Prenatal counseling for myelomeningocele in the era of fetal surgery: a shared decision-making approach

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OBJECTIVE The Management of Myelomeningocele Study demonstrated that fetal surgery, as compared to postnatal repair, decreases the rate of hydrocephalus and improves expected motor function. However, fetal surgery is associated with significant maternal and neonatal risks including uterine wall dehiscence, prematurity, and fetal or neonatal death. The goal of this study was to provide information about counseling expectant mothers regarding myelomeningocele in the era of fetal surgery.

METHODS The authors conducted an extensive review of topics pertinent to counseling in the setting of myelomeningocele and introduce a new model for shared decision-making to aid practitioners during counseling.

RESULTS Expectant mothers must decide in a timely manner among several potential options, namely termination of pregnancy, postnatal surgery, or fetal surgery. Multiple factors influence the decision, including maternal health, fetal health, financial resources, social support, risk aversion, access to care, family planning, and values. In many cases, it is a difficult decision that benefits from the guidance of a pediatric neurosurgeon.

CONCLUSIONS The authors review critical issues of prenatal counseling for myelomeningocele and discuss the process of shared decision-making as a framework to aid expectant mothers in choosing the treatment option best for them.

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KEYWORDS fetal surgery; spina bifida; myelomeningocele; prenatal counseling; shared decision-making; congenital

HISTORICALLY, fetal surgery has been limited to use for severe conditions that will result in fetal or neonatal death. All procedural risks to mother and fetus are considered in the setting of almost-certain death without intervention. Recently, the Management of Myelomeningocele Study (MOMS) demonstrated benefits from fetal surgery in children with myelomeningocele (MMC). Since MMC is not uniformly lethal, these benefits are more difficult to balance against the risks of intervention.¹ The option for fetal surgery is also limited by time because the surgery must be performed before 26 weeks' gestational age.¹ The in utero diagnosis of MMC is usually made between 16 and 18 weeks. This gives expectant mothers 8–10 weeks to receive counseling, decide on treatment, and arrange fetal surgery if they so choose. The addition of fetal surgery as a treatment option, one of only a few neurosurgical procedures supported by a random-

ized trial, can significantly complicate prenatal counseling for MMC.

At its core, the idea of shared decision-making means that patients have the opportunity to participate in decisions about their own care (as opposed to clinicians making decisions on behalf of patients).³³ The approach is based on the principle of individual self-determination. It accepts that people have different needs, values, and risk tolerances and that individuals should make decisions based on what is most important to them.

In this paper, we describe how to use the shared decision-making approach in prenatal counseling for MMC.

Key Background Information for Prenatal Counseling

The first step, a key step, to the shared decision-making

ABBREVIATIONS CM-II = Chiari malformation type II; ETV/CPC = endoscopic third ventriculostomy with choroid plexus cauterization; MMC = myelomeningocele; MOMS = Management of Myelomeningocele Study.

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model is providing high-quality information about the diagnosis and prognosis. Equally important is finding out what the patient already knows and ensuring that it is correct. Only an informed patient can make assessments about what is important to her and her child.

The sections below review key concepts that expectant mothers should understand (Table 1). This list is comprehensive, but additional topics may need to be discussed based on specific patient circumstances.

Explaining the Diagnosis

In general, the terms “spina bifida” and “myelomeningocele” need to be defined for expectant mothers. Women should understand that MMC occurs when the spinal cord fails to separate from the skin during gestation, resulting in constant leakage of spinal fluid through the defect that has consequences on the developing brain and leads to many of the comorbidities.³⁶

Most cases are sporadic and multifactorial in origin (90%); the remaining cases can be tied to chromosomal abnormalities or single-gene disorders.^{20,52} The known associated genetic disorders include trisomy 13 and 18; Börjeson-Forssman-Lehman, Meckel, and PHAVER syndromes; and X-linked neural tube defects. Other risk factors include family history and maternal medications (i.e., valproate, carbamazepine), obesity, pregestational diabetes, or febrile illness early in pregnancy.

