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Development of post-thoracotomy pain syndrome in patients undergoing lung surgery – comparison of thoracic paravertebral and epidural analgesia

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Abstract

Background and Purpose: *Post-thoracotomy pain syndrome is one of the major concerns following the thoracic surgery. Our study was aimed to compare two methods of regional analgesia in development of this syndrome as well as establish the quality of life in both groups.*

Patients and Methods: *50 patients undergoing thoracotomy were enrolled in the study and were randomized to thoracic paravertebral cathether analgesia group (group TPA; 25 patients) and to thoracic epidural analgesia group (group TEA; 25 patients). Before induction of anaesthesia patients in both groups received 60 μg/kg morphine and local anaesthetic (TEA group: 0.125% bupivacaine, TPA group: 0.5% bupivacaine according to Bromage scheme). After the procedure TEA group recieved a mixture, composed of morphine 10 mg, bupivacaine 125 mg and clonidine 0.15 mg/100 mL saline; the rate of infusion was 0.05 mL/kg/h. TPA group received another mixture, composed of morphine 10 mg, bupivacaine 250 mg and clonidine 0.15 mg/100 mL saline; the rate of infusion was the same as already noted above. PCA infusion system was used in both cases. Postthoracotomy pain was assessed in 3 month's period after the surgery. The quality of life was evaluated with Brief Pain Inventory.*

Results and Conlusion: *Post-thoracotomy pain was experienced in 52, 25% of all the patients (TPA group 47, 37%, TEA group 57, 14%). No differences in assessment of post-thoracotomy pain were observed in TPA group as compared to TEA group. No differences in the quality of life were observed between two groups.*

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INTRODUCTION

The existence of chronic pain after surgery is well known and described through out the years *(1)*. To evaluate pain after surgery following criteria must be met: the development of pain after surgical procedure; pain, which persist for at least 2 months; malignant lesions and/or inflammation must be excluded and no previous chronic pain syndrome encountered *(2)*.

Postthoracotomy pain syndrome is defined as pain that recurs or persists along a thoracotomy incision at least two months following the surgical procedure *(3)*.

Chronic pain after thoracic surgery has the prevalence of 9–80% for thoracotomy and 5–33% for video-assisted thoracoscopic surgery *(4)*. Such a difference in the prevalence of post-thoracotomy pain can be attributed to several factors, including the intraoperative technique, anaesthesia and postoperative analgesia *(4)*. The exact cause of the development of post-thoracotomy pain syndrome has not been established, possible causes include the damage of intercostal nerve (rib retraction, troacar insertion, suture placement), type of incision, personality traits (preoperative anxiety) and pain due to extensive rib retraction (disarticulation of costochondral/costovertebral junctions, injuries to the muscles) *(5,6)*. Some authors also include suboptimal management of acute post--thoracotomy pain as one of the major causes in developement of this syndrome. The patient, suffering from post-thoracotomy pain syndrome typically describes his pain as stabbing or burning in nature, dysaesthesias are almost obligate. Pain worsens on deep inspiration or during cough *(5–8)*.

Many methods of analgesia have been described to prevent its development such as modification of surgical technique, intercostal nerve block, intrapleural analgesia, lumbar and thoracic epidural, paravertebral block, intravenous narcotics together or without the use of nonsteroidal anti-inflammatory drugs (NSAIDS) *(9–11)*.

Paravertebral blockade is one of possibilities to prevent the development of post-thoracotomy pain. Proponents claim it is safe, easy to learn and has a low incidence of complications. However the incidence of the development of post-thoracotomy pain syndrome in this setting remains unknown as compared to traditional and more often used epidural analgesia.

Therefore our study was aimed to determine the incidence of post-thoracotomy pain syndrome in our patients as well as the incidence of post-thoracotomy pain syndrome when using thoracic epidural compared to thoracic paravertebral cathether. A special attention was focused on the quality of life of the patients in both groups.

PATIENTS AND METHODS

50 consecutive patients who had to undergo elective anterolateral thoracotomy (due to malignant lesions, aspergiloma, hamartoma, congenital malformations and undefined lesions) were enrolled in the study. Patients with history of anaphylaxis to local anaestetics, coagulation disorders, psychiatric disorders, active herpes zoster, preoperative neuropathic pain and those evaluated as ASA 4, were excluded from the study. Study was not performed on patients under 18 years.

