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Outcome of Posterior Fossa Decompression with Duraplasty by Different Types of Graft in Patients with Chiari Malformation Type I

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Outcome of Posterior Fossa Decompression with Duraplasty by Different Types of Graft in Patients with Chiari Malformation Type I

Neurosurgery

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ABSTRACT

Background: Chiari malformation type I (CM-I) is treated surgically by suboccipital craniectomy with or without duraplasty. Duraplasty may be performed using a variety of dural grafts, including autologous pericranium, allografts, xenografts, and synthetic substitutes.
Aim of the work: To assess outcome and CSF leakage incidence according to type of dural graft in CM-I patients.
Patients and methods: This study included twenty-eight patients with Chiari malformation type I who underwent posterior fossa decompression with duroplasty were randomly assigned into two equal groups: Group A (N=14): patients were treated with a dural substitute Engineered collagen matrix grafts (DuraGen). Group-B (N=14): patients were treated with free tissue fascia lata graft. All patients had neurological assessment and basal laboratory investigations. Magnetic resonance imaging (MRI) of the brain and craniocervical junction as well as computed tomography (CT) of the brain were done preoperatively..
Results: Regarding clinical outcome, fascia lata group showed higher significant excellent rate (92.9%) than DuraGen group (57.1%) (p=0.032). Also, one patient showed good outcome and none showed poor outcome in patients with fascia lata graft while there were four patients with good outcome, two with poor outcome in DuraGen graft patients without significance. Considering postoperative complications, only one patient (7.1%) in fascia lata group showed tight bandage while DuraGen group showed eight patients (57.1%) with CSF leakage (p=0.001), four patients (28.6%) needed reoperations (p=0.033), two cases (14.3%) with Aseptic meningitis and ten cases (71.4%) with tight bandage (p < 0.001).
Conclusion: CM-I decompression surgery with duraplasty by fascia lata graft has a better outcome and lower significant rate of CSF leakage and other postoperative complications than engineered collagen graft (DuraGen).

Keywords: *Chiari Malformation Type I; Posterior Fossa Decompression; Duraplasty.*

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INTRODUCTION

Chiari malformation type I (CM-I) defined by descend of caudal end of the cerebellar tonsil and crowding of craniocervical junction [1]. About half to seventy percent of CM-I cases are accompanied by syringomyelia (SM), which may progressively develop to chronic and often irreversible myelopathy [2,3]. Although many people with CM-I are asymptomatic, some symptomes may be present as headache, cerebellar ataxia, ocular abnormalities, spasticity or lower cranial nerve involvement [4].

Suboccipital craniectomy with or without expansile duraplasty, arachnoid dissection, and tonsillar reduction are among the surgical options. Leakage of cerebrospinal fluid (CSF) is a frequent side effect of duraplasty. Incidence of CSF leak following durapasty varies between 2% and 11.7% [5].

Duraplasty may be performed using a variety of dural grafts, including autologous pericranium, allografts, xenografts, and synthetic substitutes. It is yet unknown if any of these materials are related with greater rates of CSF leakage or other adverse effects [6]. Our rational was assess outcome and CSF leakage incidence according to type of dural graft in CM-I patients who managed by posterior fossa decompression and duraplasty.

PATIENTS AND METHODS

An interventional randomized study conducted at Department of Neurosurgery Surgery, Faculty of Medicine, Al-Azhar University during the period from 1 January 2020 to 1 December 2021. The study was accepted by Al-Azhar University's Ethics Board, and each subject signed an informed written permission form.

This study included twenty-eight patients with CM-I who underwent posterior fossa decompression with duroplasty were allocated in a simple randomised method without stratification in a 1:1 ratio to two equal groups: Group A “collagen matrix graft group”: (N=١٤): patients were treated with a dural substitute Engineered collagen matrix grafts (DuraGen; Integra Neurosciences, Plainsboro, NJ,

USA). Group-B "fascia lata graft group": (N=14): patients were treated with free tissue fascia lata graft. Asymptomatic patients and prior operation on the posterior cranial fossa were excluded.

All patients had complete history, neurological assessment and basal laboratory investigations. Magnetic resonance imaging (MRI) of the brain and craniocervical junction as well as computed tomography (CT) of the brain were done preoperatively.

We performed a midline suboccipital craniectomy, a y-shaped durotomy, a bipolar electrocautery method to shrink the cerebellar tonsils, and duroplasty either by DuraGen or fascia lata graft, watertight closure.

Clinical outcomes after surgery are classified as excellent, good, and poor [7]. If all of the patient's preoperative neurological problems have been alleviated and he is able to resume his usual daily activities, the results were rated excellent. Partial enhancement in preoperative symptoms is good, as long as the patient can resume to his regular routine while poor outcomes are characterised as deterioration of the patient's neurological state and consciousness, or even death. We continue follow-up till 12 months.

Statistical analysis:

All data analyzed using statistical package for social sciences (SPSS) version 22 (SPSS Inc, Chicago, USA). For qualitative data, frequency and percent distributions was calculated. For quantitative data, mean, standard deviation (Sd) was calculated. significance was defined as P value < 0.05. The following tests were used; Mann-Whitney U test and Chi- Square test.

