Efficiency estimation of intrapleural and thoracic paravertebral block in combination with general anesthesia at thoracoscopic interventions

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Summary

Background. Efficiency of intrapleural and thoracic paravertebral block in combination with general anesthesia in patients performed thoracoscopic interventions due to traumatic injuries of thorax have been studied.

Aim of the study. The aim of our investigation is the efficiency estimation of intrapleural (IPA) and thoracic paravertebral analgesia(TPVA) in composition of combined anesthesia in intra- and post-operative periods in patients with chest traumatic injuries.

Materials and methods. 90 patients admitted to RRCEM in urgent way with chest traumatic injuries have been examined. They have been divided into 2 groups against to the applied method of anesthesia and post-operative pain relief. The above mentioned investigations have been carried out at the following levels: Intra-operative period: 1 – outcome – before the anesthesia; 2 – after block; 3 – traumatic moment of the operation; 4 – the end of operation; Post-operative period: 1 – before the pain relief; 2 – 30 minutes after pain relief; 3 – 3 hours after pain relief; 4 – 6 hours after pain relief. Extubation time in both patients groups, analgetic first needs time have been recorded, calculation of the used phentanil narcotic analgesic intra-operationally and also it has been calculated the use of promedol narcotic analgesic in the post-operative period.

Results. The received results shows that the use of the regional way of anesthesia in combination with general anesthesia promotes a smooth course of intra- and post-operative periods with the minimal tension of hemodynamic indexes, less revealed pain syndrome in post-operative period, has the economic effect shown up by the decrease of the use of narcotic analgetics both in intra- and post-operative periods.

Conclusion. 1. Both method of the regional anesthesia cut short a pain syndrome sufficiently and safety in patients with chest injuries before an operative intervention. 2. Introduction the component of IPA and TPVB into anesthesia scheme at thoracoscopic operative interventions allows to provide it the additional antinociceptive protection both in intra- and in post-operative period with minimal stress of central and peripheral parameters and promotes the reduction of narcotic analgesic use due to significant analgetic efficiency and neuro-vegetative protection. 3. In spite of good analgetic efficiency of IPA, pain relief duration using this method is lower and it is connected with mixing the local anesthetic introduced into pleural area with serous fluid secreting by pleura and as the result of it a concentration of local anesthetic is reduced and its duration is shortened. Also the presence of drainage tube promotes outflow of the local anesthetic from pleural cavity together with exudates.

Key words: anesthesia, thoracoscopic interventions, analgetics

BACKGROUND

Chest injuries and traumas has become one of the most often reasons for admitting patients to emergency surgical hospitals for the last years. At the presence of the chest trauma, bleeding or lung injury it is usually performed thoracoscopy with the aim of pleural cavity revision. It is known that operations on the chest are one of the most traumatic ones as visceral and parietal pleuras are rich in nociceptive receptors and as a rule, they are performed by switching one lung off from the ventilation and can require a long-termed wide rupture of respiratory tracts' lumen and it is the cause of intra-operative gas exchange disorder, pulmonary and system hemodynamics [1,3,8].

In early post-operative period under the pain influence such patients often had hypoxemia and hypercapnia with the development of respiratory acidosis due to hypopnoe and the limitation of respiratory excursion. That is why just after recovery it is necessary to achieve patient's productive cough and early motor activity. It can be achieved only at the adequate anesthesia [2,6]. All it dictates definite requirements to anesthesia at thoracic interventions which can be stated as follows: a reliable antinociception, well gas exchange managing, rapid recovery and self-reliant respiration, high quality analgesia both at the recovery and at the early post-operative period [7].

