PVB versus TEA review details

reference	participants' characteristics	intervention group/ control group	outcomes	critical appraisal/ conclusion
Davies et al. 2006 A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy - a systematic review and meta-analysis of randomized trials. Br J Anaesth. 2006;96(4):418-2[6]	**databases/ search engines** - MEDLINE - EMBASE - Cochrane Central Register of Controlled Trials **search terms** - paravertebral, extrapleural, intercostal, continuous intercostal, epidural, extradural, and peridural **search period** - 1989–2005 **inclusion criteria** - randomised trials comparing PVB with TEA in thoracic surgery - administration of a local anaesthetic agent **exclusion criteria** - lumbar epidural block - epidural opioid-only regimens **included studies (n participants)** [1] Matthews et al. 1989 (20) [2] Richardson et al. 1999 (36) [3] Dhole et al. 2001 (30) [4] De Cosmo et al. 2002 (100) [5] Wedad et al. 2004 (46) [6] Luketich et al. 2005 (41) [7] Leaver et al. 2006 (50) [8] Perttunen et al. 1995 (30) [9] Kaiser et al. 1998 (30) [10] Richardson et al. 1999 (29)	[1] Matthews et al. 1989 - thoracic bupivacaine 0.25% bolus, then infusion - catheter inserted post-induction; bupivacaine 0.25% bolus+infusion [2] Richardson et al. 1999 - PVB: 20 mL 0.5% bupivacaine, 2nd bolus of 20 mL 0.25% bupivacaine chest closure, then infusion 0.5% bupivacaine at 0.1 mL/kg/h - TEA: 10–15 mL 0.25% bupivacaine; 2nd bolus of 10 mL 0.25% bupivacaine at chest closure then infusion 0.25% bupivacaine at 0.1 mL/kg/h [3] Dhole et al. 2001 - TEA: bupivacaine 0.5% intraop, then 0.25–0.375% bupivacaine + fentanyl infusion - PVB bupivacaine 0.5% bolus+infusion [4] De Cosmo et al. 2002 - thoracic bupivacaine 0.25% bolus, then infusion - single injection pre-induction, then intraop catheter placement by surgeon - pre-induction bupivacaine 0.5% bolus - intraoperative bupivacaine 0.25% bolus - postoperative bupivacaine 0.5% infusion [5] Wedad et al. 2004 - thoracic bupivacaine 0.1%+ fentanyl infusion - catheter inserted by surgeon - bupivacaine 0.5%+fentanyl bolus - bupivacaine 0.1%+fentanyl infusion [6] Luketich et al. 2005 - TEA: bupivacaine 0.5% bolus, then bupivacaine 0.25% infusion - PVB: bupivacaine 0.5% bolus then bupivacaine 0.25% infusion [7] Leaver et al. 2006 - TEA: ropivacaine 0.2%+sufentanil bolus, then infusion - PVB: ropivacaine 0.475% bolus then ropivacaine 0.3% infusion [8] Perttunen et al. 1995 - PVB: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h - TEA: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h [9] Kaiser et al. 1998 - PVB: infusion of 20 mL bupivacaine 0.5%, then CI 0.1 mL/kg/h with 0.5% bupivacaine - TEA: CI 4–6 mL/h of 0.5% bupivacaine intraop then CI 4–8 mL/h of 0.25%–0.375% bupivacaine + 2 µg/mL fentanyl [10] Richardson et al. 1999	**pulmonary complications (odds ratio (95% CI))** - a significant reduction in the rate of pulmonary complications with PVB when compared with epidural analgesia, OR 0.36 (0.14, 0.92) **morphine consumption** - there was no statistically significant difference in morphine consumption between PVB and epidural groups at 24 h or 24–48 h, WMD 5.9 mg (-18.3, 6.6), -1.9 mg (-8.8, 4.4) respectively **supplemental analgesia requirements** - there was no significant difference in the use of supplemental analgesia between the PVB and epidural groups, OR 0.63 (0.31, 1.31) - rates of failed technique were lower in the PVB group, OR 0.28 (0.2, 0.6), p=0.007 **respiratory function** - improved at both 24 and 48 h with PVB but only significantly improved at 24 h, WMD 6% (3, 9), 8% (-1, 17) respectively **length of hospital stay** - no significant difference WMD - 0.2 days (-0.9, 0.5) **adverse effects/ events (odds ratio (95% CI))** - PVB was associated with a reduction in urinary retention, postoperative nausea and vomiting, and hypotension, OR 0.23 (0.10, 0.51), 0.47 (0.24, 0.93), 0.12 (0.04, 0.36) respectively - no difference in the rates of respiratory depression between the two groups, OR 1.54 (0.61, 3.92)	**methodological shortcomings** - each outcome measure includes only a subset of the 10 selected studies - there were different methods of placement of the PVBs, the analgesic agents used and the parameters evaluated. **level of evidence: 1** **authors' conclusion** "this systematic review found no difference in analgesia with PVB techniques when compared with epidural regimens. PVB was associated with improvements in respiratory function and a reduction in complications. It appears that PVB is advantageous and can be recommended for major thoracic and upper abdominal surgery."

