Thoracotomy 2004

Summary Recommendations

Notes on PROSPECT recommendations

The recommendations of the PROSPECT Working Group are graded A–D, based on the level of evidence from the studies, which is in accordance with the Oxford Centre for Evidence-Based Medicine (CEBM Website accessed Dec 2005, Sackett 2000). In the context of PROSPECT, recommendations based on procedure-specific evidence are grade A (randomised clinical trials), those based on transferable evidence are grade B (randomised clinical trials) or grade C (retrospective studies or case series) and those based on clinical practice are grade D (Appendix A: Levels of evidence and grades of recommendation).

PROSPECT provides clinicians with supporting arguments for and against the use of various interventions in postoperative pain based on published evidence and expert opinion. Clinicians must make judgements based upon the clinical circumstances and local regulations. At all times, local prescribing information for the drugs referred to must be consulted.

Summary recommendations

Pre-, intra- and postoperative interventions have been evaluated for the management of postoperative pain following thoracotomy. Unless otherwise stated, 'pre-operative' refers to interventions applied before surgical incision, 'intra-operative' refers to interventions applied after incision and before wound closure, 'postoperative' refers to interventions applied at or after wound closure. The following peri-operative interventions for thoracotomy have been reviewed:

PRE-OPERATIVE

Recommended

Regional analgesia

- **Thoracic epidural LA + strong opioid as a bolus before surgery (Grade A), continued as an infusion**

– **epinephrine in the epidural solution is recommended if a low dose of epidural LA and/or opioid is used (Grade A)**

- **Paravertebral block with LA (bolus pre-operatively or at the end of surgery, followed by continuous infusion), as an alternative to thoracic epidural analgesia (Grade A)**
- **Single bolus spinal strong opioid as part of a multi-analgesic regimen, when thoracic epidural analgesia and paravertebral block are not possible (Grade A)**

Not recommended:

Systemic analgesia

- α2-adrenergic receptor agonists:

– clonidine (Grade A)
– dexmedetomidine (Grade D)

- Corticosteroid (Grade D)
- Conventional NSAIDs (Grade A)
- COX-2-selective inhibitors (Grade D)
- Ketamine (Grade D)
- Gabapentin/pregabalin (Grade D)
- Strong opioids (Grade A)

Regional analgesia

- Lumbar epidural strong opioid (Grade A)

- Intercostal nerve block with LA, as a single pre-operative injection (Grade D)
- Intercostal clonidine (Grade D)
- Pre-operative LA injection in the planned site of incision (Grade A)

Intra-operative

Recommended

Regional analgesia

- **Thoracic epidural infusion of LA + strong opioid, continuous infusion (Grade A)**

– **epinephrine in the epidural solution is recommended if a low dose of epidural LA and/or opioid is used (Grade A)**

- **Paravertebral block with LA (bolus pre-operatively or at the end of surgery, followed by continuous infusion), as an alternative to thoracic epidural analgesia (Grade A)**
- **Intercostal nerve block with LA (bolus at the end of surgery, followed by continuous infusion), if thoracic epidural analgesia and paravertebral block are not possible (Grade D)**

Not recommended:

Systemic analgesia

- Conventional NSAIDs (Grade D)
- COX-2-selective inhibitors (Grade D)
- Ketamine (Grade D)
- Gabapentin/pregabalin (Grade D)

Regional analgesia

- Lumbar epidural strong opioid (Grade A)
- Addition of dextran to intercostal LA solution (Grade A)
- Intercostal phenol (Grade D)
- Interpleural strong opioid (Grade D)
- Cryoanalgesia (Grade A)

Analgesia for shoulder pain

- Phrenic nerve block (Grade D)

Operative techniques

- The operative technique used should depend on factors other than pain (Grade D)

Postoperative

Recommended

Systemic analgesia

- **Conventional NSAIDs, if regional analgesia is inadequate (Grade A)**
- **COX-2-selective inhibitors, if regional analgesia is inadequate (Grade B)**
- **Intravenous PCA strong opioid, if regional analgesic techniques fail or are not possible (Grade D)**
- **Weak opioids for moderate- (VAS>30<50) or low- (VAS≤30) intensity pain in the late postoperative period, only if conventional NSAIDs/COX-2-selective inhibitors plus paracetamol are insufficient or contra-indicated (Grade D)**
- **Paracetamol, if regional analgesia is inadequate, as part of a multianalgesic regimen (Grade D)**

Regional analgesia

- **Thoracic epidural LA + strong opioid, continuous infusion for 2–3 days (Grade A)**

– **epinephrine in the epidural solution is recommended if a low dose of epidural LA and/or opioid is used (Grade A)**

- **Paravertebral block with LA, continuous infusion for 2–3 days, as an alternative to thoracic epidural analgesia (Grade A)**
- **Intercostal nerve block with LA, continuous infusion for 2–3 days, if thoracic epidural analgesia and paravertebral block are not possible (Grade D)**

Not recommended:

Systemic analgesia

- α2-adrenergic receptor antagonists

– dexmedetomidine (Grade D)

- Ketamine (Grade D)
- Gabapentin/pregabalin (Grade D)

- Paracetamol alone for high intensity pain (Grade B)

Regional analgesia

- Lumbar epidural strong opioid (Grade A)
- Thoracic epidural corticosteroid (Grade D)
- Repeated spinal analgesia (grade D)
- Interpleural LA (Grade A)

Alternative analgesic techniques

- Auricular acupuncture (Grade D)
- TENS (Grade D)

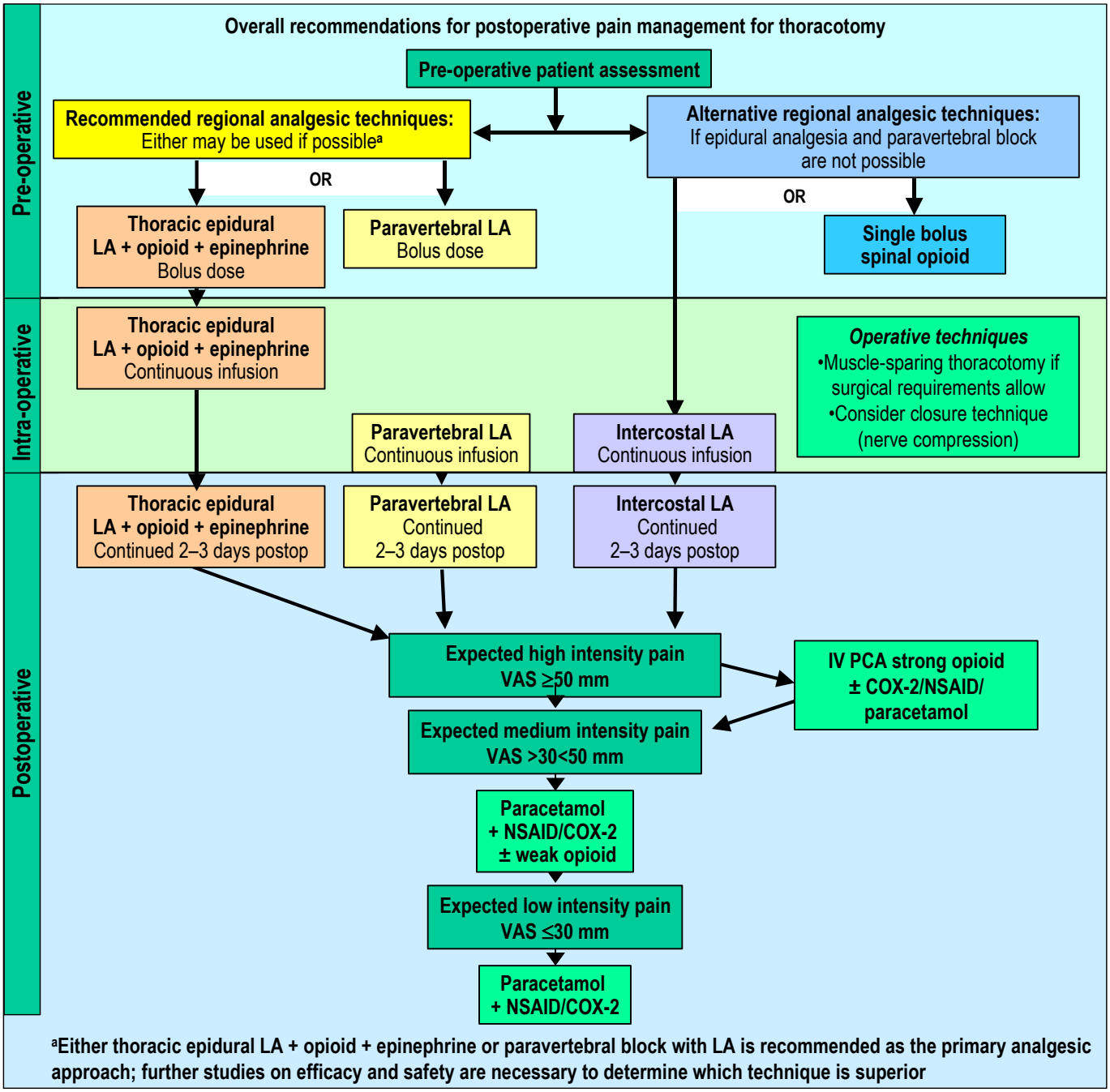
Analgesia for shoulder pain

- Suprascapular nerve block (Grade D)

Analgesia for chest tube removal

- Ice pack (Grade A)
- Interpleural local anaesthestic (Grade A)
- Topical local anaesthetic (Grade D)

Overall Recommendations: Pain Management for Thoracotomy



Not recommended: Analgesic techniques for thoracotomy
•Clonidine
•Dexmedetomidine
•Corticosteroid
•Gabapentin/pregabalin
•Ketamine
•LA injection in the planned site of incision
•Interpleural LA or strong opioid
•Lumbar epidural strong opioid
•Repeated spinal analgesia
•Cryoanalgesia
•Dextran as part of the LA solution for intercostal nerve block
•Intercostal phenol
•Auricular acupuncture
•TENS

Not recommended: Analgesic techniques for shoulder pain after thoracotomy
•Phrenic nerve block
•Suprascapular nerve block

Not recommended: Analgesic techniques for chest tube removal after thoracotomy
•Ice pack
•Interpleural LA
•Topical LA

Evidence review process

Details of systematic literature review

Literature search

Systematic review of the literature from 1966–May 2004 using MEDLINE and EmBASE, following the protocol of the Cochrane Collaboration:

- Inclusion of randomised studies assessing analgesic interventions in thoracotomy in adults, and reporting pain on a linear analogue scale (Appendix B: Thoracotomy search terms)
- Identification of 332 studies of peri-operative interventions for postoperative pain following thoracotomy
- 169 studies included (Appendix C: Thoracotomy Included studies)
- 163 studies excluded (Appendix D: Thoracotomy excluded references)
- The most common reason for exclusion was that the study was not a randomised, comparative clinical trial (60 studies) (Appendix E: Thoracotomy reasons for exclusion)

Appendix

A. Levels of evidence and grades of recommendation

Sources of evidence in PROSPECT

The evidence for prospect is derived from three separate sources, and this evidence is considered by the **prospect** Working Group to determine the prospect recommendations:

● Procedure-specific evidence derived from the systematic reviews of the literature

▲Transferable evidence from comparable procedures identified by the members of the prospect Working Group

■Current practice – A commentary on each of the interventions from the members of the prospect Working Group

◆ Practical prospect recommendations are based on all the information

PROSPECT grades of recommendation

The recommendations of the PROSPECT Working Group are graded A–D, based on the level of evidence from the studies, which is in accordance with the Oxford Centre for Evidence-Based Medicine (CEBM website accessed Dec 2003, Sackett 2000) (see table below) (http://www.cebm.net)

In the context of PROSPECT, grades of recommendation are dependent on whether the evidence is from specific studies, transferable studies or clinical practice:

● Specific evidence – grade A

▲ Transferable evidence – grade B/C

■ Clinical practice – grade D

CEBM grades of recommendation

Study criteria	**Level of evidence**	**Criteria for grading of recommendation**	**Grade of recommendation**
Systematic review (with homogeneity) of randomised, controlled trials	1a	Consistent level 1 studies	**A**
Individual, randomised, controlled trials with statistically significant results	1b		

All or none, i.e. prior to availability of new therapy, all died, now with therapy some survive; or, prior to therapy some died, now with therapy none die	1c		
Systematic review (with homogeneity) of cohort studies	2a	Consistent level 2 or 3 studies (or extrapolations* from level 1 studies)	**B**
Individual cohort study (including low quality randomised controlled trial, e.g. <80% follow up)	2b		
Outcomes research	2c		
Systematic review (with homogeneity) of case-controlled studies	3a		
Individual case-controlled study	3b		
Case-series, and poor quality cohort and case-controlled studies	4	Level 4 studies (or extrapolations* from level 2 or 3 studies)	**C**
Expert opinion without explicit critical appraisal, or based on physiology, bench research or first principles	5	Level 5 evidence (or troublingly inconsistent or inconclusive studies of any level)	**D**

*Extrapolations: Data used in a situation that has potentially clinically important differences to the original study situation. In the case of PROSPECT, extrapolation largely refers to transferable evidence.

