

## Double-blind comparison of intra pleural analgesia through a catheter and intra pleural analgesia through a catheter beside a chest tube

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**Abstract:** Thoracotomy is a surgical procedure associated with severe pain. Operative morbidity rates reduce by effective postoperative pain control and the intensity of pain is exacerbated by ventilation. Thus, the goal of the clinician is to develop an analgesic regimen that provides effective pain relief to allow post operative thoracotomy patients the ability to maintain their functional residual capacity by deep breathing. One of these methods is insertion of an intrapleural catheters. In this study we tried to compare the efficacy of current method with the newer one, which is the implementation of a double lumen chest tube. The aim of this study is to compare the effectiveness of the chest tube catheter and intrapleural catheter for pain after thoracotomy. The study was double-blind and consisted of twenty patients undergoing thoracotomy and pulmonary mass resection (indicated because of malignancy or hydrated cyst) in Shahid Modarres hospital (Tehran, Iran) during September 2006 to march 2007. In our study, anesthetics did not make a difference in the 6<sup>th</sup> hour but improve pain indices in the 12<sup>th</sup>, 18<sup>th</sup> and 24<sup>th</sup> hour (only PHS). It can be postulated that during the first hours after the surgery the pain is too severe for the anesthetic to show significant improvement. Also, no significant difference was found between the routes of administration. This study shows that pleural anesthesia through a catheter secured in a tube is more favorable to intra pleural anesthesia through a catheter, concerning risk and surgery complications.

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### 1. Introduction

Thoracotomy is a surgical procedure associated with severe pain. Operative morbidity rates reduce by effective postoperative pain control and the intensity of pain is exacerbated by ventilation. Limited ventilation may cause atelectasis, hypoxia and pulmonary infection. Thus, the goal of the clinician is to develop an analgesic regimen that provides effective pain relief to allow post operative thoracotomy patients the ability to maintain their functional residual capacity by deep breathing. Various strategies including epidural analgesia, intrapleural analgesia, intercostals nerve blockade, systemic opioids, and non steroidal anti-inflammatory drugs (NSAIDs) have been used for thoracotomy pain management [1]. Considerable pain relief may be achieved with systemic opioids; however, these drugs may cause respiratory depression and intestinal dysfunction [2]. NSAIDs may be associated with gastrointestinal bleeding and renal toxicity, although they are useful [3].

Intrapleural analgesia was first described by Reiestad and Stromskag [4], and previous studies evaluating intrapleural analgesia in patients undergoing a thoracotomy revealed conflicting results [3].

Various analgesic techniques have been developed to treat postoperative thoracotomy pain [4-5]. However, the acute pain condition associated with thoracotomy continues to be a challenge to clinicians [6]. Systemic administration of opioids is the simplest and most common method to provide analgesia for postoperative pain; unfortunately, systemic opioid administration may not be adequate for treating the intense postoperative pain associated with thoracotomy.

In a meta-analysis of 65 studies, Ballantyne et al [7] concluded that postoperative epidural pain control may significantly decrease pulmonary morbidity. However, it is not appropriate for certain patients, especially those with coagulation disorders, spinal deformities, or neurologic disorders, or who have received anticoagulant therapy [5].

Intrapleural analgesia—the administration of local anesthetic agents through a catheter positioned inside the pleural cavity to diffuse across the parietal pleura and anesthetize the intercostals nerves—may be another alternative [8]. Several studies have shown limited improvement in analgesia with IP (Intrapleural analgesia) [9, 10, and 11]. Explanations for the limited analgesic efficacy of IP include loss of local anesthetic through the chest tube, dilution of local anesthetic with blood and exudative fluid present in the pleural cavity, binding of local anesthetic with proteins, and altered diffusion across the parietal pleural after surgical manipulation and inflammation [11, 12].

