Regional Cerebral Blood Flow in Cases of Brain Tumor

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The present series consists of 21 patients with brain tumors: 12 malignant gliomas, 4 oligodendro glialomas, 3 meningeomas and 2 metastases, studied by the $^{133}$Xe-gamma-clearance rCBF method. In 16 patients at least 3 determinations of rCBF were performed: a) in the resting state, R; b) during hyperventilation, HV, and c) during hypertension, HT. Of the remaining 5 patients, 1 was studied only during R, while the other 4 were submitted either to HV or to HT additionally to the R study. The average age of this series of patients was 47 years, the youngest being 19 and the oldest 64. rCBF studies had to be performed under general anesthesia ($N_2O + O_2$, Engström respirator) in 5 instances in which the patients were uncooperative. MABP was continuously recorded through the internal carotid catheter. End-expiratory $CO_2$ was also monitored (and recorded) by means of an infrared analyser in selected cases. Arterial (and in some cases also cerebral venous) $pH$, $pCO_2$ and $pO_2$ were determined at least once for each Xenon injection.

Results

Average rCBF and focal changes: Average hemisphere blood flow in the whole series was 31.5 ml/100 g/min. All patients except 1 (without focal changes) had average rCBF values below 42 ml/100 g/min, the lowest value being 14.5 ml/100 g/min.

In 19 cases focal rCBF disturbances could be detected in agreement with the tumor location as verified directly or by other diagnostic procedures. In 13 cases a relative hyperemia was detected at the areas corresponding to the tumor site. In 6 cases there were ischemic rCBF focal changes corresponding to the tumor location.

Cases with ischemic focus: As stated, in 6 cases rCBF values at the tumor site were lower than at the surrounding areas. In 3 of these cases there was a perifocal hyperemia, i.e., the tumor site was surrounded by areas with higher rCBF than the rest of the hemisphere.

Reactivity to HV varied very much in these 6 cases, ranging from an excessive rCBF reduction at the tumor site (case 39/68) or over its periphery (case 45/68) to a “paradoxical” focal CBF increase (case 22/69). In all 6 cases but 1 (22/69) HV caused a reduction of inter-regional rCBF differences (inter-channel SD) with homogeneisation of mean hemispherical CBF at a lower level than during rest (this phenomenon will be discussed further on).

A more or less pronounced impairment of autoregulation (AR) was present in all 6 cases – either at the tumor site or at its near or remote periphery – the number of cases being still too small to allow systematization.

Cases with hyperemic focus: In 13 cases there was a hyperemic focus over the tumor location.
In contrast to the ischemic group, there was a clear increase in interregional CBF differences (inter-channel SD) in most cases (6 out of 10) with a hyperemic focus corresponding to the tumor location. The mechanism governing both types of changes seems

**EFFECTS OF HYPERVENTILATION**

![Diagram showing rCBF changes caused by hyperventilation in cases of brain tumor. The non-tumor areas react more to HV than the tumor areas. The consequence of this is a decrease of interregional CBF differences in cases with hypoxic focus](image)

Fig. 1. rCBF changes caused by hyperventilation in cases of brain tumor. The non-tumor areas react more to HV than the tumor areas. The consequence of this is a decrease of interregional CBF differences in cases with hypoxic focus.

**Fig. 2. Measurement of multichannel rCBF during the operation of brain tumors**