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メタデータ	<p>言語: English</p> <p>出版者:</p> <p>公開日: 2007-11-30</p> <p>キーワード (Ja):</p> <p>キーワード (En):</p> <p>作成者: OKAZAWA, Hidehiko, TSUCHIDA, Tatsuro, ARAI, Yoshikazu, MORI, Tetsuya, KOBAYASHI, Masato, TANAKA, Fumiko, YONEKURA, Yoshiharu</p> <p>メールアドレス:</p> <p>所属:</p>
URL	<p>http://hdl.handle.net/10098/1198</p>

Evaluation of critical hemodynamic status induced by acetazolamide challenge in patients with cerebrovascular disease: Assessment of regional perfusion pressure.

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Introduction: Autoregulatory mechanism to keep cerebral blood flow (CBF) and perfusion pressure may be impaired in patients with cerebrovascular disease (CVD). To investigate the critical hemodynamic status in the impaired cerebral circulation, changes in regional CBF (rCBF) and arterial-to-capillary blood volume (V_0) induced by acetazolamide (ACZ) were measured in CVD, as well as changes in hemodynamic parameter defined by rCBF/ V_0 ratio, which is expected to be proportional to the regional perfusion pressure.

Method: Thirty-nine patients (mean age = 64.5 ± 9.3 y) with unilateral major cerebral arterial occlusive disease underwent O-15 water PET at baseline and 10 min after ACZ administration. The mean interval between an ischemic event and the PET examination was 5.7 ± 7.4 months. Dynamic PET data were acquired to calculate rCBF, V_0 and rCBF/ V_0 ratio using the 3-weighted integral method. The hemodynamic parameters in the territories of bilateral middle cerebral arteries were obtained and compared between the 2 hemispheres and 2 conditions.

Results: Following ACZ administration, the group of patients who had a diminished rCBF response in the ipsilateral hemisphere (reduced vasodilatory capacity group = RVC; 22 patients) showed a significant V_0 increase in the same region. Thus, the rCBF/ V_0 ratio decreased significantly after ACZ administration in the ipsilateral hemisphere of RVC. This ratio did not change in the contralateral hemisphere of this group nor in the other group with normal vasodilatory capacity (NVC; 17 patients), suggesting that its reduction represented severe hemodynamic impairment and dysfunction of autoregulation for regional perfusion pressure. The significant decrease in rCBF/ V_0 ratio was associated with strokes in patients of RVC (Table). Eight patients in RVC (36%) and 15 in NVC (88%) had suffered strokes. Twelve patients in RVC (56%) had a history of TIA, whereas only one in NVC had suffered from TIA (5.9%). The incidence of past history of stroke and TIA was significantly different between the two groups ($p < 0.005$, Chi-square test).

Conclusion: The lack of rCBF increase after ACZ challenge does not necessarily reflect the exhaustion of vasodilatory capacity in patients with severely impaired cerebral circulation. Decrease in the rCBF/ V_0 ratio after ACZ challenge is presumed to represent altered regional cerebral perfusion pressure reflecting a critical hemodynamic status in patients with CVD because post-ACZ reduction of this ratio was closely associated with hemodynamic deficiency in RVC.

References:

- [1] Okazawa H, et al. *J Nucl Med* 2003;44:1875-1883.
- [2] Ohta S, et al. *J Cereb Blood Flow Metab* 1996;16:765-780.

Table: Comparing of rCBF/ V_0 ratio among different symptoms in RVC and all NVC

rCBF/ V_0 (min^{-1})	RVC Ipsilateral		NVC Ipsilateral
	Stroke (n = 8)	TIA (n = 12)	(n = 17)
Baseline	25.7 ± 6.9	24.1 ± 5.0	20.9 ± 4.3
Post-ACZ	$16.9 \pm 4.9^*$	21.5 ± 4.5	20.8 ± 4.7
% Change	$-8.8 \pm 5.2^\dagger$	-2.6 ± 2.3	-0.1 ± 2.7

* $p < 0.05$, $^\dagger p < 0.01$, comparing the 3 groups (one-way ANOVA and post-hoc Sheffe's *F*-test).