Case Report

Anesthetic Management of Laparoscopic Surgery on a Pediatric Patient: Case Report

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Abstract

Inguinal hernia is an opening on myofascial oblique muscle and transversal muscle or the failure of Nuck canal or processus vaginalis during the gestation week which allows herniation of intra-abdominal or extraperitoneal organ. A 5-year-old child was diagnosed with a left lateral inguinal hernia. The results of the inguinal ultrasound showed movement and movement of the intestines in the left inguinal area through a defect measuring approximately 2.96 centimeters. The patient was planned to undergo laparoscopic high ligation hernia. Laparoscopic technique in adult commonly applied with special consideration. However, the practice in pediatric patient could be more challenging for anesthesiologist. Although laparoscopic surgery is less invasive it could cause more stress due to the pressure of the intra-abdominal pneumoperitoneum by CO_2 that is done during the procedure, which then causes hypercapnea due to the absorption of CO_2, the decrease of tidal volume, and the decrease of end-tidal volume. Considering pediatric's different physiology compared to adult and the risks of laparoscopic surgery, special anesthesia management should be conducted.

Keywords : inguinal hernia, laparoscopy, pediatric anesthesia
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INTRODUCTION

Inguinal hernia is an opening on myofascial oblique muscle and transversal muscle or the failure of Nuck canal or processus vaginalis during the gestation week which allows herniation of intra-abdominal or extraperitoneal organ. Most of the cases in pediatric inguinal hernia is caused by anatomy abnormality. Male babies are five times more likely to get a hernia. The risk is also higher in premature babies (Olesen et al., 2019). Inguinal hernias in pediatrics can be repaired using open surgery technique or laparoscopic technique (Stabilini et al., 2023).

Although a large number of studies show that the level of stress caused by laparoscopic surgery is less than conventional laparotomy, pneumoperitoneum with CO2 during laparoscopy can trigger stress in the child's body (Lai et al., 2020; Maharani et al., 2021). Therefor, in this case report, the author would like to report a case of lateral inguinal hernia in a 5-year-old child who then underwent laparoscopic high ligation herniotomy surgery. The author then conducted a literature study on anesthesia management in similar cases.

CASE REPORT

A 5-year-old girl (13.5 kg) complained of a lump in the upper thigh and left genital area. The patient's family said that this lump appeared 2 years ago. The lump will only appear when the patient is crying, playing and running around, or tired and will then disappear by itself when the patient has stopped doing these things. However, in the last week, this lump appeared again because the patient was playing with his friends and did not disappear by itself as usual. Complaints of diarrhea, difficulty defecating, nausea and vomiting were dismissed. A history of other diseases was denied, and a family history of the same disease was denied.

Pre-operative physical examination shows normal vital signs. Abdomen examination shows soft abdomen on palpation, no tenderness, bowel sounds within normal limits. On examination of the genital area, a painless lump was found on the left labia majora, resulting in asymmetrical right and left labia majora (Figure 1).

Preoperative supporting examinations carried out include a complete blood count, blood gas analysis, AP chest x-ray and inguinal ultrasound. A complete blood count was found to be within normal limits. Blood gas analysis showed results within normal limits. On chest x-ray, thorax and pulmo there are no abnormalities. On inguinal ultrasound, it was found that there was a movement of the intestine in the left inguinal area through a defect measuring approximately 2.96 centimeters (Figure 2).

The content consist of description of the case including the symptoms, signs, diagnosis, treatment, and follow-up of an individual patient. Case reports may contain a demographic profile of the patient, but usually describe an unusual or novel occurrence.

Figure 1. Preoperative photo of a lump on the left labia majora.

