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Original Article

Neurosurgical treatment of cerebellar infarct: Open craniectomy versus endoscopic surgery

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ABSTRACT

Background: Cerebellar infarction can lead to severe morbidity and mortality. Current surgical options include decompressive craniectomy (DC) and endoscopic minimally invasive evacuation of necrotic tissue (MEN), but no randomized studies compare their outcomes.This study compares outcomes between DC and MEN in patients with cerebellar infarct using the Glasgow Coma Scale (GCS) and Scale for the Assessment and Rating of Ataxia (SARA) scores.

Methods: Retrospective review of 37 patients treated for cerebellar infarct between 2010 and 2020. Patients were divided into DC and MEN groups, with outcome measures assessed postoperatively.

Results: Both techniques produced similar improvements in GCS and SARA scores, though MEN showed faster healing time and shorter surgery duration.

Conclusion: MEN may offer advantages over traditional surgery in terms of healing and shorter operative time, warranting further investigation.

Keywords: Cerebellar infarct, Endoscopic surgery, External ventricular derivation, Minimally invasive surgery, Neurovascular, Suboccipital craniotomy

INTRODUCTION

Cerebellar infarct management remains controversial with no consensus on the best surgical approach. Unlike swollen supratentorial hemispheric ischemic stroke for which several studies confirmed the usefulness of decompressive craniectomy (DC)[10,14] for surgical management of cerebellar infarct, particularly edematous ones, it is difficult to establish practical recommendations and has a consensus, due to absence of randomized study.[2,3] Prior studies focus on DC and external ventricular derivation (EVD), but minimally invasive approaches such as Minimally Invasive Evacuation of Necrotic Tissue (MEN) have not been well compared. One reason for this may be the rarity of cerebellar infarct because only between 1% and 4% of strokes occur in the posterior fossa.[4,9,12] The guidelines and recommendations only mention that a DC could be performed without giving more precise details and decision criteria[6,7]. Therefore, this practice remains arbitrary, and the decision-making depends on the experience of each medical team.[1,5,8] In our practice, we perform surgery in three clinical settings: consciousness

deterioration at admission (Glasgow Coma Scale [GCS] fall) or/and secondary deterioration of consciousness during hospitalization or/and massive infarct. We define massive infarct as ischemic tissue volume above 5 cm^3 or/and when there was hydrocephalus or brain stem compression. Ischemic tissue volume is measured by a specific software related to computed tomography (CT) scans and magnetic resonance imaging (MRI) machines. The surgery may be DC or/and EVD.[11,13] Since 2014, we have also used a surgical alternative to craniectomy: MEN. The objective of this retrospective study is to compare outcomes between patients undergoing DC and MEN for cerebellar infarct and hypothesize that MEN offers advantages in terms of operative time and healing.

MATERIALS AND METHODS

This retrospective cohort study analyzed patients with cerebellar infarction who underwent surgical intervention at our clinical center from 2010 to 2020. All patients presenting with symptoms such as headache associated with nausea and vomiting, dysarthria, sensory disturbances, and vertigo initially underwent a brain CT scan. Patients were referred by either a neurologist or radiologist, and the confirmation of cerebellar infarction and its precise location was verified with MRI in diffusion mode [Figure 1].

All the patients were treated at a single institution with available follow-up data. The study included 37 patients who underwent surgery for cerebellar infarct, with exclusions for brainstem involvement or secondary lesions. The intervention groups were 20 patients for DC and 17 for MEN.

The primary outcomes evaluated in this study were GCS and Scale for the Assessment and Rating of Ataxia (SARA) scores assessed preoperatively, at 2 weeks, and 4 weeks postoperatively. Data were extracted from patient medical records, including clinical presentation, surgical approach, and follow-up assessments [Table 1].

Technical note: MEN

Since 2014, we have used, more often than not, a MEN. The patient is in the prone position. According to localization and laterality of necrotic lesion, a 2-cm long paramedian vertical-straight incision 2 or 3 cm from the midline is performed [Figure 2]. The head is fixed on a Mayfield headrest and rotated 45° to the contralateral side. To ensure that the lesion is effectively targeted, we use fluoroscopy. Care must be taken not to cut the occipital nerve or its branches. Instead of doing a classical craniotomy, we perform a keyhole to introduce an endoscope and drain necrotic tissue. Evacuation is performed using a bipolar hook and suction, with the resection of infarcted tissue guided by the surgeon's experience and macroscopic assessment at the surgical site. To minimize the risk of hemorrhage, a potent thrombin-based hemostatic agent is applied at the end of the procedure [Figure 3].

