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FULL PAPER

Anaesthesia management of non-obstetric surgery in pregnancy: A case series

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Non-obstetric surgery for during pregnancy has a rise in incidence these last couple of decades. However, based on the physiological changes of the pregnancy and the vulnerable state of the fetus, it poses a complicated anesthesia management. The most important principles in anesthetic care for non-obstetric pregnancy are ensuring the mother and fetus safety, which could be done in several anesthesia techniques, each with their specific considerations. The author reported four cases of non-obstetric surgery in pregnancy including an ovarian cyst excision, salphingo-oophorectomy, craniotomy, and tumor excision, also cerclage operation. All pregnancies were continued to term without adverse effects. This report particularly illustrates the specific anesthesia management for each case, with a brief review of literature on its perioperative management.

KEYWORDS

Anesthesia management; non-obstetric surgery; pregnancy.

Introduction

Anesthesia care for non-obstetric operation during pregnancy creates a unique challenge for anesthesiologist. While non-obstetric surgeries are generally avoided during pregnancy, exceptions are to be made especially when an emergency is involved or in some elective cases. Non obstetric surgery occurs during 1-2% of all pregnancies, mainly during the first and second trimester. The highest prevalence of surgeries were abdominal and adnexal procedures (35-81%), trauma (8-24%), and urological surgery (8-16%), with the most common pathologies being appendicitis (6-39%) and adnexal diseases (6-36%) [1]. Gynecological surgery had an incidence of 0.5-0.8% which was dominated by ovarian disorders. High incidence of non-obstetric surgery are correlated with increased age and BMI, smoking, and higher parity The presence of gynecological surgery was 0.3-1.2% according to age, while obstetric surgery has a prevalence of 5.4% (includes invasive diagnostic tests, cerclage, fetal reduction surgery and laser treatment of the placenta [2].

Non-obstetric surgery during pregnancy has been associated with adverse birth outcomes. A pregnant patient who goes through with a surgery have a higher risk of low APGAR score, preterm labor, miscarriage, or even stillbirth [2,3]. A study found that hospitalization for surgery during pregnancy increased the risk of miscarriage by 1.3 times, however the number does not account whether miscarriage resulted from risk of anesthesia or the underlying condition itself. Also, how non obstetric surgery increases the

risk of maternal death by 4.7 times, AR 0.4% with stillbirth and 2.6% for low birth weight [4]. In this case series, we present a series of cases in which anesthesia care was given during 4 various non-obstetric surgeries on pregnant patients with overall good outcome.

Case series

The first case details a 27-year-old female, 175 cm height and weighing 75 kg, who was waiting for an operation schedule a suspected malignant ovarian mass. The patient suddenly got pregnant during that period, where she then is diagnosed with primigravid 14-15 weeks of gestation, high social value baby and suspected ovarian cancer. After some discussion with the obstetric-gynecologists, it is decided that the patient would undergo a unilateral salphingo-oophorectomy at 18 weeks of gestation and subsequent conservative surgical staging to be done if frozen section histology were found the epithelium to be cancerous.

Preoperative vital signs and physical examinations were documented normal. The ASA score was 2 whereas the patient is having pregnancy, class 1 obesity (BMI of 30.1), and low blood albumin level (3.3 g/dL). The anesthesiologist decided to do general anesthesia and an epidural, educating the patient's family first regarding abortion and further risks. Preinduction loading was done with 500 mL crystalloid, continued by preoxygenation for 3 minutes. Intravenous induction was given with fentanyl 100 micrograms, propofol 100 miligrams, and rocuronium 50 miligrams. A sleep apnea technique was done with ETT 7.0 regular with cuff, with a successful first attempt. Patient went into ventilator with isoflurane gas 1.3-1.4 vol% with tidal volume of 400-430 mL, rate 15x/ minute, PEEP 5-8, and FiO_2 40%. Epidural anesthesia was done at the lumbar spine at the L1-L2 level with ropivacaine 0.2% and maintained during operation. Further fentanyl 50 mcg was given before incision. The operation went on for 2 hours and 30 minutes with stable hemodynamic. A 15 cm right paraovarian cyst was found where it is excised, and subsequent frozen section found the mass to be benign with a diagnosis of endometriosis cyst.

Post operation, the patient regained consciousness, only complaining of minimal pain at incision site especially when coughing, and physical examinations were found normal. Ropivacaine 0.2% were given for the first 24 hours via epidural with syringe pump, and paracetamol drip 1 grams intravenously every 8 hours until patient could take oral medication. Further examinations showed the patient having stable hemodynamics with positive FHR, no signs of labor. The patient was then discharged, then controlled routinely via outpatient clinics where 5 months later, NST category 5 were found, and a termination of pregnancy was decided to be the course of action. Subarachnoid block was done, and a 3100 grams healthy baby boy was born with an APGAR score of 8/9.

