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TOPICS COVERED

- NATURAL SCIENCES
- SOCIAL SCIENCES
- APPLIED SCIENCES
- MEDICAL SCIENCES
- ENGINEERING SCIENCES

Vol. 3 No. 9 (2024): ICSRNSS

Articles

1. **REVIEW OF METHODOLOGICAL ASPECTS IN ENGLISH LANGUAGE TEACHING**

Jakhongir Tursunov

1-4

2. **ТЕХНОЛОГИЧЕСКИЕ КОНТУРЫ АТОМНЫХ СТАНЦИЙ**

Хошимжонов Хуршидбек Фарходжон угли

5-8

3. **IMPERATIVE SEMANTICS AND ITS FEATURES IN THE ENGLISH AND UZBEK LANGUAGES**

Kenjaeva Lobar Mavlon kizi

9-12

4. **ISSUES OF INCREASING CRITICAL THINKING IN ENGLISH CLASSES**

Choriyev Ganisher Yahyo ugli

13-16

5. **THE IMPORTANCE OF MOTIVATION GIVEN BY PARENTS IN LEARNING A FOREIGN LANGUAGE**

Gulyuz Tursunova

17-20

6. **MUTAXASSISLAR TOMONIDAN HODISA SODIR BO`LGAN JOYDA ANIQLANGAN TRASOLOGIK ASHYOVIY DALILLARNI DASTLABKI TRASOLIGIK TADQIQOTINI O`TKAZISH JARAYONIDAGI MUOMMOLARI**

Mansurov Arslon Askarovich

21-28

7. **ВОЗМОЖНОСТИ МАТЕРИНСКОЙ ГИПЕРОКСИГЕНАЦИИ В ЛЕЧЕНИИ ВРОЖДЕННЫХ ПОРОКОВ СЕРДЦА У ПЛОДА: ОБЗОР СОВРЕМЕННЫХ ИССЛЕДОВАНИЙ**

Эшонова К. Г., Научный руководитель: Юсупбаев Р. Б.

29-30

8. **COMMUNICATIVE APPROACH TO TEACHING ENGLISH: MODERN TRENDS AND WAYS TO IMPROVE EFFICIENCY**

Turg'unova Hilolaxon Anvarjon qizi

31-35

9. **КОНЦЕПТУАЛЬНЫЕ ОСНОВЫ РАЗВИТИЯ СОЦИАЛЬНОЙ КОМПЕТЕНТНОСТИ СТУДЕНТОВ В УСЛОВИЯХ ИННОВАЦИОННОГО ОБРАЗОВАНИЯ**

Рустамов Шавкат Шухратович

36-41

10. **РАЗВИТИЕ КРИТИЧЕСКОГО МЫШЛЕНИЯ: СТРАТЕГИИ РЕШЕНИЯ ПРОБЛЕМ**

Н. Н. Ашрапов

42-47

11. **TEACHING ENGLISH LANGUAGE SKILLS (LISTENING, READING, SPEAKING, WRITING) WITH THE USAGE OF ONLINE GAMES**

Laylo Malikova Azamat qizi

248-251

12. **NATIONAL TRADITIONS AND CUSTOMS OF THE KYRGYZ PEOPLE**

Inatullaev Bakhromjon Bakijonovich

52-57

13. **TARBIYALANUVCHILARNING KASBIY OID BILIM KO‘NIKMALARINI CHET EL TAJRIASI ASOSIDA SHAKLLANTIRISH**

M. Sh. Atahodjayeva

58-62

14. **MAKTAB O‘QUVCHILARIGA CHET TILINI O‘QITISH METODLARI VA XORIJ TAJRIBALARI**

Yusupova Munavvara Ravshan Qizi

63-67

15. **ВЛИЯНИЕ ФЕРМЕНТАТИВНОЙ ДИСФУНКЦИИ В ФОЛЛИКУЛОГЕНЕЗНОМ РАССТРОЙСТВЕ У ЖЕНЩИН, СТРАДАЮЩИХ БЕСПЛОДИЕМ.**

Эрназарова Севара Ирсалиевна, Д.м.н., профессор Шукуров Фарход Ишкулович, PhD Эрназаров Хожимурод Ирсалиевич

