

[02-013]

Fetal Repair, Fewer Shunts: Contemporary Outcomes of Fetal Surgery for Myelomeningocele

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Background:

Myelomeningocele (MMC) is associated with hydrocephalus requiring ventriculoperitoneal shunt (VPS) placement. In a landmark study, the MOMS trial demonstrated the efficacy of fetal surgery for this condition, with VPS rates of 40% versus 82% in the postnatal surgery group. We evaluate recent outcomes of fetal versus postnatal MMC repair.

Methods:

The Epic Cosmos database was queried for patients who underwent MMC repair from 2016-2024. Rates and timing of VPS placement were compared between those who underwent fetal versus postnatal repair.

Results:

172 patients underwent fetal repair and 1,394 underwent postnatal repair. African American ($p<0.001$), Hispanic ($p=0.002$), or non-English speaking ($p=0.004$) patients were more likely to undergo postnatal repair. Fetal repair was associated with significantly lower VPS rates (26.2% vs. 62.8%, $p<0.001$). Mortality did not differ between groups (1.7% vs. 4.0%, $p=0.199$). Among those requiring shunts, most were placed within the first year of life (84% fetal surgery cohort, 95.3% postnatal surgery cohort).

Conclusion:

Fetal repair of MMC remains associated with reduced VPS rates without increased mortality. However, postnatal repair remains more common, with more research needed to understand barriers to fetal repair.

[02-014]

Fetal Myelomeningocele Repair in Fetuses with Fetal Growth Restriction: A Single-Center Case Series and Cohort Comparison

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Objective: To describe outcomes after open fetal myelomeningocele (MMC) repair in fetuses with fetal growth restriction (FGR) at referral.

Methods: We reviewed 50 consecutive open fetal MMC repairs performed at Cleveland Clinic from 2019-2025. FGR was defined as EFW below the 10th percentile at initial ultrasound. Outcomes were compared between FGR (n=7) and non-FGR (n=43) pregnancies using Mann-Whitney U or Fisher exact tests.

Results: FGR EFW percentiles ranged from the 1st to 9th percentile, and estimated weight at surgery ranged from 400 to 700 g. GA at repair was similar between groups [24.4 (23.1-25.1) vs 23.1 (22.7-24.3) weeks; $p=0.294$]. FGR pregnancies delivered at a median of 34.4 weeks versus 36.6 weeks for non-FGR pregnancies ($p=0.254$). PPROM occurred in 2/7 (28.6%) FGR pregnancies versus 8/43 (18.6%; $p=0.089$) non-FGR pregnancies. Birthweight was lower with FGR [1965 (1740-2211) vs 2760 (2464-3112) g; $p=0.015$].

Conclusion: Open fetal MMC repair in selected FGR fetuses was feasible without clear perioperative differences. Lower birthweight and numerically higher prematurity-related outcomes highlight the need for counselling and further risk-stratification for adverse pregnancy outcomes. FGR at referral should trigger individualized review rather than automatic exclusion from fetal-surgery consideration.

[02-015]

Longitudinal Evaluation of Ambulatory Outcomes Following Prenatal Open Repair of Myelomeningocele

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Aim

Ambulatory ability in conventionally treated spina bifida patients changes through childhood, influenced by neurological and orthopaedic factors. We describe age-related changes in our prenatal open repair cohort.

Methods

Retrospective analysis of prospectively collected data. Primary outcomes were prenatal anatomical level and ambulation at 3, 5 and 7 years.

Results

At 3 years, 24/62 children (39%) were walking independently, of whom 7 (29%) were prenatal L1-3 level and 17 (71%) L4-S1. At 5 years, 16/35 (46%) walked independently, half with an L1-3 level and half L4-S1.

19% (12/62) were non-ambulatory at 3 years, 9/12 (56%) were prenatal L1-3 level. At 5 years, 6/35 (17%) were non-ambulatory, half of whom were L1-3 level.

Paired data at both timepoints was available for 32 patients and was unchanged in 24 (75%). Improvement occurred in 6 (17%): non-ambulatory to walking with aids (4); walking with aids to independent walking (2). Decline from walking with assistance to wheelchair user was seen in 2 (6%); orthopaedic surgery for bilateral hip dislocation contributed in one, preference for wheelchair in the second. Ambulatory status remained stable in the 7 children that reached 7 years.

Conclusion

Longitudinal ambulatory outcomes remained predominantly stable through early childhood.

[02-016]

Meta-Analysis of Medium to Long-Term Neuroprotective Outcomes after Prenatal Spina Bifida Repair

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Aim

The short-term neuroprotective impact of prenatal repair on CSF diversion and ambulation is well described, but it is vital to understand if these benefits are sustained through childhood. A systematic review and meta-analysis was performed, focusing on childhood neuroprotective outcomes after all types of prenatal repair.

