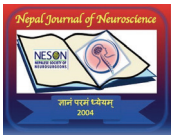
Early versus late decompressive craniectomy in large middle cerebral arterial infarct- A stitch in time saves nine



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Abstract

Introduction: The etiology of malignant MCA infarctions is mostly due to thrombosis or embolic occlusion of either the internal carotid artery or the proximal MCA. The cornerstone of ischemic stroke diagnosis remains the history and neurological examination. A prospective study to compare outcome of early verses late decompression craniotomy was done at a tertiary care hospital in India.

Methods and Materials: A prospective observational study in the neurosurgical department of a tertiary care hospital of India, for a period of 3 years from 2018-2021. A total of 30 patients (15 each for early and late decompressive craniectomy respectively) were included in study after fulfilling inclusion criteria. The patients were followed up for next 6 months with neuro examination and score making done after every 1 month, 3 months and 6 months of-decompressive craniotomy. To find the significance between early and late group of patients we have used 2 independent sample t-test for age. For MRS and Barthal index at 1st month, 3rd month and 6th month, Hospital stay we have used Mann-Whitney U test (Non-parametric test) because the data type is ordinal or not following normal Distribution/ skewed. All statistical test performed at 5% level of significance so the p-value < 0.05 considered as significant.

Results: The majority of patients were male in both the groups – early group 9 (60%) and late group 12 (80%). The mean age group for early and late groups was 44.07 and 42.87 years respectively. The comparison of MRS score in early and late group was not statistically significant at 1st month of follow up, however it showed significant difference at 2nd and 6th month respectively. MRS score with respect to affected side, in both the early and late group showed statistically significant difference at 6 months of follow up respectively. The Barthel index with respect to affected side showed significant difference in early group whereas in the late group significant difference was seen at 6th month of follow up only. The outcome of patients was not affected by side of involvement in both groups early as well as late. The mean hospital stay in early group was 14.8 days in comparison to late group where it was 42.47 days.

Conclusion: The results of the present study indicate that early surgical intervention for decompression craniectomy in cases of MCA infarct have better outcome than late intervention with shorter hospital stay better functional outcome at discharge and 6 months post discharge.

Key words: Decompressive craniectomy, Middle cerebral arterial infarct, Stroke

Introduction

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Malignant MCA infarctions constitute between 1% and 10% of all supratentorial ischemic strokes and treatment of this disorder has been a major unsolved problem in neurocritical care.[1,2] Patients with malignant MCA infarctions show a progressive deterioration of consciousness over the first24–48 h and commonly have a reduced ventilatory drive, requiring mechanical ventilation.3,4 regardless of the underlying pathology, all types of stroke are associated with accompanying

brain edema, which is classified traditionally into three subtypes: vasogenic, cytotoxic and interstitial.

Clinically, the formation of serious brain edema after MCA infarction follows a uniform course beginning with compression of the ventricular system, subsequent brain tissue shift, usually to the contralateral side, compression of formerly healthy brain structures, and later a critical increase of intracranial pressure (ICP) with subsequent complications such as compromised cerebral blood flow, and finally transtentorial or transforaminal herniation and death. Under standard care up to 80% of patients meet this fate within the first week after symptom onset.[5-10] The term ''malignant MCA infarction'' was coined 2 for these catastrophic infarctions.

The etiology of malignant MCA infarctions is mostly due to thrombosis or embolic occlusion of either the internal carotid artery or the proximal MCA. Depending on anatomical variances, the anterior and/or posterior cerebral artery territories might be involved concomitantly.[9] Within 24–48 h of stroke, there is usually a progressive deterioration in the patient's level of consciousness owing to the commonly associated serious brain swelling that develops within 1–5 days after stroke.[6,11] The resulting increased intracranial pressure and tissue shifts lead to further destruction of formerly healthy brain tissue giving rise to the term malignant MCA infarction.[2] These large cerebral infarctions often result in severe shifting of midline structures with subsequent uncal or even transtentorial herniation,[12] and thus have been associated with a poor prognosis in more than 80% of cases.[7,8,9]

