Medicine of emergency

UDK

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THE USE OF PROLONGED EPIDURAL INFUSION OF BUPIVACAINE TO REDUCE THE SIGNS OF INTRA-ABDOMIBAL HYPERTENSION, TO IMPROVE BLOOD FLOW IN GREAT ABDOMINAL VESSELS AND TO CARRY OUT ADEQUATE ANALGESIA IN THE EARLY POSTOPERATIVE PERIOD IN CHILDREN WITH ONCOPATHOLOGY

Summary.
The study was conducted in 32 children, who were operated for tumors of the abdominal cavity. Depending on the method of anesthesia, patients were divided into 2 groups: in the first group, epidural anesthesia (EA) with continuous intravenous infusion of fentanyl was used; in the second group, only continuous intravenous infusion of fentanyl was used. Multicomponent analgesia (EA and continuous intravenous infusion of opioid analgesics) significantly reduces the negative effects of inadequate analgesia in children and promotes effective analgesia after traumatic operations, minimizes the signs of intra-abdominal hypertension syndrome and improves blood flow in the vessels of the abdomen.
Key words: *analgesia, intra-abdominal hypertension, resistance index.*

Introduction

Major causes of inadequate analgesia in postoperative period in children include the following: absence in pediatrics of generally accepted and simple techniques for assessment of pain severity; administration of narcotic analgesics is rare and in less doses than needed for avoiding side effects; impossibility or limitation of use of effective up-to-date techniques for postoperative analgesia and conviction of some physicians that such children are less nociceptive [1-3]. In the practice of postoperative pain relief in children as well as in other age groups, the first place is given to narcotic analgesics with traditional way of administration, i.e. intramuscular [4].

According to many authoritative investigators, inadequate and ineffective analgesia in early postoperative period occurs in 30 - 50 % of patients; moreover, the nearest (early) postanesthetic period is considered to be a weak link of anesthetic management [1, 2]. Inadequate analgesia in the early postoperative period worsens the course and forecast of the recovery period in children as well as increases mortality due to increased risk of sepsis development and postoperative complications such as intra-abdominal hypertension syndrome and impairment of blood flow in the great abdominal vessels.

Notwithstanding the long list of opioid and non-opioid analgesics, epidural anaesthesia (EA) is the best and most effective technique of the postoperative pain relief.

Prolonged epidural anaesthesia and analgesia are more often used in surgeries and in the following period for pain relief. The prolonged epidural anaesthesia allows to significantly reduce the number of drug products administered both in

anaesthesia period and in the early postoperative period, which is very important taking into account a concomitant pathology in adult patients and combination of surgery and administration of polychemotherapy [1 -4].

The prolonged epidural anaesthesia allows to refuse from the introduction of opioid analgesics as well as to considerably accelerate the process of intestinal peristalsis recovery and the beginning of early enteral feeding, and to reduce incidence of complications associated with the surgery [4, 6].

The aim of this study was to compare efficiency and safety of usage of epidural anaesthesia combined with opioid analgesics through assessment of intra-abdominal pressure values and changes in blood flow in the abdominal vessels during surgeries of tumors of the abdominal cavity in children.

Objects and Methods of the Study

The study was performed in 32 children (12.6 ± 3.0 years) after surgery of retroperitoneal space tumors (24 children, 75 %) and ovarian tumors (8 children, 25%). All patients received multimodality intensive therapy: infusion and transfusion therapy; breathing support via Hamilton C2 apparatus - ASV mode with the following settings: FiO_2, 30 %, PEEP 2 cm H_2O, PIP 15—20 cm H_2O; antibiotics therapy; syndromic treatment.

