

ANESTHESIA FOR CESAREAN SECTION AND POSTOPERATIVE ANALGESIA FOR THE PARTURIENT

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Considering the physiological changes during pregnancy and the fact that there are two lives, obstetric anesthesia is an extremely specific and challenging area of work. The physiological changes that occur during pregnancy are among the contributing factors for complications during general and regional anesthesia. Therefore, the preoperative consideration is very important in the prevention of complications. Neuraxial anesthesia is increasingly replacing a widely applied general anesthesia, and has become the technique of choice for the majority of caesarean sections. General anesthesia is accompanied by risks related to the airway, but is still indicated for caesarean sections of the first degree of urgency. The choice of anesthesia depends on the urgency of surgery, general condition of the mother and fetus, comorbidity of pregnant woman and her consent to the proposed anesthetic procedure. The ultimate goal of all procedures is to provide safe anesthesia for mother and fetus. Multimodal analgesia is the best form of the pain treatment after caesarean section. *Acta Medica Medianae* 2015;54(4):72-78.

Key words: preoperative consideration, neuraxial anesthesia, general anesthesia, caesarean section, postoperative analgesia

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general condition of the patient and its comorbidities, complications during pregnancy or childbirth, and fetal condition. With regard to the specific physiological changes during pregnancy and the fact that there are two and very often more lives, obstetrics represents a major challenge for the anesthesiologists. An adequate preoperative evaluation of pregnant women and the choice of anesthesia should provide safe anesthesia for the mother and fetus.

Preoperative considerations for caesarean section

Introduction

Cesarean section is the most common surgery in gynecology. It is estimated that 15% of all births in the world is completed by caesarean section (1), of which 40% in developing countries. Compared to vaginal delivery, caesarean section is followed by the tenfold higher maternal mortality (2). For this type of surgery, general anesthesia is administered traditionally. The most common cause of death related to anesthesia is the inability of intubation, aspiration of gastric contents and incorrect intubation in esophagus. In recent decades, the mortality rate of pregnant women who underwent caesarean shows a declining trend due to the increasing administration of neuraxial anesthesia. The choice of anesthesia depends on several factors: the degree of urgency of surgery,

The knowledge about the physiological changes of the cardiovascular, respiratory and gastrointestinal tract during pregnancy is of great importance for anesthetic evaluation and adequate preparation of pregnant women for caesarean section.

Obstetric anesthesiologists often deal with difficult airway. Study data show that the incidence of difficult intubation of pregnant women is 1:30, and impossible 1: 274 (3). The reasons for this are mucosal edema of the pharynx and larynx, macroglossia, short neck, obesity and large breasts. Because of this, the assessment of predictors of difficult intubation is of great importance for the anesthesiologist, primarily in terms of making a decision about the type of anesthesia (general or neuraxial) and possible alternative plan in case of failed intubation. Decreased FRC in

pregnancy is the reason for rapid emergence of hypoxemia during apnea, which is why preoxygenation in pregnant women before the induction of general anesthesia is mandatory. High BMI, Mallampati score higher than I, short neck, micrognathia are considered to be the predictors of difficult intubation in pregnant women.

The prevention of aortocaval compression by gravid uterus is essential in terms of both mother and fetus. In the supine position, gravid uterus compresses the aorta and inferior vena cava, causing hypotension because of decreased preload. Hypotension during neuraxial anesthesia or induction to general anesthesia may be even more pronounced and cause perioperative nausea and vomiting. Long-lasting hypotension may be the reason for bradycardia and fetal acidosis due to reduced uterine blood flow (4). Positioning of pregnant women in the left lateral tilt at the angle of 15 degrees can prevent the occurrence of aortocaval compression.