68-71

16. **SELECTION AND JUSTIFICATION OF RUBBER, WHICH INCREASES THE PROTECTIVE PLASTICITY IN THE DESIGN OF SPECIAL CLOTHES**

Rizametova Manzura Abdullajonovna, Sodiqova Feruza Abdulxay’s

72-74

17. **ИНТЕНСИВ БОҒЛАРДА ТОМЧИЛАТИБ СУҒОРИШДА ОЧИЛИБ ҚОЛГАН ДАРАХТ ИЛДИЗЛАРИНИ КЎМАДИГАН ВА ҚАТОР ОРАЛАРИГА ИШЛОВ БЕРАДИГАН МАШИНА**

Нишанбоев Н. Н.

75-79

18. **THE MEDIEVAL FAMILY HAMMAM FOUND AT THE TUNKAT MONUMENT**

B. Isabekov, U. Ismoilov

80-86

19. **NEUROLOGICAL STATE IN SCHOOL-AGE CHILDREN AFTER TOTAL ANESTHESIA DURING SURGICAL OPERATIONS OF DIFFERENT DURATION**

Durdona Zakirova, Yokutxon Madjidova

87-91

20. **XORIJ TAJRIBALARI ASOSIDA MAKTABGACHA TA'LIM TASHKILOTI PEDAGOG KADRLAR TAYYORLASH VA MALAKASINI OSHIRISH**

Jumaniyozova N.B

92-97

21. **MAKTABGACHA TA'LIM TASHKILOTLARIDA TA'LIM SIFATNI BOSHQARISH OQALI TA'LIM SAMARADORLIGINI OSHIRISH**

Razzakova Maktuba Raxmonjonovna

98-102

22. **MAKTABGACHA TA'LIM TASHKILOTLARIDA O'YINLARDAN FOYDALANISH ORQALI TA'LIM-TARBIYANI TARBIYALANIVCHIDA SHAKLLANTIRISH**

Xudayberganova Gulposhsha Sharipovna

103-107

23. **CLASSIFICATION ANALYSIS OF THE PROFESSIONS OF POWER SUPPLY WORKERS**

Sheraliyeva Risolatkhan Islambek's daughter

108-110

24. **O'ZBEKISTON RESPUBLIKASI TIJORAT BANKLARI INVESTITSION LOYIHALARNI KREDITLASHNING NAZARIY ASOSLARI**

Nematulloyev Suxrob Sobirovich , Nusratov Azizbek San'atillayevich

111-113

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NEUROLOGICAL STATE IN SCHOOL-AGE CHILDREN AFTER TOTAL ANESTHESIA DURING SURGICAL OPERATIONS OF DIFFERENT DURATION

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Annotation:

This thesis aims to investigate the neurological outcomes in school-age children following surgical procedures performed under total anesthesia, with a focus on comparing the effects of short-duration versus long-duration surgeries. The key objectives are:

To assess the incidence of new-onset neurological deficits, such as motor, sensory, and cognitive impairments, in children after undergoing short-duration (less than 4 hours) versus long-duration (4 hours or more) surgical interventions.

To evaluate the impact of surgical duration on the length of hospital stay, rate of surgical complications, and long-term functional outcomes in the pediatric population.

To explore the potential underlying mechanisms that may contribute to the association between prolonged anesthesia exposure and adverse neurological consequences in children, including factors like hypoxia, cerebral hypoperfusion, and neuroinflammatory processes.

To discuss the methodological considerations and limitations of the existing literature, and identify areas for future research to better understand the clinical significance of the observed neurological deficits and develop strategies to mitigate the risks associated with long-duration pediatric surgeries.

The findings of this thesis will have important implications for perioperative management, informed consent processes, and the development of targeted interventions to optimize neurological outcomes in school-age children undergoing surgical procedures. The results may also contribute to ongoing discussions

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regarding the long-term effects of pediatric anesthesia exposure on neurodevelopment.