The assessment of analgesia efficiency in the early postoperative period was performed using visual analogue scale (VAS) Observation Scale for Infants and Small Children. The following parameters were evaluated: intra-abdominal pressure (IAP) by Kron technique [6, 8], abdominal perfusion pressure (APP), cortisol blood level, clinical picture of postoperative anaesthesia. Doppler velocimetry was performed additionally to evaluate mesenteric blood flow in the upper mesenteric artery, renal artery and splenic artery. The examination was carried out without preliminary preparation of a patient via LOGIQ BOOK-XP machine using a convex probe 3.5 - 5.0 MHz and a microconvex probe 4 - 8 MHz in real-time mode with measured compression by an abdominal wall probe. On the basis of the evaluation of Doppler spectrum, the quantitative parameters of blood flow in the arterial vessels were defined, namely: Vps – peak systolic velocity – maximum blood velocity in the examined vessel, Ved – end diastolic velocity – maximum blood velocity in the examined vessel at end diastole, Pourcelot, RI – resistive index – a ratio of difference of peak systolic and end diastolic velocity to peak systolic velocity: IR = (Vps – Ved)/Vps.

The study was carried out on the following stages of anaesthesia: stage 1 - 12th hour after surgery; stage 2 - 24th hour; stage 3 - 36th hour; stage 4 - 48th hour, and stage 5 - 72nd hour after surgery.

Statistical processing of obtained data was performed by methods of variation statistics using Statistica 5.5 software (owned by the CNIT of VNMU named after M.I. Pyrohov, license No. AXXR910A374605FA). Mean values, standard deviations and mean errors were determined and assessed. Probability of value differences between quantitative parameters in case of normal distribution was determined using Student's t-test and Fisher's test. Differences at $p < 0.05$ were considered statistically significant.

Results

The first group of 18 patients received for pain relief continuous epidural analgesia with 0.5 % bupivacaine (Longocain manufactured by Yuria-Pharm LLC) administered at a dose of 0.3- 0.4 mg/kg (average dose is 0.32 ± 0.24 mg/kg) and continuous infusion of fentanyl at dose of 10 mcg/kg/h (average dose is 10.2 ± 0.4 mg/kg); in 14 children from group 2 the analgesia was performed using continuous infusion of fentanyl at dose of 10 mcg/kg/h (average dose is 10.4 ± 0.3 mg/kg) [2 - 4].

The combined spinal epidural anaesthesia was performed by the standard technique: the epidural space was punctured at the level of LI-LII segment using a special dual lumen pencil-point needle (Braun B., 18/27 G), after which a thinner and longer spinal needle was advanced through the epidural needle to puncture subarachnoid space. After liquor obtaining, 0.5 % bupivacaine was injected at a dose of 0.15 - 0.2 (0.18 ± 0.04) mg/kg. After removal of the spinal needle, the catheter was inserted into the epidural space in the cranial direction and the calculated dose was injected [1, 7, 8].

The average score demonstrating pain severity in the early postoperative period at all stages of the study, according to visual analogue scale, in patients from group 1 was significantly lower than the corresponding values of the indices in patients from group 2 ($p < 0.05$) (Fig. 1).

Indications for administration of additional boluses of opioid analgesics were as follows: pain behavior, desynchronization with mechanical

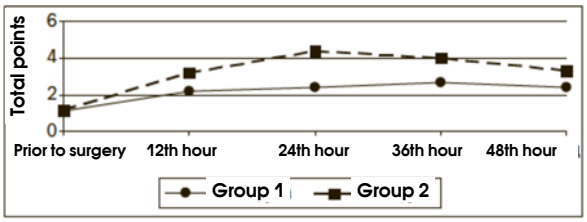

Figure 1. Average score according to VAS ($p < 0.05$) when comparing pain relief in groups 1 and 2.

ventilation and tachycardia. In the first group,

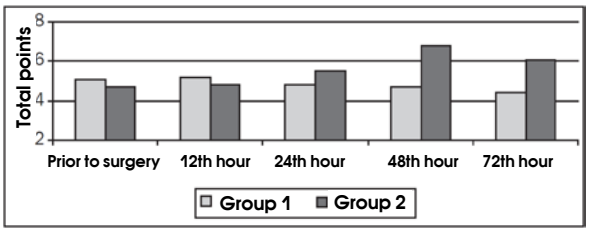

Figure 2. Dynamics of blood cortisol levels (nmol/l), p < 0.05 when comparing pain relief in groups 1 and 2

additional administration of morphine was not required, and in group 2, additional boluses of morphine were administered to 2 children (14.2 %).