The second cases detail a 23 year old woman, weighing 61 kg and a height of 156 cm, who was diagnosed with an ovarian cyst during pregnancy with gestation at 6-7 weeks. The left cyst was found to be 15.2 x 27.6 x 21.7 cm in size and suspected to be cancerous. The findings, combined with the patient having high myopia (-16/-18) and positive preeclampsia at screening, the patient was advised to undergo a salphingo-oophorectomy operation at a gestation age of 22-23 weeks. Preoperative vital signs and physical examinations were documented normal. The ASA score was 3 whereas the patient is having pregnancy, distended abdomen, and an anemia with Hb of 10.4.

The anesthesiologist decided to do general anesthesia with oral intubation. Preoxygenation was done for 5 minutes, continued by induction of propofol 90 miligrams, fentanyl 75 micrograms, and rocuronium 50 miligrams. Intubation was done with ETT sized 7.0. Isoflurane gas was

given at 1.2-1.5 vol% as maintanance. An epidural was done post operation at lumbar spine at the L2-L3 level and ropivacaine 0.2% as given at a rate of 4 mL per hour via epidural. The operation found a cystic mass with a diameter of 30 cm at the left adnexa and a gravid uterus compatible with 22 weeks' gestation of age. Salphingo-oophorectomy was done with stabile hemodynamic during the operation. Post operation, the patient regained consciousness and was treated in the high care unit. Normal vital signs, physical examination, and fetal examinations were recorded. Ropivacaine 0.2% were given for the first 24 hours via epidural with syringe pump, and paracetamol drip 1 grams intravenously every 8 hours until patient could take oral medication for 2 days, metoclopramide 10 miligrams per 8 hours for 1 day, and progesterone 400 mg intravaginal 6 hours after surgery was given. After 2 days, the patient was transferred to the low care following further examinations showing the patient having stable hemodynamics with positive FHR, and no signs of labor. The patient was then discharged

The third patient was a 31-year-old woman, weighing 85 kg with a height of 160 cm, who was diagnosed with cervical incompetency during pregnancy with a gestational age of 15-16 weeks. This is the fourth pregnancy and the patient have a history of recurrent preterm births 7-8 months gestational age, with all the babies having death several hours post-partum. The patient had undergone cerclage insertion before to prevent subsequent preterm birth. Last meal was 6 hours before operation and last drink was 2 hours before. Preoperative physical examinations revealed normal findings. ASA score was 2 whereas the patient is having pregnancy, hyponatremia (129 mEq/L), and class 1 obesity.

It was decided by the anesthesiologist to give the patient regional anesthesia via subarachnoid block. Preinduction fluid loading was 500 mL crystalloid, with oxygen supplementation via nasal cannula 3 litres per minute. The patient was positioned into left lateral decubitus and SAB was done at lumbar spine at the L3-L4 level 50 miligrams of hyperbaric lidocaine combined with epinephrine as adjuvant. The patient was positioned back into supination and the operation started after the block reached T10. Stable hemodynamic was found throughout the 15-minute operation with a stable FHR. Postoperatively, the patient's hemodynamics was stable and physical examinations were found normal. Paracetamol drip 1 grams per 8 hours was given intravenously until patient could tolerate oral medication for 2 days. The patient was initially transferred to the high care unit until stable and recovering well, and then discharged from the hospital in a well state.

The fourth patient was a 37-year-old woman, weighing 78 kg with a height of 160 cm, who suddenly complained of progressive right-side weakness before and during pregnancy. At first, it manifested as pins and needles on the right side of the body, followed by tremor movements, headache, and recurrent sudden loss of movements on the right side. CT scan found an extra axial mass 6.4 x 8 x 6.3 cm on the left parietal with the diagnosis of left parietal meningioma. The patient rejected surgery initially, when 6 months later the patient had a positive pregnancy test with a 4–5-week gestational age. A visit to the obstetrician diagnosed the patient with total placenta previa, transverse fetal position, positive preeclampsia screening added to the previous suspected convexity parietal meningioma. The patient was referred to the ophthalmologist where she was diagnosed with right homonymous hemianopsia because of a compressive lesion.

