



PROSPECTIVE RANDOMIZED TRIAL OF BILATERAL PARAVERTEBRAL BLOCK VERSUS THORACIC EPIDURAL ANALGESIA FOR OFF-PUMP CORONARY ARTERY BYPASS (OPCAB) SURGERY

Anaesthesiology

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ABSTRACT

Adequate analgesia after OPCAB prevents postoperative pulmonary complications. This study compared the efficacy of continuous thoracic epidural (TEA) versus paravertebral block (PVB) with regard to quality of analgesia and complications in sixty patients undergoing elective OPCAB. Group A received thoracic epidural at T3-T4/ T4-T5 while in group B, bilateral paravertebral spaces were catheterized at T3-T4 level. Inj Ropivacaine 0.2% + Fentanyl 2 mcg/ml@5-7ml/hr was started in both groups and continued till 24 hours after surgery. Pain score was assessed using visual analogue scale (VAS) at rest and while coughing at extubation, 6, 12 and 24 hours. VAS scores were similar but rescue analgesia requirement was higher in group A (23.3% vs 13.3%; p=0.51). Duration of mechanical ventilation, opioids and muscle relaxant requirement and hospital stay were similar.

Conclusion: Bilateral paravertebral block is a safe and effective technique during OPCAB.

KEYWORDS

Anesthesia, epidural, paravertebral, regional, block, CABG

Introduction

Anesthetic management during off pump CABG (OPCAB) aims to maintain myocardial oxygen demand supply balance. At the same time, sternotomy elicits considerable pain in the postoperative period which reduces respiratory mechanics, increases myocardial oxygen demand and hypoxemia ensues. Systemic use of narcotics or non-steroidal anti-inflammatory drugs, administered alone or in combination, often do not result in satisfactory pain relief. Furthermore, opioids are associated with respiratory depression, nausea and bowel dysfunction. NSAIDs, on the other hand, may cause GI bleeding, dyspepsia, acute renal failure or platelet dysfunction. Optimized strategies therefore aim at improving analgesia by selective and locally administered drugs to the pain-eliciting anatomic region in a continuous manner rather than systemic saturation with analgesics. This results in excellent analgesia when administered through an epidural or paravertebral catheter.¹

Anesthetic effects of 0.2% ropivacaine when used through paravertebral block and epidural route in OPCAB have been proved in fewer studies despite some evidence that ropivacaine has lower cardiovascular and central nervous system toxicity than bupivacaine and it may have clinical advantages compared with other local anaesthetics.^{2,7} Therefore, we conducted a prospective randomized clinical study to compare the efficacy of continuous thoracic epidural (TEA) versus paravertebral block (PVB) with regard to quality of analgesia, complications, and hemodynamic parameters in patients undergoing OPCAB.

Material and methods

After institutional ethics committee approval and obtaining written informed consent, 60 patients undergoing elective OPCAB were randomly divided by sealed envelope technique into two groups (n=30 each) viz. A (TEA) and B (PVB). Patients between 35-70 years age with stable angina and undergoing elective surgery were included. Patients with left ventricular ejection fraction (LVEF) <40%, combined CABG and valvular surgery, receiving antiplatelet drugs within the preceding week, requiring preoperative inotropic support or IABP, platelet count < 1,00,000/ml, international normalized ratio (INR) > 1.5 and requiring cardiopulmonary bypass were excluded from the study. Angiotensin-converting enzyme inhibitors were suspended 24 hours before surgery. Calcium-channel antagonists and β -adrenergic blocking drugs were continued until morning of surgery. On arrival in the operating room, pulse oximeter, NIBP and ECG (lead II and V5) were applied. In TEA group, epidural space was catheterized with 18 G epidural catheter using midline approach at T3-T4/ T4-T5 interspace in sitting position. In PVB group, bilateral paravertebral space was catheterized with 18 G catheter at the T3-T4 level using standard

method. All regional blocks were performed by the same operator one hour before induction of anaesthesia so as to adjust about 1.5 to 2 hrs interval between catheter insertion and heparinisation. Both spaces were identified with loss-of-resistance technique to saline. A test dose of 3 ml of 2% plain lignocaine was given in all the patients. Epidural block was established by 8-10 ml 0.2% inj. ropivacaine and paravertebral block by 10-12 ml 0.2% ropivacaine in each catheter. Assessment was done 15-20 min later by loss of temperature sensation to cold with ether swab bilaterally at the midclavicular line. Successful block was defined as block over T1 to T8 dermatomes. Procedure was considered failed if insertion required more than 2 attempts or 'bloody tap' occurred. Standard ASA monitoring along with ST segment analysis, IBP, CVP, ABG and ACT was performed. High dose intravenous narcotic induction using midazolam (0.1 mg/kg), fentanyl (10 mcg/kg) and pancuronium bromide 0.1mg/kg was done and maintained on oxygen/air/isoflurane. Infusion of 0.2% ropivacaine + fentanyl 2 mcg/ml@5-7ml/hr was started in both groups and continued till 24 hours after surgery.

