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MANAGEMENT OF CHRONIC POSTSURGICAL PAIN AND HYPERALGESIA IN CHILDREN AND ITS INFLUENCE ON COGNITIVE FUNCTIONING

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Summary

Introduction. Persistent postsurgical pain (PPSP) or chronic postsurgical pain (CPSP) is recognized as a relevant postoperative complication. Inadequate pain management in the early postoperative period may contribute to the development of hyperalgesia and the use of local anesthetics in regional anesthesia can help in its treatment and prevention.

The aim of the study was to study the effectiveness of regional analgesia techniques in preventing PPSP and hyperalgesia in children after anterior abdominal wall surgery and to assess quality of life (QoL) using the Cognitive Functioning Scale.

Material and Methods. The study included 87 children at the age of 7-18 years who underwent anterior abdominal wall surgery with different anesthetic techniques. Group I included 27 children who underwent anterior abdominal wall surgery under general anesthesia using the transversalis fascia plane block (TFPB), combined with the quadratus lumborum block 4 (QLB-4). Group II comprised 33 children who underwent anterior abdominal wall surgery under general anesthesia using fentanyl. Group III consisted of 27 children who underwent anterior abdominal wall surgery under general anesthesia using the TFPB. General anesthesia included either inhalation anesthesia or propofol infusion. The control group included 30 healthy children whose cognitive functioning was assessed.

All clinical and laboratory studies were conducted in accordance with the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects". According to the Law, prior to a subject's participation in the study, a written informed consent form was signed by each subject (parents/adult guardians). The manuscript was approved by the Ethics Committee of the Communal Non-Profit Enterprise "Ivano-Frankivsk Regional Children's Clinical Hospital of Ivano-Frankivsk Regional Council", as evidenced by an Excerpt from the Minute of the Committee Meeting No. 2 dated February 24, 2022.

The results obtained were statistically processed using statistical measures of variation, correlation analysis, Student's *t*-test. Differences were considered statistically significant at $p < 0.05$. The proportions were statistically compared by a *z*-test.

The study is a fragment of the research project of the Department of Children Diseases of Postgraduate Medical Education Faculty, Ivano-Frankivsk National Medical University "Health Status and Adaptation of Children from the Precarpathian Region with Somatic Diseases, Their Prevention" (state registration number 0121U111129; 2021-2026).

Results. A significantly higher mechanical pain threshold was observed in children of Group I and Group III both three (226.4 ± 22.2 , 220.3 ± 18.6 , and 182.4 ± 14.2 g/mm², respectively, $p_{I-II} < 0.05$, $p_{II-III} < 0.05$) and six months (288.2 ± 14.4 , 276.4 ± 14.8 , and 174.2 ± 16.4 g/mm², respectively, $p_{I-II} < 0.05$, $p_{II-III} < 0.05$) after surgery.

The surface area of hyperalgesia in children of Group I and Group III was significantly smaller as compared to children of Group II three (68.6 ± 9.4 , 79.4 ± 11.4 , and 116.8 ± 14.0 mm², respectively, $p_{I-II} < 0.05$, $p_{II-III} < 0.05$) and six months (70.2 ± 13.0 , 77.2 ± 13.2 , and 117.2 ± 12.6 mm², respectively, $p_{I-II} < 0.05$, $p_{II-III} < 0.050$) after surgery.

The frequency of CPSP was higher in children of Group II (21%) as compared to children in Group I (4%) and Group III (11%). Additionally, assessing chronic pain with the DN4 questionnaire showed its significantly lower level in children of Group I and Group III as compared to Group II six months after surgery (5.46 ± 0.42 , 8.69 ± 0.78 , and 13.69 ± 0.38 points, respectively, $p_{I-II} < 0.05$, $p_{II-III} < 0.05$, $p_{I-III} < 0.05$).