All patients included in the study were evaluated by clinical, biochemical and radiological methods.

Patients were allocated into any of two groups thoracic epidural cathether analgesia (group TEA, n=25) and thoracic paravertebral cathether analgesia (group TPA, n=25). The groups were matched for age, gender and type of operation (Table 1).

TABLE 1

Demographics of included patients.

	TPA group	TEA group
number of patients	25	25
age (years)	63±21	56, 6±30
gender (male/female)	16/9	21/4
indications for procedure		
• primary cancer	20 (80%)	18 (72%)
• indeterminate lesion	4 (16%)	5 (20%)
• hamartoma	1 (4%)	0 (0%)
• malformation	0 (0%)	2 (8%)
• aspergiloma	1 (4%)	0 (0%)

TPA group – patients with thoracic paravertebral cathether as a mode of pre-, intra- and postoperative application of analgesics

TEA group – patients with thoracic epidural cathether as a mode of pre-, intra- and postoperative application of analgesics

Informed consent was obtained from all the patients during preoperative visit. They were explained about the procedure and detailed information about postoperative analgesia was given. This included the explanation of visual analogue scale (VAS).

On the day of the surgery all patients received midazolam 7.5 mg orally one hour before induction. All patients were given cefazoline 2 g perioperatively.

After shifting the patient to the induction room, ECG, pulse oxymeter and non invasive blood pressure monitors were attached. Venous line was established along with central venous catheterisaton (cubital vein). Arterial cannulation (radial artery) was performed.

In TEA group thoracic epidural was performed using a paramedian approach. The epidural space was identified by the loss of resistance technique. Th6-Th7 interspace was used. After puncture with Touhy's needle (18 G, Portex®) epidural cathether was inserted.

In TPA group the skin was punctured approximately 2.5 cm lateral from spinous processus. Touhy's needle (18 G, Portex®) was advanced perpendicular to skin in all planes to strike transverse processus. The needle was then redirected cephalad. Loss of resistance technique was used to identify paravertebral space. Cathether was placed through the needle.

4 mL 2% lydocaine was used as a test dose in both groups. Both procedures were performed under strict aseptic precautions.

Before induction of anaesthesia patients in both groups recieved 60 μg/kg morphine and local anaesthetic (TEA group: 0.125% bupivacaine, TPA group: 0. 5 % bupivacaine according to Bromage scheme – Table 2) *(12)*. Ade-

TABLE 2

Bromage scheme.

Height (cm)	Volume of bupivacaine through epidural cathether (mL)
150	10
155	11
160	12
165	13
170	14
175	15
180	16
185	17
190	18
195	19
200	20

quacy of blockade was assessed by using a small ice-cold cylinder.

Patients were induced with fentanyl, propofol and vecuronium bromide and intubated with double-lumen endotracheal tube. Anaesthesia was maintained with infusion of propofol; mixture of air and oxygen was used (oxygen 30–60%). One – lung ventilation was performed with 100% oxygen. During the procedure invasive arterial pressure, pulse rate, end tidal CO_2 were recorded. ECG curve was observed during the procedure. We have determined tidal volume, minute ventilation as well as airway pressure.

All patients were kept in post-operative recovery room for an hour after the procedure.

As far as analgesia is considered, analgesic mixture was used in both groups for the next three days.

TEA group received a mixture, composed of morphine 10 mg, bupivacaine 125 mg and clonidine 0.15 mg/100 mL saline; the rate of infusion was 0.05 mL/kg/h.

TPA group received another mixture, composed of morphine 10 mg, bupivacaine 250 mg and clonidine 0.15 mg/100 mL saline; the rate of infusion was the same as already noted above.

As soon as VAS score exceeded 3, additional analgesic was used (diclofenac 75 mg orally and/or piritramide 3–5 mg IV).

Postoperative pain was re-evaluated in 3 months' period after the surgery. We assessed the localisation, intensity and characteristics of pain, exacerbating and relieving factors and the usage of analgesics.