It is valuable to mention during the counseling session that future pregnancies also carry an increased risk of spina bifida (5%) and that high-dose folate supplementation can lower that risk if started 3 months before conception.³⁹

Survival

Unless there are severe congenital anomalies, children with MMC will likely survive. Historically, mortality rates within the 1st year were 21%–37.5%;^{24,29} however, in a more recent series of 101 children born with MMC, there was just 1 death in the 1st year.⁵¹ The MOMS demonstrated a mortality rate of 3% in the 1st year.¹ Ventriculitis and shunt-related complications were considered the prime causes of death during infancy; however, brainstem dysfunction (due to Chiari malformation type II [CM-II]) leading to respiratory impairment and swallowing dysfunction causes most early deaths.^{7,50} As patients age, mortality remains significant—25% overall at 25 years,⁷ with an estimated mean survival of 30 years.^{13,24} Renal complications are the most common cause of death for adult patients.^{48,62} No long-term survival data exist for patients who have undergone fetal closure.

Hydrocephalus

Hydrocephalus is the most common and resource-intensive comorbidity of MMC. Shunting rates have historically been 52%–90% after postnatal closure;^{7,11,44,49} in the MOMS, the rates were 40% for the fetal surgery cohort and 82% for the postnatal closure cohort.¹ Treatment criteria during the MOMS included at least 2 of the following: increase in the occipitofrontal circumference defined as crossing percentiles, bulging fontanelle, increasing hydrocephalus on consecutive imaging studies, or head

TABLE 1. Key concepts for prenatal counseling in shared decision-making model

Defining MMC	Spinal cord fails to separate from skin during gestation, resulting in constant leakage of spinal fluid through defect
Survival	Mean survival 30 yrs; ^{13,24} 1-yr mortality: 1%–3% postnatal surgery, ⁵¹ 3%–6% fetal surgery ¹
Hydrocephalus	50%–90% in postnatal repairs; ^{7,11,44,49} 40% in prenatal repairs; ¹ ETV/CPC successful in 55%–72% ^{45,60}
Paraplegia	Ambulation directly related to lesion level; most patients w/ low lumbar & sacral lesions ambulate independently regardless of treatment choice; ^{1,46} fetal surgery preserves existing motor function ¹
Neurogenic bowel/bladder	Majority of patients affected; social continence achievable in >80%; ^{7,26,49} early results of fetal surgery do not show significant improvements (long-term studies needed) ⁸
Scoliosis	Effect of fetal surgery on incidence of scoliosis unknown
CM-II crisis	3%–8% of MMC patients; ⁵⁰ caused by severe brainstem dysplasia; not prevented by fetal surgery
Tethered cord & spinal inclusion cysts	Uncommon, but rates may be higher after fetal surgery ^{1,12}
Cognitive outcomes	Majority have average to above-average intelligence (70%); ⁴⁰ 50% of adult patients live independently & 25%–38% are employed; ^{24,56} fetal surgery has no known adverse or beneficial effects (early results) ¹

circumference > 95th percentile. Additional independent criteria included marked syringomyelia with ventriculomegaly, ventriculomegaly and symptoms of CM (stridor, swallowing difficulties, apnea, bradycardia), or persistent cerebrospinal fluid leakage from the MMC wound or bulging at the repair site. These criteria^{41,55} were used in an attempt to standardize shunt placement for MMC, but there was still much variability. Placement of a shunt imposes significant morbidity, and shunt-related complications can be detrimental to cognitive outcome³ and long-term survival.^{13,23,40,53,54} Shunt revision rates can be high in the MMC population;^{7,49} in one study,¹⁰ 46% of patients with shunts required shunt revision in the first postoperative year (75% from mechanical failure). Shunt infection rates can be higher for patients with MMC than for other hydrocephalus groups.⁵³

Since the MOMS, there has been a significant change in the management of hydrocephalus. Endoscopic third ventriculostomy with choroid plexus cauterization (ETV/CPC) has become another treatment option for hydrocephalus.^{27,59,60} It is an option regardless of whether or not the child had prenatal surgery. The long-term cognitive effects of this procedure are not clear, and there is a higher failure rate in the first 6 months than after shunt placement; however, a successful procedure avoids the lifelong morbidity associated with an implant, and ventriculitis

rates are lower. Success rates in MMC patients range from 55% to 72%.^{45,60} The role of ETV/CPC will undoubtedly be elucidated through future comparative studies.