B. Thoracotomy search terms

Limits:

Title/Abstract, 1966 to present

(pain OR analgesi* OR anaesthesi* OR anesthesi* OR "visual analogue" OR VRS OR McGill OR epidural OR neuraxial OR intrathecal OR caudal OR spinal OR “paravertebral block” OR narcotic OR cryo OR intrapleural OR “intercostal block” OR “continuous intercostal nerve block” OR “combined epidural-general” OR “combined regional-general”) AND (Lobectomy OR "Thoracic surgery” OR “Intrathoracic surgery” OR “Hemithoracic surgery” OR “Chest surgery” OR Thoracotomy OR Postthoracotomy OR Post-thoracotomy OR “Post thoracotomy” OR Cardio-thoracic OR Cardiothoracic OR Pulmonectomy OR Pneumonectomy)

C. Thoracotomy Included studies

1. Aguilar JL, Rincon R, Domingo V, Espachs P, Preciado MJ, Vidal F. Absence of an early pre-emptive effect after thoracic extradural bupivacaine in thoracic surgery. British Journal of Anaesthesia 1996;76(1):72-6.

2. Akcali Y, Demir H, Tezcan B. The effect of standard posterolateral versus muscle-sparing thoracotomy on multiple parameters. Annals of Thoracic Surgery 2003;76(4):1050-4.

3. Asantila R, Rosenberg PH, Scheinin B. Comparison of different methods of postoperative analgesia after thoracotomy. Acta Anaesthesiologica Scandinavica 1986;30(6):421-5.

4. Aykac B, Erolcay H, Dikmen Y, Oz H, Yillar O. Comparison of intrapleural versus intravenous morphine for postthoracotomy pain management. Journal of Cardiothoracic & Vascular Anesthesia 1995;9(5):538-40.

5. Azad SC, Groh J, Beyer A, Schneck D, Dreher E, Peter K. Continuous epidural analgesia versus patient controlled intravenous analgesia for postthoracotomy pain. Acute Pain 2000;3(2):84-93.

6. Bachmann-Mennenga B, Biscoping J, Kuhn DF, Schurg R, Ryan B, Erkens U, Hempelmann G. Intercostal nerve block, interpleural analgesia, thoracic epidural block or systemic opioid application for pain relief after thoracotomy?[see comment]. European Journal of Cardio-Thoracic Surgery 1993;7(1):12-8.

7. Baron CM, Kowalski SE, Greengrass R, Horan TA, Unruh HW, Baron CL. Epinephrine decreases postoperative requirements for continuous thoracic epidural fentanyl infusions. Anesthesia & Analgesia 1996;82(4):760-5.

8. Barron DJ, Tolan MJ, Lea RE. A randomized controlled trial of continuous extra-pleural analgesia post-thoracotomy: efficacy and choice of local anaesthetic. European Journal of Anaesthesiology 1999;16(4):236-45.

9. Baxter AD, Samson B, Penning J, Doran R, Dube LM. Prevention of epidural morphine-induced respiratory depression with intravenous nalbuphine infusion in post-thoracotomy patients. Canadian Journal of Anaesthesia 1989;36(5):503-9.

10. Baxter AD, Laganiere S, Samson B, McGilveray IJ, Hull K. A dose-response study of nalbuphine for posthoracotomy epidural analgesia. Canadian Journal of Anaesthesia 1991;38(2):175-182.

11. Baxter AD, Laganiere S, Samson B, Stewart J, Hull K, Goernert L. A comparison of lumbar epidural and intravenous fentanyl infusions for post-thoracotomy analgesia.[see comment]. Canadian Journal of Anaesthesia 1994;41(3):184-91.

12. Benzon HT, Wong HY, Belavic AM, Jr., Goodman I, Mitchell D, Lefheit T, Locicero J. A randomized double-blind comparison of epidural fentanyl infusion versus patient-controlled analgesia with morphine for postthoracotomy pain. Anesthesia & Analgesia 1993;76(2):316-22.

13. Berrisford RG, Sabanathan SS, Mearns AJ, Bickford-Smith PJ. Pulmonary complications after lung resection: the effect of continuous extrapleural intercostal nerve block. European Journal of Cardio-Thoracic Surgery 1990;4(8):407-10; discussion 411.

14. Bigler D, Moller J, Kamp-Jensen M, Berthelsen P, Hjortso NC, Kehlet H. Effect of piroxicam in addition to continuous thoracic epidural bupivacaine and morphine on postoperative pain and lung function after thoracotomy.[see comment]. Acta Anaesthesiologica Scandinavica 1992;36(7):647-50.

15. Bigler D, Jonsson T, Olsen J, Brenoe J, Sander-Jensen K. The effect of preoperative methylprednisolone on pulmonary function and pain after lung operations. Journal of Thoracic & Cardiovascular Surgery 1996;112(1):142-5.

16. Bilgin M, Akcali Y, Oguzkaya F. Extrapleural regional versus systemic analgesia for relieving postthoracotomy pain: a clinical study of bupivacaine compared with metamizol. Journal of Thoracic & Cardiovascular Surgery 2003;126(5):1580-3.

17. Bimston DN, McGee JP, Liptay MJ, Fry WA. Continuous paravertebral extrapleural infusion for post-thoracotomy pain management. Surgery 1999;126(4):650-6; discussion 656-7.

18. Blanloeil Y, Bizouarn P, Le Teurnier Y, Le Roux C, Rigal JC, Sellier E, Nougarede B. Postoperative analgesia by epidural methylprednisolone after posterolateral thoracotomy.[see comment]. British Journal of Anaesthesia 2001;87(4):635-8.

19. Bloch MB, Dyer RA, Heijke SA, James MF. Tramadol infusion for postthoracotomy pain relief: a placebo-controlled comparison with epidural morphine.[see comment]. Anesthesia & Analgesia 2002;94(3):523-8; table of contents.

20. Boisseau N, Rabary O, Padovani B, Staccini P, Mouroux J, Grimaud D, Raucoules-Aime M. Improvement of 'dynamic analgesia' does not decrease atelectasis after thoracotomy. British Journal of Anaesthesia 2001;87(4):564-9.

21. Bouchard F, Drolet P. Thoracic versus lumbar administration of fentanyl using patient-controlled epidural after thoracotomy. Regional Anesthesia 1995;20(5):385-8.

22. Boulanger A, Choiniere M, Roy D, Boure B, Chartrand D, Choquette R, Rousseau P. Comparison between patient-controlled analgesia and intramuscular meperidine after thoracotomy. Canadian Journal of Anaesthesia 1993;40(5 Pt 1):409-15.

23. Brichon PY, Pison C, Chaffanjon P, Fayot P, Buchberger M, Neron L, Bocca A, Verdier J, Sarrazin R. Comparison of epidural analgesia and cryoanalgesia in thoracic surgery. European Journal of Cardio-Thoracic Surgery 1994;8(9):482-6.

24. Brockmeier V, Moen H, Karlsson BR, Fjeld NB, Reiestad F, Steen PA. Interpleural or thoracic epidural analgesia for pain after thoracotomy. A double blind study. Acta Anaesthesiologica Scandinavica 1994;38(4):317-21.

25. Broome IJ, Sherry KM, Reilly CS. A combined chest drain and intrapleural catheter for post-thoracotomy pain relief.[see comment]. Anaesthesia 1993;48(8):724-6.

26. Burgess FW, Anderson DM, Colonna D, Cavanaugh DG. Thoracic epidural analgesia with bupivacaine and fentanyl for postoperative thoracotomy pain. Journal of Cardiothoracic & Vascular Anesthesia 1994;8(4):420-4.

27. Carabine UA, Gilliland H, Johnston JR, McGuigan J. Pain relief for thoracotomy. Comparison of morphine requirements using an extrapleural infusion of bupivacaine. Regional Anesthesia 1995;20(5):412-7.

28. Carretta A, Zannini P, Chiesa G, Altese R, Melloni G, Grossi A. Efficacy of ketorolac tromethamine and extrapleural intercostal nerve block on post-thoracotomy pain. A prospective, randomized study.[see comment]. International Surgery 1996;81(3):224-8.

29. Catala E, Casas JI, Unzueta MC, Diaz X, Aliaga L, Villar Landeira JM. Continuous infusion is superior to bolus doses with thoracic paravertebral blocks after thoracotomies. Journal of Cardiothoracic & Vascular Anesthesia 1996;10(5):586-8.

30. Cerfolio RJ, Bryant AS, Bass CS, Bartolucci AA. A prospective, double-blinded, randomized trial evaluating the use of preemptive analgesia of the skin before thoracotomy. Annals of Thoracic Surgery 2003;76(4):1055-8.

31. Chan VW, Chung F, Cheng DC, Seyone C, Chung A, Kirby TJ. Analgesic and pulmonary effects of continuous intercostal nerve block following thoracotomy.[see comment]. Canadian Journal of Anaesthesia 1991;38(6):733-9.

32. Coe A, Sarginson R, Smith MW, Donnelly RJ, Russell GN. Pain following thoracotomy. A randomised, double-blind comparison of lumbar versus thoracic epidural fentanyl. Anaesthesia 1991;46(11):918-21.

33. Cohen E, Neustein SM. Intrathecal morphine during thoracotomy, Part I: Effect on intraoperative enflurane requirements. Journal of Cardiothoracic & Vascular Anesthesia 1993;7(2):154-6.

34. Dauphin A, Lubanska-Hubert E, Young JE, Miller JD, Bennett WF, Fuller HD. Comparative study of continuous extrapleural intercostal nerve block and lumbar epidural morphine in post-thoracotomy pain. Canadian Journal of Surgery 1997;40(6):431-6.

35. De Cosmo G, Aceto P, Campanale E, Congedo E, Clemente A, Mascia A, Granone P. Comparison between epidural and paravertebral intercostal nerve block with ropivacaine after thoracotomy: Effects on pain relief, pulmonary function and patient satisfaction. Acta Medica Romana 2002;40(4):340-347.

36. Debreceni G, Molnar Z, Szelig L, Molnar TF. Continuous epidural or intercostal analgesia following thoracotomy: a prospective randomized double-blind clinical trial. Acta Anaesthesiologica Scandinavica 2003;47(9):1091-5.

37. Della Rocca G, Coccia C, Pompei L, Costa MG, Pierconti F, Di Marco P, Tommaselli E, Pietropaoli P. Post-thoracotomy analgesia: epidural vs intravenous morphine continuous infusion. Minerva Anestesiologica 2002;68(9):681-93.

38. Deneuville M, Bisserier A, Regnard JF, Chevalier M, Levasseur P, Herve P. Continuous intercostal analgesia with 0.5% bupivacaine after thoracotomy: a randomized study. Annals of Thoracic Surgery 1993;55(2):381-5.

39. Dich-Nielsen JO, Svendsen LB, Berthelsen P. Intramuscular low-dose ketamine versus pethidine for postoperative pain treatment after thoracic surgery. Acta Anaesthesiologica Scandinavica 1992;36(6):583-7.

40. Doyle E, Bowler GM. Pre-emptive effect of multimodal analgesia in thoracic surgery. British Journal of Anaesthesia 1998;80(2):147-51.

41. Dryden CM, McMenemin I, Duthie DJ. Efficacy of continuous intercostal bupivacaine for pain relief after thoracotomy.[see comment]. British Journal of Anaesthesia 1993;70(5):508-10.

42. El-Baz NM, Faber LP, Jensik RJ. Continuous epidural infusion of morphine for treatment of pain after thoracic surgery: a new technique. Anesthesia & Analgesia 1984;63(8):757-64.

43. Elman A, Debaene B, Magny-Metrot C, Murciano G. Interpleural analgesia with bupivacaine following thoracotomy: ineffective results of a controlled study and pharmacokinetics. Journal of Clinical Anesthesia 1993;5(2):118-21.

44. Eng J, Sabanathan S. Continuous extrapleural intercostal nerve block and post-thoracotomy pulmonary complications. Scandinavian Journal of Thoracic & Cardiovascular Surgery 1992;26(3):219-23.

45. Erolcay H, Yuceyar L. Intravenous patient-controlled analgesia after thoracotomy: a comparison of morphine with tramadol. European Journal of Anaesthesiology 2003;20(2):141-6.

46. Etches RC, Sandler AN, Lawson SL. A comparison of the analgesic and respiratory effects of epidural nalbuphine or morphine in postthoracotomy patients. Anesthesiology 1991;75(1):9-14.