We questioned the patients about their ability to work (both outside the house and in relation to the usual household duties) and the impact on social life, mood, sleep and relationships with others. Brief Pain Inventory (Short Form, C. S. Cleeland©) was used.

Similarity in intensity of postoperative pain and quality of life between TEA group and TPA group was analyzed by equivalence tests for two proportions. The alternative hypothesis was that the groups differed by less than D=0.05. A P value less than 0.05 was considered statistically significant. Data were analyzed using the PASW 18 software (SPSS Inc., Chicago, IL, USA).

RESULTS

Brief Pain Inventory was answered by 21 from 25 patients in TPA group and 16 from 25 patients in TEA group. 2 patients from each group were excluded from this study due to the progression of disease on the thoracic wall.

Post-thoracotomy pain was experienced in 52, 25% of all the patients (TPA group 47, 37%, TEA group 57, 14%). The difference was not significant ($p>0.05$).

Post-thoracotomy pain was rated at its worst in a week before the questionnaire by 37% patients in TPA group and in 50% of patients in TEA group. Furthermore pain was described as mild (VAS 0–3) by 16% in TPA group and 36% in TEA group; as moderate (VAS 4–7) by 21% in TPA group and 14% in TEA group. No one of patients described the pain as severe (VAS 8–10). The difference was not significant in all groups ($p>0.05$).

Post-thoracotomy pain was rated at its least in a week before the questionnaire by 37% of patients in TPA group and in 50% of patients in TEA group. It was described as mild (VAS 0–3) by 26% in TPA group and 43% in TEA group; as moderate (VAS 4–7) by 11% in TPA group and 7% in TEA group. No one of the patients rated their pain as severe (VAS 8–10). The difference was not significant as far as all groups are considered ($p>0.05$).

Pain on the average was rated as mild (VAS 0–3) in 21%, as moderate (VAS 4–7) in 21% of patients in TPA group. No one of the patients rated his/her pain as severe (VAS 8–10) on the average. In TEA group average pain was rated as mild (VAS 0–3) in 43% of patients and as moderate (VAS 4–7) in 14% of patients on the average. No one of the patients rated their pain as severe (VAS 8–10).

There are differences between two groups, however, they are not statistically significant ($p>0.05$).

Pain at the moment of filling out the questionnaire was rated as mild (VAS 0–3) in 26% and as moderate (VAS 4–7) in 21% of patients in TPA group. No one of the patients rated his/her pain as severe (VAS 8–10) on the average. In TEA group average pain was rated as mild (VAS 0–3) in 43% of patients and as moderate (VAS 4–7) in 14% of patients on the average. No one of the patients rated their pain as severe (VAS 8–10). The difference was not statistically significant.

Additional analgesics were used in 7 patients from TPA group, 6 patients used non-steroid analgesic and

one patient used a combination of non-steroid analgesic and weak opioid. In TEA group 5 patients used additional analgesic, 4 of them non steroid analgesic and one patient a combination of NSAID and weak opioid.

Pain is relieved by usage of drugs for more than 50% in the majority of patients in both groups. Three patients in TPA group and two patients in TEA group had pain relief for less then 50%. The difference was not significant ($p>0.05$).

Pain has interfered with general activity, mood, walking ability, normal work, relations with other people, sleep, enjoyment of life as presented in following table (Table 3). The difference was not significant in all of the groups ($p>0.05$)

TABLE 3

Interference of postthoracotomy pain syndrome on the quality of life.

		TPA group (n=9)	TEA group (n=8)
Interference of pain with:			
• general activity	no interference	4	7
	occasional interference	4	1
	complete interference	0	0
	no answer	1	0
• mood	no interference	4	7
	occasional interference	4	1
	complete interference	0	0
	no answer	1	0
• walking ability	no interference	2	7
	occasional interference	6	1
	complete interference	0	0
	no answer	1	0
• normal work	no interference	5	6
	occasional interference	2	2
	complete interference	0	0
	no answer	2	0
• relations with other people	no interference	5	7
	occasional interference	3	1
	complete interference	0	0
	no answer	1	0
• sleep	no interference	3	5
	occasional interference	4	3
	complete interference	1	0
	no answer	1	0
• enjoyment of life	no interference	5	7
	occasional interference	3	1
	complete interference	0	0
	no answer	1	0

TPA group – group of patients with postthoracotomy syndrome in which paravertebral cathether as a mode of application of analgesic pre-, intra- and postoperative

TEA group – group of patients with postthoracotomy syndrome in which epidural cathether as a mode of application of analgesic pre-, intra- and postoperative

DISCUSSION

No statistically significant differences in the incidence of post-thoracotomy syndrome were observed in TPA group as compared to TEA group. The quality of life in both groups is comparable.

