A comparison of epidural and paravertebral catheterisation techniques in post-thoracotomy pain management

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Received 27 January 2009; received in revised form 7 May 2009; accepted 27 May 2009; Available online 25 August 2009

Abstract

Background: Thoracotomy is a surgical procedure associated with severe pain. Operative morbidity rates reduce by effective postoperative pain control. The aim of this study is to compare the effectiveness of the thoracic epidural blockade (TEB) and the paravertebral blockade (PVB) methods in relieving the pain caused by a thoracotomy incision.

Materials and methods: We studied 44 consecutive patients who underwent elective posterolateral thoracotomy. The patients were classed into two groups: TEB (n = 19) and PVB (n = 25). Patients in both the groups could self-control the infusion of bupivacaine infusion and diclofenac sodium. The groups were compared according to the parameters such as analgesic efficacy (VAS), respiratory function tests (forced expiratory volume in 1 s (FEV1), peak expiratory flow rate (PEFR) and arterial blood gases), stress response (serum cortisol and glucose levels), necessity for additional analgesia, duration of catheter application procedure, mean hospital stay and postoperative follow-up. Results are analysed statistically by Mann—Whitney U, Wilcoxon, chi-square and Fisher’s exact tests, and a p-value of <0.05 was accepted to be statistically significant.

Results: There was no significant difference between the two groups with regard to age, gender, VAS, FEV1, PEFR, serum cortisol and glucose levels, necessity for additional analgesia and hospital staying days. In contrast, adverse effects and duration of catheterisation were statistically significantly lower in group PVB (p = 0.001 and p < 0.001, respectively).

Conclusion: PVB catheterisation can be easily performed and placed in a short span perioperatively. Therefore, it might be the preferred method over TEB which has a high incidence of adverse effects and complication rates.

Keywords: Paravertebral blockade; Epidural blockade; Post-thoracotomy pain; Analgesia; Respiratory function tests; Metabolic stress response

1. Introduction

Thoracotomy is possibly one surgical procedure most associated with severe postoperative pain [1]. Pain can cause respiratory complications such as hypoxia, atelectasis and pulmonary infection because of coughing and the negative impact on the respiration and, furthermore, if severe, can lead to dreadful respiratory disorders [2–4]. Therefore, prevention of pain and efficient pain management in patients who undergo thoracotomy are very important to minimise morbidity and mortality rates.

Epidural analgesia is being accepted as a gold standard in treating postoperative pain in major surgeries, and some of the thoracic surgeons use it routinely in their clinics [4–7].

Paravertebral blockade (PVB), in addition to its comparable efficiency to thoracic epidural blockade (TEB), also has a very low adverse effect profile. Therefore, it seems that PVB, because of its efficient pain management ability, may be a good alternative method in reducing stress and protecting the respiratory functions [8]. However, various studies comparing these techniques have achieved different results [9–14]. Catheterisation for providing PVB can be introduced percutaneously or can be placed under direct vision intra-operatively.

This study aimed to compare the two techniques in terms of efficacy and adverse effects in preventing pain associated with thoracotomy.

2. Materials and methods

2.1. Hypothesis

Perioperative paravertebral catheterisation might be the preferred analgesic method in patients undergoing thor-
acotomy because of its feasibility of being performed under general anaesthesia and in a much shorter time than the epidural analgesia treatment modality. In the paravertebral analgesia method, the pressing effect of the parietal pleura might increase the efficiency of the technique. The primary objectives of this study were to find out a reliable and a usable analgesic method for managing post-thoracotomy pain. The secondary objectives were to optimise the catheterisation technique, to find out the potential strengths and the weaknesses of both techniques and to offer a safe and effective pain management technique, which can be beneficial in a clinical setting, in patients who have thoracotomy.