The pathophysiological processes that lead to malignant MCA infarction are not yet completely known.[9]

The cornerstone of ischemic stroke diagnosis remains the history and neurological examination. The evolution of neuroimaging techniques, however, has enhanced the assessment of brain lesion localization and site of clot formation in the extra- and intracranial arteries. The clinical presentation of stroke is typically an abrupt onset of focal neurological signs and symptoms corresponding to a given cerebrovascular territory. The differential diagnosis includes processes that may mimic stroke, such as hypoglycemia, post ictal paralysis, atypical acute presentations of brain neoplasms, infections (eg, brain abscess and encephalitis), and immune demyelination [10]. Findings on nonenhanced brain computed tomography (CT) may be negligible or subtle in the first several hours after ischemic stroke onset. These findings initially include loss of gray–white matter differentiation in the insular or basal ganglia regions and sulcal effacement without hypodensity. In the hyperacute setting, magnetic resonance (MR) imaging may identify areas of restricted diffusion and perfusion defects suggestive of ischemia and MR angiography may suggest a proximal level of vascular compromise. A primary role of acute neuroimaging is to exclude the presence of intracranial hemorrhage and other space-occupying nonstroke lesions. These are usually readily resolved by either CT or MR imaging[10].

A prospective study to compare outcome of early verses late decompression craniotomy was done at a tertiary care hospital in India.

Methods and Materials

We conducted a prospective observational study in the neurosurgical department of a tertiary care hospital of India, for a period of 3 years from 2018-2021. A total of 30 patients (15 each for early and late decompressive craniectomy respectively) were included in study after fulfilling following criteria.

Inclusion criteria

- Presentation within 24 hours of symptomatology onset for early decompression craniectomy.
- Glassglow coma scale more or equal to 9.
- Age ranging from 18 years to 60 years
- Age survival/ life expectancy of more than 3 years that is not having any serious co-morbidities.
- MCA infarct size/ volume of more than 145cm3.
- Intact brain stem signs.
- Pre infarct Kernoffsky scale of 90 to 100.
- No major morbidity which is limiting life expectancy less than 3 years.
- Normal routine coagulation parameters.

Exclusion criteria

- Age more than 60 years.
- Hazardous co-morbidities
- Seropositivity (for immunodeficiency virus) with or without treatment.
- Partial or complete absence of brain stem signs for early and complete absence of brain stem signs for late decompression craniectomy.
- Pregnancy,
- Global internal carotid infarct and/or PCA infarct.
- Infarct size/volume of less than 145cm3.
- Signal alteration in the brain stem region.
- Patients who received rTPA therapy.
- Progressive vasculopathies (eg Moya Moya disease, Fibromuscular dysplasia)

The study was approved by the Ethics committee of the hospital. The patients/ relatives of patient were explained about their inclusion in the study, procedure, consequences of procedure in their own language and an informed consent was obtained from patients or their adult relatives in case where patient were not in position of giving valid consent. The data was anonymised to maintain confidentiality of subjects .The patients were grouped in to early decompression group (surgery within 24 hours) following the stroke onset, and late

decompression craniectomy group(surgery after24 hours) who had clinical or radiological worsening of GCS and/ or signs of herniation.

The patients were followed up for next 6 months with neuro examination and score making done after every 1 month, 3 months and 6 months of-decompressive craniotomy.

All statistical analysis was done using SPSS (statistical package for social science) software program, version 17. The mean and standard deviations were computed for continuous variables. Percentages were used for categorical variables. The mean hospital stay duration was compared in patients undergoing early and late decompression craniectomy. Functional outcome after 1month, 3 month and 6 months of the ictus was calculated as per two different scoring systems i.e. Modified Rankin Scale (mRS) and Barthel index. Final outcome duration is calculated 6 months after the decompression craniectomy.