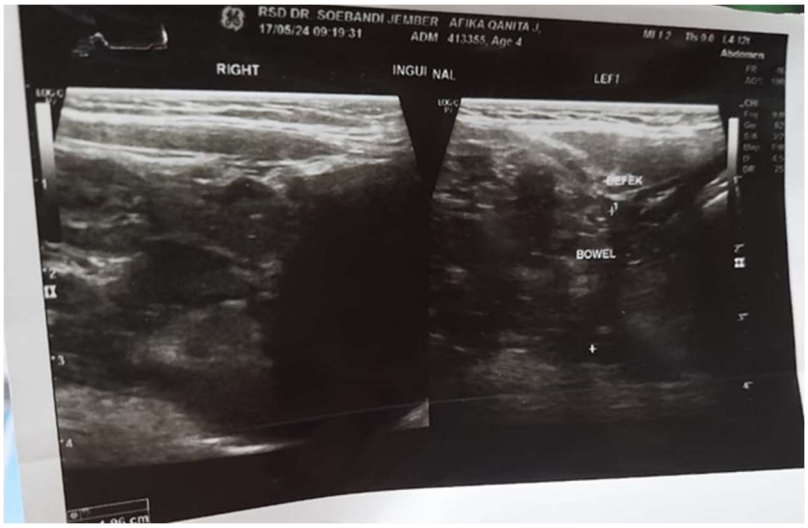

Figure 2. Pre-operative inguinal ultrasonography. Preoperative photo of a lump on the left labia majora.

Diagnosis of the patient is left lateral inguinal hernia with ASA physical status of 1 without complications. The patient was planned to undergo laparoscopic high ligation herniotomy surgery. Before surgery, informed consent was submitted to both parents of the patient and fasting was done for 6 hours before surgery. The patient was positioned

supine and preoxygenated for 5 minutes with 100% O_2 via a positive pressure mask. The patient was given premedication midazolam 0.5 mg by titrating 3 times for a total of 1.5 mg intravenously by evaluating the patient's anxiety level before induction. The patient was induced with anesthesia by administering a combination of thiopental 40 mg IV, fentanyl 50 mcg IV, and atracurium 10 mg IV. Maintenance of anesthesia by administering sevoflurane (2 vol%) ratio of 50% oxygen: 50% air, with FiO_2 60% at 2 litre per minute.

Monitoring during surgery is carried out by evaluating blood pressure (systolic/diastolic), pulse, respiratory rate and oxygen saturation which are presented in Figure 3. The patient receives fluid infusion of 500 mL D5% ½ NS. During the operation, through the laparoscopic camera it was found that lateral inguinal hernias were on both sides, so a high ligation herniotomy was performed on both. Laparoscopy using the transabdominal preperitoneal procedure (TAPP) technique was not successful due to the the surgeon's difficulty to identify the hernia sac, thus it was difficult to continue the procedure, it was then carried out using an open repair technique. The operation lasted 4 hours, with the change from laparoscopic technique to open surgery at the 2nd hour. The ventilation settings used during the surgery was frequency of 15 times, PEEP 5, FiO_2 40%, minute volume 2.7 liter per minute. During the operation procedure, pneumoperitoneum is created and patient's position is changed to head-down, thus the setting of ventilation need to be adjusted for adequate ventilation by end tidal monitoring system. Peak pressure limit in titration of pressure control, rate, time inspiration, and $etCO_2$ are the adjustment that need to be adjusted during observation.