2.2. Patients

Following approval by the ethical committee of the Ankara Numune Teaching and Research Hospital, 50 patients who were admitted to our clinic for a posterolateral thoracotomy due to any kind of aetiologies were enrolled in the study. Exclusion criteria were patients’ unwillingness, thoracic vertebrae diseases, procedures such as pleurectomy and pleuropneumonectomy, empyema, systemic sepsis, allergy to diclofenac sodium and amide-type local anaesthetics, contraindication for non-steroidal anti-inflammatory drugs (NSAIDs), psychiatric diseases, pain scoring, inability to cooperate with the patient for using a manual spirometry or patient-controlled analgesia apparatus, the need for additional incisions such as laparotomy, diabetes mellitus and concomitant endocrine diseases such as coagulopathy. The selected patients were randomised to the choice of the pain control method.

The patients were informed about the choice of pain control method to be used and the method itself. In order to obtain the basic rates to be compared, the forced expiratory volume in 1 s (FEV₁) and peak expiratory flow rate (PEFR) are measured using manual spirometry. The serum cortisol level and preprandial blood glucose levels were obtained with the arterial blood gas analysis prior to the surgical procedure. Premedication is administered preoperatively in all patients.

2.3. Epidural catheterisation

The epidural catheters were applied at the operating table prior to the induction of monitored anaesthesia. An 18-gauge Tuohy epidural needle was placed at the T7–T10 level based on the loss of resistance technique. Bupivacaine (5 ml of 0.25%) was administered just prior to thoracic closure at a rate of 0.10 ml kg⁻¹ h⁻¹ (1 h lock and 2 ml bolus) through a patient-controlled elastomeric infusion pump (Accufuser Plus®, Korea).

2.4. Perioperative paravertebral catheterisation

After the surgical procedure, just prior to the thoracic closure, an epidural-type catheter was placed extrapleurally into the paravertebral region. An 18-gauge Tuohy needle was advanced through the parietal pleura in the paravertebral space parallel to the vertebral column, including the upper and lower intercostal spaces, in accordance with the thoracotomy space. The needle was removed after placing the catheter through the needle. The catheter was inserted through the thoracic wall through the needle close to the thoracotomy incision and secured to the skin with an appropriate fixing material. Infusion of 0.25% of bupivacaine was applied at a rate of 0.10 ml kg⁻¹ h⁻¹ (1 h lock and 2 ml bolus) through patient-controlled elastomeric infusion pump (Accufuser Plus®, Korea).

2.5. Operative period

To obtain induction anaesthesia, 2 µg g⁻¹ fentanyl, 2 mg kg⁻¹ of propofol and 0.10 mg kg⁻¹ vecuronium were administered to all the patients. Maintenance anaesthesia was provided by 50% O₂, 50% N₂O and sevoflurane.

2.6. Biochemical analysis

Venous blood (5 ml) was obtained from all of the study patients at three time points: preoperatively, perioperatively 15 min after the thoracic incision performed and at 4, 12, 24 and 48 h postoperatively. The venous blood was centrifuged for 5 min at a rate of 3000 cycles before deep freezing at −80°C. The collected sera were transferred with cold chain to the Department of Clinical Biochemistry in the Medical Faculty of Gazi University, where the serum cortisol and glucose levels were measured. The serum cortisol levels were measured by chemiluminescence using prepared kits (LIAISON®, US), and the serum glucose levels were analysed in the autoanalyser using prepared kits according to the hexokinase principle (Abbott Aeroset®, UK).

2.7. Postoperative follow-up

In the postoperative period, daily interview and physical examination were carried out. Hypotension (>20% decline in the preoperative systolic/diastolic blood pressure), urinary retention, sputum changes, auscultation disparities, radiological changes, temperature over 38°C, saturation <90% and other complaints of the patients, hospital stays, morbidities and mortalities were recorded in the patient follow-up charts.

The VAS scores, oxygen saturations, pulse and blood pressure values, spirometric measurements (every 12 h), arterial blood gas analyses and daily number of pressing on the control module were all recorded in the chart every 4 h till the postoperative day 3.

Oxygen saturation was measured using pulse oximeter and the spirometric measurements with a manual spirometer while sitting. The patients were mobilised from postoperative day 1 and were administered 40% steady oxygen while sleeping in the first three postoperative days. The catheters were removed on the postoperative day 4.

