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Intensive care of acute respiratory syndrome in a child with community-acquired pneumonia (clinical case)

Gulshat N. Alimkhanova[1], Akerke B. Ibraimova[1], Assel K. Tulebayeva[1, 2], Nurmukhanbet Bokenuly[3]

[1] Scientific Center of Pediatrics and Pediatric Surgery, 146 Al-Farabi ave., Almaty, 050044/A15E2P4, Republic of Kazakhstan

[2] S.D. Asfendiyarov Kazakh National Medical University, 94 Tole bi str., Almaty, 050000, Republic of Kazakhstan

[3] Atyrau Regional Infectious Diseases Hospital, 412 Sultan Beibarysa ave., Atyrau, 060000, Republic of Kazakhstan

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ABSTRACT. Severe pneumonia is an urgent problem in pediatrics, since it is the leading cause of morbidity and mortality in children under 5 years old, mortality can reach 14%. The article discusses a clinical case of severe community-acquired pneumonia in a child, complicated by grade III respiratory failure. The child was hospitalized in an infectious diseases hospital on the 8th day of the disease. However, despite the therapy, due to the deterioration of the condition and progression of the respiratory failure clinic on the third day after hospitalization, the child was transferred to the intensive care unit. Acute respiratory distress syndrome developed, requiring invasive ventilation and therapy adjustment. The key aspects of intensive care aimed at stabilizing the patient's condition are described, including respiratory support, antibacterial, antiviral, antifungal, infusion therapy, immunomodulatory drugs and pulse therapy with glucocorticosteroids. Exogenous surfactant was also used, which contributed to the improvement of gas exchange and reduction of artificial ventilation parameters. Complex therapy was carried out in accordance with modern international recommendations for the treatment of severe pneumonia complicated by acute respiratory distress syndrome in children. The presented clinical case demonstrates the critical importance of timely and adequate therapy, as well as a multidisciplinary approach to the treatment of severe pneumonia in children.

KEYWORDS: *pneumonia, respiratory failure, intensive care, respiratory support, antibiotic therapy, clinical case, pediatrics, children*

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✉ *Gulshat N. Alimkhanova*. E-mail: a.gulya83@mail.ru

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Интенсивная терапия острого респираторного синдрома у ребенка на фоне внебольничной пневмонии (клинический случай)

Гульшат Нурмураткызы Алимханова[1], Акерке Баудынбаевна Ибраимова[1], Асель Кайратовна Тулебаева[1, 2], Нурмуханбет Бокенулы[3]

[1] Научный центр педиатрии и детской хирургии, 050044/A15E2P4, г. Алматы, пр. Аль-Фараби, д. 146, Республика Казахстан

[2] Казахский национальный медицинский университет имени С.Д. Асфендиярова, 050000, г. Алматы, ул. Толе би, д. 94, Республика Казахстан

[3] Атырауская областная инфекционная больница, 060000, г. Атырау, пр. Султан Бейбарыса, д. 412, Республика Казахстан

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РЕЗЮМЕ. Тяжелая пневмония — актуальная проблема педиатрии, поскольку она является ведущей причиной заболеваемости и смертности у детей до 5 лет, летальность может достигать 14%. В статье рассматривается клинический случай тяжелой внебольничной пневмонии у ребенка, осложненной дыхательной недостаточностью III степени. Ребенок был госпитализирован в инфекционный стационар на восьмые сутки заболевания. Однако, несмотря на проводимую терапию, в связи с ухудшением состояния и прогрессированием клинической картины дыхательной недостаточности на третьи сутки после госпитализации ребенок был переведен в отделение реанимации и интенсивной терапии. Развился острый респираторный дистресс-синдром, что потребовало применения инвазивной вентиляции легких и коррекции терапии. Описаны ключевые аспекты интенсивной терапии, направленной на стабилизацию состояния пациента, включая респираторную поддержку, антибактериальную, противовирусную, противогрибковую, инфузионную терапию, препараты-иммуномодуляторы и пульс-терапию глюкокортикостероидами. Использовался также экзогенный сурфактант, что способствовало улучшению газообмена и снижению параметров искусственной вентиляции легких. Проводилась комплексная терапия согласно современным международным рекомендациям по лечению тяжелой пневмонии, осложненной острым респираторным дистресс-синдромом у детей. Представленный клинический случай демонстрирует критическую важность своевременной и адекватной терапии, а также мультидисциплинарного подхода к лечению тяжелой пневмонии у детей.