47. Etches RC, Gammer TL, Cornish R. Patient-controlled epidural analgesia after thoracotomy: a comparison of meperidine with and without bupivacaine. Anesthesia & Analgesia 1996;83(1):81-6.

48. Ferrante FM, Chan VW, Arthur GR, Rocco AG. Interpleural analgesia after thoracotomy. Anesthesia & Analgesia 1991;72(1):105-9.

49. Gaeta RR, Macario A, Brodsky JB, Brock-Utne JG, Mark JB. Pain outcomes after thoracotomy: lumbar epidural hydromorphone versus intrapleural bupivacaine. Journal of Cardiothoracic & Vascular Anesthesia 1995;9(5):534-7.

50. Gamal G, Soliman AH, Mohamed A-R. Paravertebral ropivacaine for post-thoracotomy analgesia: A dose finding study. Egyptian Journal of Anaesthesia 2003;19(4):411-416.

51. George KA, Wright PM, Chisakuta A. Continuous thoracic epidural fentanyl for post-thoracotomy pain relief: with or without bupivacaine? Anaesthesia 1991;46(9):732-6.

52. Geurts AM, Jessen HJ, Megens JH, Hasenbos MA, Gielen MJ. Continuous high thoracic epidural administration of morphine with bupivacaine after thoracotomy. Regional Anesthesia 1995;20(1):27-32.

53. Gough JD, Williams AB, Vaughan RS, Khalil JF, Butchart EG. The control of post-thoracotomy pain. A comparative evaluation of thoracic epidural fentanyl infusions and cryo-analgesia.[see comment]. Anaesthesia 1988;43(9):780-3.

54. Grant GJ, Zakowski M, Ramanathan S, Boyd A, Turndorf H. Thoracic versus lumbar administration of epidural morphine for postoperative analgesia after thoracotomy. Regional Anesthesia 1993;18(6):351-5.

55. Grant RP, Dolman JF, Harper JA, White SA, Parsons DG, Evans KG, Merrick CP. Patient-controlled lumbar epidural fentanyl compared with patient-controlled intravenous fentanyl for post-thoracotomy pain. Canadian Journal of Anaesthesia 1992;39(3):214-9.

56. Guinard JP, Mavrocordatos P, Chiolero R, Carpenter RL. A randomized comparison of intravenous versus lumbar and thoracic epidural fentanyl for analgesia after thoracotomy.[see comment]. Anesthesiology 1992;77(6):1108-15.

57. Guo X, Li Y, Ye T, Ren H, Huang Y, Luo A. Clinical study of patient-controlled epidural analgesia with tetracaine hydrochloride after pulmonary lobectomy. Chinese Medical Sciences Journal 2003;18(1):54-58.

58. Hansdottir V, Bake B, Nordberg G. The analgesic efficacy and adverse effects of continuous epidural sufentanil and bupivacaine infusion after thoracotomy. Anesthesia & Analgesia 1996;83(2):394-400.

59. Harbers JB, Hasenbos MA, Gort C, Folgering H, Dirksen R, Gielen MJ. Ventilatory function and continuous high thoracic epidural administration of bupivacaine with sufentanil intravenously or epidurally: a double-blind comparison. Regional Anesthesia 1991;16(2):65-71.

60. Hasenbos M, Simon M, van Egmond J, Folgering H, van Hoorn P. Postoperative analgesia by nicomorphine intramuscularly versus high thoracic epidural administration. Effects on ventilatory and airway occlusion pressure responses to CO2. Acta Anaesthesiologica Scandinavica 1986;30(6):426-30.

61. Hasenbos MA, Gielen MJM, Bos J, Tielbeek E, M DAS-H, Van Egmond J. High thoracic epidural sufentanil for post-thoracotomy pain: influence of epinephrine as a adjuvant – A double blind study. Anesthesiology 1988;69(6):1017-1022.

62. Hazelrigg SR, Landreneau RJ, Boley TM, Priesmeyer M, Schmaltz RA, Nawarawong W, Johnson JA, Walls JT, Curtis JJ. The effect of muscle-sparing versus standard posterolateral thoracotomy on pulmonary function, muscle strength, and postoperative pain. Journal of Thoracic & Cardiovascular Surgery 1991;101(3):394-400; discussion 400-1.

63. Hurford WE, Dutton RP, Alfille PH, Clement D, Wilson RS. Comparison of thoracic and lumbar epidural infusions of bupivacaine and fentanyl for post-thoracotomy analgesia. Journal of Cardiothoracic & Vascular Anesthesia 1993;7(5):521-5.

64. Jacobson L, Phillips PD, Hull CJ, Conacher ID. Extradural versus intramuscular diamorphine. A controlled study of analgesic and adverse effects in the postoperative period. Anaesthesia 1983;38(1):10-8.

65. Jain PN, Sandhya, Chattopadhyay G, Dasgupta D. Combination of epidural buprenorphine and intramuscular ketorolac for post thoracotomy pain. Journal of Anaesthesiology Clinical Pharmacology 1998;14(2):129-134.

66. James MF, Heijke SA, Gordon PC. Intravenous tramadol versus epidural morphine for postthoracotomy pain relief: a placebo-controlled double-blind trial. Anesthesia & Analgesia 1996;83(1):87-91.

67. Kaiser AM, Zollinger A, De Lorenzi D, Largiader F, Weder W. Prospective, randomized comparison of extrapleural versus epidural analgesia for postthoracotomy pain. Annals of Thoracic Surgery 1998;66(2):367-72.

68. Kambam JR, Hammon J, Parris WC, Lupinetti FM. Intrapleural analgesia for post-thoracotomy pain and blood levels of bupivacaine following intrapleural injection. Canadian Journal of Anaesthesia 1989;36(2):106-9.

69. Kaplan JA, Miller ED, Jr., gallagher EG, Jr. Postoperative analgesia for thoracotomy patients. Anesthesia & Analgesia 1975;54(6):773-7.

70. Katz J, Nelson W, Forest R, Bruce DL. Cryoanalgesia for post-thoracotomy pain. Lancet 1980;1(8167):512-3.

71. Katz J, Kavanagh BP, Sandler AN, Nierenberg H, Boylan JF, Friedlander M, Shaw BF. Preemptive analgesia. Clinical evidence of neuroplasticity contributing to postoperative pain.[see comment]. Anesthesiology 1992;77(3):439-46.

72. Kavanagh BP, Katz J, Sandler AN, Nierenberg H, Roger S, Boylan JF, Laws AK. Multimodal analgesia before thoracic surgery does not reduce postoperative pain.[see comment]. British Journal of Anaesthesia 1994;73(2):184-9.

73. Keenan DJ, Cave K, Langdon L, Lea RE. Comparative trial of rectal indomethacin and cryoanalgesia for control of early postthoracotomy pain. British Medical Journal Clinical Research Ed 1983;287(6402):1335-7.

74. Larsen VH, Christensen P, Brinklov MM, Axelsen F. Postoperative pain relief and respiratory performance after thoracotomy: a controlled trial comparing the effect of epidural morphine and subcutaneous nicomorphine. Danish Medical Bulletin 1986;33(3):161-4.

75. Laveaux MM, Hasenbos MA, Harbers JB, Liem T. Thoracic epidural bupivacaine plus sufentanil: high concentration/low volume versus low concentration/high volume. Regional Anesthesia 1993;18(1):39-43.

76. Lehmann KA, Grond S, Freier J, Zech D. Postoperative pain management and respiratory depression after thoracotomy: a comparison of intramuscular piritramide and intravenous patient-controlled analgesia using fentanyl or buprenorphine. Journal of Clinical Anesthesia 1991;3(3):194-201.

77. Lemmer JH, Jr., Gomez MN, Symreng T, Ross AF, Rossi NP. Limited lateral thoracotomy. Improved postoperative pulmonary function. Archives of Surgery 1990;125(7):873-7.

78. Licker M, Spiliopoulos A, Tschopp JM. Influence of thoracic epidural analgesia on cardiovascular autonomic control after thoracic surgery. British Journal of Anaesthesia 2003;91(4):525-31.

79. Liu M, Rock P, Grass JA, Heitmiller RF, Parker SJ, Sakima NT, Webb MD, Gorman RB, Beattie C. Double-blind randomized evaluation of intercostal nerve blocks as an adjuvant to subarachnoid administered morphine for post-thoracotomy analgesia. Regional Anesthesia 1995a;20(5):418-25.

80. Liu N, Kuhlman G, Dalibon N, Moutafis M, Levron JC, Fischler M. A randomized, double-blinded comparison of intrathecal morphine, sufentanil and their combination versus IV morphine patient-controlled analgesia for postthoracotomy pain.[see comment]. Anesthesia & Analgesia 2001;92(1):31-6.

81. Liu S, Angel JM, Owens BD, Carpenter RL, Isabel L. Effects of epidural bupivacaine after thoracotomy. Regional Anesthesia 1995b;20(4):303-10.

82. Logas WG, el-Baz N, el-Ganzouri A, Cullen M, Staren E, Faber LP, Ivankovich AD. Continuous thoracic epidural analgesia for postoperative pain relief following thoracotomy: a randomized prospective study. Anesthesiology 1987;67(5):787-91.

83. Macias A, Monedero P, Adame M, Torre W, Fidalgo I, Hidalgo F. A randomized, double-blinded comparison of thoracic epidural ropivacaine, ropivacaine/fentanyl, or bupivacaine/fentanyl for postthoracotomy analgesia. Anesthesia & Analgesia 2002;95(5):1344-50, table of contents.

84. Mahon SV, Berry PD, Jackson M, Russell GN, Pennefather SH. Thoracic epidural infusions for post-thoracotomy pain: a comparison of fentanyl-bupivacaine mixtures vs. fentanyl alone. Anaesthesia 1999;54(7):641-6.

85. Mann LJ, Young GR, Williams JK, Dent OF, McCaughan BC. Intrapleural bupivacaine in the control of postthoracotomy pain. Annals of Thoracic Surgery 1992;53(3):449-53; discussion 53-4.

86. Mason N, Gondret R, Junca A, Bonnet F. Intrathecal sufentanil and morphine for post-thoracotomy pain relief. British Journal of Anaesthesia 2001;86(2):236-40.

87. Matthews PJ, Govenden V. Comparison of continuous paravertebral and extradural infusions of bupivacaine for pain relief after thoracotomy. British Journal of Anaesthesia 1989;62(2):204-5.

88. McCrory C, Diviney D, Moriarty J, Luke D, Fitzgerald D. Comparison between repeat bolus intrathecal morphine and an epidurally delivered bupivacaine and fentanyl combination in the management of post-thoracotomy pain with or without cyclooxygenase inhibition. Journal of Cardiothoracic & Vascular Anesthesia 2002;16(5):607-11.

89. Merry AF, Wardall GJ, Cameron RJ, Peskett MJ, Wild CJ. Prospective, controlled, double-blind study of i.v. tenoxicam for analgesia after thoracotomy. British Journal of Anaesthesia 1992;69(1):92-4.

90. Merry AF, Sidebotham DA, Middleton NG, Calder MV, Webster CS. Tenoxicam 20 mg or 40 mg after thoracotomy: a prospective, randomized, double-blind, placebo-controlled study. Anaesthesia & Intensive Care 2002;30(2):160-6.

91. Miguel R, Hubbell D. Pain management and spirometry following thoracotomy: a prospective, randomized study of four techniques. Journal of Cardiothoracic & Vascular Anesthesia 1993;7(5):529-34.

92. Miller JD, Urschel JD, Cox G, Olak J, Young JE, Kay JM, McDonald E. A randomized, controlled trial comparing thoracoscopy and limited thoracotomy for lung biopsy in interstitial lung disease. Annals of Thoracic Surgery 2000;70(5):1647-50.

93. Mourisse J, Hasenbos MA, Gielen MJ, Moll JE, Cromheecke GJ. Epidural bupivacaine, sufentanil or the combination for post-thoracotomy pain. Acta Anaesthesiologica Scandinavica 1992;36(1):70-4.

94. Muller LC, Salzer GM, Ransmayr G, Neiss A. Intraoperative cryoanalgesia for postthoracotomy pain relief.[see comment]. Annals of Thoracic Surgery 1989;48(1):15-8.

95. Murphy DF, Medley C. Preoperative indomethacin for pain relief after thoracotomy: comparison with postoperative indomethacin. British Journal of Anaesthesia 1993;70(3):298-300.

96. Neustein SM, Cohen E. Intrathecal morphine during thoracotomy, Part II: Effect on postoperative meperidine requirements and pulmonary function tests. Journal of Cardiothoracic & Vascular Anesthesia 1993;7(2):157-9.

97. Neustein SM, Kreitzer JM, Krellenstein D, Reich DL, Rapaport E, Cohen E. Preemptive epidural analgesia for thoracic surgery. Mount Sinai Journal of Medicine 2002;69(1-2):101-4.

