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ULTRASOUND INVESTIGATION CENTRAL HEMODYNAMICS AS A METHOD OF ASSESSMENT EFFECTIVE ANALGESIA IN CHILDREN

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Summary: The study was include in 23 children (12,4±1,2 years) operated on for tumors of the retroperitoneal space (14 children, 61%), renal tumors (6 children, 26%), ovarian cancer (3 children, 13%) showed that a comprehensive study of the reactions of pain behavior and central hemodynamics by ultrasonography showed that the use of the scheme KSME bupivacaine 0.3-0.4 mg / kg and a continuous infusion of drugs (fentanyl in a dose of 10 mcg/kg/h) for postoperative pain relief leads to effective analgesia after traumatic operations and comprehensive ultrasound including color and spectral Doppler studies, is the main tool by enabling timely and accurately assess the condition of the central hemodynamics at different methods of analgesia.

Key words: central hemodynamics, ultrasound, anesthesia.

Introduction. According to many authoritative researchers inadequate and ineffective analgesia in early postoperative period is observed in 30-50% of patients, while closest postnarcosis period is considered to be a weak link of anesthesiological support [1,2]. Among the main causes of inadequate analgesia in early postoperative period in children are: absence of universally accepted and simple methods of assessment of pain syndrome severity in

pediatrics; rare use of narcotic analgesics and in smaller dose then needed to avoid side effects; impossibility and limiting the use of effective modern methods of postoperative analgesia and convictions of doctors that these children are less sensitive to pain [3]. In the structure of postoperative analgesia in children, as in other age groups, the main place is occupied by narcotic analgesics, the traditional administration route is intramuscular [4]. In world practice complex ultrasound investigation, including gray-scale scan (B-mode), color and spectral Doppler study, regarded as one of instrumental diagnostics and monitoring of general anesthesia adequacy [6-8]. A few foreign and native publications, devoted to the capabilities of complex ultrasound investigation in the assessment of general anesthesia and patients dynamic observation in different terms of early postoperative period, are conflicting and require evaluation from positions of personal experience. This was the reason for performing this study.

Objective – definition of ultrasound evaluation criteria of analgesia adequacy in early postoperative period.

Materials and methods: Research conducted in 23 children (12,4 ± 1,2 years) operated on for tumors of retroperitoneal space (14 children, 61%), renal tumors (6 children, 26%), ovarian tumors (3 children, 13%). Patients underwent complex intensive treatment: infusion and transfusion therapy, respiratory support with "Hamillton C2" – ASV mode by parameters (FiO2, 30%, PEEP 2 см H_20, PIP 15-20 см H_20), antibacterial treatment, syndromic therapy. Assessment of analgesia effectiveness in early postoperative period was performed using visual-analogue scale (Observation Scale for Infants and Small Children), parameters studied: respiratory rate (RR), heart rate (HR), systolic blood pressure (BPsist), diastolic (BPdiast), average blood pressure (ABP), oxygen saturation (SaO2), CO2 concentration in exhaled air (CO2 ET), cortisol blood level, anesthesia clinical flow. Parameters of central hemodynamics was additionally studied without previous preparation of the patient, with LOGIQ BOOK–XP device, using convex sensor 3,5-5,0 MHz, microconvex sensor 4-8 MHz, in real time: stroke volume (SV), minute circulation volume (MCV). Parameter registration held automatically using monitor "Datascope" and "Novometrix". Research was held on the next analgesia stages: 1^{st} stage – beginning of surgical intervention, 2^{nd} stage – traumatic moment of surgical intervention, 3^{rd} stage – the end of operation, 4^{th} stage – 6 hours after operation snd 5^{th} stage – 12 hours after operation.

Statistical analysis of the data is carried out using variation statistics methods and Student criterion.. Differences considered to be reliable in $p<0,05$.