The patient was also referred to the neurosurgeon and the decision was to do a craniotomy and tumor excision after gestational age of 28 weeks. Pregnancy would be continued if the patient's condition were to

be stable during and after operation, and it will be terminated if there is any kind of emergency on the patient's or baby's state. Meanwhile, the patient was given steroid for the lung maturation of the baby. Before the operation, the patient had steroid induced hyperglycemia, hypokalemia (3.2 mEq/L), and hyponatremia (124 mEq/L) whereas she was given insulin to control her glucose level, potassium tablet to elevate her potassium level, and infusion of NaCl 3% to elevate her sodium level. Preoperative physical examinations showed right lateralization with a normal FHR. The patient was class 1 obesity with a BMI of 30.46.

ASA score was 3 whereas there is an intracranial process with GCS was scored 15 (E4M5V6) and right hemiparesis, pregnancy, hypokalemia, hyponatremia, and gestational DM (HbA1C 5.7 and GDA 123, corrected with previous Novorapid and Lantus injection). The anesthesiologist decided to of a general anesthesia intubation while keeping a close monitor to the FHR. Preinduction fluid loading was with crystalloid solution 250 mL, followed by 5-minute preoxygenation. Intravenous induction was done with fentanyl 100 micrograms, propofol with TCI, rocuronium 50 miligrams, and lidocaine 80 miligrams. A sleep apnea intubation technique was performed with ETT sized 7.0 and a successful first attempt. Patient was connected to the ventilator with TCI propofol and dexmedetomidine pump as maintanance. The ventilator setting was tidal volume 400 mL with a rate of 16x per minute, and PEEP 5, that achieved SpO2 of 99%. Scalp block was performed with ropivacaine 0.5%, and continuous pumps of propofol with TCI, dexmedetomidine, and rocuronium.were given intravenously.

The operation lasted for 10 hours with the patient having stable hemodynamic and FHR throughout the surgery. Operation finding was a tumor on the 1/3 left parasagittal region suspected of meningioma, hence a craniotomy excision tumor and osteoplasty were performed. Postoperatively, the patient was transferred to the ICU having stable condition, with tube-in and ventilator support. The further protocol was given during the ICU care. Paracetamol 1000 grams intravenously every 8 hours, ibuprofen 400 miligrams intravenously every 8 hours, and a continous pump of Dexmedetomidine at rate of 0.2 mcg/kgBW/hour were given as post-operative analgesia. The patient spent 2 days in the ICU where extubation was done on the second day, with repeated, normal physical examinations, stable hemodynamics, and normal FHR. Having a stable condition, the patient was transferred to the high care unit with pregnancy still sustained.

Discussion

The main principle of non-obstetric surgery is ensuring maternal and fetal safety by preserving uterine perfusion and embryonic oxygenation, regulate uterine contraction, and avoiding preterm birth. According to The American College of Obstetrician and Gynecologists, non-elective surgery must not be contraindicated or delayed in pregnant woman; especially if not having it will cause further harm to the pregnant woman or fetus. Non-elective surgery is best performed in the second trimester, while elective surgery must be delayed until after delivery. The uterus is lower in the abdomen, the patient is thought to be at the lowest risk for premature delivery, and main embryonic development is finished by the eighth week [5]. A 'safe' timing for surgery on a pregnant patient is mid-pregnancy or the second trimester. Organogenesis occurs during the first trimester and may be impaired by various substances or stimuli connected to anesthesia and surger. Also there is the risks of spontaneous abortion. Adnexal or pelvic surgery may harm the corpus luteum, which could have negative effects on the pregnancy during the first 10 weeks of gestation when the placenta depends on it to maintain the

pregnancy. Meanwhile, the third trimester may complicate the surgery since there is a large gravid uterus and higher risk of preterm delivery [6].

In this case series, all the surgery done was based on specific indication and on the second trimester. The first two cases were a giant suspected malignant ovarian mass and an ovarian cyst, both increasing in size, and each operation was done in the early second trimester. Large ovarian mass was rare in pregnancy and could cause complications such ass torsion, rupture, infection, or malpresentation of the fetus. Hence, the surgery can be done regardless of the gestational age if acute symptoms were present [7]. The third one detailed a cervical incompetency case where the mother has a history of repeated preterm delivery, thus cerclage is indicated since it could prevent preterm birth and subsequent perinatal death risk [8]. The fourth case was regarding a parietal mengioma that was operated in the late second trimester. The patient was experiencing severe symptoms from the condition and as such, delayed could cause premature termination of pregnancy since pregnancy could accelerate tumor progression and mask other diagnosis [9].

