頸動脈内膜剥離術後過灌流による大脳皮質神経細胞障害と高次脳機能障害：IMZ-SPECTによる検討

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１はじめに

頸動脈内膜剥離術後過灌流のうち臨床症状を呈するものは過灌流症候群とされ、わずか1%に頭蓋内出血を合併する以外は神経脱落症状の残存はないとされてきた[1-5]。一方近年の報告では、術後過灌流は無症候性であっても高次脳機能障害を来し、過灌流症候群を伴った場合、高次脳機能障害は遷延するとされている[4-8]。しかし、ほとんどの症例はMRI上所見がなく、出現したとしても一過性である[8]。^{123}I-iomazenilを用いたSPECTによるbenzodiazepine receptor結合能画像は、神経細胞密度を表す[9-12]。今回我々は、術後過灌流が大脳皮質の神経細胞障害をきたすのか、また大脳皮質の神経細胞障害は術後高次脳機能障害と関連があるのかという問題をIMZ-SPECTを用いて検討した。

２対象と方法

内頸動脈狭窄(>70%)に対し内膜剥離術を行った患者60名を対象とした[13]。IMP-SPECTによる脳血流量の評価は、術前、術直後および術後3日に行った[14,15]。IMZ-SPECTによる大脳皮質神経細胞密度の評価は、術前および術後1ヶ月に行いい3D-SSPを用いて解析した[11,12,16]。高次脳機能障害の評価は、術前および術後1ヶ月に行った[17-20]。

３結果

頸動脈内膜剥離術後過灌流(術前と比較し>100%のCBF増加)および術後高次脳機能障害は、それぞれ9例(15%)および8例(13%)に認められた。術後過灌流とbenzodiazepine receptor結合能低下(95% CIs,2.765～148.804;p=0.0031)は有意に関連した。また術後過灌流(95% CIs,1.183～229.447;p=0.0370)およびbenzodiazepine receptor結合能低下(95% CIs,1.003～77.381;p=0.0496)は、いずれも高次脳機能障害の出現と有意に関連した(図1)。代表症例は77歳男性。左内頸動脈狭窄(95%)に対し、頸動脈内膜剥離術を行った。術直後のIMP-SPECTにおいて、左大脳半球に広範な脳血流

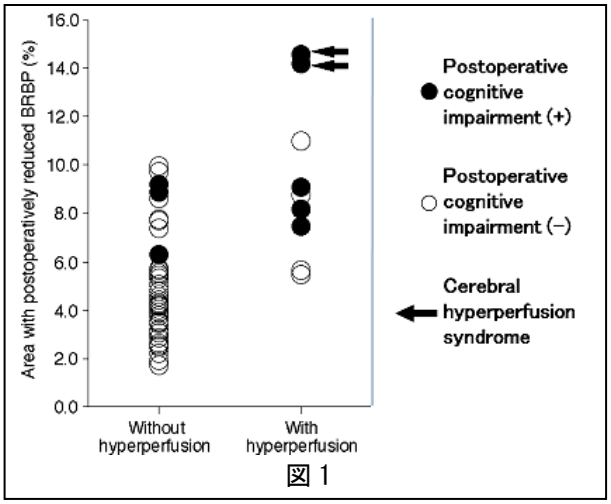

図１

の増加がみられた(図 2A)。この症例は術後高次脳機能障害を来し、術後 1 ヶ月の IMZ-SPECT において左前頭葉を中心に神経細胞障害を認めた(図 2B)。3D-SSP を用いて解析すると、術後の有意な神経細胞障害は大脳半球の 14.3%を占めていた(図 2C)。

