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Technical note

Dural Closure in Chiari I Malformation. Technique Description and Analysis of Results

Durorrafia em Malformação de Chiari Tipo 1. Descrição de Técnica e Análise dos Resultados

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ABSTRACT

***Introduction**. Surgical posterior fossa decompression of Chiari malformation type 1 (CM-I) is recommended in symptomatic patients. The classic surgery is a suboccipital craniectomy and C-1 laminectomy, with duroplasty. However, a range of complications associated with surgical management of CM-I includes pseudomeningocele, CSF leakage, aseptic meningitis, and wound infections, making dural closure and reconstruction one important step to determine morbidity. Our objective is to present a technique of pericranium harvest and dural closure and describe our experience. **Methods.** A retrospective study was conducted based on records of patients treated in Hospital das Clínicas of the University of São Paulo, diagnosed with CM-I and submitted to posterior fossa decompression from January 2008 until May 2015. We evaluated the occurrence of post-operative complications of symptomatic pseudomeningocele or incisional CSF leak. The occurrence of meningitis, surgical site infection or other complications were also available. **Results.** A total of 22 patients were evaluated in this study. Sixteen (72.7%) were female patients. Overall, the mean age at the time of surgery was 49 ± 13.6 years-old. Four patients (18%) presented complications: 3 CSF leakages (13.5%) and 1 pseudomeningocele (4.5%). **Discussion.** Postoperative complications of CM-I are still frequent and determinants of surgical success. We propose a new surgical technique with autologous pericranium graft and duraplasty. Additionally to dural closure, we propose another modality of muscular fascia closure, allowing increased tight closure. Our data corroborate with current literature. **Conclusion.** Our technique of dural closure using pericranium autologous graft in CM-I is safe and feasible.*

***Key words:** Chiari malformation; Posterior fossa decompression; Dural closure; Fistula*

RESUMO

***Introdução.** A descompressão da fossa posterior é recomendada em pacientes com Chiari 1 sintomáticos. A cirurgia clássica é uma craniectomia suboccipital e laminectomia de C-1 com duroplastia. Contudo, uma série de complicações associadas inclui pseudomeningocele, fístula liquórica, meningite asséptica e infecção de ferida. Dessa forma, o fechamento dural é uma etapa fundamental no tratamento. Nosso objetivo é apresentar uma técnica de enxertia de pericrânio e fechamento dural. **Métodos.** Um estudo retrospectivo foi realizado com dados de pacientes tratados no Hospital das Clínicas da Universidade de São Paulo, diagnosticados com Chiari 1 e submetidos a descompressão de fossa posterior de janeiro de 2008 a maio de 2015. Avaliamos a ocorrência de complicações pós-operatórias de pseudomeningocele sintomática ou fístula liquórica. Também avaliamos a ocorrência de meningite, infecção no local cirúrgico ou outras complicações. **Resultados.** Um total de vinte e dois pacientes foi avaliado neste estudo. Dezesseis (72,7%) eram pacientes do sexo feminino. No geral, a idade média no momento da cirurgia foi de 49 ± 13,6 anos de idade. Quatro pacientes (18%) apresentaram complicações, sendo 3 fístulas liquóricas (13,5%) e 1 pseudomeningocele (4,5%). **Discussão.** As complicações pós-operatórias do Chiari 1 ainda são frequentes e determinantes do sucesso cirúrgico. Propomos uma nova técnica cirúrgica com enxertia de pericrânio autólogo e duroplastia. Nossos dados corroboram com a literatura atual. **Conclusão.** Nossa técnica de fechamento dural usando enxerto autólogo é segura e viável.*

***Palavras-chave:** Malformação de Chiari; Descompressão da fossa posterior; Fechamento dural; Fístula.*

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Introduction

Chiari malformation Type I (CM-I) is an heterogeneous group of lesions united by a common physiology, which is disruption of cerebrospinal fluid (CSF) flow through the foramen magnum due to caudal displacement of the cerebellum with tonsillar herniation[1]. Surgical posterior fossa decompression of CM-I is recommended in symptomatic patients with CSF obstruction, as it has been shown to improve the clinical course of these patients[2].