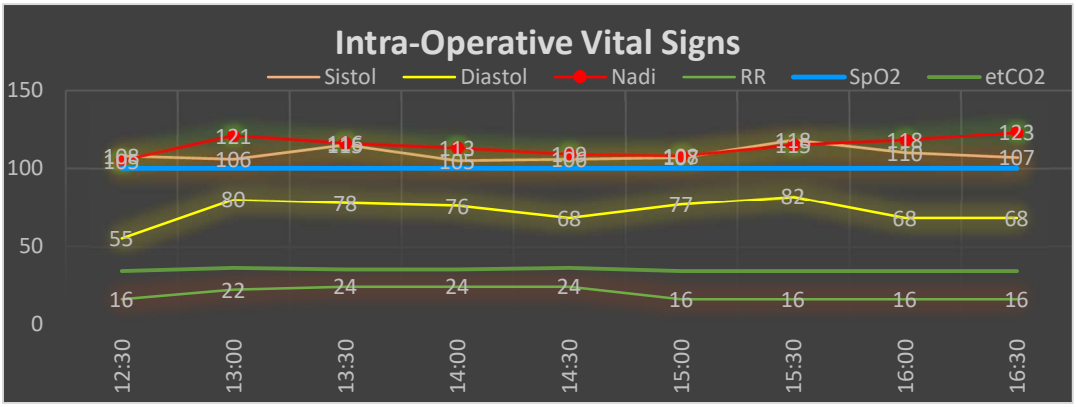

Figure 3. Intra-operative vital signs. Preoperative photo of a lump on the left labia majora.

After surgery, the patient was taken to a regular pediatric room. Postoperative monitoring is carried out by re-evaluating the patient's vital signs, complaints and pain scale at 06.00 the next day. The patient's vital signs at the time of examination were within normal limits. At the 12-hour post-operative examination (Figure 4), the patient's pain evaluation was carried out with the Wong Baker Scale showing a scale of 2. The evaluation was

carried out again 3 hours later, the patient's pain evaluation with the Wong Baker Scale showed a scale of 2 without any other complaints, so then the patient was sent home. The patient was sent home with paracetamol syrup which was consumed three times a day, 150 mg.

Figure 4. Twelve hours post surgery.

DISCUSSION

Inguinal hernia is an opening on myofascial oblique muscle and transversal muscle or the failure of Nuck canal or processus vaginalis during the gestation week which allows herniation of intra-abdominal or extraperitoneal organ. Inguinal hernias can be divided into indirect, direct and femoral based on their location. Inguinal hernias can be divided into congenital and acquired. In adults, most hernias are acquired hernias. Patients with a family history of hernias have a four times greater risk of developing a hernia compared to patients without a family history (Olesen et al., 2019).

The cause of hernias in pediatrics or children is caused by an anatomical abnormality. About 5 out of 100 babies are born with an inguinal hernia. Baby boys are five times more likely to get a hernia. The risk is also higher in babies born too early (premature babies). In men, hernias can be caused by failure to close the processus vaginalis which should close at 40 weeks' gestation. In women, hernias can be caused by failure to close the Nuck canal. Based on this anatomy, inguinal hernias are divided into direct and indirect. Indirect if the abdominal organs herniate through the Nuck canal or processus vaginalis and indirect if it does not pass through these canals and is caused by weakening of the

fascia. Patients with inguinal hernias will generally present with complaints of a lump or pain in the groin. Patients will usually describe that the lump gets bigger when the patient coughs or does activities. In pediatric patients such as in this case report, the patient's family said that the lump would appear if the patient was crying or playing (Olesen et al., 2019).

Inguinal hernias in pediatrics can be repaired using open techniques (open repair) or laparoscopic techniques (Stabilini et al., 2023). Open inguinal hernia repair involves transection and ligation of the hernia sac; in men, the patent processus vaginalis must first be separated from the testicular vessels and vas deferens. Laparoscopic inguinal hernia repair involves insertion of a camera port and closure of the open vaginal process intra- or extra-corporeally. The intra-corporeal method uses intra-corporeal sutures with the help of three ports, while the extra-corporeal closure uses sutures that are passed through two needles, and the knot is tied manually outside the patient without the need for additional ports (Maat et al., 2021).