2.8. Statistical analyses

The data were analysed using a statistical program SPSS v. 15.0 (SPSS Inc., Chicago, IL, USA); qualitative variables were presented as percentage and the quantitative variables as mean ± standard deviation (SD). Chi-square test and Fischer’s exact test were used to assess the qualitative variables, and the Mann–Whitney U test and Wilcoxon test.
were used to evaluate the quantitative variables. A p-value of <0.05 was accepted to be statistically significant.

3. Results

There were no significant differences between the groups regarding age, sex and the type of surgical procedure (Table 1).

In the group TEB, 19 patients, except two due to misplacement of the catheter and four due to removal of the catheter earlier than the planned date (because of paraesthesia preventing the patients from mobilising), were analysed. In the group PVB, no patients were excluded from the study. In all of the patients analysed, anaesthesia was detected bilaterally in the group TEB whereas unilaterally in the group PVB in relation to the thoracotomy site.

The most frequent indication for thoracotomy was bronchial cancer in both the groups (eight patients each, Table 1).

Regarding VAS scores, no significant differences were detected in the postoperative days 1—3 between the two groups (p = 0.943, p = 0.896, p = 0.686, Mann—Whitney U test, respectively; Fig. 1). There was no significant difference between the groups related to the number of pressings on the patient control module during the postoperative 3 days (p = 0.076, p = 0.215, p = 0.646, respectively; Mann—Whitney U test). Besides, there was also no significant difference between the groups in terms of the need for additional morphine sulphate dosage (p = 0.769, p = 0.949, p = 0.566, respectively; Mann—Whitney U test).

Pulmonary functions such as FEV₁ and PEFR were evaluated. Postoperative FEV₁ and PEFR values had declined compared with the preoperative values in each group. However, there was no difference between the pre- and postoperative FEV₁ and PEFR values in the groups (Fig. 2). The average FEV₁ values at the postoperative days 1—3 were 1.28, 1.24 and 1.44 l, respectively, in the group TEB and were 1.22, 1.28 and 1.48 l (p = 0.492, p = 0.822, p = 0.280, respectively; Mann—Whitney U test) in the group PVB. On the other hand, the PEFR values were 150, 165 and 201 l min⁻¹ in the group TEB, whereas 146, 168 and 197 l min⁻¹ in the group PVB (p = 0.749, p = 0.731, p = 0.758, respectively; Mann—Whitney U test).

The oxygen saturation rates for the first postoperative 3 days were 94.25%, 92.85%, 94.40% in the group TEB and 94.66%, 93.48%, 93.86% in the group PVB, respectively (it was not significantly important; p = 0.933, p = 634, p = 704, respectively; Wilcoxon signed-rank test).

The preoperative mean sera glucose levels were 105.68 ± 34.05 and 99.28 ± 28.67 and the preoperative mean sera cortisol levels were 20.11 ± 5.77 and 21.04 ± 7.54 in the groups TEB and PVB, respectively. The

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**Table 1**
The distribution of the patients regarding the age, gender, aetiology and the surgical procedures.

<table>
<thead>
<tr>
<th></th>
<th>TEB (n = 19)</th>
<th>PVB (n = 25)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>46.32 ± 16.28 (16—73)</td>
<td>49.72 ± 15.96 (13—71)</td>
<td>0.462</td>
</tr>
<tr>
<td>Gender (M:F)</td>
<td>17:2</td>
<td>19:6</td>
<td>0.433</td>
</tr>
<tr>
<td>Surgical procedures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonectomy</td>
<td>3</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bilobectomy</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Lobectomy</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Wedge resection</td>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Open biopsy</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Cystotomy and capitonnage</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Aetiology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bronchial cancer</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Secondary pulmonary cancers</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Mediastinal masses</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Bronchiectasis</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Cyst hydatid</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Solitary pulmonary nodule</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

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Fig. 1. Mean postoperative pain scores. Although it has been seen a tendency for a decrease in the postoperative pain scores toward the third day in both groups in the graph, there was no statistically significant difference detected regarding analgesic efficiency.