Results: First group – 13 patients, who received combined spinal-epidural andlgesia (CSEA) with bupivacaine 0,5% in 0,3-0,4 mg/kg dose (average dose 0,35±0,2 mg/kg) and continuous fentanyl infusion in 10 mcg/kg/h dose (average dose 10,1±0,2 mg/kg), 10 children from 2nd group received continuous fentanyl infusion in 10 mcg/kg/h dose (average dose 10,5 ±0,3 mg/kg) [2,3,4] . CSPEA anesthesia was performed by standard technique at L1 segment level [1,7,8]. Indications for additional narcotic analgesics boluses injection were pain behavior, desynchronization with mechanical ventilation and tachycardia.

In the first group there was no need for additional morphine injections, in 2nd group 4 children (40%) received additional morphine (0,5 mg/kg) boluses. The average amount of point, which characterized the pain syndrome intensity in early postoperative period at all stages of study (by visual-analogue scale - Observation Scale for Infants and Small Children) in 1st group patients was reliably lower ($p<0,05$) corresponding values in 2nd group. HR analysis in 1st group children found that in the majority of patients (11 children, 91,6%) average HR during fentanyl infusion and CSEA was lower than 120 b/min.

The minimum value of the average HR for the entire study time was 111,2± 6,2 b/min, maximal - 125,0±5,2 b/min. In the 1st group the average value of systolic BP during the whole time of drug administration was 74,4±4,2 mmHg, and average value of the diastolic BP for the entire study time - - 51,2± 2,3 mmHg. In the 2nd group in the majority of children (9 children, 60%) the average HR value during fentanyl infusion was less than 140 b/min. Minimal average HR during the whole study was 130, 4±2,0 b/min, maximal - 144,4±4,2 b/min.

In the study of the second group the mean values of systolic blood pressure during fentanyl infusion was found that in 7 children (70%) this value was more than 80 mmHg, in 8 patients (80%) the average value of systolic BP was between 57-78 mmHg. Analysis of central hemodynamics parameters, such as stroke volume and minute circulation volume according to the ultrasound data showed more stable parameters in the 1st group patients, which is associated with adequate analgesia (see Table № 1).

Table №1

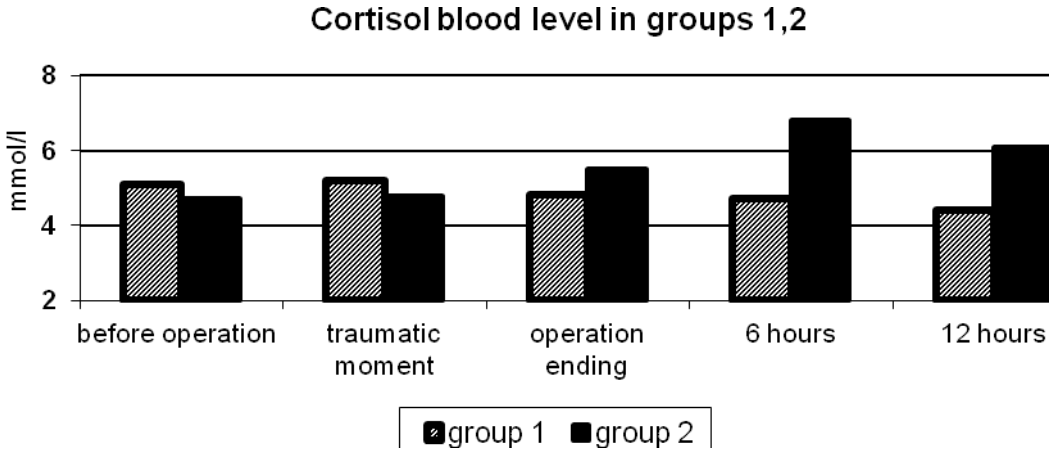
Changes of hemodynamics, pulse oximetry and capnometry parameters on research stages (M ± m).