To find the significance between early and late group of patients we have used 2 independent sample t-test for age. For MRS and Barthal index at 1st month, 3rd month and 6th month, Hospital stay we have used Mann-Whitney U test (Non-parametric test) because the data type is ordinal or not following normal Distribution/ skewed. All statistical test performed at 5% level of significance so the p-value < 0.05 considered as significant.

Results

The majority of patients were male in both the groups – early group 9 (60%) and late group 12 (80%) (Fig-1). The mean age group for early and late groups was 44.07 and 42.87 years respectively. The difference was statistically insignificant ($p > 0.05$) (Fig-2). The comparison of MRS score in early and late group was not statistically significant at 1st month of follow up, however it showed significant difference at 2nd and 6th month respectively (Table-1). MRS score with respect to affected side, in both the early and late group showed statistically significant difference at 6 months of follow up respectively (Table-2,3). Similarly, comparison of two groups with respect to Barthel index showed statistically significant difference at 1st, 3rd and 6th month follow up (Table-4). The Barthel index with respect to affected side showed significant difference in early group whereas in the late group (Table-5) significant difference was seen at 6th month of follow up only (Table-6). The outcome of patients was not affected by side of involvement in both groups early as well as late (Table-7). The mean hospital stay in early group was 14.8 days in comparison to late group where it was 42.47 days. The difference was statistically significant with p value <0.001 (Table-8, Fig-3).

Discussion

Table 1: Comparison of MRS score in early group and late group at 1st month, 3rd month and 6th month.

	Group	Median MRS Grade	P-value
1st month	Early	4	0.186
	Late	4	
3rd month	Early	4	0.07
	Late	4	
6th month	Early	2	< 0.001
	Late	3.5	

Table 2: Comparison of MRS score with respect to affected side in early group at 1st month, 3rd month and 6th month.

MRS at	Median MRS for affected side		P-value
	Left	Right	
1st month	4.5	4.5	0.177
2nd month	4	4	0.138
3rd month	3	3	0.003

Table 3: Comparison of MRS score with respect to affected side in late group at 1st month, 3rd month and 6th month.

MRS at	Median MRS for affected side		P-value
	Left	Right	
1st month	4	4	0.999
2nd month	4	3	0.999
3rd month	4	2	0.026

Table 4: Comparison of barthel index at 1st follow up, 2nd follow up and 3rd follow up in early group and late group.

	Group	Median BI	P-value
1st month	Early	20	0.001
	Late	5	
3rd month	Early	50	0.005
	Late	35	
6th month	Early	85	0.004
	Late	67.5	

Table 5: Comparison of B.I. with respect to side affected in early group

	Affected Side	Early group Median BI	P-value
1st month	Right	25	0.008
	Left	7.5	
3rd month	Right	55	0.004
	Left	32.5	
6th month	Right	85	0.004
	Left	70	

Table 6 Comparison of B.I. with respect to side affected in late group

	Affected Side	Late group Median BI	P-value
1st month	Right	5	0.535
	Left	0	
3rd month	Right	40	0.318
	Left	30	
6th month	Right	80	0.038
	Left	60	

Table 7: Comparison of outcome with respect to affected side in early group and late group.

Study group	Side	Outcome			Total	P-value
		Good	Fair	Poor		
Early	Left	0	3	1	4	0.165
	Right	4	7	0	11	
Late	Left	0	4	3	7	0.559
	Right	0	6	1	7	

Table 8: Comparison of mean hospital stay (days) in early group and late group.