98. Obata H, Saito S, Fujita N, Fuse Y, Ishizaki K, Goto F. Epidural block with mepivacaine before surgery reduces long-term post-thoracotomy pain. Canadian Journal of Anaesthesia 1999;46(12):1127-32.

99. Ochroch EA, Gottschalk A, Augostides J, Carson KA, Kent L, Malayaman N, Kaiser LR, Aukburg SJ. Long-term pain and activity during recovery from major thoracotomy using thoracic epidural analgesia. Anesthesiology 2002;97(5):1234-44.

100. Orr IA, Keenan DJ, Dundee JW. Improved pain relief after thoracotomy: use of cryoprobe and morphine infusion. British Medical Journal Clinical Research Ed 1981;283(6297):945-8.

101. Pastor J, Morales P, Cases E, Cordero P, Piqueras A, Galan G, Paris F. Evaluation of intercostal cryoanalgesia versus conventional analgesia in postthoracotomy pain. Respiration 1996;63(4):241-5.

102. Patrick JA, Meyer-Witting M, Reynolds F. Lumbar epidural diamorphine following thoracic surgery. A comparison of infusion and bolus administration. Anaesthesia 1991;46(2):85-9.

103. Pavy T, Medley C, Murphy DF. Effect of indomethacin on pain relief after thoracotomy. British Journal of Anaesthesia 1990;65(5):624-7.

104. Perttunen K, Kalso E, Heinonen J, Salo J. IV diclofenac in post-thoracotomy pain. British Journal of Anaesthesia 1992;68(5):474-80.

105. Perttunen K, Nilsson E, Heinonen J, Hirvisalo EL, Salo JA, Kalso E. Extradural, paravertebral and intercostal nerve blocks for post-thoracotomy pain. British Journal of Anaesthesia 1995;75(5):541-7.

106. Power I, Bowler GM, Pugh GC, Chambers WA. Ketorolac as a component of balanced analgesia after thoracotomy.[see comment]. British Journal of Anaesthesia 1994;72(2):224-6.

107. Puntillo KA. Effects of interpleural bupivacaine on pleural chest tube removal pain: a randomized controlled trial. American Journal of Critical Care 1996;5(2):102-8.

108. Radpay B, Karimi-Zandi S, Dabir S, Parsa T. Comparison between epidural morphine versus morphine + fentanyl in lung resection surgery. Archives of Iranian Medicine 2003;6(2):81-85.

109. Raffin L, Fletcher D, Sperandio M, Antoniotti C, Mazoit X, Bisson A, Fischler M. Interpleural infusion of 2% lidocaine with 1:200,000 epinephrine for postthoracotomy analgesia. Anesthesia & Analgesia 1994;79(2):328-34.

110. Rhodes M, Conacher I, Morritt G, Hilton C. Nonsteroidal antiinflammatory drugs for postthoracotomy pain. A prospective controlled trial after lateral thoracotomy. Journal of Thoracic & Cardiovascular Surgery 1992;103(1):17-20.

111. Richardson J, Sabanathan S, Eng J, Mearns AJ, Rogers C, Evans CS, Bembridge J, Majid MR. Continuous intercostal nerve block versus epidural morphine for postthoracotomy analgesia. Annals of Thoracic Surgery 1993;55(2):377-80.

112. Richardson J, Sabanathan S, Mearns AJ, Evans CS, Bembridge J, Fairbrass M. Efficacy of pre-emptive analgesia and continuous extrapleural intercostal nerve block on post-thoracotomy pain and pulmonary mechanics. Journal of Cardiovascular Surgery 1994;35(3):219-28.

113. Richardson J, Sabanathan S, Mearns AJ, Shah RD, Goulden C. A prospective, randomized comparison of interpleural and paravertebral analgesia in thoracic surgery. British Journal of Anaesthesia 1995;75(4):405-8.

114. Richardson J, Sabanathan S, Shah RD, Clarke BJ, Cheema S, Mearns AJ. Pleural bupivacaine placement for optimal postthoracotomy pulmonary function: a prospective, randomized study. Journal of Cardiothoracic & Vascular Anesthesia 1998;12(2):166-9.

115. Richardson J, Sabanathan S, Jones J, Shah RD, Cheema S, Mearns AJ. A prospective, randomized comparison of preoperative and continuous balanced epidural or paravertebral bupivacaine on post-thoracotomy pain, pulmonary function and stress responses.[see comment]. British Journal of Anaesthesia 1999;83(3):387-92.

116. Roberts D, Pizzarelli G, Lepore V, al-Khaja N, Belboul A, Dernevik L. Reduction of post-thoracotomy pain by cryotherapy of intercostal nerves. Scandinavian Journal of Thoracic & Cardiovascular Surgery 1988;22(2):127-30.

117. Rosseel PM, van den Broek WG, Boer EC, Prakash O. Epidural sufentanil for intra- and postoperative analgesia in thoracic surgery: a comparative study with intravenous sufentanil. Acta Anaesthesiologica Scandinavica 1988;32(3):193-8.

118. Roviaro GC, Varoli F, Fascianella A, Mariani C, Ramella G, Ceccopieri M, Pezzuoli G. Intrathoracic intercostal nerve block with phenol in open chest surgery. A randomized study with statistical evaluation of respiratory parameters. Chest 1986;90(1):64-7.

119. Roxburgh JC, Markland CG, Ross BA, Kerr WF. Role of cryoanalgesia in the control of pain after thoracotomy. Thorax 1987;42(4):292-5.

120. Sabanathan S, Mearns AJ, Bickford Smith PJ, Eng J, Berrisford RG, Bibby SR, Majid MR. Efficacy of continuous extrapleural intercostal nerve block on post-thoracotomy pain and pulmonary mechanics.[see comment]. British Journal of Surgery 1990;77(2):221-5.

121. Sahin S, Uckunkaya N, Yilmazlar A. Thoracic compared with lumbar epidural blocks for post-thoracotomy pain. The Pain Clinic 1994;7(4):311-315.

122. Salomaki TE, Laitinen JO, Nuutinen LS. A randomized double-blind comparison of epidural versus intravenous fentanyl infusion for analgesia after thoracotomy. Anesthesiology 1991;75(5):790-5.

123. Sandler AN, Stringer D, Panos L, Badner N, Friedlander M, Koren G, Katz J, Klein J. A randomized, double-blind comparison of lumbar epidural and intravenous fentanyl infusions for postthoracotomy pain relief. Analgesic, pharmacokinetic, and respiratory effects.[see comment]. Anesthesiology 1992;77(4):626-34.

124. Santambrogio L, Nosotti M, Bellaviti N, Mezzetti M. Videothoracoscopy versus thoracotomy for the diagnosis of the indeterminate solitary pulmonary nodule. Annals of Thoracic Surgery 1995;59(4):868-70; discussion 870-1.

125. Sauls J. The use of ice for pain associated with chest tube removal. Pain Management Nursing 2002;3(2):44-52.

126. Sawchuk CW, Ong B, Unruh HW, Horan TA, Greengrass R. Thoracic versus lumbar epidural fentanyl for postthoracotomy pain. Annals of Thoracic Surgery 1993;55(6):1472-6.

127. Scawn ND, Pennefather SH, Soorae A, Wang JY, Russell GN. Ipsilateral shoulder pain after thoracotomy with epidural analgesia: the influence of phrenic nerve infiltration with lidocaine.[see comment]. Anesthesia & Analgesia 2001;93(2):260-4, 1st contents page.

128. Scheinin B, Scheinin M, Asantila R, Lindberg R, Viinamaki O. Sympatho-adrenal and pituitary hormone responses during and immediately after thoracic surgery–modulation by four different pain treatments. Acta Anaesthesiologica Scandinavica 1987;31(8):762-7.

129. Scheinin B, Lindgren L, Rosenberg PH. Treatment of post-thoracotomy pain with intermittent instillations of intrapleural bupivacaine. Acta Anaesthesiologica Scandinavica 1989;33(2):156-9.

130. Schneider RF, Villamena PC, Harvey J, Surick BG, Surick IW, Beattie EJ. Lack of efficacy of intrapleural bupivacaine for postoperative analgesia following thoracotomy. Chest 1993;103(2):414-6.

131. Senturk M, Ozcan PE, Talu GK, Kiyan E, Camci E, Ozyalcin S, Dilege S, Pembeci K. The effects of three different analgesia techniques on long-term postthoracotomy pain. Anesthesia & Analgesia 2002;94(1):11-5, table of contents.

132. Shafei H, Chamberlain M, Natrajan KN, Khan MA, Gandhi RG. Intrapleural bupivacaine for early post-thoracotomy analgesia–comparison with bupivacaine intercostal block and cryofreezing. Thoracic & Cardiovascular Surgeon 1990;38(1):38-41.

133. Shorrab AA, Abdel-Mageed NA, Siam UA, Metawea AA. Intermittent thoracic epidural administration of ropivacaine-fentanyl versus bupivacaine-fentanyl after thoracotomy. Egyptian Journal of Anaesthesia 2003;19(3):243-248.

134. Shulman M, Sandler AN, Bradley JW, Young PS, Brebner J. Postthoracotomy pain and pulmonary function following epidural and systemic morphine. Anesthesiology 1984;61(5):569-75.

135. Silomon M, Claus T, Huwer H, Biedler A, Larsen R, Molter G. Interpleural analgesia does not influence postthoracotomy pain. Anesthesia & Analgesia 2000;91(1):44-50.

136. Singh H, Bossard RF, White PF, Yeatts RW. Effects of ketorolac versus bupivacaine coadministration during patient-controlled hydromorphone epidural analgesia after thoracotomy procedures. Anesthesia & Analgesia 1997;84(3):564-9.

137. Slinger P, Shennib H, Wilson S. Postthoracotomy pulmonary function: a comparison of epidural versus intravenous meperidine infusions. Journal of Cardiothoracic & Vascular Anesthesia 1995;9(2):128-34.

138. Snijdelaar DG, Hasenbos MA, van Egmond J, Wolff AP, Liem TH. High thoracic epidural sufentanil with bupivacaine: continuous infusion of high volume versus low volume. Anesthesia & Analgesia 1994;78(3):490-4.

139. Soroff HS, Hartman AR, Pak E, Sasvary DH, Pollak SB. Improved sternal closure using steel bands: early experience with three-year follow-up. Annals of Thoracic Surgery 1996;61(4):1172-6.

140. Stubbing JF, Jellicoe JA. Transcutaneous electrical nerve stimulation after thoracotomy. Pain relief and peak expiratory flow rate–a trial of transcutaneous electrical nerve stimulation. Anaesthesia 1988;43(4):296-8.

141. Sudarshan G, Browne BL, Matthews JN, Conacher ID. Intrathecal fentanyl for post-thoracotomy pain.[erratum appears in Br J Anaesth 1995 Oct;75(4):513]. British Journal of Anaesthesia 1995;75(1):19-22.

142. Sugi K, Nawata S, Kaneda Y, Nawata K, Ueda K, Esato K. Disadvantages of muscle-sparing thoracotomy in patients with lung cancer. World Journal of Surgery 1996;20(5):551-5.

143. Swann DG, Armstrong PJ, Douglas E, Brockway M, Bowler GM. The alkalinisation of bupivacaine for intercostal nerve blockade.[erratum appears in Anaesthesia 1991 Aug;46(8):707]. Anaesthesia 1991;46(3):174-6.

144. Swenson JD, Hullander RM, Bready RJ, Leivers D. A comparison of patient controlled epidural analgesia with sufentanil by the lumbar versus thoracic route after thoracotomy. Anesthesia & Analgesia 1994;78(2):215-8.

145. Symreng T, Gomez MN, Rossi N. Intrapleural bupivacaine v saline after thoracotomy–effects on pain and lung function–a double-blind study.[see comment]. Journal of Cardiothoracic Anesthesia 1989;3(2):144-9.

146. Takamori S, Yoshida S, Hayashi A, Matsuo T, Mitsuoka M, Shirouzu K. Intraoperative intercostal nerve blockade for postthoracotomy pain.[see comment]. Annals of Thoracic Surgery 2002;74(2):338-41.

147. Tan CNH, Guha A, Scawn NDA, Pennefather SH, Russell GN. Optimal concentration of epidural fentanyl in bupivacaine 0.1% after thoracotomy. BJA: British Journal of Anaesthesia 2004;92(5):670-674.

148. Tan N, Agnew NM, Scawn ND, Pennefather SH, Chester M, Russell GN. Suprascapular nerve block for ipsilateral shoulder pain after thoracotomy with thoracic epidural analgesia: a double-blind comparison of 0.5% bupivacaine and 0.9% saline. Anesthesia & Analgesia 2002;94(1):199-202, table of contents.

149. Tetik O, Islamoglu F, Ayan E, Duran M, Buket S, Cekirdekci A. Intermittent infusion of 0.25% bupivacaine through an intrapleural catheter for post-thoracotomy pain relief. Annals of Thoracic Surgery 2004;77(1):284-8.

