Craniectomy for middle cerebral artery infarction

Malignant middle cerebral artery (MCA) infarction is defined as rapid clinical deterioration and poor outcome as a result of increased intracranial pressure and transtentorial herniation, occuring in 10–15% of supratentorial infarctions and with a mortality rate of up to 80%. The case report by St George et al (p. 702) published in this issue of the *British Journal of Hospital Medicine* aims to increase the awareness of this clinical condition among physicians managing patients with ischaemic stroke and discusses the implications of an early *vs* late referral to the local neurosurgical unit.

The authors present three characteristic cases of malignant cerebral artery (MCA) infarction where early neurosurgical referral improved the long-term outcome for the patient. Although their immediate preoperative condition was consistent with impending supratentorial herniation, the well-timed referral resulted in only mild to moderate disability (Barthel index 60–70) at the 6-month clinical follow up. The authors also highlight the recommendations of the National Service Framework for managing stroke; thus, as the health economic importance of stroke is better understood, we have come to realize that a stroke should be managed as an acute medical emergency ('brain attack').

Hemicraniectomy

Hemicraniectomy can be a life-saving procedure and result in good functional outcomes. In order to reduce the raised intracranial pressure the neurosurgeon performs a large craniectomy with or without duraplasty (the technique where a patch of synthetic material is sewn into the dura), sometimes combining it with an anterior temporal lobectomy or other non-viable brain tissue resection. Craniectomy is used for other emergency conditions, namely traumatic brain injuries with uncontrollable elevation of intracranial pressure; indeed, a randomized trial called RESCUEicp is ongoing in the UK to explore this issue (www.rescueicp.com).

Hemicraniectomy has been shown in retrospective series to improve both survival rates and functional outcomes in younger patients. Certain physical features (nausea, headache, vomiting, drop of Glasgow Coma Scale (GCS) or early somnolescence) are warning signs of a potential herniation and should alert the managing physician. Factors that should be considered are the age of the patient, the clinical presentation, the rate of progression of symptoms, the anatomical involvement (dominant *vs* non-dominant hemisphere) and the extent of the infarction. Thus, older people are less likely to benefit and although survival rates are improved following surgery, functional outcomes and levels of independence are poor (Foerch et al, 2004; Yao et al, 2005). The benefit is higher if the surgery is performed within 24 hours (Schwab et al, 1998), or even within 6 hours (ultra-early decompressive craniectomy) from the time of the diagnosis (Cho et al, 2003).

Large infarct volume (more than 50% of the MCA territory, or more than 200 cm^3) is another factor that might determine poor outcome and should be closely monitored with appropriately timed computed tomography scans (von Kummer et al, 1994; Mori et al, 2004). Thus, patients older than 60 years, preoperative midline shift greater than 10 mm, GCS≤ 7, pupils being of unequal size preoperatively, clinical deterioration within 72 hours of the stoke and an internal carotid artery infarct were predictors of poor outcome in a non-randomized prospective trial of 72 patients (Kilincer et al, 2005).

Reoperations might be necessary in younger patients with larger stroke volumes (Curry et al, 2005). Furthermore, the largest retrospective study so far of 251 patients (multicentre, case-control study) confirmed a 1-month reduction in mortality (odds ratio 0.48 (P=0.12) *vs* controls) and concluded that clinicians tend to choose younger patients for hemicraniectomy and also identified the fact that infarction exceeding the MCA territory into other vascular territories (anterior cerebral artery or posterior cerebral artery) tended to negate the benefits of an operation (Demchuk et al, 2000). However, 1-month mortality rates may subsequently be increased if the patients are followed up for longer (from 31% to 50% within 6 months in one prospective non-randomized study) (Kilincer et al, 2005).

The issue of the benefit of a craniectomy *vs* standard medical management became more prominent in 2002 with the publication of a Cochrane review by Morley et al (2002) highlighting the absence of any class I evidence (evidence provided by one or more well-designed randomized controlled trials, including overviews (meta-analyses) of such trials) to support the use of decompressive surgery for the treatment of cerebral oedema in acute ischaemic stroke. Consequently, the case for well-designed randomized trials has been made in order to resolve these critical questions (Cockroft, 2004).

Randomized trials

It is therefore not surprising that six randomized trials have commenced, namely the Hemicraniectomy and Moderate Hypothermia in patients with severe ischemic stroke (from Zurich, Switcherland), HeaDDFIRST (Hemicraniectomy and durotomy for deterioration from infarction swelling trial from Chicago, USA), HeMMI (Hemicraniectomy for Malignant Middle Cerebral Artery Infarcts from Philippines), HAMLET (Hemicraniectomy after MCA infarction with life threatening oedema trial from Utrecht, Netherlands), DECIMAL (Decompressive Craniectomy in Malignant Middle Cerebral Artery infarcts) and DESTINY (Decompressive Surgery for the treatment of malignant infarction of the middle cerebral artery from Heidelberg, Germany).

The first two have been completed, whereas the last four are ongoing with expected results between 2007 and 2008. The results of the HeaDDFIRST trial have not yet been published. The DESTINY study has so far enrolled 26 patients so far (E Jüttler, personal communication, 2005), whereas the HAMLET study has enrolled 42 patients (J Hofmeijer, personal communication, 2005).

The Hemicraniectomy and Moderate Hypothermia in patients with severe ischemic stroke trial has been completed and has published its results from 36 consecutive patients, concluding that hemicraniectomy in the non-dominant hemisphere proves advantageous when compared with induced moderate (33°C) hypothermia resulting in lower mortality (12% *vs* 47%) and a higher rate of non-fatal complications. The duration of intensive care unit stay did not significantly differ between the two groups, but duration and dose of vasopressors were significantly higher in the hypothermia group. Because this study did not include a control group, it does not warrant definitive statements regarding the efficacy of either craniectomy or moderate hypothermia in reducing mortality (Georgiadis et al, 2002).

KEY POINTS

- Malignant middle cerebral artery infarction occurs in 10–15% of supratentorial infarctions and with a mortality rate of up to 80%. Hemicraniectomy has emerged as a life-saving procedure in these cases.
- No guidelines currently exist regarding the outcome of hemicraniectomy for malignant middle cerebral artery infarction. Randomized trials comparing surgical *vs* non-surgical management are ongoing with expected results in the next 2 years.
- Early surgical decompression in selected group of younger patients has been shown to improve both survival rates and functional outcomes.

Conclusions

No guidelines regarding choice of treatment in patients with large hemispheric stroke are currently available. Thus, the decision on treatment allocation should be individualized. Current literature suggests that early surgical decompression (within the first 24 hours from the time of diagnosis and before clinical signs of herniation syndrome occur) in selected group of younger patients improves both survival rates and functional outcomes. BJHM

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