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		- PVB: 20 mL 0.5% bupivacaine, 2nd bolus of 20 mL 0.25% bupivacaine chest closure, then infusion 0.5% bupivacaine at 0.1 mL/kg/h - TEA: 10–15 mL 0.25% bupivacaine; 2nd bolus of 10 mL 0.25% bupivacaine at chest closure then infusion 0.25% bupivacaine at 0.1 mL/kg/h		
Kotzé et al. 2009 Efficacy and safety of different techniques of paravertebral block for analgesia after thoracotomy: a systematic review and metaregression Br J Anaesth. 2009;103(5):626-36.	**databases/ search engines** - MEDLINE - EMBASE **search terms** - paravertebral block, nerve block, paravertebral, extrapleural, subpleural, retropleural, intercostal nerve block, thoracotomy, pneumonectomy, oesophagectomy, **search period** - to May 2008 **inclusion criteria** - RCTs in which at least one trial group received paravertebral LA with or without additives - postop pain control, pulmonary function, or both reported as outcome measure **exclusion criteria** - none reported **included studies (n participants)** [1] Perttunen et al. 1995 (30) [2] Richardson et al. 1999 (46) [3] Bhatnagar et al. 2006 (14) [4] Barron al. 1999 (22) [5] Sabanathan et al. 1990 (29) [6] Dauphin et al. 1997 (24) [7] Catala et al. 1996 (15) [8] Richardson et al. 1995 (22) [9] Carabine et al. 1995 (10) [10] Eng et al. 1992 (40) [11] Berrisford et al. 1990 (25) [12] Luketich et al. 2005 (47) [13] Kaiser et al. 1998 (30) [14] Watson et al. 1999 (23) [15] Deneuville et al. 1993 (26) [16] Wedad et al. 2004 (20) [17] Richardson et al. 1994 (56) [18] Richardson et al. 1993 (10) [19] Richardson et al. 1998 (6)	[1] Perttunen et al. 1995 - PVB: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h - TEA: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h [2] Richardson et al. 1999 - PVB: 20 mL 0.5% bupivacaine, 2nd bolus of 20 mL 0.25% bupivacaine chest closure, then infusion 0.5% bupivacaine at 0.1 mL/kg/h - TEA: 10–15 mL 0.25% bupivacaine; 2nd bolus of 10 mL 0.25% bupivacaine at chest closure then infusion 0.25% bupivacaine at 0.1 mL/kg/h [3] Bhatnagar et al. 2006 - two paravertebral groups: plain B and B + clonidine. Plain group's data used - B 2 mg/kg (0.125%) loading dose - B 0.5 mg/kg/h (0.125%) maintenance [4] Barron et al. 1999 - two paravertebral groups: B or lidocaine against placebo. B group used - B 0.3 mL/kg 0.25% loading dose - 0.1 mL/kg/h 0.25% maintenance [5] Sabanathan et al. 1990 - placebo (both had access to IM opioid) - B 100 mg loading dose - B 0.1 mL/kg/h 0.5% maintenance [6] Dauphin et al. 1997 - lumbar epidural morphine infusion - B with epinephrine 1:200000 loading dose - B 0.1 mL/kg/h 0.5% maintenance [7] Catala et al. 1996 - two paravertebral regimes: infusion and paravertebral B and norepinephrine boluses 6-hourly - B 0.375% 15 mL with epinephrine 1:200000 loading dose - B 5 mL/h 0.25% with epinephrine 1:200000 maintenance [8] Richardson et al. 1995 - interpleural B - B 150 mg loading dose - B 0.1 mL/kg/h 0.5% maintenance [9] Carabine et al. 1995 - PCA morphine - B 25 mg loading dose	**LA dosage** VAS scores - higher dose paravertebral B was strongly predictive of lower VAS scores at rest, when compared with lower dose regimes at 8 h postop (p=0.006), 24 h (p=0.001), and 48 h (p<0.001) [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17] - no statistically significant difference in pain scores on coughing between higher and lower dose B [1, 2, 3, 7, 13] - effect-size estimate for VAS improvement with higher dose B: 8 h 26.9 mm (95% CI 7.5–46.3 mm) 24 h 21.1 mm (95% CI 8.5–33.6 mm) 48 h 17.4 mm (95% CI 8.0–26.0 mm) pulmonary function - no statistically significant difference in FEV_1 at 24 and 48 h between higher and lower dose B trials - pulmonary function recovered faster in the higher dose B group - by 72 h postop, the difference reached significance (20.1% better improvement in FEV_1, 95% CI 2.08–38.07%, p=0.029) **continuous infusion vs intermittent bolus technique** - a direct comparison