КЛЮЧЕВЫЕ СЛОВА: *пневмония, дыхательная недостаточность, интенсивная терапия, респираторная поддержка, антибиотикотерапия, клинический случай, педиатрия, дети*

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✉ *Гульшат Нурмураткызы Алимханова*. E-mail: a.gulya83@mail.ru

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INTRODUCTION

Despite significant advances in the diagnosis and treatment of infectious diseases, pneumonia remains one of the leading causes of hospitalization and pediatric mortality in many countries worldwide [1, 2]. Severe disease carries an exceedingly high risk of rapidly progressive respiratory failure, hypoxemia, and the development of acute respiratory distress syndrome (ARDS) and sepsis. These conditions represent major causes of death in pediatric intensive care units (PICUs) [3–6].

According to the World Health Organization (WHO), pneumonia accounted for the deaths of an estimated 740,000 children under the age of five in 2019, representing approximately 14% of all deaths within this age group. Although this figure declined to 672,000 in 2021, the disease continues to rank among the leading causes of death in pediatrics. Mortality is particularly high in countries with limited healthcare resources, such as Nigeria, India, and Pakistan. Together, these three countries account for over half of all child deaths from pneumonia. Yet, even in countries with well-developed healthcare systems, pneumonia remains a pressing challenge in pediatrics. Although the incidence of ARDS is relatively lower in children than in adults, the associated mortality in the pediatric population is extremely high, ranging from 18% to 27%. In some countries, this figure reaches adult levels of 35% [7–10].

In recent years, a persistent trend has been observed toward an increase in severe forms of pneumonia in children. This trend has been driven by the spread of atypical pathogens (*Mycoplasma pneumoniae, Chlamydia pneumoniae*), viral infections, and COVID-19 [11, 17].

High levels of antimicrobial resistance further aggravate the course of severe pneumonia. Current treatment strategies for severe pediatric pneumonia encompass timely diagnosis, empirical antibiotic therapy, respiratory support, vital function monitoring, and complication prevention [12–14].

Clinical guidelines underscore the importance of prompt inpatient management. The presence of complications, severe or protracted disease, and progressing respiratory failure constitute indications for emergency hospitalization and transfer to a PICU. In the PICU, etiotropic, pathogenetic (fluid resuscitation, volume expansion, and hemodynamic support), and symptomatic therapy is delivered under monitoring of blood gas parameters and acid-base balance [15, 16].

Effective management of severe pneumonia in children therefore requires a comprehensive, multidisciplinary approach that integrates timely diagnosis, individualized treatment, continuous patient monitoring, and complication prevention.

AIM

The aim of this study was to present a clinical case illustrating the successful management of severe acute respiratory distress syndrome in a preschool-aged child with community-acquired pneumonia.

CASE PRESENTATION

A 2-year-8-month-old girl was admitted to the emergency department of an infectious diseases hospital with complaints of dry cough, fever reaching 38 °C, and general weakness. These complaints were reported by her mother.

At the time of admission, the child had already been unwell for seven days. The illness began with a temperature rise to 38 °C and cough, for which ibuprofen was prescribed. Despite treatment, her condition progressively worsened: the cough became more intense, dyspnea developed, and the fever persisted. On the eighth day of illness, the child was hospitalized. Her past medical history was notable for frequent acute respiratory infections and absence of vaccination due to the family's religious beliefs.

On admission, her condition was severe. She was tachypneic with a respiratory rate of 37 breaths per minute and tachycardic with a heart rate of 126 beats per minute. Oxygen saturation (SpO_2) was 99%, and body temperature was 37 °C. Auscultation of the lungs revealed harsh breath sounds conducted throughout all lung fields, with no rales. The admission diagnosis was acute respiratory viral infection complicated by acute bronchitis.

Laboratory findings are presented in Tables 1–3.

For two days, the child received antibacterial therapy in the specialized department in accordance with international guidelines and the local protocol. However, her condition deteriorated over time, with progressive respiratory failure, necessitating transfer to the PICU.

