Complications of Myelomeningocele Closure

David G. McLone, Mark S. Dias
Division of Pediatric Neurosurgery, Children’s Memorial Hospital, Northwestern University School of Medicine, Chicago, Ill., USA

Key Words. Complications · Spina bifida · Spinal dysraphism · Myelomeningocele · Spinal cord

Abstract. Closure of a myelomeningocele is a deceptively simple operation; however, attention to several subtle details can significantly reduce operative complications. Important preoperative concerns include social issues of dealing with a distraught and often overwhelmed family, the timing of surgery, and assessment of associated severe or life-threatening malformations. Operative intervention should be directed toward preserving neurological function and optimizing the subsequent repair of a tethered spine should this become necessary. Careful attention to the vascular supply to the placode, precise separation of neural from cutaneous tissues, a diligent search for associated tethering anomalies such as diastematomyelia and a thickened filum terminale, careful pia to pia reconstruction of the placode, and simple but meticulous wound closure all help in achieving these aims. The timely management of associated hydrocephalus will help to avoid cerebrospinal fluid leakage and wound breakdown. Close attention to these details will ameliorate many of the immediate and delayed complications of myelomeningocele closure.

Children with myelomeningoceles provide many challenges for the pediatric neurosurgeon. Although these children often are born with significant neurological deficits, it is vital to understand that most are of normal intelligence and have the capacity to enjoy a productive and fulfilling life [1–3]. Although myelomeningocele closure would seem, at least to some, to be a fairly mundane procedure, attention to several subtle details will result in a gratifying decrease in perioperative complications.

Family

Problems surrounding the initial management of the infant born with a myelomeningocele (table 1) must often be managed in the presence of parents who are bewildered and overwhelmed by the birth of a child with a complex birth defect. The parents, acting as surrogates for the child, are usually naive as to the problems which will face both the child and their family, and are best helped by an initial

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discussion which is purposefully kept simple, brief and compassionate. Although we realize that the ultimate decisions are largely in the hands of the pediatric neurosurgeon, it is essential to include the family and to allow them some control in the decision-making process.

Preparation of the Neonate for Surgery

While it is important for the parents to have some time to grapple with the many new issues facing them, it is equally important to proceed with definitive treatment in a timely fashion. The idea that, by significantly delaying closure of the myelomeningocele, the parents may be instructed about the nuances of this birth defect so that they can better make an informed consent is preposterous [4]. Unless the child is critically ill, repair of the myelomeningocele should proceed in a timely fashion. Significant delays increase both morbidity and mortality.

Optimally, we operate on the child soon after birth, preferably on the 1st postnatal day. Prenatal diagnosis makes this increasingly possible. However, operation may safely be deferred for up to 72 h without an increase in complications. This delay is particularly important for the unstable or critically ill infant. These infants can usually be stabilized within 72 h, and this time is usually well spent. A search for coexistent anomalies of other organ systems should be undertaken during this time. Severe anomalies or absence of other vital organs, or unreparable cardiac defects may portend a poor outcome. Renal anomalies are common but not usually life-threatening. Although the child may not produce significant amounts of urine during the first 24 h, the presence of urine in the bladder implies the presence of functioning kidneys; an ultrasound will delineate most major renal anomalies. Syndromes related to chromosomal anomalies may not be obvious upon initial inspection, but should be sought.

Although most coexisting anomalies are not immediately life-threatening and may be dealt with without much difficulty, it is important to remember that a few children with myelomeningocele may have potentially fatal associated malformations and may not be saved. Intervention to prolong the lives of these infants in the setting of a dismal outlook makes little sense; they should be kept comfortable and their family supported.

The preparation of the neonate with a myelomeningocele for surgery is usually not difficult. Most have a high hematocrit and an adequate intravascular volume; fluid resuscitation is therefore usually unnecessary. Common perioperative complications include hypothermia and hypoglycemia, both of which are easily prevented through the judicious use of heating lamps and monitoring of serum glucose.

The placode may become desiccated with prolonged exposure to the air and should therefore be protected. Covering the placode with sterile saline-soaked gauze is preferable; the dressing may be covered with plastic wrap to avoid rapid evaporation of the saline. Betadine is toxic to tissues and results in inhibition and delay of wound healing; it should therefore not be used directly on the malformation. The use of perioperative antibiotics is left to the discretion of the surgeon; we have tended to use them.

Preservation of Neurological Function

Preservation of Neural Tissue

It has clearly been shown that the exposed neural tissue is functional (fig. 1). Movement of muscles subserved by spinal cord segments involved in the placode, as well as the presence of somatosensory potentials conducted through the placode both point to the functional nature of this tissue [5]. Even when the initial examination fails to demonstrate movement of muscles innervated by the placode, the placode should still be considered functional, since over one third of these children will subsequently gain motor functions not previously detected [1]. Therefore, all neural tissue must be preserved.

Preservation of Vascular Supply

Preservation of the vascular supply to the placode is essential if this tissue is to survive. Unlike the normal spinal cord, the blood supply to the placode does not enter exclusively through the vertebral foraminae along the nerve roots (fig. 2). Many large vessels pass directly through the laterally reflected dura mater and supply the myelomeningocele. Those which supply the junction between the neurulated spinal cord and the placode seem to be at greatest risk. Rarely, it is impossible to preserve all of these vessels, and fortunately they can sometimes be sacrificed if necessary without apparent injury to the placode. Nonetheless, great care must be exercised to preserve these vessels while mobilizing the dura for closure.