The primary obstetrician should be notified of any non-obstetric surgery planned for a pregnant woman. Every case in this report includes collaboration between the surgeon and obstetrician in the cases where both were separate parties. It is important to take account of the fetal safety during said procedures, also to anticipate sudden termination of pregnancy. The American College of Obstetrician and Gynecologists also recommends that it is imperative to give corticosteroid for the fetus since there is a possibility of preterm delivery during non-obstetric operation, specifically for premature gestational age. Patients should also be closely observed for signs of labor, and screened beforehand for the risks of venous thromboembolism [10]. Only one patient was given steroid for lung maturation in this case, which is the fourth patient who had undergoes craniotomy and tumor excision, since there is a high probability of pregnancy termination. The first three patients did not receive steroid because of a lower probability for preterm delivery.

It is crucial to avoid hypotension, hypertension and hypoxia for the health of the mother and baby simultaneously. All anesthetics may have sedative effects at lower dosages than in individuals who are not pregnant, which lowers the minimum alveolar concentration needs. Preoxygenation 100% oxygen for 5 minutes should come before rapid-sequence intravenous induction and intubation with efficient cricoid pressure. Laryngeal mask airways, on the other hand, have been utilized to ventilate patients successfully and safely in the reverse Trendelenburg position for brief periods of time in cases of unsuccessful intubation. Positioning under anesthesia should be done gently since changes in the posture of the mother can have significant implications on her hemodynamics [11]. All patients who undergoes general anesthesia receive adequate pre-oxygenation with 100% oxygenation beforehand, and intubation was done with a sleep apnea technique which was successful on the first try. Induction was done with a mixture of propofol, fentanyl, and rocuronium. Most of the usual anesthetics such as barbiturates, opioids, muscle relaxants, and local anesthetics is considered safe to be used in pregnancy and did not have teratogenic effect [10].

Positioning plays an important role in non-obstetric surgery. Since inferior vena cava compression is documented in pregnant patient from early second trimester, left uterine displacement (LUD) is recommended especially starting from 18 weeks of gestational age. Applying 15 degrees of LUD could prevent aorta's compression and thus, increase venous return toward the heart. However, none of the cases reported any

adjustment for positioning aside from supination. Fetal monitoring is important as it can help positioning, to alert of any sign of aortocaval compression [12]. Furthermore, end-tidal carbon dioxide levels should be kept within the limits and positive pressure ventilation should be utilized with caution. End-tidal CO_2 ($ETCO_2$) can be utilized to direct ventilation in pregnant patients because there is a high association between $ETCO_2$ and $PaCO_2$ in pregnancy. Since most serious anesthetic problems caused by hypoventilation or airway obstruction happen during emergence, extubation, or recovery, continuous monitoring of the airway and respiratory system is necessary [11]. Patients described in these cases did not have any abnormality regarding extubation where consciousness is quickly regained and normal physical examination.

Early in the first trimester, mucosal friability and edema will appear, with the third trimester being the most prominent. Pregnant patients are more at risk for problematic intubation and mask ventilation, so it is recommended to have a smaller tracheal tube and video laryngoscope on hand [13]. Changes in first-trimester respiratory happened for the entire pregnancy. To satisfy the needs of the developing fetus, maternal oxygen intake continuously rises. Increased tidal volumes, which are primarily responsible for the increase in minute ventilation, result in compensated respiratory alkalosis with a pH that is almost 7.44. The goal $PETCO_2$ during general anesthesia or blood gas analysis should be set to 3.7-4.3 kPa. During episodes of apnea, a 20% reduction in functional residual capacity can result in rapid desaturation, frequently occurring in under three minutes. Prior to general anesthesia induction, it is crucial to give the body enough time to preoxygenate [14].

By the end of the second trimester, cardiac output has increased by 50% over baseline, which puts individuals with congenital heart defects, heart failure, or valve disease at risk for dysrhythmia or progressive heart failure. To evaluate heart function during pregnancy, a transthoracic echocardiogram may be useful. Drug metabolism and elimination could be altered by renal changes, as well as fluid and electrolyte balance. The glomerular filtration rate and renal blood flow both rise by 65% and 75% above baseline during of pregnancy. Whereas serum creatinine decreases after the first trimester, so elevated creatinine levels should be evaluated and can change drug dosage. Pregnant patients are more at risk for regurgitation and aspiration since there is a decrease of the lower esophageal sphincter tone, worsened by the mechanical displacement of the stomach caused by the gravid uterus. Rapid sequence induction with prophylaxis for aspiration should be taken into account if the patient have a full stomach, nausea/ vomiting, pain, infection, or gastro esophageal reflux; also those who haven't fasted enough or have a history of hiatal hernia [14].

