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Case Report

Anaesthesia challenges in preterm neonate physiology with abdominal emergency: A case based literature review

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ABSTRACT

Children are considered as a dynamic group of population for providing anaesthesia, since their physiological variations are presumed to be challenging. As such, special attention should be given to the use of anesthetic drugs in the neonate population especially preterm. Good patient care requires a thorough awareness of the pharmacologic, physiologic and psychological variations between children and adults while giving general anesthetic medicines to them. This article discusses the essential principles and a complete literature review on pediatric anesthesia needed before providing anaesthesia to neonate population.

1. Introduction

Neonatal intestinal obstruction occurs in 1 in 1500 live births and considered as emergency condition requiring prompt surgical intervention.[1]

New born emergency surgeries constitutes of tracheoesophageal fistula, congenital diagrammatic hernia, gastroschisis, omphalocele, cleft lip and palate. Among these 50% are gastrointestinal anomalies. Obstruction in the newborn was almost always fatal in the past.[2] With the advent of significant advances in neonatal surgery there is improved survival of newborn with congenital malformation.

The neonate's medical and surgical team must collaborate to determine the best time for the procedure. There is a more than 10-fold increase in perioperative morbidity and mortality in neonates than in other older children.[2]

In this case report, we describe challenges face in a preterm neonate who underwent surgery for ileus obstruction and the relevant literature review for guidance used for optimal clinical management.

2. Case Report

A preterm female child delivered via spontaneous vaginal delivery at 28 weeks with maternal indication of oligohydramnios. APGAR score was 6 at time of birth, mild respiratory distress seen. In the first ten minutes of life, gastric distension was noted. Antenatal Maternal scans showed Single live intrauterine fetus, cephalic presentation with weight 1328 g, dilated stomach bubble and proximal bowel loops. Differential diagnosis of jejunal atresia, malrotation, colonic atresia duplication, sepsis, meconium ileus were made and planned for urgent exploratory laparotomy.

Preoperative assessment included detailed evaluation of the neonate and to rule out other congenital anomalies. A 8F nasogastric tube was inserted and secured after confirming the position. The child was intubated in NICU with 3.00 mm size uncuffed ET tube and fixed at level of 6cms and proceeded for exploratory laparotomy.

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The Child was shifted to operation theatre complex in transport incubator with a well-organized transport service aiming to provide clinical care at a higher standard. Intraoperative ventilation was continued with gentle positive pressure lung inflations with 20-25 cmH20 peak inspiratory pressure. Analgesia was provided with judicial opioids and paracetamol suppositories.

Intraoperative the surgeon found grossly dilated stomach, lads bands present between right lateral abdominal wall and small bowel. Diagnosis of Duodenal atresia type 1 was confirmed. Ladds band was cut, mesentry was widened by longitudinal incision over small bowel mesentry. Inversion appendicectomy and duodenostomy were done. Perioperative period was uneventful. Parenteral analgesics was given for analgesia. Antimicrobial prophylaxis were continued during postoperative period.

Post-operatively child shifted to NICU for mechanical ventilation.

On POD 3, child was extubated uneventful. The child was followed up for 6 months, no new complaints occurred and tolerated breast feeding.

3. Discussion

3.1. Embryology

Gaining knowledge of the embryology and genesis of the foregut, midgut and hindgut along with their corresponding derivatives will help to explain the complex vascularization and the mesenteries of the abdominal cavity.[3] This stage of duodenal atresia formation is associated with a recanalization process defect. Sepsis and associated problems such anastomotic leakage, apnea and electrolyte imbalance are particularly common in preterm newborns.

3.2. Evaluation

In neonates, intestinal obstruction can be classified as high or low depending on the number of dilated bowel loops present for diagnostic and assessment purposes.[3] Causes of high intestinal obstruction includes gastric atresia, duodenal atresia, duodenal stenosis, duodenal web, malrotation, jejunal atresia and stenosis. Causes of low intestinal obstruction includes small bowel like ileal atresia, meconium ileus and large bowel involvement like functional immaturity of the colon, Hirschsprung disease, colonic atresia, anorectal anomalies. High intestinal obstruction such as duodenal atresia, may directly undergo surgery without any additional imaging. Duodenal atresia have commonly vacterl association during assessment.[3,4]

3.3. Preoperative

Even a skilled anaesthesiologist finds difficulty in providing anaesthesia for preterm neonates, as there are only limited clinical guidelines for support as evidence.[5]

Physical examination of the infants is required to assess the stability and patency of the neonate's airway and gas exchange. The anesthesia provider must perform a careful assessment for signs or symptoms of cardiovascular abnormalities and stability.[6] Hydration status can be assessed by vital signs (heart rate, blood pressure), capillary refill and urine output. Any evidence of dehydration, should be given first importance before induction of anesthesia.[5] Finally, assessment for the safety of the current vascular access and associated infusions to prepare for difficult venous accessibility in the perioperative time.

