Research Article

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Paravertebral Block in the Treatment of Patients With Blunt Chest Trauma

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ABSTRACTS The study was conducted in the Thoracoabdominal Department of the N.V. Sklifosovsky Research Institute for Emergency Medicine to explore the role of paravertebral block in the treatment of blunt chest trauma. The study included 715 patients with isolated chest trauma hospitalized between January 1, 2020 and August 2021. 55 patients received analgesic therapy in the form of paravertebral block. The comparison group included 660 patients who did not undergo paravertebral block, in their case pain relief was provided by systemic administration of analgesics. The compared groups did not differ significantly in sex and age composition. There were also no differences in the frequency of chronic diseases and interpleural complications. There were no significant complications during the block. The comparison revealed a significant decrease in the incidence of pleurisy and a shorter length of stay in hospital.

Paravertebral block is an effective and safe method of pain management for patients with blunt chest trauma. The use of this technique reduces the incidence of post-traumatic pleurisy and duration of hospitalization.

Keywords: paravertebral block, blunt chest trauma, rib fracture

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CCI – closed chest injury
CT – computed tomography
NSAIDs – non steroidal anti-inflammatory drugs

RELEVANCE

Along with technological progress - the development of the automotive industry, the construction of high-rise structures, the number of high-energy traumas also increases [1, 2, 3]. In the age group under 40, trauma ranks first among all causes of death [4, 5]. Closed chest injury (CCI) accounts for 15% of injuries [6, 7]. Due to the persistence of high injury rates, as well as a large number of road accidents, this problem is also relevant for Russia [8]. Pneumonia develops in 11–31% of patients with multiple rib fractures [9, 10], which increases the risk of death by 4 times [11]. Adequate anesthesia allows the patient to maintain chest excursion during breathing and mucociliary clearance thereby reducing the risk of developing pneumonia [12, 13]. The choice of anesthesia method for rib fractures is a significant factor in successful treatment. Despite the best results of pain relief when using conduction anesthesia, most surgeons and traumatologists use traditional pain relief: non steroidal anti-inflammatory drugs (NSAIDs) and opioid analgesics [14]. Our study deals with the use of paravertebral block in CCI.

Aim: to study the role of paravertebral block in improving the outcomes of treatment for CCI..

MATERIAL AND METHODS

The study was conducted in the Thoracoabdominal Department of the N.V. Sklifosovsky Research Institute for Emergency Medicine. The study included 715 patients hospitalized on an emergency basis to the N.V. Sklifosovsky Research Institute for Emergency Medicine from January 1, 2020 to August, 2021. The inclusion criteria for the study were as follows: the presence of CCI acquired no more than 14 days before hospitalization, a fracture of one or more ribs; patients are at least 18 years of age. Exclusion criteria: decompensation of chronic diseases, combined nature of the injury, patient non-compliance, mental disorders and dementia, transfer from another hospital, and coronavirus infection detected during treatment.

Probability sampling was carried out by random selection. During treatment, 55 patients received analgesic therapy in the form of paravertebral block. The patient's complaints about severe pain in the area of rib fractures were considered as an indication for the prescription of the analgesic blockade. A significant reduction in pain, the absence of a forced position and the possibility of adequate cough were considered as the criterion of its effectiveness. The mean age in this group was 59 years, the percentage of men and women was 71.5/28.5%. The blockade was performed in the patient's sitting position, slightly bent over. If the patients' condition did not allow them to be in a sitting position, then the manipulation was performed in the supine position on a healthy side. After treating the proposed injection site three times with aseptic precautions, the needle was inserted 1.5–2.0 cm lateral to the spinous processes of the V–VII thoracic vertebrae to the transverse process. Then the needle was somewhat removed and inserted 0.5 cm above the transverse process until a dip was felt (0.5–1.0 cm behind the transverse process). A solution of Ropivacaine 2 mg/ml was injected into the paravertebral space in a volume of 40 ml. If the pain recurred, the procedure was repeated. On average, the need arose 1-2 times a day in the first 2-3 days. The comparison group included 660 patients who did not undergo conduction blockade, pain relief was provided by systemic administration of analgesics (ketoprofen 100 mg 2 times a day intramuscularly, tramadol 100 mg 2 times a day, promedol 20 mg on demand, omnopon 1% 1 ml in the absence of effect from administration of promedol). The indications and efficacy of analgesia were similar to those in the paravertebral block group. The average age in this group was 58 years, the percentage of men and women was 76.5/23.2%.