No statistically significant difference in QoL assessment on the Cognitive Functioning Scale was observed on the 7th day following surgery; the QoL scores in all the groups were significantly lower compared to the control group. Three months after surgery, QoL was significantly lower in children of Group II (69.38 ± 6.93 points) as compared to children of Group I (92.08 ± 4.46 points, $p_{I-II} < 0.001$) and Group III (83.54 ± 4.16 points, $p_{II-III} < 0.01$). Six months following surgery, the lowest QoL was diagnosed in children of Group II (72.08 ± 6.64) as compared to those in Group I (94.17 ± 4.36 points, $p < 0.001$) and Group III (91.67 ± 4.27 , $p < 0.001$).

Conclusions.

1. The use of general analgesia in combination with regional anesthesia techniques (TFPB or TFPB+QLB) was associated with a higher mechanical pain threshold and a smaller area of hyperalgesia around the postoperative wound three and six months after anterior abdominal wall surgery, compared to conventional anesthesia.

2. In addition, combined use of regional (TFPB or QLB+TFPB) with general anesthesia demonstrated a lower frequency of CPSP, a lower level of chronic pain, and a higher level of cognitive functioning in children throughout these time intervals.

3. The results obtained provide a foundation for introducing these analgesia techniques (TFPB or TFPB+QLB) in pediatric patients undergoing anterior abdominal wall surgery, with the aim of mitigating the effects of pain syndrome and improving their QoL.

Key words: Chronic Postsurgical Pain; Hyperalgesia; Regional Anesthesia; Myofascial Block; Children.

Introduction

Neuropathic pain is defined as pain caused by a lesion or disease of the somatosensory system, followed by impaired perception of touch, pressure, pain, temperature, position, and vibration [1]. A disease, trauma, or medication can

affect the peripheral and/or central nervous system [2, 3], resulting in acute or persistent pain, the intensity of which is maintained by a trigger and/or changes in nociceptive signaling and modulation. Peripheral nerve injury can alter the function of sensory nerves and enhance the transmission

of nerve signals. The ascending pain pathways project to brain areas involved in sensory, affective, and autonomic pain responses, while the descending pain pathways can have both facilitatory and inhibitory effects on spinal nociceptive transmission. Increased excitability and reduced inhibition at multiple levels from the periphery to the brain may contribute to the development of neuropathic pain. As a result, patients may experience hyperalgesia (increased pain in response to a normally noxious stimulus), allodynia (pain caused by a normally non-noxious stimulus), or pain in areas with reduced sensitivity or sensory loss. The diagnosis of neuropathic pain requires a relevant neurological disease or lesion and a neuroanatomically plausible distribution of pain [4], while altered nociception and sensitization without clear signs of peripheral nociceptor activation or somatosensory nerve disorder/lesion are classified as nociplastic pain [5]. Chronic neuropathic pain can be challenging to treat in children as current pharmacological treatments are extrapolated from adult data [6] and often have limited efficacy and/or significant side effects. Pain is often severe and prolonged, and there may be associated impairments in physical, emotional, and social functioning that require interdisciplinary management [7, 8]. In adults, the prevalence of chronic pain is about 30-50%, while neuropathic pain affects approximately 6-11% of the adult population [9]. In children, chronic recurrent pain is common (overall 40-50%), with a tendency to increase during adolescence [10, 11]. Chronic pain that interferes with patient's functioning occurs in 5-6% of cases [12], but the prevalence of neuropathic pain in children is unknown and requires clarification.

Persistent postsurgical pain (PPSP) or chronic postsurgical pain (CPSP) is recognized as a relevant postoperative complication in adults. There is no universally accepted definition of PPSP. The definition proposed by Macrae [13], and later updated by Werner [14], is usually used, which states that PPSP is pain that persists at least three months after surgery (various authors propose different threshold values ranging from two to six months), significantly differs in characteristics and intensity from any other perioperative pain localized to the surgical site or a referred area, and cannot be attributed to the other possible causes of pain (e.g., cancer recurrence, infection). In adults, the reported incidence of PPSP for different surgical procedures ranges from 10% to 80% [15]. Persistent pain can lead to significant suffering and functional disability as well as pose a significant burden for healthcare and the economy. Today, there is an increasing awareness of the impact of PPSP and its consequences in the pediatric patient group. A recent meta-analysis based on four studies involving a total of 628 participants undergoing all types of surgery has found the average PPSP prevalence to be 20% twelve months after surgery [16].