study, showed a slight improvement in VAS at 24 h postop when an infusion regime was used (difference of 15 mm at rest and 23 mm on coughing (p=0.003 in both cases)) - indirect comparison studies showed use of a continuous infusion for maintenance of PVB is associated with an improvement in analgesia at rest at all time points up to 48 h - the effect size: 8 h 29.8 mm (95% CI 0.98–58.7 mm, p=0.04) 24 h 26.7 mm (95% CI 9.2–44.3 mm, p=0.003) 48 h 23.3 mm (95% CI 13.7–32.9 mm, p<0.001) **choice of LA** - no difference between B and lidocaine in terms of VAS at rest, morphine requirements, or postoperative pulmonary function **the use of additives to LA** clonidine - no significant difference in pain scores on addition of clonidine to B compared with B alone (p=0.7) [1, 2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 20, 21] fentanyl - no significant difference in pain scores between the trials with fentanyl added to the LA for PVB, and those without (p=0.648) [1, 2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 20, 21]	**methodological shortcomings** - each outcome measure includes only a subset of the 10 selected studies - there were different methods of placement of the PVBs, the analgesic agents used and the parameters evaluated. **level of evidence: 1** **authors' conclusion** "this systematic review found no difference in analgesia with PVB techniques when compared with epidural regimens. PVB was associated with improvements in respiratory function and a reduction in complications. It appears that PVB is advantageous and can be recommended for major thoracic and upper abdominal surgery."

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		- B 5 mL/h, 0.25% maintenance [10] Eng et al. 1992 - placebo (both had access to IM opioid) - B 100 mg loading dose - B 0.5 mg/kg/h maintenance [11] Berrisford et al. 1990 - placebo (both had access to IM opioid) - B 100 mg loading dose - B 7 mL/h 0.5% maintenance [12] Luketich et al. 2005 - TEA: bupivacaine 0.5% bolus, then bupivacaine 0.25% infusion - PVB: bupivacaine 0.5% bolus then bupivacaine 0.25% infusion [13] Kaiser et al. 1998 - PVB: infusion of 20 mL bupivacaine 0.5%, then CI 0.1 mL/kg/h with 0.5% bupivacaine - TEA: CI 4–6 mL/h of 0.5% bupivacaine intraop then CI 4–8 mL/h of 0.25%–0.375% bupivacaine + 2 µg/mL fentanyl [14] Watson et al. 1999 - two paravertebral groups: bupivacaine 0.5% and lidocaine 1% in identical volumes - B 10 mL 0.5% loading dose - B 0.1 mL/kg/h 0.5% maintenance [15] Deneuville et al. 1993 - placebo and regular IM buprenorphine - B 20 mL 0.5% loading dose - B 3 mL/h 0.5% maintenance [16] Wedad et al. 2004 - epidural (local only), interpleural block - B 10 mL 0.25% loading dose - B 6 mL/h 0.25% maintenance [17] Richardson et al. 1994 - pre-emptive PVB vs PVB after surgery - B 20 mL 0.5% loading dose - B 0.1 mL/kg/h 0.5% maintenance [18] Richardson et al. 1993 - B 20 mL 0.5% loading dose - B 0.1 mL/kg/h 0.5% maintenance [19] Richardson et al. 1998 - interpleural B - B 20 mL 0.5% loading dose - B 0.1 mL/kg/h 0.5% maintenance		
Scarci et al. 2010 In patients undergoing thoracic surgery is paravertebral block as effective as epidural analgesia for pain management? Interact Cardiovasc Thorac Surg. 2010;10(1):92-6.	**databases/ search engines** - MEDLINE **search terms** - [postthoracotomy.mp OR thoracotomy.mp] AND [paravertebral.mp] AND [epidural.mp] **search period** - 1950 to August 2009 **inclusion criteria** - best evidence to answer the question “In [patients undergoing thoracic surgery] is [paravertebral Block] as effective as [epidural analgesia] for [pain Management]? **exclusion criteria**	[1] Joshi et al. 2008 - thoracic epidural analgesia with LA plus opioid - continuous PVB with LA [2] Davies et al. 2006 - PVB - TEA [3] Detterbeck, 2005 - PVB - TEA [4] Richardson et al. 1999 - PVB: 20 mL 0.5% bupivacaine, 2nd bolus of 20 mL 0.25% bupivacaine chest closure,	**postoperative pain scores [VAS]** - three studies showed that TEA and PVB were comparable for postop pain scores [1–3] - three studies found that PVB was superior to TEA for postop VAS [4–6] **analgesic use** **pulmonary function** - pulmonary function, as assessed by PEFR, was significantly better preserved in the PVBl group.	**methodological shortcomings** - not stated **level of evidence: 3** **authors’ conclusion** PVB can be at least as effective as epidural analgesia. It also has a better side-effect profile and a lower complication rate than epidural analgesia