It is known that blood cortisol level is one of the indices of stress reactions including pain reaction. Dynamics of blood cortisol level in postoperative period is demonstrated in Fig. 2.

The dynamics of blood cortisol levels in group 1 is indicative of elimination of severe stress in the most of children during first 12 - 72 hours after surgery. This stress emergence was associated with the underlying disease or surgery conducted with the following sufficient postoperative analgesia.

Examination of the arterial circulation in the superior mesenteric artery and renal artery revealed the high resistance index in group 2 - 0.98 ± 0.02 and 0.92 ± 0.05, respectively; in group 1, it was 0.74 ± 0.04 and 0.69 ± 0.04 (norm is 0.6 - 0.8) ($p < 0.05$), which pathogenetically reflects the blockade of the microcirculatory bloodstream and, as a consequence, ineffective analgesia [7 - 9].

The same trend was observed when evaluating the intraperitoneal pressure. For example, in group 2, the intraperitoneal pressure was considerably higher than in group 1 (14.98 ± 4.02; in group 1 - 5.42 ± 2.2) after initiation of prolonged infusion of bupivacaine ($p < 0.05$).

It should be noted that in patients from group 2, the abdominal perfusion pressure was significantly higher than in patients from group 1 - 64.8 ± 4.2 (57.4 ± 6.4 - in group 1) ($p < 0.05$), which is indicative of normalization of the intraperitoneal pressure and, possibly, of adequacy of analgesia (Table 1).

Find below the description of a medical case that arouses interest due to its clinical course, anatomic features and, at the same time, is indicative of the efficiency of the epidural analgesia with the prolonged infusion of bupivacaine.

Medical case

A 2.5-year-old child V., MKSKh No. 1443, was hospitalized 29.02.2012 in the onco-hematology unit of the VDOKL due to complaints of enlargement of abdomen. According to the parents, the enlargement of abdomen was noted some 2 weeks earlier. The family sought medical attention in the community outpatient clinic where abdominal ultrasound was performed, which revealed a tumor mass. Prior to the disease diagnosis, the child has been developing according to the age; injuries were rejected by the parents. Hereditary oncological history was not burdened; vaccinations were received according to the age.

The general state of the patient on admission was rather critical due to the underlying disease. Consciousness was maintained. The skin and mucous membranes were pale pink and clear. Peripheral lymph nodes were not enlarged. HR - 97 per minute, RR - 22 per minute. The abdomen was enlarged, had the shape of a ball, participated in

Table 1. Variations of indices of the abdominal blood flow and intraperitoneal pressure at the study's stages (M ± m)

Indices	Study's stage				
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Group 1(infusion of fentanyl + EA with bupivacaine)					
IAP	11,7 ± 2,2	7,4 ± 4,1*	5,9 ± 2,0*	5,4 ± 1,8*	5,2 ± 2,2*
APP	64,4 ± 4,4	65,2 ± 4,0*	63,5 ± 2,8*	65,3 ± 5,1*	64,6 ± 3,4*
IR (a.mes.sup)	0,74 ± 0,04	0,64 ± 0,03*	0,62 ± 0,02*	0,68 ± 0,07*	0,72 ± 0,04*
IR (a.renal.dex.)	0,68 ± 0,06	0,63 ± 0,04*	0,70 ± 0,04*	0,69 ± 0,05*	0,70 ± 0,08*
IR (a.renal.sin)	0,70 ± 0,08	0,66 ± 0,04*	0,72 ± 0,02*	0,78 ± 0,07*	0,74 ± 0,04*
Group 2 (infusion of fentanyl 10 mcg/kg/h)					
IAP	14,9 ± 2,2	14,4 ± 4,1	14,9 ± 2,0	15,0 ± 1,8*	11,2 ± 2,6*
APP	60,8 ± 4,4	55,5 ± 3,2*	52,2 ± 2,6*	52,4 ± 6,0*	58,4 ± 4,8*
IR (a.mes.sup)	0,79 ± 0,02	0,94 ± 0,02*	0,90 ± 0,04*	0,98 ± 0,07*	0,92 ± 0,03*
IR (a.renal.dex.)	0,70 ± 0,04	0,97 ± 0,03*	0,96 ± 0,08*	0,99 ± 0,03*	0,93 ± 0,09*
IR (a.renal.sin)	0,78 ± 0,02	0,91 ± 0,03*	0,94 ± 0,04*	0,98 ± 0,02*	0,89 ± 0,02*