Examination of patients with CCI included a set of diagnostic methods, namely: clinical diagnostic tests, X-ray, ultrasound, computed tomography (CT) evaluation.

The primary and fastest method for diagnosing rib fractures and interpleural complications was an X-ray examination, including plain chest and rib radiography. X-rays of the chest and ribs in standard projections (frontal and lateral) were performed using Continental (Siemens, Germany) and GE Prestilix 1600x (USA) x-ray machines.

Ultrasound examination of pleural cavities, pericardial cavities was performed on Medison 8800 (Korea) and B-K Medical 2102 Hawk (Germany) devices with 3.5 MHz, 7.5 MHz sensors. Two-dimensional B-mode ultrasound imaging was used.

Chest CT was performed on CT/e and ZXi helical CT scanners (General Electric Company, USA) and a multislice (80x2) Aquilion Prime CT scanner (Toshiba Medical Systems, Japan). The scanning area was selected from the angle of the jaw to the posterior costophrenic sinuses. Chest scanning was performed at the height of a quiet breath with completely held breath.

The criterion for the presence of pneumonia was chest X-ray and/or CT scan detection of lung tissue infiltration in combination with symptoms of an inflammatory reaction (leukocytosis, elevated C-reactive protein levels, hyperthermia).

The criterion for the presence of atelectasis was the identification of a uniform shading of the lung tissue accompanied by a shift of the mediastinum to the affected side according to chest X-ray evaluation and (or) signs of lung tissue compaction in the absence of a bronchus lumen according to chest CT.

The criterion for the presence of pleurisy was considered an increase in the dynamics of the hydrothorax volume, according to ultrasound of the pleural cavities, and the occurrence of serous or serous-hemorrhagic effusion during puncture. The initial increase in hydrothorax volume followed by regression after anti-inflammatory and diuretic therapy was also considered to be pleurisy.

The criterion for empyema was purulent, turbid discharge during drainage or videothoracoscopy in combination with an increased level of inflammatory markers (blood leukocytes, C-reactive protein).

Complications from the procedure were recorded with an entry in the medical history.

In order to systematize and analyze the results of patient treatment, a database was developed in the Microsoft Excel program.

Statistical processing was performed using the Statistica 12 program. Pearson's chi-squared test and Mann–Whitney U test. To test data for normal distribution, we used the Shapiro–Wilk test.

RESULTS

The compared groups did not statistically significantly differ in terms of sex and age composition. There were no significant differences in the incidence of chronic diseases and interpleural complications before treatment. Moreover, in the study group, the severity score of the patients' condition on the Abbreviated Injury Scale (AIS) was statistically significantly higher ($p<0.05$). Patients' more severe condition suggested a greater number of complications and longer duration of hospital stay, however, despite this, the treatment outcomes in the comparison group were worse (Table 1).

Table 1

Comparison of groups of patients treated with and without paravertebral block, according to the severity of their condition

	Systemic anesthesia (N660)	Paravertebral block (N55)	Level, p
Gender m/f, %	76.5/23.2	71.5/28.5	>0.05
Age, years	58.02	59.9	>0.05
Time to hospitalization, h	79.08	41.3	>0.05
Number of damaged ribs	3.46	3.75	>0.05
AIS score	2.7	3.07	0.002674
Pneumothorax, %	45.7	67.8	>0.05
Drainage, %	43	42.8	>0.05
Chronic obstructive pulmonary disease, %	3.1	7.1	>0.05
Diabetes, %	4.1	0	>0.05

During the analysis, it turned out that the use of paravertebral block compared with systemic anesthesia reduces the number of complications such as pneumonia, atelectasis and pleural empyema, but this positive effect is not statistically significant ($p>0.05$). The absence of repeated hospitalizations in the group with

paravertebral block is also noteworthy. A statistically significant effect in the list of complications was found only in pleurisy rate ($p<0.05$). Of the study group, only one patient had post-traumatic pleurisy. A lower number of complications in total also led to a reduction in the average duration of hospitalization by 2.5 bed-days ($p<0.05$) (Table 2). There were no complications associated with the paravertebral block procedure, such as bleeding and pneumothorax. Given the small volume of the drug administered, no episodes of loss of consciousness or severe hypotension were noted.