Inclusion Dermoid

Great care should be exercised in separating the edge of the placode from the contiguous cutaneous epithelium (fig. 3); magnification is often very helpful. Retained fragments, possibly even a single cell, could, if imbricated within the closure, produce an inclusion dermoid (fig. 4).
Fig. 1. A newborn child with a large thoracolumbar myelomeningocele. This child had nearly normal sensorimotor function in the lower extremities. Note the well-developed legs and feet.

Fig. 2. Same infant as in figure 1. At the time of closure, several large blood vessels (arrows) entered the placode and were preserved.

Fig. 3. Dissection of the placode. The thin epithelium at the edge of the placode (arrows) is carefully dissected free.

Fig. 4. At the time of un tethering of the placode, a large inclusion dermoid is encountered (arrows). Note the dense arachnoidal inflammation in response to the epidermoid material.
These inclusion dermoids not only produce tumors but associated desquamative debris may also stimulate an intense arachnoiditis. Tethered cord release in the face of the scar produced by this inflammatory process can therefore be difficult.

**Missed Abnormalities**

**Diastematomyelia**

Both the cranial and caudal ends of the closure site should be closely inspected prior to closure of the placode to identify associated tethering bony spurs or fibrous bands. Cranially, removal of an additional lamina may be necessary to adequately visualize the adjacent spinal cord (fig. 5). Hemimyelomeningoceles may also be readily visualized by examining the adjacent spinal cord. The presence of an asymmetrical neurological deficit preoperatively should alert the surgeon to the presence of a hemimyelomeningocele or an associated split cord malformation.

**Thickened Filum Terminale**

Caudal to the placode, a thickened filum terminale may often be found; this should be sectioned if present. Spinal cord tethering in these children may be as much from a missed thickened filum as by adhesions from the placode repair (fig. 6).

**Minimize Retethering**

Once the neural tissue is freed, every attempt should be made to prevent later retethering of the placode. While pial-to-pial closure of the placode into a tubular structure has not completely prevented retethering, it may reduce the incidence of this complication (fig. 7) [5]. More importantly, it makes later untethering considerably easier to perform. The reapproximated neural tube is usually adherent only along the dorsal closure line (fig. 8). In contrast, unclosed neural tissue is often densely adherent along the entire exposed ependymal area of the placode; the laterally displaced dorsal roots are usually caught in the scar and require tedious dissection to free them (fig. 9). Unfortunately, even after reapproximating the neural placode the dura may occasionally be inadvertently sutured to the underlying neural tissue; great care should be taken to avoid this preventable complication.

**Neural Compression during Closure**

Dural closure is an important part of the myelomeningocele repair. Most pediatric neurosurgeons advocate a watertight dural closure. However, a more important consideration, in our opinion, is creating enough space to house the neural placode. To preserve the placode through careful dissection, then strangulate it with a tight, constricting dural closure makes little sense. Under these circumstances, a dural patch graft may be utilized. While the
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Fig. 7 Pial-to-pial closure of the myelomeningocele brings the smooth pia-arachnoid over the dorsum of the placode and limits the area of adhesion with the overlying dural closure.

Fig. 8. CT myelography shows the limited line of adherent cord (arrows) when the placode is closed with pial-to-pial sutures.

Fig. 9. Neural placode (white arrow) left open at the time of initial closure develops a broad area of attachment (black arrows) to the overlying dural closure.

The number of repairs that leak CSF postoperatively may be increased by this type of closure, the ultimate functional outcome is better.

**Wound Closure**

Wound closure is fairly straightforward, although several controversies exist.

Mobilizing the paraspinal muscles and overlying fascia to cover the closure is desirable, but not always possible (fig. 10). Moreover, the frequency of complications is the same whether or not this layer is included in the closure [6].

The method of skin closure is also a matter of debate. Although some authors have advocated complex plastic surgical closures (fig. 11), this is rarely necessary [7]. A linear, midsagittal closure is most satisfactory and provides easy access to the placode should later untethering or spinal stabilization procedures become necessary. In contrast, cutting across complex wound closures carries the potential risk of devascularizing segments of skin.
Fig. 10. Lumbodorsal fascia and paraspinous muscles have been mobilized and are brought together loosely in the midline.

Fig. 11. Complex skin closure of a myelomeningocele. This is rarely necessary for good skin closure.

However, cutting across such incisions has occasionally been necessary at reoperation, and fortunately in none of these cases has a portion of the closure been lost.

A significant kyphosis may preclude a simple wound closure. In addition, we have found that almost all of these deformities are progressive and are associated with a sequential loss of neural function below the level of the kyphosis by 3 or 4 years of age. When significant kyphosis is present at birth, we now perform a kyphectomy at the time of closure (fig. 12).
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Hydrocephalus

The timing of shunt placement is a matter of some debate. Since about 10% of children with myelomeningoceles will not need a shunt, several authors have advocated delaying a shunt procedure until well after the initial closure. However, in the presence of obvious hydrocephalus at birth, it would seem to make little sense to subject the infant to a second anesthetic. Placement of the shunt at the time of initial closure is safe, and reduces the risk of CSF leakage and/or wound breakdown postoperatively. We therefore perform a shunt at the time of the initial closure under these circumstances.

Postoperative Management of the Closure Site

A variety of techniques have been employed to protect the closure site postoperatively, and include placing the infant prone or suspending the infant from a sling. These maneuvers are of little value; we simply place the child in a bassinet postoperatively, and allow the child to be held in the mother’s arms without restrictions. We have not encountered any significant problems using this regimen.

References


David G. McLone, MD, PhD
Division of Pediatric Neurosurgery 28
Children’s Memorial Hospital
2300 Children’s Plaza
Chicago, IL 60614 (USA)