All patients were operated by the same team of surgeons. Heparinisation (1.5-2 mg/kg) was targeted to maintain ACT between 250-300 seconds. Heart rate (HR), mean arterial pressure (MAP), central venous pressure (CVP) were recorded at baseline, during anterior (LAD & diagonal) and posterior (OM & RCA) coronary artery anastomoses and in the ICU. Hypotension was defined as MAP < 55 mmHg and accordingly corrective measures (vasopressor/ inotrope/fluid) were taken and local anesthetic infusion was stopped if deemed necessary. LA infusion was restarted after achieving hemodynamic stability.

In the ICU, attendant nurse recorded visual analogue scale (VAS) at rest and while coughing (0-no pain; 10-maximum pain) at extubation, 6, 12 and 24 hours after extubation. If the VAS score at rest was >5 or whenever the patient demanded, additional analgesia was provided with inj paracetamol 1 gm IV. All complications were noted.

All data are presented as mean + SD and analyzed using Statistical Package for the Social Sciences (SPSS) version 16.0 (Chicago, USA) software. Sample size was calculated using power 80% and type 1 error 5%. Parametric and non-parametric data were compared using two sided Student t-test and Mann Whitney U test respectively. Discrete data were analyzed using Chi-square or Fisher's exact test. P value <0.05 was considered significant.

Results

Both groups were comparable with regard to demographic data, ejection fraction and duration of surgery. Duration of mechanical

ventilation, hospital stay, opioids and muscle relaxant requirement were also similar. [Table 1] Hemodynamic parameters were comparable in both groups. The magnitude of decrease in MAP was clinically insignificant after completion of posterior coronary arterial anastomoses. [Table 2] Though VAS scores were relatively higher in group A, all patients were comfortable. [Tables 3] Rescue analgesia requirement was greater in group A but could not reach statistical significance. None of the patients had any catheter related complication. [Table 4]

Discussion

OPCAB is associated with hemodynamic alterations, postoperative pain and respiratory dysfunction.^{8,9} The aim of anesthesia is to provide myocardial protection, maintain hemodynamic stability & excellent postoperative analgesia. The addition of regional anesthesia to general anesthesia improves quality of recovery after CABG. While TEA has been successfully used in OPCAB; use of PVB for median sternotomy has not been addressed firmly in the literature; although its efficacy is proved during thoracotomy and MIDCAB.¹⁰⁻¹³ Proposed advantages of PVB are less extensive sympathetic blockade, low risk of epidural hematoma, urinary retention and ease of technique as compared to TEA.¹² PVB acts on intercostal nerves, sympathetic chain, posterior rami and dorsal root ganglia. Bilateral PVB may spread into the epidural space, enhancing its analgesic effect. Therefore, PVB is an attractive anesthetic technique for OPCAB.¹⁴

Till date, only few studies have used Inj. Ropivacaine in TEA during OPCAB surgery.³⁻⁶ Concentrations used were different in all these studies. A dose-finding study with 0.1%, 0.2% and 0.3% Ropivacaine demonstrated that 0.2% Ropivacaine provided best balance between analgesia and motor block.¹⁵ Ropivacaine was also chosen because of low toxicity and its successful use for epidural analgesia in a similar setting.¹⁶⁻¹⁷ Fentanyl also acts in the dorsal root ganglia which is affected by paravertebral blockade.¹⁸

