Neuroimaging Highlight

Editors: Richard Farb, David Pelz

Repeated Hemicraniectomy for Malignant Cerebral Edema: Getting it Right First Time

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Can. J. Neurol. Sci. 2008; 35: 652-654

A 47-year-old previously fit man presented to his local hospital with right-sided headache three weeks after sustaining a neck injury playing hockey. A computed tomogram (CT) scan revealed the presence of a hyperdense right terminal internal carotid artery (Figure 1). Later that day he developed right gaze deviation, left sided weakness and neglect. Further imaging revealed right middle cerebral artery infarction due to probable carotid dissection (Figures 2 and 3). When it was recognized that the patient was suffering an acute stroke, he was beyond the therapeutic time window. In addition, there were already established infarct signs on the CT scan. Thrombolytic therapy was therefore not administered.

The following day the patient became irritable and his consciousness fluctuated. Consent for decompressive hemicraniectomy was obtained from the patient's family who were informed of all possible outcomes. A decompressive hemicraniectomy and expansile duraplasty was performed (Figure 4).

The following day the patient remained sedated but his clinical state was stable. A CT brain scan was performed (Figure 5).

The second postoperative day the patient's right pupil became fixed and dilated. Despite administration of hyperosmolar fluids and hyperventilation, there was no clinical improvement. A repeat CT brain scan confirmed further hemispheric swelling (Figure 6).

Following discussion with the patient's family, a second surgical procedure, removing additional frontal and parietal bone and widening the duraplasty, was performed (Figure 7).

The patient required both a tracheostomy and percutaneous gastrostomy. He went on to undergo intensive rehabilitation in an institution for the following nine months. He can now walk independently but needs help for dressing due to his paralyzed left arm (Figure 8). He retains insight into his functional limitations and therefore becomes tearful when he considers life prior to the stroke but currently does not regret his decision for surgery. This low mood has in part, responded to antidepressants but in depth psychological assessment shows persistent neurocognitive impairments that fall into the moderate to severe range. These impairments make it unlikely that he will return to performing fully in his previous occupation, however, this does not preclude him from making further future improvements with continued support.

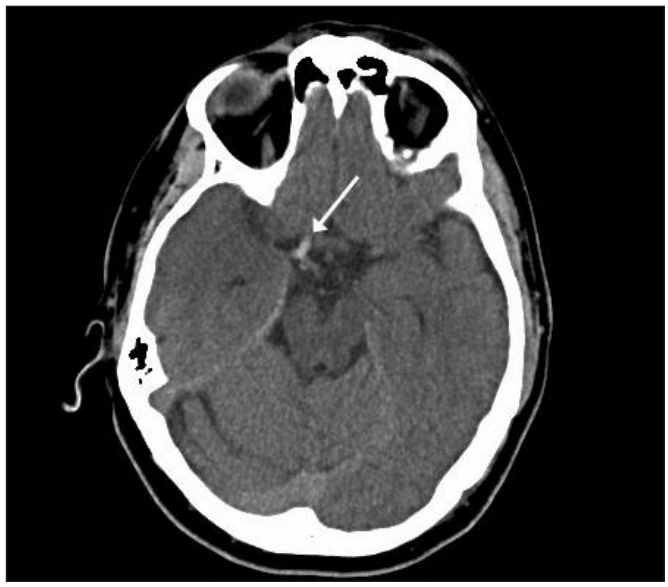

Figure 1: *Non-contrast CT brain scan with hyperdense right terminal internal carotid artery (arrow).*

Complete middle cerebral artery distribution stroke with malignant edema has up to a 80% mortality rate, even with

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Received April 7, 2008. Final Revisions Submitted May 6, 2008.
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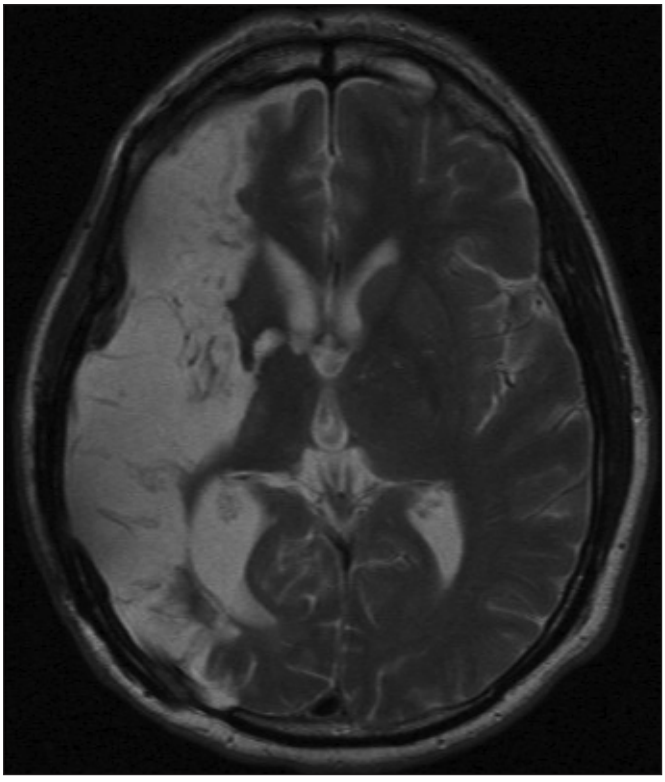