Differentiating neuropathic pain from nociceptive pain in adults using screening tools demonstrates high sensitivity and specificity [17]; however, their assessment and application in children are limited. For example, the Neuropathic Pain Questionnaire (NPQ) [18, 19], the Identification Pain Questionnaire (ID-Pain) [20], and the painDETECT Questionnaire [21] rely solely on questionnaire responses. The Leeds Assessment of

Neuropathic Symptoms and Signs (LANSS) Pain Scale [22] and the Douleur Neuropathique 4 Questions (DN4) [23] use both questionnaire responses and physical tests; therefore, they are more sensitive and specific compared to the previous questionnaires.

Inadequate pain management in the early postoperative period exacerbates the clinical course and prognosis of children by increasing the risk of postoperative complications and contributing to the development of hyperalgesia. Hyperalgesia is a state of increased pain sensitivity induced by intense nociceptive stimulation or exposure to opioids. Hyperalgesia primarily arises at the spinal cord level and is associated with an increase in pain intensity, and, consequently, the development of a stress response to pain, an increased risk of pain chronicization, opioid tolerance, and the necessity for higher opioid doses [24]. Regional anesthesia can impact central sensitization and reduce hyperalgesia after surgery as well. In addition to reducing acute postsurgical pain, local anesthetics reduce acute inflammation, early cytokine production, and central markers of pain sensitization [25, 26]. Studies indicate that regional anesthesia should be used before surgery to achieve intraoperative pain relief and reduce intraoperative opioid use, thus reducing the risk of central sensitization and opioid-induced hyperalgesia [27]. Some authors suggest that the timing of regional anesthesia – preoperatively, intraoperatively, or postoperatively, is less significant compared to the application of regional analgesia in the acute postoperative period [28, 29]. Local anesthetics have been found to act as n-methyl-D-aspartate (NMDA) receptor antagonists; therefore, their use in regional anesthesia may contribute to the treatment and prevention of opioid-induced hyperalgesia [30-36].

The aim of the study was to study the efficacy of regional analgesia techniques in preventing CPSP and hyperalgesia in children after anterior abdominal wall surgery and to assess quality of life (QoL) using the Cognitive Functioning Scale.

Material and Methods

The study included 87 (46 boys and 41 girls) children at the age of 7-18 years who were treated at the surgical department of a Communal Non-Profit Enterprise “Ivano-Frankivsk Regional Children's Clinical Hospital of Ivano-Frankivsk Regional Council”, Ivano-Frankivsk, Ukraine, and underwent anterior abdominal wall surgery with different analgesic techniques during 2020-2022.

Inclusion criteria were children with appendicitis ASA grades I-II at the age of 7-18 years, with the mandatory parental consent to involve their child in clinical research. The patients were randomly selected based on inclusion criteria. Surgery was performed using an open approach, with an incision on the anterior abdominal wall.

Exclusion criteria included children under 7 years of age; those with ASA grade III or higher, mental disorders, neoplasms, or tumors, sepsis, shock; those who previously underwent lower abdominal surgery; those who experienced pain for six months prior to surgery; children whose parents refused to give consent and children who gave no consent.

All children were divided into 3 groups: Group I included 27 children who underwent anterior abdominal wall surgery under general anesthesia using the transversalis fascia plane block (TFPB), combined with the quadratus lumborum block 4 (QLB-4) via a single injection; Group II included 33 children who underwent anterior abdominal wall surgery under general anesthesia using fentanyl; Group III comprised 27 children who underwent anterior abdominal wall surgery under general anesthesia using the TFPB alone. General anesthesia included either inhalation anesthesia or propofol infusion. The control group included 30 healthy children whose cognitive functioning was assessed.

To diagnose hyperalgesia, the pain threshold was determined using a kit of 10 Von Frey monofilaments (VFMs) calibrated to deliver an increasing force from 4 g (39.216 mN) to 300 g (2941.176 mN) (Touch-Test Sensory Evaluator, North Coast Medical, Inc., Morgan Hill, CA, USA) which were placed perpendicularly against the skin surface until they bent, for 1-1.5 s. An interval of 10 s was allowed between trials [16]. The assessment of acute pain and the quality of pain management was carried out by means of the Face, Legs, Activity, Cry, Consolability (FLACC) scale. The FLACC scale scores were determined at discharge in all children.