It has been proved by many investigations for the last years that modern inhalation and intravenous ways of the general anesthesia are not able to completely block of passing nociceptive impulses neither at spinal nor at supraspinal levels and do not prevent the development of the response reaction on a surgical stress [4,9,10]. Another result of insufficient antinociceptive protection at the peripheral and segmental levels of SNC block are the changes of neuronal flexibility of nociceptive system with forming peripheral and central concaveation and hyperalgesia. Nowadays for preventing the secondary hyperalgesia they use "preemptive analgesia" way by performing afferent block with local anesthetics of nociceptive stimulation associated by the surgical intervention. So, balanced anesthesia is pharmacological means in combination with regional methods effecting on physiological processes fulfilling nociception, transmission, modulation and perception on the multimodal base. [3,10]. The main point of regional anesthesia contains in the block of conducting nociceptive impulses from operation sphere at different levels proximal from the surgical approach [11].

AIM OF THE STUDY

The aim of our investigation is the efficiency estimation of intrapleural (IPA) and thoracic paravertebral analgesia(TPVA) in composition of combined anesthesia in intra- and post-operative periods in patients with chest traumatic injuries.

MATERIALS AND METHODS

90 patients admitted to RRCEM in urgent way with chest traumatic injuries have been examined. They have been divided into 2 groups against to the applied method of anesthesia and post-operative pain relief.

There were 47 patients in the first (control) group, average age of them was 38,5±2,4 years (36 men and 11 women). This patients' group has been used in premedication ketonal in the dose of 100 mg on the principle of preventive analgesia and also Dimedrol and atropine. IPA has been done before the induction into anesthesia into the second intercostal space from the damaged side with local anesthetic bupivakain in the dose of 75-100 mg. Catheter has been left in the pleural cavity for the recurrent introduction of the local anesthetic as needed and for post-operative pain relief. The induction into anesthesia was carried out intravenously by introduction of dormicum 0,8-1mg/kg (5-10mg), phentanil 3-5 mkg/kg, ketamin 1,2 mg/kg. General anesthesia has been maintained by dormicum, ketamin in the dose of 0,8-1mg/kg with the aim of NMDA receptors block. Analgetic component has been maintained by the above mentioned IPA and phentanil bolus dosing. The average duration of operative intervention in that group was 65,4±7,6 min.

The second group has been made up from 43 patients, the average age of them was 36,8±5,4 years (32 men and 13 women). One-sided TPVB has been maintained before the induction at Th_{IV}, Th_{VII} levels 0,5% -5 ml (25 mg) bupivacain dosing (at the average totally 750100ml) with the posterior paravertebtal area's catheterization for the post-operative pain-relief. After efficient paravertebral block it has become the induction into anesthesia 0,8mg/kg dormikum, 3mkg/kg phentanil, 1,2 mg\kg ketamin dosing intravenous. Analgetic component has been maintained by paravertebral analgesia and phentanil bolus dosing. The average duration of operative intervention in that group was 63,7±8,9 min. Post-operative pain relief has been maintained in ICU. Patients of the first group have been maintained 25-50 mg bupivacain bolus dosing into intra-pleural cavity, the second groups patients has been maintained 25-50 mg bupivacain bolus dosing into paravertebral catheter. In both groups 300mg of ketonal a day and narcotic analgesic promedol have been added as needed.

According to the physical state and the nature of the revealed disorders patients of both groups have been rated to II-III class by ASA.

Artificial pulmonary ventilation (APV) by semienclosed circuit has been carried out by «Fabius» (Drager, Germany). Non-stopped monitoring of blood pressure (BP), heart rate (HR), ECG, SatO2 has been fulfilled by «Nikon-Kohden» (Japan) monitor.

The central hemodynamics indexes based on EchoCG have been analyzed in peri-operative period, there were registered systolic blood pressure (SBP), diastolic blood pressure (DBP),average blood pressure (ABP), heart rate (HR), stroke volume (SV), ejection fraction (EF), general peripheral vascular resistance (GPVR) which were counted upon the following formula:

$$ABP = DBP + (SBP-DBP) / 3 \quad (1)$$

$$SV = FDV-FSV \quad (2)$$

$$EF = FDV-FSV/FDV \quad (3)$$

$$GPVR = ABP/CO \quad (4)$$

Acid-base blood status (ABBS), pO_2, pCO_2, BE of arterial and arterialized capillary blood have been determined by «Medica Easy Blood Gas» (USA) apparatus.

