Anesthesia for and analgesia after in-utero repair of myelomeningocele

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Myelomeningocele (MMC) is a congenital neuroaxial malformation that occurs during embryogenesis and if untreated leads to the postpartal diagnosis of spina bifida. Without early intrauterine surgical tissue coverage, secondary destruction of the exposed neural tissue by trauma or amniotic fluid may occur throughout the pregnancy. Prognosis is dependent on the anatomic level of the MMC, as well as on the occurrence and severity of hydrocephalus and hindbrain herniation. At midterm of pregnancy there is a narrow time widow to perform the in-utero intervention between the 20th and 25th week of gestation. Surgery consists of ureterotomy, exposure of the fetal lesion and closure of the dura and coverage of the site with myofascial flaps and skin. Tight closure of the uterus preventing loss of amniotic fluid and normal further expansion of the organ is essential. If successfully operated and after conclusion of pregnancy, the baby is born via cesarean section. The MMC repair site is expected to show a perfectly healed skin, no cerebrospinal fluid leak and a suture that is still in place. Anesthesia for in-utero MMC repair has to shield mother and fetus from surgical stimuli and pain, but also to blunt uterine contractions that would occur due to the tissue damage caused by uterotomy. During the intervention maintaining stable maternal, uterine and fetal hemodynamics is essential. After conclusion of surgery, fast emergence from anesthesia is mandatory with immediately sufficient spontaneous breathing of the mother, who in spite of the large surgical intervention should have a comfortable and pain free recovery and an intact pregnancy till its termination. The most specific characteristic for this kind of procedure is the simultaneous anesthetic treatment of mother and fetus in the way that the anesthetics given to the mother have to penetrate the placental barrier and to exert their anesthetic effect on the fetus as well. This implies that the anesthetics systemically given to the mother must penetrate the utero-placental barrier with a sufficiently fast kinetics in order to have the fetus well anesthetized during the neurosurgical repair. The in- and outward move of the anesthetics is hereby mainly dependent on the actually invoked and maintained concentration gradients. While general anesthesia with tracheal intubation, infusion of hypnotics, opioids and muscle relaxants is the mainstay during surgery, for the complete perioperative coverage of the mother's needs, an additional low-thoracic epidural analgesia is necessary too. In particular, this regional component is aimed not only to provide postoperative pain reduction and comfort, but it also has to contribute to suppress uterine contractions that might represent a cause for miscarriage or premature delivery. The general anesthesia plan follows the usual precautions for pregnant women undergoing non-obstetric surgery. This encompasses left lateral tilt, rapid sequence induction, aspiration prophylaxis and a fast onset of neuromuscular blockade. Maintenance of anesthesia must be easily steerable by continuous application of short acting agents. Additionally it must be profound in order to ensure sufficient transplacental diffusion of the drugs and to provide the very essential uterine relaxation. For this purpose, as a main hypnotic we use the inhaled volatile anesthetic desflurane, which is administered at a high dose of 2 MAC. This measure may cause maternal hemodynamic depression that in turn has to be monitored carefully and treated instantly with vasoactive drugs. The continuous neuromuscular blockade is achieved with rocuronium, however, its action might be boosted and prolonged by the

concomitant administration of magnesium. The standardized magnesium infusion during the intervention of 6 g in 30 min followed by 4 g/h is considered very high and has the goal to prevent uterine contractions. This treatment prolongs the effect of the muscle relaxant rocuronium, which in turn must be scavenged at the end of surgery by the use of sugammadex. Otherwise spontaneous ventilation would not be possible. In order to protect and paralyze the fetus, an additional intramuscular injection of fentanyl and atracurium is given by the surgeon as soon as the baby is directly accessible. The epidural catheter that has been placed before anesthesia induction remained silent during the surgery, not only because it was not necessary for pain relief, but most importantly because it would have compromised the otherwise fragile maternal hemodynamic stability. Towards end of surgery and anesthesia, however, epidural analgesia is initiated with a low concentrated local anesthetic that is delivered in a patient controlled fashion composed by a background infusion that might be augmented with intermittent bolus upon patient request. This way is ensured that a smooth and pain free transition from general anesthesia to wakefulness is possible and overdosing is avoided. This pain therapy is continued for up to the third postoperative day and gradually supplemented by a variety of enteral medications which allows the stepwise reduction of invasive methods and return to normal life.

References

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