To assess the presence of chronic or neuropathic pain, the DN4 neuropathic pain diagnostic questionnaire and the LANSS pain scale (M. Bennett, 2001) were used. The DN4 and LANSS scale scores were determined three and six months after surgery, respectively.

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Functioning Scale from the Mapi Research Trust, as evidenced by a corresponding letter.

The results obtained were statistically processed using statistical measures of variation, correlation analysis, Student's t-test. Differences were considered statistically significant at $p < 0.05$. The proportions were statistically compared by a z-test.

The study is a fragment of the research project of the Department of Children Diseases of Postgraduate Medical Education Faculty, Ivano-Frankivsk National Medical University "Health Status and Adaptation of Children from the Precarpathian Region with Somatic Diseases, Their Prevention" 2021-2026, state registration number 0121U111129; the author is a co-researcher.

Results and Discussion

An analysis of group distribution revealed that the average age of children was 11.8 ± 0.11 years, 12.78 ± 0.22 years, and 11.29 ± 0.29 years in Group I, Group II, and Group III, respectively. Body weight was found to be 38.14 ± 1.83 kg, 39.03 ± 1.44 kg, and 37.28 ± 2.99 kg in Group I, Group II, and Group III, respectively. When assessing gender differences, a higher prevalence of the condition was observed in boys across all groups ($56.21 \pm 2.31\%$, $51.4 \pm 0.84\%$, and $62.11 \pm 1.22\%$, respectively).

Postoperative pain management was conducted following the principles of multimodal analgesia. Children who received conventional opioid anesthesia were found to require greater doses of analgesics in the early postoperative period. Thus, children of Group II required paracetamol injections at a dose of 366.93 ± 69.46 ml that significantly exceeded paracetamol dosage in children of Group I (166.63 ± 20.05 ml, $p_{I-II} < 0.05$) and Group III (209.38 ± 47.12 ml, $p_{II-III} < 0.05$), who received regional anesthesia.

To study the manifestations of hyperalgesia in the postoperative period, the mechanical pain threshold and the area of hyperalgesia around the postoperative wound were examined three and six months after surgery, depending on the anesthesia type. The assessment of data on the mechanical pain threshold three and six months after surgery revealed higher indicators in patients of Group I and Group III as compared to children in Group II (Table 1).

Table 1

Mechanical pain threshold and hyperalgesia area (M±m)

Indicators	Study Period		
	Immediately after surgery	Three months after surgery	Six months after surgery
Group I (n=27)			
Mechanical pain threshold (g/mm ²)	196.1±20.4	226.4±22.2*	288.2±14.4*
Area of hyperalgesia around the postoperative wound (mm ²)	-	68.6 ±9.4*	70.2 ±13.0*
Group II (n=33)			
Mechanical pain threshold (g/mm ²)	195.3±18.9	182.4±14.2	174.2±16.4
Area of hyperalgesia around the postoperative wound (mm ²)	-	116.8±14.0	117.2±12.6
Group III (n=27)			
Mechanical pain threshold (g/mm ²)	195.8±19.7	220.3±18.6**	276.4±14.8**
Area of hyperalgesia around the postoperative wound (mm ²)	-	79.4±11.4**	77.2 ±13.2**

Notes: * – a statistically significant difference between Group I and Group II ($p_{I-II} < 0.05$); ** – a statistically significant difference between Group III and Group II ($p_{II-III} < 0.05$).

It should be noted that the determination of the surface area of hyperalgesia zone three and six months after surgery revealed its 1.7-fold reduction in patients who received the TFPB or the combined regional nerve block, TFPB+QLB, in combination with conventional anesthesia, as opposed to selective conventional analgesia.