Methods

Prospective registration of review in PROSPERO (CRD42022376309). PubMed, Embase and OVID Medline were searched from 1980 - October 2025. Random-effects meta-analysis was performed to calculate pooled outcome proportions at sample size-weighted mean ages.

Results

32 studies reported childhood neuroprotective outcomes. CSF diversion was undertaken in 43% (95% CI 0.39-0.46, $I^2=0\%$) by a mean age of 4.7 years (range of means 2–10.5). Inclusion cysts were detected in 16% (95% CI 0.13-0.2, $I^2=2.2\%$) at a mean age of 5 years (range 2–10.5). At a mean age of 3.4 years (range 3–5) 47% (95% CI 0.26-0.69, $I^2=78.2\%$) walked with devices. Later, community ambulation was possible in 74% (95% CI 0.65 – 0.81, $I^2=0\%$) at a mean age of 8.6 years (range 7.5 – 10.5).

Conclusions

Though these pooled estimates are limited by sample size and between study heterogeneity, they provide key longer-term information to inform parental decision-making.

[02-017]

Fetoscopic versus Open Approaches to Fetal Myelomeningocele Closure, A Single Institution Experience

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Myelomeningocele (MMC) is a congenital malformation resulting from aberrant neural tube closure. Fetal repair is now standard of care following evidence that it reduces shunt requirements. With increasing adoption, select centers have transitioned from open to fetoscopic techniques given the potential for vaginal delivery. We compared outcomes of open and fetoscopic MMC closures at our single fetal care center. In this retrospective study, 44 maternal-fetal dyads undergoing fetal MMC repair between October 2021-July 2025 were analyzed, including 22 most recent open and 22 fetoscopic cases. Maternal comorbidities were similar, though BMI was higher in the open cohort. Fetoscopic closures were performed at a later gestational age and had longer operative times. Both approaches demonstrated comparable improvement in hindbrain herniation on two-week post-operative MRI (>90%). Fetoscopic repair was associated with higher rates of vaginal delivery (53% vs 0%, $p<0.01$), lower incidence of preterm premature rupture of membranes (44% vs 81%, $p=0.02$), and later gestational age at delivery (36.1 vs 32.9 weeks, $p=0.01$). Shunt placement rates were not significantly different, though lower in the fetoscopic group (25% vs 6%). Overall, fetoscopic MMC closure was associated with improved maternal outcomes; longer follow-up is needed to assess neonatal outcomes, including shunt requirements.

[02-018]

Path to and early experience of fetoscopic myelomeningocele repair at the Grant Scott Bonham Fetal Center in Salt Lake City, Utah

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Background: Following the MOMS trial, fetal repair of myelomeningocele (MMC) became the standard of care for eligible patients. Fetoscopic MMC (fMMC) repair has gained acceptance as a less invasive alternative but remains technically challenging requiring substantial institutional preparation. We describe the implementation of a fMMC program and our initial clinical outcomes.

Methods: Beginning in 2023, our center undertook preparation for fMMC repair through site visits to experienced centers, protocol development, team training, and simulation. The first proctored fMMC repair was performed in 2025. Outcomes of all subsequent cases were reviewed.

Results: Fourteen patients underwent fMMC repair at a median GA of 25+6 weeks. All repairs were completed fetoscopically, with median operative time of 4.2 hours. No maternal or fetal transfusions were required, and all fetuses survived to delivery. CMS occurred in 36% and PPROM in 80%, 42% required antepartum admission. Complete reversal of hindbrain herniation was observed in all cases on postoperative MRI. Median GA at delivery was 34 weeks; none delivered before 30 weeks. Two neonates required CSF shunting, and one early case required postnatal wound revision.

Conclusion: Early outcomes following implementation of a fetoscopic MMC repair program are encouraging and comparable to those reported by established centers.

[02-019]

Fetal Heart Rate Monitoring in Fetal Myelomeningocele Repair: Open Versus Fetoscopic Surgical Approaches

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Introduction: Our center established a fetoscopic fetal myelomeningocele (fMMC) repair technique using the same myofascial flap approach as our standard open fetal repair. We compared fetal bradycardia incidence and hemodynamics between our open and fetoscopic procedures.

Methods: A pediatric cardiologist recorded intraoperative fetal heart rate (FHR) every 2 minutes and mitral (MV) and tricuspid valve (TV) filling time fractions (FTF) every 5 minutes using echocardiography. Data were analyzed by surgical stage.

Results: We performed 64 fetoscopic and 26 open (2 converted) procedures with identical imaging protocols. Groups were similar in demographics and surgical parameters, except for longer operative times and more frequent fetal repositioning in fetoscopic cases, and higher maternal blood loss in open. Overall, FHR was higher in open cases (123 vs. 121 bpm, <0.001), but fetal bradycardia (<110 bpm) was infrequent in both groups. Sustained fetal bradycardia (<110 bpm >10min) occurred most often at fetal positioning during uterine access (2/26 open, 11/64 fetoscopic). MV and TV FTF decreased with FHR (-0.45, -0.41 Pearson's), but were stable across groups and operative stages.