The choice of general or regional anesthesia for a non-obstetric operation depends on the patient's needs and history. Although regional anesthetic provides the benefits of efficiently lowering pain and having little to no effect on the fetal heart rate variability compared to general anesthesia, not all surgical procedures can be performed under it. It is recommended to prioritize rapid sequence induction if general anesthesia must be done. Even though inhalation anesthesia is still the most widely used form of general anesthesia for urgent non-obstetric or open fetal surgery, spinal anesthesia is still the primary way of anesthetic management for pregnancy [6]. The first and second case of gynecologic surgery utilized a combination of general anesthesia and an epidural. The blended method has been found to reducing immune and stress response, it has also been reported to improve postoperative pain control and decreasing analgetic needs [15]. The third case involving cerclage surgery only

uses regional anesthesia or subarachnoid block, in account of short surgery duration and its less invasive technique compared to other technique. The fourth case which is the craniotomy requires general anesthesia with an added target-controlled infusion (TCI) with propofol. The use of TCI propofol resulted in faster induction, better hemodynamic control during surgery, lower apnea incidence, and faster recovery, all while also having a neuroprotective effect without the risk of increasing intracranial pressure [16].

Pregnant women who underwent invasive, non-obstetric treatments that required anesthesia delivered more preterm babies. Women giving birth after interventions performed under GA (either required by the intervention or selected by the anesthetist) had a greater incidence of low birth weight. The association between general anesthetic and a higher rate of low birth weight neonates matches earlier findings, which is why it is advised to use regional anesthesia whenever possible. Types of surgery didn't cause much difference with fetal outcome, whereas the results of extra-abdominal and abdominal surgery are same [17]. In terms of the total bad outcome, which includes preterm labor, premature birth, and fetal loss, non-obstetric surgery conducted during pregnancy at a gestational age of over 20 weeks was linked to a higher incidence of an adverse event than surgery performed before 20 weeks. Longer anesthesia and surgery times are associated with worse outcomes in fetal loss rate [18,19].

Before and after the operation, the fetal heart rate must be assessed using Doppler USG. Electronic fetal heart rate and contraction monitoring should be done if the fetus is deemed viable to evaluate the fetus' health and whether there are contractions or not. To enable positioning or oxygenation intervention, intraoperative fetal monitoring may be explored for previable fetuses. However, fetal monitoring itself should be individualized based on the gestational age, patient's risk factors, type of operation, and the resources available that needs a collaboration between surgeon, obstetrician, pediatrician, and nurses [10,20-21]. Intraoperative FHR monitoring could be performed by using cardiotocography and ultrasonography with a transesophageal echocardiography; however, USG is usually more preferred because of the availability, repeatability, and no radiation risk [21].

FHR tracing may be impacted by most anesthetics that cross the placenta. Reduced variability is frequently observed after beginning anesthesia or analgesia. Although perspectives on the best methods and timing for fetal monitoring vary, fetal monitoring can notify if the mother's positioning, oxygenation, or blood pressure needs to be improved [21,22]. The incidence of non-reassuring intraoperative FHR are closely associated with unstable maternal vital signs, and the risks of pathologic FHR pattern only happened in hemodinamically unstable or intraoperatively febrile patients. Anesthetics that cross the placenta can directly impact FHR patterns, or they can do so indirectly through changes in maternal hemodynamics brought on by anesthesia and surgery. Variations found in intraoperative FHR monitoring include temporary decrease in FHR baseline, variability, and tachycardia, the latter correlates with maternal fever [23,24]. FHR monitoring was done in all cases with stable FHR results and consequently, no termination of pregnancy was reported during these cases.

Conclusion

Non-obstetric surgery has overall risks of increased adverse pregnancy outcomes. Generally, pregnant woman who undergoes non-obstetric surgery have an increased risk of preterm delivery, low birth weight, and stillbirth compared to pregnant woman with no non-obstetric surgery. With the increasing number of non-obstetric operation done during pregnancy, it is imperative to have an

adequate anesthesia care in ensuring maternal and fetal safety. Various aspects needed to be carefully monitored from the timing of the operation in relation to gestational age, type of anesthesia given, patient positioning and duration of said surgery. The safest period for surgery is during the second trimester with lower adverse outcome, while the choice general versus regional anesthesia itself depends on the patient's needs and history. The four cases described in this case series demonstrate how various anesthesia techniques could be utilized for different type of non-obstetric surgeries and diverse medical history to achieve the best prognosis for the patient and the fetus.

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Authors' Contribution

All authors contributed to data collection, article preparation, and manuscript revision and have collectively assumed responsibility for all aspects of this work.

Conflict of Interest

The authors declare that there is no conflict of interest regarding to this study.

Data Availability

The article contains all the necessary data to support the results and no supplementary source data is needed.

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