According to the analysis of questionnaires for chronic pain assessment in children (DN4 questionnaire, LANSS pain scale), in patients of Group II, the prevalence of chronic pain was greater (21%) as compared to Group I and Group III (4% and 11%, respectively), which certainly confirmed the efficacy of the combined QLB+TFPB in conjunction with general anesthesia for the prevention and treatment of both acute pain and chronic pain syndrome.

The comparison of the studied groups revealed a statistically significant difference in the DN4 indicator six months after surgery and the LANSS indicator three and six months after surgery (Table 2). The Fisher's least significant difference (LSD) test for pairwise comparison of groups found a statistically significant difference in the DN4 indicator six months after surgery between all the studied groups ($p < 0.001$). There was a statistically significant difference in the LANSS pain scale indicator three months after surgery between Group I and Group II ($p_{I-II} < 0.001$) as well as Group II and Group III ($p_{II-III} < 0.001$). The Fisher's LSD test for pairwise comparison of groups found a statistically significant difference in the LANSS pain scale indicator six months after surgery between all the studied groups.

Table 2

Chronic pain assessment scales (M±m)

Indicator		Group I	Group II	Group III
DN4	Three months after surgery	4.85±0.19	4.62±0.18	4.54±0.18
	Six months after surgery	5.46±0.42	13.69±0.38*	8.69±0.78 **Δ
LANSS	Three months after surgery	6.62±0.66	12.08±0.31*	7.38±0.76 **
	Six months after surgery	6.38±0.5	13.54±0.33*	10.46±0.35 **Δ

Notes: * – a statistically significant difference between Group I and Group II ($p_{I-II} < 0.05$); ** – a statistically significant difference between Group III and Group II ($p_{II-III} < 0.05$); Δ – a statistically significant difference between Group I and Group III ($p_{I-III} < 0.05$).

The results of the assessment using the PedsQL™ 3.0 Cognitive Functioning Scale questionnaires on the scale of Cognitive Functioning showed differences both compared to the control groups and among the study groups.

In healthy children of the corresponding age (the control group), the average QoL on the Cognitive Functioning Scale scored 91.46±5.97 points.

Compared to the control group, in children of Group I, QoL on the Cognitive Functioning Scale reduced by 40.32% on the seventh day after surgery (54.58±6.75 points, $p < 0.01$) and approached the values of the control group three (92.08±4.46 points, $p > 0.05$) and six months (94.17±4.36 points, $p > 0.05$) following surgery.

Compared to the control group, in children of Group II, QoL on the Cognitive Functioning Scale reduced by 40.77% on the seventh day after surgery (54.17±7.4 points, $p < 0.01$), by 24.15% three months following surgery (69.38±6.93 points, $p < 0.01$), and by 21.18% six months postoperatively (72.08±6.64 points, $p < 0.01$).

In children of Group III, compared to the control group, QoL on the Cognitive Functioning Scale reduced by 41% on the seventh day of the study (53.96±7.21 points, $p < 0.01$) and by 8.66% three months following surgery (83.54±4.16 points, $p < 0.01$), approaching the control values six months postoperatively (91.67±4.27 points, $p > 0.05$).

When comparing the study groups, no statistically significant difference in QoL assessment on the Cognitive Functioning Scale was observed on the 7th day following surgery; the QoL scores in all the groups were significantly lower compared to the control group.

Three months after surgery, QoL was significantly lower in children of Group II (69.38±6.93 points) – by 24.66% as compared to children of Group I (92.08±4.46 points, $p_{I-II} < 0.001$) and by 24.15% as compared to children of Group III (83.54±4.16 points, $p_{II-III} < 0.01$). It should be

noted that while using regional anesthesia techniques, TFPB+QLB, QoL approached the control values as early as three months after surgery.

Six months following surgery, the lowest QoL on the Cognitive Functioning Scale was diagnosed in children of Group II (72.08±6.64), which was 23.45% lower as compared to children in Group I (94.17±4.36 points, $p < 0.001$) and 21.17% lower than in children of Group III (91.67±4.27, $p < 0.001$). Moreover, six months after surgery, QoL on the Cognitive Functioning Scale approached the control values when using both the TFPB and TFPB+QLB and remained the lowest when using conventional analgesia.

