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Comparative use of inhaled anesthetics in neonates operated for necrotizing enterocolitis

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Keypoints

Multicomponent anesthesia with the use of sevoflurane at the stages of induction and basic anesthesia provides adequate protection for newborns during surgical interventions for necrotic enterocolitis.

Abstract

Introduction

Multicomponent anesthesia with inhaled components is the most common type of anesthesia in neonatal anesthesiology. Among modern inhaled anesthetics, the closest to the requirements is sevoflurane. The objective of the study is to improve the anesthesia care for newborns operated on for necrotic enterocolitis by comparing different methods of anesthesia with an inhaled component.

Material and Methods

To optimize the anesthetic benefits, we studied and carried out a comparative analysis of two options for inhalation anesthesia during surgical interventions for necrotic enterocolitis. The study included 67 newborns operated on for necrotic enterocolitis. Patients were divided into 2 groups depending on the applied inhalation anesthetic: I A (n = 42) group anesthesia was performed with halothane, I B (n = 25) group with sevoflurane.

Results

Many of the positive properties of sevoflurane listed above make it optimal for multicomponent anesthesia in newborns with necrotic enterocolitis.

Conclusion

Multicomponent anesthesia with the use of sevoflurane at the stages of induction and basic anesthesia provides adequate protection for newborns during surgical interventions for necrotic enterocolitis.

Keywords

Newborn, necrotic enterocolitis, sevoflurane

Introduction and aim of the study

Multicomponent anesthesia with inhaled components is the most common type of anesthesia in neonatal anesthesiology. The introduction of narcotic substances through the respiratory tract along with oxygen is characterized by several advantages over the non-inhalation method (1, 2, 3, 4). The main advantages include good controllability of anesthesia and maintaining the desired concentration of the drug in the blood. The main advantage of inhalation anesthesia is its simplicity. The choice of drugs for optimal inhalation anesthesia methods, which did not have an irritating effect on the respiratory tract, the presence of a pleasant smell, the absence of respiratory depression and signs of arousal are relevant. The main requirements for the use of an inhaled anesthetic in pediatric anesthesiology are: the absence of a pungent odor and irritant effect on the upper respiratory tract, low

flammability, safety, low toxicity, rapid onset and termination of action, low MAC, high anesthetic activity, good fat solubility, minimal cardiodepressive effect and respiratory depression, good analgesic effect, dose-dependent muscle relaxation (5, 6, 7, 8). Among modern inhaled anesthetics, the closest to the requirements is Sevoflurane (9, 10, 11).

The aim of the study is to improve the anesthesia care for newborns operated on for necrotic enterocolitis by comparing different methods of anesthesia with an inhaled component.

Material and Methods

To optimize the anesthetic benefits, we studied and carried out a comparative analysis of two options for inhalation anesthesia during surgical interventions for necrotic enterocolitis. The study included 67 newborns operated on for necrotic enterocolitis. Patients were divided into 2 groups depending on the applied inhalation anesthetic: I A (n = 42) group anesthesia was performed with halothane, I B (n = 25) group with sevoflurane. Anesthesia was performed using anesthesia machines from the Dräger model of the Fabius Plus type (Drägerwerk AG, Germany). Intraoperative assessment of respiratory parameters was carried out by excursion of the chest and registration of the following indicators: respiratory rate (f), fractional concentration of oxygen (FiO2), peak inspiratory pressure (Ppeak, see water column), positive pressure at the end of exhalation (PEEP, see vg), tidal volume (Vt, ml), minute lung ventilation (MV, l / min), partial pressure of carbon dioxide at the end of expiration (PetCO2, mm Hg), concentration of inhaled anesthetic on inhalation and exhalation (vol%), minimum alveolar concentration (MAK,%) during mechanical ventilation on apparate «Fabius plus» (Drager Medikal, Germany). The parameters of lung ventilation: BH, (ETCO2), Vt, MV, t ° C, lung extensibility and the concentration of inhaled anesthetics in the circuit were recorded using a respiratory function monitor integrated directly into the Dräger anesthesia machine itself. In the process, Dräger-Vapor 2000 vaporizers were used, which have a thermo-barometric compensation mechanism, provide accurate dosing of anesthetics in a wide range of fresh gas flows (0.25-15 l / min). Hemodynamic parameters (heart rate (HR), systolic blood pressure (BP), diastolic blood pressure (BP))) were evaluated using a BM 5 apparatus (Bionet, Germany), capnometry was performed using a Respironix analyzer (USA). Monitoring of the neuromuscular block was carried out using the TOF-Watch device. Central and peripheral thermometry was carried out on a Cardiocap electrothermometer manufactured by Datex (Finland). Two types of sensors were used - rectal and peripheral. Central temperature was recorded in an ampoule of the rectum, peripheral on the skin of the chest. The severity of hemodynamic disturbances was judged not only by the nature of the decrease in central temperature, but also by the magnitude of the gradient between central and peripheral temperatures.