Present study showed clinically acceptable hemodynamics in both the groups. Heart rate and MAP decreased within acceptable clinical limits after thoracic sympathetic blockade in both groups. This was possibly due to constriction of capacitance vessels in the remaining unblocked lower body segments which maintained MAP.¹⁹ VAS score revealed similar analgesic efficacy with both techniques. Although epidural group had consistently high VAS scores and rescue analgesic requirement, it was statistically insignificant. This comparable requirement by PVB is consistent with other similar studies.^{12,13} We did not encounter any catheter related complications like epidural hematoma and neuro-motor insult. When both techniques are performed under strict protocols with appropriate neurologic monitoring, potential for permanent neurologic damage from an epidural hematoma is judged to be acceptably low. The importance of factors including presence of a normal coagulation system prior to insertion and removal of the catheter, avoidance of repeated attempts, postponing surgery in the presence of a bloody tap and close neurological surveillance are helpful in minimizing risk.²⁰⁻²² In some studies, epidural catheter was inserted >12 hr before surgery in an attempt to decrease the risk of epidural hematoma in patients posted for CABG.^{23,24} There are certain disadvantages with this like manpower issues (anesthesiologists, nurse anesthetists) for catheter insertion the day before surgery, increased need for preoperative monitoring and enhanced healthcare cost. However, few studies have not found any neurological complications when TEA was placed immediately before anesthesia induction.²⁵⁻²⁷

OPCAB surgery needs reduced heparinization as compared to on pump CABG, which theoretically reduces bleeding complications associated with epidural anesthesia. Authors chose paravertebral space between third and fourth vertebra which is near to the largest space between first and second, or second and third, thoracic vertebrae, where the parietal pleura is farthest from the vertebral bodies and thus complications like pneumothorax and failure rates were reduced.²⁸

Duration of mechanical ventilation, requirement of opioid, time for extubation and duration of hospital stay were similar in both groups. This denotes safety of PVB.

This single centered study had relatively small sample size. We did not perform bedside pulmonary function tests which indicate improved lung mechanics due to appropriate analgesia. Additional requirement of local anesthetic agent in bilateral paravertebral catheters would have improved analgesia in PVB group. Overall, PVB compared

reasonably well with TEA in terms of safety and efficacy during OPCAB.

Conclusion

Bilateral paravertebral block is a safe and effective alternative to thoracic epidural analgesia technique during OPCAB.

