Cerebrospinal Fluid Analysis: A Predictor of Chronic Hydrocephalus Following Spontaneous Subarachnoid Hemorrhage

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Hydrocephalus is a well-recognized condition following spontaneous subarachnoid hemorrhage (SSAH). Ninety-one medical records of patients whopresented with SSAH were reviewed, 56 patients were included in this study. The amount of red blood cells (RBCs) in the cerebrospinal fluid (CSF) and the occurrence of chronic hydrocephalus requiring shunt placement were analyzed. In the group that did not require shunt placement, the average amount of RBCs in the CSF was 45823 $\pm$ 48789 cells/mm^3 , whereas, in the shunted group (total of 15 patients) it was 86788 $\pm$ 71045 cells/mm^3 which was statistical significantly higher than the non-shunted group ($p < 0.05$). The authors concluded that CSF analysis is a useful predictor for shunt placement following SSAH.

Keywords : *Subarachnoid hemorrhage, Hydrocephalus, Cerebrospinal fluid analysis*

J Med Assoc Thai 2004; 87(8): 898-901

Spontaneous subarachnoid hemorrhage (SSAH) is a common neurosurgical condition. Hydrocephalus following SSAH has been well recognized as a consequence. As high as 20 percent of patients with SSAH develop hydrocephalus[1]. Approximately 10-15 percent of these patients ultimately require shunting devices[7,8]. There was a high correlation between hydrocephalus and Hunt Hess grades and Fisher grades of SSAH. However, to the authors' knowledge, the correlation between the amount of subarachnoid blood, measured in number of red blood cells (RBCs) in the cerebrospinal fluid (CSF), and the hydrocephalus has not been previously investigated.

Patients and Method

Medical records of patients admitted to King Chulalongkorn Memorial Hospital with the diagnosis of SSAH from January 1st, 1996 to December 31st, 1998 were retrospectively reviewed. The pertinent variables were collected as well as the timing of admission, timing of surgery, type of surgery, etiology of SSAH, diagnosis of hydrocephalus, timing of shunting, number of red blood cells in the CSF. The CSF was obtained from ventriculostomy or lumbar puncture. In patients whose CSF was analyzed several times, the one with the highest number of red blood cells was analysed. The patients who expired before shunting or CSF was not obtained or the results were not available for analysis were excluded. Patients presenting with SSAH were admitted to either the intermediate care unit or intensive care unit depending on the severity, comorbidity, and the requirement for monitoring. Four vessel cerebral angiography was performed within 24 hours unless the patient appeared unsalvagable. If the surgical lesion was identified on the angiogram, the patient would be treated accordingly. The majority of them were aneurysms. Ventricular drainage was placed selectively in patients with ventricular dilatation associated with increased intracranial pressure. Craniotomy and clipping aneurysm would be carried out early in the patients with Hunt Hess grade I-III and at surgeon discretion in patients with Hunt Hess grade IV-V. Following surgery, the CSF obtained from ventricular drainage or lumbar puncture was analyzed in patients who were suspicious for meningitis. Lumbar puncture was also performed to measure and release the pressure in patients who demonstrated

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symptoms and signs of increased intracranial pressure e.g. decreased level of consciousness, persistent headache, confusion, papilledema, etc. The CSF was analyzed for cell count, protein, glucose, and microbial culture. Hydrocephalus requiring a shunting device was diagnosed if the patient continued to have elevated intracranial pressure on several lumbar punctures and radiographic evidence of ventricular dilatation. The shunting devices primarily employed were ventriculoperitoneal shunt inserted via the parietal entrance.

Statistic analysis

The difference of the amount of red blood cells in the CSF was analyzed by using the Nonparametric Mann Whitney U-test.