Fig. 2. Mean postoperative PEFR values. Although there was a rapid decline in the PEFR values in both groups in the first postoperative day (1) comparing to the preoperative day (0), there was a tendency for increment toward the third postoperative day. But, no statistically significant difference was detected between the groups related to the PEFR values.
postoperative mean sera glucose levels were 136.29 ± 35.53 and 133.91 ± 31.47, and the postoperative cortisol levels were 20.68 ± 3.61 and 21.80 ± 4.16 in the groups TEB and PVB, respectively. The postoperative serum glucose levels were detected to be higher compared with the preoperative basic values (for groups TEB and PVB; \( p = 0.001 \), \( p = 0.001 \), respectively; Wilcoxon signed-rank test). On the contrary, there was no significant difference in the cortisol levels upon comparing with the preoperative values (for the groups TEB and PVB; \( p = 0.643 \), \( p = 0.397 \), respectively; Wilcoxon signed-rank test). There was no significant discrepancy between the two groups with regard to the preoperative glucose and cortisol levels (\( p = 0.666 \), \( p = 0.991 \), respectively; Mann–Whitney \( U \) test). Similarly, the postoperative values were not significantly different in the two groups (for the glucose and cortisol levels, \( p = 0.820 \), \( p = 0.410 \), respectively; Mann–Whitney \( U \) test).

With regard to side effects, there was no side effect in the group PVB, whereas some side effects were detected in five patients in the group TEB (Table 2). The difference was statistically significant (\( p = 0.001 \); Fisher’s exact test). Only in two patients in the group TEB there was a need to stop the infusion transiently due to hypotension.

In the anaesthesia room, the thoracic epidural catheter was placed under local anaesthesia, whereas the paravertebral catheter was placed just before the closure of the thoracotomy under direct vision during general anaesthesia. There was a statistically significant difference between the two groups with regard to the duration of the procedure: 13.21 ± 3.42 min (range, 9–20) in the group TEB and 4.24 ± 0.72 min (range, 3–6) in the group PVB (\( p < 0.001 \); Mann–Whitney \( U \) test, Table 2).

The mean hospital stay was 15.74 ± 5.02 days (range, 6–28) in the group TEB and 14.60 ± 5.57 days (range, 8–30) in the group PVB. Excluding the preoperative preparation time, the postoperative follow-up duration was 8.63 ± 2.16 days (range, 5–12) and 7.96 ± 2.11 days (range, 4–13) in the groups TEB and PVB, respectively. The difference was not statistically significant (\( p = 0.269 \) and \( p = 0.265 \), respectively; Mann–Whitney \( U \) test, Table 2). Three patients in the group TEB and one in the group PVB were followed up in the ICU soon after extubation. No mortality was observed in both the groups.

### 4. Discussion

TEB, despite being performed generally in the patients who have thoracotomy, has some risks such as dural puncture, nerve injury, epidural haematoma, epidural abscess and paraplegia. Besides, apart from a failure of catheterisation due to anatomical difficulties and lack of experience, it is contraindicated in sepsis, coagulopathies and neurological diseases previously present. Because it needs close follow-up due to the possible risks and complications, the thoracic epidural analgesia could be performed only in the multidisciplinary hospitals that can afford this [4]. The only requirement for the PVB procedure is that the parietal pleura should be intact. Therefore, some authors do propose the PVB as an alternative method for the TEB [11,13,15].

Currently, to the best of our knowledge, there is no randomised study with large series comparing the TEB with PVB. The case number was only 520 in a very recent meta-analysis reviewing 10 studies in total [4]. In this study, Davies et al. did not conclude any significant difference between the techniques with regard to analgesic efficiency, but they found out that the PVB had a positive impact on the respiratory functions and reduced the procedure-related complications [4]. In a study similarly to ours, better pain scores, much higher pulmonary function values, low pulmonary morbidity and better oxygenation were reported in the group PVB compared with the group TEB. In this series by Richardson et al., 10% of the patients in the group TEB were excluded from the study due to inability to place the epidural catheter [13]. In our study, there were no statistically significant differences between the groups in terms of analgesic efficiency, pulmonary functions, arterial blood gas values, oxygen saturations and postoperative respiratory morbidities. On the other hand, there were statistically significant differences in drug adverse effects and procedure-related complications in the group PVB. Six patients (24%) in total were excluded from the study in the group TEB: two due to inability to place the catheter and four due to early removal of the catheter because of the development of paraesthesia. Besides, the duration for the catheter placement was shorter in the group PVB.

