Pericranial Hinged Flap for Congenital Posterior Meningoencephalocele Closure

Tessa Miranda Atmaja, Prasetyanugrahenni Kreshanti, Siti Handayani, Kristaninta Bangun
Jakarta, Indonesia

Background: Posterior meningoencephalocele is a complicated case that requires adequate method for closure of the defect. Congenital meningoencephalocele is a rare incidence estimated at 1:3000 to 10000 live births; with occipital encephaloceles are the most common. The method for closure should prevent leakage of cerebrospinal fluid (CSF) and coverage for the calvarial bone. Meningoencephalocele are treated by excising the non-functional brain tissue and closed the defect using thick connective tissue graft, alloplastic material and local flaps. The problems with closure are continuous leakage of cerebrospinal fluid and infection, especially when alloplastic material is used. In this case report, a pericranial flap is used to close the dura.
Patient and Method: A neonate with occipital meningoencephalocele was consulted to the Plastic Surgery Department with wound dehiscence and recurrent herniation of brain tissue after undergoing first surgery by the neurosurgery team. On the second operation, a premilene mesh was placed which was later infected and causing wound dehiscence. We then close the defect using pericranial hinged flap and primary closure of the skin and subcutaneous tissue.
Result: After the closure using pericranial hinged flap, there were no signs of infection and no CSF leakage. In 4 month follow up, the defect has completely healed.
Summary: Closure of calvarial bone defect with pericranial-hinged flap provides a tight closure of the intracranial space, without increased risk of infection. Pericranial hinged flap should be considered as a method of choice for closure of intracranial defect, preventing leakage of cerebrospinal fluid and reducing risk of infection.
Keywords : *posterior meningoencephalocele, pericranial flap, hinged flap*
Latar Belakang: *Meningoencephalocele* posterior adalah kasus rumit yang membutuhkan metode yang adekuat dalam penutupan defek. *Meningoencephalocele* kongenital adalah insiden langka yang diperkirakan terjadi dalam 1:3000 hingga 10000 kelahiran hidup, dengan yang tersering adalah *encephalocele* oksipital. Metode penutupan defek harus dapat mencegah kebocoran cairan serebrospinalis dan menutup tulang kalvaria. Penatalaksanaan *meningoencephalocele* termasuk eksisi dari jaringan otak non fungsional dan penutupan defek dengan *thick connective tissue graft*, material alloplastik dan flap lokal. Permasalahan yang timbul dari penutupan defek adalah kebocoran cairan serebrospinalis dan infeksi, terutama dengan penggunaan material alloplastik. Pada laporan kasus ini, digunakan *pericranial flap* untuk penutupan dura.
Pasien dan Metode: Seorang neonatus dengan *meningoencephalocele* oksipital dikonsul ke divisi bedah plastik dengan dehisensi luka dan herniasi berulang dari jaringan otak setelah dilakukan operasi yang pertama oleh tim bedah saraf. Pada operasi yang kedua, dilakukan pemasangan *premilene mesh* yang kemudian terinfeksi hingga menyebabkan dehisensi luka. Kami kemudian melakukan penutupan pada defek dengan menggunakan *pericranial hinged flap* dan melakukan penutupan kulit dan jaringan subkutan secara primer.
Hasil: Setelah dilakukan penutupan dengan *pericranial hinged flap*, tidak didapatkan tanda- tanda infeksi dan kebocoran cairan serebrospinalis. Pada follow up 4 bulan pasca operasi defek telah sembuh sepenuhnya.
Kesimpulan: Penutupan defek tulang kalvaria dengan *pericranial hinged flap* memberikan penutupan yang rapat dari ruang intrakranial, tanpa peningkatan resiko infeksi. *Pericranial hinged flap* harus diperhitungkan sebagai metode pilihan dalam penutupan defek intrakranial yang dapat mencegah kebocoran cairan serebrospinalis dan mengurangi resiko infeksi

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Meningoencephalocele includes meninges, cerebrospinal fluid (CSF) and/or brain extending beyond the cranial cavity through a bony defect in the skull. It is a congenital malformation that has a high incidence in the population of Southeast Asia. Congenital encephalocele is rare and the incidence is estimated at 1: 3000 to 10000 live births, with a female to male ratio of 2.3: 1. Occipital encephaloceles are the most common.

From the Division of Plastic Reconstructive, and Aesthetic Surgery University of Indonesia Cipto Mangunkusumo Hospital, Jakarta, Indonesia.
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Fronto-ethmoidalencephaloceles comprise about 9.8% of all encephaloceles and requires surgical treatment [1].

