Muscle-sparing versus posterolateral thoracotomy: a prospective study

Kalliopi Athanassiadi *, Stamatios Kakaris, Nick Theakos, Ion Skottis

1st Department of Thoracic Surgery, General Hospital for Chest Diseases, Athens, Greece

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Abstract

Objective: Although the thoracotomy incision is guided in part by the exposure required, both cosmesis and the potential for improved recovery are important factors to be taken into account. We conducted a prospective randomized study in order to compare muscle sparing thoracotomy (MST) and standard posterolateral thoracotomy (PLT) for postoperative pain and physical function during and after hospitalization.

Material and method: One hundred patients operated from June through December 2004 were recruited in this study. Fifty patients underwent MST of 6—8 cm and 50 had a PLT of more than 8 cm with division of latissimus dorsi and serratus anterior muscles. Operations performed were atypical resections and lobectomies. Pneumonectomies and operations on tumors invading the chest wall or brachial plexus were excluded. Perioperative care was standardized concerning analgetics and physiotherapy. Postoperative pain (quantitated by the visual analogue scale), preoperative and postoperative pulmonary function, shoulder strength, and range of motion were evaluated. Results: There was no difference in demographics, tumor stage, and type of lung resection. Patients were also matched for the number of chest tubes, length of chest tube duration, and length of hospital stay. Pain reported during hospitalization and after hospital discharge within 1 and 2 months did not differ within the two groups (p > 0.05). Shoulder function was shown to decrease less in cases of MST, but physical function was not found statistically significant in comparison of the two groups (p > 0.05) within 1 month. Rehabilitation was also similar. Conclusion: The rates of occurrence of acute or chronic pain and morbidity were equivalent after MST and PLT. It appears that the single advantage of MST over PLT involves the preservation of chest wall musculature in case rotational muscle flaps should be needed along with a better cosmetic result.

Keywords: Muscle sparing thoracotomy; Posterolateral thoracotomy; Postoperative pain; Shoulder function

1. Introduction

Posterolateral thoracotomy is the standard traditional approach for thoracic procedures such as lung cancer surgery. It provides an excellent access and can be very easily extended if it is necessary [1,2]. Although the thoracotomy incision is guided in part by the exposure required, both cosmesis and the potential for improved recovery are important factors to be taken into account.

A prospective randomized study was conducted in order to assess the advantages of the muscle sparing thoracotomy comparing standard posterolateral thoracotomy (PLT) and lateral muscle sparing thoracotomy (MST) for postoperative pain followed by reduction of shoulder range motion and compromised pulmonary function during and after hospitalization.

2. Material and method

2.1. Patient selection

One hundred patients operated from June through December 2004 were recruited in this study. Informed consent was obtained from these 100 patients scheduled for primary elective lung surgery. There were 69 male and 31 female ranging in age between 46 and 77 years. Patients with previous thoracic trauma or surgery including VATS were excluded because of the possibility of existing intercostal injury. They were divided in two groups. Group I consisted of 50 patients submitted to a standard PLT of more than 8 cm (mean of 21.6 cm) and Group II of 50 patients who underwent MST of 6—8 cm. Consultant A performed all operations of Group I and consultant B the ones of Group II. Operations performed were atypical resections and lobectomies. Pneumonectomies and operations on tumors invading the chest wall or brachial plexus were excluded. No conversion to posterolateral thoracotomy was needed in Group II. Perioperative care was standardized concerning analgetics and physiotherapy. Postoperative pain (quantitated by the visual analogue scale), postoperative pulmonary function, shoulder strength, and range of motion were evaluated.
2.2. Technique of thoracotomy

PLT was performed with the patient in the appropriate lateral decubitus position with the arm elevated and secured on an armboard, while in MST the patient was positioned with a slight posterior tilt. The operating table was flexed to 30° between the level of nipples and umbilicus to open up the intercostal spaces and was returned to its original position before the insertion of pericostal sutures. The consultant thoracic surgeon in charge always controlled proper patient positioning before thoracotomy.

