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Is decompressive craniectomy for malignant middle cerebral artery territory infarction of any benefit for elderly patients?

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Abstract

Background: Malignant middle cerebral artery (MCA) infarction is characterized by mortality rate of up to 80%. The aim of this study was to determine the value of decompressive craniectomy in patients who present with malignant MCA territory infarction and to compare functional outcome in elderly patients with younger patients.

Methods: Patients with malignant MCA territory infarction treated in our hospital between January 1997 and March 2003 were included in this retrospective analysis. The National Institutes of Health Stroke Scale (NIHSS) assessed neurologic status at admission, operation, and at 1 week after surgery. All patients were followed up for assessment of functional outcome by the Barthel Index (BI) and the modified Rankin Scale (RS) at 3 to 9 months after infarction.

Results: Twenty-five patients underwent decompressive craniectomy. The mortality was 7.7% in younger patients (ages <60 years) compared with 33.3% in elderly patients (ages ≥60 years) ($P > .05$). All patients had significant decrease of NIHSS after surgery ($P < .001$). At follow-up, younger patients who received surgery had significantly better outcome with mean BI of 75.42 and Rankin score of 3.00; however, none of the elderly survivors had a BI score above 60 or a Rankin score below 4.

Conclusion: Decompressive craniectomy in younger patients with malignant MCA territory infarction improves both survival rates and functional outcomes. Although survival rates were improved after surgery in elderly patients, functional outcome and level of independence were poor.

Keywords: Decompressive craniectomy; Cerebral infarction; Middle cerebral artery (MCA); Elderly patients

1. Introduction

The management of ischemic stroke has evolved greatly over the past 2 decades. Large multicenter trials and studies provide many believable proof of the value of intravenous thrombolysis with thrombolysis recombinant tissue plasminogen activator, anticoagulants, antiplatelet agents, and so on. There is strong evidence that outcomes after stroke can be improved and that death or disability from stroke can be reduced with appropriate treatment [1,8,9,14].

Despite these advances, there is still a subpopulation of patients who deteriorate rapidly after hospital admission for cerebral infarction, with a mortality approaching 80% when treated conservatively [4,11,25]. This accounts for 10% to 15% of supratentorial infarction cases [10,18] and involves the entire MCA territory. They may have concomitant ACA or PCA territory involvement. This "malignant" MCA territory infarction suffers from progressive clinical deterioration because of increasing brain swelling, raised ICP, and brain herniation. This patient subpopulation constitutes a particularly difficult challenge for clinicians charged with their cases. Considering the high mortality with conservative treatment, therapy for malignant MCA territory infarction should be more aggressive.

Decompressive craniectomy was first described by Kocher in 1901 for the treatment of posttraumatic brain edema [3,19,26]. The rationale for decompressive surgery is

Abbreviations: ACA, anterior cerebral artery; BI, Barthel Index; CT, computed tomography; DSA, digital subtraction angiography; ICP, intracranial pressure; MCA, middle cerebral artery; MRI, magnetic resonance imaging; NIHSS, National Institutes of Health Stroke Scale; PCA, posterior cerebral artery; RS, modified Rankin Scale.

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to reduce ICP and the vicious circle of extensive edema and further infarction. Several authors worldwide have shown that decompressive craniectomy not only reduces mortality, but can also result in good functional outcome [6,12,16,17,20-22]. Despite these encouraging results, decompressive craniectomy has not gained widespread acceptance, especially in developing countries like China, where the incidence of stroke is much higher. Furthermore, as most stroke victims are elderly patients, however, the benefit of surgery for elderly patients is still questionable [24]. We therefore examined the role of decompressive craniectomy in patients with malignant MCA territory infarction and compared functional outcome in elderly patients with younger patients.

2. Patients and methods

2.1. Patient selection

From January 1997 to March 2003, 25 patients with malignant MCA territory infarction were surgically treated in our department. The criteria for malignant MCA territory infarction were the following: (1) infarction of more than 50% of the MCA territory as defined by computed tomography and/or magnetic resonance imaging with an acute onset of corresponding clinical signs and symptoms (such as hemiplegia, hemianopia, hemianesthesia, progressive deterioration in consciousness); (2) neuroradiologic evidence of local brain swelling such as midline shift of 5 mm or more indicating space-occupying edema. We excluded patients with small infarctions, as they usually were treated successfully by conservative methods. All these 25 patients were first treated using standardized conservative management including controlling good blood pressure, hyperosmolar treatment, hypertonic saline solution, hyperventilation, and so on [23]. Decompressive craniectomy was used as second-line treatment in cases of significant neurologic deterioration, such as further decrease of consciousness to stupor or the development of anisocoria, and National Institutes of Health Stroke Scale (NIHSS) of 20 or more. Meanwhile, informed consent was obtained from the patients' relatives.

The 25 surgically treated patients in this study were divided into 2 groups according to age. Group A (n = 13) included patients whose ages were less than 60 years. Elderly patients (ages $\geq$60 years) were enrolled in group B (n = 12).

2.2. Operative technique

Decompressive craniectomy was done by removing parts of the frontal, parietal, temporal, and occipital squama, resulting in a large bone flap (diameter >12 cm) [22]. A star-shaped durotomy was then opened centered on the flap. To protect major vessels across the dural margins from compression, we used absorbable gelatin with medical mucilage on its bone surface to create a "vascular tunnel" beside the vessels. This may provide free circulation to the herniated brain substance. Dural patch or homologous temporal fascia was placed into the incision for volume-enlarged dural repair. Cranioplasty was done about 3 months after discharge.

2.3. Patient evaluation

Clinical status was rated on admission and at operation or surgical decision time using the NIHSS which was repeated 1 week after surgery. Patients were assessed 3 to 9 months after surgery and the outcome was quantified on BI and the modified RS.

2.4. Statistical analysis

SPSS 11.5 (SPSS Inc, Chicago, IL) for Windows package was used for statistical analysis. All values are expressed as means $\pm$ SE. Paired t test was applied to analyze the difference of NIHSS change within groups. Mann-Whitney nonparametric U tests and t tests were used

Table 1
Characteristics of patients in group A

Patient no.	Sex/age	Location of infarction	Infarction reason	NIHSS			Hours between onset and operation	Follow-up		
				At admission	At operation	After surgery		Time	BI	RS
1	F/19	L.MCA + ACA	Takayasu arteritis	13	20	11	140	9 mo	90	1
2	M/36	R.MCA + ACA	Thrombosis	17	27	9	54	8 mo	85	2
3	M/43	R.MCA	Embolism	14	25	10	43	9 mo	85	2
4	M/45	R.MCA	Embolism	15	23	11	25	3 mo	90	1
5	M/46	R.MCA	Thrombosis	16	28	9	50	3 mo	85	2
6	M/46	L.MCA	Embolism	15	22	12	40	3 mo	75	3
7	F/46	L.MCA + PCA	Embolism	16	28	13	52	8 mo	70	3
8	M/52	R.MCA + PCA	Embolism	15	27	15	29	8 mo	75	3
9	M/54	R.MCA	Embolism	11	26	13	35	9 mo	80	2
10	F/56	R.MCA + ACA	Embolism	13	26	13	35	9 mo	60	4
11	F/56	L.MCA + ACA	Thrombosis	17	27	15	71	3 mo	40	4
12	F/57	L.MCA	Embolism	19	29	19	135	↓26 d	NA	NA
13	M/59	R.MCA + PCA	Thrombosis	17	20	10	34	8 mo	70	3

↓ indicates that patient died at x days; NA, not applicable.