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	- none reported **included studies (n participants)** [1] Joshi et al. 2008 (171) [2] Davies et al. 2006 (520) [3] Detterbeck, 2005, (619) [4] Richardson et al. 1999, (100) [5] Kaiser et al. 1998, (30) [6] Casati et al. 2006, (42)	then infusion 0.5% bupivacaine at 0.1 mL/kg/h - TEA: 10–15 mL 0.25% bupivacaine; 2nd bolus of 10 mL 0.25% bupivacaine at chest closure then infusion 0.25% bupivacaine at 0.1 mL/kg/h [5] Kaiser et al. 1998 PVB: infusion of 20 mL bupivacaine 0.5%, then CI 0.1 mL/kg/h with 0.5% bupivacaine TEA: CI 4–6 mL/h of 0.5% bupivacaine intraop then CI 4–8 mL/h of 0.25%–0.375% bupivacaine + 2 µg/mL fentanyl [6] Casati et al. 2006 - PVB: 0.75% ropivacaine x3 injections, postop 0.2% ropivacaine infusion - TEA: 0.75% ropivacaine bolus, postop 0.2% ropivacaine infusion	- lowest PEFR as a fraction of preop control was 0.73 in the PVB group in contrast with 0.54 in the TEA group (p<0.004). Oximetric recordings were better in the PVB group (96%) compared to the TEA group (95%) (p=0.0001) - statistically significant differences (FVC 46.8% for PVB and 39.3% for TEA group P<0.05; forced expiratory volume in 1 s (FEV_1) 48.4% in PVB group and 35.9% in TEA group, P-0.05) were reached in day 2 and continued until day 3 **complication rate** - plasma concentrations of cortisol, as marker of postoperative stress, increased markedly in both groups, but the increment was statistically different in favour of the PVB group (p=0.003) - TEA side effects included urinary retention (42%), nausea (22%), itching (22%) and hypotension (3%) and respiratory depression (0.07%) - TEA prolonged operative time and was associated with technical failure or displacement (8%). - TEA was also related to a higher complication rate compared to the PVB (2 vs. 0) - PVB was of equal efficacy to TEA but with a favourable side effect profile, and lower complication rate - PVB had fewer pulmonary complications and was accompanied by quicker return to normal pulmonary function	
Júnior et al. 2013 Comparison between continuous thoracic epidural and paravertebral blocks for postoperative analgesia in patients undergoing thoracotomy: Systematic review. Rev Bras Anestesiol. 2013;63(5):433-442	**databases/ search engines** - MEDLINE - Cochrane **search terms** - "pulmonary surgical procedures", "thoracotomy", "epidural", "peridural", "extradural", "paravertebral", "intercostal", "nerve block", "postoperative pain". **search period** - to September 2011 **inclusion criteria** - randomised prospective clinical studies - patients undergoing thoracotomy - comparing techniques of continuous epidural and paravertebral blocks with infusion of local anaesthetics alone or combined with opioids via catheter insertion in the thoracic region - included adult patients (aged over 18 years) - no language restriction **exclusion criteria** - articles using single injection of local anaesthetic - intrapleural analgesia - blockade outside the thoracic area - opioids alone - procedures other than thoracotomy **included studies (n participants)** [1] Matthews et al. 1989 (19) [2] Perttunen et al. 1995 (30) [3] Kaiser et al. 1998 (30) [4] Richardson et al. 1999 (95) [5] Bimston et al. 1999 (50) [6] Debreceni et al. 2003 (50) [7] Casati et al. 2006 (42) [8] Gulbahar et al. 2010 (44)	[1] Matthews et al. 1989 - thoracic bupivacaine 0.25% bolus, then infusion [2] Perttunen et al. 1995 - PVB: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h - TEA: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h [3] Kaiser et al. 1998 PVB: infusion of 20 mL bupivacaine 0.5%, then CI 0.1 mL/kg/h with 0.5% bupivacaine TEA: CI 4–6 mL/h of 0.5% bupivacaine intraop then CI 4–8 mL/h of 0.25%–0.375% bupivacaine + 2 µg/mL fentanyl [4] Richardson et al. 1999 - PVB: 20 mL 0.5% bupivacaine, 2nd bolus of 20 mL 0.25% bupivacaine chest closure, then infusion 0.5% bupivacaine at 0.1 mL/kg/h - TEA: 10–15 mL 0.25% bupivacaine; 2nd bolus of 10 mL 0.25% bupivacaine at chest closure then infusion 0.25% bupivacaine at 0.1 mL/kg/h [5] Bimston et al. 1999 - PVB: Bolus 0.5% bupivacaine + 2 ml fentanyl, infusion 10 µg/mL fentanyl + 0.1% bupivacaine - TEA: Bolus 0.5% bupivacaine + 2 ml fentanyl, infusion 10 µg/mL fentanyl + 0.1% bupivacaine [6] Debreceni et al. 2003	**postoperative pain at rest at four, eight, 12, 16, 20, 24, 36, and 48 hours** - no significant difference between PVB and TEA **frequencies reported for nausea and vomiting, urinary retention, and hypotension** **frequency of nausea and vomiting** - no significant difference between PVB and TEA (OR = 3.00, 95% CI = 0.49-18.45). **frequency of urinary retention** TEA was associated with a higher incidence of urinary retention compared to PVB (OR = 7.19, 95% CI = 1.87-27.7). **incidence of hypotension** TEA was associated with a higher incidence of hypotension compared to PVB (OR = 10.28, 95% CI = 2.95-35.77)	**methodological shortcomings** - results may have been biased by the heterogeneity of the studies included in the meta-analyses - except for the coefficients of heterogeneity smaller than 30% shown by studies measuring pain outcomes at 24 h postop and hypotension, all other study sets used for meta-analyses of other outcomes showed high coefficients of heterogeneity - this may be due to the small number of patients included in each study, inclusion of poor quality studies and/or small number of studies available for the meta-analyses - confidence intervals of the weighted mean differences between study sets varied in amplitude, suggesting insufficient sample sizes in the studies available. - lack of significant differences may have been the result of Type II statistical error - lack of comparisons between techniques may be a limitation regarding pain on movement and deep inspiration - a digital method was used for data extraction available only in graphical form, which may be responsible for the inaccuracy in values**level of evidence: 1** **authors' conclusion** "There were no statistically significant differences in pain relief after thoracotomy between EB and

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		- bupivacaine 0.25% infusion [7] Casati et al. 2006 - PVB: 0.75% ropivacaine x3 injections, postop 0.2% ropivacaine infusion - TEA: 0.75% ropivacaine bolus, postop 0.2% ropivacaine infusion [8] Gulbahar et al. 2010 - bupivacaine 0.25% infusion		PVB. PVB showed a lower incidence of side effects with reduced frequency of urinary retention and hypotension."
Baidya et al. 2014 Analgesic efficacy and safety of thoracic paravertebral and epidural analgesia for thoracic surgery: A systematic review and meta-analysis. Interact Cardiovasc Thorac Surg. 2014;18(5):626-35.	**databases/ search engines** - PubMed - PubMed Central - Scopus - Google Scholar - Cochrane Central Register of Controlled Trials (CENTRAL) **search terms** - 'thoracic paravertebral', 'thoracotomy', 'thoracic epidural', 'thoracic epidural analgesia', 'thoracic epidural anaesthesia' and 'paravertebral block' **search period** - to August 2013 **inclusion criteria** - English language comparing the efficacy of PVB with that of TEA after thoracotomy for lung surgery **exclusion criteria** - patients undergoing thoracotomy for non-lung surgery eg cardiac surgery, lumbar epidural anaesthesia /analgesia - where only epidural opioid regimens were used **included studies (n participants)** [1] Matthews et al. 