Figure 2: *An axial MRI scan, T2 sequence, showing extensive infarction in the territory of the right middle cerebral artery.*

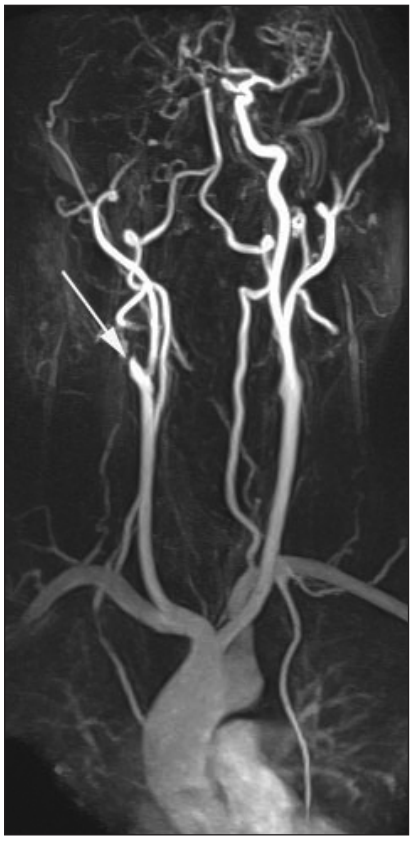

Figure 3: *MR angiogram showing occlusion of the right internal carotid artery distal to the carotid bifurcation (arrow).*

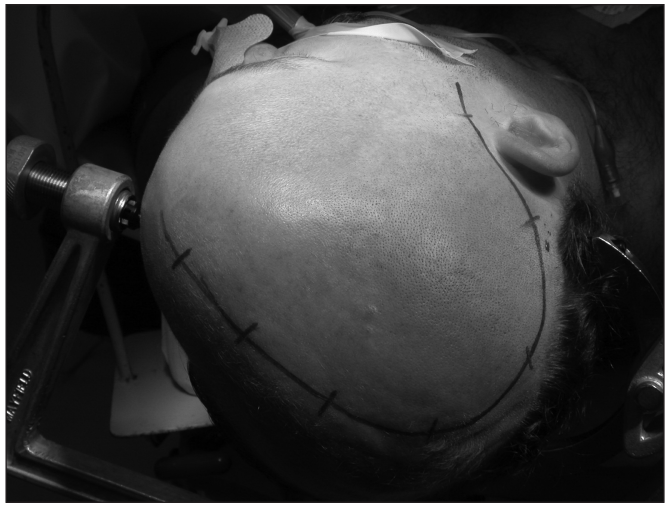

Figure 4: *Planned skin excision for first operation, uncovering extensive portions of the right frontal, parietal and temporal bones.*

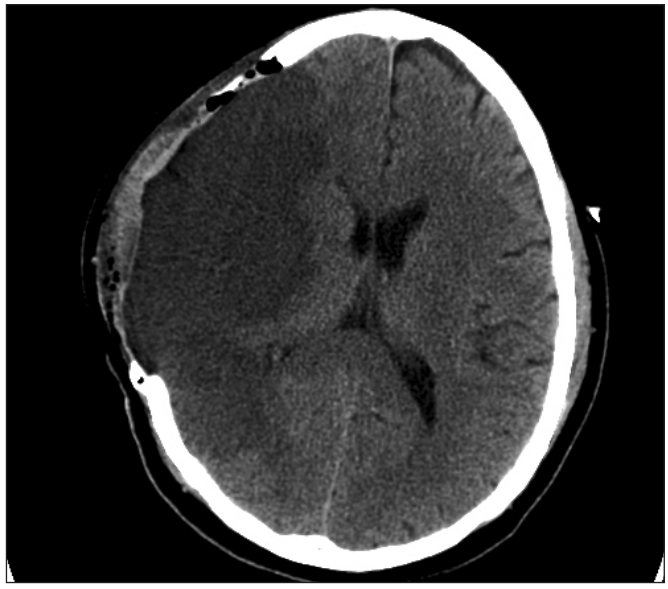

Figure 5: *A CT brain scan following decompressive hemicraniectomy. Note the area of infarction extending beyond the limits of the bone flap posteriorly.*