The above mentioned investigations have been carried out at the following levels: Intra-operative period: 1 – outcome – before the anesthesia; 2 – after block; 3- traumatic moment of the operation; 4 – the end of operation; Post-operative period: 1 – before the pain relief; 2 – 30 minutes after pain relief; 3 – 3 hours after pain relief; 4 – 6 hours after pain relief. Extubation time in both patients groups, analgetic first needs time have been recorded, calculation of the used phentanil narcotic analgesic intra-operationally and also it has been calculated the use of promedol narcotic analgesic in the post-operative period.

The pain estimation in the post-operative period has been carried out by visual- analog scale (VAS). The character of the operative intervention in both groups was practically identical: thoracoscopy with post-traumatic hemothorax elimination – 35 (38,8%); thoracoscopy with post-traumatic pneumothorax elimination – 15 (16,6%); thoracoscopy with the closure of the ruptured bulla – 28 (31,1%); mini- thoracoscopy with the closure of the lung injured parts – 12 (13,3%).

RESULTS

Our investigations have revealed that both groups patients admitted to operation room with existing respiratory failure conditioned by the chest injury, hemo- pneumothorax with hypertension and tachycardia which has been regarded as organism's reaction on trauma pain. The conducted premedication has not removed the pain totally and at the admission to the operation room all the patients have felt the pain equal to 7-8 points by VAS which fits severe pain.

Hemodynamics indexes in intra-operative period given in Table 1. have undergone the following changes. In both groups at the initial level (before the block) according to pain sensation, the main hemodynamics indexes were high. A significant difference between groups in hemodynamics indexes has not been revealed.

After conducting the regional blocks – IPA in the first group and TPVB in the second one - a significant decrease of hemodynamics indexes has been pointed. ABP in the 1st group in compare with the initial level of investigation has been decreased on 23,5% , HR – on 29,2% and GPVR on 18,4%.In turn, SV and EF after IPA in the 1st group have been increased on 24% and 11%. In the second one after TPVB ABP has been decreased on 27%, HR – on 33,3%, GPVR – on 17,1 % in compare with the initial level of investigation.SV index has been raised on 24,3% and EF index has been increased on 11% in compare with the initial level of investigation, approaching to the normal ones. So, reduction of painful factor by use of IPA and TPVB has promoted the solving of medium respiratory failure. It has been also managed to achieve normalization of the main hemodynamics indexes.

The differences in hemodynamics indexes appeared at the traumatic moment of operation (thoracoscopy and mini-thoracotomy with the further chest cavity revision).Thus, in the group with using IPA the medium hypertension with ABP raise on 25,5%, higher rate of HR on 26,1%, GPVR on 22% were observed and it was followed by the decrease of SV on 24,6% and EF on 13% on compare with the 2nd group. There were not significant difference between groups neither in surgical interventions volume nor in the volume of hemorrhage and infusion. Conducting anesthesia in the 1st group hyperdinamic reactions of the systemic hemodynamics at the separate traumatic levels of operation were followed by unbalance of hemodynamic rhythms indicating about insufficient prevention from surgical aggression. During the traumatic moment of operative intervention in the 2nd group as the results of the development of segmental sympathetic block the indexes of ABP, HR and GPVR were not higher than normal ones. The raise of SV, decrease of GPVR with simultaneous raise of EF and also