The classical recommendation is suboccipital craniectomy and C-1 laminectomy with duroplasty[3-12]. A range of complications associated with surgical management of CM-I (range 3%–40%) includes pseudomeningocele, CSF leakage, aseptic meningitis and wound infections[1,3,13-19].

Different tissue grafts have been used for dural augmentation in Chiari decompression surgery. However there is no consensus as to the optimal material[4]. Most surgeons have preferred autologous grafts over nonautologous substitutes, such as pericranium, autologous fascia lata, ligamentum nuchae. Pericranium is one of the most preferred and is associated with a minimal risk of CSF leak and low infection rate[5,6].

Our objective is to present a technique of pericranium harvest and dural closure and to describe our experience.

Methods

It is a retrospective study based on records review from assisted patients in Hospital das Clínicas, University of São Paulo, diagnosed with Chiari I malformation and submitted to posterior fossa decompression from January 2008 until May 2015 by a single surgeon.

Patient sample

Inclusion criteria were patients submitted to suboccipital craniotomy and duroplasty with the same surgical technique from 2008 to 2015. Exclusion criteria: patients were excluded if their initial Chiari decompression was done at an outside hospital, if they had Chiari malformation type 2, if they were <16 years old, if their overall follow-up was <6 months or if they were operated by other surgeon.

Outcomes

The analyzed outcome was the presence of surgical complications: symptomatic pseudomeningocele or incisional CSF leak. If there was a new revision surgery, it was considered as a new procedure for tracking the overall success of the surgical technique. The occurrence of meningitis, surgical site infection or other complications were also available. Complementary data analyzed were age and sex.

Surgical technique

Patient under general anesthesia and orotracheal intubation is positioned in the prone position with the head slightly bent in cranial fixation head holder. The skin incision is made in the median line, extending from the external occipital protuberance to the height of the fourth or fifth spinous process of the cervical vertebra. An extension of the incision, 3 cm above the occipital protuberance, is for pericranium removal for graft. The subcutaneous tissue is displaced from the cervical aponeurosis. The aponeurosis incision is performed in a "T-shaped" with superior incision 5 mm below the external occipital protuberance, extending bilaterally 2-3 cm. The procedure is the longitudinal section along the midline exposing the occipital bone and the posterior C1 arch. Care is taken not to deactivating the spinal muscles of the spinous process of C2 due to its biomechanical implications. Patients were submitted to suboccipital craniectomy, diameter of 3 to 4 cm, with removal of the C1 arch (Figure 1). Posteriorly, dural exposure is carried out with debridement and decompression at the level of the foramen magnum.

The opening of the subcutaneous tissue with preservation of the aponeurotic plane and its extension to pericranium is carefully performed. It is then removed a pericranium autograft in triangular shape with 3 cm base, with preservation of muscle insertions in the superior nuchal line. Preserving a muscular band adhered to the superior nuchal line makes it easier to suture muscle and aponeurosis after craniectomy, with less risk of CSF leakage.

Under microscopy the dura is opened in Y-shaped incision, exposing the hemispheres and the cerebellar tonsils herniated in the occipital foramen. Adhesions of the arachnoid membrane are removed, moving the tonsils laterally and superiorly, and performing the opening of the foramen of Magendie. When necessary, tonsil coagulation is performed maintaining fourth ventricle opened.