RESULTS

A total of twenty-eight patients with CM-I underwent posterior fossa decompression with duroplasty either by DuraGen graft or Facia lata graft, their mean of age was 30.71 +7.96 and 33.64 +11.27 years, respectively. The majority in both groups were females 64.3% and 57.1%, respectively. There was no significance between both groups regarding age and sex (Table 1).

Regarding symptoms in DuraGen and Facia lata group, the most prominent symptoms in both groups was occipital pain which presented in all patients followed by neck pain which presented in 78.6% and 71.4%, respectively without significance among both groups (Table 2).

Regarding clinical outcome, fascia lata group showed higher significant excellent rate (92.9%) than DuraGen group (57.1%) (p=0.032) Figure 1. Also, one patient showed good outcome and none showed poor outcome in patients with fascia lata graft while there were four patients with good outcome, two with poor outcome in DuraGen graft patients without significance (Table 3) Figure 2.

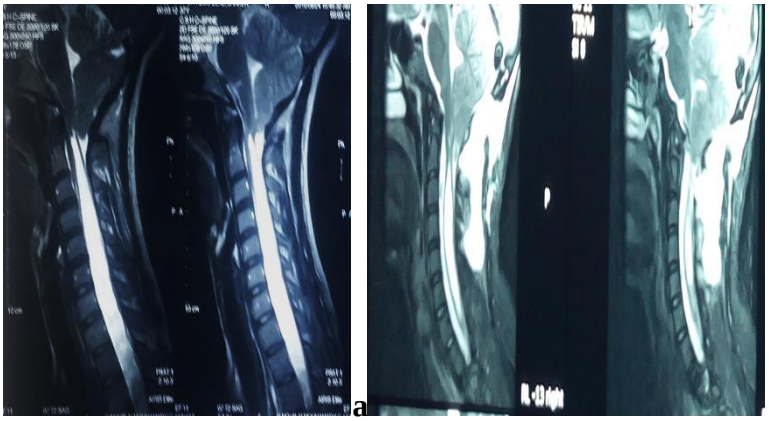
Considering postoperative complications, only one patient (7.1%) in fascia lata group showed tight bandage while DuraGen group showed eight patients (57.1%) with CSF leakage (p=0.001), four patients (28.6%) needed reoperations (p=0.033), Figure 3 two cases (14.3%) with Aseptic meningitis and ten cases (71.4%) with tight bandage (p < 0.001) (Table 4).

The majority of both groups showed marked reduction in size of syrinx (64.3% and 78.6%) without significance (Table 5).

a b

Fig. 1: a) MRI preoperative chiari type I b) postoperative using fascia lata

Fig. 2 : a) MRI preoperative chiari type I b) postoperative using dura Gen



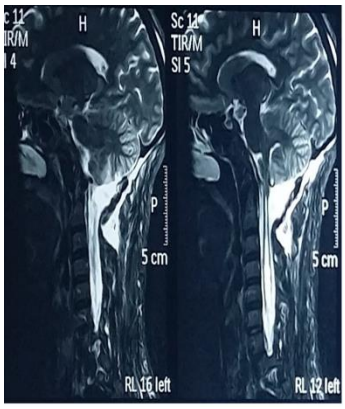


Fig. 3: a) MRI preoperative chiari type I b) postoperative using duragen c) after repair using fascia lata

		DuraGen graft (n=14)	Facia lata graft (n=14)	Test value	P value
Age (year)	Mean ±SD	30.71 ±7.96	33.64 ±11.27	0.795	0.434
	Range	18 - 41	20 - 52		
Gender	Male	5 (35.7%)	6 (42.9%)	0.147	0.702
	Female	9 (64.3%)	8 (57.1%)		

Table 1: Demographic data of studied patients

	DuraGen graft (n=14)	Facia lata graft (n=14)	Test value	P value
	No (%)	No (%)		
Neck pain	11 (78.6%)	10 (71.4%)	0.187	0.665
Occipital pain	14 (100%)	14 (100%)	0.000	1.000
Numbness and parasthesia	8 (57.1%)	8 (57.1%)	0.000	1.000
Weakness	8 (57.1%)	6 (42.9%)	0.544	0.461
Sphincteric dysfunction	2 (14.3%)	1 (7.1%)	0.366	0.545
Cerebellar manifestations	0 (0%)	1 (7.1%)	0.994	0.318

Table 2: Distribution of symptoms in studied patients

	DuraGen graft (n=14)	Facia lata graft (n=14)	Test value	P value
	No (%)	No (%)		
Excellent	8 (57.1%)	13 (92.9%)	4.614	**0.032***
Good	٤ (28.6%)	1 (7.1%)	2.128	0.145
Poor	2 (14.3%)	0 (0%)	2.079	0.149

