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Impact of duraplasty on clinical outcome in surgical management of chiari malformation type I

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ABSTRACT

Background & Objectives: In Chiari malformation type I (CIM), the cerebellar tonsils and the medial parts of the inferior cerebellar lobules are displaced downward through the foramen magnum into the upper cervical spinal canal. The primary surgical treatment for the Chiari I malformation is foramen magnum decompression. This study was undertaken to assess the clinical outcome in terms of clinical symptoms improvement in patients with Chiari malformation type I treated with foramen magnum decompression with duraplasty vs. primary repair of dura.

Materials and Methods: A total of 32, 24 patients retrospectively and 8 cases prospectively were studied after being diagnosed and operated on for Chiari malformation type I. Patients with Chiari types II, III, and IV were not allowed to participate. Before and one year after surgery, a questionnaire was utilized to measure improvements in neck pain and impairment caused by it, head aches and disability caused by it, and overall health. The findings of both groups' questionnaires were analysed and compared.

Results: The third decade (34.38%) was the most prevalent age group for presentations, followed by the fourth decade (31.25 %). The ratio of males to females was 1.2:1. Sensory disturbances were the most frequent presenting symptom, found in 25 patients (78.13%), and followed by neck discomfort in 14 patients (43.75%). Leg weakness was the most frequent symptom, which was reported in 20 patients (62.50%). The foramen magnum decompression and duraplasty was done in 18 patients, whereas the foramen magnum decompression and primary repair was done in 14 patients. In the duraplasty group, there were greater problems. The Duraplasty group had an overall clinical improvement rate of 88.89%, while the non duraplasty group had a lower overall clinical improvement rate of 50%. Specific complaints such as neck discomfort improved at a comparable rate (88.89%) in the duraplasty group compared to the non-duraplasty group (80%).

Conclusions: Although foramen magnum decompression with duraplasty is preferable to foramen magnum decompression with primary repair, duraplasty is associated with a slightly greater risk of complication. Selected patients benefit from foramen magnum decompression alone, but further prospective randomized control studies are needed to learn more.

1. Introduction

The growing degree of hindbrain herniation via the foramen magnum is referred to as the Chiari malformations.[1] The cerebellar tonsils and the medial parts of the inferior

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cerebellar lobules are displaced downward through the foramen magnum into the upper cervical spinal canal in Chiari malformation type I (CIM).[2] A significant percentage of these individuals have Syringomyelia as well.[3] Patients complain of headaches, neck pain, generalized discomfort, nausea, vomiting, dizziness, hearing loss, visual abnormalities, paraesthesias, weakness, tiredness, and gait difficulties, among other symptoms.[4]

The anatomical demonstration of the aberrant location of the cerebellar tonsils below the foramen magnum, the presence of syrinx, and concomitant bone abnormalities of the posterior cerebral fossa and craniovertebral junction are all used to diagnose Chiari I malformation. The radiological workup is crucial in identifying this disease, with MRI being the preferred examination.

Decompression of the foramen magnum has long been thought to be the primary surgical therapy for the Chiari I malformation. This is because the herniation of cerebellar tissue owing to a bigger cerebellar mass in a smaller posterior cerebral fossa is the major pathophysiology explanation for Chiari malformation. However, many procedures of foramen magnum decompression have been documented in the literature, with differences such as the extent of the decompression, the dural aperture used, and duraplasty with an allograft or an autograft. Numerous researches have demonstrated the benefits and drawbacks of each of these approaches.

Several researches on the usage of duraplasty have been published. However, no definitive benefits or drawbacks have been determined. Although there is no substantial difference in clinical results between patients who have duraplasty and those who do not, few writers advocate the use of duraplasty, and a few authors have observed a greater risk of problems linked with it.[5,6] As a result, we were compelled to conduct this research at our institution to assess the clinical outcomes of foramen magnum decompression with and without duraplasty.

2. Materials and Methods

Retrospective and prospective study done in Patients treated in Department of Neurosurgery, KIMS hospitals Secunderabad from January 2016 to December 2019 were included

2.1. Sample size

A review of the Neurosurgery OT records revealed a total of 30 CM I cases that underwent surgery. We were unable to contact six patients for follow-up and were thus omitted from the research. A total of 8 patients who were operated on for CM I between December 2018 to December 2019 were prospectively included in the research.

2.2. Inclusion criteria

Chiari malformation type I was identified and treated in these patients.

2.3. Exclusion criteria

Chiari type II, III, and IV patients.

Patients who met the eligibility criteria were recruited. All retrospectively included cases had a detailed clinical history that was collected from the patients' case records and prospectively recorded in the cases operated till December 2019. Patients were divided into two groups based on whether they underwent foramen magnum decompression with or without duraplasty. Patients who had foramen magnum decompression with duraplasty were assigned to group A, whereas those who underwent foramen magnum decompression without duraplasty were assigned to group B. Depending on the operating surgeon's choice, prospective cases were divided into groups.