Group	Number of patients	hospital stay (days)		P-value
		Mean	SD	
Early	15	14.80	9.13	< 0.001
Late	15	42.47	14.15	

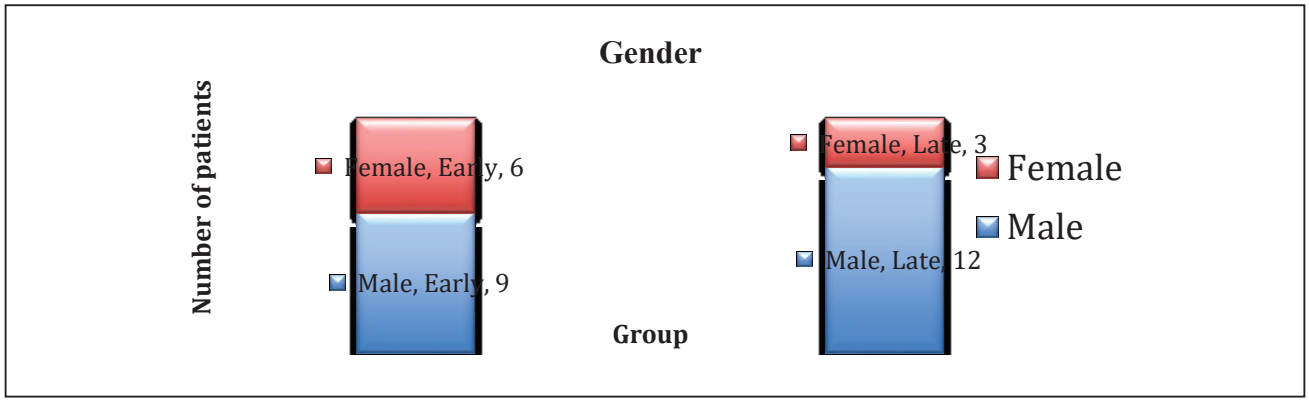
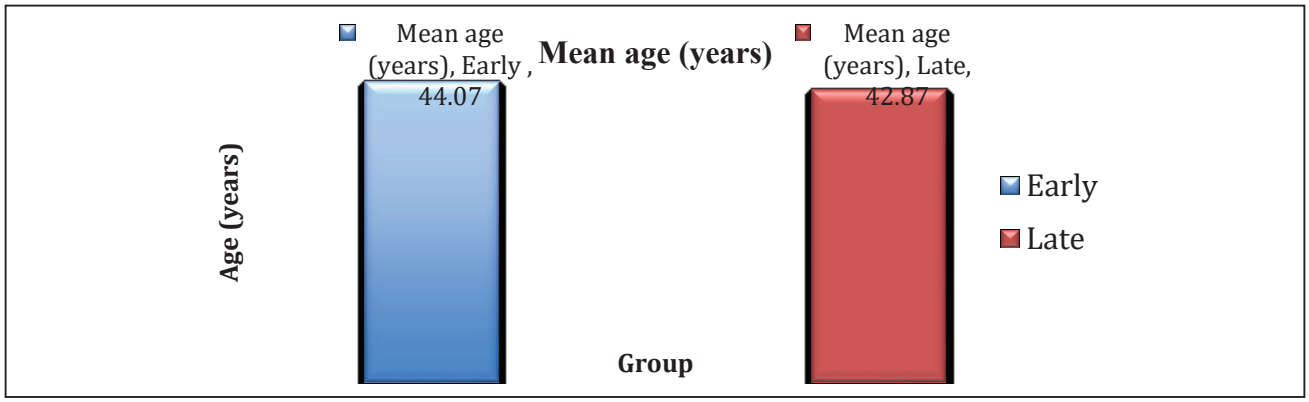


Figure 1: Gender wise distribution of patients with respect to early group and late group



p-value > 0.05 therefore there is no significant difference

Figure 2: Comparison of mean age (years) in early group and late group.

