

# Prospective Randomized Evaluation of Intrathoracic Intercostal Nerve Block with Bupivacaine on Postoperative Ventilatory Function

Luis H. Toledo-Pereyra, M.D., Ph.D., and Tom R. DeMeester, M.D.

**ABSTRACT** This prospective and randomized study demonstrates the beneficial effect of intrathoracic intercostal block with bupivacaine on the recovery of pulmonary function after thoracotomy. A significantly ( $p < 0.05$ ) better forced expiratory volume was seen in the treated group in the early postoperative period. Similar findings were observed in forced vital capacity. Also, the requirements for analgesics were decreased in the treated group. We believe that intrathoracic intercostal block with bupivacaine when properly utilized can be a good adjuvant in the improvement of pulmonary function after thoracotomy.

Decreased ventilation and subsequent hypoxia secondary to the pain of a thoracic incision is not an uncommon problem for thoracic surgeons. Decreasing postoperative pain following thoracotomy by the administration of narcotics can improve the depth of ventilation and hypoxia but at the expense of producing stupor and suppressing the respiratory center and cough reflex. Several authors [1-7] have tried the intercostal infiltration of local anesthetic agents in order to reduce incisional pain and improve the pulmonary function after thoracotomy. The results of these studies are inconclusive. The present paper reports the results of a prospective and randomized study to assess the effect of intraoperative intercostal nerve block with bupivacaine on the pulmonary function after thoracotomy.

## Material and Methods

Twenty patients who underwent thoracotomy (anterior, lateral, or posterolateral) without

From the Department of Surgery, Thoracic and Vascular Service, Division of Biological Sciences, Pritzker School of Medicine, University of Chicago, Chicago, IL.

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Address reprint requests to Dr. Toledo-Pereyra, Department of Surgery, Section of Transplantation and Surgical Research, Henry Ford Hospital, 2799 W Grand Blvd, Detroit, MI 48202.

pulmonary resection were assessed in this study. All patients were distributed randomly and prospectively into a control or treated group at the time of closure of the thoracotomy (Table). Ten patients received no treatment, and the other 10 were administered an intraoperative intercostal nerve block with 10 ml of 0.5% bupivacaine without epinephrine before closure of the thoracotomy. The technique of intrathoracic intercostal nerve block was the injection of 2 ml of the anesthetic solution into the posterior subcostal neurovascular bundle after attempted aspiration to prevent an intravascular injection. The intercostal block was performed at the level of the incision and two spaces above and below it. All intercostal nerve blocks were performed in a similar fashion in all patients. The amount of preoperative and postoperative medication was recorded in each group. Postoperative analgesic was given in the same dosage as circumstances required for each group.

One day before operation and on postoperative days 1, 2, 3, 4, 7, and 10, pulmonary ventilatory tests consisting of forced vital capacity (FVC) and forced expiratory volume ( $FEV_1$ ) were obtained. The postoperative values were reported as percent of preoperative function.

Complete statistical analysis of all factors was obtained by Student's *t* test.

## Results

There was no significant difference in age or sex in both groups of patients. The primary disease and type of thoracotomy were not notably different either. Figure 1 shows the difference in  $FEV_1$  in both groups of patients. There was a significant decrease in  $FEV_1$  ( $p < 0.05$ ) between the control group and the treated group for postoperative days 1 to 7. At day 10 there was not a significant difference ( $p < 0.1$ ). The changes in FVC are shown in Figure 2. There was significantly ( $p < 0.01$ ) better FVC volume

*Differences in Age, Sex, Weight, and Type of Operation Between the Control and Treated Groups*

Factor	Control	Treated
Age (yr)	22-69	18-67
Sex	F,5; M,5	F,4; M,6
Weight (kg)	45-73	39-81
Operation		
Hiatus hernia repair	3	4
Open lung biopsy	2	2
Exploratory thoracotomy	4	3
Esophagomyotomy	1	1
Total	10	10

in the treated group from day 1 to day 4. Days 7 and 10 showed no significant difference ( $p > 0.08$ ).

