Regional Cerebral Blood Volume During Acute Transient Rises of the Intracranial Pressure (Plateau Waves)*

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It is a well-known fact that progressive intracranial hypertension during one stage of its development is characterized by intermittent, sometimes paroxysmal symptoms. Continuous recording of the ventricular fluid pressure (VFP) in patients with expanding intracranial lesions has shown that such intermittent symptoms coincide with acute temporary rises of the VFP level. The corresponding VFP curve usually follows a specific pattern, characterized by a steep rise to a high level (60–100 mm Hg) and, following some minutes, an often equally steep fall. This gives the curve a plateau-like appearance (Figs. 1–3).

The plateau waves have been subjected to extensive clinical studies. Variations of the VFP curve similar to plateau waves could be provoked by increasing the pressure in the ventricles at ventriculography or by exerting pressure on the region of a skull defect. It was inferred that an induced or spontaneous increase of the intracranial pressure may cause dilatation of cerebral vessels which in turn causes the intracranial pressure to rise further. By means of simultaneous recording of the cerebral blood flow and the ventricular fluid pressure combined with cerebral angiography, it was shown that the plateau waves are accompanied by dilatation of cerebral arteries and, at the same time, a decrease of the cerebral blood flow. These findings indicate that during the plateau waves there is an increase of the intracranial blood volume. In general, the studies quoted suggest that the plateau waves may appear independently of systemic circulatory events and that they are related to cerebral vasomotor changes and to a failure of mechanisms compensating intracranial volume and pressure variations.

The observation of Langfitt and his group in animal experiments should be recalled in this connection. They produced a rise in intracranial pressure by expanding a subdural balloon. This initial rise was followed by a "secondary rise" which these investigators ascribed to a reactive dilatation of cerebral vessels.

In the present investigation we have measured the regional cerebral blood volume (rCBV) in patients with plateau waves. The rCBV measurements have been carried out by means of a new, continuous, and relatively atraumatic method. Since this method is continuous, it has been possible to record the intracranial pressure simultaneously and to compare the VFP and rCBV events in detail. It will be shown that rCBV augmentations always took place during the plateau waves. Furthermore, the tracings we obtained show that the interrelations of the VFP and rCBV followed a well-defined pattern, with maximal blood volume values during the minutes preceding the rapid fall of the intracranial pressure at the end of the plateau wave.

Material

The rCBV was measured in two patients in whom the VFP was continuously recorded for other purposes consistent with established principles practised in our neurosurgical department.

Case 1. Intracranial Hypertension of Unknown Origin. A 42-year-old woman had a history of legal abortion because of rubeola, following which she complained of impaired
Case 2. Simultaneous recordings of regional cerebral blood volume (rCBV) and ventricular fluid pressure (VFP) during a spontaneous plateau wave. The rCBV was measured in eight regions over the right hemisphere. The mean changes in the eight regions (m 1–8) are shown in the uppermost curve of the rCBV diagram.

There was a basic pressure of 10 to 30 mm Hg and intermittent, regular, and rhythmic plateau waves (height 70 to 90 mm Hg, duration 10 to 15 min). The plateau waves were accompanied by headache, facial flush, blurred vision, numbness in the fingers, and a feeling of unreality and confusion. Following a Spitz-Holter shunt operation, the pressure level remained low, between 5 and 10 mm Hg without any gross variations. The vision, tinnitus, unsteadiness of gait, and paresthesias in the limbs. Ophthalmoscopy revealed bilateral papilledema with a protrusion of 5 to 6 diopters. On admission, neurological examination, including air studies and cerebral angiography, revealed no abnormalities besides the papilledema. A ventricular catheter was inserted into the frontal horn of the right lateral ventricle for continuous recording and control of the VFP.