Result

There were 91 patients consisting of 36 males (39.56%) and 55 females (60.44 %). Age ranges from 11 to 88 years with a mean of 56.70 years. The mean interval between the onset of SAH and the time when the patient was admitted was 4.55 days. The number of patients in Hunt Hess grade I, II, III, IV, V were 34 (37.36%), 23 (25.27%), 22 (24.75%), 6 (6.59%), 6 (6.59%) respectively (Fig.1). The overall mortality rate was 17.58 % (16 out of 91). Of 91 patients, 16 patients did not survive and there were 19 patients who survived but the CSF was not analyzed or the results were not available. These patients were excluded from the study. Of the remaining 56 patients, 15 patients developed hydrocephalus which necessitated a shunting device placement. The mean interval between the onset of SAH and the time of shunt placement was 37.8 days. The average duration between onset of rupture and surgical clipping of aneurysm in the shunt and nonshunt groups was 6.6 and 6.57 days respectively.

In the hydrocephalus group there were 11 females (73.3%), 4 males (26.7%) with an average age of 56.41 years. The number of patients in each Hunt Hess grade for Grade I, II, III, IV were 6 (40%), 2 (13.33%), 4 (26.67%), 3 (20%) respectively. The etiology of SAH was unknown in 3 (no lesion responsible for SAH was found on at least 1 angiographic study), dural arteriovenous malformation in 1, and aneurysm in 11 patients (Fig. 2). Of these aneurysms, they were anterior cerebral artery in 1, anterior communicating artery in 5, and internal carotid artery in 1, and posterior communicating artery in 4 patients.

Of the 41 patients who did not require a shunt, there were 25 females (60.97%), 16 males (39.03%) with a mean age of 60.93 years. The number of patients in Hunt Hess grade I, II, III, IV were 18 (43.9%), 9 (21.95%), 13 (31.7%), 1 (2.44%) respectively. None of the patients with Hunt Hess grade V survived. The etiology of SAH was unknown in 13 patients. There were 28 aneurysms consisting of a middle cerebral artery in 6, anterior cerebral artery in 2, posterior communicating artery in 7, anterior communicating artery in 8, , posterior inferior cerebellar artery in 1, internal carotid artery in 1, basilar artery in 1, and posterior cerebral artery in 2 patients (Fig.3).

In the group that did not require a shunt the mean of the red blood cells in the CSF was 45823.37 ± 48789.46 cells/mm^3 ,whereas in the shunted group it was 86788.27 ± 71045.73 cells/mm^3 which was significantly higher ($p < 0.05$) (Fig. 4).