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Table 1. Results of clinical and biochemical blood tests

Таблица 1. Результаты клинического и биохимического анализов крови

День болезни Day of illness	Гемоглобин, г/л Hemoglobin, g/l	Лейкоциты, $\times 10^9$/л White blood cells, $\times 10^9$/L	Палочкоядерные Band neutrophils, %	Сегментоядерные Segmented, %	Лимфоциты Lymphocytes, %	Тромбоциты, $\times 10^9$/л Platelets, $\times 10^9$/l	СОЭ, мм/час Erythrocyte sedimentation rate, mm/hour	СРБ, мг/л CRP, mg/L
При поступлении Upon admission	114	5,1		65	32,7	357	5	40,6
Перевод в ОАРИТ Transfer to the ICU	98	4,5	6	60	30	549	15	40,6
На момент перевода на ИВЛ At the time of transfer to AVL	85	8.9	6	73	30	455	44	
7-й день госпитализации 7th day of hospitalization	121	13	15	55	26	641	65	139,7
12-й день госпитализации 12th day of hospitalization	92	13	7	57	30	746	58	178,6
25-й день госпитализации 25th day of hospitalization	113	10	3	65	28	620	24	7,7
Выписка из стационара Discharge from hospital	115	9,8	3	63	30	580	20	3,3

The table is prepared by the authors using their own data

Таблица составлена авторами по собственным данным

Note: ALV — artificial ventilation of the lungs; ICU — intensive care unit; ESR — erythrocyte sedimentation rate; CRP — C-reactive protein.

Примечание: ИВЛ — искусственная вентиляция легких; ОАРИТ — отделение анестезиологии, реанимации и интенсивной терапии; СОЭ — скорость оседания эритроцитов; СРБ — С-реактивный белок.

Table 2. Gas composition and acid-base balance of venous blood

Таблица 2. Газовый состав и кислотно-основное состояние венозной крови

День болезни Day of illness	pH	pCO_2, мм рт.ст. mm Hg	pO_2, мм рт.ст. mm Hg	HCO_3, ммоль/л mmol/L	Лактат, ммоль/л Lactate, mmol/L	OSI
Перевод в ОАРИТ Transfer to the ICU	7,32	48	34	25,9	1,9	11
На момент перевода на ИВЛ At the time of transfer to AVL	7,422	38,6	31,6	24,6	1,43	14
7-й день госпитализации 7th day of hospitalization	7,432	34,6	26,6	22,6	1,21	10
12-й день госпитализации 12th day of hospitalization	7,4	42,7	50,5	29,4	1,88	–
25-й день госпитализации 25th day of hospitalization	7,49	38,5	32,0	28,7	1,89	–
Выписка из стационара Discharge from hospital	7,492	35,0	34,4	26,2	1,88	–

The table is prepared by the authors using their own data

Таблица составлена авторами по собственным данным

Note: ALV — artificial ventilation of the lungs; ICU — intensive care unit; OSI — oxygen saturation index.

Примечание: ИВЛ — искусственная вентиляция легких; ОАРИТ — отделение анестезиологии, реанимации и интенсивной терапии; OSI — оксигенационно-сатурационный индекс (oxygen saturation index).

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Table 3. Coagulogram

Таблица 3. Коагулограмма

День болезни Day of illness	ПТИ, % PTI, %	Фибриноген, г/л Fibrinigene, g/l	АЧТВ, с APTT, s	D-димер, нг/мл D-dimer, ng/ml	ПВ, с Pt, s
Перевод в ОАРИТ Transfer to the ICU	89	2,5	33	–	–
На момент перевода на ИВЛ At the time of transfer to AVL	90,7	3	32,8	1237	11,1
7-й день госпитализации 7th day of hospitalization	106,0	2,70	39,00	1786,2	10,20
12-й день госпитализации 12th day of hospitalization	98,8	2,73	31,50	1589,1	10,60
25-й день госпитализации 25th day of hospitalization	110,0	3,10	50,50	3136,7	10,0
Выписка из стационара Discharge from hospital	108,0	2,60	34,50	1646,3	10,10

The table is prepared by the authors using their own data

Таблица составлена авторами по собственным данным

Note: APTT — activated partial thromboplastin time; ALV — artificial ventilation of the lungs; ICU — intensive care unit; Pt — prothrombin time; PTI — Prothrombin index.

Примечание: АЧТВ — активированное частичное тромбопластиновое время; ИВЛ — искусственная вентиляция легких; ОАРИТ — отделение анестезиологии, реанимации и интенсивной терапии; ПВ — протромбиновое время; ПТИ — протромбиновый индекс.

