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ACHIEVEMENTS AND PROBLEMS OF PEDIATRIC ANESTHESIOLOGY AND INTENSIVE CARE

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Abstract
The achievements of pediatric anesthesiology and intensive care in recent years are reviewed. The author focuses on the humanization of critical care medicine in children, the effect of anesthesia on the developing brain, providing pain therapy in children, and also highlights problems in the field of respiratory support, diagnosis and intensive care of sepsis in children and newborns, nutritional support in children in critical conditions.

Keywords: children, anesthesiology and resuscitation, intensive care.

Introduction
Pediatric anesthesiology and intensive care, for obvious reasons, always follow advances in adult patients. Largely due to the lack of evidence-based research, the existing problems of our specialty in the pediatric population are obvious [1-8]. Let's look at the progress made in pediatrics in recent years. One of the most important areas of modern critical care medicine is its humanization, which is the subject of an editorial in the journal Critical Care » [2 0]. In particular, it points out the critical importance of the policy of restrictive visiting of patients in intensive care units (ICU), which undoubtedly contributes to dehumanization towards patients. There is no doubt that creating conditions for the greatest comfort, in particular, for children in pediatric intensive care units (PICUs) and operating rooms, is an equally important factor for the success of therapy [1, 1]. It should be noted that in this regard, significant changes have been noted in our country. Thus, in the Russian Children's Clinical Hospital (head of the department V.S. Kochkin) since 2016, a premedication ward and a recovery ward have been successfully operating. Both of them are designed as playrooms. Parents and children are allowed there, and younger children can drive small electric cars from the premedication ward directly to the operating room. In addition, domestic specialists under the auspices of the Association of Pediatric Anesthesiologists and Resuscitators of Russia (ADAR) have issued and are successfully implementing methodological and clinical recommendations on the joint stay of a child with parents in the PICU and the Open Resuscitation methodology [1]. Although the incidence of death due to anesthesia in children remains very low, the incidence of serious complications in the perioperative period remains high in pediatric anesthesiology. In the APRICOT observational study, the results of which were published in February this year [15], in 261 European hospitals, the incidence of such incidents was 5.2%, among them the most common were bronchospasm (0.9%) and stridor (1.1%).) and cardiovascular instability (0.9%). The authors noted the great variability of their occurrence, and therefore came to the conclusion that it is necessary to improve the special training of

anesthesiologists and their skills in managing anesthesia in children. They also concluded that children under 3 years of age and patients in ASA risk classes III and IV should not undergo anesthesia without the direct involvement of a pediatric anesthesia specialist. Domestic practice shows that this problem is very important for our country, especially at the level of the central district hospital, and requires its own organizational solution. Effects of anesthesia on the developing brain. In recent years, this problem has become one of the central ones in foreign literature; Last year alone, the results of several large studies were published [18]. Previously, experimental work has shown that air - The effects of most anesthetics used clinically at normal doses alter the brain structure of young animals and affect the cognitive functions and behavior of animals later in life [14]. A number of studies indicate that the developing brain is susceptible to injury due to anesthesia during painful procedures [1–9]. One large study [66] examined the neurocognitive effects of general anesthesia and surgery in children, comparing patients who had undergone general anesthesia before the age of 4 years with children who had never had anesthesia at all. The authors found that children who underwent general anesthesia before age 4 developed less well when they entered school and were behind in their academic performance. Therefore, the US Food and Drug Administration (FDA) issued a warning [13] to limit the use of general anesthetics in children under 3 years of age, noting that repeated or prolonged anesthesia (more than 3 hours) or sedation may affect development of the child's brain, although it is unlikely that a single or short anesthesia or sedation has a negative effect on neuropsychic development . At the same time, a number of studies [1-3] have not revealed any differences in neurological and cognitive outcomes in children with conservative and surgical treatment in the immediate and long-term periods.

of protective mechanical ventilation using small tidal volumes currently dominates during mechanical ventilation in adults , then in studies conducted in children, including those receiving respiratory support for acute respiratory distress syndrome (ARDS), no difference in mortality was noted between groups with tidal volumes of 6 and 10 ml/kg [8]. In pediatrics, there is virtually no evidence-based research on this issue [3], although a number of studies show a direct connection between final inspiratory pressure and mortality [3]. Ventilation in the prone position in the RuVentu study of children was used twice as often as in the group as a whole (8.7% in children versus 4.5% in children and adults), although there is currently no sufficient evidence on the effect of pronation on survival on this issue. children with ARDS and the duration of respiratory support [17]. In children, compared to adults, especially in newborns and infants, high-frequency oscillatory ventilation (HFOVL) is used much more often.

In ARDS in children, the RESTORE study [9] did not reveal the effect of HFPE on mortality. Nevertheless, a number of studies indicate the effectiveness of the use of HFOVL for obstructive diseases of the respiratory tract and after heart surgery [16]. In general, it seems that at present, HFOVL in pediatric practice is more of a “reserve” method used in case of ineffectiveness of conventional (“convection”) mechanical ventilation. Non-invasive mechanical ventilation (NIV) has become widespread in children .

