIS OF CYSTICERCOSIS OF THE POSTERIOR FOSSA

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Cysticercosis is a result of the encystment of the larvae of Taenia solium or Taenia saginata in the tissues of different kinds of animals. Usually man harbors the adult taenia, but under certain conditions he may become the intermediary host, harboring the larvae.

Taenia saginata is as common as Taenia solium. The predominance of one or the other type of parasite in human infestations is related chiefly to the kind of food ingested. Thus there is a higher rate of infestation by Taenia solium in Germany where pork is eaten mainly, and by Taenia saginata in those countries where beef is the common meat. In Chile there are more Taenia saginata cases in the cities, whereas Taenia solium cases are more frequent among the rural population. Nevertheless, Cysticercus bovis is extremely rare and there is doubt that it has ever been observed in man. The literature records only one case. Actually, then, human cysticercosis may be said to be due exclusively to Taenia solium.

The life cycle of the parasite is well known. It is granted that once embryonic eggs reach the stomach through ingestion of contaminated food or drink, auto-infection through dirty hands, or possibly regurgitation in an individual harboring an adult taenia, these are digested and the embryo, being freed, proceeds to bore its way through the intestinal wall and thus enters the portal or the lymphatic system, thence reaching the general circulation.

Although it is not the purpose of our work, let us point out some interesting facts. Cysticercus cellulosae shows a great preference for the central nervous system and its coverings. Its hepatic or pulmonary localization is rare. On the other hand, the hydatid, which enters the circulation in the same way, localizes itself usually in the liver and frequently in pulmonary tissues. It is rarely found in the nervous system.

Two observations throw some light on this question of preferences for certain tissues. (1) We have observed cysticerci of the nervous system associated with localizations in the skin. The subcutaneous cysticerci were small and appeared and disappeared in from 15 to 25 days. Death of the larva was confirmed by histological examination. (2) In the brain itself we have

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been able to observe, especially in cases where the fourth ventricle and posterior fossa were involved, numerous dead cysticerci whose destruction was histologically confirmed.

This has led us to think that the human organism may produce special substances that destroy the cysticerci. It is conceivable that the amount of these substances might vary in different tissues, thus explaining the more frequent invasion of the eye and brain. This possibility is being investigated at the Institute.

LOCALIZATION OF CYSTICERCII

A brief historical résumé may be given. Trelles and Lazarte\textsuperscript{11} cite Dressel (1877) who found that in 87 cases of cysticercosis the brain was affected in 72 (82 per cent); Stiles (1906) who in 155 cases found cysticerci in the brain in 117 (75 per cent); and Vosgien (1911) who reported that in 807 cases the brain was affected in 330 (40 per cent). The highest percentage of the figures above, therefore, correspond to localization in the central nervous system.

Krause\textsuperscript{7} reported that Küchenmeister in 88 cases of brain cysticercosis found the meninges involved in 49, the cortex in 59, and the ventricles in 18. When the ventricular system was invaded the fourth ventricle was most often affected. Only in 19 cases were cysticerci seen deep in the white matter.

Localization in the ventricles is very frequent. Sato,\textsuperscript{10} for instance, in 128 cases of brain cysticercosis found 48 examples (38 per cent), 22 of which were cysts of the fourth ventricle.

At the Instituto Central de Neurocirugía we have had, during a period of three and a half years, 25 cases of brain cysticercosis in a total of 202 intracranial tumours. This gives an idea of the practical importance of this condition. As will be shown later, the percentage of localization in the posterior fossa is very high.

DIAGNOSIS OF CYSTICERCOSIS OF THE BRAIN

The purpose of this paper is to throw some light on the diagnosis of this important medical problem. The diagnosis of cysticercosis is difficult. The clinical picture is variable and obscure. Trelles and Lazarte,\textsuperscript{11} Henneberg\textsuperscript{6} and Lopez Albo\textsuperscript{8} have given excellent descriptions. In spite of their complexity, the signs and symptoms found constitute one of the bases of the diagnosis. Certain biological procedures yield valuable data in cysticercosis of the brain but in most instances they are of little use in arriving at the correct diagnosis. Recent publications mention this problem and Hare\textsuperscript{5} says: “Pre-mortem diagnosis is often difficult; the condition may be revealed only at autopsy.” This is quite explainable because of the scarcity of this affection in the United States.