Paraplegia and Ambulation

In the absence of severe developmental delay, which can occur in approximately 13% of children with MMC, independent mobility is directly related to the lesion level. For lower lumbar and sacral lesions, ambulation occurs in almost all cases. For lesions above L2, the loss of quadriceps and iliopsoas muscle function means that independent ambulation is not likely and wheelchair dependence is expected.^{34,46} Early intervention from physical therapy and orthopedics is encouraged to achieve the best motor function possible. As patients age, they become less ambulatory likely because of weight gain, progressive lower-extremity deformity, and pulmonary compromise.⁹ One study found that 30% of patients were ambulatory at the 30-year follow-up (88% for lesions below L4),⁴⁰ and another reported that 52% of adult patients walked independently and 21% were ambulatory with aids; all patients with sacral-level MMC remained ambulatory.⁴⁶ In the MOMS, children in the fetal surgery group were more likely than those in the postnatal surgery group to be able to walk without orthotics or devices (42% vs 21%, respectively, $p = 0.01$). On both the Bayley and Peabody motor scales, motor function was superior in the prenatal surgery group even though children in that group had more severe anatomical lesions. Long-term results regarding ambulation and functionality remain to be seen.¹

Neurogenic Bladder and Bowel

Urinary incontinence and damage to the upper urinary tract are common features of MMC. Kidney damage from reflux and recurrent urinary tract infections are early sources of morbidity and subsequent mortality.¹⁵ Improved management, including intermittent catheterization, anticholinergic drugs, and aggressive management of constipation, has significantly improved the urological prognosis. Social continence (bowel and bladder) can now be achieved in more than 80% of children.^{7,26,49} Surgical procedures to increase bladder capacity are also used in this population. Macedo et al.³¹ found little benefit to fetal surgery, with a high incidence of abnormal bladder patterns, and early analysis of subjects in the MOMS showed no significant benefit from fetal surgery in terms of bladder outcomes.⁸ Longer-term follow-up is needed, but fetal surgery does not appear to prevent neurogenic bowel and bladder.

Scoliosis

MMC is a major cause of neuromuscular scoliosis, and spinal deformity is common. The multifactorial causes in MMC include spinal bony anomaly, neuromuscular imbalance, and spasticity associated with pelvic and hip deformity.¹⁴ The severity of scoliosis and the need for surgical intervention are related to neurological level, functional status, pulmonary compromise related to curvature, skin breakdown, sitting balance, and curve progression. There is no known effect of fetal surgery on the rates of neuromuscular scoliosis.

CM-II and Chiari Crisis

CM-II is present in almost all MMCs and can be symptomatic in up to 25%–33% of cases.^{62,63} Characterized by hindbrain herniation, the CM-II consists of multiple anomalies of the brain brought on by decompression of fluid in the vesicles through the MMC defect. The most recognized characteristic is growth of the vermis through the foramen magnum into the cervical canal, but other features include caudal displacement of the brainstem, tectal beaking, aqueductal stenosis, polymicrogyria, absence of the corpus callosum, brainstem dysplasias, and enlargement of the massa intermedia. Fetal surgery significantly reduces hindbrain herniation at 1 year,¹ but other features are variable and not reversible with fetal surgery. McLone and Dias³⁵ have argued that symptomatic CM-II with brainstem dysplasia is the major determinant of quality of life for children with MMC. Infants manifest central apnea and lower cranial nerve deficits or dysfunction, whereas older children present with neck pain, headache, and sensory or motor disturbances of the limbs. Apnea, stridor in the setting of vocal cord paralysis, and difficulty swallowing may constitute a CM-II crisis, with up to 15% of symptomatic patients dying by the 3rd year.⁵⁰ Hydrocephalus can drive worsening symptoms and is always addressed before considering surgical decompression, tracheostomy, and gastric tube placement. The rates of severe brainstem dysplasia leading to CM-II crisis are not known to be influenced by fetal surgery; however, in the MOMS, 1 child in the prenatal surgery group required CM-II decompression versus 4 in the postnatal surgery group ($p = -0.37$). Further detailed attention to specific symptoms when comparing techniques will be important in future investigations.