1989 (20) [2] Perttunen et al. 1995 (30) [3] Richardson et al. 1999 (100) [4] Bimston et al. 1999 (50) [5] De Cosmo et al. 2002 (50) [6] Casati et al. 2006 (42) [7] Messina et al. 2009 (24) [8] Gulbahar et al. 2010 (50) [9] Mukherjee et al. 2010 (60) [10] Pintaric et al. 2011 (32) [11] Kanazi et al. 2012 (42) [12] Grider et al. 2012 (75) [13] Kobayashi et al. 2013 (70)	[1] Matthews et al. 1989 - PVB: Bolus 10 mL 0.25% bupivacaine, then 5 mL/h infusion, adjusted to 3–10 mL/h to achieve analgesia of T5–T12 dermatome - TEA: Bolus 10 mL 0.25% bupivacaine, then 5 mL/h infusion, adjusted to 3–10 mL/h to achieve analgesia of T5–T12 dermatome [2] Perttunen et al. 1995 - PVB: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h - TEA: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h [3] Richardson et al. 1999 - PVB: 20 mL 0.5% bupivacaine, 2nd bolus of 20 mL 0.25% bupivacaine chest closure, then infusion 0.5% bupivacaine at 0.1 mL/kg/h - TEA: 10–15 mL 0.25% bupivacaine; 2nd bolus of 10 mL 0.25% bupivacaine at chest closure then infusion 0.25% bupivacaine at 0.1 mL/kg/h [4] Bimston et al. 1999 - PVB: Bolus 0.5% bupivacaine + 2 ml fentanyl, infusion 10 µg/mL fentanyl + 0.1% bupivacaine - TEA: Bolus 0.5% bupivacaine + 2 ml fentanyl, infusion 10 µg/mL fentanyl + 0.1% bupivacaine [5] De Cosmo et al. 2002 - PVB: 20 mL bolus 0.475% ropivacaine, infusion 0.3% ropivacaine at 5 mL/h - TEA: 3 mL 0.2% ropivacaine, then 0.2% ropivacaine + 0.75 µg/mL sufentanil infusion at 5 mL/h [6] Casati et al. 2006 - PVB: 0.75% ropivacaine x3 injections, postop 0.2% ropivacaine infusion - TEA: 0.75% ropivacaine bolus, postop 0.2% ropivacaine infusion [7] Messina et al. 2009 - PVB: 0.25% levobupivacaine + fentanyl 1.6 µg/mL at 0.1 mL/kg/h - TEA: 0.125% levobupivacaine + 2 µg/mL fentanyl at 0.08 mL/kg/h [8] Gulbahar et al. 2010	**postoperative pain (4–8, 24, 48 h) score** **VAS score** - scores were similar in both the PVB and TEA groups both at rest and on movement **postoperative opioid consumption** - pooled analysis showed patients who received PVB may require 14.26 mg (95% CI −3.71, 32.24) of morphine in the first 24 h postop - one study showed PVB patients had significantly more morphine in 72 h postop period [7] - four studies reported similar postop opioid requirement in both groups [6,8,10,12] **postoperative haemodynamics** - pooled analysis of 8 studies showed PVB is associated with significantly less hypotension than TEA (odds ratio [OR] 0.13; 95% CI 0.06, 0.31; M-H fixed) in both the intra- and postop period [1,3,4,5,6,8,12,13] **postop respiratory parameters** - the effect of PVB or TEA on respiratory parameters was inconsistent across studies – different parameters were studied, including FEV_1, FVC, PEFR, $PaCO_2$, SpO_2 **other complications** - pooled data analysis from 5 studies showed postop urinary retention may be less in PVB patients (p= 0.0001; OR 0.18; 95% CI 0.07, 0.43;M-H fixed) compared with TEA	**methodological shortcomings** Despite extensive electronic search in many databases, we were able to include only 494 patients for this meta-analysis. All the included studies were individually small and some studies did not reveal the methods of randomization. Data reporting among the included studies varied significantly and we were not able to include most of the studies for quantitative analysis. The techniques of both epidural and paravertebral analgesia were different across the studies. Therefore, at times, it was very difficult to interpret the reported results from all these studies. There are some methodological issues with some studies, e.g. Mukherjee et al. [26] did use a postoperative infusion, and only evaluated the duration of analgesia after a single injection. Kanazi et al. [28] targeted a VAS of <7, and this level of pain may be unacceptable. We only included RCTs published in the English language; hence, inclusion of studies published in other languages may influence the final result. **level of evidence: 1** **authors conclusion** Thoracic PVB may be as effective as thoracic epidural analgesia for post-thoracotomy pain relief and is also associated with fewer complications