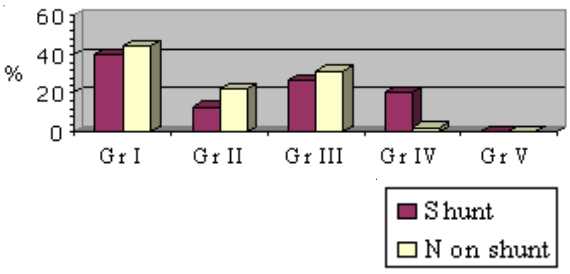

Fig. 1 Hunt Hess grades in the shunted and non shunted groups

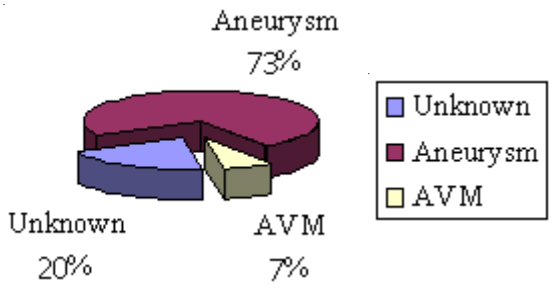

Fig. 2 Etiologies in the shunted group

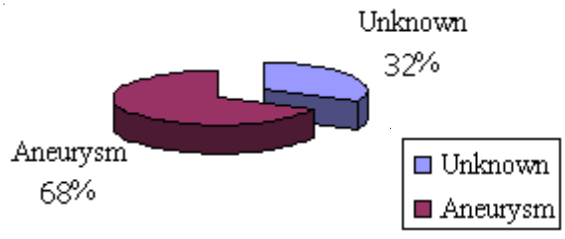

Fig. 3 Etiologies in non the shunted group

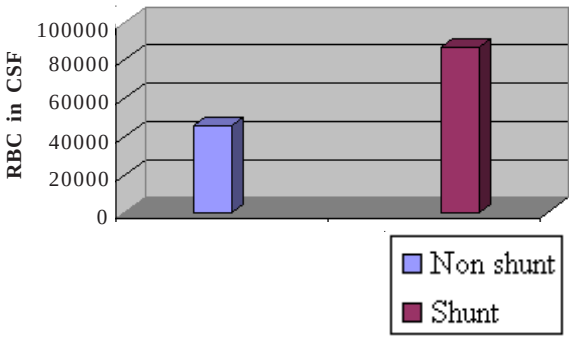

Fig. 4 Red blood cells in each group

Discussion

Hydrocephalus is a common consequence of SAH. It was estimated to be 20% in the acute phase but 50% of these recovered spontaneously within the first 24 hours[1,2,9,10]. However, the incidence of chronic hydrocephalus requiring a shunt following subarachnoid hemorrhage is not precisely known[3]. In the literature, there was no statistically significant correlation between chronic hydrocephalus and the patients'age, gender, aneurysm type and size or the use of perioperative drainage. The location and site of the aneurysm were found to be good predictors of chronic hydrocephalus[4]. There was also a high correlation between hydrocephalus and Hunt Hess grades and Fisher grades ($p < 0.05$)[3,6]. However, it has been shown that even with the 4 tiered classification Fisher grading system, there was high interobserver disagreement[5]. The Hunt Hess classification is often found to be less "clear cut" in clinical practice.

CSF analysis is a simple test. It provides the quantitative measurement of subarachnoid blood. This study has shown that the amount of subarachnoid blood correlates with the incidence of chronic hydrocephalus with statistical significance ($p < 0.05$). The authors believe that with more patients in the shunting group it would be possible to identify the incidence of chronic hydrocephalus when different ranges of the amount of subarachnoid blood are given. This could be done in a prospective study in the future.

Conclusion

CSF analysis is a simple test that can be a useful predictor to identify patients who are likely to require a CSF shunting device placement.

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การวิเคราะห์น้ำหล่อเลี้ยงสมองและไขสันหลังเพื่อพยากรณ์การเกิดภาวะน้ำคั่งในโพรงสมองตามหลังการเกิดเลือดออกใต้ชั้น อแรคนอยด์

กฤษณพันธ์ บุณยะรัตเวช, สุพัฒน์ โอเจริญ

ภาวะน้ำคั่งในโพรงสมองตามหลังการเกิดเลือดออกใต้ชั้นอแรคนอยด์ชนิดเกิดขึ้นเองเป็นภาวะที่พบได้บ่อย การศึกษานี้ได้จากแฟ้มประวัติผู้ป่วยที่มาด้วยภาวะเลือดออกใต้ชั้น อแรคนอยด์ชนิดเกิดขึ้นเองโดยศึกษาความสัมพันธ์ระหว่างจำนวนเม็ดเลือดแดงในน้ำไขสันหลังและการเกิดภาวะน้ำคั่งในโพรงสมองที่ต้องรักษาโดยการใส่ shunt มีผู้ป่วยจำนวน 56 รายที่เข้าเกณฑ์ในการศึกษา ผลการศึกษาพบว่าผู้ป่วยกลุ่มที่ต้องใส่ shunt จำนวน 15 ราย ซึ่งมีค่าเฉลี่ยจำนวนเม็ดเลือดแดง 86788 $\pm$ 71045 ซึ่งสูงกว่ากลุ่มที่ไม่ต้องใส่ shunt ซึ่งมีค่าเฉลี่ย 45823 $\pm$ 48789 อย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) จากการศึกษาพบว่าการตรวจวิเคราะห์จำนวนเม็ดเลือดแดงในน้ำหล่อเลี้ยงสมองและไขสันหลังสามารถใช้เป็นตัวช่วยพยากรณ์การใส่ shunt ในผู้ป่วยที่มาด้วยภาวะเลือดออกใต้ชั้น อแรคนอยด์ชนิดเกิดขึ้นเองได้