Thus, the analysis conducted has demonstrated that, compared to conventional opioid analgesia, combined use of regional (TFPB, QLB+TFPB) with general anesthesia increases the mechanical pain threshold, reduces the area of hyperalgesia around the postoperative wound as well as the incidence of chronic pain syndrome, and contributes to maintaining a sufficient QoL level on the Cognitive Functioning Scale three and six months after anterior abdominal wall surgery.

Conclusions

1. The use of general analgesia in combination with regional anesthesia techniques (TFPB or TFPB+QLB) was associated with a higher mechanical pain threshold and a smaller area of hyperalgesia around the postoperative wound three and six months after anterior abdominal wall surgery, compared to conventional anesthesia.

2. In addition, combined use of regional (TFPB or QLB+TFPB) with general anesthesia demonstrated a lower frequency of CPSP, a lower level of chronic pain, and a higher level of cognitive functioning in children throughout these time intervals.

3. The results obtained provide a foundation for using these analgesia techniques (TFPB or TFPB+QLB) in pediatric patients undergoing anterior abdominal wall surgery, with the aim of mitigating the effects of pain syndrome and improving their QoL.

4. When choosing a regional anesthesia technique, we consider TFPB+QLB as a more priority option due to its ease of administration (via a single injection), higher mechanical pain threshold, lower incidence of chronic pain syndrome, and better QoL.

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Prospects of further research

Further research on the impact of regional anesthesia techniques on hyperalgesia processes and triggers for the development of CPSP is promising.

Conflict of Interests. The authors have no conflicts of interest to declare.

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МЕНЕДЖМЕНТ ХРОНІЧНОГО ПІСЛЯОПЕРАЦІЙНОГО БОЛЮ І ГІПЕРАЛГЕЗІЇ У ДІТЕЙ ТА ЙОГО ВПЛИВ НА КОГНІТИВНУ АКТИВНІСТЬ

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Резюме

Вступ. Постійний післяопераційний біль (persistent postoperative pain, PPSP) або хронічний післяопераційний біль (chronic postsurgical pain, CPSP) визнано важливим післяопераційним ускладненням. Неадекватне лікування болю в ранньому післяопераційному періоді може сприяти розвитку гіпералгезії, а використання місцевих анестетиків у регіональній анестезії може допомогти її запобіганню та лікуванню.

Метою дослідження було оцінити ефективність методик регіонарної анальгезії в профілактиці PPSP та гіпералгезії у дітей після хірургічного втручання на передній черевній стінці та оцінити якість життя (quality of life, QoL) за шкалою когнітивної активності.

Матеріал і методи дослідження. Обстежено 87 дітей віком 7-18 років, які перенесли операцію на передній черевній стінці з використанням різних методик знеболювання. I групу склали 27 дітей, оперованих на передній черевній стінці, під загальним знеболенням із застосуванням регіонарного блоку поперечної фасції живота (transversalis fascia plane block, TFPB) у поєднанні з блокадою квадратного м'яза попереку (quadratus lumborum block 4, QLB-4); II групу склали 33 дітей, оперованих на передній черевній стінці під загальним знеболенням із використанням фентанілу; III групу склали 27 дітей, оперованих на передній черевній стінці, під загальним знеболенням із застосуванням регіонарного блоку поперечної фасції живота (TFPB). Загальне знеболення включало або інгаляційний наркоз, або інфузію пропофолу. Контрольну групу склали 30 здорових дітей, у яких оцінювалась когнітивна активність.

Усі клінічні та лабораторні дослідження проводились відповідно до Гельсінської декларації Всесвітньої медичної асоціації «Етичні принципи медичних досліджень із залученням людей». Відповідно до законодавства перед участю в дослідженні кожний суб'єкт (батько/опікун) підписував письмову інформовану згоду. Рукопис погоджено Етичною комісією КП «Івано-Франківська обласна дитяча клінічна лікарня Івано-Франківської обласної ради», про що свідчить витяг з протоколу засідання комісії № 2 від 24 лютого 2002 р.