reference	participants' characteristics	intervention group/ control group	outcomes	critical appraisal/ conclusion
		- PVB: 0.25% bupivacaine (5 mL of 0.25%) at 0.10 mL/kg/h (1 h lo + 2 mL bolus) - TEA: 0.25% bupivacaine at 0.10 mL/kg/h (1 h lo + 2 mL bolus) [9] Mukherjee et al. 2010 - PVB: 0.25% bupivacaine + 50 µg fentanyl - TEA: 0.25% bupivacaine + 50 µg fentanyl [10] Pintaric et al. 2011 - PVB: 0.5% levobupivacaine + 30 µg/kg morphine - TEA: 0.25% levobupivacaine + 30 µg/kg morphine [11] Kanazi et al. 2012 - PVB: Bolus 20 mL of 0.25% bupivacaine + 5 µg/mL adrenaline; infusion 0.125% bupivacaine 8 mL/h for 24 h - TEA: Bolus 10 mL of 0.125% bupivacaine + 5 µg/ml adrenaline; infusion 0.125% bupivacaine 8 mL/h for 24 h [12] Grider et al. 2012 - PVB: paravertebral infusion 0.25% bupivacaine at 8 ml/h - TEA: group EB 0.25% bupivacaine - TEA: group EBO 0.25% bupivacaine + 0.01 mg/mL hydromorphone [13] Kobayashi et al. 2013 - PVB: 10 mL 0.375% ropivacaine then 84 mL 0.2% ropivacaine + 800 µg fentanyl at 5 mL/h - TEA: 0.2% ropivacaine bolus 5 mL, 84 mL 0.2% ropivacaine + 800 µg fentanyl at 5 mL/h		
Ding et al. 2014 A comparison of the analgesia efficacy and side effects of paravertebral compared with epidural blockade for thoracotomy: an updated meta-analysis. PLoS One. 2014;9(5):e96233.	**databases/ search engines** - Pubmed - EMBASE - Cochrane **search terms** - paravertebral - epidural - thoracotomy - randomised controlled trial **search period** - January 2006 to 2 February 2013 **inclusion criteria** - randomised controlled trials comparing the analgesic efficacy and side effects of PVB and TEA for thoracotomy - English language **exclusion criteria** the thoracic area - opioids alone - procedures other than thoracotomy **included studies (n participants)** [1] Kunihisa et al. 2011 (48) [2] Jay et al. 2012 (75) [3] Casati et al. 2006 (42) [4] Mehta et al. 2008 (36)	[1] Kunihisa et al. 2011 - PVB: Bolus 5 mL 0.75% ropivacaine then bolus 5 mL 0.75% ropivacaine. CI 0.2% ropivacaine at 4 mL/h for 60 h - TEA: CI 0.2% ropivacaine at 4 mL/ h after a 2nd bolus of 5 mL 0.75% ropivacaine for 60 h [2] Jay et al. 2012 - PVB: 0.25% bupivacaine at 8 mL/h - TEA: Basal 2 mL/h + 1 mL (10 min lo) via PCA either 0.25% bupivacaine alone or 0.25% bupivacaine + 0.01 mg/mL hydromorphone [3] Casati et al. 2006 - PVB: 0.75% ropivacaine x3 injections, postop 0.2% ropivacaine infusion - TEA: 0.75% ropivacaine bolus, postop 0.2% ropivacaine infusion [4] Mehta et al. 2008 - PVB: Bolus 8 mL 0.5% bupivacaine, CI 0.25% bupivacaine at 0.1 mL/kg/h - TEA: Bolus 8 mL 0.5% bupivacaine; CI 0.25% bupivacaine at 0.1 mL/kg/h [5] Gultekin et al. 2009	Eighteen trials involving 777 patients were included in the current analysis. There was no significant difference in pain scores between PVB and TEA at 4–8, 24, 48 h, and the rates of pulmonary complications and morphine usage during the first 24 h were also similar. PVB was better than TEA in reducing the incidence of urinary retention ($p<0.0001$), nausea and vomiting ($p=0.01$), hypotension ($p<0.00001$), and rates of failed block were lower in the PVB group ($p=0.01$).	**methodological shortcomings** This meta-analysis is characterized by several limitations that should be noted. Firstly, the findings are based on relatively low-quality data with a high risk of bias. This is a common limitation of systematic reviews. In addition, only papers written in English were included. Secondly, surgical placement of the catheter under direct vision must influence the results of side effects because it avoids complications and reduces failure rates. Thirdly, various drug regimens were implemented for EPI and PVB. In contrast to the studies of Richardson et al. and Casati et al. in which only a local anesthetic solution was used, Tatjana et al. administrated an infusion of a local anesthetic-opioid combination to both group. This influences not only analgesic efficacy but also respiratory depression, because a combination of local anesthetic and opioid administration carries a high risk of respiratory depression. **level of evidence: 1** **authors conclusion**

