CASE REPORT

The effects of high Fresh Gas Flow in treatment of Pediatric Severe Hypercapnia During General Anesthesia: A Case Report

Alireza Ahmadi[1], Abbas Ahmadi[1]*

Hypercapnia is a frequent event but severe hypercapnia is a harmful complication of general anesthesia. A 6 month-old Iranian baby boy who had an appendicitis under general anesthesia exhibited severe hypercapnia during surgery. Arterial blood gas revealed a PCO2 of 95mmHg. Troubleshooting immediately were taken, but the level of CO2 did not decline. Under that situation by elevating fresh gas flow to twice or three times, the hypercapnia decreased and by adjusting FGF we could reach the best end tidal PCO2 and paco2. This report will increase our experience about this phenomenon during anesthesia, how we can change the circle circuit of anesthesia machine concordant to decreasing dead space formation and hypercapnia.

Keywords: hypercapnia; high fresh gas flow; general anesthesiology

Pediatric maturation process especially respiratory system in not complete and effective compared to adults. In pediatrics, hypercapnia and hypoxia can shift the oxyhemoglobin curve right ward and cause subsequent injury to immature lung and brain [5]. In pediatric hypercapnia has some harmful effects like periventricular white matter injury, retinopathy and intraventricular hemorrhage [2]. In Van Kaam study in Europe, hypercapnia is a frequent event in pediatric patients [1]. Now we report a 6-month boy infant with severe hypercapnia.

Case Description

A 6-month old boy infant with 9-kilogram weight candidate for appendectomy born at term by vaginal delivery and had no past medical history. The induction of anesthesia was with 6 mg/kg thiopental sufentanyl 0.2µg/kg and paralyzed with atracurium 0.5mg/kg and intubated with a 4 sized cuffed endotracheal tube. Ventilation was started with a pressure-limited, time-cycled mode with a pediatric circuit, with a respiratory rate of 20min and maximum pressure (Pmax) of 15cm H2O. Tidal volume was 68mL. End-tidal carbon dioxide (PETCO2) was 44mmHg 5 minute after induction. Electrocardiogram, Noninvasive blood pressure, PETCO2, pulse oximetry, and body temperature were monitored during the operation. The maintenance of anesthesia was with isoflurane and fentanyl.

During anesthesia, PETCO2 elevated gradually from 44mmHg to 60mmHg and up to 95mmHg in 60 minutes. No changing in body temperature and other parameters was seen.

All measures were taken to correct and decrease it. The CO2 absorber had been recently changed, no sign of change in color and humidity was there but replaced. The endotracheal tube depth was checked and was normal. Elevation of respiratory rate or Pmax didn't change the PETCO2. Other options like leaks of circuit or neuromuscular blockers were checked and were normal, but PETCO2 was still high.

During these measures by elevating FGF three times the PETCO2 surprisingly decreased gradually. The operation was finished. Arterial blood gas analysis during surgery showed respiratory acidosis (Table 1). The next arterial blood gas analysis at the end of surgery was near normal.

Table 1- Artery blood gas at the end of the surgery

PH	PCO2	PAO2	BD
7.11	96 mmHg	152 mmHg	−9.1

Discussion

In this patient we had no positive preexisting disorder or metabolic malfunction. Pediatrics are more likely to develop hypoxia, hypercapnia and other metabolic abnormalities due to physiologic age-related immaturities like respiratory or circulatory systems. In our patient we can predict two mechanisms of hypercapnia, first load of CO2 production and second any problem in evacuation of CO2. We evaluated any preexisting disease or other aspects like hyper metabolic state like malignant hyperthermia, or respiratory failure. Body temperature was normal, no sign of rigidity was detected. The room temperature was near 31 centigrade. The circle system was standard pediatric circle system and no leak or malfunction of anesthesia machine were found.

From the [1]Department of Anesthesiology, Imam Reza Anesthesiology Center, Kermanshah University of Medical Sciences, Kermanshah, Iran.

Received: 28 November 2016, Revised: 20 December 2016, Accepted: 2 January 2017

The authors declare no conflicts of interest.

*Corresponding author: Abbas ahmadi, MD. Imam Reza Anesthesiology Center, Kermanshah University of Medical Sciences, Kermanshah, Iran. E-mail: abbasahmadi27@yahoo.com

Cone Heat and moisture filter (HEM) were not between Y-piece outlet and endotracheal tube [3].

Control of hypercapnia in general anesthesia is one of the important measures to decrease mortality and morbidities [4]. In pediatrics, hypercapnia and hypoxia can shift the oxyhemoglobin curve right ward and cause subsequent injury to immature lung and brain [5].

Many hypercapnia reported cases were due to respiratory disorders and anesthesia related defects [6-7].

Severe hypercapnia is not a rare phenomenon during general anesthesia specially in pediatric patients. It has several side effects and by preventing dead space volume in circle system we can prevent fatal events or any morbidities in neonate and infants [8].

Conclusion

Pediatric patients are vulnerable rank of patients that need special attention during anesthesia for their physiologic characteristics particularly respiratory physiology. The common causative factor for hypercapnia is circle circuit dead space formation after preexisting disease. An increase in PACO2 can be decreased by increasing FFG and this helped us in our patient.

References

1. van Kaam AH, De Jaegere AP, Rimensberger PC, Neovent Study Group. Incidence of hypo- and hyper-capnia in a cross-sectional European cohort of ventilated newborn infants. Arch Dis Child Fetal Neonatal Ed. 2013; 98:F323-6.
2. Pray-Roberts C, Smith WDA, Nunn JF. Accident severe hypercapnia during anesthesia-A case report and review of some physiological effect. Brit J Anaesth. 1967; 39:257-65.
3. Karlin A, Umeh U, Girshin M. Hypercapnia and tachycardia in a 2-year old. Paediatr Anaesth. 2009; 19(6):629-30.
4. Hickling KG, Henderson SJ, Jackson R. Low mortality associated with low volume pressure limited ventilation with permissive hypercapnia in severe adult respiratory distress syndrome. Intensive Care Med. 1990; 16(6):372–7.
5. Jankov RP, Tanswell AK. Hypercapnia and the neonate. Acta Paediatr. 2008; 97(11):1502-9.
6. Urwin L, Murphy R, Robertson C, Pollok A. A case of extreme hypercapnia: implications for the prehospital and accident and emergency department management of acutely dyspnoeic patients. Emerg Med J. 2004; 21(1):119-20.
7. Potkin RT, Swenson ER. Resuscitation from severe acute hypercapnia. Determinants of tolerance and survival. Chest. 1992;102(6):1742-5.
8. Wei K, Xu H, Liao W, Zhang Ch, Yao W. A newborn tolerated severe hypercapnia during general anesthesia: a case report. J Med Case Rep. 2015; 9: 196.