References

- Caputo M, Alwair H, Rogers CA, Pike K, Cohen A, Monk C et al. Thoracic epidural anesthesia improves early outcomes in patients undergoing off-pump coronary artery bypass surgery: a prospective, randomized, controlled trial. *Anesthesiology*. 2011;114(2):380-90.
- Cantó M, Sánchez MJ, Casas MA, Bataller ML. Bilateral paravertebral blockade for conventional cardiac surgery. *Anaesthesia*. 2003;58(4): 365-70.
- Kessler P, Neidhart G, Bremerich DH, Aybek T, Dogan S, Lischke V et al. High thoracic epidural anesthesia for coronary artery bypass grafting using two different surgical approaches in conscious patients. *Anesth Analg*. 2002;95(4):791-7
- Achurin RS, Lepilin MG, Bajaliev A, Torshin SV, Lepilin PM. Peculiarities of hemodynamic changes during high thoracic epidural anesthesia in beating heart surgery. *Eur J Gen Med* 2005; 2(4): 144-149.
- Bakhtiyari F, Therapidis P, Dzemali O, Ak K, Ackermann H, Meninger D et al. Impact of high thoracic epidural anesthesia on incidence of perioperative atrial fibrillation in off-pump coronary bypass grafting: A prospective randomized study. *J Thorac Cardiovasc Surg* 2007; 134(2):460-4.
- Kirov MY, Eremeev AV, Smetkin AA, Bjertnaes LJ. Epidural anaesthesia and postoperative analgesia with ropivacaine and fentanyl in off-pump coronary artery bypass grafting: a randomized, controlled study. *BMC Anesthesiol* 2011; 11:17.
- Batra RK, Krishnan K, Agarwal A. Paravertebral block. *J Anaesthesiol Clin Pharmacol*. 2011; 27(1):5-11.
- Scott BH, Seifert FC, Grimson R, Glass PS: Resource utilization in on- and off-pump coronary artery surgery: factors influencing postoperative length of stay: an experience of 1,746 consecutive patients undergoing fast-track cardiac anaesthesia. *J Cardiothorac Vasc Anesth* 2005; 19(1):26-31.
- Ngaage DL: Off-pump coronary artery bypass grafting: the myth, the logic and the science. *Eur J Cardiothorac Surg* 2003, 24(4):557-70.
- Clowes GH Jr, Neville WE, Hopkins A, Anzola J, Simeone FA. Factors contributing to success or failure in the use of a pump oxygenator for complete bypass of the heart and lung, experimental and clinical. *Surgery* 1954; 36(3): 557-79.
- Joachimsson PO, Nyström SO, Tyden H. Early extubation after coronary artery surgery in efficiently rewarmed patients: a postoperative comparison of opioid anesthesia versus inhalational anesthesia and thoracic epidural analgesia. *J Cardiothorac Anesth* 1989; 3(4): 444-54.
- Mehta Y, Arora D, Sharma KK, Mishra Y, Wasir H et al. Comparison of continuous thoracic epidural and paravertebral block for postoperative analgesia after robotic-assisted coronary artery bypass surgery. *Ann Card Anaesth* 2008; 11(2):91-6.
- Dhole S, Mehta Y, Saxena H, Juneja R, Trehan N. Comparison of continuous thoracic epidural and paravertebral blocks for postoperative analgesia after minimally invasive direct coronary artery bypass surgery. *J Cardiothorac Vasc Anesth*. 2001; 15(3):288-92.
- Purcell-Jones G, Pither CE, Justins DM. Paravertebral somatic nerve block: a clinical, radiographic, and computed tomographic study in chronic pain patients. *Anesth Analg* 1989; 68(1): 32-9.
- Scott DA, Charmley DM, Mooney PH, Deam RK, Mark AH, Hagglob F. Epidural Ropivacaine infusion for postoperative analgesia after major lower abdominal surgery—a dose finding study. *Anesth Analg* 1995; 81(5):982-6.
- Morrison SG, Dominguez JJ, Frascaro P, Reiz S. A comparison of the electrocardiographic cardiotoxic effects of racemic bupivacaine, levobupivacaine, and ropivacaine in anesthetized swine. *Anesth Analg* 2000; 90(6): 1308-14.
- Cantó M, Casas A, Sánchez MJ, Lorenzo A, Bataller L. Thoracic epidurals in heart valve surgery: neurologic risk evaluation. *J Cardiothorac Vasc Anesth* 2002; 16(6): 723-6.
- Dickinson AH. Spinal cord pharmacology of pain. *Br J Anaesth* 1995; 75(2): 193-200.
- Baron JF, Payen D, Coriat P, Edouard A, Viars P. Forearm vascular tone and reactivity during lumbar epidural anesthesia. *Anesth Analg* 1988; 67(11):1065-70. Salvi L, Sisillo E, Brambillasca C, Juliano G, Salis S, Marino MR. High thoracic epidural anesthesia for off-pump coronary artery bypass surgery. *J Cardiothorac Vasc Anesth*. 2004; 18(3):256-62.
- Sanchez R, Nygard E. Epidural anaesthesia in cardiac surgery: is there an increased risk? *J Cardiothorac Vasc Anesth* 1998; 12:170-3.
- Pastor MC, Sanchez MJ, Casas MA, Mateu J, Bataller ML. Thoracic epidural analgesia in coronary artery bypass graft surgery: seven years' experience. *J Cardiothorac Vasc Anesth* 2003; 17(2):154-159.
- Liem TH, Booi LH, Hasenbos MA, Gielen MJ. Coronary artery bypass grafting using two different anaesthetic techniques: Part I: Hemodynamic results. *J Cardiothorac Anesth* 1992; 6(2): 148-55.
- Kirno K, Friberg P, Grzegorzczak A, Milocco I, Riksten SE, Lundin S. Thoracic epidural anaesthesia during coronary artery bypass surgery: effects on cardiac sympathetic activity, myocardial blood flow and metabolism, and central hemodynamics. *Anesth Analg* 1994; 79(6): 1075-81.
- El-Baz N, Goldin M. Continuous epidural infusion of morphine for pain relief after cardiac operations. *J Thorac Cardiovasc Surg* 1987; 93(6): 878-83
- Olivier JF, Le N, Choinière JL, Prieto I, Basile F, Hemmerling T. Comparison of three different epidural solutions in off-pump cardiac surgery: pilot study. *Br J Anaesth* 2005; 95(5): 685-91.
- Turfrey DJ, Ray DA, Sutcliffe NP, Ramayya P, Kenny GN, Scott NB. Thoracic epidural anaesthesia for coronary artery bypass graft surgery. Effects on postoperative complications. *Anaesthesia* 1997; 52(11): 1090-113
- Desai PM. Thoracic paravertebral block. *Br J Anaesth* 1999; 82(1): 149-50.