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Decompressive Craniectomy in MCA Infarct Patients: An Institutional Experience

Raja K Kutty[1], Jyothish LS[2], Paresh Korde[3], Anil P[4], Rajmohan BP[5]

[1]Assistant Professor, Dept of Neurosurgery, Govt Medical College Trivandrum

[2]Associate Professor, Dept of Neurosurgery, Govt Medical College Trivandrum

[3]Senior Resident, Dept of Neurosurgery, Govt Medical College Trivandrum

[4]HOD &Professor, Dept of Neurosurgery, Govt Medical College Trivandrum

[5]Professor & Unit Chief, Dept of Neurosurgery, Govt Medical College Trivandrum

Abstract: ***Decompressive craniectomy as a surgical treatment for brain edema has been performed for many years and for several different pathophysiologies, including malignant middle cerebral artery (MCA) infarct. The purpose of this article was to share author's experience with decompressive craniectomy in malignant MCA infarct with special insight on what all needs to be done at a tertiary centre level without stroke clinic when an MCA infract patient is encountered, so as to improve the outcome in terms of morbidity and mortality by timely intervention.***

Keywords: MCA Infarct, Decompressive Craniectomy, Stroke Clinic, Outcome, mRS

1. Introduction

So-called "malignant" middle cerebral artery (MCA) territory infarction is the most devastating form of ischemic stroke. Death or neurological devastation results from progressive swelling of the infarct, brain tissue shifts, compartmentalized elevation of intracranial pressure, and the extention of ischemia to adjoining vascular territories. Decompressive hemicraniectomy and duroplasty for malignant MCA territory infarction is intended to prevent the death spiral by normalizing intracranial pressure, restoring compromised flow in the penumbra and adjacent vascular territories, and restoring the midline position of the brain stem and diecephalon.Several case series and nonrandomized casecontrol studies have suggested that hemicraniectomy can improve survival,but the evidence has been far from definitive, particularly regarding the extent of residual handicap in those who survive the procedure. Given the lack of evidence from clinical trials to date, hemicraniectomy has remained one of the most controversial and hotly debated topics in stroke care. Is it "radical surgery" that only leads to more pain and suffering, or a beneficial procedure that can give some patients a second chance on life? Several trials including HeADDFIRST , DESTINY, DECIMAL, HAMLET and their metaanalysis were undertaken to judge the place of decompressive craniectomy and duraplasty in management of malignant MCA infarct. We also evaluated patients of MCA infarct patients addmitted at our institute undergoing surgery, in terms of outcome and the prospects which would had improved the outcome at the tertiary level hospital settings. We present our experience of patients of MCA infarct who underwent decompressive craniectomy in last 2 yrs.

1.2 Literature Survey

The concept of decompressive surgery for treatment of elevated intracranial pressure has been developed already in the beginning of the 20th century.[1] The rationale of this treatment modality consists of opening of the skull and removal of a bone flap to allow the edematous brain to swell outward, thereby preventing intracranial tissue shifts and life-threatening downward herniation. The use of decompressive hemicraniectomy (DHC) in the context of ischemic brain edema had been reported already in 1956.[2] Since that time, DHC has been increasingly studied in the setting of different conditions, including traumatic brain injury, subarachnoid hemorrhage, and malignant middle cerebral artery (MCA) infarction.

Depending on the location of the affected area, different surgical decompression techniques have been developed. In the presence of diffuse brain edema without a midline shift, as commonly seen in traumatic brain injury, bilateral (eg, bifrontal) craniectomy has been advocated. Hemicraniectomy, or removal of a frontotemporoparietal bone flap, is suitable in patients with unilateral hemisphere swelling as seen after ischemic stroke.[3] Accumulating experience with DHC over the years has led to increasing refinement of the surgical technique. The size of the removed bone fragment has been recognized as a factor of crucial importance for generation of a sufficient decompressive effect.[4] Hemicraniectomy with a diameter of ≤10 cm, especially in combination with sharp trepanation edges, has been associated with an increased incidence of shearing injury to the herniated brain.[4]Furthermore, dural opening, usually followed by insertion of a dural graft (duraplasty), has meanwhile become an integral part of the decompressive surgery technique.[3]

