Surgical Decompressive Hemicraniectomy for a Massive Hemispheric Ischemic Stroke: A Case Report and an Update

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Abstract: The significant space-occupying effect resulting from a complete middle cerebral artery (MCA) infarction leads to a dramatic increase in intracranial pressure, and impairment of level of consciousness ending in coma and brain death within few days in almost 80% of patients treated with medical therapy alone. Survivors are severely disabled with poor quality of life. Decompressive surgery is back on stage as a means of dropping the massive increase in intracranial pressure, and is gaining a momentum after the rekindled interest in this old procedure over the last few years. I am reporting here a patient who had a massive middle cerebral artery ischemic stroke that underwent decompressive hemicraniectomy followed by a review of recent updates.
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Introduction

The significant space-occupying effect resulting from a complete middle cerebral artery (MCA) infarction leads to a dramatic increase in intracranial pressure, and impairment of level of consciousness ending in coma and brain death within few days in almost 80% of patients treated with medical therapy alone. Survivors are severely disabled with poor quality of life. Luckily, this aggressive form of stroke representsless than 10% of all ischemic strokes [1].This complication appears to occur less frequently in elderly patients with similar-sized infarcts, in part because edema may be compensated for by brain atrophy[2].Patients who have a second vascular territory like anterior cerebral artery (ACA), or posterior cerebral artery (PCA) involved fare worse and are in need for an immediate action to save their lives[3].A patient with a complete MCA occlusion is reported here with a review of surgical decompressive hemicraniectomy as the treatment of choice.

Case Report

A 54-year-old right-handed man presented to emergency room (ER) with a history of a left sided weakness. Family last saw him well at lunch time, when he ate lunch then they left him to take a nap. He did not wake up as expected, so family checked on him to find him unable to move his left side. Apparently, he was trying to call for help but he was not heard. There was an extra delay in transporting him to ER in the family private car. By the time he arrived to ER, four hours have elapsed since he was last seen well. On arrival to ER, his initial set of vitals showed a blood pressure of 180/100 mmHg, heart rate was 80 beats per minute and was regular, temperature 37 °C, O_2 saturation 98% on room air. He was awake and oriented. He had a gaze preference to the right side and a complete neglect to the left. He had upper motor neuron facial palsy on the left and his power testing was 0/5 over the left side, arm and leg, and normal on the right. His reflexes were brisk with clonus on the left with up going planter, and normal reflexes on the right. Tone was normal on the right side and decreased on the left. His NIH Stroke Scale (NIHSS) score was 20.His vascular risk factors included a reasonably controlled type 2 diabetes requiring insulin, for over 20 years, and hypertension on enalapril. He is a non-smoker with no past history of ischemic heart disease, transient ischemic attack, stroke or atrial fibrillation.

His initial non enhanced computerized tomography (CT) scan (Figure 1) showed early changes in grey white matter differentiation involving complete right MCA territory with no mass effect or midline shift. A brain magnetic resonant imaging (MRI) was done few hours later (Figure 2) that showed a hyper intense T2 signal involving the complete right MCA distribution on T2 diffusion weighted imaging (DWI), with a correspondent dark signal on apparent diffusion coefficient (ADC) map (Figure 3). Magnetic resonance angiogram (MRA) showed a non-visualization of the distal portion of the right internal carotid artery, and right MCA.

Because of the extensive ischemic region, a massive swelling and an early herniation were anticipated and a discussion with the patient's family led to the consideration of surgical decompression of the ischemic right hemisphere. He was transferred to the critical care unit (ICU) and he had a right decompressive hemicraniectomy done at 36 hours since he had the stroke.