Defect on the scalp and cranial bones usually resulted from trauma or neurosurgery procedures. One of the key elements for scalp reconstruction is the use of alloplastic material and bone replacement material. Other important points to consider are the application of basic wound management that include adequate debridement, removal of dead space, non-tension closure and good vascularization. Prolapsed brain tissue as a result of strangulation are usually non-functional, thus it can be safely excised. Surgical approaches for meningoencephalocele include the trans-mastoid approach, middle cranial fossa approach and a combination of both. Many combination of autologous tissue, such as fat, fascia, muscle, cartilage and bone can be used to cover the defect. The dura defect can be repaired using a thick connective tissue graft such as temporalis fascia, pericranium and fascia lata. Alloplastic material such as bone wax and silicon may also be used.[1]

The scalp consists of five separate layers: skin, subcutaneous tissue, galea (aponeurosis), loose areolar tissue and pericranium. A relatively avascular plane exist deep to the galea, which is the plane raised in a pericranial flap. The pericranium consists of an outer layer of loose areolar tissue and an inner lining of osteoblasts and rich vascular network. The main blood supply to the pericranial flap is the deep branches of the supratrochlear and supraorbital vessels. These two vessels are divided into superficial and deep branches after emerging from their bony foramina at the superior orbital rim. The main branches of these vessels have an axial length ranging from 15 to 60 mm, and typically 40 mm long. These flaps may also received vascularization from the superficial temporal vessels. The volume of these pericranial flaps range from 3 to 16 cc. An anatomic study performed by Yoshioka and Kishimoto (1991) (Figure 1) showed that dissection of the pericranial flap on the galeal side should be performed to a level of 10 mm above the supraorbital rim to preserve both main arterial branches. The blood supplies of the pericranial flap however, remain inconsistent. Pericranial flap is a pedicled myofascial flap that consists of the scalp periosteum and the overlying loose connective (areolar) tissue. [2,3,4]

Pericranial flap has been used by otolaryngologists to close difficult medial orbital and upper lateral nasal defects.[2] Many authors have described pericranial and galeal flaps for reconstruction of the anterior cranial base as well as for other craniofacial deformities. Separation of intracranial and extracranial spaces after major reconstructive efforts in the head, neck and anterior skull base using pericranial flaps has been successful. These flaps are used to prevent CSF leakage, meningitis and brain herniation.[4]

Technique for raising the pericranial flap was described in the following. A standard bicoronal incision is performed; hair stapled and secured from the wound, skin flap is dissected anteriorly in the subgaleal plane to expose the frontal bone. The percranial flap is designed, the borders incised sharply using the superior temporal line as guidance, and the flap was then gently elevated from the underlying calvarium using a periosteal elevator from posterior to anterior. When used to closed defect in the frontal sinus, a frontal craniotomy was performed, exposing the sinuses, dura and intracranial contents. Necrotic tissue and/or foreign material were debrided, the relation with sinonasal cavity abolished and sinus mucosa was removed, the pericranial flap is draped over the frontal sinus wall. The flap was secured using dural tacking sutures and fibrin glue. Other alternative to fixate the pericranial flap is the use of titanium miniplates and screws for anchoring the flap to the inner surface of the bone. This technique has been used to repair a transgressed frontal sinus.[4,5]

Failure to close cranial defect primarily may cause complicated chronic defect. Difficulty to close the wound may be caused by failure of previous attempts to close the wound. This paper will review a case in which simple basic management of wound is adequate to close a chronic scalp defect. The authors combined neurosurgical and craniofacial approaches for the development of a simple technique that corrects meningoencephalocele in a one-step procedure that has not been discussed in the literature previously.

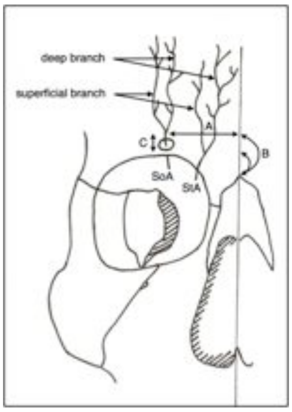

Figure 1.The Illustration of main branches arteries supplying the pericranial flap. SoA (Supraorbital vessels), StA (Supratrochlear vessels).[3]