Table 2

Comparison of groups of patients treated with and without paravertebral block, according to the treatment outcomes

	Systemic anesthesia (N660)	Paravertebral block (N55)	Level, p
Pneumonia, n (%)	57 (8.6)	2 (4.4)	>0.05
Atelectasis, n (%)	49 (7.4)	2 (4.4)	>0.05
Pleurisy, n (%)	93 (14.1)	1 (2.2)	0.011893
Empyema, n (%)	5 (0.75)	0 (0)	>0.05
Duration of hospitalization, bed-day	7.7	5.2	0.000100
Readmission, n (%)	7 (1.1)	0 (0)	>0.05

DISCUSSION

Pain relief in patients with CCI is one of the fundamental aspects of treatment. Pain syndrome leads to a significant increase in both pulmonary complications (pneumonia, atelectasis) and overall morbidity, which in turn affects the duration of treatment and mortality [15]. From the numerous list of possible anesthesia methods, two groups can be distinguished: systemic and conductive. The most popular method is systemic anesthesia, including NSAIDs and opioid analgesics administration.

There are a significant number of articles devoted to the outcomes of treatment using systemic anesthesia. Moreover, regardless of the route of analgesic administration (oral, intravenous, intramuscular, transdermal, spray), a good analgesic effect was observed [16, 17, 18, 19]. A survey conducted in the UK among doctors in intensive care units showed that the lower popularity of regional methods of analgesia is associated with a lack of sufficient time and skills for the manipulation. At the same time, pain relief was better achieved using regional analgesia [16]. Conduction analgesia includes epidural, paravertebral, intercostal and myofascial blocks. Epidural analgesia has historically been the gold standard for the treatment of patients with multiple rib fractures and shown to improve respiratory performance and reduce the incidence of respiratory depression compared to pain relief with the administration of opiate analgesics [20]. And subjectively, patients noted the best analgesic ability of epidural block [16, 17]. However, in randomized controlled meta-analyses, this method did not lead to a significant reduction in the duration of hospitalization and length of stay in intensive care units [21].

In our study, we did not use epidural block due to the fact that the vast majority of patients were not in the intensive care unit and epidural anesthesia would limit the ability to move and become active. Intercostal block, being a simple method of anesthesia, is characterized by fairly frequent complications associated with the absorption of the anesthetic, since it is necessary to anesthetize the intercostal spaces above and below the fracture level [15]. In addition, the need to perform multiple punctures and palpation of broken ribs causes discomfort to the patient and increases the risk of developing iatrogenic pneumothorax [22]. Paravertebral block, which we chose for anesthesia as the simplest and safest, is deprived of these shortcomings. Moreover, the analgesic effect in unilateral fractures is comparable to that of epidural anesthesia [23]. Also in their study comparing paravertebral block with systemic anesthesia [24], Ge Yeying et al. demonstrate a significant improvement in the parameters of external respiratory function (FVC, FEV1/FVC) and blood oxygenation (PaO2, PaO2/FiO2), but do not provide data demonstrating the effect of these parameters on the number of infectious complications and length of stay in hospital.

In a meta-analysis conducted in 2018 comparing various methods of pain relief in CCI, it was shown that, regardless of the method of pain relief, there was no significant difference in the incidence of pneumonia and other complications [25, 26]. In our study, neither did we evaluate spirometry nor use scales to assess the level of

pain, however, the outcomes of treatment demonstrated a significant positive effect of paravertebral block on the incidence of post-traumatic pleurisy.

No significant difference was noted for complications such as atelectasis, pneumonia, and empyema, which is consistent with the data of Ahmed SM, Yeh DD, Kieninger AN [27–29]. The vast majority of comparative studies note a decrease in the duration of the patient's stay in the intensive care unit and the hospital as a whole, but this difference was not statistically significant [25]. In our study, the duration of hospitalization significantly differed in favor of paravertebral block. There were no serious complications associated with the manipulation (pneumothorax, bleeding, hematomas, hypotension).

CONCLUSION

Paravertebral block is an effective and safe method of pain relief for patients with closed chest injuries. The use of this technique reduces the incidence of post-traumatic pleurisy by 12% and the duration of hospital treatment by 2.5 days.