150. Thomson CA, Becker DR, Messick JM, Jr., de Castro MA, Pairolero PC, Trastek VF, Murray MJ, Schulte NK, Offord KP, Ferguson JA. Analgesia after thoracotomy: effects of epidural fentanyl concentration/infusion rate. Anesthesia & Analgesia 1995;81(5):973-81.

151. Tschernko EM, Hofer S, Bieglmayer C, Wisser W, Haider W. Early postoperative stress: video-assisted wedge resection/lobectomy vs conventional axillary thoracotomy. Chest 1996;109(6):1636-42.

152. Tschernko EM, Klepetko H, Gruber E, Kritzinger M, Klimscha W, Jandrasits O, Haider W. Clonidine added to the anesthetic solution enhances analgesia and improves oxygenation after intercostal nerve block for thoracotomy. Anesthesia & Analgesia 1998;87(1):107-11.

153. Tulunay M, Tulunay FC, Ozdemir N, Akal M, Yavuzer S, Alkis N. Ketorolac and metomizol in post-thoracotomy pain: A double blind study. Turkish Journal of Medical Sciences 1996;26(4):333-338.

154. Valenzuela RC, Rosen DA. Topical lidocaine-prilocaine cream (EMLA) for thoracostomy tube removal. Anesthesia & Analgesia 1999;88(5):1107-8.

155. Von Dossow V, Welte M, Zaune U, Martin E, Walter M, Ruckert J, Kox WJ, Spies CD. Thoracic epidural anesthesia combined with general anesthesia: the preferred anesthetic technique for thoracic surgery.[see comment]. Anesthesia & Analgesia 2001;92(4):848-54.

156. Wang FH, Chen CL, Chen MC, Wang PY, Lin JM, Jih KS. Auricular electroacupuncture for postthoracotomy pain. Chung Hua i Hsueh Tsa Chih – Chinese Medical Journal 1988;41(5):349-56.

157. Warfield CA, Stein JM, Frank HA. The effect of transcutaneous electrical nerve stimulation on pain after thoracotomy. Annals of Thoracic Surgery 1985;39(5):462-5.

158. Watson DS, Panian S, Kendall V, Maher DP, Peters G. Pain control after thoracotomy: bupivacaine versus lidocaine in continuous extrapleural intercostal nerve blockade.[see comment]. Annals of Thoracic Surgery 1999;67(3):825-8; discussion 828-9.

159. Wedad M, Zaki MK, Haleem M. The effect of addition of wound infiltration with local anaesthetics to interpleural block on post-thoracotomy pain, pulmonary function and stress response in comparison to thoracic epidural and paravertebral block. Egyptian Journal of Anaesthesia 2004;20(1):67-72.

160. Welte M, Haimerl E, Groh J, Briegel J, Sunder-Plassmann L, Herz A, Peter K, Stein C. Effect of interpleural morphine on postoperative pain and pulmonary function after thoracotomy. British Journal of Anaesthesia 1992;69(6):637-9.

161. Whiting WC, Sandler AN, Lau LC, Chovaz PM, Slavchenko P, Daley D, Koren G. Analgesic and respiratory effects of epidural sufentanil in patients following thoracotomy. Anesthesiology 1988;69(1):36-43.

162. Woltering EA, Flye MW, Huntley S, Kapp P, Dwyer A, McLees B. Evaluation of bupivacaine nerve blocks in the modification of pain and pulmonary function changes after thoracotomy. Annals of Thoracic Surgery 1980;30(2):122-7.

163. Wurnig PN, Lackner H, Teiner C, Hollaus PH, Pospisil M, Fohsl-Grande B, Osarowsky M, Pridun NS. Is intercostal block for pain management in thoracic surgery more successful than epidural anaesthesia? European Journal of Cardio-Thoracic Surgery 2002;21(6):1115-9.

164. Yang TC, Chan KH, Shu CC, Jong HR, Tswei TS, Lee TY. Postoperative pain relief: lumbar and thoracic epidural morphine in thoracotomy. Chung Hua i Hsueh Tsa Chih – Chinese Medical Journal 1993;52(4):235-40.

165. Yegin A, Erdogan A, Kayacan N, Karsli B. Early postoperative pain management after thoracic surgery; pre- and postoperative versus postoperative epidural analgesia: a randomised study. European Journal of Cardio-Thoracic Surgery 2003;24(3):420-4.

166. Zwarts SJ, Hasenbos MA, Gielen MJ, Kho HG. The effect of continuous epidural analgesia with sufentanil and bupivacaine during and after thoracic surgery on the plasma cortisol concentration and pain relief. Regional Anesthesia 1989;14(4):183-8.

D. Thoracotomy excluded references

1. Abd El-Hakeem EE, Mohamed MS, Ali SM, El-Minshawy AM. Haemodynamic and pulmonary shunt fraction changes with sevoflurane or propofol anaesthesia during one-lung ventilation for thoracic surgery. Egyptian Journal of Anaesthesia 2003;19(3):233-241.

2. Alex J, Ansari J, Bahalkar P, Agarwala S, Rehman MU, Saleh A, Cowen ME. Comparison of the immediate postoperative outcome of using the conventional two drains versus a single drain after lobectomy. Annals of Thoracic Surgery 2003;76(4):1046-9.

3. Augoustides JG, Ochroch EA. Perioperative use of nitric oxide in cardiothoracic anesthesia and intensive care. Progress in Anesthesiology 2001;15(7):115-122.

4. Ayed AK, Al-Din HJ. Video-assisted thoracoscopy versus thoracotomy for primary spontaneous pneumothorax: A randomized controlled trial. Medical Principles & Practice 2000;9(2):113-118.

5. Azad SC, Groh J, Beyer A, Schneck D, Dreher E, Peter K. [Continuous peridural analgesia vs patient – controlled intravenous analgesia for pain therapy after thoracotomy]. Anaesthesist 2000;49(1):9-17.

6. Bachiocco V. Mixed regimens for post-thoracotomy pain. Pain Digest 2001;11(4):171-178.

7. Badner NH, Bhandari R, Komar WE. Bupivacaine 0.125% improves continuous postoperative epidural fentanyl analgesia after abdominal or thoracic surgery. Canadian Journal of Anaesthesia 1994;41(5 Pt 1):387-92.

8. Badner NH, Komar WE. Bupivacaine 0.1% does not improve post-operative epidural fentanyl analgesia after abdominal or thoracic surgery.[see comment]. Canadian Journal of Anaesthesia 1992;39(4):330-6.

9. Badner NH, Sandler AN, Leitch L, Koren G. Analgesic and respiratory effects of continuous lumbar epidural fentanyl in post-thoracotomy patients. Canadian Journal of Anaesthesia 1989;36(3 II).

10. Baumrucker SJ. Post-thoracotomy pain syndrome: an opportunity for palliative care. American Journal of Hospice & Palliative Care 2002;19(2):83-4.

11. Bedi A, Murray JM, Dingley J, Stevenson MA, Fee JP. Use of xenon as a sedative for patients receiving critical care.[see comment]. Critical Care Medicine 2003;31(10):2470-7.

12. Benedetti F, Vighetti S, Amanzio M, Casadio C, Oliaro A, Bergamasco B, Maggi G. Dose-response relationship of opioids in nociceptive and neuropathic postoperative pain. Pain 1998;74(2-3):205-11.

13. Benumof JL, Augustine SD, Gibbons JA. Halothane and isoflurane only slightly impair arterial oxygenation during one-lung ventilation in patients undergoing thoracotomy. Anesthesiology 1987;67(6):910-5.

14. Bergh NP, Dottori O, Lof BA, Simonsson BG, Ygge H. Effect of intercostal block on lung function after thoracotomy. Acta Anaesthesiologica Scandinavica 1966;24:85-95.

15. Block BM, Liu SS, Rowlingson AJ, Cowan AR, Cowan JA, Jr., Wu CL. Efficacy of postoperative epidural analgesia: a meta-analysis.[see comment]. JAMA 2003;290(18):2455-63.

16. Boldt J, Muller M, Uphus D, Padberg W, Hempelmann G. Cardiorespiratory changes in patients undergoing pulmonary resection using different anesthetic management techniques. Journal of Cardiothoracic & Vascular Anesthesia 1996;10(7):854-9.

17. Bormann B, Weidler B, Dennhardt R, Sturm G, Scheld HH, Hempelmann G. Influence of epidural fentanyl on stress-induced elevation of plasma vasopressin (ADH) after surgery. Anesthesia & Analgesia 1983;62(8):727-32.

18. Brose WG, Tanelian DL, Brodsky JB, Mark JB, Cousins MJ. CSF and blood pharmacokinetics of hydromorphone and morphine following lumbar epidural administration. Pain 1991;45(1):11-5.

19. Burgess FW, Anderson DM, Colonna D, Sborov MJ, Cavanaugh DG. Ipsilateral shoulder pain following thoracic surgery.[see comment]. Anesthesiology 1993;78(2):365-8.

20. Cerfolio RJ, Price TN, Bryant AS, Sale Bass C, Bartolucci AA. Intracostal sutures decrease the pain of thoracotomy. Annals of Thoracic Surgery 2003;76(2):407-11; discussion 411-2.

21. Chan V, Chung F, Cheng DCH, Kirby TJ, Chung A, Sandler A. Continuous intercostal nerve block for pain relief following thoracotomy – A new approach. Canadian Journal of Anaesthesia 1988;35(3 II).

22. Chan VWS, Ferrante FM, Arthur GR. Analgesic effect of intrapleural bupivacaine following thoracotomy. Canadian Journal of Anaesthesia 1989;36(3 II):S154-S155.

23. Chatham K, Marshall C, Campbell IA, Prescott RJ. The flutter VRP1 device for post-thoracotomy patients. Physiotherapy 1993;79(2):95-98.

24. Chelly JE, Grass J, Houseman TW, Minkowitz H, Pue A. The safety and efficacy of a fentanyl patient-controlled transdermal system for acute postoperative analgesia: a multicenter, placebo-controlled trial. Anesthesia & Analgesia 2004;98(2):427-33, table of contents.

25. Conacher ID. Pain relief after thoracotomy. British Journal of Anaesthesia 1990;65(6):806-12.

26. de la Rocha AG, Chambers K. Pain amelioration after thoracotomy: a prospective, randomized study. Annals of Thoracic Surgery 1984;37(3):239-42.

27. Delilkan AE, Lee CK, Yong NK, Ganendran A. Post-operative local analgesia for thoracotomy with direct bupivacaine intercostal blocks. Anaesthesia 1973;28(5):561-7.

28. Dellinger A, Marchand A, Zoheir F, Kirkorian G, Touboul P. [Comparison of etomidate and thiopental for the anesthesia in cardioversion]. Annales Francaises d Anesthesie et de Reanimation 1988;7(2):128-31.

29. Diegeler A, Walther T, Metz S, Falk V, Krakor R, Autschbach R, Mohr FW. Comparison of MIDCAP versus conventional CABG surgery regarding pain and quality of life. Heart Surgery Forum 1999;2(4):290-5; discussion 295-6.

30. Eng J, Sabanathan S. Post-thoracotomy analgesia. Journal of the Royal College of Surgeons of Edinburgh 1993;38(2):62-8.

31. Etches RC, Sandler AN. Analgesic effects of epidural nalbuphine in post-thoracotomy patients. Canadian Journal of Anaesthesia 1989;36(3 II):S156-S157.

32. Faust RJ, Nauss LA. Post-thoracotomy intercostal block: comparison of its effects on pulmonary function with those of intramuscular meperidine. Anesthesia & Analgesia 1976;55(4):542-6.

33. Forster R, Storck M, Schafer JR, Honig E, Lang G, Liewald F. Thoracoscopy versus thoracotomy: a prospective comparison of trauma and quality of life. Langenbecks Archives of Surgery 2002;387(1):32-6.

34. Francois T, Blanloeil Y, Pillet F, Moren J, Mazoit X, Geay G, Douet MC. Effect of interpleural administration of bupivacaine or lidocaine on pain and morphine requirement after esophagectomy with thoracotomy: a randomized, double-blind and controlled study. Anesthesia & Analgesia 1995;80(4):718-23.

35. Fromme GA, Steidl LJ, Danielson DR. Comparison of lumbar and thoracic epidural morphine for relief of postthoracotomy pain. Anesthesia & Analgesia 1985;64(4):454-5.

36. Furrer M, Rechsteiner R, Eigenmann V, Signer C, Althaus U, Ris HB. Thoracotomy and thoracoscopy: postoperative pulmonary function, pain and chest wall complaints. European Journal of Cardio-Thoracic Surgery 1997;12(1):82-7.