Tab. 1. Hemodynamics indexes in intra-operation period

Indexes	Out-come – before anesthesia		After block		After trachea intubation		Traumatic moment of operation		The end of operation	
	I	II	I	II	I	II	I	II	I	II
SBP, mm. m.c..	150,2±1,8	148,5±2,1,	118,5±1,3*	112,6±1,5*	110,3±1,4**	115,4±1,6**	138,4±2,4**	110,4±1,5**	125,2±1.,2	117,3±2,0
DBP, mm, m.c.	98,6±2,4	99,3±1,2	73,3±1,1*	70,2±0,9*	68,3±0,8**	67,6±0,7**	90,4±0,8**	65,4±0,5**	81,5±1,1	74,3±0,9
ABP, mm, m.c.	115,8±1,4	115,3±1,7	88,3±0,9*	84,3±0,8*	82,3±0,8**	83,5±0,9**	106,4±1,6**	80,4±0,9**	96,0±1,1	88,6±0,9
HR per min.	110,7±1,5	108,5±1,7	78,4±0,9*	72,4±0,9*	67,5±0,9**	68,7±0,8**	100,2±0,8**	74,1±0,5**	91,4±0,7	78,1±0,5**
GPVR, din.sm.-5	1342,5±10,5	1355,7±11,2	1095,9±12,4*	1124,8±11,6*	1152,7±10,6	1167,1±12,1	1313,7±12,2**	1022,3±9,8**	1320,8±11,6	1076,4±10,5**
SV ml.	62,5±0,4	62,7±0,6	82,2±0,7*	82,8±0,8*	84,6±0,5	83,3±0,3	64,4±0,8	85,5±0,7	63,6±0,6	84,4±0,5
EF %	52,5±0,8	53,4±0,9	58,6±0,9*	59,4±0,7*	60,4±0,7	59,3±0,8	54,3±0,6	62,4±0,7**	53,8±0,5	60,4±0,6**

* $p < 0,05$ in compare with initial level ** $p < 0,05$ in compare with the 1st group

the decrease of post- load due to sympathetic block, improving of diastolic relaxation of miocard with improvement of tissue perfusion testified to saving activity of cardio-vascular system.

By the end of operative intervention the indexes of HR were higher in the 1st group on 15% and GPVR on 18,6% in compare with the 2nd one. SV index in the 1st group was 24,7% lower and EF index was 11% lower in compare with the 2nd group. The above pointed dynamics of hemodynamics indexes obviously pointed on good anesthetic effect of both regional blocks in pre-operative period at chest injuries. In intra-operative period neuro-vegetative prevention and analgesic efficiency of IPA is lower than at TPVB.

ABBS indexes are given in the Table 2. As it is shown in the Table, there were appearances of respiratory acidosis in all patients at the initial level and it might be connected with pain factor and respiratory limitation due to rib fracture.

After conducting regional anesthesia of IPA in the 1st group and TPVB in the 2nd one, there is some improving of ABBS revealing by pH raise, PO_2 increasing on 25,8% in both groups. pCO_2 index has been also decreased on 11,6% in the 1st group and on 16,3% in the second one, BE index has been normalized in compare with the initial level. At the further levels of operative intervention ABBS indexes had a normal size.

The accounted phentatanil used in intra-operative period has revealed the followings: In the 1st group where it has been used the general anesthesia with IPA there have been used up 560,4±85,4 mkg , in the 2nd one - 450,3±83,5 mkg of phentatanil. In the group with the use of TPVB it has been noticed the decrease of phentatanil on 20% in compare with the group using IPA. It proves once again the high analgesic efficiency of TPVB, especially during operative interventions at chest injuries with hemo- and pneumo-thoraxes eliminations. Time from the initiation of operative intervention till patients' extubation in the 1st group was 62,5±9,2 min. and it was authentically 43,2% higher than in the 2nd group where the same index was 35,5±5,4 min. Such comparison has revealed the extubation time prolongation in 1st group in