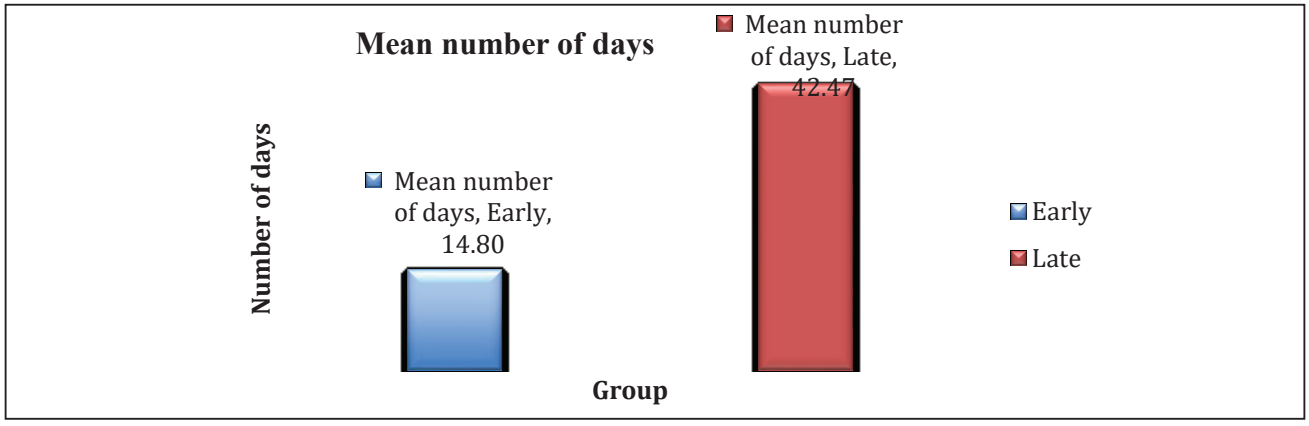


Figure 3: Comparison of mean hospital stay (days) in early group and late group.

The initial presentation of MCA infarct is with focal neurological deficit which later transforms like an acute space occupying lesion (SOL). The management of MCA infarct has evolved over the years from conservative to aggressive intervention in the form of decompression craniectomy in the past was that of a life saving measure but the scenario has changed over years [11, 12].

In the present study the mean hospital stay of early group was significantly shorter 14.8 days as compared to late group 42.47 days. The comparison of mRS grades showed that 90% of patients from early group were converted to grade 2 in final assessment against 50% of patients of late group who were converted to grade III. The findings suggest that early decompression craniectomy

carries better outcome in terms of post surgery morbidity . The findings of the present study are similar to the study by Vahedi K Hofmeijer J et al [13] who in their study of 93 patients with 51 randomized to decompressive surgery and 42 to conservative management found reduced mortality and favorable functional outcome among those treated with surgery intervention within 48 hours of stroke .

Schneck MJ and Origitano [14] in their study stressed on case by case individualized approach for selection of patients for decompressive craniectomy as there is paucity of clear data as to when intervention is to be done or which patients will progress to cerebral herniation or not .

Yonas S and Jannetta P J in their study on 52 patients categorized patients for decompressive craniectomy into three groups- ultra early (<6hours) , late group (>6 hours) and conservative managed group. The post operative recovery and Barthel index were statistically better in early group.

Rahme R , Zuccarello Met et al [15] in meta analysis concluded that majority of patients undergoing decompressive surgery will satisfied with outcome without any regrets.

Flechsenhar J et al[16] revied European clinical trials and concluded that early hemicraniectomy decreased mortality significantly from 71.4% in conservative group to 21.6% in surgical arm.

Conclusion

The results of the present study indicate that early surgical intervention for decompression craniectomy in cases of MCA infarct have better outcome than late intervention with shorter hospital stay better functional outcome at discharge and 6 months post discharge.

The only limitation of present study is small size but keeping in view the limited availability of resources in developing country like India it will prompt others to work on this front.

Early decompression craniectomy has better outcome , short stay in hospital but the treatment decision should be taken as per patient comorbidity , preexisting health condition , age and social support.

Conflict of interest – Nil
Sources of funding -Nil

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