The patients of Group I were submitted to standard PLT with transection of the entire latissimus dorsi and lower edge of the serratus anterior. In the lateral MST thoracotomy, the posterior fascial membrane of the serratus anterior was incised and the muscle was freed until to its inferior attachment on the anterior aspect of the sixth rib, no rib was cut or resected. In both thoracotomies, the bed of the fifth rib was incised and the chest was entered through the fifth intercostal space. One retractor was positioned in the PLT, while one or two retractors were used in the MST. No fracture occurred in both groups.

All patients underwent pulmonary resection and radical lymphadenectomy. Thoracotomies were closed with absorbable sutures by approximating the fifth and sixth ribs without approximator, one pericostal suture was used in Group II, whereas two or more sutures were needed in Group I. The transected muscles in Group I were sutured in layers with continuous absorbable sutures.

2.3. Chest tubes

In both groups, two chest drains (28 F and 32 F) were placed through lower separate intercostals incisions, an apical and a basal one. The basal was removed when drainage was less than 150 ml/day and the apical when there was no air leak or residual pneumothorax. Mean length of chest drainage was 4.7 days while mean hospitalization was 5.9 days.

2.4. Assessment of postoperative pain—clinical evaluation

Patients of both groups received immediately postoperatively 30 mg of opioids daily subcutaneously for the first two postoperative days and then pain was controlled with oral administration of paracetamol and codeine. No inflammatory agents were used.

All patients were evaluated for postoperative pain with a visual analogue scale by an independent assistant thoracic surgeon and for shoulder motion range (abduction, flexion, and rotation) by an independent physiotherapist within 2, 8, 30, and 60 days postoperatively. Pain was quantitated by an 11-point scale (0 = no pain, 10 = maximal imaginable pain) [3].

Pulmonary function tests such as vital capacity (VC) and forced expiratory volume in 1 second (FEV1) were measured preoperatively and at 8, 30, and 60 days postoperatively.

2.5. Statistical analysis

All data were expressed as mean ± standard deviation. Statistical analysis was performed by means of the two-tailed Student’s t-test and Mann—Whitney U-test. Probability of less than 0.05 was considered statistically significant.

3. Results

Demographic analyses demonstrated no differences in age and sex between the two groups. There was also no difference in preoperative lung function, tumor stage, and type of lung resection. (Tables 1 and 3) Patients were also matched for the number of chest tubes, length of operating time, and duration of chest tube drainage. Although not included in our analysis no rib fractures were observed and no postoperative complications were recorded or attributed to the type of incision.

Concerning the recorded intra- and postoperative data intraoperative blood loss and postoperative chest drainage volume were found to be in favor of the MST without any
clinical implementation. No transfusions were required and operating time was not proven to be different in Group I and II (Table 2).

Pulmonary function expressed by VC and FEV1 was not influenced by the type of incision and returned almost to normal values within 1–2 months postoperatively (Table 3).

The analysis of shoulder motion range demonstrated a slight but statistically significant difference between Group I and II favoring MST only within a week. None of our patients being questioned in a personal interview felt to be affected after hospital dismissal in any way in his routine life (Table 4). Pain reported during hospitalization and after hospital discharge within 8, 30, and 60 days did not differ within the two groups (p > 0.05) (Table 5). A statistically significant difference was only found on the second postoperative day (Fig. 1).

Finally, cosmetic results were indeed better in Group II without any bulging observed along the incision line.

4. Comments

The traditional PLT providing excellent exposure of the lung, hilum, and mediastinum has been the standard incision for pulmonary procedures for the past 90 years [4]. MST has been devised to produce less postoperative pain and better cosmetic results while reducing soft tissue injury and complications [5–8]. Another advantage often mentioned in the literature is the preservation of major chest wall muscles to be used if complications such as empyema and bronchopleural fistula arise [9,10].

