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Case reports

Clinical evolution of dysphagic patients after malignant infarction and decompressive craniectomy: a case series

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ABSTRACT

This study aimed to characterize clinical-neurological factors and the functional swallowing capacity of patients with malignant infarction submitted to decompressive craniectomy during the hospital stay. This retrospective, descriptive, observational study was conducted between January 2020 and December 2021. The following data regarding up to eight stages were extracted for descriptive analysis: age, location of the lesion, level of awareness according to the Glasgow Coma Scale, neurological impairment according to the National Institutes of Health Stroke Scale, and the functional swallowing capacity according to the Functional Oral Intake Scale. Data on five patients were collected, with a mean of 0.2 days for the first neurological assessment. Decompressive craniectomy was performed in a mean of 2 days after admission. The speech-language-hearing assessment occurred in a mean of 8.2 days, and the speech-language-hearing discharge took a mean of 35.4 days. The neurological impairment score remained the same as in the first neurological assessment after decompressive craniectomy, with a mean score of 16.6. The functional swallowing capacity was the same in the first assessment after decompressive craniectomy, on FOIS level 1, improving considerably by the discharge, with a mean level of 4.8. It is concluded that clinical-neurological factors can interfere with the functional swallowing capacity, although they did not hinder either speech-language-hearing treatment or their evolution to a full oral diet during the hospital stay.

Keywords: Decompressive Craniectomy; Deglutition; Deglutition Disorders; Ischemic Stroke; Speech, Language and Hearing Sciences; Neurology

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INTRODUCTION

Decompressive craniectomy (DC) is a surgical procedure that immediately reduces intracranial pressure, usually indicated in cases of brain swelling, acute subdural hematoma, and nontraumatic diseases[1]. Regarding stroke, it is mainly used in patients with malignant infarction (MI) to improve their prognoses, reducing the possibility of death[1].

MI has a high mortality rate (which is why it has this name) and occurs due to middle cerebral artery (MCA) syndrome, which causes brain swelling[2].

Adequate MI management relieves intracranial pressure because it gives room to accommodate cerebral edema, reverts or prevents cerebral herniation, and restores cerebral perfusion, minimizing possible secondary damage to tissues[3], and often ensuring a better quality of life for patients[4]. Despite reducing mortality and providing clinical recovery, all these post-DC results may cause in patients a degree of incapacity that will require follow-up over time[5,6].

Stroke, as proven in the literature, can affect the neurophysiology of swallowing and the corticobulbar pathways[7-10]. Such affection is called dysphagia, which is a swallowing disorder that may occur in all or any of the phases: anticipatory, preparatory, oral, pharyngeal, and esophageal[9]. Speech-language-hearing (SLH) therapy is the specialty responsible for treating the four first phases described above. Individuals with oropharyngeal dysphagia may need food and liquid restrictions, consistency modifications, and/or an alternative feeding route until they can receive a full oral diet safely and efficiently[11].

Dysphagia can affect 22 to 65% of post-stroke patients and last for months[12]. Some studies in the literature point to dysarthria, facial palsy, and location and extension of the neurological damage as possible risk factors for dysphagia[6]. MI patients are more likely to develop severe dysphagia due to the damage to MCA, which vascularizes areas representative of the swallowing process (e.g., the thalamus, internal capsule, and subinsular region) and other cortical and subcortical areas[7]. They control swallowing through coordinated synergic movements of oral, pharyngeal, and laryngeal muscles and stomatognathic functions (such as breathing and mastication), along with cognitive processing (when these movements are voluntary) and sensory processing of ingested food[13,14]. Thus, severe dysphagia can cause greater pulmonary complications due to aspiration, malnutrition, dehydration, and prolonged hospital stay, possibly leading to death[8].

Given the above, this study aimed to characterize clinical-neurological factors and the functional swallowing capacity of MI patients submitted to DC during the hospital stay. This study is necessary because of the scarcity of research in the literature describing clinical-neurological risk factors for dysphagia in MI patients submitted to DC. This research highlights the importance of being attentive to the functional swallowing capacity in post-MI and post-DC patients, as well as the need for SLH therapists during acute treatment; their participation as health professionals is extremely important to the patient's prognosis and quality of life.