As a minimally invasive technique, laparoscopic surgery (LO) has been widely used in the surgical field due to its advantages such as less incision bleeding, less trauma, and rapid postoperative recovery. Although a large number of studies show that the stress level caused by laparoscopic surgery is less than conventional laparotomy, this is due to the pressure of the intra-abdominal pneumoperitoneum by CO_2, which then causes hypercapnea due to the absorption of CO_2. Then, when the pressure drops, reperfusion injury and ischemia can induce the body's stress response (Bhattarai & Hamal, 2021). Pneumoperitoneum during laparoscopy can cause disharmony in blood perfusion ventilation, increase IAP, decrease FRC, and easily cause asthma (Maharani et al., 2021). Peritoneal carbon dioxide diffuses into the blood, and the partial pressure of carbon dioxide ($PaCO_2$) of arterial blood increases, which can effectively maintain respiratory function during hypercapnic respiratory acidosis. This can cause changes in endocrine metabolism, triggering an inflammatory immune response (Lai et al., 2020). A study shows that children's response to stress is different from adults due to developmental imbalances in several body systems, especially during laparoscopic surgery. In pediatric laparoscopic surgery with the child positioned supine, diaphragm function increases, residual lung function capacity (FRC) decreases, and abdominal compliance decreases. At the same time, IAP increases, the diaphragm will be affected by gravity and intra-abdominal pressure, FRC decreases, tidal volume decreases, and minute ventilation decreases, which will affect the child's oxygen levels (Maharani et al., 2021). Due to that reason, intraperitoneal maximum pressure and ventilation setting should be properly adjusted. Normal intra-abdominal pressure in children should be in the range of 5-7 mmHg. According to that research, intraperitoneal pressure for laparoscopy procedure of 6-8 mmHG is considered safe with minimal physiological changes in children aged 1-5 years-old (Joon et al., 2024).

Pre-medication anesthesia for children is crucial. Children tend to be very anxious before the surgery, and studies show that extremely anxious children are likely to develop more adverse outcome. Inhalation pre-medication and the avoidance of using needle is preferred in children, thus inhaled dexmedetomidine, ketamine, or midazolam is usually conducted. Induction technique in children should be carefully considerated. The combination of intravenous and inhalation is commonly used. Inhalation is used in infants and children with difficult venous access. Sevoflurane induction is considered safe and quick in children, thus is commonly used. Intravenous induction is considered fast, and less likely to induce respiratory complications rather than inhalation induction. Propofol is the most used drugs, followed by thiopental. Propofol has a very painful administration process, thus thiopental is commonly used in children nowadays, considering it also has a longer residual sedation (Dave, 2019).

Research by Zheng *et al* (2021) with a large amount of data shows that general anesthesia cannot effectively and completely prevent stress reactions caused by pneumoperitoneum and stimulation during surgery, which will then manifest with increased pulse rate, blood pressure, and others. So, to prevent this reaction, generally the dose of narcotic analgesics is increased to deepen the anesthesia. This increase in dose can increase the workload of the liver and kidney metabolism in children, so that the recovery process will take longer. For this reason, another study conducted by Yu *et al* (2020) provided general anesthesia combined with epidural block in laparoscopic surgery in children. With this technique, intraoperative hemodynamics, changes in stress hormones, and changes in immunity and anti-cytokines are all altered compared with general anesthesia alone. But until this day, there is no specific region of anesthesia used in children undergoing laparoscopic surgery and a standard pediatric anesthesia guideline is still commonly used (Spinelli et al., 2016).

CONCLUSION

Inguinal hernia is an opening on myofascial oblique muscle and transversal muscle or the failure of Nuck canal or processus vaginalis during the gestation week which allows herniation of intra-abdominal or extraperitoneal organ. A technique that is currently being developed because it is minimally invasive is the laparoscopic method. In this case, a 5-year-old girl was reported with an inguinal hernia who then underwent laparoscopic high ligation herniotomy surgery. A literature study was then carried out to analyze anesthesia management in pediatrics who were planning to undergo laparoscopic procedures. There is no specific anesthesia region for laparoscopic procedure in pediatric, thus a standard anesthesia guideline is used. Ventilation adjustment is considered more important in laparoscopic surgery to maintain a physiological condition in children, avoiding the adverse effects caused by pneumoperitoneum either it is the increased of intra-peritoneal pressure or hypercapnic condition.

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