In 2015, the Consensus on Pediatric ARDS was published [10], which contains 151 recommendations, of which 132 are strict. Unlike the Berlin definitions for adults, it uses not the respiratory coefficient (PaO_2 /FiO_2) to identify ARDS in children, but the oxygenation index (OI), which is determined by introducing the average pressure in the respiratory tract into the formula: Oxygenation index (OI) = (FiO_2 × mean airway pressure)/PaO_2. If OI is less than 5.3 –

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mild ARDS; 6.7 – moderate and 8.1 or more – severe. When assessing the new pediatric consensus [15], it is noted that its use can significantly increase the number of identified patients with ARDS and reduce overall mortality (with severe ARDS it reaches 31.0% or more in children). There is also a lack of evidence-based studies on improved outcomes when using recruitment and optimal PEEP in children. Sepsis. Data regarding the latest advances in pediatric sepsis were published this year in the journal "Bulletin of Anesthesiology and Reanimatology" [6]. I would like to add something to this. First of all, global patterns of mortality rates in sepsis and septic shock (SS) are still poorly understood, and differences remain between developing and developed countries [70]. It should also be emphasized that pediatric SS is usually associated with severe hypovolemia , and children often respond well to aggressive volume loading [19]. Moreover , in contrast to adult patients, in children a low level of cardiac output, and not low peripheral vascular resistance, is associated with mortality, and achieving a cardiac index of 3.3–6.0 l/(min · m-2) can lead to an increase survival rate [20].

In this regard, despite ongoing efforts in early diagnosis, treatment and prevention, neonatal sepsis still remains a mysterious area for neonatologists due to changes in epidemiology and the lack of ideal diagnostic markers [12]. The so-called late -onset sepsis (LOS) is a serious nosocomial infection, especially common among premature and extremely low birth weight (ELBW) infants [1–4]. Compared with infants without E OS, infants with LOS have a higher mortality rate, require prolonged hospitalization, and have an increased risk of neurodevelopmental disorders [1–8]. In a clinical report on the epidemiology of EOS in preterm infants less than 34 weeks' gestation , KM Puopolo et al . [1-3] note that the epidemiology, microbiology and pathogenesis of EOS differ significantly between full-term and preterm infants with ELBW. The authors proposed measures for risk assessment and basic clinical approaches in newborns of this category. Of significant interest is a domestic study [2], in which the authors found in newborns with EOS a good diagnostic value with low specificity of a comprehensive assessment of the level of platelets, neutrophils, blood protein and body weight. The specificity of this algorithm could likely be improved by simultaneous measurement of blood procalcitonin levels . Nutritional support. Nutritional support (NS) practice in the pediatric ICU is still largely driven by expert opinion or consensus, with very few evidence-based studies [1–3]. A uniform strategy for assessing nutritional status and accurate markers of nutritional status in critical illness in children are not available, nor is accurate assessment of energy requirements in all phases of critical illness [1 , 1]. Indirect calorimetry, as the gold standard for estimating energy costs, is not widely available and cannot be used occur in most patients [11]. Various formulas developed for healthy infants and children are not accurate for critically ill children and lead to the risk of unintentional underfeeding or overfeeding, especially in the youngest patients [13]. The results of clinical nutrition practice in children in pediatric ICUs in Russia "NutriPed-13" and "NutriPed-15" [5] showed that the vast majority of patients received enteral (EN) and parenteral (PN) nutrition, with half receiving both EN and PP (additional PP - DPP), and the rest - either EP or full PP. It was noted that modern NP technologies have become significantly more widely used. Only 2.4% of children did not receive PN without contraindications, all components of PN began to be used almost 3 times more often (69% in 2015 versus 22% in 2013), and the latest generation of lipids and multi-chamber containers became more widely used. At the same time, a number of questions remain regarding methods for individual calculation of energy and protein requirements, resolution of gastrointestinal dysfunction, and active implementation of assessment of the effectiveness of NP

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in children's ICUs. A review of NP practice in pediatric ICUs during the same period abroad (156 ICUs from 52 countries) [1 0] showed that EP begins in the first 24 hours in 60% of ICUs and in 70% within 24-48 hours. PN starts within 24–48 hours in 58%. If EN covers less than 50% of energy needs, 72% of pediatric ICUs use DPN. At the same time, a large difference was revealed in the goals of NP, start time, calorie intake , and indications for DPP. So, the key issues when conducting NP in critically ill children are: time of initiation, determination of energy and protein requirements, choice of delivery method (EN, PN, DPP) and the impact of NP on treatment outcomes. Today, as can be seen from the above data from clinical practice in Russia and abroad, the start of PN in most children in critical conditions occurs in the first 24 or 48 hours. The preferred method of delivering nutrition to a child is EN, but PN is also widely used. A number of studies [21,51, 52] have convincingly proven that in the pediatric ICU one should not strive to fully meet energy and protein requirements from the first days of critical illness. It is proposed to achieve only by the 8th day of stay in the ICU at least two thirds of the prescribed daily energy needs (average target dose - 64 kcal / kg per day), and as for protein, its target dose should be by this time 1. 5–1.7 g/kg per day. This NP tactic is associated with a significant reduction in 60-day mortality. If difficulties with EN are associated with the inability to tolerate gastric nutrition [11], postpyloric nutrition should be used [4, 14, 21, 22, 23] In this regard, these aspects call into question the transferability of the PEPaNIC results. For standard clinical practice in accordance with current standards of care and clinical practice. It is clear that EN has priority in critically ill children, and as for PN, it should not be used routinely and should be more strictly prescribed. Further research is needed. Concluding the section on NP, it should be emphasized that in children, especially young children, starvation can be considered an extremely undesirable event. NP should be started in the first 24-48 hours, EN has priority, if necessary, post-pyloric nutrition should be used, if EN is inadequate, DPN should be used, and full caloric intake should not be achieved in the first days. Conclusion Data from the adult population cannot be transferred to children, and evidence-based studies in pediatrics are practically absent. In the current conditions, we consider it necessary to create local protocols in pediatric anesthesiology and resuscitation based on existing clinical recommendations, taking into account the nosological characteristics of patients in a given clinic, the age of the children and monitoring capabilities.

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