CASE PRESENTATION

This retrospective, descriptive, observational study was approved by the Research Ethics Committee of the *Universidade Federal de Minas Gerais*, Brazil, under evaluation report no. 5.311.165 (CAAE: 55091222.6.0000.5149).

Data were initially searched in the department of information technology of the *Hospital Risoleta Tolentino Neves*, verifying the list of patients whose codes in the International Classification of Diseases (ICD-10) were cataloged as MI and who were treated by the SLH team in the intensive care unit (ICU).

Based on this list, it was decided to collect data from January 2020 to December 2021. Then, the medical record data of MI patients submitted to DC was surveyed.

The patients' sociodemographic, clinical-neurological, and SLH data were extracted from the electronic records, approaching up to eight different stages: hospital admission, DC, ICU admission, first post-DC neurological assessment, first post-DC SLH assessment, SLH discharge, ICU discharge, and hospital discharge.

These data include age, sex, location and extension of damage, orotracheal intubation (OTI) time, tracheostomy, level of awareness according to the Glasgow Coma Scale (GCS)[15], neurological impairment according to the National Institutes of Health Stroke Scale (NIHSS)[16], time in days at each stage since the hospital admission, description of clinical aspects, and the number of deaths. Also, the following SLH data were analyzed: the functional swallowing capacity, according to the Functional Oral Intake Scale (FOIS)[17], other SLH abnormal results in the institution's SLH team clinical assessment protocol, and the number of SLH visits.

FOIS is a standardized tool that verifies the level of oral ingestion indicated to each patient, ranging from 1 to 7. Individuals in level 1 cannot orally swallow anything safely, while those in level 7 can eat with no restrictions[17]. Their functional swallowing capacity was considered to have progressed when the FOIS level improved after SLH therapy. SLH therapy records encompassed traditional swallowing therapy, including tactile thermal oral stimulation, myofunctional exercises, and direct and indirect training[13]. Exercises were defined for each patient according to their best adjustment, considering swallowing changes and exercise performance.

The study comprised individuals above 18 years old of both sexes diagnosed with MI (confirmed through neurological assessment and head computed tomography [CT scan]), who underwent clinical SLH assessment, and had a stable clinical condition. Individuals with a history of previous stroke, other neurological diseases or impairments, history of head and neck cancer, oral-pharyngeal-laryngeal anomalies, or who died were excluded from the study.

Data were collected from 15 patients, although two of them had previous MI, one died, and seven had missing data in the electronic records. Hence, it was possible to collect all necessary data from five patients, who met the study inclusion criteria.

The following data on the five individuals in this study were transcribed into an Office 365 Excel table: the time in days at each stage since the hospital admission, the description of clinical-assistance aspects at each stage, and the comparison of functional swallowing capacity and neurological impairment throughout the hospital stay to find the neurological and SLH evolution from hospital admission to discharge.

RESULTS

The analysis of all five patients' collected data addressed in this study is described below.

The time in days at each of the eight stages since hospital admission approached in this study is shown in Table 1. It is important to highlight that all patients were admitted to the hospital within 24 hours of symptoms onset (ictus). The mean time to the first neurological assessment was 0.2 and the median time was 0 – i.e., immediately at hospital admission. ICU admission occurred in a mean of 1.6 days, and DC was performed in a mean of 2 days after hospital admission. SLH assessment took place in a mean of 8.2 days, and SLH discharge took a mean of 35.4 days. There is a great variation (standard deviation > 20) in the time of SLH discharge and neurology team hospital discharge between patients. The time to resume a full oral diet likewise varied greatly between patients, with a mean of 17 days.

Table 1. Time in days at each analyzed stage since hospital admission

Stages	Patients (N = 5)			
	Mean (+ SD)	Median	Minimum	Maximum
1. Neurological assessment at hospital admission	0.2 (+ 0.45)	0	0	1
2. ICU admission	1.6 (+ 0.55)	2	1	2
3. Decompressive craniectomy	2 (+ 0.71)	2	1	3
4. First neurological assessment after decompressive craniectomy	2.6 (+ 0.89)	2	2	4
5. ICU discharge	7.2 (+ 4.92)	7	3	15
6. First SLH assessment after decompressive craniectomy	8.2 (+ 6.46)	6	3	19
7. Full oral diet resumed	17 (+ 22.83)	10	0	57
8. Speech-language-hearing discharge	35.4 (+ 20.72)	27	17	66
9. Discharge from the hospital by the neurology team	42.6 (+ 24.21)	30	17	70

Captions: N = number; SD = standard deviation; ICU = intensive care unit; SLH = speech-language-hearing.