REFERENCES

1. Agadzhanyan VV. Polytrauma: Problems And Practicalities. *Polytrauma*. 2006;(1):5–8. (In Russ.).
2. Porkhanov VA, Zavrazhnov AA, Polyakov IS, Bosko OYu, Kovalenko AL, Naryzhnyy NV, et al. Sovremennye tendentsii v lechenii zakrytykh travm i raneniy grudi mirnogo vremeni. In: *Okazanie skoroy meditsinskoy i neotlozhnoy meditsinskoy pomoshchi ranenym i postradavshim pri massovom postuplenii: materialy Vserossiyskoy konferentsii v ramkakh 3-go s"ezda vrachey neotlozhnoy meditsiny (k 125-letiyu S.S. Yudina), (Moskva, 6–7 oktyabrya 2016 goda)*. Moscow: Nauchno-issledovatel'skiy institut skoroy pomoshchi im. N.V. Sklifosovskogo Publ.; 2016:38–39. (In Russ.).
3. Schulz-Drost S, Grupp S, Pachowsky M, Oppel P, Krinner S, Langenbach A, et al. Bony injuries of the thoracic cage in multiple trauma: incidence, concomitant injuries, course and outcome. *Unfallchirurg*. 2016;119(12):1023–1030. PMID: 26070732 https://doi.org/10.1007/s00113-015-0026-7
4. Levchenko TV, Kravtsov SA, Shatalin AV. Analiz gospital'noy letal'nosti u postradavshikh s politravmoy. In: *Mnogoprofil'naya bol'nitsa: integratsiya spetsial'nostey: Materialy XVIII Vserossiyskoy nauchno-prakticheskoy konferentsii, (Leninsk-Kuznetskiy, 11-12 sentyabrya 2014 g.)*. Kemerovo, 2014:37–39. (In Russ.).
5. Bagnenko SF, Shapot YuB, Alekperov UK, Kartashkin VL, Kurshakova IV, Alekperli AU, et al. Principles of Organization of Emergency Care to Victims of Traffic Accidents at the Stages of Evacuation Under Conditions of a Megapolis. *Grekov's Bulletin of Surgery*. 2009;168(4):92–96. (In Russ.).
6. Demirhan R, Onan B, Oz K, Halezeroglu S. Comprehensive analysis of 4205 patients with chest trauma: a 10-year experience. *Interact Cardiovasc Thorac Surg*. 2009;9(3):450–453. PMID: 19541693 https://doi.org/10.1510/icvts.2009.206599
7. Eghbalzadeh K, Sabashnikov A, Zeriouh M, Choi YH, Bunck AC, Mader N, et al. Blunt chest trauma: a clinical chameleon. *Heart*. 2018;104(9):719–724. PMID: 29203574 https://doi.org/10.1136/heartjnl-2017-312111
8. Kostychakov VF. Dorozhno-transportnye proisshestviya v Rossiyskoy Federatsii: statistika, osnovnye prichiny vozniknoveniya DTP. *Alleya nauki*. 2018;8(24):538–541. (In Russ.).
9. Chapman BC, Herbert B, Rodil M, Salotto J, Stovall RT, Biffl W, et al. RibScore: A novel radiographic score based on fracture pattern that predicts pneumonia, respiratory failure, and tracheostomy. *J Trauma Acute Care Surg*. 2016;80(1):95–101. PMID:26683395 http:/doi.org/10.1097/TA.0000000000000867
10. Jensen CD, Stark JT, Jacobson LL, Powers JM, Joseph MF, Kinsella-Shaw JM, et a. Improved outcomes associated with the liberal use of thoracic epidural analgesia in patients with rib fractures. *Pain Med*. 2017;18(9):1787–1794. PMID: 27550958 https://doi.org/10.1093/pm/pnw199
11. Battle C, Hutchings H, Lovett S, Bouamra O, Jones S, Sen A, et al. Predicting outcomes after blunt chest wall trauma: development and external validation of a new prognostic model. *Crit Care*. 2014;18(3):R98. PMID: 24887537 http:/doi. org/10.1186/cc13873
12. Bulger EM, Edwards T, Klotz P, Jurkovich GJ. Epidural analgesia improves outcome after multiple rib fractures. *Surgery*. 2004;136(2):426–430. PMID: 15300210 http:/doi.org/10.1016/j.surg.2004.05.019
13. Bulger EM, Arneson MA, Mock CN, Jurkovich GJ. Rib fractures in the elderly. *J Trauma*. 2000;48(6):1040–1047. PMID: 10866248 http:/doi.org/10.1097/00005373-200006000-00007
14. Beard L, Holt B, Snelson C, Parcha C, Smith FG, Veenith T. Analgesia of Patients with Multiple Rib Fractures in Critical Care: A Survey of Healthcare Professionals in the UK. *Indian J Crit Care Med*. 2020;24(3):184–189. PMID: 32435097 http:/doi.org/10.5005/jp-journals-10071-23375
15. Kim M, Moore JE. Chest Trauma: Current Recommendations for Rib Fractures, Pneumothorax, and Other Injuries. *Curr Anesthesiol Rep*. 2020;10(1):61–68. PMID: 32435162 http:/doi.org/10.1007/s40140-020-00374-w
16. Mackersie RC, Karagianes TG, Hoyt DB, Davis JW. Prospective evaluation of epidural and intravenous administration of fentanyl for pain control and restoration of ventilatory function following multiple rib fractures. *J Trauma*. 1991;31(4):443–449. PMID: 1902264
17. Moon MR, Luchette FA, Gibson SW, Crews J, Sudarshan G, Hurst JM, et al. Prospective, randomized comparison of epidural versus parenteral opioid analgesia in thoracic trauma. *Ann Surg*. 1999;229(5):684–691. PMID: 10235527 http:/doi.org/10.1097/00000658-199905000-00011
18. Solak O, Oz G, Kokulu S, Solak O, Dogan G, Esme H, et al. The effectiveness of transdermal opioid in the management multiple rib fractures: randomized clinical trial. *Balkan Med J*. 2013;30(3):277–281. PMID: 25207119 http:/doi.org/10.5152/balkanmedj.2013.8191
19. Fulda GJ, Giberson F, Fagraeus L. A prospective randomized trial of nebulized morphine compared with patient-controlled analgesia morphine in the management of acute thoracic pain. *J Trauma*. 2005;59(2):383–388. PMID: 16294079 http:/doi.org/10.1097/01.ta.0000179452.70520.1b
20. Simon BJ, Cushman J, Barraco R, Lane V, Luchette FA, Miglietta M, et al. Pain management guidelines for blunt thoracic trauma. *J Trauma*. 2005;59(5):1256–1267. PMID: 16385313 http:/doi.org/10.1097/01.ta.0000178063.77946.f5