During the induction of general anesthesia, pregnant women are at increased risk of regurgitation, aspiration of gastric contents and the occurrence of Mendelson's syndrome. Moving of the gravid uterus cranially increases the intragastric pressure, while progesterone decreases gastroesophageal sphincter tone and slows the intestinal motility. The increased secretion of gastrin results in increased acidity of gastric contents. For this reason, all pregnant women regardless of the time of the last food intake, are considered to be patients with the full stomach, so special attention within the preoperative consideration should be paid to the prevention of regurgitation and aspiration of gastric contents. The recommendations of the American Society of Anesthesiologists on preoperative fasting for elective cesarean section are: for solid food 6-8 hours before anesthesia and 2h for clear liquids (5). Antacid prophylaxis is mandatory no matter if neuraxial or general anesthesia will be performed. For elective cesarean section: 150 mg of ranitidine orally 12 hours and 2 hours before surgery, 10 mg of metoclopramide orally 2 hours before surgery and 30 ml of 0.3 M sodium citrate. For urgent cesarean section prophylaxis is carried out before surgery: 50 mg iv ranitidine (an alternative is the proton pump inhibitor), 10 mg of metoclopramide IV and 30 ml of 0.3 M sodium citrate per os. The aim is to reduce the volume and acidity of gastric contents.

The decision about the type of anesthesia is made on the basis of several parameters: the degree of urgency of surgery and general condition of the mother and the fetus, the comorbidities of woman and her consent to the proposed anesthetic procedure.

General anesthesia for caesarean section

Due to complications related to the airway, neuraxial anesthesia is increasingly replacing a widely used general anesthesia. General anesthesia is indicated only in the case of cesarean section

- the degree of urgency 1, hemodynamically unstable pregnant women, and in situations when neuraxial anesthesia is contraindicated.

During general anesthesia, it is necessary to provide adequate uteroplacental perfusion and oxygenation of the mother and the fetus, to reduce uterine atony to a minimum and transfer of anesthetics to the fetus.

After antacid prophylaxis, the prevention of aortocaval compression, and mandatory 100% oxygen preoxygenation, "rapid-sequence induction" (RSI) are carried out in order to prevent regurgitation and aspiration of gastric contents. All intravenous hypnotics can be safely administered for induction. Sellick's maneuver in preventing aspiration is controversial (6). Succinyl-choline remains the relaxant of choice, although rocuronium is being increasingly used. Rocuronium at a dose of 1-1.2 mg/kg can be used only if in the case of failed intubation it is possible to use sugammadex as an agent for the reversal of neuromuscular blockade (4, 7). Prolonged effect of non-depolarizing muscle relaxants can be expected in patients who received magnesium sulfate, and in this case neuromuscular monitoring is desirable.

A common problem during general anesthesia for caesarean section is the presence of consciousness. Volatile anesthetics, which are used to maintain anesthesia, can cause dose-dependent uterine atony and potentiate bleeding, and because of that they are used in low concentrations, which results in an inadequate depth of anesthesia. Research shows that maintaining a mixture of sevoflurane anesthesia <1% (0.5 MAC) and 50% nitrous oxide is accompanied by BIS values > 60 (8). Studies have confirmed that sevoflurane in a concentration of 1.5% (MAC 0.75) up to the moment of administration of the opioid considerably reduces the risk of intraoperative awareness (8, 9).

In patients with pre-eclampsia and eclampsia at the induction of anesthesia, it is possible to expect a significant increase in blood pressure, which may impair cerebral perfusion. Considering the fact that the opioids are not administered before the umbilical cord is clamped because of fetal bradycardia, remifentanyl may be used for the attenuation of hemodynamic response at the induction of anesthesia (10, 11).

During anesthesia, it is necessary to maintain uteroplacental perfusion by maintaining the mean arterial pressure and avoiding hyperventilation.

The advantages of general anesthesia are: rapid introduction, controlled ventilation and therefore a better oxygenation of the fetus, a lower degree of hypotension compared to neuraxial anesthesia, and because of this it is the technique of choice in hemodynamically unstable patients (placenta praevia accreta, and percreta). In the case of breech presentation, general anesthesia has the advantage because the administration of muscle relaxants facilitates the extraction of the fetus.