Отримані результати були статистично оброблені з використанням показників статистичної варіації, кореляційного аналізу, t-критерію Стьюдента. Відмінності вважалися статистично значущими при $p < 0,05$. Пропорції статистично порівнювали за z-тестом.

Дослідження є частиною наукового проекту кафедри дитячих хвороб факультету післядипломної медичної освіти Івано-Франківського національного медичного університету «Стан здоров'я та адаптація дітей Прикарпаття із соматичними захворюваннями, їх профілактика» (державний реєстраційний номер 0121U111129; 2021-2026 рр.).

Результати дослідження. Встановлено достовірно вищий поріг механічного болю у дітей I та III груп, порівняно з дітьми II групи, як через 3 місяці (відповідно $226,4 \pm 22,2$, $220,3 \pm 18,6$ та $182,4 \pm 14,2$ г/мм², $p_{I-II} < 0,05$, $p_{II-III} < 0,05$), так і через 6 місяців (відповідно $288,2 \pm 14,4$, $276,4 \pm 14,8$ та $174,2 \pm 16,4$ г/мм², $p_{I-II} < 0,05$, $p_{II-III} < 0,05$) після оперативного втручання.

Периметр зони гіпералгезії у дітей I та III груп, порівняно з дітьми II групи, був достовірно меншим через 3 місяці (відповідно $68,6 \pm 9,4$, $79,4 \pm 11,4$ та $116,8 \pm 14,0$ мм², $p_{I-II} < 0,05$, $p_{II-III} < 0,05$) та 6 місяців (відповідно $70,2 \pm 13,0$, $77,2 \pm 13,2$ та $117,2 \pm 12,6$ мм², $p_{I-II} < 0,05$, $p_{II-III} < 0,050$).

Частота хронічного післяопераційного болю була вищою у дітей II групи (21%) порівняно з дітьми I групи (4%) та III групи (11%). При цьому, оцінка хронічного болю відповідно до тесту DN-4 показала достовірно менший його рівень у дітей I та III груп порівняно з дітьми II групи через 6 місяців після оперативного втручання (відповідно $5,46 \pm 0,42$, $8,69 \pm 0,78$ та $13,69 \pm 0,38$ балів, $p_{I-II} < 0,05$, $p_{II-III} < 0,05$, $p_{I-III} < 0,05$).

Встановлена відсутність достовірної різниці оцінки якості життя за шкалою когнітивної активності на 7 добу життя після оперативного втручання, яка в усіх групах була достовірно нижчою, порівняно з контрольною групою. Через 3 місяці після оперативного втручання дана оцінка була достовірно нижчою у дітей II групи ($69,38 \pm 6,93$ балів), порівняно з дітьми I групи ($92,08 \pm 4,46$ балів, $p_{I-II} < 0,001$) та з дітьми III групи ($83,54 \pm 4,16$ балів, $p_{II-III} < 0,01$). Через 6 місяців найнижча оцінка якості життя за шкалою когнітивної активності також була діагностована у дітей II групи ($72,08 \pm 6,64$) порівняно з дітьми I групи ($94,17 \pm 4,36$ балів, $p < 0,001$) та з дітьми III групи ($91,67 \pm 4,27$ $p < 0,001$).

Висновки.

1. Використання методів комбінованої загальної та регіональної анестезії (TFPB або TFPB+QLB) асоційовано з вищим порогом механічного болю та меншою площею поверхні гіпералгезії через 3 та 6 місяців після оперативного втручання на передній черевній стінці, порівняно з традиційною анестезією.

2. Застосування комбінованої загальної та регіональної анестезії (TFPB або TFPB+QLB) також продемонструвало меншу частоту формування хронічного післяопераційного болю, менший рівень хронічного болю та вищий рівень когнітивних здібностей у дітей через дані проміжки часу.

3. Отримані результати надають підґрунтя щодо впровадження даних методик знеболення (TFPB або TFPB+QLB) у педіатричних пацієнтів, які потребують оперативного втручання на передній черевній стінці, для зменшення наслідків больового синдрому та покращення їх якості життя.

Ключові слова: хронічний післяопераційний біль; гіпералгезія; регіонарна анестезія; міофасціальний блок; діти.

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