Figure 2. Neonate with meningoenchepalocele and protrusion of brain tissue

Figure 3. Post debridement and defect closure using polyprophilene mesh

Figure 4. Wound dehiscence with leakage of cerebrospinal fluid and infection

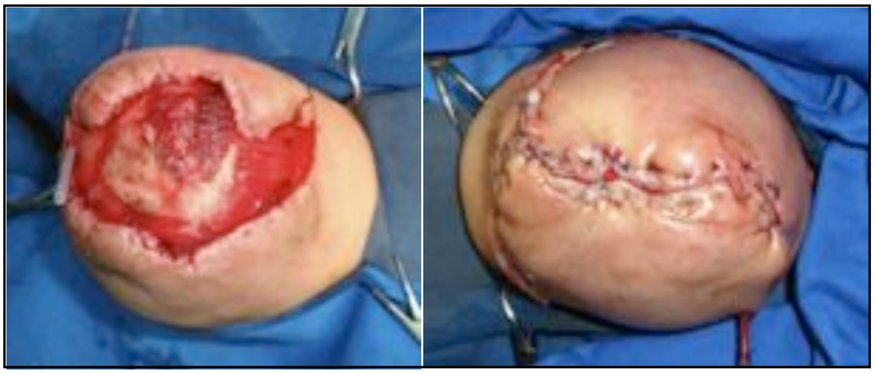

Figure 5.Third operation of the patient showing raised pericranial flap and primary closure of the wound

Figure 6. Patient’s appearance 4 months after the surgery, the wound from previous operations has healed completely, leaving a small visible scar, hair has grown in the adjacent area

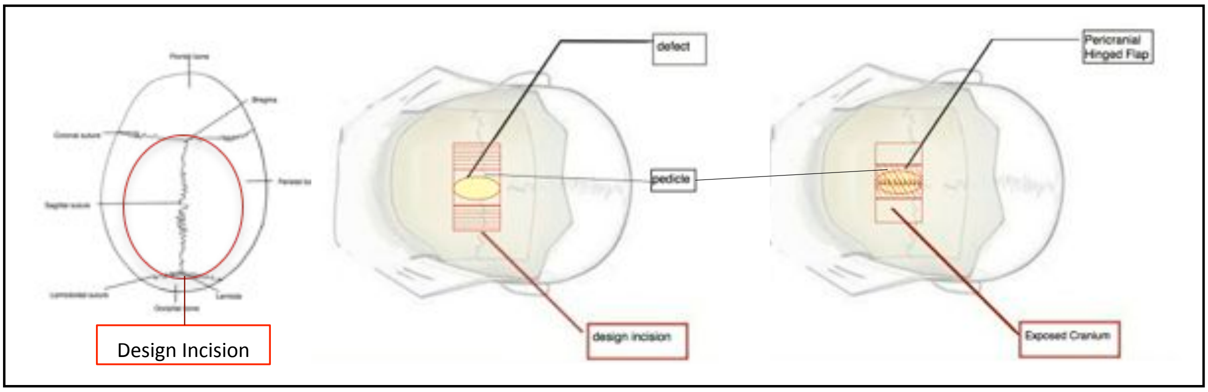

Figure 7. Design and elevation of the pericranial flap

PATIENT AND METHOD

The patient was a neonate born with posterior meningoencephalocele. The patient underwent excision of necrotic brain tissue by the neurosurgery team within 2 weeks after birth. 2 days after the first operation, there was wound dehiscence and about a week later, there was prolapse of brain tissue from the operation wound. The patient was then referred to the plastic surgery department for wound closure. Condition of the patient can be seen in Figure 2.

The patient underwent the second operation within one month of the first operation. The prolapsed brain tissue was debrided and the defect closed with poliprophilene mesh. The skin coverage was done using cutaneous rotational flap. The result of the second operation shown in figure 3. The second operation resulted in another episode of wound dehiscence with evidence of infection in the wound side and continuous leakage of cerebrospinal fluid (Figure 4). The patient condition was optimal for surgery, oral intake was sufficient for daily calories requirements, with adequate weight gain, laboratory result was normal and there was no symptom of intracranial infection such as seizures and neck stiffness.

A third operation was performed which include replacement of the poliprophilene mesh and debridement of the surrounding necrotic tissue. The operation resulted in a defect of the cranium in the middle of the sagittal suture, revealing brain tissue. The defect was first covered using a new poliprophilene mesh. The mesh cannot provide a tight closure between in the cranium, the defect was covered using pericranial flap. The flap was closed with a hinged method as shown in figure 5. The pericranial flap was elevated from both sides of the defect and placed together in the middle to cover the mesh. The 2 pericranium were sutured together using non-absorbable suture to provide a tight barrier between intracranial and extracranial space.