Note. * p < 0.05 when comparing pain relief in groups 1 and 2.

respiratory movements, and was symmetrical. On palpation, the abdomen was soft and nontender. On palpation, there was detected a mass 10 x 11 cm in dimensions of dense-elastic consistence. A tumor-like mass was nontender and had smooth and uniform surface. Symptoms of peritoneal irritation were negative in all parts. On auscultation, the motility was ordinary; abnormal noises were not heard. The liver and spleen were not palpated. The intra-abdominal pressure amounted to 21 cm H2O.

Taking into account the severity of the condition, the child was transferred to the resuscitation unit with the diagnosis "abdominal mass" to carry out additional examination and preoperative preparation. Complete blood count on admission was as follows: Hb — 118 g/l, RBC — 3.9 • 1012/l, WBC — 6.2 • 109/l, stab — 1, seg. — 69, EOS — 1, MON — 3, lymph. — 27, ESR— 8 mm/h. On abdominal ultrasound, a mass lesion 120 x 140 mm in dimensions was revealed. After an appropriate preoperative preparation, left-sided transverse laparotomy 7 cm long was performed.

The general anaesthesia included: total intravenous anaesthesia (propofol + fentanyl), mechanical ventilation in PSV mode according to the age parameters. Surgery duration - 3.0 hours. Induction: propofol 3 mg/kg, fentanyl 3 mcg/kg i.v., myoplegia - succinylcholine 2 mg/kg, intubation - tube Nos. 4, 5 with no special feature. Anaesthesia maintenance - continuous infusion of propofol according to the following scheme: 10 mg/kg/h for the first ten minutes, 8 mg/kg/hour for the next ten minutes and 6 mg/kg/hour thereafter. Analgesia - continuous infusion of fentanyl 10 mcg/kg/hour and infusion of 0.125 % bupivacaine (Longocain, Yuria-Pharm) into the epidural space. The following myoplegia was maintained by arduan 0.06 mg/kg for the first 40 minutes with the following dose decline to 0.02 mg/kg. During surgery the rate of fentanyl infusion was increased by 3 mcg/kg/hour.

The intraoperative infusion therapy was performed using polyionic solutions. The intraoperative monitoring of vital signs: in the preoperative and intraoperative period the arterial blood pressure (AP) was within the age norms: systolic AP - 90-100 Mmhg, diastolic AP - 55-60 Mmhg; HR - 110 - 115 bpm; SPO2 97–99 %.

During laparotomy it was revealed that a tumor mass of big size was adjacent to the incision (Fig. 3). At exploration of the small intestine, 1 - 1.5 m apart from the ligament of Treitz, it was revealed that the tumor mass extended to the both sides of the mesentery and tied to it intimately. Resection of a compromised intestine area along with a wedge-shaped cutting off of the changed area of its mesentery and ganglion was conducted. End-to-end enteroenterostomy using a double row suture was performed. Mutual mesentery of small and large intestine was revealed. Lavage of the abdominal cavity. Postoperative wound was oversewn in layers.