Results

Assessment of anesthesia for multicomponent anesthesia with halotan was performed in 42 newborns. Upon induction into anesthesia with halotane, the patient received 100% oxygen for 2 minutes with a gradual increase in the concentration of halotane to 3-4%. In most cases, induction in anesthesia went smoothly. In 2 patients, we observed phenomena of respiratory tract irritation with an anesthetic, which were expressed in partial laryngospasm and stopped on their own for a short time. With halotan anesthesia during the stage of excitation, a short-term motor reaction, hypertonicity, convergent strabismus were noted. With the transition of anesthesia to the surgical stage, muscle relaxation occurred, breathing became more rapid and superficial, eyeballs were fixed in the center. Next, fentanyl was administered intravenously at a rate of 2.5-3 μg / kg and 0.5 mg / kg of rocuronium bromide. The average time from the beginning of induction into anesthesia to the loss of the corneal reflex was 168.4 ± 10.2 sec (2 min. 48 sec.). The total induction time into anesthesia with halotan is 238.4 ± 11.2 seconds (3min. 58sec). The average anesthesia time was 60-150 minutes. Signs of arousal during induction were observed with halotane. With induction of anesthesia with Sevoran, the stage of excitation is less pronounced. From the side of the cardiovascular system during halotane induction, the heart rate decreased by an average of 6% ($p < 0.01$), the average blood pressure decreased by 3.2% ($p < 0.01$). The minute volume of blood circulation (IOC) decreased by 5.1%, the work of the left ventricle of the heart increased

against an increase in stroke volume compared with the outcome by an average of 1% ($p < 0.01$) due to a decrease in mean arterial pressure (SBP) (Fig. 2) and heart rate (heart rate). An analysis of the results when assessing the parameters of central hemodynamics during halotan anesthesia showed a change in the main components (decrease in heart rate and increase in stroke volume) against a background of a decrease in mean arterial pressure and total peripheral vascular resistance. And these changes allow us to conclude that the hemodynamic regime has reached a more intense regulation mechanism that accompanies an increase in the work of the heart to maintain the overall performance of the cardiovascular system in normodynamics at the level of the initial values. This type of hemodynamic regime cannot be considered useful, since it can lead to the depletion of compensatory mechanisms.