The incidence of post-thoracotomy syndrome in our study was comparable to the other similar studies in both groups (the all over incidence of post-thoracotomy pain syndrome was 52, 25%) *(13)*. The number of patients suffering from this syndrome is a bit lower in TPA group, however, this is not statistically significant.

Studies considering the development of post-thoracotomy syndrome have shown higher incidence of this syndrome in patients with poorly cooped acute postoperative pain regardless of the method of regional analgesia used *(14–16)*. As according to some authors quality of analgesia with thoracic paravertebral technique (which is rarely used in all fields of the surgery) equals thoracic epidural technique *(8)*.

As according to the Brief Pain Inventory pain described at its worst and its least in a week before the inventory, pain described on the average and at the moment of the questionnaire was limited to VAS 7 as the peak value. This value is significantly lower as the VAS value in comparable studies *(17)*. Our multimodal approach of analgesia should be emphasized in this setting, which includes regular applications of non-steroid analgesics intravenously and administration of opioids as salvation analgesic in the perioperative period.

Most of the patients use non-steroid analgesics as a form of analgesia to prevent post-thoracotomy pain in our study. A minority of patients uses the combination of non-steroid analgesic and weak opioids. As according to VAS, provided by our patients, we find that this is appropriate therapy. Both groups had no statistically significant differences ($p>0.05$)

It is our primary concern to provide adequate analgesia to all the patients with developed post-thoracotomy syndrome. However, there are still patients who don't use analgesics despite the pain. It is also obvious that none of the patients uses the non-pharmacological methods such as acupuncture. As already mentioned, the patients were provided with sufficient information by the anaesthesiologist. Therefore we strongly recommend additional individual treatment and explanation about the analgesia following the thoracic surgery. Multimodal approach is strongly recommended by some authors and should involve a team of experts such as anaesthesiologist, algologist, physiotherapist and psychologist *(5)*.

The quality of life is comparable in both groups. As according to our knowledge there are currently no stud-

ies which would compare every day's life of the patients after thoracic surgery with fully developed post-thoracotomy syndrome. However, statistical analisys in such a small sample should be interpreted with caution. Post-thoracotomy syndrome is related to personality traits such as anxiety *(6)*. We cannot ignore the long-term effects of the surgical procedure and its' impact on the respiratory function. Patients, undergoing thoracic surgical procedures, have also other diseases which could have an impact on quality of life. Therefore, other comorbidities should be ruled out and we strongly advice close collaboration with general practitioner and surgeon.

As already mentioned, the number of patients is significantly low, which is the same problem as already described by other authors *(14–17)*. Brief Pain Inventory is a short questionnaire, appropriate for evaluation of chronic pain but we find it too non specific to evaluate post thoracotomy pain. Therefore other specific questionnaires should be provided to patients suffering from this condition *(18–23)*. However, these questionnares are not yet available in Slovenia.

CONCLUSION

Postoperative pain syndromes still remain a great challenge in temporary medicine. As far as anaesthesiologist's role is considered the modern methods of preemptive, intraoperative and postoperative analgesia are still the main stay of the prophylaxis. The emphasis is on the regional techniques, however.

As far as the method of the regional techniques is considered we strongly recommend the application of analgesic mixtures through the paravertebral cathether as compared to standard epidural as our study proved the equivalence of these two methods in development of post-thoracotomy syndrome, chronic pain after the procedure as well as the quality of life.

Patients in whom the post-thoracotomy syndrome has already developed will benefit from multidisciplinary approach as far as analgesia is considered. We especially emphasize the importance of informing the patients about the possibility of the development of postoperative pain syndromes before the surgical procedure and its' impact on the quality of life.

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