Another option to minimize post thoracotomy pain is extra pleural regional anesthesia. Extra pleural regional anesthesia depends primarily on diffusion of the analgesic agent into the par vertebral region [13]. Local anesthetic agents affect not only ventral nerve roots but also afferent fibers of the posterior primary ramos. Posterior ligaments of the posterior primary ramos innervate posterior spinal muscles and skin. These ligaments are usually traumatized during poster o lateral thoracotomy [14]. The procedure involves intermittent administration of local anesthetic to this area through a catheter placed in the extra pleural region. Depth and width of the anesthetized area depend on diffusion of the local anesthetic. This finding is one of the method's objective criteria for providing pain relief after thoracotomy.

## 2. Material and Methods

### Patients:

The study had a double-blind interventional design. Twenty patients underwent thoracotomy and pulmonary mass resection (indicated because of malignancy or hydrated cyst) in Shahid Modarres hospital (Tehran, Iran) during September 2006 to march 2007. All patients considering their primarily problem, indicated for thoracotomy and their written approval had gotten these patients who referred to Shahid Modarres hospital during September 2006 to march 2007 which twenty patients followed the treatment regularly.

### Exclusion criteria

The patients with: Under 12 years old, Under 30 kilograms, Low level of consciousness, Addicted , Depressed and the persons with psychological problems, empyema, Bleeding diathesis, Broncho pleural fistula, Sever adhesions of pleura, Underling problem of pleura such as chemical or surgical pleurodesis were eliminated from study.

### Treatment protocol:

All patients got intra pleural analgesia through a catheter and intra pleural analgesia through a catheter beside a chest tube and also got two

different solution that there name were solution A and B. Anesthetic substance was 0.25% bupivacaine in amount of 0.5 mg /kg of patient weight.

In every time of injection intra pleural catheter (solution A) and intra pleural catheter beside a chest tube (solution B) got solution by chance. Only Anesthesiologists did know the Information about the type of solution so the patients and researcher did not know about it (double-blind).

After the surgery in every 6 hours, we decreased the pain until 24 hours. Before injection the pain score was measured by VAS and PHS (prince Henry score of pain), also maximum expiratory flow was measured by peak flow meter.

Te VAS that we used in our study as Linear scale that lied vertically and the patients were informed to show their pain score. Previous studies showed that this method is the appropriate method in compare with others.

By referring to previous studies we have known that PHS is appropriate and specific method in patients who underwent thoracic operation.

prince Henry score of pain	score
No pain on coughing	0
Pain on coughing, not deep breathing	1
Pain on deep breathing but not at rest	2
Pain at rest, slight	3
Pain at rest, severe	4

According to the previous studies one of the best factors in patients recovery is the rate of expiratory flow in patients so we measured this important factor with peak flow meter.

### Statistical analysis

Data were expressed as means  $\pm$  SD. Differences among various groups were tested for statistical significance using the Mannwithney U test. A P value of less than 0.05 denoted the presence of a statistically significant difference.

### 3. Results

In this study twenty patients underwent thoracotomy. They were ten men and ten women. Mean age was  $50.6 \pm 13.92$ .

These patients were divided to 2 groups into ten patients. And every 6 hours were injected analgesics by catheter or chest tube randomly. Pain score was estimated and compared with PFM, PHS, VAS factors before injection and half an hour after injection.

In first 6 hours estimated mean of VAS in patients who were got the drug from catheter, before injection of the analgesic was  $74 \pm 17.127$  and after injection was  $73 \pm 18.287$ . In the other hand in patients who were got the drug from chest tube, mean before the injection was  $56 \pm 18.378$  and after that mean was  $58 \pm 18.738$ .

In second 6 hours estimated mean of VAS in patients who were got the drug from catheter, before the injection of analgesic was 47.5 and SD was 23.243 but after the injection was 41 and SD was 23.781. In the other hand in patients who were got the drug from chest tube mean before the injection of drug was 72 and SD was 15.491 but after that mean was 64 and SD was 16.455.

In third 6 hours estimated mean of VAS in patients who were got the drug from catheter, before the injection of analgesic was 48 and SD was 30.840 but after the injection was 38 and SD was 30.110. In

the other hand in patients who were got the drug from chest tube mean before the injection of drug was 32 and SD was 28.596 but after that mean was 29 and SD was 26.012.