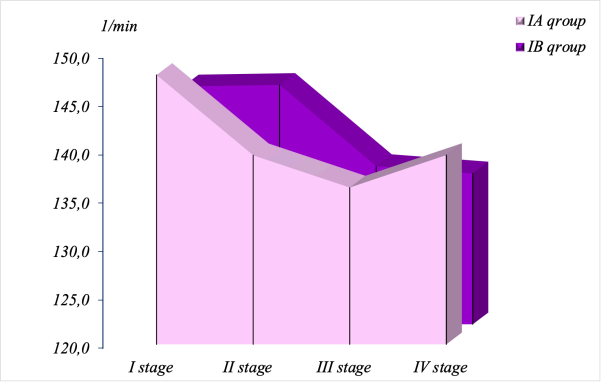

Figure1. Change in heart rate

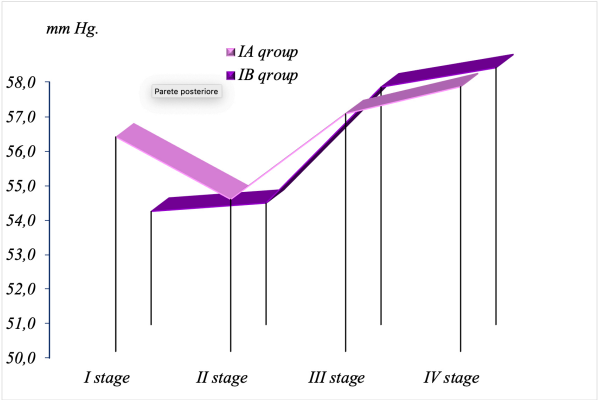

Figure 2. Average blood pressure

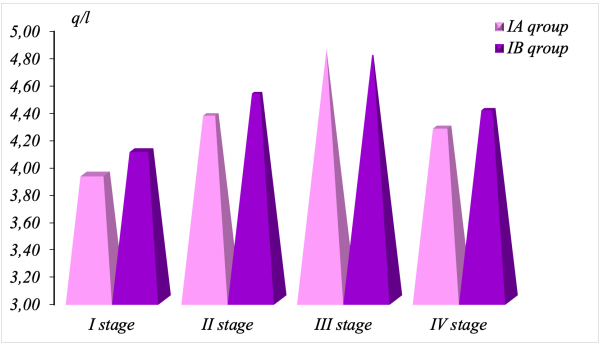

Figure 3. Change in glucose

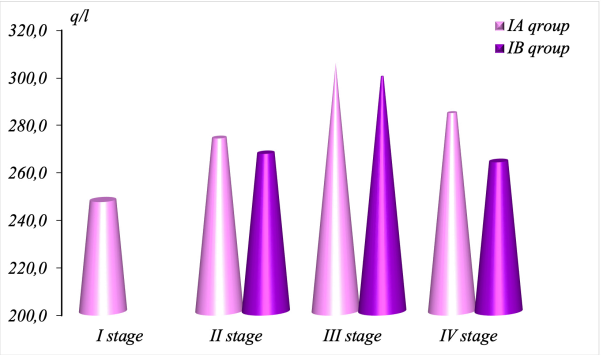

Figure 4. Change in cortisol

Imbalances in the main parameters of central hemodynamics indicate hemodynamic stress that occurred during halotan anesthesia. And this quite clearly and objectively characterizes the cardiodepressive effect of halotane, as a factor that causes the most typical changes in hemodynamic homeostasis parameters. As can be seen from Figs. 3 and 4, an increase in the level of cortisol and glucose at the traumatic stage of the operation indicates the inadequacy of the anesthetic protection for operational stress.

Sevoflurane anesthesia was assessed in 25 newly born I B groups with a diagnosis of necrotizing enterocolitis using fast “bolus” inhalation induction. The technique was carried out by inhaling vapors of high concentration sevoflurane (bringing the concentration of anesthetic to 4% was carried out for 1 min. From the moment of applying a facial mask with a gas flow of 4-5 l / min). After introducing the patient into an unconscious state and losing his motor activity, the concentration of the drug was reduced to 1.5-2.0% vol. Induction was characterized by a rapid loss of consciousness in 2′12 "± 18.5". All patients lacked psychomotor agitation and irritation of the

respiratory tract in the form of hiccups, respiratory arrest, hypersalivation, laryngospasm, bronchospasm. Studies were carried out four times in each patient at the following stages:

Stage I - before anesthesia;

Stage II - after induction in anesthesia;

Stage III - the traumatic moment of the operation;

Stage IV - the end of the operation.