Routinely not all the biochemical investigations are done in neonate and infant age group. Pre-operative assessment should consider review of the available laboratory studies that includes complete hemogram to assess the risk for anemia and platelet counts to look for evidence of consumptive coagulopathy.

The preterm clinical profile changes from older children because of dynamic physiologies and their response to pain for noxious stimulus.[7]The anaesthesia challenges faced includes prevention of the physiological stress from surgical stimulation and control of relative cardiovascular responses.[8]

3.4. Intraoperative

3.4.1. Respiratory System

Changes in pH, paCO2 and paO2 effectively control the respiratory process in both neonates and premature newborns. A newborn's hypoxic breathing regulation is not fully developed at birth and its oxygen receptors and their functions are still developing.[9]

Respiratory arrest (apnea) is a common occurrence in premature newborns, manifesting as irregular or regular breathing intervals. Phases of apnea may be caused by an obstruction, which is less common, or by a central issue (no physical exertion of breathing). However, if respiratory stoppage lasts longer than 30 seconds, it may result in bradycardia and a drop in blood O_2 partial pressure.

The breathing regulation of premature newborns and neonates are influenced by pulmonary compliance.[10]Compliance triggers breathing reflex via mechanoreceptors i.e. Hering -Breuer reflex. Overinflation of lungs will inhibit this reflex, thus interrupts the extension of expiratory phase. Therefore result in decrease of functional residual capacity that limits oxygen reserve during periods of apnoea and readily predisposes the neonate to atelectasis and hypoxemia.[11] Moreover, hypoxic and hypercapnic ventilatory drives are not well developed in neonates and infants.

Depending on the child's oxygenation level, PEEP is set to between 4 and 8 mbar. Higher levels are not normally tolerated by paediatric patients. And also, side effect of ventilating with PEEP is disruption of the cardiac and circulatory system.

3.4.2. Surfactant

Surfactant is a surface-active material composed of lecithin-based lipoprotein that is present on the surface of alveoli. It aids in alveolar stabilization and keeps them from collapsing during the expiration phase.[2] Because surfactant is not yet mature, premature babies have respiratory distress syndrome. Significant difficulties with pulmonary gas exchange are caused by inadequate surfactant. Within the first six to twelve hours after receiving surfactant treatment, the functional residual capacity of preterm neonates improves. To avoid a possible pneumothorax, it's critical to keep an eye on tidal volume and lower pressure.

3.4.3. Ventilation

The primary benefit of pressure control ventilation versus volume controlled modes (IPPV) in traditional partial rebreathing systems is the ability to use an uncuffed endotracheal tube for newborns and young children, allowing for a significant amount of leakage (> 20% of minute ventilation).[12] Furthermore, PCV makes sure that the healthy lung is not harmed by too much pressure and that the lungs fill more evenly.

Tidal volumes of 4–6 ml/kg are advised for premature newborns and 6–8 ml/kg for neonates. Capillary CO_2 and the resultant etc O_2 are two indicators of tidal volume settings and both should be in the range of 35 to 40 mm Hg.

3.4.4. Cardiovascular System

Compared to an adult heart, a newborn heart has fewer contractile components. The increased metabolic rate results in a comparatively high cardiac output.i.e., adults need 70 ml/kg/min, whereas newborns need 200 ml/kg/min. Infants frequently experience heart rate rhythm abnormalities, of which extraventricular systoles arise with the introduction of anesthesia.[13,14]In this instance, though, there shouldn't be any chance of hypoxemia or hypercapnia.

3.4.5. Blood Volume

Children's blood volume lowers as they get older.Even the smallest blood loss can result in anemia and a lack of volume. The hemoglobin value falls in preterm babies. faster and gets to lower points.

3.4.6. Temperature and Metabolism System

As children are more likely to have hypothermia both during and after surgery, one of the anesthesiologist's primary intraoperative tasks is to regulate the body temperature of these patients.[14]This is because thermal regulatory responses to hypothermia starts when body temperature deviates greatly from the usual i.e.35.5^{0}celcius, heat transferred from the core of the body to the periphery.

Adverse effects of hypothermia can lead to hypoxia, acidosis and hypoglycaemia.

Measures taken for maintaining constant body temperature in neonate includes use of heating pad, warm the operating theatre to between 26 and 30^{0}Celsius, limit the length of time that child is uncovered, use of warmer during preop phase, use prewarm and humidify breathing gas.[15] Transport newborns in an incubator is vital.