1.3 Functional Outcome and Quality of Life

Early hemicraniectomy significantly reduces mortality after malignant MCA infarction; however, it also increases the probability of survival with moderately severe disability (mRS of 4). With approximately 40% of survivors becoming disabled after decompressive surgery, the question arises if a mRS of 4 (unable to walk without assistance and unable to attend to own bodily needs without assistance) can be considered a favorable outcome. Looking at motor function, the benefit of surviving largely outweighed by the high incidence of moderately severe or severe disability in survivors.[5] However, the more important question is if the mRS is an adequate outcome measure in those patients. From the patients' perspective, neuropsychological deficits, aphasia, or depression may have an equally strong impact on quality of life as compared with motor function. Other factors such as psychosocial environment, caregiver burden, familial support, and financial support should be additionally considered in this context. The prospective trials and pooled analyses published to date[6-9] do not provide conclusive results on quality of life and depression in patients who survived malignant MCA infarction after surgery, and those aspects certainly deserve further investigation.

1.4 Timing of Surgery

From the pathophysiological point of view, earlier decompression should prevent brain tissue damage by avoiding or reducing exposition to increased intracranial pressure in the course of development of ischemic brain edema. On the other hand, poststroke edema often peaks later than 48 hours after symptom onset. Therefore, there might be a wider time window within which decompressive surgery may be beneficial for such patients. This aspect has not been sufficiently addressed in the 3 European RCTs. The pooled analysis from 2007 could not demonstrate any difference in functional outcome, comparing patients treated earlier versus later than 24 hours after symptom onset[9]; however, all patients included in that analysis were treated within 48 hours. The HAMLET study allowed delayed surgery up to 96 hours after stroke onset, and secondary outcome analyses showed that surgery within 48 hours significantly reduced the probability of severe disability or death (mRS 5 or 6), whereas delayed hemicraniectomy did not influence outcome.[8] However, considering the small number of patients who received surgery beyond 48 hours (n=11), no final conclusion can be drawn. Further data on timing of decompressive surgery are derived from observational studies, which have brought up contradictory results. Although some studies report reduced mortality and improved outcome with early treatment, as compared with treatment after clinical deterioration,[10-12] a systematic review published in 2004, including all data reported up to that date, could not confirm this finding.[13]This issue certainly deserves further investigation to identify the optimal time window for decompressive surgery after malignant MCA infarction. In the absence of other conclusive data and considering the findings reported from RCTs as well as the pathophysiological background, at present, early decompression (<48 hours after symptom onset) seems to be beneficial.

1.5 Age Limit for Surgery

None of the RCTs investigating hemicraniectomy in malignant MCA infarction included patients >60 years. Because a considerable proportion of the patients experiencing this type of stroke belong to this age cohort,[14] it still remains unclear if those patients would benefit from surgical treatment. Data from observational studies indicate that hemicraniectomy may lead to improved survival, however, at the cost of poor outcome and functional dependency in patients >60 years of age.[14,15] Moreover, age was identified as a major factor influencing outcome in a systematic review of 138 patients treated with hemicraniectomy.[13] This finding could not be confirmed in the pooled meta-analysis of the 3 European RCTs published in 2007.[9] The HAMLET trial even found a trend toward better outcome in the upper age range (51 to 60 years) as compared with younger patients treated with hemicraniectomy.[8]

2. Aim and Objectives

To study…
Role of decompressive craniectomy in malignant MCA infarct in patients aged below 60 years and above 60 years
Factors influencing the outcome of patients, in order to create awareness of the disease, indications and decision-making processes for surgical intervention

3. Materials and Methods

Totally, 20 patients who underwent decompressive craniectomy after malignant MCA infarction between January 2015 and December 2016 at tertiary care hospital were analyzed for timing of ictus to diagnosis , preoperative clinical condition, timing of ictus to surgery and location and extension of infarction with associated imaging findings. The outcome was assessed in terms of mortality and scores like modified Rankin scale (mRS).