### Table 2

<table>
<thead>
<tr>
<th>Side effects</th>
<th>TEB (n = 19)</th>
<th>PVB (n = 25)</th>
<th>( p )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary retention</td>
<td>14</td>
<td>0</td>
<td>0.011</td>
</tr>
<tr>
<td>Nausea</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Vomiting</td>
<td>5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hypotension</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Need for ICU</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Indication for catheter removal</td>
<td>4</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Unable to place the catheter</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>The duration for the procedure (min)</td>
<td>13.21 ± 3.42 (9–20)</td>
<td>4.24 ± 0.72 (3–6)</td>
<td>0.000</td>
</tr>
<tr>
<td>Hospital stay (day)</td>
<td>15.74 ± 5.02 (6–28)</td>
<td>14.60 ± 5.57 (8–30)</td>
<td>0.269</td>
</tr>
<tr>
<td>Postoperative hospital stay (day)</td>
<td>8.63 ± 2.16 (5–12)</td>
<td>7.96 ± 2.11 (4–13)</td>
<td>0.265</td>
</tr>
</tbody>
</table>

TEB: thoracic epidural blockade; PVB: paravertebral blockade; ICU: intensive care unit.
PVB catheterisation can be performed either peroperatively just before the closure of the thoracotomy and also percutaneously preoperatively for pre-emptive analgesia. However, there are some possible risks for the preoperative percutaneous catheterisation. Lönqvist et al. observed PVB-related clinical problems in a series of 367 cases and reported that hypotension (4.60%), vascular puncture (3.80%) and pneumothorax (0.50%) might develop as a complication [16]. Therefore, it is better to place the catheter under direct vision in patients indicated for thoracotomy to prevent procedure-related complications and to obtain a homogeneous distribution of the cocktail through the observed area. Several studies report the safety of placing the catheter under direct vision to prevent complications [1,15,17–20]. On the other hand, Karmakar et al. reported catheter blockage in two cases [17].

Unlike the study of Richardson et al., it seems our perioperative PVB catheterisation technique provided no significant difference between the groups with regard to VAS scores, stress response and pulmonary functions [13]. Richardson et al. used the technique described by Sabanathan in the group PVB [21]. In this technique, the parietal pleura is elevated over the upper and lower two intercostal spaces in accordance with the intercostal space where the thoracotomy is applied adjacent to the vertebral column and the catheter is placed into this pocket. While choosing the technique, we hypothesised that the agent infused through the catheter would collect at the bottom of the pocket due to the gravitational action upon standing and would not be as effective. Keeping the parietal pleura close to the chest wall would provide a homogeneous distribution of the cocktail administered through the catheter by the pressure effect of the pleura in all directions. Therefore, we preferred to obtain PVB by placing the catheter through a tunnel created under the parietal pleura. However, good results obtained by Richardson et al., who used the technique described by Sabanathan, made us reconsider that the tunnel method could not provide enough distribution of the cocktail administered. Therefore, we concluded that further studies comparing the efficiency of the two techniques in a large series are warranted.

In the study by Richardson et al. comparing the PVB and the TEB techniques, they have used twice the higher doses of bupivacaine in the group TEB [13]. Although it is essential to use the same dose of drugs while comparing the two techniques, it is not possible to use higher doses in the group TEB due to the side effects such as hypotension occurring after upper thoracic distribution; perhaps it is safer to use higher doses of the bupivacaine in the group PVB. Therefore, we preferred to use the highest possible values when adjusting the doses while comparing the groups in our study. In the series of Richardson et al., they noted ambiguity in three out of 46 cases in the group PVB for whom they used the highest doses. On the other hand, in the group TEB for which they used half the regular dose, nausea, vomiting, respiratory morbidity and hypotension were statistically significantly higher than in the other group. In the study in which we used the same doses for both the groups, there were no agent-related side effects in the group PVB, whereas urinary retention in four patients, nausea in five, vomiting in three and hypotension in two were detected in the group TEB. The high rate of adverse effects might be due to administration of the highest possible doses instead of the minimal doses, which would have been sufficient to provide the analgesia in our study.