Clinical aspects analyzed regarding neurological and SLH assessments are indicated in Table 2. FOIS was found only in SLH assessments and SLH discharge. The level of awareness and neurological impairment worsened from the admission to the first post-DC neurological assessment – the mean score in GCS was 10.4 and in NIHSS, 16.6. The GCS score improved from the first post-DC neurological assessment to the first SLH assessment and then remained the same throughout the hospital stay. The NIHSS score remained the same as in the first post-DC neurological assessment, with a mean of 16.6. The functional swallowing capacity in the first post-DC SLH assessment was the same between patients, with a mean FOIS level 1 (nothing by mouth), having improved considerably by SLH discharge, with a mean level of 4.8 (total oral diet of a single consistency).

Table 2. Clinical aspects analyzed in neurological and speech-language-hearing assessments

Clinical aspects	Admission		1st post-DC neurological assessment		1st post-DC speech-language-hearing assessment		Speech-language-hearing discharge		Discharge from the hospital by the neurology team	
	Mean (+ SD)	Median (Min-Max)	Mean (+ SD)	Median (Min-Max)	Mean (+ SD)	Median (Min-Max)	Mean (+ SD)	Median (Min-Max)	Mean (+ SD)	Median (Min-Max)
GCS	13.2 (+ 2.39)	14 (9 – 15)	10.4 (+ 2.79)	9 (8 – 15)	14 (+ 2.59)	14 (10 – 15)	13.2 (+ 2.49)	15 (10 – 15)	13.2 (+ 2.49)	15 (10 – 15)
NIHSS	14 (+ 5.43)	14 (6 – 19)	16.6 (+ 3.44)	18 (12 – 20)	16.6 (+ 3.44)	18 (12 – 20)	16.6 (+ 3.44)	18 (12 – 20)	16.6 (+ 3.44)	18 (12 – 20)
FOIS	-	-	-	-	1 (+ 0)	1 (1 – 1)	4.8 (+ 2.68)	6 (1 – 7)	-	-

Captions: GCS = Glasgow Coma Scale; 1st: first; DC = decompressive craniectomy; NIHSS = National Institutes of Health Stroke Scale; FOIS = Functional Oral Intake Scale; SD = standard deviation; Min = minimum; Max = maximum

The five patients' sociodemographic, clinical-neurological, and SLH aspects are shown in Table 3. There was a prevalence of males (60%); the overall mean age was 51 years. All patients were submitted to DC, with a prevalence of impairment in the right hemisphere (80%). The location varied between the frontotemporal and frontotemporoparietal regions – the former comprised 60% of cases. All patients were submitted to OTI, whereas tracheostomy was only needed in 40% of them. Facial palsy affected all patients in this study, while aphasia occurred in only one and apraxia, in none of them. All patients had dysphagia, with initial FOIS level 1 and final FOIS ranging from levels 1 to 7 – three patients (60%) resumed a full oral diet. The number of SLH visits also varied between patients, with a mean of 15.8 visits. As for post-discharge procedures, 60% of the patients went to a rehabilitation hospital. Only one patient (20%) underwent DC within 24 hours of hospital admission. All patients had hemiparesis according to the hemisphere affected by MI.

Table 3. Descriptive analysis of sociodemographic, clinical-neurological, and speech-language-hearing aspects

Patient	Age	Sex	GCS at admission	NIHSS at admission	Time to DC (hours)	Hemisphere	Local	Post-DC GCS	Post-DC NIHSS	OTI time (days)	TS	FP
1	65	M	15	19	>24	Right	FT	11	19	3	N	Y
2	40	M	14	12	<24	Right	FT	9	12	2	N	Y
3	31	F	14	14	>24	Right	FT	15	14	1	N	Y
4	55	F	14	6	>24	Right	FTP	9	18	11	Y	Y
5	64	M	9	19	>24	Left	FTP	8	20	6	Y	Y