On arrival in the PICU, her body temperature was 38 °C. She was tachypneic, with a respiratory rate of 40–45 breaths per minute, an SpO_2 of 85%, a productive cough, and chest wall retractions. Noninvasive ventilation via a nasal mask was initiated. With respiratory support, SpO_2 rose to 90%. Venous blood gas analysis revealed respiratory acidosis: pH 7.32; pCO_2 48 mm Hg; pO_2 34 mm Hg; BE −2 mmol/L; lactate 1.9 mmol/L.

Based on the presumed susceptibility, antibacterial agents were prescribed (ceftazidime 80 mg/kg/day and amikacin 15 mg/kg/day), and mucolytic, bronchodilator, and symptomatic therapy was initiated.

Two days later, the patient's condition deteriorated sharply, with the clinical manifestation of ARDS. Her SpO_2 was 83%, the respiratory rate was 50 breaths per minute, and auscultation of the lungs revealed diminished breath sounds bilaterally. A follow-up chest radiograph showed negative dynamics with an increase in the zones of infiltration (Fig. 1).

On emergency indications, tracheal intubation was performed, and invasive mechanical ventilation was initiated using pressure-controlled ventilation with an FiO_2 of 0.9. SpO_2 ranged between 50% and 70%. Venous blood gas analysis performed immediately before intubation revealed decompensated respiratory acidosis: pH 7.20; pCO_2 82 mm Hg; pO_2 33 mm Hg; BE −2 mmol/L; lactate 1.8 mmol/L. A chest radiograph showed further progression of infiltrative changes (see Fig. 1).

Given the constellation of clinical and laboratory findings and the progressively severe course of the disease, a decision was made to modify the therapeutic regimen. Pentaglobin was prescribed for passive immunization at a dose of 5 mL/kg intravenously for three days. To suppress the pronounced inflammatory response and cytokine cascade, pulse methylprednisolone therapy was administered at a dose of 30 mg/kg for three days.

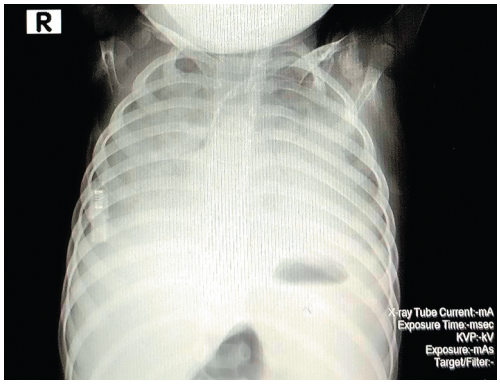

Fig. 1. Chest radiography (4th day of hospitalization). Bilateral pneumonia. Pulmonary edema? (photo from the authors' personal archive)

Рис. 1. Рентгенография органов грудной клетки. Двусторонняя пневмония. Отек легких? (фото из личного архива авторов)

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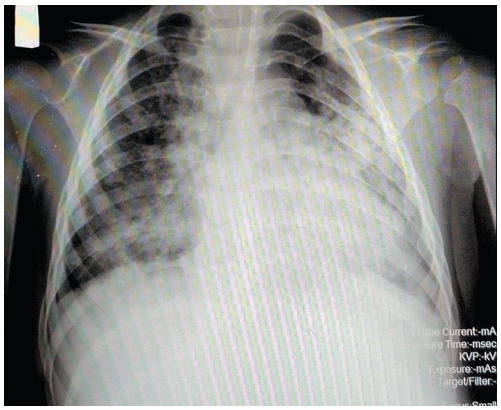

Fig. 2. Chest radiography (7th day of hospitalization) (photo from the authors' personal archive)

Рис. 2. Рентгенограмма органов грудной клетки на 7-й день госпитализации (фото из личного архива авторов)

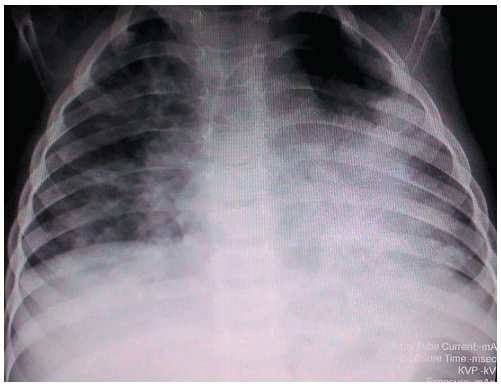

Fig. 3. Chest radiography (12th day of hospitalization) (photo from the authors' personal archive)

Рис. 3. Рентгенограмма органов грудной клетки на 12-й день лечения в стационаре (фото из личного архива авторов)

As part of the respiratory support strategy and to promote alveolar recruitment, poractant alfa was administered endotracheally on two occasions at a dose of 120 mg.

