

Technique

Revision of Paine's technique for intraoperative ventricular puncture

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Abstract

Background: The aim of this study was to determine the ideal point for a ventricular puncture in pterional craniotomies.

Methods: Using a circle that had its center around the junction of the columns of the fornix and conforming to the surface of the frontal lobe on an axial computed tomography scan 2.5 cm superior to the lateral orbital roof, we simulated the introduction of a catheter perpendicular to the cortex by drawing the radii of the circle in 70 patients with an acute subarachnoid hemorrhage. The cortical point at which perpendicular puncture provides the best trajectory for ventricular access, traversing the least brain tissue and avoiding important brain structures, such as the head of the caudate nucleus, anterior limb of the internal capsule, and Broca's cortex in the dominant hemisphere, was measured.

Results: The new landmark was located at the point 44 ± 4 mm anterior to the sylvian fissure on the level of 2.5 cm superior to the lateral orbital roof and was consistent regardless of the ventricular dimensions and sex. Clinical trial of the ventriculostomy in 32 patients with a ruptured aneurysm approved the new landmark.

Conclusions: An intraoperative ventriculostomy can be performed safely and reliably using the new landmark 2.5 cm superior to the lateral orbital roof and 4.5 cm anterior to the sylvian fissure in aneurysm surgery using a pterional craniotomy.

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Keywords:

Aneurysm; Pterional craniotomy; Ventricular puncture; Ventriculostomy

1. Introduction

Adequate brain relaxation is necessary for exposure of aneurysms of the circle of Willis and is achieved by opening the arachnoid of the optic cistern, enabling drainage of cerebrospinal fluid, in addition to intraoperative maneuvers such as positioning, hyperventilation, and osmotic diuresis. However, in some patients after recent subarachnoid hemorrhage, the edematous brain may limit retraction to safely expose the optic cistern. Instead, a ventricular catheter can be placed using the Paine's point, although it may be very difficult even in experienced hands in cases of a red, angry, and swollen brain.

Paine's point, which is defined as “the intersection at right angles of the lines measured 2.5 cm superior from the floor

of the anterior cranial fossa (lateral orbital roof) and 2.5 cm anterior to the sylvian fissure,” was devised to puncture the frontal horn of the lateral ventricle after dural opening during pterional craniotomies [5], and it has been widely used in aneurysm surgery [1,2,7], despite concerns about its proximity to the Broca's speech cortex in the dominant hemisphere and lack of further investigation [6,10,11]. Accordingly, the current study was performed to determine the ideal point for a ventricular puncture in a pterional craniotomy to improve the Paine's technique.

2. Materials and methods

2.1. Patient population and data collection

From July 2005 to June 2006, 177 Korean patients with an acute subarachnoid hemorrhage were admitted to the authors' hospital. For the CT examination of the cranium,

Abbreviations: BI, bicaudate index; CT, computed tomography.

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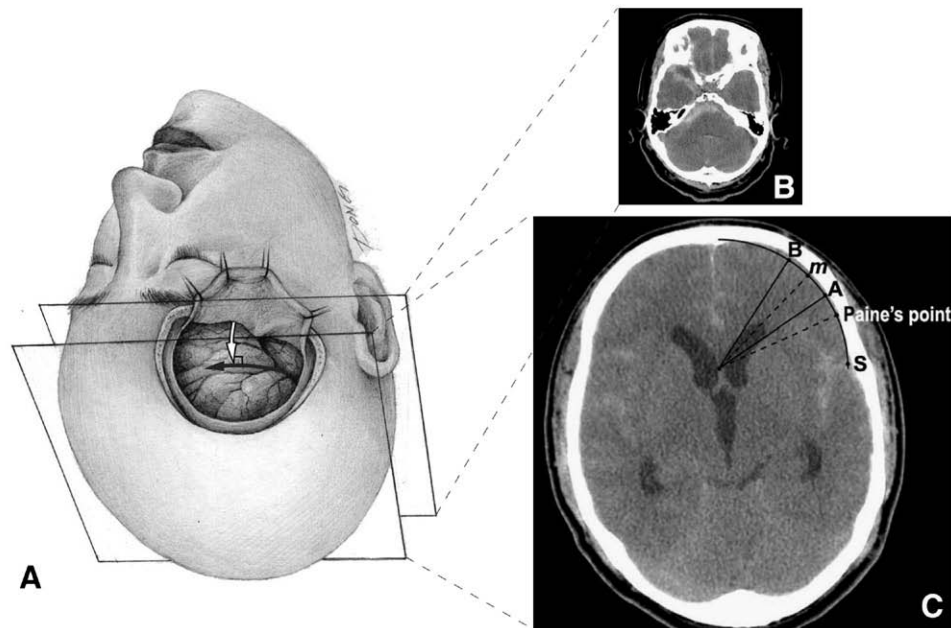