All patients who were prospectively included in the research gave their written informed consent. Before and one year after surgery, a questionnaire was utilized to measure improvements in neck pain and impairment caused by it, head pain and disability caused by it, and overall health. A person who was not engaged in the study recorded the responses to this questionnaire over the phone.

To prepare the questionnaire and assess overall clinical improvement ussing the Numeric Rating Scale (NRS) for Neck pain (NRS neck), Headache pain (NRS -Head), Neck Disability index (NDI), Headache Disability Index, and General health by RAND 36-Item Health Survey 1.0. (SF-36).[7,8] The findings of both groups questionnaires were analyzed and compared.

2.4. Statistical analysis

For data analysis, SPSS version 21 will be utilized. The proportion of improvement in each symptom was compared using Fisher's test. Statistical significance was defined as a P value of less than 0.05.

3. Results

A total of 32 patients were included in the study. The study comprised 24 cases retrospectively and 8 cases prospectively.

The third decade (34.38 %) was the most prevalent age group for presentations, followed by the fourth decade (31.25%). In the research, there were 18 men (56%) and 14 women (44%) participants. In our study, the male to female ratio was 1.2:1.Table 1

Sensory disturbances were the most frequent presenting symptom, found in 25 patients (78.13%), followed by neck discomfort in 14 patients (43.75%). Leg weakness was the most frequent symptom, which was reported in 20 patients

Table 1: Demographic distribution in study

Age	Number of cases	percentages
0-10[7,8]	1	3.13%
1-20	4	12.50%
20-30	11	34.38%
30-40	10	31.25%
40-50	4	12.50%
50-60	0	0.00%
60-70	2	6.25%
Gender		
Male	18	56
Female	14	44

Table 2: Clinical Presentation

Symptoms	No.	Percentage	Duraplasty Group A	Non Duraplasty Group B	P-value
Neck Pain	14	43.75%	9	5	0.49
Head ache	6	18.75%	4	2	0.67
Limb pain	13	40.63%	7	6	1
Sensory	25	78.13%	13	12	0.43
Spasticity	17	53.13%	9	8	0.73
Limb Weakness	20	62.50%	11	9	0.48
Limb deformity	1	3.13%	0	1	0.44
Cerebellar signs	2	6.25%	2	0	0.49

Table 3: Clinical Improvement in present study after treatment

Overall Clinical Improvement	N	Clinically Improved	%	Not Improved	%	P-Value
Duraplasty (Group A)	18	16	88.89%	2	11.11%	**0.02**
Non Duraplasty (Group B)	14	7	50.00%	7	50.00%	
Improvement In Neck Pain						
Duraplasty (Group A)	9	8	88.89%	1	11.11%	1
Non Duraplasty(Group B)	5	4	80.00%	1	20.00%	
Improvement In Headache						
Duraplasty (Group A)	4	4	100.00%	0	0.00%	0.33
Non Duraplasty (Group B)	2	1	50.00%	1	50.00%	
Improvement In Limb Pain						
Duraplasty (Group A)	7	7	100.00%	0	0.00%	0.19
Non Duraplasty (Group B)	6	4	66.67%	2	33.33%	
Improvement In Sensory Symptoms						
Duraplasty (Group A)	13	11	84.62%	2	15.38%	0.04
Non Duraplasty (Group B)	12	5	41.67%	7	58.33%	
Improvement In Spasticity						
Duraplasty (Group A)	9	8	88.89%	1	11.11%	0.049
Non Duraplasty (Group B)	8	3	37.50%	5	62.50%	
Improvement In Limb Weakness						
Duraplasty (Group A)	11	10	90.91%	1	9.09%	0.02
Non Duraplasty (Group B)	9	3	33.33%	6	66.67%	

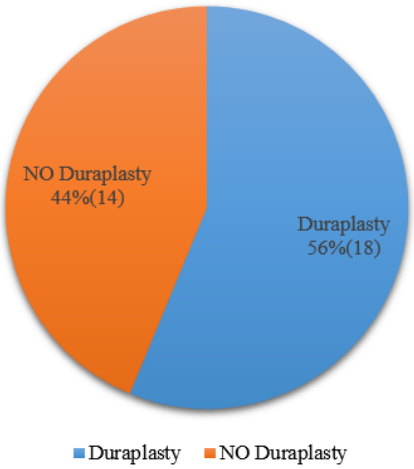

Fig. 1: Surgical procedure in study

(62.50 %).Table 2

A total of 32 patients were divided into two groups: duraplasty (Group A) and non duraplasty (Group B). Bony decompression without duraplasty was performed on 14 patients in Group B. The bulk of the cases in our research (18 cases) were in Group A. They had a decompression of the posterior fossa, duraplasty of durotomy. Autologous grafts such as fascia lata or pericranial graft were utilized for duraplasty.

Complications were reported in four patients out of 32. Three patients in group A had CSF leaks, whereas only one patient in group B had a surgical site infection. Although the duraplasty group had greater problems, statistical analysis revealed that this was not significant ($p>0.05$).