In many studies [11,12], it is emphasized that long-lasting postoperative pain often present several weeks after thoracotomy might be due to intercostal nerve impairment. Stretching or damages of the intercostal nerves, transection of their cutaneous branches may contribute to the development of an important neuropathic component of postoperative pain [12]. The authors doubt that the pain is less in cases of MST since the surgeon works through a compromised incision where the retraction of nerves might be stronger as the rib spreader stretches the anterior and posterior structures and might damage the intercostal nerves in order to compensate for a decreased exposure [13]. Benedetti et al. [11,12] showed the disappearance of abdominal reflexes and a higher degree impairment of the intercostal nerves within 1 month postoperatively in PLT cases, whereas none of our patients of Group I was influenced. Flexing the operating table to 30° to get between the level of nipples and umbilicus to open up the intercostal spaces and returning it back before the insertion of pericostal sutures probably minimizes the damage of intercostal nerves. As advised by Rogers and Duffy [14] careful intercostal incision, minimal spreading of ribs and meticulous closure might be the solution to the reduction of postoperative pain, although Maguire et al. [15] could not demonstrate that intraoperative nerve damage is associated with chronic pain or altered sensation. One should consider that in the majority of centers thoracotomy is usually performed by young assistants, which was not the case in this series. Nomori et al. [7] also assumed that since the muscle group connected to the scapula is spared in MST, shoulder pain is prevented, while Landreneau et al. [9] and Ponn et al. [16] demonstrated that there was no statistical difference in early and late postthoracotomy pain between PLT and MST. The authors believe that since latissimus dorsi and serratus anterior are neither transected nor stretched, shoulder motion and not postoperative pain might be influenced, a hypothesis also supported by this series. A significant reduction in postoperative pain as
determined by the visual analogue scale was shown only on POD2 in Group II, but not later on POD8 or POD30. The routine use of postoperative epidural pain management [17] makes the observed difference between the two groups a moot issue. In this series, the authors intentionally used opioids, since according to some colleagues [11] opioids do not help in cases of damage of intercostal nerves.

Another difference observed was the blood loss in these two methods. Although it was turned to be statistically significant in PLT, the amount lost was not substituted and in that way there was no different management in the clinical practice.

In contrast to the results of Nomori et al. [7], Ponn et al. [16], and Lemmer et al. [18] pulmonary function tests did not reveal any statistically significant difference in patients undergoing either PLT or MST. This was expected since neither the latissimus dorsi nor the serratus anterior contribute to the respiratory function [4].

Preservation of major chest wall muscles such as the latissimus dorsi that stabilizes and rotates the scapula facilitating shoulder motility have been described as an advantage in muscle sparing thoracotomies, although there is little objective evidence [10] demonstrating to what degree the quality of life of a patient is influenced by this procedure. This study did not demonstrate any difference in shoulder function favoring the MST over PLT within 1 or 2 months postoperatively. Only in the immediate postoperative period a statistical difference was observed concerning a wider range of shoulder dysfunction in the PLT group with no important influence on the quality of life of the patient. Shoulder abduction, rotation, and flexion were no longer apparent by the 1-month postoperative visit without any additional physiotherapeutic measure.

In conclusion, the rates of occurrence of acute or chronic pain and morbidity are equivalent after lateral MST and standard PLT when there is careful handling of the nerves and avoidance of any operative technique that might result in unnecessary injury. The exposure is adequate in both methods without favoring the one over the other concerning postoperative pulmonary function, postoperative chest pain, or quality of life.

It appears that the single advantage of MST over PLT involves the preservation of chest wall musculature if rotational transposition of muscle flaps is needed in cases of postresectional space problems along with a better cosmetic result.

References


Appendix A. Conference discussion

Dr P. Thomas (Marseille, France): I have one question. If I understood, this study compared two surgeons?