Fig. 1. Drawing showing the measurement of the points of ventricular access on the brain surface and in the CT scans. Empty arrow indicates superior direction from the lateral orbital roof, and solid arrow indicates anterior direction from the sylvian fissure. A: CT scan traversing the lateral orbital roof. B: CT scan 2.5 cm superior to the lateral orbital roof. The sylvian fissure (S), points A and B, determined by perpendicular lines (radii) along the lateral and medial walls of the frontal horn, midway (m) between points A and B, and Paine's point are all demonstrated on a circle with its center around the junction of the bilateral columns of the fornix and conforming to the surface of the frontal lobe. Note the CT scans are turned over left to right to gain a better understanding.

axial images were taken parallel to the floor of the anterior cranial fossa at a thickness of 5 mm. The CT scans showing the ventricles with a BI of 0.14 or greater before intracranial procedures such as craniotomies, ventriculostomies, and ventriculoperitoneal shunts were selected at first. The BI was measured using an axial CT scan including the foramen of Monro. Among these, axial scans 2.5 cm superior to the lateral orbital roof, showing a remarkable sylvian fissure owing to hyperdensity caused by a subarachnoid hemorrhage or hypodensity for a remarkable sylvian fissure,

were chosen for the present study. As such, CT scans of 80 hemispheres of the 70 patients (26 males, 44 females; age, 60.9 ± 12.3 years) were identified as suitable for this study. The BI of the patients ranged from 0.14 to 0.23 (mean, 0.19; SD, 0.02).

2.2. Determination of the ideal landmark on the basis of CT scans

The Paine's technique involves the introduction of a ventricular catheter perpendicular to the convexity of the

Table 1

Evaluation of ideal point for ventricular puncture with respect to sylvian fissure using CT scans 2.5 cm superior to lateral orbital roof ^a

	Total hemispheres	BI		Male	Female
		0.14 - 0.18	0.19 - 0.23		
No. of hemispheres	80	32	48	30	50
BI	0.19 ± 0.02	0.16 ± 0.01	0.21 ± 0.01	0.19 ± 0.03	0.19 ± 0.02
S-A distance (mm)	33 ± 5	$35 \pm 5^*$	$32 \pm 4^*$	34 ± 5	33 ± 5
S-B distance (mm)	55 ± 5	54 ± 5	55 ± 5	55 ± 4	55 ± 5
A-B distance (mm)	22 ± 6	$19 \pm 3^{**}$	$24 \pm 6^{**}$	21 ± 5	22 ± 6
S-m distance (mm)	44 ± 4	44 ± 5	44 ± 4	44 ± 4	44 ± 4
Ventricular depth at new landmark (mm)	$33 \pm 3^{***}$	34 ± 4	33 ± 2	33 ± 2	34 ± 3
Ventricular depth at Paine's point (mm)	$44 \pm 4^{***}$	$46 \pm 4^*$	$43 \pm 3^*$	45 ± 3	44 ± 4

A indicates intersection of a circle conforming to the surface of the frontal lobe and its radius along the lateral wall of the frontal horn; B, intersection of a circle conforming to the surface of the frontal lobe and its radius along the medial wall of the frontal horn; m, midway between points A and B; S, sylvian fissure.

^a Values are expressed as mean \pm SD.

* $P < .05$ between the patients with smaller ventricles (BI, 0.14-0.18) and larger ventricles (BI, 0.19-0.23).

** $P < .01$ between the patients with smaller ventricles and larger ventricles.

*** $P = .000$ between the values at Paine's point and the landmark.

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