Patient	Dysarthria	Aphasia	Apraxia	Dysphagia	Initial FOIS	GCS at 1st SLH assessment	NIHSS at 1st SLH assessment	Final FOIS	No. SLH visits	Procedure
1	Y	N	N	Y	1	15	19	3	18	Rehabilitation Hospital
2	N	N	N	Y	1	14	12	7	11	Rehabilitation Hospital
3	Y	N	N	Y	1	15	14	7	21	Home care
4	N	N	N	Y	1	10	18	6	22	Permanent palliative care
5	N	Y	N	Y	1	10	20	1	7	Rehabilitation Hospital

Captions: M = male; F = female; GCS = Glasgow Coma Scale; NIHSS = National Institutes of Health Stroke Scale; DC = decompressive craniectomy; SLH = speech-language-hearing; FT = frontotemporal; > = more than; < = less than; FTP = frontotemporoparietal; Y = yes; N = no; OTI = orotracheal intubation; TS = tracheostomy; PF = facial palsy; 1st: first; initial FOIS = initial score on the Functional Oral Intake Scale; final FOIS = final score on the Functional Oral Intake Scale; No. = number.

The five patients' pre-DC and post-DC head CT scan findings are described in Table 4. All MI occurred in the MCA, on different sides according to the affected hemisphere. All patients had pre-DC ipsilateral or contralateral midline shift – contralateral ones remained after DC in only one case (20%). Herniation occurred in two patients, one before DC and the other after DC. The lateral ventricle suffered ipsilateral compression in four cases (80%) before DC and three cases (60%) after DC and ipsilateral displacement before DC in one case (20%). The compression was relieved after DC in one patient, whereas in another case, it appeared after DC. The midline shift and contralateral midline shift either improved or disappeared in all patients. In one of them (20%), the midline shift improved by 3.7 mm, while in three patients (60%) it disappeared. The contralateral midline shift improved by 0.2 mm in one patient (20%) and disappeared in three of them (60%). Only one patient (20%) had a hemorrhagic transformation, which occurred after DC. All patients had effaced sulci and gyri and an unclear distinction between white and gray matter. DC was indicated for different reasons, ranging from sensory loss to poorer CT scan results.

Table 4. Head computer tomography findings before and after decompressive craniectomy

MCA	Hemisphere	Location	Pre-DC MLS	Measure	Post-DC MLS	Measure	Pre-DC CL MLS	Measure	Post-DC CL MLS	Measure	Pre-DC herniation	Post-DC herniation	Pre-DC lateral ventricle	Post-DC lateral ventricle
Y	Right	FT	Y	1 mm	N	-	Y	11 mm	N	-	N	N	Compression	Compression
Y	Right	FT	Y	-	N	-	Y	3.5 mm	Y	3.3 mm	Y	N	Compression	Compression
Y	Right	FT	Y	5 mm	N	-	N	-	N	-	N	Y	Compression	Displacement
Y	Right	FTP	N	-	N	-	Y	2 mm	N	-	N	N	Compression	-
Y	Let	FTP	Y	10 mm	Y	6.3 mm	N	-	N	-	N	N	-	Compression

Captions: MCA = middle cerebral artery; Y = yes; N = no; FT = frontotemporal; FTP = frontotemporoparietal; MLS = midline shift; CL MLS = contralateral midline shift; DC = decompressive craniectomy.

DISCUSSION

Clinical-neurological factors can interfere with post-DC functional swallowing capacity in MI patients, as all those in the present study had dysphagia. However, these factors did not hinder SLH treatment.

This study found that hospital admission took place within 24 hours of ictus, that all patients had post-DC dysphagia and facial palsy, and that the mean time to begin SLH treatment was 8.2 days. Moreover, it verified the patients' evolution throughout the hospital stay, observing the level of awareness and neurological impairment, including imaging tests and functional swallowing capacity. The latter evolved excellently in 60% of the cases, whose SLH discharge occurred with a full oral diet. The head CT scan results also progressed regarding ipsilateral and contralateral midline shifts, which either improved or disappeared in all patients.