Neonates carries the majority risk for anesthesia related arrest in the perioperative time.[16] Most of the arrest are noted to occur at the time of anesthesia induction, clinically manifest as low spo2, bradycardia and hypotension preceding to detrimental event. The overall incidence of cardiac arrest in neonate and infant appear to be 1.4 in 10,000.The events are monitored and recorded by The Pediatric Perioperative Cardiac arrest Registry provides a useful database for assessing pediatric anesthetic risk and prevention.[17,18]

4. Conclusion

Anaesthetist should be encouraged to take a proactive approach in managing the "littlest of patients" during the perioperative period, especially in monitoring for physiology responses to prevent adverse incidents. In order to do this more effectivel, anesthetist must have an understanding of the physiologic, pharmacologic and psychological differences between children and adults with regard to anesthesia and physiology.

5. Patient Consent

Written informed consent was obtained from parents for the publication of this case report and all associated images.

6. Conflict of Interest

None.

7. Source of Funding

None.

References

1. Wyllie R, , . Intestinal atresia, stenosis and malrotation. In: Kliegman R, III JG, editors. Nelson Textbook of Pediatrics. vol. 2. Philadelphia: Elsevier; 2008. p. 1558–62.
2. Ogundoyin OO, Afolabi AO, Ogunlana DI, Lawal TA, Yifieyeh AC. Pattern and outcome of childhood intestinal obstruction at a tertiary hospital in Nigeria. *Afr Health Sci*. 2009;9(3):170–3.
3. Saha A, Ali MB, Biswas SK, Sharif HM. Neonatal intestinal obstruction : patterns, problems and outcome. *Bangladesh Med J Khulna*. 2013;45:1–2.
4. Verma A, Rattan KM, Yadav R. Neonatal Intestinal Obstruction: A 15 Year Experience in a Tertiary Care Hospital. *J Clin Diagn Res*. 2016;10(2):10–3.
5. Ademuyiwa AO, Sowande OA, Ijaduola TK, Adejuyigbe O. Determinants of mortality in neonatal intestinal obstruction in Ile Ife, Nigeria. *Afr J Paediatr Surg*. 2009;6(1):11–3.

6. American Academy of Pediatrics. Evaluation and preparation of pediatric patients undergoing anesthesia. *Pediatrics*. 1996;98(3):508–8.
7. Anand KJS, Hickey PR. Pain and its effects in the human neonate and fetus. *N Engl J Med*. 1987;317(21):1321–9.
8. Current World Literature. *Curr Opin Anaesthesiol*. 2002;15(5):583–603.
9. Polgar G, Weng TR. The functional development of the respiratory system from the period of gestation to adulthood. *Am Rev Respir Dis*. 1979;120(3):625–95.
10. Sandberg K, Sjöqvist BA, Hjalmarson O, Olsson T. Analysis of alveolar ventilation in the newborn. *Arch Dis Child*. 1984;59(6):542–7.
11. Mccoy KS, Castile RG, Allen ED, Filbrun DA, Flucke RL, Yishay EB. Functional residual capacity (FRC) measurements by plethysmography and helium dilution in normal infants. *Pediatr Pulmonol*. 1995;19(5):282–90.
12. Patel R, Lenczyk M, Hannallah RS, Mcgill WA. Age and the onset of desaturation in apnoeic children. *Can J Anaesth*. 1994;41(9):771–4.
13. Nassar R, Reedy MC, Anderson PA. Developmental changes in the ultrastructure and sarcomere shortening of the isolated rabbit ventricular myocyte. *Circ Res*. 1987;61(3):465–83.
14. Ohlson KB, Lindahl SG, Cannon B, Nedergaard J. Thermogenesis inhibition in brown adipocytes is a specific property of volatile anesthetics. *Anesthesiology*. 2003;98(2):437–48.
15. Soll RF. Heat loss prevention in neonates. *J Perinatol*. 2008;28(1):57–9.
16. Bhananker SM, Ramamoorthy C, Geiduschek JM, Posner KL, Domino KB, Haberkern CM, et al. Anesthesia-related cardiac arrest in children: update from the Pediatric Perioperative Cardiac Arrest Registry. *Anesth Analg*. 2007;105(2):344–50.
17. Flick RP, Sprung J, Harrison TE, Gleich SJ, Schroeder DR, Hanson AC, et al. Perioperative cardiac arrests in children between 1988 and 2005 at a tertiary referral center: a study of 92,881 patients. *Anesthesiology*. 2007;106(2):226–37.
18. Keenan RL, Boyan CP. Cardiac arrest due to anesthesia. A study of incidence and causes. *JAMA*. 1985;253(16):2373–7.

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