In 4th 6 hours estimated mean of VAS in patients who were got the drug from catheter, before the injection of analgesic was 30.5 and SD was 26.294 but after the injection was 32.5 and SD was 28.987. In the other hand in patients who were got the drug from chest tube mean before the injection of drug was 43 and SD was 32.335 but after that mean was 40 and SD was 29.439.

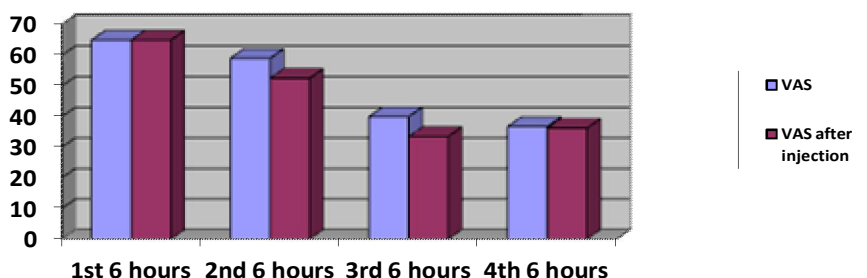


Figure 1. The diagram of the changes in patients pain before and after the analgesic injection according to the VAS scale.

In first 6 hours estimated mean of PHS in patients who were got the drug from catheter, before the injection of analgesic was  $3.5 \pm 0.707$  and after that was  $3.4 \pm 0.843$ . In the other hand in patients who were got the drug from chest tube mean before injection was  $2.8 \pm 1.135$  but after that mean was  $2.6 \pm 1.075$ .

In second 6 hours estimated mean of PHS in patients who were got the drug from catheter, before the injection of analgesic was  $2.5 \pm 1.269$  but after the injection was  $2.1 \pm 1.197$ . In the other hand in patients who were got the drug from chest tube mean before the injection of drug was  $3.6 \pm 0.699$  but after that mean was  $3.3 \pm 0.823$ .

In third 6 hours estimated mean of PHS in patients who were got the drug from catheter, before the injection of analgesic was  $2.5 \pm 1.581$  but after the injection was  $2 \pm 1.333$ . In the other hand in patients who were got the drug from chest tube mean before the injection of drug was  $2.1 \pm 1.370$  but after that mean was  $1.9 \pm 1.370$ .

In 4th 6 hours estimated mean of PHS in patients who were got the drug from catheter, before the injection of sedative was  $1.9 \pm 1.633$  but after the injection was  $1.9 \pm 1.663$ . In the other hand in patients who were got the drug from chest tube mean before the injection of drug was  $2 \pm 1.553$  but after that mean was  $2 \pm 1.563$ .

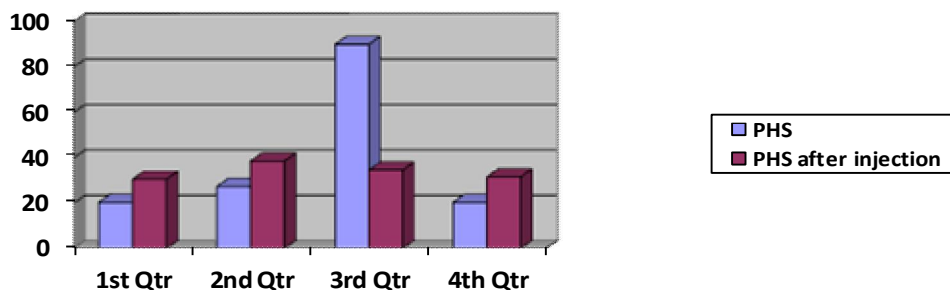


Figure 2. The diagram of the changes in patients pain before and after the analgesic injection according to the PHS scale

In first 6 hours estimated mean of PFM in patients who were got the drug from catheter before the injection of analgesic was  $98 \pm 33.928$  but after the injection was  $103 \pm 34.335$ . In the other hand in patients who were got the drug from chest tube mean before the injection of drug was  $149 \pm 85.173$  but after that mean was  $154 \pm 84.089$ .