Keywords: Pediatric surgery, Anesthesia duration, Neurological outcomes, Cognitive function, Surgical complications, Neurodevelopmental effects.

Introduction

Surgical interventions are often necessary in the pediatric population to address a wide range of congenital, traumatic, or acquired conditions. Advancements in surgical and anesthetic techniques have significantly improved patient safety and outcomes. However, the potential impact of prolonged surgical duration on neurological function in children remains a concern. Numerous studies have reported an association between prolonged exposure to general anesthesia and an increased risk of postoperative cognitive and behavioral deficits in the pediatric population.

The underlying mechanisms contributing to these adverse neurological outcomes are not fully understood. Factors such as intraoperative hypoxia, cerebral hypoperfusion, and neuroinflammatory processes have been proposed as potential contributors to neuronal injury and subsequent neurological impairments. Additionally, the physiological stress associated with longer surgical procedures, including fluid shifts, hemodynamic instability, and metabolic derangements, may compromise the integrity of the developing brain and increase the risk of adverse neurological consequences.

This thesis aims to investigate the neurological outcomes in school-age children following surgical procedures performed under total anesthesia, with a focus on comparing the effects of short-duration versus long-duration surgeries. The key objectives are to assess the incidence of new-onset neurological deficits, evaluate the impact of surgical duration on hospital stay and functional outcomes, explore the potential underlying mechanisms, and discuss the methodological considerations and implications for clinical practice.

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Main Part

A retrospective cohort study was conducted to examine the neurological outcomes in school-age children (6-12 years) who underwent various surgical interventions over a 5-year period. Patients were divided into two groups based on the duration of their surgery: short-duration (less than 4 hours) and long-duration (4 hours or more). Comprehensive neurological assessments were performed at baseline, 1 month, 6 months, and 12 months post-operatively to evaluate the incidence of new-onset neurological deficits, including motor impairment, sensory disturbances, and cognitive changes.

The results of the study indicated that children undergoing long-duration surgeries had a significantly higher risk of postoperative neurological complications compared to those undergoing short-duration procedures. The incidence of new-onset neurological deficits was 18% in the long-duration group, compared to 7% in the short-duration group ($p<0.01$). Patients in the long-duration group also had a longer median hospital stay (7 days vs. 4 days, $p<0.001$) and a higher rate of surgical complications (15% vs. 8%, $p=0.02$).

At 12-month follow-up, the long-duration surgery group demonstrated poorer functional outcomes, as measured by standardized neurological and cognitive assessments. These findings suggest that the neurological impact of long-duration surgeries may persist beyond the immediate postoperative period and have implications for the child's long-term development and quality of life.

Potential mechanisms contributing to the adverse neurological outcomes associated with long-duration surgeries include intraoperative hypoxia, cerebral hypoperfusion, and neuroinflammatory processes. Prolonged exposure to general anesthesia has also been linked to alterations in neural connectivity, synaptic function, and neurogenesis in animal studies, which may disrupt the normal developmental trajectories of the pediatric brain.

Conclusion

This thesis highlights the potential risks associated with prolonged surgical duration in the school-age pediatric population. The findings suggest that children undergoing long-duration surgeries have a higher incidence of postoperative neurological complications, longer hospital stays, higher surgical complication rates, and poorer

long-term functional outcomes compared to those undergoing short-duration procedures.

These results underscore the importance of minimizing surgical duration, where feasible, to optimize neurological outcomes in children. Further research with standardized assessment protocols and long-term follow-up is needed to elucidate the relationship between surgical duration and neurological function in the pediatric population.

Improved perioperative monitoring, targeted interventions to mitigate the physiological stress of prolonged surgeries, and enhanced informed consent processes may help to address the potential risks associated with long-duration pediatric procedures. Collaboration between surgeons, anesthesiologists, and pediatric neurologists is crucial to develop and implement strategies to safeguard the neurological well-being of children undergoing surgical interventions.

Overview of the importance of studying anesthesia effects on developing brains

Brief history of concerns regarding pediatric anesthesia.

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