This retrospective study included a total of 20 patients who underwent decompressive craniectomy after malignant MCA infarction between January 2015 and December 2016 at our institute. Clinical characteristics included preoperative clinical condition, timing of surgery, cause, location, and extension of infarction. In addition, the time delay from the onset of symptoms to diagnosis and surgery and preoperative signs of herniation and their relation to the final outcome was analyzed. The final outcome was assessed in terms of mortality and scores such as modified Rankin scale (mRS). Functional outcome was divided into two groups: Favorable outcome (mRS score 0–3) versus poor outcome (mRS score 4–6).

Patients with poor GCS (<4) with pupils dialated and fixed , with or without inotropic support were excluded from the study.

On addmission pt were clinically evaluated in medicine wards and radiologically screened with NCCT brain. According to the CT scan findings which included malignant MCA territory infarct with subsequent edema causing mass

effect and mid line shift of >5mm with or without anisocoria were taken up for surgery after explaining the due risk associated with surgery and prognosis postop to the bystanders and after obtaining their written informed consent for the same. Postop patients were nursed in neurosurgery ICU. Patients POD 2 and POD 5 score were taken into account and once patient shifted to ward were assessed on mRS and also at 3 months and 6 months interval. During surgery decompressive craniectomy were performed using wide Fronto- Temporo-Parietal skin flap. The burr holes were connected using an electrical drill, with subsequent removal of a 12 cm × 15 cm free bone flap on affected side. The dura was usually opened with a stellate incision in the areas involving the frontal, temporal and parietal lobes extensively. Cortical resection was not performed in any patients. After duraplasty using G patch , the temporal muscle was loosely re-approximated to the healthy dura and the skin flap was then closed in two layers.

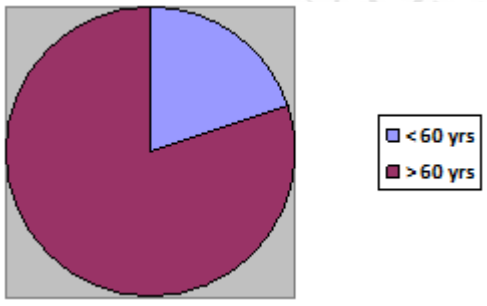
4. Results

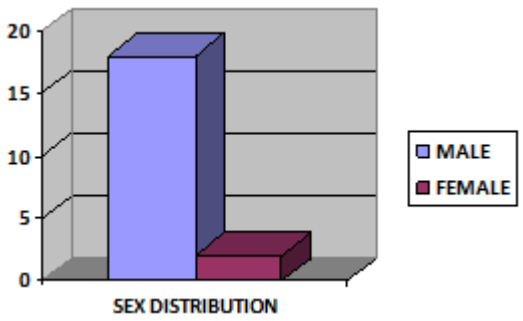
Total 20 patients underwent decompressive craniectomy for MCA Infarct with indications as per our inclusion and exclusion criterias. Amongst our sample size -

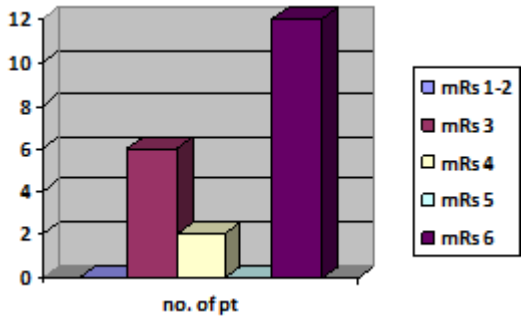
Patients with –
Age <60 yrs - 16
Age > 60 yrs - 4
Sex - Male - 18 Female- 2
Infarct on Left - 16 Right – 4