In second 6 hours estimated mean of PFM in patients who were got the drug from catheter, before the injection of analgesic was  $156 \pm 87.076$  but after the injection was  $178 \pm 100.862$ . In the other hand in patients who were got the drug from chest tube mean before the injection of drug was  $105 \pm 33.082$  but after that mean was  $125 \pm 37.785$ .

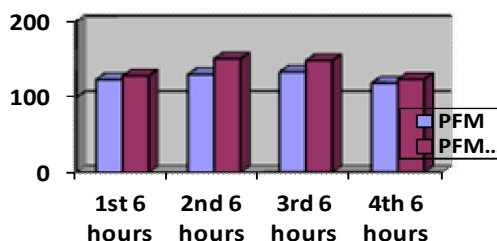


Figure 3. The diagram of the mean changes in patients PFM before and after the analgesic injection. Generally in the first time of checking patients means 6 hours after the surgery the average of pain before the injection of analgesic according to the VAS criterion was 65 which was still 65 half-hour after the injection.

According to the second criterion the average of pain in patients was 3.15 which was reduced to 3 half-hour after the injection of the analgesic.

The third criterion of the pain measurement for the patients is PFM in which the overall average before the injection of analgesic was 123.5 and half-hour after that was 128.5.

In second evaluation means 12 hours after the surgery, average of patients' pain according to the VAS criterion was 59, PHS was 3.05 and PFM was 13.05. These numbers reduced to 52.5, 2.7 and 151.5 half-hour after the analgesic injection respectively.

But in third stage mean of VAS, PHS and PFM before the injection was 40, 2.3, 134 and after that was 33.5, 1.95 and 149 respectively.

After 24 hours mean of VAS, PHS and PFM before the injection was 36.75, 1.9 and 119 and after that was 36.25, 1.95 and 124 respectively.

As we observed the effect of the analgesics in first 6 hours did not reduce patients pain indexes significantly but 12, 18 and 24 hours after that reduced the pain significantly (Tables 1 and 2).

In third 6 hours estimated mean of PFM in patients who were got the drug from catheter, before the injection of analgesic was  $106 \pm 62.751$  and after the injection was  $118 \pm 78.993$ . In the other hand in patients who were got the drug from chest tube mean before the injection of drug was  $162 \pm 96.355$  and after that mean was  $180 \pm 106.874$ .

In 4th 6 hours estimated mean of PFM in patients who were got the drug from catheter, before the injection of sedative was  $155 \pm 120.023$  but after the injection was  $161 \pm 120.779$ . In the other hand in patients who were got the drug from chest tube mean before the injection of drug was  $83 \pm 63.779$  but after that mean was  $88 \pm 68.280$  (Figures 1,2 and 3).

In addition that there was no significant relationship between the way of analgesic prescription (catheter or chest tube) and reducing the patients pain.

Table 1. The table of the efficacy of analgesics to reduce pain.

	test	Difference before and after anesthetic instillation(P Val)
6 <sup>th</sup> hour	VAS	0.7
	PHS	0.83
	PFM	0.058
12 <sup>th</sup> hour	VAS	0.009
	PHS	0.008
	PFM	0.003
18 <sup>th</sup> hour	VAS	0.016
	PHS	0.008
	PFM	0.007
24 <sup>th</sup> hour	VAS	0.783
	PHS	0.05
	PFM	0.62

Table2. The table of Methods of pain relief medication for patients.

	test	Difference before and after anesthetic instillation(P Val)
6 <sup>th</sup> hour	VAS	0.529
	PHS	0.739
	PFM	0.393
12 <sup>th</sup> hour	VAS	0.853
	PHS	0.739
	PFM	0.796
18 <sup>th</sup> hour	VAS	0.218
	PHS	0.28
	PFM	0.353
24 <sup>th</sup> hour	VAS	0.315
	PHS	0.971
	PFM	0.97