Tethered Cord and Spinal Inclusion Cysts

After the initial surgery to untether the neural placode from the skin, the placode remains low in the spinal canal and retethers to the dura mater through the formation of scar tissue. Serial lumbar spine MRI scans will continue to show elongation of the spinal cord to the level of the spina bifida defect, and the spinal cord will always appear radiographically tethered. As axial growth occurs, traction exerted on the spinal cord and nerve roots can lead to mechanical stretch, ischemic injury, and subsequent neurological deterioration.⁶³ Additional symptoms can include urological dysfunction and foot and spinal deformity. Early recognition of this process and timely surgical intervention to untether the spinal cord can lead to significant improvement.²² Early results from the MOMS have suggested a trend toward higher rates of symptomatic tethered cord after fetal intervention (8% vs 1%, $p < 0.06$).¹ This finding may be attributable to differences in the closure technique, to better motor function in the fetal intervention group that makes them more sensitive to tethering, or to both.

Epidermoid and dermoid inclusion cysts can occur after closure in both fetal and postnatal surgery because of retention of ectodermal elements in the spinal canal. Serial imaging studies can demonstrate this, but children often present with neurological worsening and signs compatible with spinal cord tethering. Early reports of fetal

MMC closure before the MOMS have suggested higher rates of inclusion cysts after fetal surgery, but this finding was not seen in the MOMS.^{1,12}

Cognitive Outcome

Although cognitive dysfunction depends on many factors, approximately 70% of patients with MMC will have an IQ ≥ 80 .⁴⁰ According to one study, approximately half of adult patients with MMC were living independently, while the remainder required supervision or were completely dependent on care.²⁴ Hunt concluded that only 25% of adult patients with MMC were capable of open employment.²⁴ However, a more recent study showed that 38% of adults were actively employed.⁵⁶ The MOMS reported no significant difference in Bayley's mental development index at 30 months between prenatal and postnatal surgery groups.¹ Long-term cognitive outcomes are still being evaluated in the fetal surgery patients.

Spina Bifida Clinic

Parents should understand that although most major comorbidities of MMC have treatments, there is no cure for MMC. To achieve optimal outcomes, long-term monitoring and coordination of care among specialists are necessary and can be achieved through a multidisciplinary spina bifida clinic. Discussion with the spina bifida clinic helps families develop an idea of the care involved and how each condition will be monitored by neurosurgery, urology, physical medicine and rehabilitation, pediatrics, and orthopedic surgery.

Discussion of Treatment Options in a Shared Decision-Making Model

The US Preventive Services Task Force defines shared decision-making as the "process in which patients are involved as active partners with the clinician in clarifying acceptable medical options and choosing a preferred course of clinical care."⁴⁷ As is the case in fetal MMC repair, shared decision-making is particularly important given that some patients may benefit from the intervention and some may not.^{18,57} For the shared decision-making to be successful, expectant mothers should understand that multiple legitimate treatment options exist and that there is not one best treatment. Women should make decisions based on informed preferences unique to their situation.

Pregnancy Termination

Laws regarding pregnancy termination vary among states. Most expectant mothers have decided not to terminate before seeing a neurosurgeon, although this is not always true. In such cases, it can be valuable to gain the perspective of a pediatric neurosurgeon regarding treatments and quality of life issues.

Postnatal Repair

Postnatal repair is the safest treatment option for mother and baby; it is associated with the lowest mortality and complications.¹

Postnatal closure usually occurs within the first 72

hours of life;¹ however, closure within 24–48 hours is commonly performed. Prenatal counseling by the neurosurgeon is a good opportunity to discuss the goals of surgery, the surgical technique, the risks, and the recovery. The goals of surgery to obtain a watertight seal, prevent infection, and protect nerves from external trauma should be emphasized so parents are aware that the surgery does not restore function.

For postnatal repair, most obstetricians recommend a cesarean section to avoid trauma to the exposed neural tube.³⁰ Pregnancy complications and preterm delivery are rare; there were no cases of extreme prematurity in the MOMS postnatal group.¹

Introducing the Option of Fetal Surgery During Counseling

Screening Patients for Fetal Surgery

Initial screening of patients for fetal surgery at most centers uses the MOMS criteria.¹ Noncandidates can be advised early that fetal surgery is not an option. The fetal MMC surgery criteria include both maternal and fetal characteristics (Table 2). If both mother and fetus meet the criteria for fetal surgery, then a detailed screening process is undertaken, which includes fetal echocardiogram and possibly MRI. The fetal echocardiogram must be normal to justify the risk of fetal surgery. The MRI helps with the planning for surgery by characterizing the lesion, uterine anatomy, and placental location.