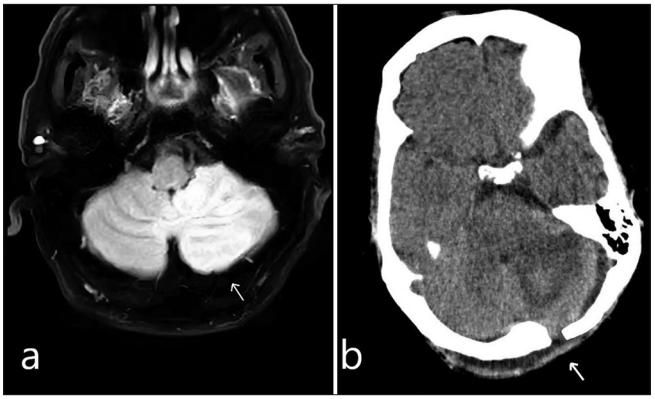

Figure 1: (a) Axial T1-weighted magnetic resonance imaging scan, the white arrow shows a cerebellar infarction with a measured volume of 7.8 cm^3, as determined by the software (preoperative image). (b) Postoperative computed tomography scan demonstrating the removal of necrotic tissue. The white arrow shows the creation of an endoscopic fenestration.

RESULTS

Table 1 presents the data related to each group. Nine patients were comatose (GCS ≤7) in admission. Thirty-one patients were operated on the day of admission. Three patients were operated on the day after admission, and 3 patients underwent surgery within 2 days after admission. Table 2 shows types of surgery, GCS score, SARA score on admission, and 2 and 4 weeks after surgery. Comparing the outcome of patients with cerebellar infarct operated by DC versus MEN, 20 patients operated by DC had an average GCS score of 9.15 and 32.45 SARA average score on the day of the surgery. Seventeen patients operated on by MEN had an average GCS score of 9.11 and 32.11 SARA average score on the day of the surgery. For DC patients, the average GCS score was 11.5 and 10.76 for MEN patients two weeks after surgery. At that time, the SARA average score for DC patients and MEN patients was, respectively, 23.75 and 25.41. Four weeks after surgery, the average GCS score was 13.05 for DC patients and 12.41 for MEN patients. In that time, the SARA average score became 15.5 for DC patients and 16.76 for MEN patients. There are no significant differences in GCS scores and SARA scores between the two groups in any episode ($P > 0.05$).

DISCUSSION

MEN is a surgical alternative to classical craniectomy for swollen cerebellar and posterior fossa infarct. We have used this method since 2014. We believe that with this technique, the magnitude of the surgery is less. It seeks to avoid major surgery in this category of patients who are

Table 1: Patient characteristics.

	Gender		Surgery method		Surgery time	
Total patients number=37	Male	22	MEN	17	Day of admission	31
	Female	15	DC	20	One day later	3
					Two days later	3

MEN: Minimally invasive evacuation of necrotic tissue, DC: Decompressive craniectomy

Table 2: Types of surgery, GCS score, and SARA score on admission, and at 2 and 4 weeks postsurgery.

Surgery type	Patient number	D0:		W2:		W4:		Dead patient
		GCS Mean	SARA Mean	GCS Mean	SARA Mean	GCS Mean	SARA Mean	
DC	20	9.15	32.45	11.5	23.75	13.5	15.5	1
MEN	17	9.11	32.11	10.76	25.41	12.41	16.76	1

GCS: Glasgow coma scale, SARA: Scale for the assessment and rating of ataxia, DC: Decompressive craniectomy, MEN: Minimally invasive evacuation of necrotic tissue, D0: First day, W2: Second week, W4: Fourth week

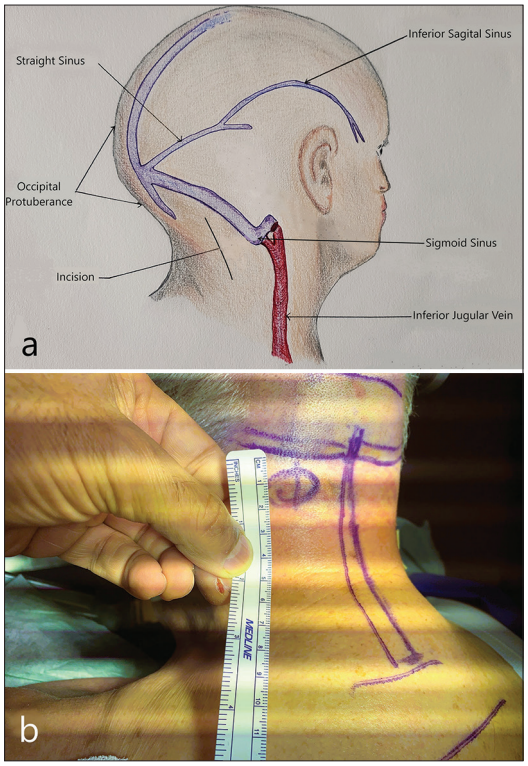

Figure 2: (a) Anatomical landmarks in minimally-invasive evacuation of necrotic tissue surgery. (b) Preoperative marking of the minimally invasive evacuation of necrotic tissue surgery (1.5–2 cm incision).

