Protective effects of epidural analgesia on pulmonary complications after abdominal and thoracic surgery: a meta-analysis
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CRD summary
This review assessed the impact of epidural versus systemic analgesia on postoperative pulmonary complications, concluding that epidural analgesia protected against pneumonia following abdominal or thoracic surgery, although the beneficial effect has reduced over the last 35 years due to decreased baseline risk. The review appeared well conducted, but limitations with the included trials should be borne in mind.

Authors' objectives
To review the impact of epidural versus systemic analgesia on postoperative pulmonary complications.

Searching
MEDLINE, the Cochrane Library, BIOSIS Previews and CINAHL databases were searched for studies published between 1966 and March 2006; no language restrictions were applied. Bibliographies of included studies were searched for further relevant studies.

Study selection
To be eligible for inclusion, trials had to use a randomised design that compared epidural analgesia with systemic analgesia in adults (18 years or older) undergoing thoracic and abdominal surgery. Epidural analgesia was required to have started preoperatively, intraoperatively or immediately postoperatively, and last at least 24 hours. Systemic analgesia was defined as opioids given alone or in combination with non-opioid analgesics. Eligible trials were required to report lung function, gas exchange, and any pulmonary complications. Trials were excluded if the control group received loco-regional analgesia (e.g. intercostal nerve blocks), if they had fewer than ten patients, or they were of trauma patients. Outcomes were pneumonia, prolonged ventilation (over 24 hours) and re-intubation.

The publication date of included trials ranged from 1971 to 2006. In included trials, the types of surgery included thoracic, abdominal, aortic, and cholecystectomy. Most included studies used morphine as the main opioid (where reported). Most of the later trials had patient controlled analgesia and non-opioid analgesics. The duration of epidural analgesia ranged from two to five days. Most included trials used clinical and radiological signs to identify incidences of pneumonia (where reported).

One reviewer selected studies for the review; queries were resolved by discussion with two other reviewers.

Assessment of study quality
It appeared that two reviewers assessed trial quality using randomisation, allocation concealment, blinding, and reporting of drop-outs. Disagreements were resolved by discussion with a third reviewer.

Data extraction
One reviewer extracted data required to calculate effect sizes; two reviewers checked the extraction. Authors were contacted for further information.

Methods of synthesis
For continuous data, mean differences (MDs), with 95% confidence intervals (CIs), were pooled. For dichotomous data, odds ratios (ORs) with 95% confidence intervals were pooled using the Peto method. It appeared that statistical heterogeneity was assessed using the Q test; if heterogeneity was statistically significant (using a p <0.10 threshold), a random-effects rather than fixed-effect model was used to pool the data. Numbers needed to treat (NNT) and numbers needed to harm (NNH) were calculated. A range of subgroup analyses were performed.

Results of the review
Nineteen trials were included in the review (n=3,504 patients, range 21 to 984). All the trials reported randomisation, but only six trials specified method of randomisation. Four trials reported allocation concealment. Two trials reported blinding, but in only one of these was blinding adequate. Fourteen trials reported follow-up. Seven trials had detailed reporting allowing the use of intention-to-treat analysis.

**Pneumonia** (19 trials): Patients receiving epidural analgesia had statistically significantly reduced odds of contracting pneumonia compared with those receiving systemic analgesia (7.5% of patients in epidural arm; 12.8% of patients in systemic arm; OR 0.54, 95% CI 0.43 to 0.68; NNT=18, 95% CI 14 to 27; p value for heterogeneity <0.10), but heterogeneity was statistically significant.

**Prolonged ventilation** (seven trials): Epidural analgesia significantly reduced the odds of prolonged ventilation compared with systemic analgesia (OR 0.61, 95% CI 0.40 to 0.93; NNT=30, 95% CI 19 to 167; p value for heterogeneity >0.10).

**Re-intubation** (seven trials): Epidural analgesia significantly reduced the odds of re-intubation compared with systemic analgesia (OR 0.70, 95% CI 0.55 to 0.88; NNT=21, 95% CI 14 to 62; p value for heterogeneity >0.10).

A wide range of subgroup analyses were performed. One important result was that older trials (published between 1970 and 1980; OR 0.17, 95% CI 0.05 to 0.57) showed a greater difference in the odds of catching pneumonia between epidural and systemic analgesia patients than newer trials (published from 2000 onwards; OR 0.62, 95% CI 0.47 to 0.81).

There was no evidence of publication bias for the primary outcomes.

**Authors’ conclusions**
Epidural analgesia protected against pneumonia compared with systemic analgesia following abdominal or thoracic surgery, although the beneficial effect has reduced over the last 35 years because of a decrease in baseline risk.

**CRD commentary**
This review addressed a clear review question using appropriate study selection criteria. The search was comprehensive, with no language or substantial date restrictions. The main stages of the review were conducted with sufficient efforts to minimise reviewer error and bias.

The quality assessment of included trials was appropriate and clearly reported. None of the trials met all of the quality assessment criteria, which raised the risk of bias. Many primary trial details were reported, although patient characteristics (such as age and gender) were not reported or explored within the subgroup analyses, reducing review transparency and raising the possibility that differences in these characteristics may have biased the results. The method of synthesis and results appeared appropriate, comprehensive, and clearly reported. It appeared that studies with zero events were excluded from the analysis; the impact on the results was unclear. There was statistical heterogeneity among trials reporting pneumonia.

The authors’ conclusions appeared to be an accurate reflection of the results, but potential limitations with the included trials (such as poor quality and heterogeneity) should be borne in mind when interpreting the findings.

**Implications of the review for practice and research**

**Research:** The review stated that the impact of changes in standard care on the efficacy of an experimental intervention should be explored in appropriate sensitivity analyses.

**Practice:** The review did not state any implications for practice.

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