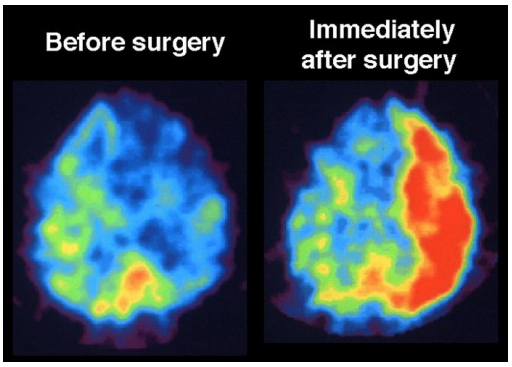

図 2A

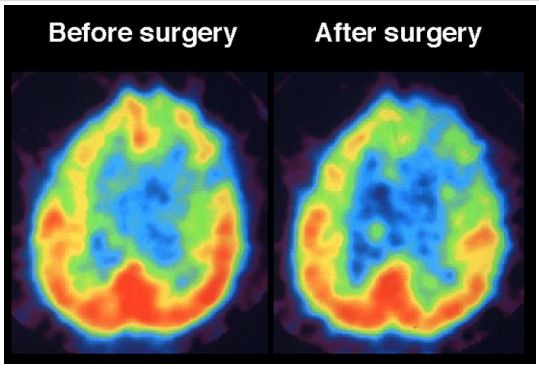

図 2B

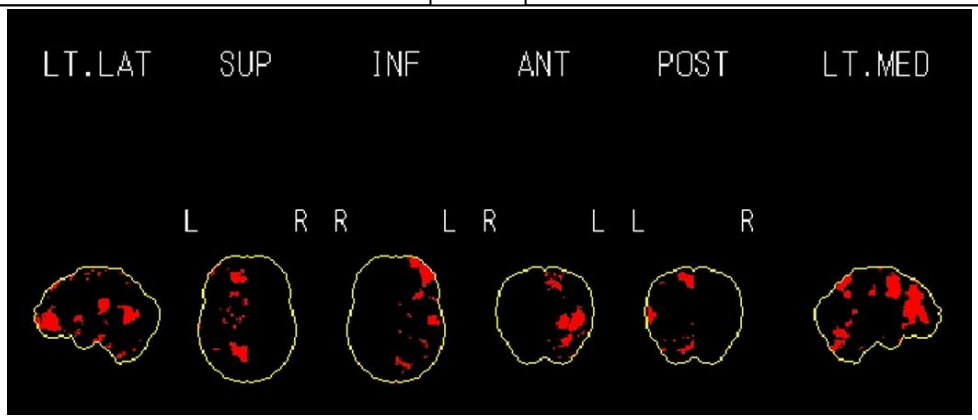

図 2C

４考察

頸動脈内膜剥離術後の神経細胞障害は、術中塞栓や遮断虚血によって生じる可能性もある [21,22]。本研究では術後に DWI にて新たな虚血巣が出現した症例は約 23%であったが、新たな虚血巣の有無と術後の benzodiazepine receptor 結合能低下との相関はみられなかった。また内頸動脈の遮断時間も、術後の benzodiazepine receptor 結合能低下と相関はみられなかった。術後過灌流を来した群における術後の benzodiazepine receptor 結合能低下領域は、過灌流を来さなかった群に比して有意に大きかった。つまり、術後過灌流は術後の大脳皮質神経細胞障害を来すと考えられる。

頸動脈内膜剥離術後過灌流を来した症例において高次脳機能障害を伴う頻度は、約 10%～30%と報告されている [23,24]。しかし、術後高次脳機能障害を来したほとんどの症例において MRI 上所見がない [25]。本研究において術後の benzodiazepine receptor 結合能低下領域は、術後高次脳機能障害を伴った群で有意に大きかった。つまり、頸動脈内膜剥離術後の大脳皮質神経細胞障害は術後高次脳機能障害と関連すると考えた。

過灌流が大脳皮質神経細胞障害を来す機序に関しては、明確なところは不明である。我々は術後過灌流に伴い MRI 上血管原性の脳浮腫を来した症例を経験しており、脳血管関門の破綻が神経細胞障害に関与しているのではないかと考える。

５結語

頸動脈内膜剥離術後過灌流は大脳皮質の神経細胞を障害し、高次脳機能障害を来すと考えられた。

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Postoperative cortical neural loss associated with cerebral hyperperfusion and cognitive impairment following carotid endarterectomy: ^{123}I-iomazenil SPECT study

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Abstract

Background and Purpose

While cerebral hyperperfusion following carotid endarterectomy (CEA) often impairs cognitive function, magnetic resonance imaging does not always demonstrate structural brain damage associated with postoperative cognitive impairment. The purpose of the present study was to determine whether postoperative cortical neural loss, which can be detected by ^{123}I-iomazenil (IMZ) single-photon emission computed tomography (SPECT), is associated with cerebral hyperperfusion following CEA and whether it correlates with postoperative cognitive impairment.

Methods

In 60 patients undergoing CEA for ipsilateral ICA stenosis (> 70%), cerebral blood flow (CBF) was measured using *N*-isopropyl-*p*-[^{123}I]-iodoamphetamine SPECT before and immediately after CEA and on the third postoperative day. The distribution of benzodiazepine receptor binding potential (BRBP) in the cerebral cortex was assessed using ^{123}I-IMZ SPECT before and one month after surgery and was analyzed using three-dimensional stereotactic surface projection. Neuropsychological testing was also performed preoperatively and at the first postoperative month.

Results

Post-CEA hyperperfusion (CBF increase >100% compared with preoperative values) and postoperative cognitive impairment were observed in 9 patients (15%) and 8 patients (13%), respectively. Post-CEA hyperperfusion was significantly associated with postoperative hemispheric reduction of BRBP (95% CIs, 2.765 to 148.804; $p = 0.0031$). Post-CEA hyperperfusion (95% CIs, 1.183 to 229.447; $p = 0.0370$) and postoperative hemispheric reduction of BRBP (95% CIs, 1.003 to 77.381; $p = 0.0496$) were also significantly associated with postoperative cognitive impairment.

Conclusions

Cerebral hyperperfusion following CEA results in postoperative cortical neural loss that correlates with postoperative cognitive impairment.