Dr Athanassiadi: Yes. This study started because one of the surgeons in our department was doing only posterolateral thoracotomy and I was doing only small lateral thoracotomies. So we agreed to start with a study, since our principles in treating the patient, for example, the timing of taking out the chest tube were almost the same. Having one surgeon doing both approaches could be the best way to compare both methods.

Dr B. Witte (Koblenz, Germany): I have just a comment on indications. The sparing of the latissimus is not only important for the shoulder function in the early postoperative course, but it may be very important to have this tissue saved for several complications that may occur later on, especially bronchial stump insufficiency, especially in neoadjuvant pretreated patients, when you may decide to put latissimus inside later on.

Dr Athanassiadi: Yes, I fully agree with you.

D.T. Grodzki (Szczecin, Poland): I share the thoughts presented by Pascal Thomas, that it could be a study of the performance of two surgeons anyway. I have another question. I think we should define the term ‘muscle sparing thoracotomy’, because what I saw on the slide, one of the muscles was quite widely mobilized. We are doing it in a completely different fashion. We save the muscle in a completely different way.

Another question is the time of surgery, the length of surgery. I think the average time was 250 min. I can understand it for lobectomy, but for nonanatomical resection, it seems to be a little bit too long.
Dr Athanassiadi: Well, first of all, for the sparing thoracotomy, if you look in the literature, there are six different types of sparing thoracotomy. We save the latissimus dorsi and we go through the fascia where serratus anterior ends. So, both muscles, since their vascular supply is saved can be used in case you need them. I don’t know if I answered your comments.

Concerning the wedge resections (segmentectomies also included), the majority of them were not lung cancer, they were metastasectomies, and sometimes there were more than one atypical resection during every operation. I think the operating time is justified, since all lesions are not in the periphery of the lung and one should also inspect the whole lung and sometimes one should wait for the pathologist too intraoperatively.

Dr Grodzki: Yes.

Dr D. Kim (Seoul, South Korea): My question is about the comparison itself. Do you have any comparison between the operative side and the nonoperative side in same patient? It is important to distinguish the results from the thoracotomy methods (muscle-sparing vs posterolateral) and from the operation itself. Your results are equivalent between the two thoracotomy methods. I think it means that the main impact is the operation itself in early postoperative periods.

Dr Athanassiadi: If I understood correctly, you suggested that we should compare both sides? No we did not do that neither preoperatively nor postoperatively. To tell you the truth I do not understand your objective by comparing both sides.

Dr M. Beshay (Bielefeld, Germany): Do you do anterolateral thoracotomy, and, if not, why?

Dr Athanassiadi: Well, I do anterolateral thoracotomy, but I don’t think with the anterolateral thoracotomy that the hilum and the mediastinum have a very good exposure, you do not have a control over the vascular hilar structures. On the other hand, as a woman, I wouldn’t like to have an anterolateral thoracotomy. I would like to have more a lateral thoracotomy. I think that the cosmetic result is better. You cannot see it.

Dr Beshay: Exactly. In a woman you cannot see it because it is under her breast.

Dr Athanassiadi: The incision comes actually under the breast and the possibility that chyloid develops is bigger as some plastic surgeons say, while with the lateral, if you have the hand down, nobody can see it. That is my experience.

Dr Beshay: But if you come from in front, you see the hilum directly, so we don’t find a problem with it. On the other hand this approach is much acceptable by patients as it is less painful.

Dr Thomas: Could you briefly comment on the methods of postoperative analgesia? Did you use any form of locoregional analgesia?

Dr Athanassiadi: Normally we use epidural analgesia. In this series we used only opioids, and we did that for the 2 first postoperative days. There are studies that say that in cases of intercostal nerve injury, no opioids are helpful. So not to miss any intercostal injury, we have done it during the operation. We administrated 30 mg of morphine subcutaneously for the 2 first days, and later on we had only an oral administration of paracetamol and codeine, nothing else. But normally we’re using epidural analgesia.