Parameters	Research stage				
	1st stage	2nd stage	3rd stage	4th stage	5th stage
First griup (fentanyl infusion) + CSEA					
HR	134,4±10,4	122,2±8,3*	120,4±9,2*	130,3±10,3*	134,4±13,2*
BP_{syst}	72,1±1,3	72,2±1,2	71,3±1,6	70,3±1,2	69,3±1,2
BP_{diast}	43,3±1,4	40,3±1,4	39,4±1,6	42,2±1,3	44,4±1,4
SaO_2	96,1±0,4	97,4±0,2*	97,2±1,4	98,4±0,2	98,2±1,4
SV(ml)	10,2 ±1,1	10,4 ±1,2	10,8 ± 1,3	10,8 ±1,1	10,3 ± 1,2
MCV(l)	1,7 ±0,2	1,8 ±0,2*	1,8 ±0,1*	1,3 ±0,2	1,4 ±0,4
CO_2 et.	37,4±1,2	37,0±1,2	38,0±1,1	36,1±1,1	38,2±0,9
Second grou[(fentanyl infusion 10 mcg/kg/h)					
HR	136,4±7,4	152,3±8,2	140,2±10,1	150,4±7,3	142,3±6,2
BP_{syst}	71,4±1,4	74,2±1,4	73,3±1,4	76,4±1,2	74,2±1,3
BP_{diast}	42,3±1,3	40,3±1,3	42,6±1,4	42,4±1,4	41,4±1,2
SaO_2	96,2 ±0,1	96,2±0,1	95,8±0,2	98,1 ±0,1	98,0±0,2
SV(ml)	10,3 ±2,1	10,2 ±1,9	10,6 ± 2,0	11,0 ±1,2	10,5 ± 1,4
MCV(l)	1,6 ±0,2	1,2 ±0,1	1,2 ±0,2	1,4 ±0,2	1,3 ±0,3
CO_2 et.	37,4±0,8	36,8±1,2	37,8±1,4	35,8±1,2	38,4±1,0

Note: * $p < 0,05$ when compared anesthesia in the 1st and 2nd groups.

Prolonged tachycardia was registered in 2 children from the 1st group (15,3%), while only in one child it was associated with pain. In the majority of children tachycardia was registered since admission to the department from operating and was associated with hypovolemia, intoxication, perhaps with inadequate intraoperative analgesia and disappeared during infusion therapy. The possible reduction of mean value of HR and BP in patients of the 1st group on the study last stages may indicate the elimination of hemodynamic changes related to the underlying disease or operation and the achievement of sufficient level of analgesia and sedation. Isolated hemodynamic changes, that indicate pain, are fairly rare. In most cases, they are short-term in response to increasing physical activity during the reaction

of pain behavior. It is known that cortisol is one of the indicators of stress reaction, including pain. Cortisol blood level dynamics in postoperative period is shown on diagram №2.



Pic 2. Cortisol blood level dynamics (nmol/l), $p < 0,05$ comparing anesthesia in 1st and 2nd group.

Cortisol blood level dynamics in the 1st group on liquidation of severe stress in majority of children during first 12-24 hours after operation, which occurrence is associated with main illness or operation and sufficient analgesia after operation.

Thus, the efficiency of using of CSEA and continuous fentanyl infusion is based on the possibility to influence different mechanisms of pain as central (narcotic analgesics) and peripheral mechanisms (CSEA) [9]. CSEA can significantly lower requirement of opioids , and their combination can restore opioid analgesic potential. Various mechanisms of action of these drugs allow to assigh them in combination and small doses for negative impact on central hemodynamics parameters. Using of complex ultrasound investigation, which includes grey-scale scan (B-mode), color and spectral Doppler study, allows time to evaluate state of central hemodynamics and diagnose signs of inadequate analgesia.

Conclusion:

1. Complex study of pain behavior reactions, central hemodynamics parameters by ultrasound showed that using of scheme of CSEA with bupivacaine 0,3-0,4 mg/kg and continuous drug infusion method (fentanyl 10 mcg/kg/h) for postoperative analgesia results in effective analgesia following traumatic operations.
2. Complex ultrasound investigation, which includes grey-scale scan, color and

spectral Doppler study, is the main instrumental method to timely and reliably asses state of central hemodynamics with different methods of analgesia.

3. Holding of multimodal analgesia (CSEA and continuous opiod analgesic infusion) significantly reduces the negative effect of inadequate analgesia in children operated on for tumors of abdominal cavity and improves central hemodynamic parameters, such as stroke volume and minute circulation volume.

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