Disadvantages of general anesthesia include: failed intubation and ventilation, the possibility of aspiration of gastric contents and also drug-induced neonatal depression. Compared to neuraxial anesthesia, general anesthesia is accompanied by the major intraoperative blood loss and lower Apgar score in the first minute (12). Due to complications related to the airway in relation to neuraxial anesthesia, general anesthesia is accompanied by a higher rate of maternal mortality.

Neuraxial anesthesia for caesarean section

Due to the fatal complications related to the airway, neuraxial anesthesia has become more popular and widely used than general anesthesia. Tuffier's line in nonpregnant women is passing through L4 spinous process or L4-L5 intervertebral space. During pregnancy, pelvis is rotated more forward and the lumbar lordosis of the spinal column increases, which is why Tuffier's line moves cephalic. Therefore, one should be careful if spinal anesthesia is performed in more than one intervertebral space according to the Tuffier's line. Increased lumbar lordosis and thoracic kyphosis decrease potential cephalic spread of the anesthetic, and thus lower doses of a local anesthetic should be given intrathecally. The increase in intra-abdominal pressure and compression of the inferior vena cava by gravid uterus increase the stasis in the vein system of azygos, thereby leading to the enlargement of the epidural veins. These changes result in an increased risk of accidental intravascular administration of anesthetic.

Spinal anesthesia is the choice for most elective cesarean sections, as well as caesareans of 2nd, 3rd and 4th degree of urgency. The advantages of these techniques are simple and quick onset of the block. For caesarean section the height of the block should be up to T4 dermatome. During the procedure, the best solution is to position the expectant mother to the left tilt. The anesthetic of choice is hyperbaric bupivacaine at a dose of 7.5-15 mg. The optimal dose of local anesthetic for spinal anesthesia depends on the use of adjuvants, position of the patient, and tolerance of hypotension. Lower doses of local anesthetic given intrathecally will cause a lower degree of hypotension, but there is a possibility of insufficient height of the block. Intrathecal opioids, as the adjuvants, potentiate the analgesic effect of the local anesthetic, but not the duration of the block. Small doses of opioids are used, so they do not affect the fetus. The most commonly used is fentanyl at a dose of 10-20 mcg, whereas sufentanil at a dose 2.5-5 mcg is rarely used. The addition of morphine at a dose of 100-200 mcg provides postoperative analgesia for up to 24 hours. Fentanyl and morphine can be combined at the same time, thus achieving faster analgesic effect and long-lasting analgesia. Combining a lower dose of morphine intrathecally (100 mg) and NSAIDs per os results in the same analgesic effect when higher doses of morphine are used, but the

incidence of its adverse events (pruritus, hypotension) is significantly decreased (13).

The most important disadvantage of spinal anesthesia is hypotension, which may have multiple effects on the mother and the fetus. Reducing uteroplacental flow impairs fetal oxygenation, leading to fetal acidosis and bradycardia, and on the other hand causes nausea and vomiting. Because of this, prevention and treatment of hypotension is very important. It is achieved by prevention of aortocaval compression, crystalloid and colloid infusion, and the use of vasopressors-ephedrine, phenylephrine or adrenaline. The study showed lower values of umbilical artery blood pH after the application of phedrine in comparison with fenylefrine (14). Moreover, spinal anesthesia can be safely applied in pregnant women with preeclampsia, in the absence of coagulation disorder. The literature data show a considerably lower decrease of blood pressure in the preeclampsia patients than in those with normal pregnancy (15).

Epidural anesthesia for the cesarean section is most often applied in pregnant women who have already had the painless delivery epidural catheter placed (top-up epidural). The main disadvantage of epidural anesthesia is the block onset. In order to accelerate the block onset, an alkalization of local anesthetic by adding 8.4% sodium-bicarbonate can be applied. The use of adrenaline 1:200.000 in epidural anesthesia accelerates block onset and its quality, as well as the recognition of space in the case of an accidental intravascular anesthetic application, without any influence on uteroplacental circulation. The quality of intraoperative analgesia can be improved by opioids: fentanyl 75-100 mcg, sufentanil 10-20 mg, while morphine applied epidurally in a 4mg dose results in postoperative analgesia lasting for 6-24 hours.

