

**Title:** Bupivacaine With and Without Epinephrine for Intercostal Nerve Blocks  
**Authors:** Mark Johnson, M.D., Thomas Mickler, M.D., Richard Arthur, Ph.D., Stewart Rosenburg, M.D., Roger Wilson, M.D., Benjamin Covino, M.D.  
**Affiliation:** Departments of Anesthesia, Massachusetts General Hospital, Brigham and Women's Hospital, and Harvard Medical School, Boston, MA

**Introduction:** Intercostal nerve blocks (ICNB) are associated with higher blood levels of local anesthetics than most other types of nerve block. Epinephrine is frequently added to the local anesthetic to decrease the rate of vascular uptake and systemic toxicity, but it may have adverse cardiovascular effects. Studies on ICNB with mepivacaine have shown decreased blood levels when epinephrine was added to the solution, whereas blood levels of etidocaine used for ICNB were not significantly reduced when epinephrine was added to the solution. Blood levels of bupivacaine with and without epinephrine, following ICNB, have not been reported to date.

This study was designed to evaluate whether or not epinephrine should be added to bupivacaine for ICNB. Blood levels of bupivacaine, epinephrine and norepinephrine were measured and correlated with clinical cardiovascular parameters.

**Methods:** With the approval of the Massachusetts General Hospital Human Studies Committee, written informed consent was obtained. Patients consisted of ASA class I and II patients undergoing elective lateral thoracotomy for pulmonary resection. Patients with significant cardiac, renal or hepatic disease, clinically significant malnutrition or those requiring postoperative ventilation were excluded.

In a double-blinded collaborative study, 18 patients were randomized by hospital admission number, into two groups for ICNB, one with bupivacaine 0.5% with epinephrine (1:200,000) and one with bupivacaine without epinephrine. ICNB was performed per standard ICU protocol, as soon as the patient was awake from general anesthesia and complained of pain. The general anesthetic agents consisted of halothane-nitrous oxide and oxygen. No perioperative narcotics were administered.

Each patient underwent six intercostal nerve blocks (3 nerves above and 3 nerves below the incision). Using sterile technique, in the lateral position, with a 23 gauge short bevel needle, 4 ml of 0.5% bupivacaine with or without epinephrine (1:200,000) was used for each block; for a total of 24 ml (120 mg of bupivacaine). Serial blood samples were obtained from the indwelling radial artery catheter at 0, 2.5, 5, 10, 30, 60, 90, 180, and 240 minutes from the time of the ICNB, and assayed for bupivacaine, epinephrine and norepinephrine. These patients were placed in a 30° head-up position and 6L flow mask oxygen was administered. Blood pressure, heart rate, respiratory rate, temperature, and EKG were continuously monitored and routine arterial blood gases were obtained. The results were evaluated with an independent T-test, probability less than .05 was considered significant.

**Results:** Peak blood bupivacaine levels were

significantly lower in patients treated with bupivacaine with epinephrine (table). The highest bupivacaine level seen in patients who received bupivacaine without epinephrine was 1.92 µg/ml. The time to peak bupivacaine level was not significantly affected by the addition of epinephrine. Peak norepinephrine levels were not statistically changed. The bupivacaine level generally peaked within 5 minutes of the ICNB. Peak epinephrine levels were significantly greater in the patients who received bupivacaine with epinephrine. No significant difference in HR, systolic BP, RR, or temperature was seen and no arrhythmias occurred.

**Discussion:** Pain following thoracic surgery is often severe and may lead to marked respiratory impairment and cardiovascular stimulation. Many patients receive ICNB following thoracotomy for analgesia and to reduce respiratory splinting and improve cough. Bupivacaine is frequently used for ICNB because of its long duration of action. Bupivacaine may exhibit cardiotoxic and neurotoxic effects when high (> 4 µg/ml) blood levels are present. In this study, the addition of epinephrine (1:200,000) to 0.5% bupivacaine for ICNB significantly reduced peak blood bupivacaine levels. Thus, the potential risk of producing toxic blood levels of bupivacaine can be lessened by the addition of epinephrine to bupivacaine for ICNB.

**References:**

- Tucker G.T., Moore, D.C.: Systemic absorption of mepivacaine in commonly used regional block procedures. *Anesthesiology*, 37: 277, 1972.  
 Kennedy, W.F., Bonica, J.S.: Cardio-respiratory effects of epinephrine when used in regional anaesthesia. *Acta Anaesthesiol. Scand.* 23:320, 1966.

Concentrations of Bupivacaine, Epinephrine and Norepinephrine After ICNB with 0.5% Bupivacaine, With and Without Epinephrine

	Bupivacaine Plain			Bupivacaine With Epinephrine (1:200,000)		
	Mean	SD	N	Mean	SD	N
Peak Bupivacaine Concentration (µg/ml) Whole Blood	1.32*	0.41	7	0.68	0.21	8
Time to Peak Bupivacaine Concentration (min)	4.2	3.1	7	9.1	9.1	8
Peak Epinephrine Concentration (ng/l)	401*	181	7	926	175	7
Peak Norepinephrine Concentration (ng/l)	669	178	7	506	161	7

\* p < 0.01