After falling asleep, fentanyl was administered at a dose of 2-3 μg / kg. Intubation was performed after administration of 0.5 mg / kg rocuronium bromide. During induction in anesthesia, an increase in respiratory rate was noted with Spo2 of 99-100%. Maintenance of anesthesia was carried out with oxygen and sevoflurane in a concentration of 1.5-2ob% (MAK 0.7-0.9), depending on the morbidity of each stage of the operation and the patient's hemodynamics. At the last stage of the operation (layered wound closure), the concentration of the anesthetic was reduced to 0.8%, when suturing the skin, the flow of the gas-narcotic mixture was stopped and switched to inhalation of pure oxygen. After the gas-narcotic mixture was discontinued, all hemodynamic parameters and external respiration rapidly recovered to baseline values. Awakening was quick. Immediately after the last suture was applied, muscle tone was restored, and a distinctly expressed motor reaction to a pain stimulus appeared. Recovery of consciousness occurred approximately 10 minutes after the end of the operation. 10 patients required extended mechanical ventilation, the rest were transferred to the intensive care unit on spontaneous breathing. The use of sevoflurane in multicomponent anesthesia led to a decrease in heart rate by 5.7% and 6.2% at the last stages of the study, and ABP by 2.6%. A statistically significant decrease in blood pressure indicators was established depending on the amount of drug administered. A decrease in total peripheral resistance by 2.8% ($p < 0.01$) reduces the afterload of the left ventricle and thus, maintaining the stroke volume more optimal, which was expressed by a slight increase in stroke volume of the heart by 2.1%. An analysis of heart rate did not reveal a reliable relationship between heart rate changes and the dose of anesthetic. And the indicators of stroke volume of the heart, minute volume of blood circulation did not significantly change (Figure 1, 2, 5, 6).

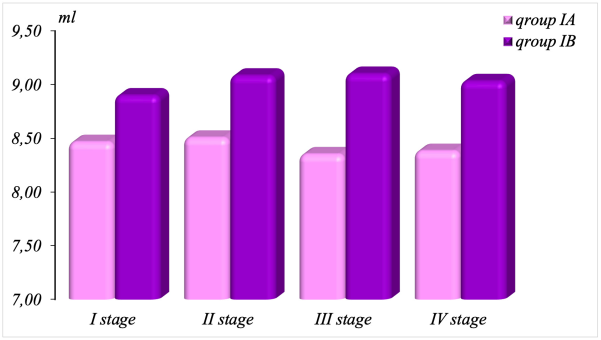

Figure 5. Changes stroke volume of the heart

The total time of induction into anesthesia with sevoflurane was 1 min. ± 30 sec., and with halotane 5 min. ± 22.4 sec. Thus, the shortest time of induction anesthesia with sevoflurane and the largest time was observed with halotan anesthesia. The irritating effect on the respiratory tract is more pronounced with halotan anesthesia and less pronounced with sevoflurane anesthesia. In 2 cases, we observed the phenomena of irritation of the respiratory tract with an anesthetic, which were expressed in partial laryngospasm and stopped on their own for a short (about a minute) time. Therefore, we can conclude that the obtained data on relatively low solubility (blood / gas), the absence of adverse effects on the respiratory tract, and fast and smooth induction allow us to consider sevoflurane as the optimal drug in multicomponent anesthesia in newborns with necrotic enterocolitis. Multicomponent anesthesia using sevoflurane during introductory and basic anesthesia due to a dose-dependent effect on the main indicators of central hemodynamics contributes to adequate protection of newborns and good controllability of anesthesia. he significant muscle relaxant effect of this drug helps to reduce the need for non-depolarizing muscle relaxants. A significant decrease in the level of glucose and cortisol in the blood at the last stage of the operation indicates the adequacy of the anesthesia.

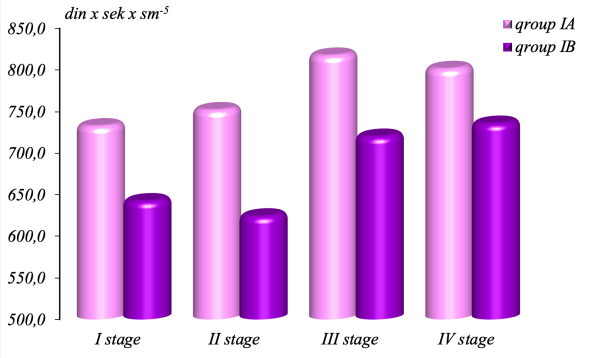

Figure 6. Indicators of total peripheral resistance

Conclusion

Many of the positive properties of sevoflurane listed above make it optimal for multicomponent anesthesia in newborns with necrotic enterocolitis. Multicomponent anesthesia with the use of sevoflurane at the stages of induction and basic anesthesia provides adequate protection for newborns during surgical interventions for necrotic enterocolitis.

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