Effect of Therapy on Cerebral Blood Flow Following Aneurysm Surgery

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SUMMARY: The authors report on a patient with a ruptured anterior communicating aneurysm treated surgically on the day following her subarachnoid hemorrhage (SAH). Repeated measurements of cerebral blood flow (rCBF) were carried out using the inhalational Xenon 133 method. Dramatic acute increases in rCBF occurred, coincident with clinical improvement, following mannitol, CSF drainage and dopamine. Later, further elevation to normal levels occurred following ventriculoperitoneal shunting.

INTRODUCTION

Regional cerebral blood flow (rCBF) responses to subarachnoid hemorrhage (SAH) from ruptured aneurysms has been the object of several recent studies (Grubb et al., 1977; Ishii, 1979; Weir et al., 1978). The necessity of intracarotid administration of Xenon 133 (Xe 133) limited the applicability of this method. The atraumatic inhalation method of Obrist (Obrist et al., 1975) has permitted us to make repeated examinations on the same patient. Recently, new therapeutic regimens have been advocated (Brown et al., 1978; Kosnik and Hunt, 1976; Pritz et al., 1978) to improve cerebral perfusion following SAH and aneurysm surgery. It has been assumed, but not demonstrated that such measures as induced arterial hypertension, hypervolemia, increased cardiac output, and intracranial hypotension would all increase rCBF.

We report on a patient in whom the beneficial effects of such therapy were documented with repeated rCBF measurements.

CASE REPORT

A previously well 26 year old female suddenly collapsed five hours prior to admission. She remained unconscious and upon arrival at the emergency department was unresponsive to deep pain, flaccid, intubated, but breathing spontaneously. There were basal and apical rales. Retinal hemorrhages were present in both eyes and the pupils were 2 mm. and fixed. A CAT scan performed at about eight hours following her SAH revealed intraventricular and subarachnoid blood. There was evidence of vasospasm. A CAT scan performed at the same time showed residual intraventricular blood.

She did not rouse following the surgery and the next day remained without spontaneous movement or eye opening and was still intubated although she was breathing on her own. Blood pressure ranged from 200/120 to 140/90 and intracranial pressure (ICP) was around 20 to 40 (all in mm Hg) although the latter occasionally peaked higher. Regional cerebral blood flow (rCBF) was then measured* and various acute therapies were instituted. These are shown in figure 3 with the results of therapy. The use of mannitol increased mean rCBF by 28%. CSF drainage and dopamine resulted in a further increase to 38% above baseline (Table 1). In this period of just under two hours the patient became much lighter and started to open her eyes to command and move her limbs to request. In addition, the sluggish response of the left pupil became normal.

*Inhalational Xenon 133 method using "Inhamatic 17"

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Her catheters, ICP monitor and endotracheal tubes were all removed by the third post-operative day. Her ICP remained between 5 and 10 mm Hg subsequent to the rCBF measurements. Intermittent CSF drainage and mild hyperventilation were employed. She was disoriented, incontinent and showed a paucity of spontaneous movement with her left limbs during this time.

On the tenth day following SAH she became less responsive and developed increased weakness of her left side and right leg. CAT scan demonstrated a lucent area in the region of the internal capsule on the right. This diminished in subsequent scans. After three days she started to improve again.

Her repeated CAT scans showed no change in ventricular size until the 16th day post-SAH. Her neurologic improvement had plateaued and she complained of increasing headache. By the 21st day post-SAH even further enlargement in ventricular size was present. The next day rCBF was identical to what it had been on the day following surgery after the specific therapies. A ventriculoperitoneal shunt was carried out uneventfully on the 22nd day post-SAH.

Her headache improved and she became progressively brighter, fed herself, but was not entirely appropriate or walking on her own. A CAT scan showed normal size ventricles. She was transferred to a rehabilitation institution on the 48th post-SAH day (47th day post-clipping and 25th day post-VP shunting).

A follow up blood flow study was carried out on the 91st day post-SAH. At that time she was fully oriented with no weakness or demonstrable psychological change. Her mean rCBF was 63 ml/100gm/min. or 97% higher than the initial post-operative level.

**DISCUSSION**

Given this patient's prolonged initial unconsciousness, the large volume of intraventricular and subarachnoid blood, and her poor grade on initial assessment, her final outcome was gratifying.

Early surgery prevents rebleeding and permits the more vigorous use of hypertension and hypervolemia than...
might be judiciously employed in the presence of an unclipped, recently ruptured aneurysm. With intraoperative ventricular drainage, and the employment of mannitol and lasix, dissection of the aneurysm was not difficult.

Clinical improvement in the neurologic status of patients in the postoperative period following aneurysm surgery has been obtained with hypertension, intravenous fluids and transfusion (Kosnik and Hunt, 1976), albumin, transfusion, digitalization, intravenous fluids (Pritz et al., 1978) and dopamine-induced hypertension, mannitol and large volumes of intravenous fluids (Brown et al., 1978). It has been assumed that this treatment improves cerebral perfusion by increasing cerebral blood flow and reducing intracranial pressure. Measurements of cerebral blood flow in such cases were not carried out.

The deterioration on the 10th day post-SAH with a lucent lesion developing in the CAT scan was probably due to cerebral vasospasm.

This case also illustrates the association of post-SAH hydrocephalus with low mean rCBF levels and failure to improve clinically. Successful shunting permitted a return of rCBF to the normal range.

The management of these severely ill patients necessitates the close monitoring of blood and intracranial pressure, blood gases and electrolytes, angiographic vessel caliber and ventricular size. The ability to measure cerebral blood flow in an atraumatic and risk-free fashion is a further advance.

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REFERENCES