- Time interval from ictus to admission at tertiary centre- avg 1day (range 12hrs -3 days)
- Time interval from ictus to diagnosis - avg 72hrs (range 1-6 days)
- Time interval from diagnosis to surgery - <12 hrs
- Time interval from ictus to surgery - >24 hrs
- Total no. of deaths – 12
- No. of pt with unfavourable (4-6)mRs- 12
- No. of pt with favourable (0-3)mRS – 6

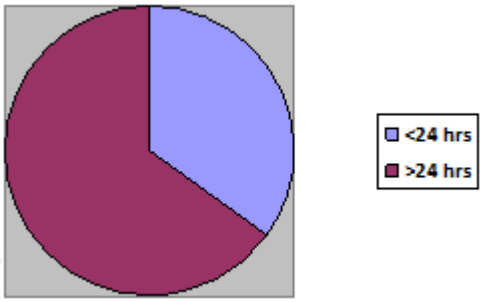
Age Distribution







Patients Outcome on Modified Rakin Score



Time Interval from Ictus to Diagnosis

Totally, 20 patients aged between 22 and 80 years (mean age was 54.92 ± 11.8 years) were analyzed in this study. Approximately, 20% patients were older than 60 years. Approximately, all patients operated within 24 h of diagnosis (20 patients) with 30 % pt has mRS 0–3 at discharge while 10% patients operated had mRS 4 at discharge and rest 60% pt operated expired (mRs 6). 80 % patients aged below 60 years had mRS 0–3 at discharge while only 20 % patients aged above 60 years had expired (mRS 6) which was significant. Also the time interval from ictus to admission at tertiary hospital was approximately 24 hrs (all the pt age >60yrs were found to be admitted after 24 hrs), the time interval from ictus to diagnosis was >24 hrs in 65% pt and time interval from ictus to surgical intervention in the two age groups namely above 60 yrs and below 60 yrs was invariably > 24 hrs due to delay in diagnosis or delay in admission

From our study we infer that there is obvious delay at the bystanders level and the time interval from ictus to the imaging proven diagnosis which has significantly hampered outcome of our study. If the bystanders would had been educated and aware enough of the disease then the disease could have been addressed at early stages. Unnecessary hospitalisation at local hospital and conservative management for days together after the ictus without proper neurological evaluation led the patients to pay with their lives.Unwillingness of bystanders for surgical intervention in view of old age of pt and postop morbidity and also financial constraints has led to the unfavourable outcome .Also delay in pick up of infarct on initial CT brain followed by repeat CT suggestive of flarred up imaging findings depicted the need for emergency MRI brain which is another restricting factors at tertiary level hospital without flourished STROKE CLINIC. At our centre where one MRI machine is catering numerous patients from different medical and surgical disciplines, emergency MRI Brain to screen for MCA infarct is another challenging hurdle. Other factors like old age and associated co-morbidities has also added on the poor outcome. We wonder our outcome would

had been even more worse if our exclusion criteria was not in play.

5. Conclusion

Decompressive craniectomy has reduced morbidity and mortality especially in people aged below 60 years and those operated within 48 h of malignant MCA stroke though those operated outside 48 h of stroke are likely to end up with mortality with add risk factors of old age, delay in hospitalization with added delay in the diagnosis owing to failure of timely imaging studies. This all loop holes in the diagnosis and management can be addressed by establishing a full fledge STROKE CLINIC with its own imaging and interventional/procedural theatres and critical care units for the most required timely intervention. Public awareness in terms of stroke will also help to save more life with less morbidity."A STTCH IN TIME SAVES NINE" – Early medicinal management may perhaps prevent patients landing up in operation theatres for moribund surgeries and compelling both doctors and relatives from keeping their fingers crossed for better outcome of the patient.

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