The literature defines MI based on head CT scan findings regarding hyperdense MCA stem or internal cerebral artery, effacement of sulci and gyri, and an unclear distinction between white and gray matter[4]. The head CT scan of the patients in this study characterized MI diagnosis – all patients had hyperdense MCA, and 80% had their right hemisphere affected. MI usually affects only one cerebral hemisphere[1], although a study did not find significant differences in the overall functional capacity of post-DC patients between right and left hemisphere craniectomy[3]. Nevertheless, the only patient whose left hemisphere was affected did not have a clinical evolution. This patient had aphasia (as in most people, this is the hemisphere in which the language function resides) and dysphagia with tracheostomy; their functional swallowing capacity did not improve, as their initial and final FOIS level remained the same. Furthermore, they had the worst GCS and NIHSS at admission and after DC, remaining like this throughout the hospital stay, and their post-DC head CT scan detected hemorrhagic transformation.

Left hemisphere stroke normally damages structural aspects of language, verbal memory, and some executive function components, whereas in the right hemisphere, deficits are expected in visual perception and memory, some executive function components, and emotional processing[18]. Concerning dysphagia in ischemic stroke, no consensus has been reached yet on how each hemisphere works in the swallowing process. Classically, some authors describe that right hemisphere lesions can cause greater impairment in the pharyngeal phase, while those in the left hemisphere affect the oral phase of swallowing[19]. Thus, the size of the lesion is more important than its location, and oropharyngeal dysphagia is more associated with patients with ischemic stroke in MCA, as found in the literature[20]. This is likewise observed in the present study, as all patients had FOIS level 1 dysphagia in the first SLH assessment. Some authors have described that MI patients with right hemisphere lesions have longer pharyngeal transit duration and greater incidence of liquid aspiration than those with left hemisphere lesions[12]. Also, patients with lesions in the anterior MCA region have longer pharyngeal transit duration than those with posterior lesions. The cases of severe and persistent dysphagia normally occurred in subcortical and frontal preinsular cortex bilateral lesions around the frontal horns of the lateral ventricles in the MCA region, with a predominance of the left hemisphere[12]. Unfortunately, this study could not observe swallowing patterns, as the SLH assessment in most records lacked information on biomechanical swallowing parameters and different food consistencies. MI that affects MCA impairs areas representative of swallowing (e.g., the thalamus, internal capsule, and subinsular region) and other subcortical areas[12]. All patients in this study had dysphagia, which corroborates the literature.

GCS and NIHSS scores must be observed from the onset of the first symptoms because of the severe MI clinical neurological manifestation, including hemiparesis, hemiparesthesia, hemianopia, conjugate eye deviation, unawareness, and sleepiness[4]. GCS aims to assess the level of awareness[15], which is particularly considered for DC indication when values are equal to or below 14[21]. The mean GCS score in this study was 13.2 at admission and 10.4 immediately after DC. The pre-DC score indicated a sensory loss, which is likewise taken into account to perform DC. Immediately after surgery, the level of awareness is naturally even lower because the patient is still intubated. Nonetheless, all patients' GCS scores improved after these stages until the neurology discharge, indicating a higher level of awareness and possible success of this intervention.

NIHSS, in turn, aims to quantify neurological impairment due to stroke[16] and is an important predictor of a malignant stroke course and DC indication[22]. This procedure is indicated when the nondominant hemisphere is affected and the NIHSS score is higher than 20 and when the dominant hemisphere is affected and the NIHSS score is higher than 15[22]. This study could not obtain information on the patients' dominant side. Moreover, studies indicate that NIHSS scores between 12 and 19 are predictors of dysphagia[8]. This study corroborates the literature, as 100% of patients had dysphagia and their NIHSS scores were higher than 12 after DC and in the first SLH assessment.

The mean time to perform DC in this study was 2 days (48 hours), ranging between patients from 1 to 3 days (24 to 72 hours). The literature states that the earlier the DC, the better the patient's prognosis[3,15] and recommends that it be performed within 48 hours of symptoms onset[4]. However, such time still varies in current studies, ranging from 24 to 72 hours[3,4,21]. Only one out of the five patients approached in this study was submitted to DC within 24 of hospital admission. It is important to point out that this was the patient who had fewer SLH visits and had a full oral diet with no consistency restrictions. This reinforces the assertiveness of the DC clinical procedure.

