Encephaloscope

Basic Study

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In 1910, Lespinsasse in Chicago inserted a small cystoscope into the ventricle of a brain for the purpose of cauterization of the choroid plexus of the lateral ventricles in the treatment of hydrocephalus.  

Later, in 1934, Putnam made a new device on the cystoscope and named it “ventriculoscopes.” But the size of the ventriculoscope was too large (6–7 cm. in diameter) and it therefore was limited in selection of the site of examination and by its repeated use.

We started the study of a new endoscope in the spring of 1960 and finally completed a fairly satisfactory instrument in April 1963 after various researches and improvements with the aid of the Machida Medical Instrument Co. Ltd. We have named this new endoscope: encephaloscope.

Indications in Use of the Encephaloscope

1. Differential diagnosis of apoplexy and its treatment (especially in an early operation with the aspiration and irrigation of deeply situated intracerebral hematoma).

2. Diagnosis, biopsy and treatment of brain tumor and brain abscess (especially in diagnosis by insertion of fine G. M. counter, and in treatment by the insertion or the injection of radio-active substance into a deeply situated malignant tumor through the trocar tube and evaluation of the effectiveness of this treatment by secondary biopsy).

3. Ventricular tap and ventricular drainage. (Insertion of a drainage tube through the trocar tube.)

4. Use of the ventriculoscope in place of the endoscope as an optical unit. It is applicable for the diagnosis and the cauterization of intraventricular lesions and for the observation of intracystic condition. (A new type of ventriculoscope which fits the encephaloscopic tube is now under production.)

5. Stereotaxic localized freezing of tissue or destruction through the trocar tube after the encephaloscopic observation.

Structure and Character of Encephaloscope

As shown in Fig. 1, the instrument consists of three major portions: An optical telescope with a trocar tube, a stroboscopic power unit and a camera. In biopsy, biopsy forceps will be used. Fig. 2 illustrates the tip of the optical telescope with trocar tube.

The outside diameter of the optical telescope is 3.1 mm. and its length is 22 cm. The outside diameter of the trocar tube is 3.6 mm. and the lens of the optical telescope is 2 mm. in diameter.

The light guide is composed of glass fibers and surrounds the central lens in a ring-like fashion. It consists of about 10,000 glass fibers of 18 μ. The light is adjusted by a transformer, then guided to an objective through a converging lens, entering from the side and passing the light guide (Fig. 3).

The magnification is ten times and there is no danger of overheating or leakage of electricity. With the use of stroboscopic power unit, color photography is possible under direct view in 1/500 of a second. A 16 mm. lens mono-eye reflex camera is in use but a 35 mm. lens, modified Olympus Pen-F, is also applicable.

The outside diameter of our optical telescope is 3.1 mm. and this is the finest among direct-viewing endoscopes which have been in clinical use. On inserting this unit into the brain, it can be used safely while observing the object closely which is in direct contact with the lens at the tip, thus avoiding danger. Therefore, no hemorrhages caused by injury of vessels were encountered either in animal experiments or in some cases of operations on humans.

Moreover, we experienced a case in which the aspiration of a deeply situated intracerebral hematoma was carried out successfully. This will be submitted later. Fig. 4 illustrates the inspection with an encephaloscope and Fig. 5 illustrates photographing with a camera in ventriculostomy.

Animal Experiment

1. Safety in Insertion of the Encephaloscope. The animal experiment carried out to test the safety in the insertion of the encephaloscope into brain substance was done on 12 adult dogs and no objective neurological abnormality and no sequel was found in any case. Even when the motor or sensory area was punctured, there was no noticeable neurological deficit. Fig. 6 illustrates the cases in which frontal and occipital insertion was made.

2. Findings in a Normal Dog Brain. As for the controls, a piece of gauze (Fig. 7, 1) and a piece

Received for publication March 31, 1964.
Revision received October 25, 1964.

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of hair from an adult woman (Fig. 7, 2) were shown.

Vessels of the brain surface (Fig. 7, 3, 4, 5), dura mater, and ventricular wall of a normal dog could be shown by photography. The dura mater is colored pale yellowish-tan and sometimes has small vessels (Fig. 7, 6, 7). The brain substance is nearly white or yellowish-white and entirely homogeneous (Fig. 7, 8). When the wall of the ventricle is penetrated, as shown in Fig. 7, 9, the field will suddenly become dark and the border of white ventricular wall will be identified easily. The interior of the wall of the lateral ventricle may be inspected and vessels of the tela choriodea can be visualized, as shown in Fig. 7, 10, thus enabling identification of obstructions or congestions in the deep vascular system of the brain.

3. Diagnosis and Treatment of Experimental Intracerebral Hematoma. Experimental intracerebral hematomas were inspected with the en-
Encephaloscope immediately, 1 to 2 hours, 4 days, and 70 days after the injection respectively through the frontal or occipital lobe.

Hematoma was clearly circumscribed from normal brain substance immediately after, or 1 to 2 hours after the injection and when the encephaloscope entered into the hematoma, a red color, the same as that of normal blood, appeared in the field (Fig. 7, 11). Hemorrhage less than 1 mm. in diameter was observed as a small petechia as shown in Fig. 7, 12 and there was no possible danger. On the 4th day of injection, hematoma appeared in dark reddish color and blood was partly coagulated. The border of the hematoma was somewhat irregular and appeared yellowish-brown in many portions (Fig. 7, 13, 14, 15). But when the injected blood ruptured into the ventricle and formed intraventricular hemorrhage (as shown in Fig. 7, 16), there was quite a distinct ventricular wall and it appeared dark red. When blood was still in fluid form, a syringe was connected to the trocar tube and the content could be aspirated. On the 70th day, the hematoma was nearly completely absorbed and became small, having an irregular border and appeared as a brownish dark red color.

From the above mentioned experimental observation in dogs, it was considered that the encephaloscope can be applied clinically with safety in the diagnosis and treatment of human intracerebral hematoma.
Conclusion and Summary

We have completed a new endoscope which can be used safely in making diagnosis and treatment of intracerebral changes under direct vision. This new instrument is named "encephaloscope."

As for its character, the outside diameter of the optical telescope is 3.1 mm, which is the finest among direct-viewing endoscopes that have been in clinical use. It can be inserted safely into the brain while observing the object closely which is in direct contact with the lens at the tip, avoiding any danger. The light guide consists of glass fibers and color photography is possible by the use of a stroboscopic power unit under direct view.

The animal experiment carried out to test the safety in the insertion of the encephaloscope into brain substance was done on 12 adult dogs and no intracerebral hemorrhages and no sequels were found in any case. The dura mater, cerebral vessels, and ventricular wall of a normal dog could be shown by photography. The experimental intracerebral hematomas of dogs could be inspected and drained with the encephaloscope.

Clinically, the encephaloscope is going to be used not only to make differential diagnosis and treatment (aspiration and irrigation) of cerebral hematoma, but also to make diagnosis, treatment, and biopsy of brain tumor and brain abscess.

References