The Duraplasty group exhibited an overall clinical improvement of 88.89 percent after a year, while the non duraplasty group had a lower overall clinical improvement rate of 50 percent. On investigation, this difference was found to be statistically significant ($p < 0.05$).

Patients in the duraplasty group had a virtually same rate of improvement in neck discomfort (88.89%) as those in the non-duraplasty group (80%).

Patients in the duraplasty group had less headache and limb discomfort than those in the non-duraplasty group. However, due to the limited sample size, this difference was not statistically significant.

Patients in the duraplasty group improved faster than those in the non-duraplasty group in terms of sensory symptoms, stiffness, and limb weakness. On analysis, this difference was statistically significant ($p < 0.05$).

4. Discussion

When the cerebellar tonsils descend into the cervical spinal canal, it is known as a Chiari I malformation. It can be caused by a variety of hereditary and acquired causes. The Chiari I malformation has long been thought to be a disease that only affects teenagers and young adults. According to Aska Arnautovic et al, the median age of adult patients diagnosed with Chiari I malformation was 40.5 years, with a range of 37 to 45.3 years, while the median age of pediatric patients was 8 years, with a range of 6 to 10.5. The average age of presentation was 35 years old, with a range of 27.3–40 years. These findings matched the data from our study, which revealed that the majority of the patients were in their third or fourth decade at the time of presentation. In 2017, an Indian study of 75 patients revealed a similar average age of 35 years.[9,10]

In our study, there was a small male majority (56%). In both adult and pediatric series, Aska Arnautovic's analysis of 145 articles revealed female dominance.[10] Our findings, however, were in line with a retrospective examination of 51 cases with type I Chiari malformation treated at the National Institute of Mental Health and Neurosciences, which also revealed a male majority.[5]The compression of neural structures by inferiorly herniated tonsils or syringomyelia in the cord causes clinical symptoms and signs in individuals with Chiari malformations.

The sensory disturbance was the most prevalent presenting complaint in our study, with 25 patients experiencing it (78.13%). This was supported by the findings of two Indian studies: Ramnarayan R et al[5] found sensory problems in 62 percent of their patients, and B.D Bharath Singh Naik et al[9] found sensory complaints in 68 percent of their patients. The most prevalent presenting complaint is headache and neck discomfort, according to several studies. Neck discomfort was the second most prevalent complaint in our study, with 14 patients (43.75%) reporting it. Leg weakness was the most frequent symptom, which was reported in 20 patients (62.50%).

Decompression of the foramen magnum is the preferred therapy for symptomatic Chiari-1 malformation and improves quality of life.[11] However, there is still a lot of disagreement over which surgical approach to use. As an alternative to duraplasty, it can be done without dural opening. There was no unanimity on a conventional surgical technique in a worldwide study of 76 surgeons conducting Foramen magnum decompressions. Foramen magnum decompression, dural opening, and duraplasty were performed on 18 of the 32 patients in our series. Group A and Group B were made up of 14 patients that were operated on only by bone decompression with no duraplasty. Duraplasty has been linked to the development of pseudomeningocele, cerebrospinal fluid leak, and subsequent meningitis.[12] CSF leak was detected in three patients in Group A and surgical site infection was seen in one patient in Group B in our series. Although the duraplasty group had greater problems, statistical analysis revealed that this was not significant ($p>0.05$).

Various writers have investigated the clinical outcomes of patients treated with decompression alone vs decompression plus duraplasty, with varied conclusions regarding the advantages and drawbacks of each. Vibhor Krishna et al.[13] found that people with symptomatic Chiari-1 malformation following foramen magnum decompression without dural incision have moderate complication rates but significant long-term symptomatic recurrence rates.[13] A one-year follow-up of the patients in our study revealed that the duraplasty group had an overall clinical improvement rate of 88.89 percent, compared to a lower overall clinical improvement rate of 50 % in the no duraplasty group. It was determined that this difference was statistically significant (p0.05). With the information above, we may infer that, while patients having duraplasty have a greater complication rate, their overall clinical improvement is better than the non-duraplasty group.

Zhao J-L et al., who conducted a meta-analysis of 18 publications including a total of 1242 patients, backed up this theory.[11] However, a subgroup of patients in the non-duraplasty group also exhibited clinical improvement. This was notably evident in symptoms such as neck discomfort (80 percent of the patients showed improvement). As a result, the approach of bone decompression cannot be entirely ruled out, especially given that our findings are based on a limited number of patients, the majority of whom were retrospectively evaluated. As a result, further large-scale prospective randomized control trials are required before we can reach a conclusion in this area.

5. Conclusions

Although foramen magnum decompression with duraplasty is preferable to foramen magnum decompression without duraplasty, duraplasty is associated with a slightly greater risk of complication. Select people benefit from foramen magnum decompression alone, and further prospective randomized control studies are needed to learn more.

6. Conflict of Interest

There are no conflicts of interest in this article.

7. Source of Funding

None.

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