The X-ray has been useful. All the publications that we have been able to consult, when referring to X-ray diagnosis, take into account the images formed by the calcified cysticerci. Thus Henneberg describes small clear images, numerous, rounded and homogeneous. The tumours, he states, if
calcified appear more granulated with less clearly defined contours. Brailsford,\(^1\) in an article on the diagnosis of Cysticercus cellulosae in the muscles and in the central nervous system, refers only to this type of picture. Calcification is, therefore, the only possible means of revealing the cysticercus in simple X-ray plates. It is interesting to recall that, according to Dixon and Smithers,\(^2\) in 71 cases of intracerebral cysticercosis the cysticerci calcification in the brain was found only three times by X-ray.

As to ventriculography, the literature is poorer. We have at our disposal only isolated reports of ventriculographic interpretations. One is the case of Heymann, whose ventriculograms were reproduced in Henneberg’s work.\(^6\) Another is that of Grana and Schenone\(^4\) in which the authors describe a suspicious image of the third ventricle and of the right occipital horn. Fracassi, Babbini and associates\(^3\) present a careful encephalographic study but refer only to its localizing values; the same is true of the report by Ray in 1941.\(^9\) All ventriculograms published relate exclusively to supratentorial localizations. Usually supratentorial cysticercosis is intraparenchymal (encysted). This is not true of cysticercosis of the posterior fossa cisternae, where racemose clusters (‘‘bunches of grapes’’) are found.

In our experience localization in the ventricular cavities and cisternae of the infratentorial region is much more frequent. In 25 cases of brain cysticercosis, we have been able to study 92 series of ventriculograms (representing 20 ventriculographies and 2 encephalographies). There were 20 cases of infratentorial cysticercosis: in 13 the predominant localization was in the posterior fossa and in 7 there was a single cysticercosis of the fourth ventricle. All were verified either surgically or by autopsy. The results of the ventriculographic studies in each group are given in the following case reports.

**VENTRICULOGRAPHY IN CYSTICERCOSIS OF THE POSTERIOR FOSSA**

(Thirteen Cases)


Ventriculogram: Dilated ventricular system. Aqueduct of Sylvius is visible only for an extent of about ½ cm. from its opening in the third ventricle. Good filling of the fourth ventricle, at least in its upper part. There is also air in the posterior fossa, as can be clearly seen in Figs. 1 and 2. The rest of the plates show no displacement of the aqueduct.


Discharge: Nov. 12, 1940. The patient died in January 1941 at home.


Ventriculogram: Marked dilatation of the ventricular system. Aqueduct of Sylvius and fourth ventricle are not visible. Good filling of the posterior fossa.

Death Aug. 4, 1941. Autopsy: Hydrocephalus; racemose cysticercosis.

Case 3. R.H.S., female, aged 45. Admission: Aug. 15, 1941. For 11 years, vertigo, tinnitus and diminution of visual acuity. For 5 years, vomiting. For 3 years, headache. Left eye: optic atrophy; right eye: choked disc.

Ventriculogram: Picture similar to Cases 1 and 2 with air passage to the posterior fossa and poor visualization of the aqueduct.


Discharge: Oct. 21, 1941.

Figs. 1 and 2. Case 1. Ventriculograms showing good filling of the fourth ventricle. No displacement of the aqueduct.


Ventriculogram: Ventricular system greatly dilated. Enlargement of the aqueduct and fourth ventricle. Good filling of the posterior fossa.


Death Nov. 13, 1941. Autopsy: Hydrocephalus and racemose cysticercosis of the posterior fossa.


Ventriculogram: Aqueduct of Sylvius occupied by air in its initial portion. After a tract of 2 cm. its shadow becomes invisible. Plenty of air in the posterior fossa.


Racemose cysticercosis.


Ventriculogram: Bilateral and symmetrical enlargement of the lateral ventricles. Aqueduct of Sylvius obstructed. Fourth ventricle is visible. Good filling of the posterior fossa.