In the case of the existence of zones without analgesia, 10-20 mg of ketamine i.v combined with 30% nitrous-oxide could be given.

Being different from spinal anesthesia, the advantages of the epidural anesthesia are a lower degree of hypotension, the possibility of sensory blockade titration and postoperative analgesia. The disadvantages are: a slow block onset, zones without analgesia; if compared to the spinal, the procedure is more complex to perform, and there is a greater risk of the anesthetic toxic effects. Due to a slow blockade onset, it is not applied in the caesarian section's urgency of degree 1 and 2.

Combined spinal-epidural (CSE) anesthesia enables a rapid block onset due to an interteally applied anesthetic, as well as block level titration by using an epidural catheter, and postoperative analgesia. The technique can be performed either by a separately performed spinal and epidural anesthesia at one or two different sites, or by the technique "needle through needle" which is a more often one. With the technique "needle through needle", there is a possibility of the epidural catheter to pass through the hole on the dura into

the subarachnoid space, but this possibility is less likely when applying a 25-gauge needle. The chance for a local anaesthetic to spread from the epidural into the subarachnoid space is negligible (16). CSE anesthesia can be performed in two ways:

1. By applying a full subarachnoid dose of anesthetic while the epidural catheter is used only in case of an inadequate blockade or when the duration of the spinal anesthesia is exceeded by the length of surgery. This type of anesthesia is followed by a higher degree of hypotension.

2. By applying smaller doses of anesthetic subarachnoidally and adding anesthetic epidurally, the height of blockade is elevated. In this way, the degree of hypotension is lower, but the time for the onset of an adequate height of blockade is longer.

Complications of the cesarean section

From the anesthesiologists' point of view, the biggest percentage of complications is related to the airway and followed by very severe consequences.

Two most significant complications are impossibility of the pregnant woman's intubation and ventilation, and aspiration of gastric contents. Anticipation of a difficult airway is very significant, because it reduces the possibility of these complications to minimum. Therefore, it is necessary to estimate the predictors of a difficult intubation: Mallampati score, mobility of atlas-occipital vertebra, tireomental distance and the possibility of mouth opening, based on which the type of anesthesia is decided.

Because of the previously mentioned physiological changes, difficult intubation is very common in pregnant women. In such situations, the placement of compresses under the pregnant woman's arms and neck, bimanual laryngoscopy and a flexible tip laryngoscope can be helpful. Repeated attempts of intubation are followed by catecholamine increase which can reduce uterine blood flow, while mask ventilation between the intubation attempts increases the risk of regurgitation and aspiration of gastric contents. The Obstetric Anaesthetists Association recommends asking for help and immediate placing of LMA after the second unsuccessful intubation attempt. If ventilation through LMA is possible, the decision on the patient's weaning is made on the basis of the cesarean section urgency. In cases of an elective cesarean section without a fetal distress, it is recommended to wake the pregnant woman up and to perform regional anesthesia. In case of "cannot ventilate cannot intubate", an urgent cricothyroidotomy is indicated.

Other fatal consequences are the aspiration of the gastric contents and the occurrence of the Mendelson's syndrome. The prevention of this complication means: the application of antacids and prokinetics according to already mentioned protocol, the pregnant woman's positioning in

anti-Trendelenburg position position, preoxygenation, RSI and the pregnant woman's extubation after the swallowing reflex has been recovered. However, sometimes, in spite all precaution measures, it is impossible to prevent regurgitation. In that case, turn the pregnant woman back into anti-Trendelenburg position. Aspirate the mouth contents, apply 100% oxygen. In case of bronchospasm, bronchodilators should be used, whereas there are opposite opinions regarding corticosteroids usage. If after all the applied procedures the patient is distinctly cyanotic, bronchoscopy, for the purpose of the food bits removal, is indicated. Mendelson syndrome and impossibility of the pregnant woman's intubation and ventilation are the leading causes of parturients' death. An increasing number of the cesarean sections performed under neuraxial anesthesia have considerably reduced the incidence of these complications.