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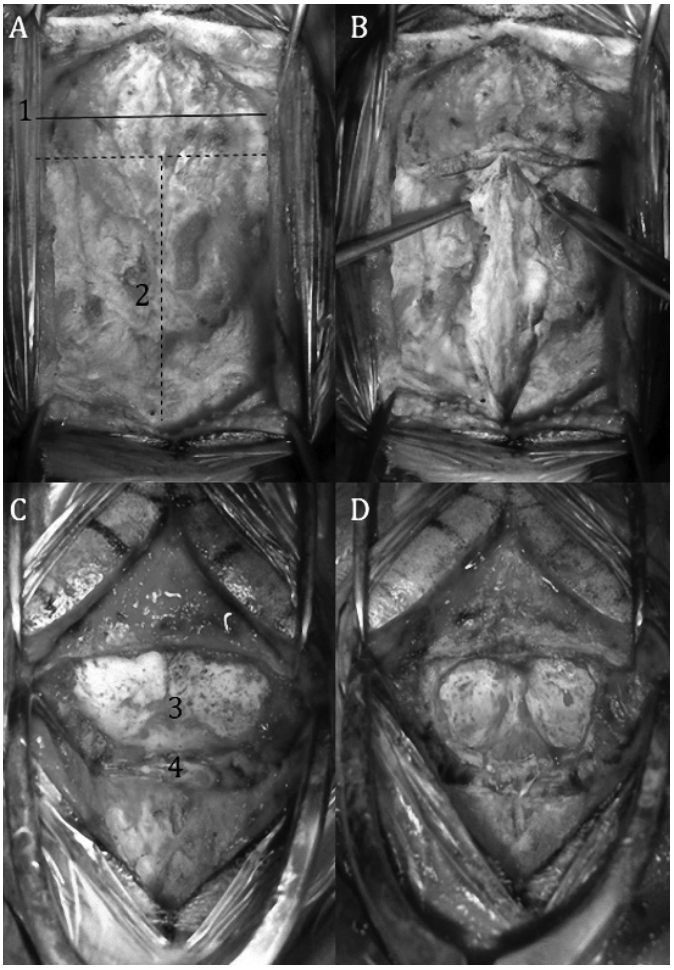

Figure 1. A. Exposure of muscle fascia; **1.** Superior nuchal line; **2.** Alba Line; - Surgical incision; **B.** Opening and muscle dissection; **C** Bone exposure; **3.** occiput; **4.** Posterior C1 arch; **D** Dural exposure after suboccipital craniectomy and removal of C1 arch.

The closure of the dura mater is then performed with the interposition of autologous pericranium graft sutured with continuous polypropylene 5-0. Suture sealing is performed with biological glue of fibrin (Tisseel Baxter Healthcare, Deerfield, IL). Then, the closure of muscular planes, aponeurotic fascia, subcutaneous and skin are performed (Figure 2).

Statistical analysis

It was used descriptive statistics with proportion and interval confidence calculation for variables. Complementary data was expressed by means and standard deviation.