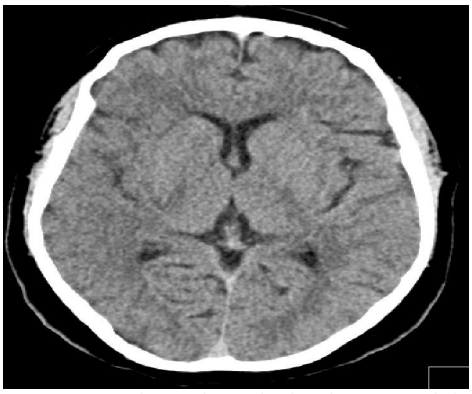

Figure 1: A non-enhanced CT brain shows a subtle hypo density involving the right frontal lobe with loss of grey – white differentiation more marked at the insular ribbon indicating an early ischemic stroke.

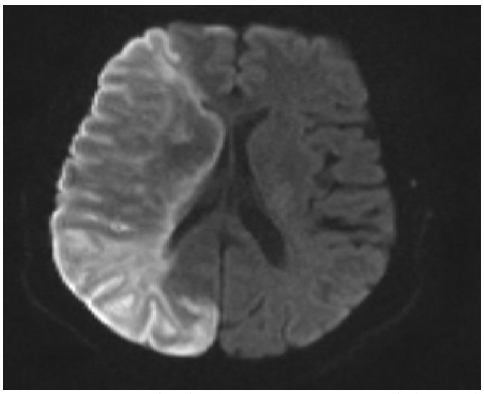

Figure 2: A T2 MRI brain (DWI sequence) of the patient in figure 1 few hours later demonstrating a bright signal in the complete right MCA territory indicating restriction of water movement that represents an acute ischemia (see figure 3).

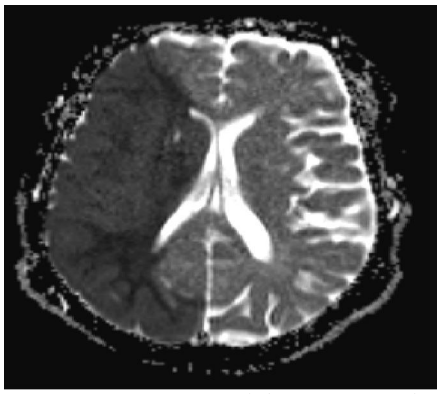

Figure 3: An MRI ADC map of the same area depicted in figure 2 shows a dark signal in the right MCA distribution. Taken with DWI sequence in figure 2, both indicate an acute ischemia in the whole right MCA territory.

After returning to ICU, his EKG tracing showed atrial fibrillation. His neurological exam showed a fixed mid-sized non-reacting pupil on the right, and a slowly reacting one on the left. His other brainstem reflexes including doll's eye, corneal, grimacing, cough and gag reflexes were intact. A repeat CT scan post-surgery showed thecomplete right MCA infarction and the craniectomy site with a healthy looking left hemisphere (Figure 4).

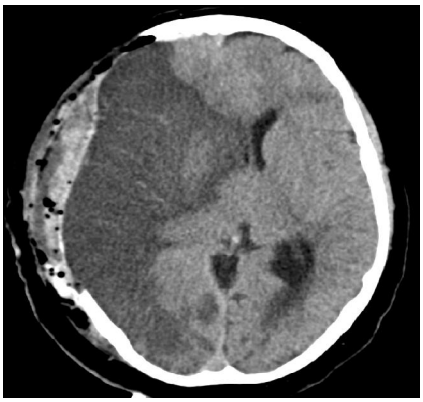

Figure 4: A non-enhanced CT brain shows post-surgicaldecompression changes, and an established complete right MCA territory ischemic infarction

Three days later, he was requiring less ventilatory support, andhe was switched to pressure support mode. Arterial line tracing signal in his left radial artery was lost, and a doppler ultrasound of his left brachial artery showed a complete occlusion. He was taken by vascular surgery team to the surgical theater and he had that clot removed uneventfully.Clinical status remained unchanged and he had a tracheostomy and a discharge from ICU was planned over the next few days. At day 7 after decompressive surgery was done, he deteriorated over night and required more ventilatory support. A repeat CT brain (Figure 5) showed a new ischemic stroke in the left healthy hemisphere around the occipital horn of the lateral ventricle with a new hemorrhage in the pons (Figure 6).