Figure 3. Abdominal tumor in patient V., MKSKh No 1443, at surgery

The catheterization of the epidural space was performed intraoperatively. Postoperative pain management was carried out using the continuous infusion of the local analgesic - 0.125 % bupivacaine (Longocain, Yuria-Pharm) - into the epidural space. The additional administration of opioid analgesics in the course of postoperative pain management was not required. Blood glucose and cortisol levels were similar to the preoperative levels. At the start point of 0.125 % bupivacaine infusion after removal of the tumor-like mass, an increase of IAP up to 12 cm H20 and IR up to 0.925 was observed (Fig. 4). 10 - 15 minutes after the beginning of the infusion into the epidural space, a normalization of IAP value up to 4 cm H2O and IR value up to 0.694 was observed (Fig. 5).

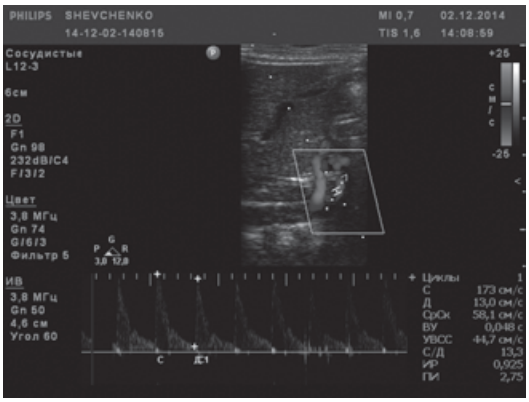

Figure 4. Sonogram at the start point of bupivacaine infusion in patient V., MKSKh No. 1443

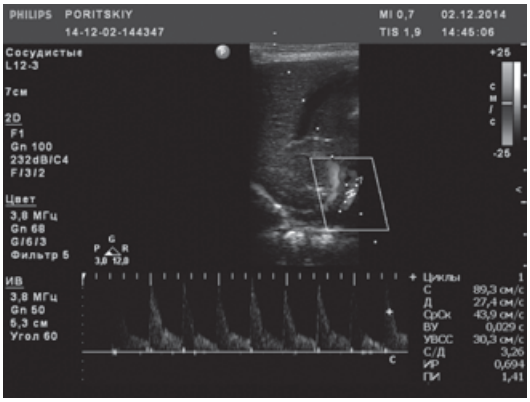

Figure 5. Sonogram in the 15th minute of bupivacaine infusion in patient V., MKSKh No. 1443

On March 1, 2012 the patient was transferred to the somatic unit. The course of the postoperative period was satisfactory; flatus in the patient passed in 36 hours post surgery and the child started walking 48 hours post surgery. The postoperative wound healed by primary adhesion. The child was discharged from hospital in a satisfactory condition on March 5, 2012.

Thus, the effectiveness of usage of EA and prolonged infusion of fentanyl is grounded on the possibility to impact various mechanisms of pain occurrence - both the central mechanism (opioid analgesics) and the peripheral mechanism (EA) [9]. EA administration minimizes significantly the signs of intra-abdominal hypertension syndrome and improves blood flow in the great vessels of the abdomen. Different mechanisms of action of these drug products allow to administer them in combinations and in small doses with the aim to achieve a considerable analgesic effect and to improve the course of the early postoperative period.

Conclusions

1. Comprehensive evaluation of the reactions of pain behaviors, physiological parameters and laboratory stress tests showed that the usage of EA with bupivacaine continuous infusion for the postoperative pain relief provides an effective analgesia after traumatic surgery.

2. The use of EA with bupivacaine continuous infusion for the postoperative pain relief minimizes the signs of intra-abdominal hypertension syndrome and improves blood flow in the great vessels of the abdomen in children after surgery of abdominal tumors.

3. EA significantly reduces the negative effects of inadequate analgesia in children after surgery of abdominal tumors, and EA could be administered in the postoperative period.

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