**Discussion:**

Post thoracotomy pain is known as severe and intense as a result of tissue damage to the ribs, muscles, and peripheral nerves. It is a complex phenomenon involving multiple neurotransmitters and excitatory and inhibitory pathways that are difficult to target and quantify. Pain is exacerbated by motion and coughing. These actions result in weak, superficial breathing and nonproductive coughing. The earliest change in respiratory mechanics during the postoperative period is the decrease in FEV1 and forced vital capacity. Decreased functional residual capacity and alveolar collapse during anesthesia may be impaired further by restrictive ventilation caused by postoperative pain and abnormal respiration pattern. Therefore, pain management plays a vital role in decreasing morbidity and alteration of lung function after thoracotomy [15, 16]

Various analgesic techniques have been developed to treat postoperative thoracotomy pain [4-5]. However, the acute pain condition associated with thoracotomy continues to be a challenge to clinicians [6]. Systemic administration of opioids is the simplest and most common method to provide analgesia for postoperative pain; unfortunately, systemic opioids administration may not be adequate for treating the intense postoperative pain associated with thoracotomy.

In a meta-analysis of 65 studies, Ballantyne et al [7] concluded that postoperative epidural pain control may significantly decrease pulmonary morbidity. However, it is not appropriate for certain patients, especially those with coagulation disorders, spinal deformities, or neurologic disorders, or who have received anticoagulant therapy [5].

Intrapleural analgesia—the administration of local anesthetic agents through a catheter positioned inside the pleural cavity to diffuse across the parietal pleura and anesthetize the intercostals nerves—may be another alternative [8]. Several studies have shown limited improvement in analgesia with Intrapleural analgesia [9, 10, and 11]. Explanations for the limited analgesic efficacy of Intrapleural analgesia include loss of local anesthetic through the chest tube, dilution of local anesthetic with blood and exudative fluid present in the pleural cavity, binding of local anesthetic with proteins, and altered diffusion across the parietal pleural after surgical manipulation and inflammation [11,12].

Another option to minimize post thoracotomy pain is extra pleural regional anesthesia. Extra pleural regional anesthesia depends primarily on diffusion of the analgesic agent into the par vertebral region [13]. Local anesthetic agents affect not only ventral nerve roots but also afferent fibers of the posterior primary ramos. Posterior ligaments of the posterior primary

ramous innervate posterior spinal muscles and skin. These ligaments are usually traumatized during poster o lateral thoracotomy [14]. The procedure involves intermittent administration of local anesthetic to this area through a catheter placed in the extra pleural region. Depth and width of the anesthetized area depend on diffusion of the local anesthetic. This finding is one of the method's objective criteria for providing pain relief after thoracotomy.

In our study, we aimed to compare two analgesic modalities for post thoracotomy pain (intra pleural analgesia through a catheter vs. intra pleural analgesia through a catheter beside a chest tube)

In this study there is no meaningful decrease in pain index in first 6 hour this phenomenon because of severe pain in first 6 hours after the operation, but these indexes were decreased meaningfully after 12, 18 and 24 hours in administration of analgesic substance.

In this study we understand that there are no meaningful differences between the ways of analgesic administration and rate of pain decreases.

As we mentioned the limitations of intra pleural analgesia through a catheter and intra pleural analgesia through a catheter beside a chest tube it seems intra pleural analgesia through a catheter beside a chest tube is easier and cheaper way to decrease the pain after thoracotomy, also it has low rate complication after surgery.

**Authors' Contribution**

Saviz Pazhhan and Shahin Mir Mohammad Sadeghi designed and supervised the study, Mehdi Zamiri and Babak Hajipour collected the data and wrote the paper. Mehdi Zamiri and Babak Hajipour and Hamze Majidi contributed to the data entry. Hamze Majidi contributed to the analyzed and interpreted the data. All authors read and approved the final revision.

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