Tab. 2. ABBS indexes in intra-operative period

Indexes		Out-come	After block	After trachea intubation	Traumatic moment of operation	The end of operation
pH	I II	7,23±0,3 7,24±0,2	7,36±0,6 7,38±0,7	7,37±0,6 7,35±0,8	7,37±0,7 7,35±0,4	7,38±0,8 7,4±00,9
pCO2	I II	45,8±4,6 47,5±3,2	40,5±4,3* 39,7±8,5*	34,6±7,8 36,3±9,1	36,4±9,2 33,8±5,4	34,8±9,1 35,9±8,3
pO2	I II	65,1±6,7 62,8±5,7	87,7±9,8* 84,8±9,3*	98,2±6,5 98,7±8,3	96,9±9,8 98,2±7,4	98,3±8,4 98,7±7,5
BE	I II	-3,3±0,04 -3,2±0,05	-2,5±0,08 -2,7±0,04	1,2±0,01 1,1±0,02	1,3±0,05 1,2±0,04	1,2±0,01 1,3±0,06

* p < 0,05 in compare with the initial level

Tab. 3. Hemodynamics indexes in the post-operative

Indexes		Before pain relief	30 min. after pain relief	3 hours after pain relief	6 hours after pain relief
SBP mm. m.c.	I II	158,4±1,6 140,2±1,2	120,2±1,3* 114,6±1,3*	130,8±1,6 110,2±1,4**	126,2±1,3 116,2±1,6
DBP mm. m.c.	I II	92,6±1,2 80,6±1,5	75,4±1,5* 70,5±1,6*	86,7±1,5 68,6±1,4	80,6±1,3 65,3±1,2**
ABP mm. m.c.	I II	114,5±0,5 100,4±0,8*	90,5±1,8* 85,4±1,3*	101,3±1,7 82,4±1,2**	96,1±1,4 82,2±0,2**
HR per min	I II	92,6±1,5 88,7±1,3	78,4±1,2* 70,1±1,5*	89,4±1,4 76,1±1,2*	88,2±1,3 74,4±1,1**
GPVR din.sm.-5	I II	1524,7±15,1 1401,5±13,4	1111,8±10,3* 1169,9±10,5*	1422,3±12,3 1047,4±9,3**	1343,7±11,5 1070,3±9,6**
SV ml	I II	65,6±0,8 67,3±0,7	83,1±0,2* 83,4±0,9*	64,8±0,3** 82,8±0,5**	65,3±0,7 83,4±0,4**
EF%	I II	54,3±0,9 56,7±0,8	59,3±0,3 60,4±0,9	54,7±0,7 59,4±0,5**	54,8±0,6 60,3±0,2**

* p < 0,05 in compare with initial level, ** p < 0,05 in compare with control group

compare with the 2nd one and it has proved the efficiency of TPVB as analgesic component and reducing APV duration due to less use of narcotic analgesics in intraoperative period.

Patients from the 1st group have complained of pain just after extubation, VAS in quiescent mode was 6-7-points and it needed the introduction of local anesthetic 0,5 % bupivakain 75 mg intra-pleurally in combination with intravenous introduction of promedol 20 mg. So, analgesic first needs time (AFNT) in the 1st group was 78,1±8,5 min. The same index in the 2nd group was 150,3±7,9* min. Comparing both groups we have pointed significant prolongation of AFNT on 48% in the 2nd group and it has proved a longer efficiency of pain relief using TPVB. Pain estimation by VAS in the 2nd group was 3-4 points (pict.1).

Hemodynamics indexes in post-operative period have changed according to painful sensation by both groups patients (Table 3). At the level of investigation of post-operative period – before pain relief starting there were no differences in hemodynamics indexes between groups. At the 2nd level of investigation there were reductions of ABP on 21%, HR on 15,4% in the 1st group. In the 2nd group against the background of using TPVB by bupivakain 50mg, ABP decreased on 16,9% and HR – on 22,7%. GPVR index has been reduced on 27% against the background of pain relief. SV has been increased due to the normalization of hemodynamics on 21%. There were reductions of ABP on 15%, HR on 21% in compare with the initial level in the 2nd group. GPVR has been reduced on 16%. SV has increased on 19,4%.

3 hours after pain relief it has been pointed the significant difference in hemodynamics indexes between groups. ABP in the 1st group was significant higher on 18,7%, HR – on 15%, GPVR – on 26,4% in compare with the 2nd one.SV was significant higher on 21,8% in the 2nd group.

