# Pre-Operative Management and Its Influence on Maladaptive Behavioural Disorders in Children

Z. Adamcová Petríková[1,*], P. Kenderessy[2], O. Petrík[3] and T. Adamec[4]

[1]*Department of Paediatric Anaesthesiology and Intensive Care, Children University Hospital Banská Bystrica, Slovak Republic*

[2]*Department of Paediatric Anaesthesiology and Intensive Care, Children University Hospital Banská Bystrica, Slovak Republic*

[3]*Department of Paediatric Anaesthesiology and Intensive Care, Children University Hospital Banská Bystrica, Slovak Republic*

[4]*Department of Pharmaceutical Laborants, Medical High School Banská Bystrica, Slovak republic*

**Abstracts:** Anaesthetics and their influence on children's brains have become one of the most discussed problems in paediatric anaesthesiology. The experimental studies on animal models have shown that the anaesthetics used in general anaesthesia should have an influence on neurodegenerative processes, neuroapoptosis and the unregulated death of the neuronal cells in the developing brain. Due to this reality, scientists are trying to discover how to minimize the adverse effects of anaesthesia and revise other alternatives of prevention anaesthesia-induced maladaptive behavioural disorders, especially in children.

The paper will present the procedures of preoperative management at a children's faculty hospital in Banská Bystrica, Slovakia, our working place, and reveal how to minimize the adverse effects of anesthesia presenting in maladaptive behavioural disorders.

**Keywords:** Neurotoxicity of anaesthetics, Maladaptive behavioural disorders, Mechanism of neurotoxicity, Maladaptive behavioural disorders in children, Post-anaesthesia behavioural changes in children, Future of paediatric anaesthesiology.

## INTRODUCTION

The importance of this theme confirm data from retrospective and observational studies appear to indicate behavioural and neurocognitive abnormalities in children who have undergone general anaesthesia. These disorders occur in up to 50% of children operated and are resolved within one month after the operation. This phenomenon is observed more often among younger children (3-6 years) (Deshui, 2017) [1].

The influence of these adverse affects can be seen in acute neuronal damage and neurocongnitive disorders.

Post- operative delirium is a neurological impairment, disturbance in congnition, thinking, memory, concentration, overlapping the adaptation potential of the developing brain.

In critically ill new-born children, especially those with low birth weight, a decrease in IQ, a higher incidence of cerebral palsy and visual and hearing impairments have been reported at their school age. Especially in new-born age, it is very difficult to separate the consequences of stress, homeostasis disorders, surgery and several days of critical condition from the effect of anaesthetics (Mason, 2017) [2].

The findings from prospective study from 2002 was 30% incidence of inconsolable crying during 10 minutes among 10 months – 6 years old children. In 2003 Voepel- Lewis et col. described 18% incidence of post. operative delirium taking 14-45 minutes. (Voepel-Lewis, 2003)

## BACKGROUND

The brain development and growth in a mammalian is a complex process starting with neurogenesis, continuing with the differentiation of neurons into different subpopulations, migration of nerve cells to their definitive localisation in the central nervous system (CNS), synaptogenesis, synapse formation and myelination of neuron-axon connections. These processes significantly depend on the gestational age and species of the mammal in direct relation to the expected life expectancy of the mammal (Moore, 2002) [3].

*Address correspondence to this author at the Department of Paediatric Anaesthesiology and Intensive Care, Children University Hospital Banská Bystrica, Slovak Republic; E-mail: zuzankapetrikova@yahoo.com

E-ISSN: 2311-8687/23

Laboratory studies related to *in vitro* cultures demonstrate the dependence of the extent of neurodegenerative changes on the age of the individual, the dose of anaesthetic and the duration of its exposure. (Clausen, 2018, Berghams, 2019) [6, 7].

A similar effect is described after long-term administration of drugs (especially benzodiazepines) during treatment in intensive care units.

The neurotoxicity of anaesthetics in animals, which persists into adulthood, depends on the dose and number of anaesthetics, the maturity of the developing brain at the time of exposure to the anaesthetics and the presence of other factors, especially inflammatory processes in the body. The combination of all influences increases the sensitivity of the brain to the effect of the anaesthetic (Kamat, 2019, Lei, 2018) [ 4, 9] . "Pharmaceuticals commonly used in intensive care units and operating rooms, such as isoflurane, benzodiazepines, barbiturates, etomidate, propofol and ketamine, are involved in the development of neurotoxicity in animals" (Kamat, 2019) [4].

## MATERIALS AND METHODS

Our study was concerned on maladaptive behavioural disorders and the possibilities of their pharmacological and non - pharmacological interventions.