37. Galway JE, Caves PK, Dundee JW. Effect of intercostal nerve blockade during operation on lung function and the relief of pain following thoracotomy. British Journal of Anaesthesia 1975;47(6):730-5.

38. Garutti I, Cruz P, Olmedilla L, Barrio JM, Cruz A, Fernandez C, Perez-Pena JM. Effects of thoracic epidural meperidine on arterial oxygenation during one-lung ventilation in thoracic surgery. Journal of Cardiothoracic & Vascular Anesthesia 2003;17(3):302-5.

39. Gebhard FT, Becker HP, Gerngross H, Bruckner UB. Reduced inflammatory response in minimal invasive surgery of pneumothorax. Archives of Surgery 1996;131(10):1079-82.

40. Giudicelli R, Thomas P, Lonjon T, Ragni J, Morati N, Ottomani R, Fuentes PA, Shennib H, Noirclerc M. Video-Assisted minithoracotomy versus musclesparing thoracotomy for performing lobectomy. Annals of Thoracic Surgery 1994;58(3):712-718.

41. Glantz L, Godovic G, Lekar M, Kramer M, Eidelman LA. Efficacy of transdermal nitroglycerin combined with etodolac for the treatment of chronic post-thoracotomy pain: An open-label prospective clinical trial. Journal of Pain & Symptom Management 2004;27(3):277-281.

42. Glynn CJ, Lloyd JW, Barnard JD. Cryoanalgesia in the management of pain after thoracotomy. Thorax 1980;35(5):325-7.

43. Gordh T, Jr. Epidural clonidine for treatment of postoperative pain after thoracotomy. A double-blind placebo-controlled study. Acta Anaesthesiologica Scandinavica 1988;32(8):702-9.

44. Gowan JD, Hurtig JB, Fraser RA, Torbicki E, Kitts J. Naloxone infusion after prophylactic epidural morphine: effects on incidence of postoperative side-effects and quality of analgesia. Canadian Journal of Anaesthesia 1988;35(2):143-8.

45. Gozal Y, Drenger B. The pharmacology of new drugs and new uses for older drugs used for thoracic pain relief. Seminars in Cardiothoracic & Vascular Anesthesia 1999;3(3):144-155.

46. Granell Gil M, Aguar Olba F, Arnau Obrer A, Grau Real F, Canto Armengod A, Palanca Sanfrancisco JM. [Lung function and quality of analgesia after lung resection with epidural alfentanyl]. Revista Espanola de Anestesiologia y Reanimacion 2000;47(7):293-8.

47. Grant RP, Dolman JF, Harper JA, White SA, Parsons DG, Evans KG, Merrick P. Patient controlled lumbar epidural fentanyl for post thoracotomy pain. Canadian Journal of Anaesthesia 1990;37(4 Pt 2):S45.

48. Gray JR, Fromme GA, Nauss LA, Wang JK, Ilstrup DM. Intrathecal morphine for post-thoracotomy pain. Anesthesia & Analgesia 1986;65(8):873-6.

49. Griffiths DP, Diamond AW, Cameron JD. Postoperative extradural analgesia following thoracic surgery: a feasibility study. British Journal of Anaesthesia 1975;47(1):48-55.

50. Grosmanova T, Koutna J, Scheinarova A. Analgesia after intercostal thoracotomy. Acta Universitatis Palackianae Olomucensis Facultatis Medicae 1993;136:53-5.

51. Gundersen RY, Andersen R, Narverud G. Postoperative pain relief with high-dose epidural buprenorphine: a double-blind study. Acta Anaesthesiologica Scandinavica 1986;30(8):664-7.

52. Haak-van der Lely F, van Kleef JW, Burm AG, Bovill JG. An intra-operative comparison of lumbar with thoracic epidural sufentanil for thoracotomy. Anaesthesia 1994a;49(2):119-21.

53. Haak-van der Lely F, van Kleef JW, Burm AG, Bovill JG. Preoperative interpleural administration of sufentanil or bupivacaine reduces intraoperative intravenous sufentanil requirements during thoracotomy. Journal of Cardiothoracic & Vascular Anesthesia 1993;7(5):526-8.

54. Haak-van der Lely F, van Kleef JW, Gesink-van der Veer BJ, Burm AG, Bovill JG. Efficacy of epidurally administered sufentanil versus bupivacaine during thoracic surgery. A randomised placebo-controlled double-blind study. Anaesthesia 1994b;49(2):116-8.

55. Hachenberg T, Pfeiffer B. Use of thoracic epidural anaesthesia for thoracic surgery and its effect on pulmonary function. Bailliere's Best Practice in Clinical Anaesthesiology 1999;13(1):57-72.

56. Hansdottir V, Woestenborghs R, Nordberg G. The pharmacokinetics of continuous epidural sufentanil and bupivacaine infusion after thoracotomy. Anesthesia & Analgesia 1996;83(2):401-6.

57. Hasenbos M, van Egmond J, Gielen M, Crul JF. Post-operative analgesia by epidural versus intramuscular nicomorphine after thoracotomy. Part I. Acta Anaesthesiologica Scandinavica 1985a;29(6):572-6.

58. Hasenbos M, van Egmond J, Gielen M, Crul JF. Post-operative analgesia by epidural versus intramuscular nicomorphine after thoracotomy. Part II. Acta Anaesthesiologica Scandinavica 1985b;29(6):577-82.

59. Hasenbos M, van Egmond J, Gielen M, Crul JF. Post-operative analgesia by high thoracic epidural versus intramuscular nicomorphine after thoracotomy. Part III. The effects of per- and post-operative analgesia on morbidity. Acta Anaesthesiologica Scandinavica 1987;31(7):608-15.

60. Hasenbos MA, Eckhaus MN, Slappendel R, Gielen MJ. Continuous high thoracic epidural administration of bupivacaine with sufentanil or nicomorphine for postoperative pain relief after thoracic surgery. Regional Anesthesia 1989;14(5):212-8.

61. Hayward RH, Knight WL, Baisden CE, Korompai FL. Access to the thorax by incision. Journal of the American College of Surgeons 1994;179(2):202-8.

62. Higgins TL, Yared JP, Estafanous FG, Coyle JP, Ko HK, Goodale DB. Propofol versus midazolam for intensive care unit sedation after coronary artery bypass grafting. Critical Care Medicine 1994;22(9):1415-23.

63. Inada K, Shirakusa T, Yoshinaga Y, Yoneda S, Shiraishi T, Okabayashi K, Iwasaki A, Kawahara K. The role of video-assisted thoracic surgery for the treatment of lung cancer: lung lobectomy by thoracoscopy versus the standard thoracotomy approach. International Surgery 2000;85(1):6-12.

64. Inderbitzi R, Flueckiger K, Ris HB. Pain relief and respiratory mechanics during continuous intrapleural bupivacaine administration after thoracotomy. Thoracic & Cardiovascular Surgeon 1992;40(2):87-9.

65. Iwasaki A, Hamatake D, Shirakusa T. Biosorbable Poly-L-Lactide Rib-Connecting Pins May Reduce Acute Pain after Thoracotomy. Thoracic & Cardiovascular Surgeon 2004;52(1):49-53.

66. Jain S, Datta S, Tundis D. Management of chronic postthoracotomy pain. Seminars in Cardiothoracic & Vascular Anesthesia 1999;3(3):191-203.

67. Jakobsen CJ, Bille S, Ahlburg P, Rybro L, Hjortholm K, Andresen EB. Perioperative metoprolol reduces the frequency of atrial fibrillation after thoracotomy for lung resection. Journal of Cardiothoracic & Vascular Anesthesia 1997a;11(6):746-51.

68. Jakobsen CJ, Bille S, Ahlburg P, Rybro L, Pedersen KD, Rasmussen B. Preoperative metoprolol improves cardiovascular stability and reduces oxygen consumption after thoracotomy. Acta Anaesthesiologica Scandinavica 1997b;41(10):1324-30.

69. Jimenez-Merchan R, Garcia-Diaz F, Arenas-Linares C, Giron-Arjona JC, Congregado-Loscertales M, Loscertales J. Comparative retrospective study of surgical treatment of spontaneous pneumothorax. Thoracotomy vs thoracoscopy. Surgical Endoscopy 1997;11(9):919-22.

70. Johnson MD, Mickler T, Arthur GR, Rosenburg S, Wilson R. Bupivacaine with and without epinephrine for intercostal nerve block. Journal of Cardiothoracic Anesthesia 1990;4(2):200-3.

71. Jones RM, Cashman JN, Foster JM, Wedley JR, Adams AP. Comparison of infusions of morphine and lysine acetyl salicylate for the relief of pain following thoracic surgery. British Journal of Anaesthesia 1985;57(3):259-63.

72. Joucken K, Michel L, Schoevaerdts JC, Mayne A, Randour P. Cryoanalgesia for post-thoracotomy pain relief. Acta Anaesthesiologica Belgica 1987;38(2):179-83.

73. Katz J, Jackson M, Kavanagh BP, Sandler AN. Acute pain after thoracic surgery predicts long-term post-thoracotomy pain. Clinical Journal of Pain 1996;12(1):50-5.

74. Kavanagh BP, Katz J, Sandler AN, Nierenberg H, Boylan JF, Friedlander M, Davies A. Pain and narcotic use following thoracic surgery are reduced by preemptive lumbar epidural fentanyl: A randomized prospective double-blind crossover study. Canadian Journal of Anaesthesia 1992;39(5 II SUPPL).

75. Kessler P, Neidhart G, Bremerich DH, Aybek T, Dogan S, Lischke V, Byhahn C. High thoracic epidural anesthesia for coronary artery bypass grafting using two different surgical approaches in conscious patients. Anesthesia & Analgesia 2002;95(4):791-7, table of contents.

76. Kim KH, Kim HK, Han JY, Kim JT, Won YS, Choi SS. Transaxillary minithoracotomy versus video-assisted thoracic surgery for spontaneous pneumothorax.[see comment]. Annals of Thoracic Surgery 1996;61(5):1510-2.

77. Kirby TJ, Mack MJ, Landreneau RJ, Rice TW. Lobectomy–video-assisted thoracic surgery versus muscle-sparing thoracotomy. A randomized trial. Journal of Thoracic & Cardiovascular Surgery 1995;109(5):997-1001; discussion 1001-2.

78. Kiss J, Bacsa S. The application of probon, a new analgesic in thoracic surgery. Therapia Hungarica 1976;24(1):15-6.

79. Kolvenbach H, Lauven PM, Schneider B, Kunath U. Repetitive intercostal nerve block via catheter for postoperative pain relief after thoracotomy. Thoracic & Cardiovascular Surgeon 1989;37(5):273-6.

80. Koren G, Sandler AN, Klein J, Whiting WC, Lau LC, Slavchenko P, Daley D. Relationship between the pharmacokinetics and the analgesic and respiratory pharmacodynamics of epidural sufentanil. Clinical Pharmacology & Therapeutics 1989;46(4):458-62.

81. Kovacs M, Keszler P. A new analgesic (probon) in thoracic surgery. Therapia Hungarica 1971;19(4):162-3.

82. Kruger M, McRae K. Pain management in cardiothoracic practice. Surgical Clinics of North America 1999a;79(2):387-400.

83. Kruger M, Sandler AN. Post-thoracotomy pain control. Current Opinion in Anaesthesiology 1999b;12(1):55-109.

84. Landreneau RJ, Pigula F, Luketich JD, Keenan RJ, Bartley S, Fetterman LS, Bowers CM, Weyant RJ, Ferson PF. Acute and chronic morbidity differences between muscle-sparing and standard lateral thoracotomies. Journal of Thoracic & Cardiovascular Surgery 1996;112(5):1346-50; discussion 1350-1.

85. Lange MP, Dahn MS, Jacobs LA. Patient-controlled analgesia versus intermittent analgesia dosing.[see comment]. Heart & Lung: Journal of Acute & Critical Care 1988;17(5):495-8.

86. Laxenaire MC, Boileau S, Dagrenat P, Menu N, Drouet N. Haemodynamic and respiratory effects of post-operative doxapram and almitrine in patients following pneumonectomy. European Journal of Anaesthesiology 1986;3(4):259-71.

87. Lebovits AH, Zenetos P, O'Neill DK, Cox D, Dubois MY, Jansen LA, Turndorf H. Satisfaction with epidural and intravenous patient-controlled analgesia. Pain Medicine 2001;2(4):280-286.

88. Lepage-Savary D, Poulin E, Labrecque G, Belley H, Laliberte J, Brie M, Leclerc P, Nadeau L, Pouliot M. Comparative study on the effectiveness of intravenous or subcutaneous morphine. Canadian Journal of Hospital Pharmacy 1991;44(2):63-69.

89. Li WW, Lee RL, Lee TW, Ng CS, Sihoe AD, Wan IY, Arifi AA, Yim AP. The impact of thoracic surgical access on early shoulder function: video-assisted thoracic surgery versus posterolateral thoracotomy. European Journal of Cardio-Thoracic Surgery 2003;23(3):390-6.