reference	participants' characteristics	intervention group/ control group	outcomes	critical appraisal/ conclusion
	[5] Gultekin et al. 2009 (44) [6] Messina et al. 2009 (24) [7] Tatjana et al. 2011 (32) [8] Medha et al. 2009 (30) [9] Ghassan et al. 2012 (42) [10] Kaiser et al. 1998 (30) [11] Richardson et al. 1999 (29) [12] Leaver et al. 2006 (50) [13] Matthews et al. 1989 (20) [14] De Cosmo et al. 2002 (20) [15] Perttunen et al. 1995 (30) [16] Dhole et al. 2001 (30) [17] Luketich et al. 2005 (41) [18] Bimston et al. 1999 (50)	- PVB: CI 0.25% bupivacaine at 0.10 mL/kg/h (1 h lo, 2 mL bolus) via patient-controlled elastomeric infusion pump - TEA: 0.25% bupivacaine (5 mL) 0.10 mL/kg/h 1 h lo, 2 mL bolus) via patient-controlled elastomeric infusion pump [6] Messina et al. 2009 - PVB: 0.25% levobupivacaine + fentanyl 1.6 µg/mL at 0.1 mL/kg/h - TEA: 0.125% levobupivacaine + 2 µg/mL fentanyl at 0.08 mL/kg/h [7] Tatjana et al. 2011 - PVB: 0.5% levobupivacaine + 30 µg/kg morphine. - TEA: 0.25% levobupivacaine + 30 µg/kg morphine [8] Medha et al. 2009 - PVB: bolus 0.5% bupivacaine in 0.3 mL/kg, CI 0.25% bupivacaine at 0.1–0.2 mL/kg/h - TEA: 0.5% bupivacaine in 1–1.5 mL/segment bolus, then CI 0.125% bupivacaine at 0.1–0.2 mL/kg/h [9] Ghassan et al. 2012 - PVB: Bolus 20 mL 0.25% bupivacaine, CI 0.125% bupivacaine at 8 mL/h - TEA: 10 mL 0.125% bupivacaine, CI 0.125% bupivacaine 8 mL/h [10] Kaiser et al. 1998 - PVB: infusion of 20 mL bupivacaine 0.5%, then CI 0.1 mL/kg/h with 0.5% bupivacaine - TEA: CI 4–6 mL/h of 0.5% bupivacaine intraop then CI 4–8 mL/h of 0.25%–0.375% bupivacaine + 2 µg/mL fentanyl [11] Richardson et al. 1999 - PVB: 20 mL 0.5% bupivacaine, 2nd bolus of 20 mL 0.25% bupivacaine chest closure, then infusion 0.5% bupivacaine at 0.1 mL/kg/h - TEA: 10–15 mL 0.25% bupivacaine; 2nd bolus of 10 mL 0.25% bupivacaine at chest closure then infusion 0.25% bupivacaine at 0.1 mL/kg/h [12] Leaver et al. 2006 - TEA: ropivacaine 0.2%+sufentanil bolus, then infusion - PVB: ropivacaine 0.475% bolus then ropivacaine 0.3% infusion [13] Matthews et al. 1989 - PVB: Bolus 10 mL 0.25% bupivacaine, then 5 mL/h infusion, adjusted to 3–10 mL/h to achieve analgesia of T5–T12 dermatome - TEA: Bolus 10 mL 0.25% bupivacaine, then 5 mL/h infusion, adjusted to 3–10 mL/h to achieve analgesia of T5–T12 dermatome [14] De Cosmo et al. 2002 - PVB: 20 mL bolus 0.475% ropivacaine, infusion 0.3% ropivacaine at 5 mL/h		This meta-analysis showed that PVB can provide comparable pain relief to traditional EPI, and may have a better side-effect profile for pain relief after thoracic surgery. Further high-powered randomized trials are to need to determine whether PVB truly offers any advantages over EPI.

reference	participants' characteristics	intervention group/ control group	outcomes	critical appraisal/ conclusion
		- TEA: 3 mL 0.2% ropivacaine, then 0.2% ropivacaine + 0.75 µg/mL sufentanil infusion at 5 mL/h [15] Perttunen et al. 1995 - PVB: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h - TEA: Bolus 0.25% bupivacaine according to height of patient, then infusion 0.25% bupivacaine at a rate of 4, 6 and 8 mL/h [16] Dhole et al. 2001 - TEA: bupivacaine 0.5% intraop, then 0.25–0.375% bupivacaine + fentanyl infusion - PVB bupivacaine 0.5% bolus+infusion [17] Luketich et al. 2005 - TEA: bupivacaine 0.5% bolus, then bupivacaine 0.25% infusion - PVB: bupivacaine 0.5% bolus then bupivacaine 0.25% infusion [18] Bimston et al. 1999 - PVB: Bolus 0.5% bupivacaine + 2 ml fentanyl, infusion 10 µg/mL fentanyl + 0.1% bupivacaine - TEA: Bolus 0.5% bupivacaine + 2 ml fentanyl, infusion 10 µg/mL fentanyl + 0.1% bupivacaine		