Besides the level of awareness and neurological impairment, DC indication requires other criteria; however, these vary from author to author. They include head CT scan findings [4], age between 18 and 60 years[3,23,24], absence of cerebral hernia[2,24], midline shift greater than 5 mm in neuroimaging, worsened shift[25], NIHSS score higher than 15, and a decrease of 1 or more points in the level of awareness in the first NIHSS item[24]. This study found that sensory loss was another criterion to perform DC, in addition to all patients' poorer CT scan results regarding the aforementioned aspects. Even though two patients were above the ideal age for DC indication, it is supposed that they were given priority to undergo surgery because their midline shift had worsened. This may also be true of the patient who had cerebral herniation – although it is an exclusion criterion for DC, he also had a midline shift relevant enough to undergo the procedure. Despite the lack of findings in the literature, it must be highlighted that all patients had lateral ventricle compression in the head CT scan.

In 98% of cases in the literature, patients had hemiparesis[4]. This was verified in the present study as well, as all five patients had hemiparesis and ipsilateral central facial palsy – which the SLH therapist treated in the acute phase. Moreover, as previously mentioned, one patient (20%) had aphasia, and two (40%) had dysarthria, which were also addressed in the acute phase of the disease. The occurrence of other abnormal SLH conditions (including aphasia, facial palsy, and dysarthria) are risk factors for dysphagia, as cognitive and communication capacities must be preserved[6]. Fluctuating awareness and cognitive functions hinder learning, which would otherwise favor swallowing[26]. Nevertheless, despite the occurrence of these other abnormal SLH conditions, the rehabilitation process with the SLH team improved dysphagia during the acute phase in the hospital stay, which demonstrates the importance of having such professionals at the hospital.

The first post-DC SLH assessment occurred in a mean of 8.2 days after hospital admission and a mean of 6 days after DC. This delay may be due to the severity of the clinical manifestation, as the SLH assessment requires the patient's awareness[8]. Furthermore, two patients had a tracheostomy, which along with the clinical condition can also delay SLH treatment.

Dysphagia is common among patients in the acute phase of stroke, 80% of whom recover through rehabilitation and are apt to swallow again in 2 to 4 weeks[12]. Four patients in the present study progressed to FOIS 3, 6, and 7. Full oral diet resumed in a mean of 17 days, agreeing with what is indicated in the literature[12]. It is important to highlight that these patients had greater neuronal damage due to the size and location of the lesion – which is characteristic of MI and can aggravate dysphagia. Both patients whose final FOIS levels were 3 and 1 were above 60 years old, which may have hindered the evolution of their functional swallowing capacity. Moreover, the patient with final FOIS 1 remained with a tracheostomy, had a post-DC hemorrhagic transformation, remained with midline shift after the surgical intervention, and had worse NIHSS parameters. These may have been the factors that hindered this patient's evolution. The literature indicates that SLH discharge during the hospital stay can occur in a mean of 22 days in cases of stroke[27]. However, there is no survey of such data regarding MI. In the present study, SLH discharge took a mean of 35.4 days, and four patients (80%) improved their FOIS score.

The patients mean length of stay was 42.6 days, though it varied between patients. This demonstrates a difference in their evolution, which may depend on age, head CT scan findings, tracheostomy, OTI time, and SLH findings. Three patients (60%) were discharged from the hospital to continue treatment at a rehabilitation hospital, particularly to continue SLH therapy – in the case of two of them, the main issue was dysphagia. Studies demonstrate that one of the exogenous factors that hinder a good prognosis is the patient's lack of access to health services to continue and/or remain in treatment[28]. Hence, when patients await at the hospital and are directly admitted for rehabilitation at a reference health institution, this certainly favors a good final prognosis.

The limitation of the present study was its sample size and the lack of inferential statistical analysis of the findings – although it presented data on different cases, demonstrating the importance of the SLH team at the stroke unit. So far, only one case report of an MI patient with dysphagia was found in the literature. It would also be interesting to analyze pre-DC SLH assessment to define the actual impact of DC on the swallowing process. However, awareness is knowingly indispensable for SLH assessment.

CONCLUSION

Even though clinical-neurological factors interfered with the functional swallowing capacity, they did not hinder either the SLH treatment or the clinical evolution, with a full oral diet resumed during the hospital stay. This shows the importance of having an SLH team at the stroke unit and beginning assessment and intervention as soon as possible in the acute phase to reach a good prognosis.

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