90. Lieou FJ, Lee SC, Ho ST, Wang JJ. Interpleural bupivacaine for pain relief after transthoracic endoscopic sympathectomy for primary hyperhidrosis. Acta Anaesthesiologica Sinica 1996;34(1):21-5.

91. Ludwick F, Hall L, Gaines SK. Examining management of pain for infants following cardiothoracic surgery. DCCN – Dimensions of Critical Care Nursing 1995;14(3):136-43.

92. Mascotto G, Bizzarri M, Messina M, Cerchierini E, Torri G, Carozzo A, Casati A. Prospective, randomized, controlled evaluation of the preventive effects of positive end-expiratory pressure on patient oxygenation during one-lung ventilation. European Journal of Anaesthesiology 2003;20(9):704-10.

93. Matsumura Y, Matsubara Y, Uchida I, Mashimo T, Yoshiya I. [Comparison of propofol and isoflurane anesthesia on postoperative nausea, vomiting and pruritus induced by epidural morphine]. Masui – Japanese Journal of Anesthesiology 2000;49(9):1000-4.

94. McCrory C, Fitzgerald D. Spinal prostaglandin formation and pain perception following thoracotorny: Arole for cyclooxygenase-2. Chest 2004;125(4):1321-1327.

95. Moon MR, Luchette FA, Gibson SW, Crews J, Sudarshan G, Hurst JM, Davis K, Jr., Johannigman JA, Frame SB, Fischer JE. Prospective, randomized comparison of epidural versus parenteral opioid analgesia in thoracic trauma. Annals of Surgery 1999;229(5):684-91; discussion 691-2.

96. Moote C. Efficacy of nonsteroidal anti-inflammatory drugs in the management of postoperative pain. Drugs 1992;44(Suppl 5):14-29; discussion 29-30.

97. Murphy DF, Graziotti P, Chalkiadis G, McKenna M. Patient-controlled analgesia: a comparison with nurse-controlled intravenous opioid infusions. Anaesthesia & Intensive Care 1994;22(5):589-92.

98. Nelson KM, Vincent RG, Bourke RS, Smith DE, Blakeley WR, Kaplan RJ, Pollay M. Intraoperative intercostal nerve freezing to prevent postthoracotomy pain. Annals of Thoracic Surgery 1974;18(3):280-5.

99. Nordberg G, Hansdottir V, Bondesson U, Boreus LO, Mellstrand T, Hedner T. CSF and plasma pharmacokinetics of pethidine and norpethidine in man after epidural and intrathecal administration of pethidine. European Journal of Clinical Pharmacology 1988;34(6):625-31.

100. Nordberg G, Hansdottir V, Kvist L, Mellstrand T, Hedner T. Pharmacokinetics of different epidural sites of morphine administration. European Journal of Clinical Pharmacology 1987;33(5):499-504.

101. Nordberg G. Pharmacokinetic aspects of spinal morphine analgesia. Acta Anaesthesiologica Scandinavica 1984;79:1-38.

102. Nordberg G, Hedner T, Mellstrand T, Dahlstrom B. Pharmacokinetic aspects of epidural morphine analgesia. Anesthesiology 1983;58(6):545-51.

103. Nordberg G, Mellstrand T, Borg L, Hedner T. Extradural morphine: influence of adrenaline admixture. British Journal of Anaesthesia 1986;58(6):598-604.

104. Novak-Jankovic V, Paver E, rcirc, en V, Bovill JG, Ihan A, Osredkar J. Effect of epidural and intravenous clonidine on the neuro-endocrine and immune stress response in patients undergoing lung surgery. European Journal of Anaesthesiology 2000;17(1):50-6.

105. Oakes DD, Cohn RB, Brodsky JB, Merrell RC, Sherck JP. Lateral thoracotomy and one-lung anesthesia in patients with morbid obesity. Annals of Thoracic Surgery 1982;34(5):572-80.

106. Orr IA, Keenan DJ, Dundee JW, Patterson CC, Greenfield AA. Post-thoracotomy pain relief: combined use of cryoprobe and morphine infusion techniques. Annals of the Royal College of Surgeons of England 1983;65(6):366-9.

107. Panos L, Sandler AN, Stringer DG, Badner N, Lawson S, Koren G. Continuous infusions of lumbar epidural fentanyl and intravenous fentanyl for post-thoracotomy pain relief. I: Analgesic and pharmacokinetic effects. Canadian Journal of Anaesthesia 1990;37(4 Pt 2):S66.

108. Petit J, Comar D, Pigot B, Eustache ML, Oksenhendler G, Winckler C. [Epidural analgesia after thoracic surgery: morphine versus buprenorphine]. Annales Francaises d Anesthesie et de Reanimation 1988;7(6):464-70.

109. Phillips DM, Moore RA, Bullingham RE, Allen MC, Baldwin D, Fisher A, Lloyd JW, McQuay HJ. Plasma morphine concentrations and clinical effects after thoracic extradural morphine or diamorphine. British Journal of Anaesthesia 1984;56(8):829-36.

110. Pigot B, Petit J, Eustache ML, Oksenhendler G, Winckler C. [Effects of intravenous naloxone on the secondary effects and analgesia after epidural injection of fentanyl]. Annales Francaises d Anesthesie et de Reanimation 1987;6(5):434-8.

111. Poopalalingam R, Chow MY, Wong LT. Patient-controlled epidural analgesia after thoracic and upper abdominal surgery using sufentanil with and without bupivacaine 0.125%. Singapore Medical Journal 2003;44(3):126-30.

112. Power I, Chambers WA, Greer IA, Ramage D, Simon E. Platelet function after intramuscular diclofenac. Anaesthesia 1990;45(11):916-9.

113. Quimby CW, Jr., Timmes JJ, Demos NJ. A re-evaluation of regional anesthesia for thoracic surgery. Anesthesia & Analgesia 1966;45(1):97-101.

114. Raff H, Flemma RJ, Findling JW. Fast cortisol-induced inhibition of the adrenocorticotropin response to surgery in humans. Journal of Clinical Endocrinology & Metabolism 1988;67(6):1146-8.

115. Ragni J, Guillen JC, Auge A, Bordigoni L, Giudicelli R, Fuentes P. [Prolonged epidural analgesia following thoracotomy. Clinical study and serum levels over five days]. Annales de Chirurgie 1991;45(2):167-76.

116. Randell TT, Tierala EK, Lepantalo MJ, Lindgren L. Prophylactic minitracheostomy after thoracotomy: a prospective, random control, clinical trial. European Journal of Surgery 1991;157(9):501-4.

117. Rawal N, Sjostrand U, Dahlstrom B. Postoperative pain relief by epidural morphine. Anesthesia & Analgesia 1981;60(10):726-31.

118. Richardson J, Lonnqvist PA. Thoracic paravertebral block. Br J Anaesth 1998;81(2):230-8.

119. Richardson J, Sabanathan S, Shah R. Post-thoracotomy spirometric lung function: The effect of analgesia. Minerva Pneumologica 1999a;38(3-4):151-164.

120. Richardson J, Sabanathan S, Shah R. Post-thoracotomy spirometric lung function: the effect of analgesia. A review. Journal of Cardiovascular Surgery 1999b;40(3):445-56.

121. Rooney SM, Jain S, Goldiner PL. Effect of transcutaneous nerve stimulation on postoperative pain after thoracotomy. Anesthesia & Analgesia 1983;62(11):1010-2.

122. Rooney SM, Jain S, McCormack P, Bains MS, Martini N, Goldiner PL. A comparison of pulmonary function tests for postthoracotomy pain using cryoanalgesia and transcutaneous nerve stimulation. Annals of Thoracic Surgery 1986;41(2):204-7.

123. Rosenberg PH, Scheinin BM, Lepantalo MJ, Lindfors O. Continuous intrapleural infusion of bupivacaine for analgesia after thoracotomy. Anesthesiology 1987;67(5):811-3.

124. Rubin JW, Finney NR, Borders BM, Chauvin EJ. Intrathoracic biopsies, pulmonary wedge excision, and management of pleural disease: is video-assisted closed chest surgery the approach of choice? American Surgeon 1994b;60(11):860-3.

125. Rubin JW. Video-assisted thoracic surgery: the approach of choice for selected diagnosis and therapy. European Journal of Cardio-Thoracic Surgery 1994a;8(8):431-5.

126. Sabanathan S, Smith PJ, Pradhan GN, Hashimi H, Eng JB, Mearns AJ. Continuous intercostal nerve block for pain relief after thoracotomy.[see comment]. Annals of Thoracic Surgery 1988;46(4):425-6.

127. Sabanathan S. Has postoperative pain been eradicated? Annals of the Royal College of Surgeons of England 1995;77(3):202-9.

128. Salomaki TE, Leppaluoto J, Laitinen JO, Vuolteenaho O, Nuutinen LS. Epidural versus intravenous fentanyl for reducing hormonal, metabolic, and physiologic responses after thoracotomy. Anesthesiology 1993;79(4):672-9.

129. Salzer GM, Klingler P, Klingler A, Unger A. Pain treatment after thoracotomy: is it a special problem?[see comment]. Annals of Thoracic Surgery 1997;63(5):1411-4.

130. Sandler AN. Post-thoracotomy analgesia and perioperative outcome. Minerva Anestesiologica 1999;65(5):267-74.

131. Satoh M, Hirabayashi Y, Inoue S, Seo N. [The effect of intravenous patient controlled analgesia on activities of daily life and medical expense after thoracotomy]. Masui – Japanese Journal of Anesthesiology 2001;50(7):736-41.

132. Satoh M, Hirabayashi Y, Seo N. [Intravenous patient controlled analgesia combined with continuous thoracic epidural analgesia for post-thoracotomy pain]. Masui – Japanese Journal of Anesthesiology 2000;49(11):1222-5.

133. Savage C, McQuitty C, Wang D, Zwischenberger JB. Postthoracotomy pain management. Chest Surgery Clinics of North America 2002;12(2):251-63.

134. Savoia G, Loreto M, Gravino E. Sufentanil: an overview of its use for acute pain management. Minerva Anestesiologica 2001;67(9 Suppl 1):206-16.

135. Schultz AM, Werba A, Ulbing S, Gollmann G, Lehofer F. Peri-operative thoracic epidural analgesia for thoracotomy. European Journal of Anaesthesiology 1997;14(6):600-3.

136. Sekine Y, Miyata Y, Yamada K, Yamada H, Yasukawa T, Saitoh Y, Yoshida S, Fujisawa T. Video-assisted thoracoscopic surgery does not deteriorate postoperative pulmonary gas exchange in spontaneous pneumothorax patients. European Journal of Cardio-Thoracic Surgery 1999;16(1):48-53.

137. Sofianos E, Alevizou F, Zissis N, Kostaki P, Balamoutsos N. Hormonal response in thoracic surgery. Effects of high-dose fentanyl anesthesia, compared to halothane anesthesia. Acta Anaesthesiologica Belgica 1985;36(2):89-96.

138. Stenseth R, Sellevold O, Breivik H. Epidural morphine for postoperative pain: experience with 1085 patients. Acta Anaesthesiologica Scandinavica 1985;29(1):148-56.

139. Stratton SA, Smith MM. Postoperative thoracotomy. Effect of transcutaneous electrical nerve stimulation on forced vital capacity. Physical Therapy 1980;60(1):45-7.

140. Subramaniam B, Pawar DK, Kashyap L. Pre-emptive analgesia with epidural morphine or morphine and bupivacaine. Anaesthesia & Intensive Care 2000;28(4):392-8.

141. Sugiura H, Morikawa T, Kaji M, Sasamura Y, Kondo S, Katoh H. Long-term benefits for the quality of life after video-assisted thoracoscopic lobectomy in patients with lung cancer. Surgical Laparoscopy, Endoscopy & Percutaneous Techniques 1999;9(6):403-8.

142. Sulek CA, Blas ML, Lobato EB. A randomized study of left versus right internal jugular vein cannulation in adults. Journal of Clinical Anesthesia 2000;12(2):142-5.

143. Sutton BA, Gillbe CE. Continuous epidural diamorphine provides significantly better analgesia after thoracotomy than continuous intravenous pethidine. Journal of Cardiothoracic & Vascular Anesthesia 1994;8(3 SUPPL. 2).

144. Suwanchinda V, Suksompong S, Prakanrattana U, Udompunthurak S. Epidural analgesia for pain relief in thoracic surgery. Journal of the Medical Association of Thailand 2000;83(4):358-63.

145. Takahashi N, Tsunematsu K, Sugawara H, Abe T. [Limited thoracotomy as surgical therapy for lung cancer: lobectomy and lymph node dissection by means of 12 cm skin incision]. Kyobu Geka – Japanese Journal of Thoracic Surgery 2001;54(3):197-202.

