A New Neurosurgical Ventriculoscope

—Technical Note—

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Abstract

A new, flexible fiberoptic ventriculoscope for observation of the ventricles and major cisterns is reported. This device has been safely used to examine patients with obstructive hydrocephalus due to lesions within the lateral and third ventricles or to congenital aqueductal stenosis. With this instrument, a pineal tumor protruding into the third ventricle was successfully observed and photographed *in situ*.

Key words: ventriculoscope, pineal tumor, hydrocephalus, intraventricular lesions, aqueductal stenosis

Introduction

The causes of obstructive hydrocephalus include intraventricular tumors, intracerebral hematomas, inflammation, and congenital anomalies. Computed tomography (CT), magnetic resonance imaging, and ventriculography are used to preoperatively determine the cause of hydrocephalus. However, although these technologies provide much useful information, certain lesions cannot be visualized directly. If the diagnostic work-up for hydrocephalus were to include analysis of cerebrospinal fluid and direct observation of the ventricles, in many cases more appropriate and effective treatment plans could be formulated.

To date, numerous endoscopes have been designed for ventriculscopy and cisternscopy.^{1,3-8)} The majority are hard endoscopes,^{1,3,4,6,7)} which have the disadvantages of inflexibility and the potential to damage brain tissue. The fiberscopes that have been developed^{5,8)} do not produce sufficiently clear images. In the hope of overcoming some of the existing deficiencies in ventriculscopy, we have designed a new fiberscope for intraventricular observation.

Materials and Methods

The ventriculoscope, shown in Fig. 1A, features

a forward-viewing fiberscope (PF 22 prototype, Olympus Optical Company, Tokyo) with a field of view of 75° and tip flexion of 120° in two directions (Fig. 1B). Its diameter is 2.2 mm (Fig. 1C), which makes it suitable for use in children as well as adults. The depth of field is 3–50 mm and the working length 30 cm. It has automatic exposure capability when used with the appropriate cold light supply (CLV 10, Olympus Optical Company), and the photographic images can be projected onto a color television screen (OTV-F2, Olympus Optical Company). In addition, the entire procedure can be simultaneously recorded.

This ventriculoscope is very simple to use. Through a right frontal burr hole, after routine tapping of the lateral ventricle, the fiberscope is inserted into the anterior horn of the lateral ventricle. We have found that the anterior route is better than the posterior route through the occipital horn because the approach to the third ventricle through the foramen of Monro is easy and safe and the intraventricular orientation can be readily confirmed. The posterior route is used, however, in patients with temporal intraventricular lesions.

Case Report

A 19-year-old male presented on April 26, 1988 with a history of headaches and diabetes insipidus. Neurological examination revealed Parinaud's syn-

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Fig. 1 A: Photograph of the newly developed flexible fiberoptic ventriculoscope. B: The tip of the ventriculoscope has a flexion range of 240° . C: The tip of the ventriculoscope (middle) and needles used for ventricular puncture.

Fig. 2 Pre- (upper) and postcontrast (lower) CT scans, showing enlarged lateral and third ventricles and an irregular, high-density mass with homogeneous enhancement in the pineal region.

drome. A CT scan showed hydrocephalus due to a high-density mass in the pineal region and homogeneous contrast enhancement (Fig. 2). On the 2nd day of hospitalization, a ventriculoperitoneal shunt was emplaced. At the same time, the ventriculoscope was introduced into the third ventricle *via* the anterior horn of the right lateral ventricle and the foramen of Monro (Fig. 3A). A mass protruded

anteriorly into the third ventricle, occupying the pineal region and obliterating the entrance to the cerebral aqueduct (Fig. 3B). No normal structures of the posterior or habenular commissures were found. Tiny masses implanted in the optic and infundibular recesses were also seen. It appeared that metastasis had occurred at the floor of the third ventricle.

Laboratory data, including tumor markers (carcinoembryonic antigen, human chorionic gonadotropin, and alpha-fetoprotein), were within normal limits. The tumor was diagnosed as a pineal germinoma with metastatic spread, and it proved sensitive to radiation therapy.

Discussion

In 1922, Dandy^{1,2)} performed ventricular endoscopy for the treatment of hydrocephalus. Later, Putnam⁷⁾ attached a new device to a cystoscope, containing a lens and a small electric light, and termed it a "ventriculoscope." Recently, the fiberscope was introduced into clinical diagnosis. Mori *et al.*⁵⁾ described a newly designed fiberscope that could be applied to diagnosis of tumors in the third ventricle prior to direct surgery. Yamadori *et al.*⁸⁾ developed a 2-mm fiberscope equipped with an electrocoagulating apparatus (Yamadori type III) and applied it to intraventricular structures. However, the images obtained were of little value in clinical evaluation.

Our flexible fiberoptic ventriculoscope not only has an extremely small diameter (2.2 mm) but also offers improved maneuverability, owing to the extended tip flexion range (total, 240°) and yields clear photographic and television images.

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Fig. 3 Intraoperative photographs with explanatory illustrations. A: Ventriculoscopic view of the choroid plexus of the lateral ventricle, the thalamostriate vein of the right lateral ventricle, and the foramen of Monro. B: A tumor protrudes into the third ventricle and obliterates the entrance of the cerebral aqueduct. The choroid plexus of the third ventricle is visible above the tumor.

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