The stress response is the group of responses (i.e., autonomic, metabolic and immunologic), initiated by many stimulants and provide homeostasis intending maintenance of the life. The factors causing stress response are the type of the surgical procedure, anaesthetic agents, anaesthesia duration, fluid—electrolyte disturbances during the anaesthesia, haemorrhage, postoperative pain and anxiety. These factors could cause the release of ACTH through some neural routes in the brain, leading to a 10-fold increase in the blood cortisol levels [22]. The cortisol levels could cause hyperglycaemia and also increase the metabolic effects of the catecholamines. The anaesthesia procedures and the agents used have role in the amplitude of the stress response. An efficient pain management could decrease the stress response and the resultant morbidity. The cortisol is the biochemical parameter being used in depicting the stress response. Richardson et al. showed that the stress response was better suppressed in the group PVB because lower cortisol and blood glucose levels were achieved in the group PVB than in the group TEB. Comparing the patients who had systemic opioids with those in the groups PVB and TEB, lower cortisol and blood glucose levels were noted, showing that the regional blockade procedures could better suppress the stress response than the systemic opioid applications [23,24]. In our study, we have also measured the cortisol and glucose levels in blood to compare the impact of the regional blockade methods on the neuroendocrine stress response. No statistically significant difference was detected in the impact of both the techniques on the stress response.

5. Conclusion

Continuous PVB and epidural blockade methods, being one of the components of the analgesia strategy, are quite effective techniques in managing the post-thoracotomy pain. There is no statistically significant difference in the two methods in terms of efficient analgesia. The continuous PVB technique should probably be the preferred method in the post-thoracotomy pain management due to the ability to be applied at the desired anatomical locations in a shorter time span and due to the lower adverse effects and the complications compared with the TEB technique postoperatively.

Acknowledgements

We would like to express our gratitude to Erkan Yildirim, MD, FETCS and Demet Albayrak, MD for their valuable additional revisions and corrections of English grammar and typographical errors throughout the article.

References

[16] Lo¨nnqvist PA, MacKenzie J, Soni AK, Conacher ID. Paravertebral blockade or both groups are matched for that? Could you comment on both, please.

Appendix A. Conference discussion

Dr K.S. Rammohan (Cardiff, UK): May I ask two questions, please. For your resections, was the thoracotomy standardized in terms of muscle sparing, muscle splitting, removal of ribs, and surgeon, and, second, you haven’t quite mentioned in addition to your paravertebral block and the epidural if you had any other adjuncts in terms of analgesia and whether that has been normal across the board or both groups are matched for that? Could you comment on both, please.

Dr Kocer: We didn’t use muscle sparing in our thoracotomy patients but standardized our surgical techniques, the first question, and the second one, diclofenac sodium was used for the patients additionally.

Dr E. Stoelben (Cologne, Germany): How were the patients randomized in this study? Because you are talking in the abstract about allocation, but there was no mechanism of randomization given in this abstract.

Dr Kocer: Could you ask the question again, please?

DR Stoelben: How was the randomization of the patients in this study done, the allocation to the treatment groups?

Dr Kocer: Before the study began we took the envelopes including the block randomization lists and randomized it with them.

Dr W. Weder (Zurich, Switzerland): Did you compare other advantages or disadvantages between the two methods such as low blood pressure and the need for vasopressor drugs which occurs often in epidural anesthesia or the prolonged need of a urinary catheter?

Dr Kocer: No. We only compared the two techniques, epidural anesthesia and our tunnel technique with paravertebral blockage in terms of pain control efficacy, adverse effects and duration of the procedures.