The treated group was subjectively more comfortable in terms of pain response on days 1 and 2 after operation. Postoperative narcotic medication was significantly ( $p < 0.05$ ) decreased during these days in the treated group. From day 3 on, both groups were similar in response to pain and use of narcotic medication ( $p > 0.5$ ). No significant differences in anesthetic requirements during operation were noted. There were no differences in the complication rate between the two groups nor were side effects or other abnormalities related to the local anesthetic agent noted in either group.

### Comment

This prospective randomized study indicates that intrathoracic intercostal block with bupivacaine after thoracotomy significantly improved the ventilatory function in the first week after the procedure. The requirements of analgesics were also diminished in the treated group, particularly in the first 2 postoperative days.

The results of this study confirm those obtained by Kaplan [5], Bridenbaugh [2], and their associates with regard to the effect of local anesthetics in improving pulmonary function but disagree with those of Galway [3], Holley [4], and their co-workers, as well as others. We believe that in order to obtain a beneficial effect from the local anesthetic bupivacaine, the agent should be properly injected into the subcostal nerves before closing

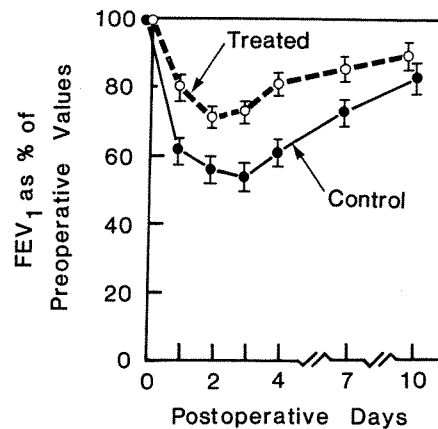


Fig 1. Forced expiratory volume (FEV<sub>1</sub>) values for 10 days after operation plotted as the percentage of preoperative function (mean  $\pm$  standard deviation). There was a significant difference ( $p < 0.05$ ) between the control and treated groups for the first 7 postoperative days; thereafter the values are similar.

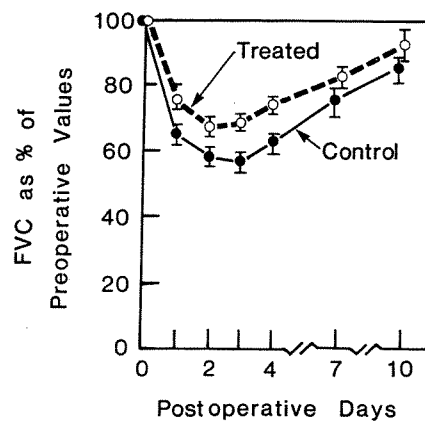


Fig 2. Forced vital capacity (FVC) values for ten days after operation plotted as the percentage of preoperative function (mean  $\pm$  standard deviation). There was a significant difference ( $p < 0.01$ ) between the control and treated groups for the first 4 postoperative days; thereafter the values were similar.

the thoracotomy. Although several studies indicate that the length of action of these anesthetic drugs varies considerably [8], in general, the effect in our patients was maintained for 12 hours, as far as anesthetic action is concerned. Use of this drug in an intercostal block partially eliminates the thoracic pain, and, therefore, the patient can breathe more satisfactorily after operation.

Pain related to differences in incision size, amount of dissection, and variations in anesthetic should be negligible since patients were randomized to a control or treated group. All

these factors, which were standard in our patients, were well controlled.

Others [9] have used intraoperative intercostal nerve freezing to prevent postthoracotomy pain. Their results showed improvement in coughing and reduction in the need for narcotics postoperatively. There was no indication of the ventilatory functional response. Our data showed similar results when the intrathoracic intercostal block with bupivacaine was utilized.

We conclude that bupivacaine when it is properly utilized is of help in relief of postthoracotomy pain and improves pulmonary function after operation. Intrathoracic intercostal block with this agent was demonstrated to be beneficial for pulmonary function recovery in a prospective and randomized study of 20 postthoracotomy patients. Subjective data also indicated that the requirements of analgesics were diminished in the initial postoperative period in the treated group.

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