The aim of this research was to study the procedures of preoperative management at children's faculty hospital, based on theoretical evidence and knowledge about pre-operation management with the increase in recent studies about maladaptive behavioural disorders. (Mason, 2017, Malarbi, 2011, Goldschmidt, 2017) [2, 5, 8]

Based on theoretical knowledge about the structure and the influences of anaesthetics used in paediatric anaesthesiology, their neurotoxic potential and its mechanism, we choose 2 questionnaires: 1) PAED scale – Paediatric anesthesia emergency delirium scale and 2) PHBQ – Post hospitalization behavioural questionnaire, for our research.

The aim of our study was to review possible ways to minimize the adverse effects of anaesthesia, and revise the other alternatives of prevention the maladaptive behavioural disorders after anaesthesia. Questionnaires were focusing on 3 topics. The first was to identify the worries of child patients and their parents before the procedure – PHBQ, which contained 25 questions.

**Table: 1: The Paediatric Anaesthesia Emergence Delirium (PAED) Scale[2]**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | The child makes eye contact with the caregiver. | | | | | |
| 2. | The child's actions are purposeful. | | | | | |
| 3. | The child is aware of his/her surroundings | | | | | |
| 4. | The child is restless. | | | | | |
| 5. | The child is inconsolable. | | | | | |
| Items 1, 2 and 3 are reversed scores as follows: | | 4 = not at all | 3 = just a little | 2 = quite a bit | 1 = very much | 0 = extremely |
| Items 4 and 5 are scored as follows: | | 0 = not at all | 1 = just a little | 2 = quite a bit | 3 = very much | 4 = extremely |
| The scores are summed and the total score correlates positively with the degree of ED. | | | | | | |

Adopted from South Afr J Anaesth Analg (SAJAA), 2011 – The agitated child in recovery.

From: internet -https://slideplayer.com/slide/4059577/

**Table 2: PHBQ Questionnaire**

| n | Factor | Original factor | | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|
| | I | IV | Does your child spend time just sitting or lying and doing nothing? | 0.411 | 0.311 | | | |
| | | I | Does your child need a pacifier? | 0.732 | | | | |
| | | I | Does your child seem to be afraid of leaving the house without you? | 0.634 | | | | |
| | | I | Is your child uninterested in what goes on around him (or her)? | 0.738 | | | | |
| | | VI | Does your child wet the bed at night? | 0.780 | | | | |
| | | I | Does your child bite his (or her) finger nails? | 0.809 | | | | |
| | | VI | Is it difficult to get your child interested in doing things (like playing games, with toys and so on)? | 0.423 | 0.392 | | | |
| | II | IV | Does your child make a fuss about eating? | | 0.901 | | | |
| | | IV | Does your child have a poor appetite? | | 0.850 | | | |
| | III | II | Does your child get upset when you leave him (or her) alone for a few minutes? | | | 0.490 | | |
| | | I | Does your child seem to avoid or be afraid of new things? | 0.314 | | 0.525 | | |
| | | I | Does your child have difficulty making up his (or her) mind? | | | 0.464 | | |
| | | II | Does your child seem to get upset when someone mentions doctors or hospitals? | | | 0.727 | | |
| | | II | Does your child follow you everywhere around the house? | | | 0.573 | | |
| | | VI | Does your child seem to be shy or afraid around strangers? | | | 0.649 | | |
| | IV | II | Does your child spend time trying to get or hold your attention? | | | | −0.558 | |
| | | III | Is your child afraid of the dark? | | | 0.319 | −0.537 | |
| | | I | Is your child irregular in his (or her) bowel movements? | 0.326 | | | −0.436 | |
| | | V | Does your child tend to disobey you? | | | | −0.817 | |
| | | VI | Does you child break toys or other objects? | | | | −0.897 | |
| | | I | Does your child suck his (or her) fingers or thumbs? | | | | −0.897 | |
| | V | III | Does your child make a fuss about going to bed at night? | | | | | 0.826 |
| | | V | Does your child have temper tantrums? | | | 0.366 | | 0.429 |
| | | II | Does your child have bad dreams or wake up and cry? | | | | | 0.488 |
| | | III | Does your child have trouble getting to sleep at night? | | | | | 0.658 |

tor loadings <0.3 are suppressed. Items 10 and 15 omitted.