21. Carrier FM, Turgeon AF, Nicole PC, Trepanier CA, Fergusson DA, Thauvette D, et al. Effect of epidural analgesia in patients with traumatic rib fractures: a systematic review and meta-analysis of randomized controlled trials. *Can J Anaesth*. 2009;56(3):230–242. PMID: 19247744 http:/doi.org/10.1007/s12630-009-9052-7
22. Shanti CM, Carlin AM, Tyburski JG. Incidence of pneumothorax from intercostal nerve block for analgesia in rib fractures. *J Trauma*. 2001;51(3):536–539. PMID: 11535906 http:/doi.org/10.1097/00005373-200109000-00019
23. Mohta M, Verma P, Saxena AK, Sethi AK, Tyagi A, Girotra G. Prospective, randomized comparison of continuous thoracic epidural and thoracic paravertebral infusion in patients with unilateral multiple fractured ribs - a pilot study. *J Trauma*. 2009;66(4):1096–1101. PMID: 19359920 http:/doi.org/10.1097/TA.0b013e318166d76d
24. Yeying G, Liyong Y, Yuebo C, Yu Z, Guangao Y, Weihu M, et al. Thoracic paravertebral block versus intravenous patient-controlled analgesia for pain treatment in patients with multiple rib fractures. *J Int Med Res*. 2017;45(6):2085–2091. PMID: 28635359 http:/doi.org/10.1177/0300060517710068
25. Peek J, Smeeing DPJ, Hietbrink F, Houwert RM, Marsman M, de Jong MB. Comparison of analgesic interventions for traumatic rib fractures: a systematic review and meta-analysis. *Eur J Trauma Emerg Surg*. 2019;45(4):597–622. PMID: 29411048 http:/doi.org/10.1007/s00068-018-0918-7
26. Peek J, Beks RB, Kingma BF, Marsman M, Ruurda JP, Houwert RM, et al. Epidural Analgesia for Severe Chest Trauma: An Analysis of Current Practice on the Efficacy and Safety. *Crit Care Res Pract*. 2019;2019:4837591. PMID: 31016043 http:/doi.org/10.1155/2019/4837591
27. Ahmed SM, Athar M, Ali Sh, Doley R. Acute pain services in flail chest-a prospective randomized trial of epidural versus parenteral analgesia in mechanically ventilated ICU patients. *Egypt J Anaesth*. 2006;31(Iss 4):327–330. http:/doi.org/10.1016/j.egja.2015.06.001
28. Yeh DD, Kutcher ME, Knudson MM, Tang JF. Epidural analgesia for blunt thoracic injury–which patients benefit most? *Injury*. 2012;43(10):1667–1671. PMID: 22704784 http:/doi.org/10.1016/j.injury.2012.05.022
29. Kieninger AN, Bair HA, Bendick PJ, Howells GA. Epidural versus intravenous pain control in elderly patients with rib fractures. *Am Surg*. 2005;189(3):327–330. PMID: 15792761 http:/doi.org/10.1016/j.amjsurg.2004.11.022

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