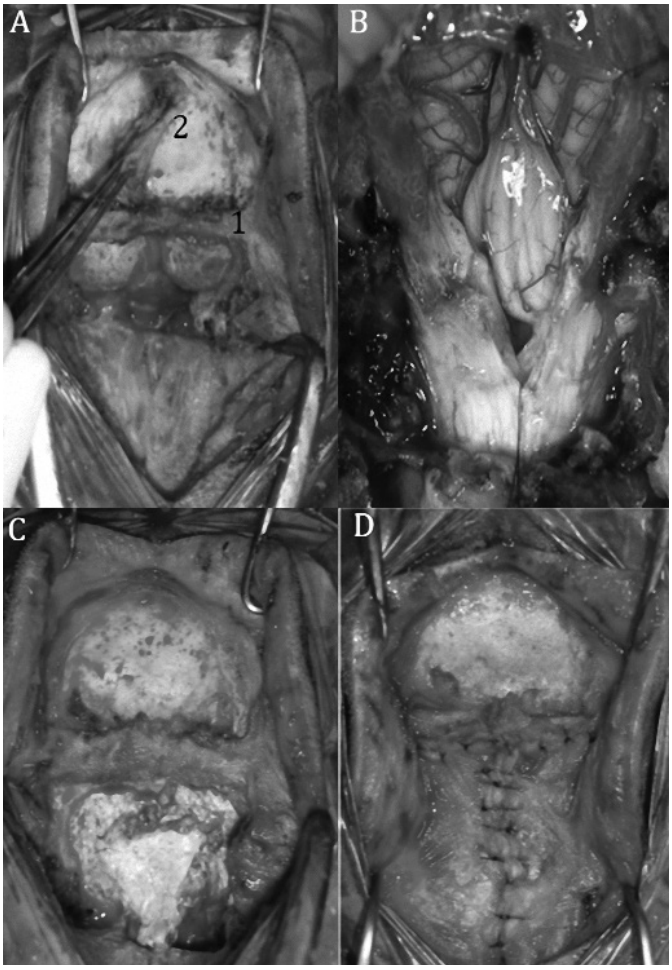

Figure 2. A. Withdrawal of autograft; **1.** Insert the cervical muscles in the superior nuchal line; **2.** Autologous pericranium graft; **B.** Decompression dura and debridement of arachnoid; **C** Duraplasty; **D.** Closure of muscle fascia maintaining muscle insertion.

Results

Patient population

A total of 34 patients with the diagnosis of Chiari syndrome type I were operated in this period from January 2008 until May 2015. Four patients did not undergo posterior fossa decompression; therefore they were not included in this study. From the remaining 30 patients, 8 were excluded (6 of them because they were operated by other surgeons, 1 whose follow-up was less than 6 months and 1 who was younger than 16 years-old). Finally, 22 patients were evaluated in this study. Sixteen (72.7%) were female patients. Overall, the mean age at the time of surgery was 49 ± 13.6 years-old.

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Postoperative

Four patients (18%) presented complications related to CSF: three presented CSF leakage (13.5%) and 1 presented pseudomeningocele (4.5%).

One patient (4.5%) developed postoperative meningitis, treated with antibiotics for 14 days without permanent morbidity. Two of these patients (9%) required surgical intervention for fistula repair. In our sample, no patients presented surgical site infection.

Discussion

Chiari malformation type I is a congenital disease characterized by an anatomic defect of the skull base, in which the cerebellum herniates through the foramen magnum into the cervical spinal canal[16,22,23]. Historically, it has been the cerebellar tonsillar herniation has been anatomically defined as 5 mm or greater below the foramen magnum[17,22,23].

Elevated or reduced velocity of cerebrospinal fluid (CSF) at the craniovertebral junction (CVJ) has been suspected to play a role in the pathophysiology of Type I Chiari malformation (CMI). Decompression surgery may be quantified in terms of geometric and hydrodynamic parameters and these parameters change near the CVJ, when compared to pre-operative patients[18].

The low availability and high cost of heterologous grafts or dural substitutes makes the reconstruction after posterior fossa decompression a procedure with potential harmful complications related to CSF fistula and its consequences[18-23]. A low cost, safe and efficient method for dural closure is a valuable alternative to address these complications[18-23].

We described a new surgical technique with autologous pericranium duraplasty and tested its effectiveness in a sample of CM-I patients. This technique allows an airtight dural, fascia and muscle closure. Main advantages are the easy learning curve and reproductibility of technique and inexistence of additional costs for health institutions. In a moment where artificial dural substitutes and dural sealants have increased success of surgery and decreased complications related to CSF fistula with concomitant increase in costs, it is important to revisit the need of autologous substitutes, especially in low and middle-income countries.

Our results suggest that it is feasible, easily available and with CSF complications similar to those of current literature. Our sample presented 13.5% of CSF fistula, 4.5% of pseudomeningocele, 4.5% of post operative meningitis and 9% of additional surgery for fistula repair among a sample of 22 subjects.

Some limitations should be remembered. At first, our sample size is still small and greater sample may reveal improvements of the technique. Then, retrospective studies have intrinsic methodological impairments which may interfere in our results.

We believe that our technique is an option for dural and fascia closure with low cost and efficiency, avoiding use of heterologous dural grafts.

Conclusion

Our technique proposes successful treatment with safe, low-cost and effective dural closure using autologous pericranium graft.

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