The ongoing therapy was associated with positive clinical dynamics: gas exchange improved, ventilatory parameters decreased, and SpO_2 rose to 92% at a fraction of inspired oxygen of 50%. The SpO_2/FiO_2 ratio was 184.

A follow-up chest radiograph demonstrated a reduction in infiltrative changes, decreased density of inflammatory foci, and partial clearing of the lung fields compared with the previous examination (Fig. 2).

By day 5 of intensive combined therapy in the hospital (day 12 of illness), the child showed unequivocal positive dynamics across clinical, laboratory, and instrumental parameters. Blood gas values stabilized, infiltrative changes on the chest radiograph diminished, and systemic hemodynamic parameters normalized.

Given the sustained clinical improvement, a decision was made to extubate the patient and transition her to noninvasive ventilation. The patient was conscious, oriented, and responsive. She was able to drink and eat independently, although her appetite remained reduced. Mild mixed dyspnea persisted but did not necessitate an increase in the level of respiratory support.

By day 7 of inpatient treatment (day 14 of illness; hospital day 12), the girl was successfully transitioned to spontaneous breathing with humidified oxygen delivered via binasal cannulae at a flow rate of 2 L/min. Follow-up chest radiographs demonstrated unequivocal positive dynamics (Fig. 3).

Throughout the PICU stay, the patient received comprehensive therapy aimed at suppressing the severe infectious and inflammatory process, stabilizing respiratory function, and preventing systemic complications.

Given that sputum culture on day 5 of inpatient treatment yielded *Pseudomonas aeruginosa* susceptible to meropenem and colistimethate sodium, antibacterial therapy was adjusted accordingly. The regimen included meropenem (60 mg/kg/day), colistin (1,500,000 IU/kg/day), and linezolid (30 mg/kg/day).

As IgM and IgG antibodies against herpes simplex virus and Epstein–Barr virus were positive, antiviral therapy (acyclovir at 80 mg/kg/day) was initiated to reduce the risk of viral coinfection.

For prophylaxis of fungal complications, fluconazole was prescribed at the initial stage of treatment at a dose of 6 mg/kg every 48 hours. Subsequently, when *Candida lipolytica* was isolated from urine on day 11 of hospitalization, caspofungin was added to the therapeutic regimen at a dose of 50 mg/m^2/day for 7 days.

To manage broncho-obstructive syndrome, aminophylline (1 mg/kg/hour for three days) and nebulized ipratropium bromide 150 μg every 6 hours were administered.

The comprehensive therapy resulted in sustained positive dynamics. The patient's condition stabilized: gas exchange parameters and laboratory values normalized, and the foci of pulmonary infiltration diminished significantly (Fig. 4).

Thirty-five days after admission, the patient was discharged from the hospital in satisfactory condi-

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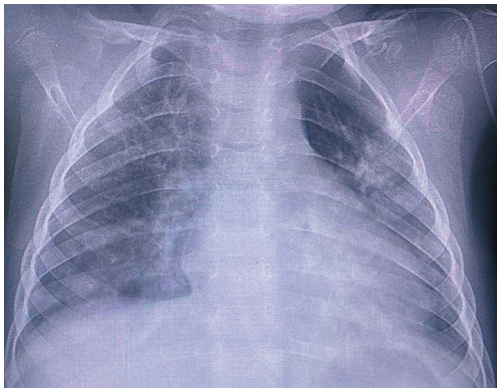

Fig. 4. Chest radiography (25th day of hospitalization) (photo from the authors' personal archive)

Рис. 4. Рентгенография органов грудной клетки (25-й день госпитализации) (фото из личного архива авторов)

tion with recommendations for further outpatient follow-up. A consultation with a pediatric pulmonologist was scheduled. The recommendations also included dynamic monitoring via follow-up laboratory and instrumental investigations and continuation of rehabilitative therapy in the outpatient setting.

DISCUSSION

This clinical case describes severe acute respiratory distress syndrome in a preschool-aged child with community-acquired bilateral polysegmental pneumonia. It underscores the critical importance of a comprehensive and timely approach to the management of severe community-acquired pneumonia in pediatric practice.

Despite the availability of modern diagnostic and therapeutic modalities, pneumonia remains the leading cause of child mortality worldwide. According to current WHO and UNICEF data, pneumonia-related mortality among children under five years of age has declined only marginally: from approximately 740,000 deaths in 2019 to approximately 725,000 in 2023–2024.