Conclusion: Fetal repositioning resulted in some transient bradycardia in our fetoscopic patients, but hemodynamics for fetoscopic cases were stable and comparable with open despite longer anesthetic exposure.

[02-020]

Reversal of Hindbrain Herniation in Infants Undergoing Fetal Myelomeningocele (fMMC) Repair

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Fetal repair of MMC has been demonstrated to ameliorate or fully reverse hindbrain herniation in many neonates. We examined the degree of hindbrain herniation reversal after fetoscopic versus open fMMC repairs.

We abstracted data from the health records of the first 100 liveborn infants who underwent fMMC closure using a (fetoscopic or open) myofascial flap technique at our center since its inception in April 2016. Hindbrain herniation was assessed by neurosurgical review of neonatal MR images to evaluate the degree of cerebellar extension below the foramen magnum (none: none below, mild: <5 mm below, moderate: <1 cm below, severe: ≥1 cm below); rates were compared between the open and fetoscopic repair groups.

Overall, 43 maternal-fetal dyads received fetoscopic MMC repairs and 57 underwent open repairs. None, mild, moderate, and severe hindbrain herniation were observed on postnatal imaging in 48.7%, 35.1%, 10.8% and 5.4% of fetoscopic patients and in 47.2%, 41.5%, 9.4% and 1.9% of open patients, respectively (p=0.80).

Degree of hindbrain herniation in the neonatal period was comparable between the two surgical methods. There are no standard definitions for evaluation of hindbrain herniation reversal; future standardization would increase data reproducibility and facilitate comparison between programs.

[02-021]

Early Outcomes of Antibiotic Stewardship in Infants Undergoing Fetal Myelomeningocele (fMMC) Repair

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There is no evidence-based standard of care for antibiotic use in neonates post-fMMC repair. We developed an antibiotic protocol and described neonatal intensive care unit (NICU) adherence and infection rates before and after implementation.

The protocol used wound evaluation and beta-2-transferrin (β 2T) testing to confirm cerebrospinal fluid at the surgical site and inform antibiotic administration. Data were abstracted for fMMC repair neonates born 4/25/2016-5/19/2025 and discharged from our NICU by 5/19/2025. Antibiotic dosing, duration, treatment indications, culture positivity, and protocol adherence metrics were compared across the pre- and post-protocol periods.

Overall, 15 patients were treated after protocol implementation and 88 before. The protocol was followed for 10/15 (67%), with 100% adherence to initial antibiotic selection and duration; compliance varied beyond these first steps. β 2T testing had poor adherence: 1/15 neonates (7%) was tested, and results were received after surgical site revision. The post-protocol group had higher rates of wound dehiscence (86% vs 49%, $p=0.01$) but lower mean number of antibiotic days (7.7 vs. 20.1 days, $p<0.0001$).

Preliminary results suggest provider education is needed to promote protocol uptake, particularly β 2T testing. This initial dataset was underpowered to confirm reductions in antibiotic use, but demonstrated feasibility and the need for further study.

[02-022]

Cervico-uterine rupture: a rare and harrowing occurrence following fetoscopic myelomeningocele repair

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Background: Uterine rupture is a recognized complication following open fetal surgery, necessitating cesarean delivery for the index and subsequent pregnancies. To our knowledge, uterine rupture has not previously been reported following fetoscopic fetal surgery.

Case: A 35-year-old G4P3003 underwent laparotomy-assisted fetoscopic repair of an L2/L3 myelomeningocele at 25+3 weeks' gestation. Her postoperative course was notable only for limited chorioamniotic membrane separation managed with close surveillance. Labor was induced at 38+2 weeks, resulting in uncomplicated vaginal delivery of a 3,940-g infant. Following placental delivery, severe postpartum hemorrhage persisted despite uterotonics and tranexamic acid. Manual examination identified a large right-sided uterine defect, prompting emergent laparotomy. Exploration revealed a 10-cm uterine rupture extending into the right broad ligament, remote from the three healed fundal fetoscopic trocar sites. Massive transfusion was required. Definitive management included supracervical hysterectomy, arterial embolization, and staged abdominal closure. Both mother and infant recovered well and were discharged home.

Conclusion: This case represents, to our knowledge, the first reported uterine rupture following fetoscopic myelomeningocele repair. Although the rupture was not associated with prior fetoscopic entry sites, this case demonstrates that uterine rupture can occur after fetoscopic surgery and underscores the importance of rapid recognition and multidisciplinary management of obstetric hemorrhage.