From: internet- https://www.semanticscholar.org/paper/Behavioural-changes-after-anaesthesia%3A-validity-and-Karling-Stenlund/5b35fc41d0ce61cdfb2c548b0633f327cc0583dd

The second to recognize the incidence of postoperative behavioural changes at the PACU – PAED scale, 5 questions. And the third part points the behavioural changes marked 1 month after the operation – PHBQ, 25 questions. The examples of PAED scale and PHBQ are standardized questionnaire shown on pictures up and were translated to Slovak language.

The study was conducted from September 2020 to February 2021 and contained 100 patients, age 3-10 years, who underwent the procedure in Children Hospital Banská Bystrica, Slovakia. The study took part during the second period of COVID pandemy, but as the children were affected by COVID less than the adults, this didn´t affect our study. Our hospital is one of three children complex health care providers in Slovakia, where specialized paediatric anesthesia and intensive care is performed for children.

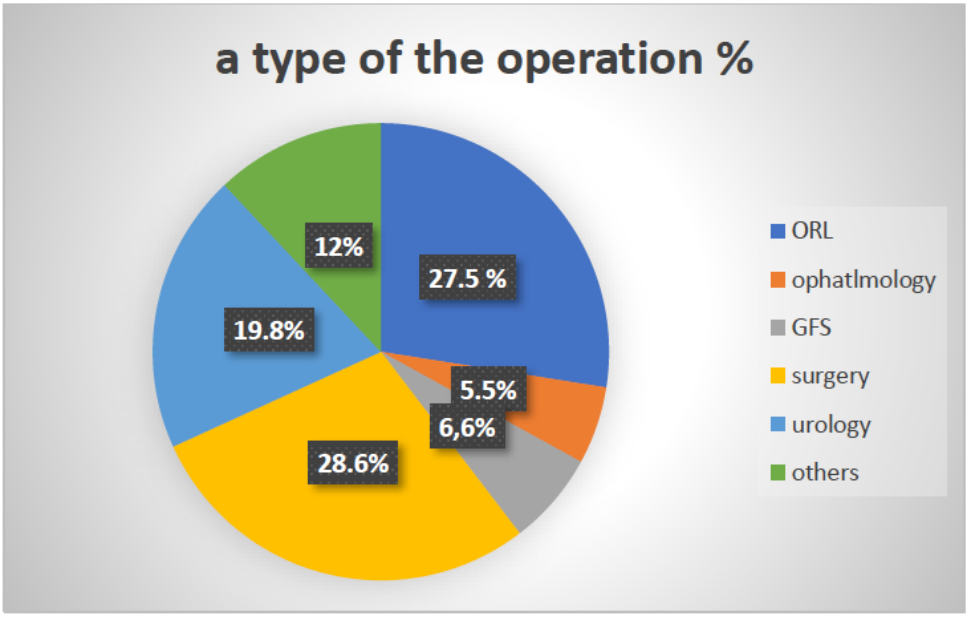
The final number of patients who completed all three parts of questionnaire were 91: 59 boys (65%) and 32 girls (35%). The average age of paediatric patients was 5.41 years, average duration of the operation 40.7 minutes, with a modus and median 30 minutes. We compared children's behaviour during the pre- and post-procedural period.

The questionnaires in 1st and 3rd part were fulfilled by the parents of the patients, 2nd part was fulfilled by the nurses at recovery room.

Accoarding to variety of the operations, we choose the second criterion of their separation -the duration of the operation. But this model had no statistical importance.

We are presenting the results by comparing children behaviour in pre- and post-procedural period.

**The types of operation at our hospital:**




**Graph 1:** Distribution of the types of operations.

**Analysis of 1. and 3. part**

Maladaptive behavioural disorders after anesthesia are defined as a no eye contact with a caregiver, a lack of purposeful actions, restlessness, nervosity, inconsolability and feeling and suffering from pain. All these aspects are involved in the PAED scale.

By analysing the results from 1st part of the PHBQ, we obtained a profile of preoperative behaviour of children after they entered the hospital, without any pharmacological or hospital influence. On the opposite site were the answers from 2nd part PHBQ, which was completed by the parents at home, approximately one month after the hospitalization and probably late onset of adverse effects of anesthetics.

We compared all the 25 question in the graphs. By comparison between the 1. and 3. part of PHBQ with a level of significance 3%, we noticed fewer children were not afraid of hospital care and unknown procedures, as well as the number of children whose problems with concentration increased (3.3 %). We also noticed a correlation between a duration of the operation and incidence of postoperative behavioural disorders. We found an influence between the type of operation and senselessness (50% stomatology) and 100% connection between ORL operations and psychomotoric discomfort.

**Analysis of 2. part**

In analysis of the 2. part of questionnaire we were trying to identify the incidence of maladaptive behavioural disorders at recovery room of children patients in our hospital.