In the present case, despite treatment initiation in the infectious diseases hospital, the patient developed progressive respiratory failure necessitating transfer to the PICU. The subsequent development of ARDS provided the rationale for invasive mechanical ventilation and treatment modification in accordance with the PALICC-2 recommendations [4, 18].

A comprehensive therapeutic strategy encompassing broad-spectrum antibacterial agents, immunomodulators, and antiviral and antifungal medications was implemented. Together with pulse glucocorticoid therapy, this strategy allowed stabilization of the patient's condition [19–23].

The administration of surfactant contributed to improved gas exchange and a reduction in ventilatory parameters. This outcome aligns with current recommendations for the management of severe pneumonia and ARDS in children [4, 5, 24, 25]. In our opinion, such an approach substantially enhances the effectiveness of treatment for severe forms of community-acquired pneumonia in children. The successful outcome was achieved through effective multidisciplinary collaboration among pediatricians, intensivists, infectious disease specialists, and other healthcare professionals working in close coordination within the intensive care unit.

CONCLUSION

This clinical case illustrates the severe course of ARDS secondary to community-acquired pneumonia in a child, marked by rapidly progressive severe hypoxemic respiratory failure that necessitated intensive care with invasive respiratory support. The application of current clinical guidelines substantially increases the likelihood of a favorable outcome even in the most critical situations, and this principle formed the basis of the child's recovery in the present case.

ADDITIONAL INFORMATION

Authors' contribution. G.N. Alimkhanova – development of the research concept; A.B. Ibraimova, N. Bokenuly — collection, data analysis and preparation of illustrations; A.B. Ibraimova, N. Bokenuly — writing the first text; G.N. Alimkhanova, A.K. Tulebayeva — scientific advice and guidance; G.N. Alimkhanova, A.K. Tulebayeva — editing the final text; G.N. Alimkhanova, A.K Tulebayeva, A.B. Ibraimova, N. Bokenuly — approval of the final text.

All authors read and approved the final version before publication.

Competing interests. The authors declare that they have no competing interests.

Consent for publication. Written consent was obtained from legal representatives of the patient for publication of relevant medical information within the manuscript.

ДОПОЛНИТЕЛЬНАЯ ИНФОРМАЦИЯ

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Authors' info

✉ **Gulshat N. Alimkhanova** — Cand. Sci. (Med.), Head of the Anesthesiology and Intensive Care Unit, Scientific Center of Pediatrics and Pediatric Surger; Assistant Professor, Department of Pediatric Anesthesiology and Intensive Care, Kazakh Research Medical University named after S.D. Asfenidyarov. E-mail: a.gulya83@mail.ru; https://orcid.org/0000-0001-7304-9102
Akerke B. Ibraimova — Master of Public Health, Head of the Department of Anesthesiology and Intensive Care for Older Children. E-mail: akerke.ok@mail.ru; https://orcid.org/0009-0005-6053-2660
Assel K. Tulebayeva — PhD, Associated Professor, Children Diseases Department named after N.A. Barlybayeva. E-mail: tulesya@mail.ru; https://orcid.org/0000-0002-0639-8879
Nurmukhanbet Bokenuly — pediatric anesthesiologist-resuscitator of the intensive care unit. E-mai: Bokenuly.nurhan-12@mail.ru

Об авторах

✉ **Гульшат Нурмураткызы Алимханова** — к.м.н., заведующий реанимационно-анестезиологическим блоком, Научный центр педиатрии и детской хирургии; ассистент, кафедра детской анестезиологии и интенсивной терапии, Казахский исследовательский медицинский университет им. С.Д. Асфенидяирова. E-mail: a.gulya83@mail.ru; https://orcid.org/0000-0001-7304-9102
Акерке Баудынбаевна Ибраимова — магистр здравохранения, заведующий отделением анестезиологии, реанимации и интенсивной терапии детей старшего возраста. E-mail: akerke.ok@mail.ru; https://orcid.org/0009-0005-6053-2660
Асель Кайратовна Тулебаева — PhD, доцент, кафедра детских болезней им. Н.А. Барлыбаевой. E-mail: tulesya@mail.ru; https://orcid.org/0000-0002-0639-8879
Нурмуханбет Бокенулы — врач — детский анестезиолог-реаниматолог отделения реанимации и интенсивной терапии. E-mai: Bokenuly.nurhan-12@mail.ru

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