DISCUSSION

Posterior meningoencephalocele presents a challenge in closure for plastic surgeons. The problem is to create a barrier that can completely separate intracranial and extracranial space, preventing leakage of CSF, and prevents infection. Current treatment includes the use of alloplastic material such as bone wax, silicon, or premilene mesh. Another option is to use autologous tissue such as fascia, pericranium or fascia lata.[4]

Pericranial flap has been used by otolaryngologists and neurosurgeons to close defect in the frontal bone and sinuses after trauma of tumor excision. Since the late 1970, pericranial flap has played a role in skull base surgery. It has been proven to be an effective method to separate intracranial and extracranial space. Pericranium flap is durable enough to protect the intracranial structure, thus preventing CSF leakage, brain herniation, controlling infection and pneumocephalus.[2,3,6] Vascularization of the pericranium comes from three sources, (1) vessels arising from underlying cranial bones, (2) deep branches of the superficial temporal, supratrochlear and supraorbital vessels, and (3) interconnecting vessels arising from superficial branches.

The patient in this case has previously underwent surgery using alloplastic material, a premilene mesh for closure of the dural defect. This method has proven to be unsuccessful due to continuous leakage of CSF, thus intervening with wound healing in the skin and subcutaneous tissue, causing inflammation and prolonged wound healing. Another debridement was performed to excise necrotic tissue and remove the infected mesh. The use of premilene mesh leaves a problem of CSF leakage, which needs a watertight closure. Afterwards, it was decided to close the wound using pericranial flap because the length of the wound in the sagittal suture is most reachable using this flap.

The pericranium was exposed from the previous operation wound. Flap was designed from the medial side to lateral side of the sagittal suture as seen in figure 8. The border was sharply incised and the flap rose gently using periosteal elevator. Afterwards the flap was used to cover the exposed area as a hinged flap. Vascularization of the pericranium comes from three sources, (1) vessels arising from underlying cranial bones, (2) deep branches of the superficial temporal, supratrochlear and supraorbital vessels, and (3) interconnecting vessels arising from superficial branches. The source of vascularization in this design is mainly the interconnecting vessels arising from superficial branches.[7]

The bilateral pericranial hinged flap used to close the defect in this patient was secured using non-absorbable suture. The size of the flap was around 5 x 3 cm. Closure of the defect leave some part of the cranium without a layer of pericranium. The surrounding subcutaneous tissue and skin are still vital; therefore it is used to close the defect with primary suturing. A tension free closure was achieved using primary closure.

SUMMARY

Closure of calvarial bone defect with pericranial-hinged flap provides a tight closure of the intracranial space, without increased risk of infection. Pericranial hinged flap should be considered as a method of choice for closure of intracranial defect, preventing leakage of cerebrospinal fluid and reducing risk of infection.

Kristaninta Bangun, M.D.
Plastic Surgery Division
Cipto Mangunkusumo General National Hospital
kristaninta@yahoo.com

REFERENCE

1. Chen KP, Chen PR, Chou YF. Meningoencephalocele of the temporal bone repaired with a free temporalis muscle flap: Case report. Tzu Chi Med J 2006; 18:149-153.
2. Newman, J., P. Costantino, et al. The Use of Unilateral Pericranial Flaps for the Closure of Difficult Medial Orbital and Upper Lateral Nasal Defects. Skull Base Surg 2003;13(4): 205-209.
3. Yoshioka N, Kishimoto S. Anteriorly based pericranial flap: an anatomic s tudy of feeding arteries. Skull Base Surg. 1991;1(3):161-4.
4. Donath A, Sindwani R. Frontal Sinus Cranialization Using the Pericranial Flap: An Added Layer of Protection. Laryngoscope 2006;116:1585–1588
5. Paolini S, Ciappetta P. Pericranial flap fixation using titanium miniplates and screws. British Journal of Neurosurgery 2003; 17(1): 65-66
6. Miles B, Davis S, Crandall C, Ellis E.cLaser-Doppler Examination of the Blood Supply in Pericranial Flaps. J Oral MaxillofacSurg 2010;68:1740-1745, 2010
7. Al-Qattan MM. The Use of MultifoldedPericranial Flaps as “Plugs” and “Pads”. Plast Reconstr Surg 2001; 108(2): 366-342
8. Patel V, Osborne S, Morley AMS, Malhotra R. The Use of Pericranial Flaps for Reconstruction and Elevation of the Lower Eyelid. Orbit, 29(1), 1–6