As the highest PAED score should be 20 pp, in our research we noticed 18 pp, the lowest was 0 pp. As higher ist the score, as more probably the behavioural disorder will ocure.

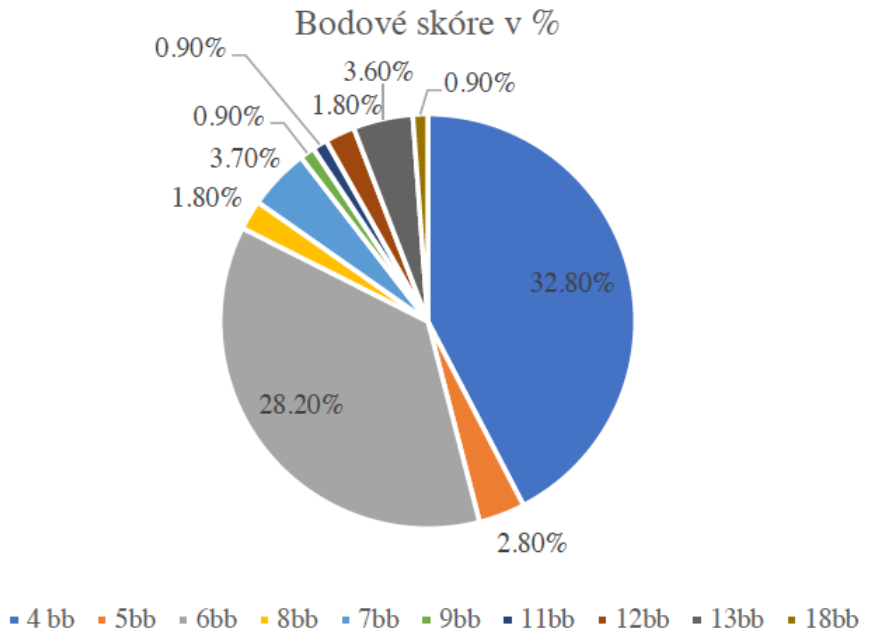
The largest was the group of 4 pp (36 children) and the second largest was group of 6 pp (31 children).

The average PAED Scale score was 5.89 pp, boys 6.0, girls 5.93, modus 6.0 pp, median. According to the variability of the operations, we tried to compare a duration of the operations and scale from the questionnaire, but this mode was not statistically significant.

By quantitative evaluation of the answers to each guestion we obtain the incidence of 46% no eye contact with caregiver, 87% children whose action were purposeful, 80% children were awere of surroundings, only 20 % weren't restless and 3% of children who were inconsolable.

For testing a correlation between the age of the patients and their PAED Scale, we used ANOVA test,

**Score PAED scale:**




**Graph 2:** Percentual distribution of PAED Scale.

P = 0,103; significance level 5% (£ = 0,05). It did not indicate a connection between the age of the patients and the PAED Scale.

We did not find evidence between peripheral nerve blockade and the age of the patient.

Premedication was used only for two patients, so there was no statistical evidence with postoperative maladaptive behavioural disorders.

There was an important statistical connection between the duration of the operation and the PAED Scale. P value 0.00003208, Spearman coefficientis

**Table n.1: Correlation between the Duration of the Operation and PAED**

| Regression Statistics | |
|---|---|
| Multiple R | 0,421103909 |
| R Square | 0,177328502 |
| Adjusted R Square | 0,168085003 |
| Standard Error | 2,652053786 |
| Observations | 91 |

**ANOVA**

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 1 | 134,9294524 | 134,9294524 | 19,18412972 | 3,23089E-05 |
| Residual | 89 | 625,9716465 | 7,033389286 | | |
| Total | 90 | 760,9010989 | | | |

| | Coefficients | Standard Error | t Stat | P-value |
|---|---|---|---|---|
| Intercept | 4,338232446 | 0,450363497 | 9,6327355 | 1,8392E-15 |
| X Variable 1 | 0,036350282 | 0,00829921 | 4,379969146 | 3,23089E-05 |

0,421 – it means statistically medium strong connection between the duration of the operation and the PAED Scale and the risk of maladaptive behavioural disorder.

The longest duration had stomatological attentions with a duration of 90-120 minutes. They were responsible for 50% of emotional distress.

As the ORL children operations are connected by making no eye contact soon after the operation, at our research they had 3. position, after surgical and urological operations.

The urological surgery was most responsible for restlessness (nervosity, inquietude). Awareness of the surroundings was not influenced by the type of operation.

## DISCUSSION

### Conclusion

Actually, the management of many children hospitals is considered to elimination of the pain and bad children experiences from hospital.