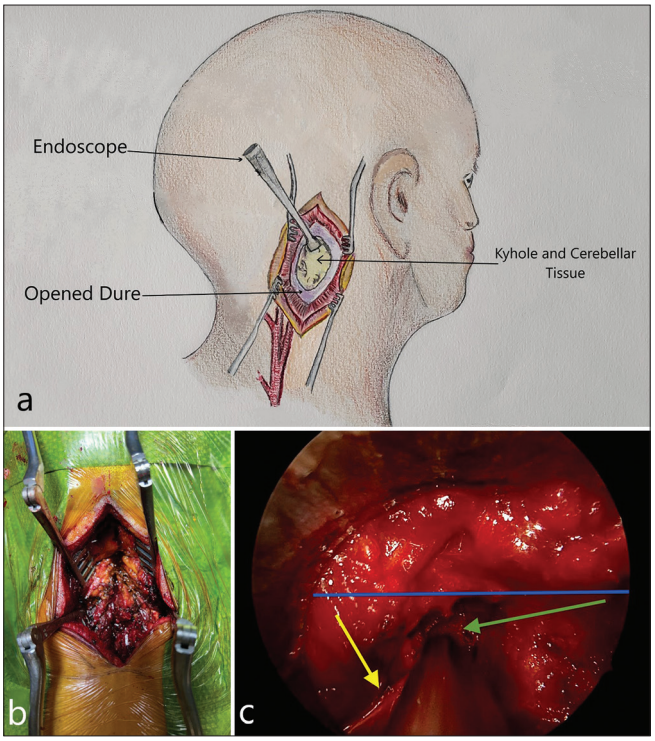

Figure 3: (a) Minimally invasive evacuation of necrotic tissue surgery description. (b) Open craniectomy method with 10 cm incision. (c) View of surgery field in an endoscopic method: The yellow arrow indicates dura, the green arrow indicates necrotic tissue and the blue line indicates the keyhole diameter.

generally relatively aged and in a poor general condition. We performed a linear incision from inion to spinous process of C3 or C4 (8–9 cm) in patients operated by DC. For MEN patients, we carried out a 3 cm linear left or right paramedian incision, depending on the side of the lesion. In all patients, the wound was closed by simple interrupted sutures. In patients operated by DC, 10 patients (50%) presented delayed healing of the wound. In general, the wounds were oozing with serosity, requiring different treatments. Therefore, wound care had to be continued for 18–32 days. In MEN-operated patients, we have only two patients who presented

delayed wound healing, and wound care had to be continued in some cases for 15–19 days. The average duration of healing in the DC patients was 21 days. The mean duration of healing in the MEN patients was 13 days. We used the two tools of assessment for this study. GCS for the level of consciousness and SARA scale to quantify the functional disabilities experienced by these patients with Posterior Fossa Syndrome (PFS). The analysis and comparison of the results of operated patients in each group before and after surgery show a substantially similar outcome. DC patients gained an average of 2 points 2 weeks and 4 points 4 weeks after surgery in GCS. In MEN patients, the increase in score points was 2.50 in 2 weeks and 3.3 in 4 weeks after surgery. As for the scale of SARA, DC-operated patients had a decreased score of 8.7 (21.75%) 2 weeks and 16.95 (42.38%) 4 weeks after surgery. MEN patients had a decreased score of 6.7 (16.75%) 2 weeks and 15.35 (38.38%) 4 weeks after surgery. The average length of surgery was 91 min in DC patients versus 69 min in MEN patients. In endoscopic technique, the surgery is much faster than traditional surgery. The only additional act in endoscopic surgery is preoperative fluoroscopy to ensure that the lesion is targeted. This act lasts an average of 3 min [Table 2].

Our findings indicate that both surgical techniques led to comparable outcomes in terms of neurological status and functional disability. Specifically, patients in both groups showed improvement in GCS scores over time, with MEN patients demonstrating slightly higher increases compared to DC patients. Similarly, both groups experienced reductions in SARA scores postoperatively, indicating improved functional disability, with slightly greater improvements observed in DC patients.

To consider the limitations, the sample size of each group was relatively small in our project. Furthermore, the study focused on short-term outcomes immediately postsurgery and did not assess long-term neurological recovery or functional outcomes.

While our findings suggest that MEN may offer advantages over traditional DC in terms of surgical magnitude and wound healing, further research with larger sample sizes and longer follow-up periods is needed to confirm these findings. In addition, future studies should consider the inclusion of a control group and multivariate analysis to account for potential confounders and biases. Nevertheless, our study contributes valuable insights into the comparative effectiveness of MEN versus DC for cerebellar infarct patients, highlighting the need for further investigation in this area.

The small sample size nature of the study may limit the generalizability of the study results. In addition, the study population consisted of patients with cerebellar infarct who underwent surgery at a single institution, which may not be representative of all patients with similar conditions. Therefore, caution should be exercised when extrapolating the findings to other populations or clinical settings.

CONCLUSION

We believe that the evacuation of infarcted tissue by endoscopy provides an interesting alternative to conventional surgery. The clinical outcome is almost identical; however, in terms of healing and the length of the surgery, the outcome is more interesting. MEN presents a promising alternative to traditional DC for cerebellar infarct, with comparable clinical outcomes and benefits such as faster recovery and shorter surgical time.

Ethical approval

Institutional Review Board approval is not required as it is retrospective study.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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