A Multidisciplinary Approach

When considering fetal surgery, practitioners often place the highest level of importance on neonatal benefits, followed by the risk of maternal complications. Even in the setting of fetal surgery, there are differences in attitude toward fetal intervention. Antiel et al.² identified 4 attitudes toward fetal intervention: fetocentric, risk sensitive, maternal autonomy, and family impact and social support. Neonatologists were more likely to be in the fetocentric group, whereas surgeons were more likely to be in the risk-sensitive group, and maternal-fetal medicine physicians made up the largest percentage of the group focused on family impact and social support. Thus, a nonbiased, multidisciplinary approach should be taken toward the potential for fetal surgery and include input from maternal-fetal medicine specialists, neurosurgeons, anesthesiologists, pediatric surgeons, neonatologists, and social workers.

Details of Fetal Repair to Review With Candidates

There are several myths about fetal MMC repair, perhaps attributable to the popularization of information through the media and social media, that must be addressed early in the counseling process (Table 3). One common misconception is that "without fetal surgery, my child has no chance to walk." As discussed above, the ability to ambulate independently is related to the lesion level, with patients harboring lesions below L4 having greater success. Fetal surgery has improved motor outcomes at 30 months and increased the percentage of ambulatory patients,¹ but the notion that there is no chance of ambulation

TABLE 2. Fetal surgery screening criteria in MMC

Inclusion Criteria		Exclusion Criteria	
Fetal	Maternal	Fetal	Maternal
Level of lesion btwn T1 & S1	Singleton pregnancy	Spinal kyphosis >30°/gibbus deformity	Placenta previa or placental abruption
Presence of hindbrain herniation			Short cervix (<2 cm)
Defect not thought to be skin covered			Pregestational insulin-dependent diabetes mellitus
Normal karyotype			History of incompetent cervix
Gestational age <26 wks			Obesity (BMI >35 kg/m ²)
No other major fetal anomaly			Previous spontaneous singleton delivery before 37 wks
			Maternal-fetal Rh isoimmunization, Kell sensitization, or history of neonatal alloimmune thrombocytopenia
			HIV or hepatitis B or C
			History of neonatal alloimmune thrombocytopenia
			Uterine anomaly such as large fibroids
			No support person
			Hypertension

Rh = Rhesus.

without fetal surgery is false. Another misconception is that “fetal surgery is a cure for spina bifida.” There is no cure for spina bifida, but fetal surgery can help improve motor function and some of the outcomes related to hydrocephalus. A further related misconception is that “fetal surgery is the new standard of care”; however, the standard of care remains postnatal closure, which has the lowest risk of fetal death and maternal morbidity. Fetal surgery is a new treatment option but has not replaced postnatal closure.

Benefits of Fetal MMC Repair

The benefits of fetal MMC repair include a lower risk of hydrocephalus and improved lower-extremity motor outcomes.¹ In the MOMS, the risk of hydrocephalus was reduced by 50% in the fetal surgery group (40% required a shunt vs 80% in the postnatal repair group). Lower-extremity motor function was also improved, with 40% of fetal surgery patients ambulating independently versus 20% in the postnatal repair group. These are clinically significant improvements that justify the option of fetal surgery, but expectant mothers should also be told that not every patient avoids hydrocephalus or achieves independent ambulation.

Data obtained during the prenatal evaluation can iden-

tify patients most likely to benefit from fetal intervention and should be presented to every expectant mother considering it. Post hoc evaluation of the MOMS revealed that ventricular size in the second trimester predicts the rate of hydrocephalus in the fetal surgery group, with smaller ventricles (< 10 mm across the atrium of the lateral ventricle) yielding the lowest risk (20%) and larger ventricles (> 15 mm) yielding the highest (79%).⁵⁵ The risk of hydrocephalus with large ventricles is almost as high as the risk in the postnatal surgery group; therefore, in these cases, it makes little sense to choose fetal surgery to avoid hydrocephalus.

Lower-extremity motor function can be determined by fetal ultrasonography.³² Ultrasound can be used to determine the degree of movement and identify the presence of clubbed feet. When the fetus already has significant weakness of the lower extremities with clubbing of the feet, fetal intervention will not reverse the paralysis. However, when lower-extremity function is normal, without clubbed feet, especially when the lesion is high, fetal surgery can protect the exposed nerves from trauma and the toxicity of the amniotic fluid, thus preserving motor function.