Discharge: Feb. 15, 1942.
CYSTICERCOSIS OF THE POSTERIOR FOSSA


Ventriculogram: Great and symmetrical dilatation of the lateral ventricles with enlargement of the third ventricle and the aqueduct. Fourth ventricle cannot be seen and there is no air in the posterior fossa.


Death April 17, 1942. Autopsy: Hydrocephalus; racemose cysticercosis.


Ventriculogram: Outlet of the aqueduct of Sylvius perfectly visible with embossment-like deformities, gradually enlarging to form the fourth ventricle.

Air in the posterior fossa which is more plainly visible in position 7 of Lysholm. In position 3 of Lysholm there is a shadow in the pia-arachnoidal space that suggests an arachnoidal cysticercosis process. This image can be seen in the simple X-ray plate.


Discharge: June 29, 1942.


Ventriculogram: Ventricular system grossly dilated. Aqueduct of Sylvius is clearly visible, but not the fourth ventricle. There is air in the posterior fossa.


Ventriculogram: General enlargement of the ventricular system maintaining its normal position. Aqueduct is visible at its opening in the third ventricle. After a tract of 1 1/2 cm. it vanishes, due probably to a partial obstruction, since there is plenty of air in the posterior fossa.

Discharge: May 20, 1943.

Case 11. R.L.C., male, aged 42. Admission: June 21, 1943. Progressive disorders for 6 years with headache, vomiting, slow cerebration, dizziness, trembling, and failing of the visual acuity. No choked disc.

Ventriculogram: Great dilatation of the ventricular cavities. Aqueduct is visible to 1 cm. from its outlet. There are air bubbles in a zone corresponding to the fourth ventricle. Poor filling of the posterior fossa.


Ventriculogram: Bilateral and symmetrical enlargement of the lateral ventricles and dilatation of the third ventricle and aqueduct. The fourth ventricle appears dilated. There is plenty of air in the posterior fossa.


Patient discharged Jan. 14, 1944 in very good condition.


Ventriculogram: Bilateral and symmetrical dilatation of the ventricular cavities. No visualization of the aqueduct of Sylvius. Good filling of the posterior fossa.


Comment. From the cases reported it may be derived that cysticercosis of the posterior fossa gives a ventriculographic picture similar to that caused by tumours occurring in this region, i.e., (a) bilateral hydrocephalus of the whole supratentorial system; (b) slight and symmetrical dilatation, with only some variations in form; (c) dilatation of the foramen of Monro; (d) dilatation of the third ventricle with maintenance of suprapineal recess, anterior commissure, posterior commissure and massa intermedia.

However, a careful study of the ventriculograms in cases of cysticercosis reveals a special appearance that is of assistance in reaching a pre-operative diagnosis. This is important since the disease is usually incurable. Only if there is evidence of a single cysticercus or a localized collection is there a chance that the patient can be cured. This is true when dealing with single cysticercosis of the fourth ventricle.

Cysticercosis of the posterior fossa produces three principal lesions that are the basis of X-ray diagnosis: (1) partial obliteration of the aqueduct of Sylvius, fourth ventricle and cisternae by the cysts; (2) arachnoiditis; (3) toxic and diffuse encephalitis associated with cerebellar atrophy.

Any intracerebellar tumour means an expanding and progressive process that sooner or later causes a complete obliteration of the aqueduct. According to its localization, displacement of this channel is upwards, downwards, to the right or left, forward or backward. It has a characteristic appearance: the obliterating point is outlined definitely and precisely. Passage of air to
the posterior cisterna is rare. In cysticercosis the picture is very different: the characteristics are (a) dilatation of the aqueduct of Sylvius (up to 1 cm.) with absence of deviation; (b) only partial obliteration of the aqueduct—there is always some filling of the aqueduct and fourth ventricle; (c) good passage of air to the cisterna magna; (d) presence of air around the cerebellum as a consequence of the atrophy of that region.

These facts are based upon a study of the 13 cases reported above. It is possible to make a diagnosis of cysticercosis before operation if one considers the clinical picture together with the X-ray findings as described.