146. Tartiere J, Samba D, Lefrancois C, Deshayes JP, Samii K, Bricard H, Quesnel J. Intrapleural bupivacaine analgesia after thoraco-abdominal incision for oesophagectomy. European Journal of Anaesthesiology 1991;8(2):145-9.

147. Tenling A, Joachimsson PO, Tyden H, Wegenius G, Hedenstierna G. Thoracic epidural anesthesia as an adjunct to general anesthesia for cardiac surgery: effects on ventilation-perfusion relationships.[see comment]. Journal of Cardiothoracic & Vascular Anesthesia 1999;13(3):258-64.

148. Toledo-Pereyra LH, DeMeester TR. Prospective randomized evaluation of intrathoracic intercostal nerve block with bupivacaine on postoperative ventilatory function. Annals of Thoracic Surgery 1979;27(3):203-5.

149. Tovar EA, Roethe RA, Weissig MD, Lloyd RE, Patel GR. One-day admission for lung lobectomy: an incidental result of a clinical pathway. Annals of Thoracic Surgery 1998;65(3):803-6.

150. Trinder TJ, Johnston JR, Lowry KG, Phillips AS, Cosgrove J. Propofol and alfentanil total intravenous anaesthesia: a comparison of techniques for major thoracic surgery. Acta Anaesthesiologica Scandinavica 1998;42(4):452-9.

151. Tsui SL, Chan CS, Chan AS, Wong SJ, Lam CS, Jones RD. A comparison of two-lung high frequency positive pressure ventilation and one-lung ventilation plus 5 cm H2O non-ventilated lung CPAP, in patients undergoing anaesthesia for oesophagectomy. Anaesthesia & Intensive Care 1991;19(2):205-12.

152. Ueda M, Ishibe Y, Yamasaki K. Comparison of sevoflurane and propofol combined with thoracic epidural anesthesia on arterial oxygenation during one-lung ventilation for thoracotomy. Hiroshima Journal of Anesthesia 1999;35(3-4):139-143.

153. Urschel HC, Jr., Razzuk MA. Median sternotomy as a standard approach for pulmonary resection. Annals of Thoracic Surgery 1986;41(2):130-4.

154. Usui A, Ueda Y, Watanabe T, Kawaguchi O, Ohara Y, Takagi Y, Tajima K, Nishikimi N, Ishiguchi T. Comparative clinical study between endovascular stent grafting on open surgery and conventional graft replacement for distal arch aneurysm. Journal of Artificial Organs 2001;4(4):283-287.

155. Vara-Thorbeck R, Guerro-Fernandez JA, Prados N. [Thoracic epidural analgesia (TEA) with morphine as an alternative to the administration of general anesthesia in thoracotomized patients]. Zentralblatt fur Chirurgie 1987;112(3):170-4.

156. Waller DA, Forty J, Morritt GN. Video-assisted thoracoscopic surgery versus thoracotomy for spontaneous pneumothorax.[see comment]. Annals of Thoracic Surgery 1994;58(2):372-6; discussion 376-7.

157. Wiebalck A, Brodner G, Van Aken H. The effects of adding sufentanil to bupivacaine for postoperative patient-controlled epidural analgesia. Anesthesia & Analgesia 1997;85(1):124-9.

158. Wied U, Andersen K, Schultz A, Rasmussen E, Watt-Boolsen S. Silver nitrate pleurodesis in spontaneous pneumothorax. Scandinavian Journal of Thoracic & Cardiovascular Surgery 1981;15(3):305-7.

159. Wilhelm AJ, Dieleman HG. Epidural fentanyl and sufentanil for intra- and postoperative analgesia. A randomized, double-blind comparison. Pharmacy World & Science 1994;16(1):7-12.

160. Willdeck-Lund G, Edstrom H. Etidocaine in intercostal nerve block for pain relief after thoracotomy; a comparison with bupivacaine. Acta Anaesthesiologica Scandinavica 1975;60:33-8.

161. Wulf H, Leger R, Raetzell M, Olmer A, Scheiderer U. Cholestasis as a side effect of bupivacaine? Regional Anesthesia & Pain Medicine 1998;23(3):278-82.

162. Yim AP, Wan S, Lee TW, Arifi AA. VATS lobectomy reduces cytokine responses compared with conventional surgery. Annals of Thoracic Surgery 2000;70(1):243-7.

163. Zawadzki A. Combined anaesthesia based on thoracic epidural blockade for thoracic surgery. Medical Science Monitor 1997;3(SUPPL. 1):24-28.

E. Thoracotomy reasons for exclusion

Study	Reason for exclusion
ABD EL-HAKEEM EE 2003	No linear pain scale
ALEX J 2003	Not randomised
AUGOUSTIDES JG 2001	Review
AYED AK 2000	No linear pain scale
AZAD SC 2000	Not English
BACHIOCCO V 2001	Not a comparative clinical trial
BADNER NH 1989	Not a comparative clinical trial
BADNER NH 1992	Subgroups not defined
BADNER NH 1994	Subgroups not defined
BAUMRUCKER SJ 2002	Review
BEDI JP 2003	No VAS scores
BENEDETTI F 1998	Not a comparative study for pain with different regimens, comparison of effectiveness of one drug in same patients at different times.
BENUMOF JL 1987	No linear pain scale
BERGH NP 1966	No linear pain scale
BLOCK BM 2003	Review, meta-analysis
BOLDT J 1996	No linear pain scale
BORMANN B 1983	Subgroups not defined, no linear pain scale
BROSE WG 1991	No comparison of analgesic regimens
BURGESS FW 1993	No comparison of pain scores between randomised groups.
CERFOLIO RJ 2003	Not randomised

Study	Reason for exclusion
CHAN V 1988	Not a comparative clinical trial
CHAN VWS 1989	Abstract only
CHATHAM K 1993	No linear pain scale
CHELLY JE 2004	Mixed surgery, subgroups not defined.
CONACHER ID 1990	Review
DE LA ROCHA AG 1984	No linear pain scale
DELILKAN AE 1973	No linear pain scale
DELLINGER A 1988	Not English
DIEGELER A 1999	Not randomised
ENG J 1993	Review
ETCHES RC 1989	Abstract only
FAUST RJ 1976	No linear pain scale
FORSTER R 2002	Not randomised
FRANCOIS T 1995	Thoracotomy and upper abdominal incision
FROMME GA 1985	Retrospective
FURRER M 1997	Not randomised
GALWAY JE 1975	No linear pain scale
GARUTTI I 2003	No linear pain scale
GEBHARD FT 1996	No linear pain scale
GIUDICELLI R 1994	Not randomised
GLANTZ L 2004	Not randomised
GLYNN CJ 1980	Not randomised
GORDH T 1988	No linear pain scale

Study	Reason for exclusion
GOWAN JD 1988	Study of naloxone, which is not relevant to the review
GOZAL Y 1999	Review
GRANELL GIL M 2000	Not English
GRANT RP 1990	Abstract only
GRAY JR 1986	No linear pain scale, randomisation not clear
GRIFFITHS DPG 1975	No linear pain scale
GROSMANOVA T 1993	No linear pain scale
GUNDERSEN RY 1986	Subgroups not defined
HAAK VAN DER LELY 1994B	No linear pain scale
HAAK-VAN DER LELY 1993	No linear pain scale
HAAK-VAN DER LELY 1994	No linear pain scale
HACHENBERG T 1999	Review
HANSDOTTIR V 1996b	Same patients as Hansdottir V 1996a, pharmacokinetics study. Analgesic info in other paper.
HASENBOS M 1985	No linear pain score
HASENBOS M 1985B	No linear pain scale
HASENBOS M 1987	No linear pain scale
HASENBOS MAWM 1989	Not randomised
HAYWARD RH 1994	Not randomised, retrospective
HIGGINS TL 1994	No linear pain scale
INADA K 2000	Not randomised
INDERBITZI R 1992	No linear pain scale

Study	Reason for exclusion
IWASAKI A 2004	Not randomised
JAIN S 1999	Review
JAKOBSEN CJ 1997	No linear pain scale
JAKOBSEN CJ 1997B	No linear pain scale
JIMENEZ-MERCHAN 1997	Retrospective
JOHNSON MD 1990	No linear pain scale
JONES RM 1985	Study of lysine acetyl salicylate, which is no longer available
JOUCKEN K 1987	No linear pain scale
KATZ J 1996	Not a comparative clinical trial
KAVANAGH BP 1992	Abstract only
KESSLER P 2002	Not randomised
KIM KH 1996	Not randomised
KIRBY TJ 1995	No linear pain scale scores
KISS J 1976	Not randomised comparative trial
KOLVENBACH H 1989	Not randomised
KOREN G 1989	Same data as Whiting 1988 (but less detail)
KOVACS M 1971	Not randomised, no linear pain scale
KRUGER M 1999	Review
KRUGER M 1999B	Review
LANDRENEAU RJ 1996	Not randomised
LANGE MP 1988	No linear pain scale
LAXENAIRE MC 1986	No linear pain scale
LEBOVITS AH 2001	Subgroups not defined

Study	Reason for exclusion
LEPAGE-SAVARY D 1991	Subgroups not defined
LI WWL 2003	Not randomised
LIEOU FJ 1996	Not thoracotomy
LUDWICK F 1995	Paediatric
MASCOTTO G 2003	No linear pain scale
MATSUMURA Y 2000	Not English
MCCRORY C 2004	Repeat data from McCrory C 2002, focus on prostaglandin formation
MOON MR 1999	Thoracic injury, not thoracotomy surgery
MOOTE C 1992	Review
MURPHY DF 1994	Abdominal and thoracic surgery
NELSON KM 1974	No linear pain scale
NORDBERG G 1983	No linear pain scale
NORDBERG G 1984	No linear pain scale
NORDBERG G 1986	No linear pain scale
NORDBERG G 1987	No linear pain scale
NORDBERG G 1988	No linear pain scale
NOVAK-JANKOVIC 2000	No linear pain scale
OAKES DD 1982	Not randomised study
ORR IA 1983	Not fully randomised, extension of 1981 study
PANOS L 1990	Abstract only
PETIT J 1988	Not English
PHILLIPS DM 1984	Not randomised
PIGOT B 1987	Not English

Study	Reason for exclusion
POOPALALINGAM R 2003	Thoracic and upper abdominal surgery, subgroups not defined for results.
POWER I 1990	No linear pain scale
QUIMBY CW 1966	No linear pain scale
RAFF H 1988	No linear pain scale
RAGNI J 1991	Not English
RANDELL TT 1991	No linear pain scale
RAWAL N 1981	Not a comparative trial
RICHARDSON J 1999B	Review
RICHARDSON J 1999C	Review
ROONEY SM 1983	No linear pain scale
ROONEY SM 1986	No linear pain scale
ROSENBERG PH 1987	Not a comparative trial
RUBIN JW 1994	Not randomised
RUBIN JW 1994B	Not randomised, comparative trial
SABANATHAN S 1995	Not a comparative clinical trial
SABANATHAN S 1995b	Study data published in more detail in Richardson J 1994
SALOMAKI TE 1993	Data published in Salomaki TE 1991 (pain data in more detail there)
SALZER GM 1997	Not randomised
SANDLER AN 1999	Review
SATOH M 2000	Not English
SATOH M 2001	Not English
SAVAGE C 2002	Review
SAVOIA G 2001	Review

Study	Reason for exclusion
SCHULTZ AM 1997	Not a comparative study
SEKINE Y 1999	No linear pain scale
SOFIANOS E 1985	No linear pain scale
STENSETH R 1985	No linear pain scale
STRATTON SA 1980	No linear pain scale
SUBRAMANIAM B 2000	Subgroups not defined
SUGIURA H 1999	Retrospective
SULEK CA 2000	Subgroups not defined
SUTTON BA 1994	Abstract only
SUWANCHINDA V 2000	Not randomised
TAKAHASHI N 2001	Not English
TARTIERE J 1991	Thoraco-abdominal surgery
TENLING A 1999	No linear pain scale
TOLEDO-PEREYRA 1979	No linear pain scale
TOVAR EA 1998	Not a comparative clinical trial
TRINDER TJ 1998	No linear pain scale
TSUI SL 1991	Thoracic plus abdominal incision
UEDA M 1999	No linear pain scale
URSCHEL HC 1986	Not randomised
USUI A 2001	Not randomised, retrospective
VARA-THORBECK VR1987	Not English

Study	Reason for exclusion
WALLER DA 1994	No linear pain scale
WIEBALCK A 1997	Subgroups not defined
WIED U 1981	Thoracoscopy, not thoracotomy
WILHELM AJ 1993	Subgroups not defined
WILLDECK-LUND G 1975	No linear pain scale
WULF H 1998	No linear pain scale
YIM APC 2000	Not randomised
ZAWADZKI A 1997	Not randomised, comparative study