In summary, our study highlighted a decrease in the number of children who were afraid without their parents and an increase in the amount of children who had no fear from the hospital and the hospitalization in our hospital.

Since the average age of our patients was 5 years and 5 months which is the age when children are fully capable to realize and reflect their senses and emotions, we are able to ascertain that the pre-operation management in our hospital is well organized and has a positive influence.

The positive fact of our pre-operation management is evident in that we did not notice a sense of uninterpretable fear and nightmares among the children in our research.

Another limitation is that the PHBQ was created in 1960 and is not accurate to circumstances of actual health care and time development. For this reason, we choose the PAED Scale as a complement.

There is an urgent need for the creation of complex questionnaires in paediatric anaesthesia, containing all three phases.

In this study, we tried to determine improvement of our recent preoperative management and the application of these findings by creating new educational and information materials, which will be soon incorporated in practice. The new materials should be adequate to the age, using new modern technologies – notebook, tablet, mobile, internet applications, videos, paper form (colouring book, exercise book).

Using these materials, variable for every age category, will benefit the children, but also their parents, in presenting hospital care and those who are providing care.

Spanish study of M.C. Sanchez- Garcia *et al.* has proved the benefit of clown doctors presence on the reduction of children fear. The French study of J. Hilly from 2015 proved the positive effect pre- operative materials, firgurins. The level of anxiety was measured by PHBQ questionnaire as in our study.

In cooperation with pedagogues, physiologists and other authorities have designed colouring books for children between 3-7 years. We plan to continue making application, project of virtual hospital, and video-clips. They should be distributed by the ambulance, where the doctor books the operation for the child, followed by anesthesiological ambulance, the admission to the hospital and transportation to the operating room. And the story of the colouring book will end with the discharge from the hospital

Future research in paediatric anesthesiology should seek to influence absolute and dose dependent intravenous and inhalation medications on the developing brains of children.

Essentially, the findings of recent studies can help us better understand and identify risk factors, the possibilities of prevention and the therapy of maladaptive behavioural disorders caused by anesthesia.

## REFERENCES

[1] Deshui Y., Linji Li, Neonatal anesthetic neurotoxicity: Insight into molecular mechanism of long- term neurocognitive deficits, Biomedicine and Pharmacotherapy, 2017, p.: 196-199 https://doi.org/10.1016/j.biopha.2016.12.062

[2] Mason K.P., Paediatric emergence delirium: a comprehensive review and interpretation of the literature, British Journal of Anaesthesia, 2017, Oxford University Press, p. 335-343 https://doi.org/10.1093/bja/aew477

[3] Moore Keith L., Persaud T.V.N., The Developing Human: Clinically Oriented Embryology, ISV nakladatelství, 1. Edition, 2002, ISBN: 80-85866-94-3

[4] Kamat P.P., Kudchadkar S.R., The Journal of Pediatrics, 2018, p: 285-290 https://doi.org/10.1016/j.jpeds.2018.08.039

[5] Malarbi S., Stragatt R., Characterizing the behaviour of children emerging with delirium from general anesthesia, Pediatric Anesthesia, 2011, p.942-950 https://doi.org/10.1111/j.1460-9592.2011.03646.x

[6] Clausen N.G., Kähler S., Systemic review of the neurocognitive outcomes used in studies of paediatric anaesthesia neurotoxicity, British Journal of Anaesthesia, 2018, p.: 1255-1273 https://doi.org/10.1016/j.bja.2017.11.107

[7] Berghams J., The influence of preoperative emotional and behavioral function of children on postoperative behaviour: Child Behaviour Checklist ANESthesia Emergence Delirium, https:// www.ncbi.nlm.nih.gov/pubmed/24861721,2019

[8] Goldschmidt K., Woolley A., Using Technology to reduce Childrens'Anxiety Throughout the Perioperative Period, Journal of Pediatric Nursing, 2017 https://doi.org/10.1016/j.pedn.2017.04.006

[9] Lei S., Riva K., Neurocognitive impact of anesthesia in children, Advances in anesthesia, 2018, p.: 125-137 https://doi.org/10.1016/j.aan.2018.07.010

[10] O'Leary J.D., Warner D.O., What do recent human studies tell us about the association between anaesthesia in young children and neurodevelopmental outcomes?, British Journal of Anaesthesia, 2017, p.: 458-464 https://doi.org/10.1093/bja/aex141

Received on 14-10-2023 Accepted on 13-11-2023 Published on 16-11-2023

DOI: https://doi.org/10.12974/2311-8687.2023.11.13