VENTRICULOGRAPHY IN SOLITARY CYSTICERCOSIS OF THE FOURTH VENTRICLE
(Seven cases)


Ventriculogram: Bilateral and symmetrical hydrocephalus. Irregular filling of the fourth ventricle. Aqueduct is visible only at its opening in the third ventricle.

Operation: June 21, 1940. Suboccipital decompression. Cysticercosis of the fourth ventricle.

Death June 24, 1940. Autopsy. No other cysticercus found in rest of the body.


Ventriculogram: Slight dilatation of both ventricular cavities. Aqueduct of Sylvius is not visible. Air present in the fourth ventricle and the posterior fossa.

Sudden death Aug. 31, 1940. Autopsy: Single cysticercosis of the fourth ventricle. No other parasite found in rest of the body.


Ventriculogram: Bilateral and symmetrical hydrocephalus of the ventricular system. Obstruction of the aqueduct in its outlet from the third ventricle. Presence of air in its inferior part, which is dilated. Dilatation of the fourth ventricle and the posterior fossa.


Discharge: Dec. 13, 1941.


No ventriculogram.


No ventriculogram—the patient died suddenly the night before scheduled operation.

Death: Oct. 4, 1943. Autopsy: Solitary cysticercus of the fourth ventricle (Fig. 5). No parasites in rest of the tissues.

Fig. 5. Case 18. Single cysticercus of the fourth ventricle.

Figs. 6 and 7. Case 19. Ventriculograms showing enlargement of the aqueduct, which is obstructed in a tract of 1½ cm. from its opening in third ventricle. Dilatation of the fourth ventricle. Air around the cerebellum and the cisterna cerebellum medullaris.

Fig. 8 (left). Case 19. Single cysticercus removed from the fourth ventricle and aqueduct of Sylvius. Fig. 9 (right). Case 19. Patient nine months after operation.
Ventriculogram: Ventricular system grossly dilated. Dilatation of the aqueduct, which is obstructed in a tract of 1½ cm. from its opening in the third ventricle (Figs. 6 and 7). Marked dilatation of the fourth ventricle.

Operation: Oct. 15, 1943. Suboccipital decompression. Solitary cysticercus of the fourth ventricle (Fig. 8). Atrophy of the cerebellum.

Discharge: Nov. 17, 1943. Follow-up examination: July 1944. Patient in good condition (Fig. 9).


**Figure 10 (left).** Case 20. Good filling of the aqueduct in a tract of 1½ cm., which is dilated. Air in the cisterna cerebellum medullaris.

**Figure 11 (right).** Case 20. Patient six months after operation.

Ventriculogram: Bilateral and symmetrical hydrocephalus. Good filling of the aqueduct in a tract of ½ cm., which is dilated. Presence of air in the cisterna magna (Fig. 10).


Discharge: Jan. 6, 1944. Follow-up examination: July 1944. Patient in good condition (Fig. 11).

**Comment.** The ventriculograms in cysticercosis of the fourth ventricle reveal a picture similar to that in cysticercosis of the posterior fossa. Complete obliteration of the aqueduct is rare, while practically always there is free passage of air to the cisterna magna. In two cases we have been able to see the outline of the cysticercus within the aqueduct.

**SUMMARY**

Twenty cases of brain cysticercosis have been studied by ventriculograms obtained by injection of air. In 13 the predominant localization was in the posterior fossa and in 7 there was a single cysticercosis of the fourth ventricle. All were verified either surgically or by autopsy.

The X-ray findings that point to cysticercosis of the posterior fossa are: 1) hydrocephalus, 2) absence of displacement of the ventricular system, especially of the aqueduct, and 3) partial obliteration of the aqueduct and fourth ventricle with presence of air in both and in the cisterna magna. These
same features can be observed in cases of single cysticercosis of the fourth ventricle. In the latter the contours of the cysticercus may be outlined.

Ventriculography, associated with careful clinical, biological, and laboratory examinations, is the most valuable method for reaching an accurate localization in cysticercosis of the posterior fossa.

REFERENCES


For convenience of reference a list of other contributions to the subject that are of interest is appended.