One of the most frequent surgical complications of the cesarean section is hemorrhage. Placenta previa, accreta, percreta are followed by great losses of intravascular volume. Due to large losses, intraoperative blood salvage and tranexamic acid have got their application in obstetrics while the literature data point out that the recombinant factor VII can be an alternative therapy for the patients with massive periparturial hemorrhage (17)

Postoperative analgesia after the cesarean section

In relation to other laparotomies, after the caesarian section, an early mobilization of the parturient who should look after her newborn infant is expected. The period from moderately strong to extremely strong pains after the caesarian section may last for up to 48 hours. Therefore, parturients should be provided with better postoperative analgesia. The ideal analgesia has to meet a few criteria: to be economical and efficient, simple to apply, to enable an early mobilization of mother, to prevent the occurrence of chronic pain after the cesarean section, and also to provide minimum drug secretion into milk, without any undesirable effects upon the newborn infant.

Neuraxial analgesia is frequent due to an increasing number of cesarean sections performed under regional anesthesia.

Intrathecal applied opioids provide both intra- and postoperative analgesia, but the speed of analgesia onset and its duration will depend solely on pharmacokinetics and liposolubility of the applied opioid.

Fentanyl and sufentanyl are particularly liposoluble, they diffuse quickly from cerebrospinal fluid into the nervous tissue and, if compared to hydrosoluble morphine, their effects occur faster but last shorter. For this reason, given intrathecally, they produce an excellent intraoperative analgesia, but cannot provide the adequate postoperative analgesia. Because of an increased

intake in the spinal cord horns, their concentration in the cerebrospinal fluid decreases so that there is neither a cranial spreading nor a postponed respiratory depression which can be seen after morphine usage. Their intraoperative application does not decrease the necessity for postoperative opioids.

Morphine has found the right place in the postoperative analgesia of a parturient. Owing to hydrosolubility, morphine is being kept in liquor in a bigger concentration if compared to liposoluble opioids, because of which its analgetic effect lasts longer. However, due to cranial spreading, there is a risk of a postponed respiratory depression. Morphine given intrathecally in the dose of 100-200 mcg results in an efficient postoperative analgesia lasting for up to 24 hours, whereas the doses of more than 200 mcg do not result in a better analgesia and are followed by considerably more distinct undesirable effects (18). Pruritus, nausea and vomiting are common after the administration of morphine in comparison with fentanyl, however, these side effects can be mitigated by the administration of lower doses of morphine (100 mcg) with the use of NSAID per os at fixed intervals (13). There is a higher probability of reactivation of labial herpes after neuraxial application of morphine (19).

Epidural analgesia can be performed by applying opioids only or by applying their combinations with the local anesthetics, as intermittent bolus or as a continuous infusion. The combination of opioids and local anesthetics proved to be superior related only to opioids concerning the postoperative pain control (20). Morphine given epidurally in a 3 mg dose will result in analgesia of duration of up to 24 hours, whereas the liposoluble fentanyl and sufentanyl have faster but shorter effect, and that is why it is better to apply them combined with local anesthetics such as PCEA (Patient controlled epidural analgesia). Pruritus, as a side effect of morphine, is present both in intrathecal and epidural administration, but the research has proved a lower incidence of pruritus and other side effect when morphine is applied within 3 hours' time from the administration time (21).

Systemic opioids administration means intramuscular, intravenous and subcutaneous drug application. Systemic administration has its advantages (it is simple and cheap), but also there are numerous disadvantages. Intramuscular and subcutaneous injections are unpleasant for the patient because of their frequent application, an analgesic effect does not occur immediately, and the changes of the medicine concentration in blood are followed by a pain breakthrough at the fall of concentration, as well as by undesirable effects at the maximum medicine concentration in blood. These disadvantages are overcome by patient-controlled intravenous analgesia-IVPCA.