intensive medical treatment.[1,2] The results of surgical intervention for this condition has recently come to medical attention from the pooled analysis of three randomized controlled trials comparing early decompressive surgery with medical therapy. The combined results showed that hemicraniectomy reduced mortality by one half and tripled "favourable" outcomes.[3] Favourable outcome however, included inability to walk without assistance and requirement for help in daily life. While the results did not depend on the hemisphere affected, only patients less than 60 years of age were included in the trials.

https://doi.org/10.1017/S0317167100009471 Published online by Cambridge University Press

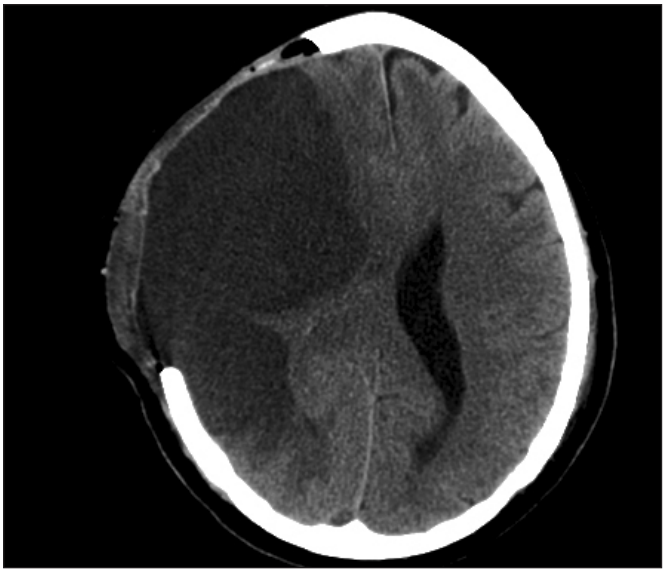

Figure 6: *A CT scan showing increased mass effect with herniation of the swollen brain through the craniectomy.*

Survival and best possible outcome (however defined) are dependent upon an adequate surgical procedure allowing sufficient external brain herniation. This was not achieved in the patient illustrated here, resulting in subsequent uncal herniation and the requirement for additional surgery. While there are no firm guidelines on this recommended size, in the trials mentioned, the target was to excise at least 12 cm of skull. Our suggestions for an adequate craniectomy and decompression are to be found in an accompanying "review article" in this edition of the Journal.

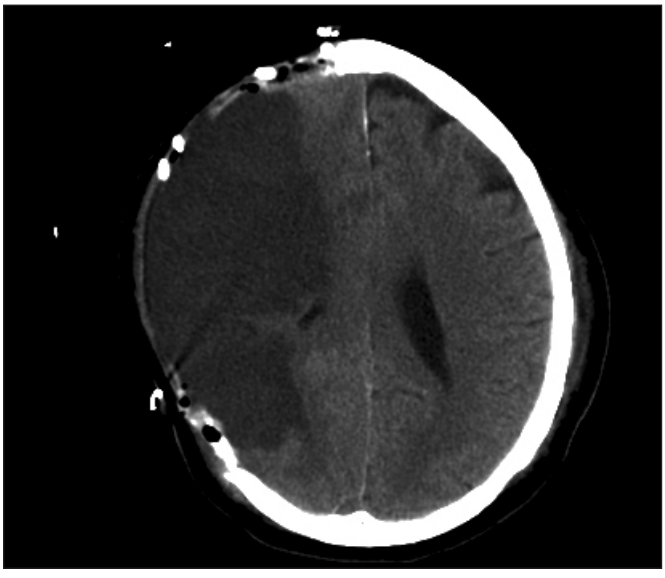

Figure 7: *CT scan following the expanded craniectomy- note the additional bone removed now respects the margin of infarcted brain.*

Expected quality of life levels should be discussed openly with relatives in every case and with patients if possible. They must understand that survival may be accompanied by severely reduced function resulting in loss of independence and occupation. The decision regarding decompression is an enormous and difficult one, but if the choice is for a better chance at life regardless of disability, we wish to point out through the experience shared here, the importance of getting it right the first time.

Figure 8: *Photograph of patient taken 9 months after his stroke.*

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