The best candidates for fetal surgery meet the MOMS criteria, have small ventricles, and have good lower-extremity motor function with a high lesion level. The

TABLE 3. Common misconceptions about fetal surgery

Misconception	Reality
“Without fetal surgery, my child has no chance to walk”	Ability to walk depends on lesion level
“Fetal surgery is a cure for spina bifida”	No cure; this is chronic, lifelong condition
“Fetal surgery is the new standard of care”	Postnatal repair is still standard of care; fetal surgery is new treatment option

FIG. 1. Shared decision-making model for MMC. IDDM = insulin-dependent diabetes mellitus; Rh = Rhesus. Figure is available in color online only.

poorest candidates, because the chances of benefit are so low, have enlarged ventricles, significant paraplegia, and clubbed feet at the time of evaluation.

Risk of Fetal MMC Repair

The risks of fetal surgery are significant. There is a risk of fetal or infant death (2%–6%), and although it has never been reported, maternal death could occur.^{1,21,37,38} With fetal surgery, there is an increase in preterm birth (34.1 vs 37.3 weeks, $p < 0.001$), and approximately 13% of patients are born before 30 weeks.^{1,43} Finally, an open hysterotomy can create significant complications for mother and child during the remainder of the pregnancy and in future pregnancies. There was an 10% incidence of uterine dehiscence in the MOMS,¹ and recent reports have detailed significant complications in subsequent pregnancies as a result of open hysterotomy.¹⁹ Additional maternal pregnancy risks include chorion-amnion membrane separation, spontaneous membrane rupture, oligohydramnios, placental abruption, and pulmonary edema. Newer minimally invasive techniques to improve maternal outcomes and lower pregnancy complications, such as mini-hysterotomy and fetoscopy, remain experimental.^{4–6}

Significant Maternal Commitment and Sacrifice in Fetal Surgery

Undergoing fetal surgery requires significant lifestyle changes for the duration of the pregnancy. Many women must relocate nearer to a fetal care center and must submit to significant inconveniences, including bed rest, which can place additional stress on family and caregivers.^{1,25,28,58,61} Additional considerations can include unemployment during this time and reduction of care of other children.

Given these demands and the potential for intensive monitoring during the antepartum period, these women must have robust support. If the expectant mother is a candidate for fetal surgery but lacks the resources or the desire to meet these requirements, fetal surgery is not a good option because of the complications that can ensue.

Shared Decision-Making Model

Shared decision-making depends on building a good relationship so that patients are supported and encouraged to deliberate and express their views during the decision-making process.¹⁶ It is broadly defined as “an approach where clinicians and patients share the best available evidence when faced with the task of making decisions, and where patients are supported to consider options, to achieve informed preferences.”¹⁷ Three steps characterize a shared decision-making model: 1) introducing choice, 2) describing options, and 3) helping patients explore preferences and make decisions (Fig. 1).¹⁷ The model is derived from the notion that decisions should be made by considering the question of “what matters most,” which carries different definitions for different families.

In the setting of MMC, mothers must understand that they have choices. Termination, postnatal closure, or fetal surgery may all be options. If the mother and fetus meet the criteria set forth,¹ then counseling the mother on all options is necessary. However, mothers should not feel obligated to choose fetal surgery in order to “do everything they can for the child.” Fetal surgery can have poor outcomes. The risk of death must be honestly discussed. If what matters most is safety, then postnatal closure of the

MMC remains the best option. We recently reviewed our experience with the prenatal counseling of 175 referrals for MMC; 80 (46%) patients qualified for repair, and of these, 57 (71%) went on to have fetal surgery.⁴²

If the decision is made to have fetal surgery, a final meeting before surgery with all surgical care providers helps ensure that all questions are answered and that there are no misunderstandings about the potential outcomes and risks. At our institution, the meeting occurs 24–72 hours before surgery.

Conclusions

Counseling expectant mothers requires a thorough knowledge of MMC and the treatment options. Pediatric neurosurgeons play an important role in the process. Multiple legitimate treatment options exist, but choosing the best option is difficult because of the many variables. The shared decision-making model provides a framework to help expectant mothers choose the treatment option best for them.

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Author Contributions

Conception and design: Whitehead. Drafting the article: Whitehead, Ravindra. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Whitehead.

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