*p value was significant

Table 3: Clinical outcome after surgery

	DuraGen graft (n=14)	Facia lata graft (n=14)	Test value	P value
	No (%)	No (%)		
CSF leak	8 (57.1%)	0 (0%)	10.789	**0.001***
Reoperation	4 (28.6%)	0 (0%)	4.505	**0.033***
Aseptic meningitis	2 (14.3%)	0 (0%)	2.079	0.149
Tight bandage	10 (71.4%)	1 (7.1%)	11.704	< **0.001***

*p value was significant

Table 4: Postoperative complications in studied patients

	DuraGen graft (n=14)	Facia lata graft (n=14)	Test value	P value
Marked reduction	9 (64.3%)	11 (78.6%)	0.677	0.441
Mild reduction	4 (28.6%)	2 (14.3%)	0.819	0.365
No change	1 (7.1%)	1 (7.1%)	0.000	1.000

Table 5: Size of syrinx after surgery

DISCUSSION

Using an expansile duroplasty after CMI decompression is expected to reduce foramen magnum crowding while also aiding the return of more normal CSF flow phenomena. However, the most frequent consequence is pseudomeningocele development if a CSF leak is not prevented during duroplasty closure [8].

Materials and techniques for repairing a dural defect are numerous. Avascular grafts comprise autologous grafts and engineered collagen grafts. Autologous grafts involve fat, fascia, bone, cartilage, and free mucosa grafts taken from patients. Engineered collagen grafts (i.e., DuraGen), thought to act as scaffolding for the growth of indigenous cells can be used suturelessly, but post-operative complications may predispose the patients [9,10].

The goal of this research was to establish if the kind of dura graft used in patients with CM-I affects the outcome and/or minimises the occurrence of problems in these individuals. To our knowledge, this is a novel study which compare facia lata graft with engineered collagen graft.

In short-term follow-up, Klekamp found that posterior fossa decompression with duraplasty improved clinical outcomes in patients by 73.6%, irrespective to type of the graft whether an autologous or nonautologous. Additionally, he found that 14.3% of patients within 5 years and 15.4% of patients within 10 years had substantial neurological impairment, with a much greater recurrence rate when the autologous graft was applied [11].

The two study groups, exhibited comparable demographic parameters. Also, the most prominent compliant in both groups was occipital pain which presented in all participants followed by neck pain which presented in 78.6% and 71.4%, respectively without significant difference between groups. These results are comparable to the findings of the research, in which headache happened in 100% of individuals and neck ache occurred in 89% of cases, respectively [12].

Regarding clinical outcome, fascia lata group showed higher significant excellent rate (92.9%) than DuraGen group (57.1%) (p=0.032). Also, one patient showed good outcome and none showed poor outcome in patients with fascia lata graft while in DuraGen graft patients, there were four patients with

good outcome, two with poor outcome and one with incapacitated outcome without significance.

In the same line, a study by Elsaid et al. [7] who used fascia lata graft duraplasty reported at the end of follow up for one year that excellent clinical outcome was noted in twelve patients (75%), the rate of good outcome was 12.5% (two patients), fair outcome in one patient (6%) and poor outcome in one patient (6%).

Another study done by Elkatatny et al. [13] who used fascia lata graft showed that 18 (60%) cases showed a significant postoperative enhancement, 6 (20%) showed fair enhancement & 6 (20%) were poor.
On the other hand, a study by Chotai and Medhkour [14], who involved ten patients and used artificial dura graft for duraplasty and reported that six patients have excellent outcome, two patients with both good and poor outcome.

Some materials, such as nonautologous grafts, appear to predispose cases to specific complications, such as aseptic meningitis and bacterial infections [15]. In our study, there were two patient (14.3%) had aseptic meningitis in DuraGen group.

Our study revealed that CSF leakage observed in 8 patients (57.1%) in DuraGen group while none in fascia lata group showed a leakage. Vanaclocha *et al.* [16] found that nonautologous grafts (Polytetrafluoroethylene) resulted in leaking of CSF fluid by 15% following duraplasty, whereas pericranium did not. After a duraplasty with pericranium, Attenello et al. [17] found a greater incidence of CSF leakage. A recent multi-center research conducted by Yahanda *et al.* [18] found that autografts and nonautologous grafts had a similar overall complication rate (p=0.12), with greater incidence of pseudomeningocele (p=0.04) associated with the use of the nonautologous graft which was similar to our results. A recent study by Elkatatny et al. [13] observed CSF leakage in 6.6% in fascia lata graft.

People with CM-I are more likely to suffer from syringomyelia, which is one of the most common causes of neurological symptoms and impairments in these patients. One of the major aims of surgical therapy for individuals with CM-I is the enhancement or elimination of syringomyelia [19]. Syringomyelia enhancement or resolution was recorded in all of the published series (paediatric, adult, combined and total) for almost three-quarters of the patients (78%) and there was no significant difference in syringomyelia outcomes across any of the series subgroups [20]. Our study showed a comparable result regarding reduction of size of syrinx.

Our study limitations were small sample of patients and short period of follow-up which may have a role in our findings.

CONCLUSION

CM-I decompression surgery with duraplasty by fascia lata graft has a better outcome and lower significant rate of CSF leakage and other postoperative complications than engineered collagen graft (DuraGen).

Conflict of interest : none

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