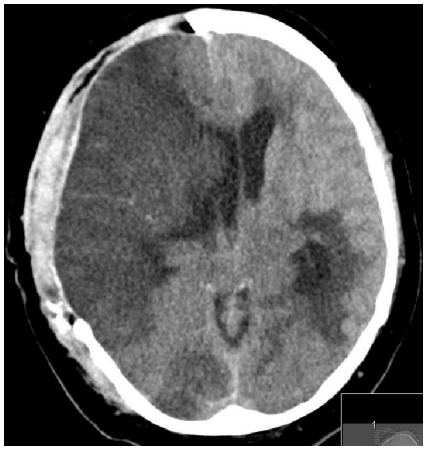

Figure 5: A non-enhanced CT brain shows a new left posterior hemispheric hypo density around the posterior horn of left lateral ventricle representing a new ischemia.

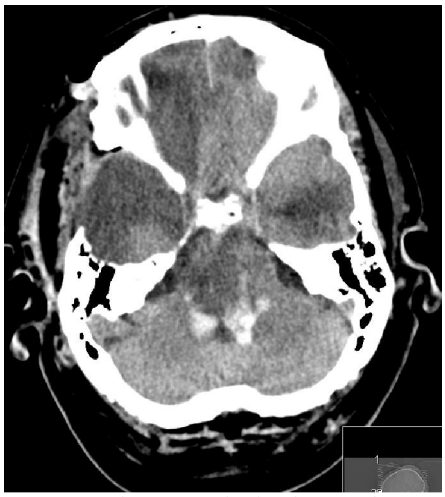

Figure 6: A non-enhance CT brain shows a lower cut than figure 5, at the pons level, demonstrating a hemorrhage in and around the pons with pontine expansion.

He lost all his brainstem reflexes over the next twelve hours. His family was informed and a withdrawal of care followed shortly.

A Discussion and an Update

Intermittent atrial fibrillation was possibly the culprit in this complete MCA ischemic stroke, whichdespite the early surgical decompressive hemicraniectomy did not fare well, and he had a recurrent ischemia and a brainstem hemorrhage leading to withdrawal of care.After abandoning decompressive hemicraniectomy for years for being "too aggressive", it was brought back on stage as a life-saving procedure for patients deteriorating after a large hemispheric stroke [4, 5]. A relatively recent case series with a favorable outcome rekindled the interest in using hemicraniectomy very early after a large hemispheric stroke [6]. Females and patients with MCA plus another vascular territory infarction on initial CT scan fared worse in one series[3].Patients with large hemispheric stroke deteriorate quickly, with brain stem compression first causing deterioration of consciousness, usually followed by a brainstem dysfunction [7, 8].Mortality jumps to 70% once level of consciousness is impaired,even with medical treatment maximized [3, 9]. Decompressive hemicraniectomy reduces mortality from 80% to around 20% [6, 10]. A recent pooled analysis of three major controlled trials demonstrated the potential benefit of the decompressive hemicraniectomy[11]. In this pooled analysis, individual data for patients aged between 18 years and 60 years, with space-occupying MCA infarction, included in one of the three trials, and treated within 48 hours after stroke onset were analyzed. The study concluded that "in patients with malignant MCA infarction, decompressive surgery undertaken within 48 hours of stroke onset reduces mortality and increases the number of patients with a favorable functional outcome". It stressed that "decision to perform decompressive surgery should, however, be made on an individual basis in every patient". An early discussion with the patient and his/her family, once the large stroke size is appreciated on initial imaging, is warranted, so an early decompressive hemicraniectomy can be planned in advance rather than been rushed into once signs of impending herniation start appearing.

Conclusion: Early recognition of large ischemic strokes that either involve a complete MCA territory or more than one vascular territory is critical, as decompressive hemicraniectomy can save lives. Involvement of either hemisphere should have no impact on the decision to operate, as survivors of dominant and non-dominant hemispheres decompressive surgeries did not differ in outcome.

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