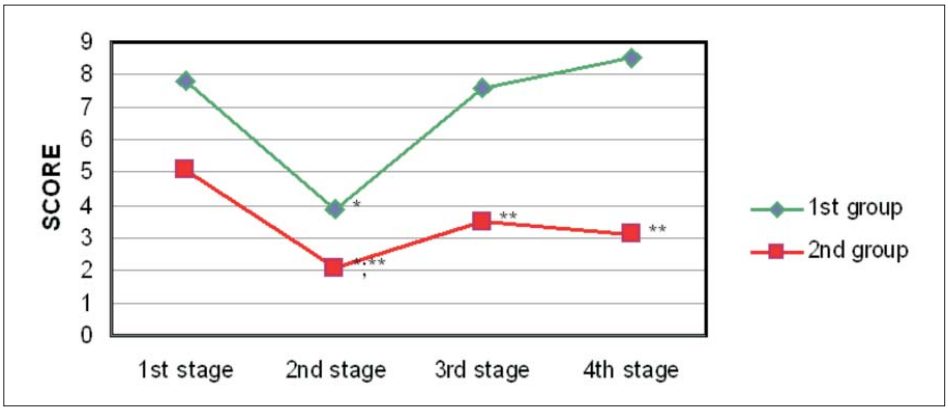
Concerning to VAS patients of the 1st group had 7-8 points pain sense and it corresponded to medium pain by subjective scale of pain estimation (pict.1).2nd group patients felt less intensive pain and it was significant lower on 55,8% in compare with the control group patients. 2nd group patients had post-operative pain relief duration longer, higher and more effective than 1st group ones. 60% of 1st group patients at this investigation level needed additional pain relief and analgesic promedol 20mg once has been used.

6 hours after pain relief hemodynamics indexes in both groups had the following differences. ABP was 15% higher, HR – 16% higher and GPVR – 20 % higher in the 1sr group. SV and EF have changed accordingly to BP and HR, decreasing on 22% and 10% correspondingly. Subjective pain estimation index by VAS shows a better quality and pain relief duration in patients who has been performed GPVR combined with non-steroid antiinflammatory drugs (NSAID)

The dynamics of investigated ABBS indexes in the post-operative period has not revealed any significant changes. Decreased $đÎ_2$ and increased $ŃÎ_2$ indexes have been changed at the top of painful sensation by patients but they have not been out of the normal sizes.

The total drugs consumption used for post-operative pain relief in both groups is given in the Table 4. As it

Fig. 1. Pain estimation by VAS in post-operative period



Tab. 4. The total drugs consumption for post-operative pain relief in both groups

Name of drug	I group IPA+ NSAID+ narcotic (as needed)			II group TPVB+NSAID+narctotic (as needed)		
	1-day	2-day	3-day	1-day	2-day	3-day
Promedol 2%, mg	40	20	—	20	—	—
Ketonal, mg	300	300	300	300	—	—
Bupivakain 0,25%, mg	150	150	150	150	150	150

is shown in the Table, the consumption of promedol in the group with TPVB using is 66,7% less than in the group with IPA.

CONCLUSION

1. Both method of the regional anesthesia cut short a pain syndrome sufficiently and safety in patients with chest injuries before an operative intervention.
2. Introduction the component of IPA and TPVB into anesthesia scheme at thoracoscopic operative interventions allows to provide it the additional antinociceptive protection both in intra- and in post-operative period with minimal stress of central and peripheral parameters and promotes the reduction of narcotic analgesic use due to significant analgetic efficiency and neuro-vegetative protection.
3. In spite of good analgetic efficiency of IPA, pain relief duration using this method is lower and it is connected with mixing the local anesthetic introduced into pleural area with serous fluid secreting by pleura and as the result of it a concentration of local anesthetic is reduced and its duration is shortened. Also the presence of drainage tube promotes outflow of the local anesthetic from pleural cavity together with exudates.

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