IVPCA means that the patient can give herself the intravenous bolus of analgetics while using the IVPCA apparatus. In this way, it is

possible to decrease the fluctuations in the opioids concentration and that is why IVPCA is superior to intramuscular analgesia. The main disadvantage of IVPCA is related to the correct usage of the apparatus. The application of a continuous analgesic infusion combined with intravenous boluses on the parturient's demand is still a subject of debating.

System administration of the neopioid analgesics - The most frequently applied neopioids for pain control after the cesarean section are non-steroid anti-inflammatory drugs (NSAID). NSAIDs only are not sufficient for pain control, but combined with neuraxial smaller dose of opioids, they improve the quality of analgesia and decrease the undesirable opioid effects. Applying NSAID in the fixed time intervals provides a better postoperative analgesia than when applied according to the needs. NSAIDs are efficient in pain control which occurs due to uterus contractions. Ketorolac and Diklofenac can provoke uterus atony (18).

TAP block (transverses abdominis plane) is efficient in a postoperative pain therapy after the cesarean section. A meta-analysis of five randomized controlled studies, which included 312 pregnant women, has found that TAP block in pregnant women who have not received intrathecal morphine significantly reduces the need for intravenous morphine during the 24 hours after caesarean section, but not in those with the morphine given intrathecally (22).

Multimodal analgesia is the best one for the treatment of post-cesarean pain. Commonly, intrathecal morphine is used at a dose of 100 mcg with NSAID per os, while breakthrough pain can be treated by opioids also, the combination of the opioid intravenously and TAP block can be applied.

Conclusion

A preoperative consideration for the cesarean section and an evaluation of airway are of great significance in the prevention of complications during anesthesia.

General anesthesia is accompanied by a higher rate of mortality in pregnant women, but it has the advantage in better oxygenation of the fetus and a lower degree of hypotension. It is the technique of choice for caesarean sections of the first degree of urgency. Advantages of neuraxial anesthesia compared to the general one are multiple: complications related to the airway are avoided, there is less fetal exposure to potentially depressant effect of drugs, the mother is awake at the moment of the child's birth, there is a possibility of postoperative analgesia, and the incidence of thromboembolism is reduced. The choice of anesthesia and a benefit-risk estimation of the general anesthesia compared to the neuraxial anesthesia in the context of obstetric status; comorbidity and general state of both mother and fetus remain in the domain of the anesthesiologist's estimation. The postoperative

analgesia is very important for an early mobilization of the mother who ought to take over care of her new-born infant. In that context, a

multi-modal anaesthesia represents the best way of pain therapy after the cesarean section.

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ANESTEZIJA ZA CARSKI REZ I POSTOPERATIVNA ANALGEZIJA PORODILJE

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Uzimajući u obzir fiziološke promene tokom trudnoće i činjenicu da pred sobom ima dva, a često i više života, opstetrijska anestezija predstavlja izuzetno specifično i izazovno područje rada. Fiziološke promene koje nastaju tokom trudnoće jedan su od faktora koji doprinosi nastanku komplikacija tokom opšte i regionalne anestezije. Stoga je preoperativna priprema trudnica veoma značajna u prevenciji komplikacija. Neuraksijalna anestezija je potisnula široko primenjivanu opštu anesteziju i postala tehnika izbora za većinu carskih rezova. Opšta anestezija praćena je rizicima vezanim za disajni put, ali je i dalje indikovana kod carskih rezova prvog stepena hitnosti. Izbor vrste anestezije zavisi od hitnosti hirurške intervencije, opšteg stanja majke i fetusa, komorbiditeta trudnice i njene saglasnosti za predloženu anesteziološku proceduru. Krajnji cilj svih procedura je obezbediti sigurnu anesteziju kako za majku tako i za plod. Multimodalna analgezija je najbolji vid terapije bola nakon carskog reza. *Acta Medica Medianae 2015;54(4):72-78.*

Ključne reči: *preoperativna priprema, neuraksijalna anestezija, opšta anestezija, carski rez, postoperativna analgezija*

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