Regional versus general anaesthesia for caesarean section (Review)

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ABSTRACT

Background
Regional and general anaesthesia (GA) are commonly used for caesarean section (CS) and both have advantages and disadvantages. It is important to clarify what type of anaesthesia is more efficacious.

Objectives
To compare the effects of regional anaesthesia (RA) with those of GA on the outcomes of CS.

Search strategy
We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (30 December 2005), the Cochrane Central Register of Controlled Trials (*The Cochrane Library* 2005, Issue 1), MEDLINE (1966 to December 2005), and EMBASE (1980 to December 2005).

Selection criteria
Randomised and quasi-randomised controlled trials evaluating the use of RA and GA in women who had CS for any indication.

Data collection and analysis
Two authors independently assessed trials for inclusion, data extraction and trial quality.

Main results
Sixteen studies (1586 women) were included in this review.

Women who had either epidural anaesthesia or spinal anaesthesia were found to have a significantly lower difference between pre and postoperative haematocrit (weighted mean difference (WMD) 1.70, 95% confidence interval (CI) 0.47 to 2.93, one trial, 231 women) and (WMD 3.10, 95% CI 1.73 to 4.47, one trial, 209 women). Compared to GA, women having either an epidural anaesthesia or spinal had a lower estimated maternal blood loss (WMD -126.98 millilitres, 95% CI -225.06 to -28.90, two trials, 256 women) and (WMD -84.79 millilitres, 95% CI -126.96 to -42.63, two trials, 279 women). More women preferred to have GA for subsequent procedures when compared with epidural (odds ratio (OR) 0.56, 95% CI 0.32 to 0.96, one trial, 223 women) or spinal (OR 0.44, 95% CI 0.24 to 0.81, 221 women). The incidence of nausea was also less for this group of women compared with epidural (OR 3.17, 95% CI 1.64 to 6.14, three trials, 286 women) or spinal (OR 23.22, 95% CI 8.69 to 62.03, 209 women).

No significant difference was seen in terms of neonatal Apgar scores of six or less and of four or less at one and five minutes and need for neonatal resuscitation with oxygen.

Authors' conclusions
There is no evidence from this review to show that RA is superior to GA in terms of major maternal or neonatal outcomes. Further research to evaluate neonatal morbidity and maternal outcomes, such as satisfaction with technique, will be useful.

PLAIN LANGUAGE SUMMARY

Regional compared with general anaesthesia for caesarean section

Caesarean section is when a baby is born through an incision in the mother's abdomen and uterine wall. This requires effective anaesthesia which can be regional (epidural or spinal) or a general anaesthetic. With regional epidural anaesthesia, the anaesthetic is infused into the space around the mother's spinal column, whilst with regional spinal anaesthesia, the drug is injected as a single dose into the mother's spinal column. With the two types of regional anaesthesia, the mother is awake for the birth but numbed from the waist down. With general anaesthesia, the mother is unconscious for the birth with the anaesthetic affecting her whole body. As well as women having a view as to whether they might wish to be awake or asleep for the caesarean birth, it is important to know the balance of the benefits and adverse effects of these different types of anaesthesia. The review of trials sought to assess these benefits and harms, and identified sixteen randomised controlled trials involving 1586 women. There were some differences which favoured general anaesthesia, for example, less nausea and vomiting. There were also some differences which favoured regional anaesthesia, for example, less blood loss and less shivering. The evidence on the differences in pain was difficult to evaluate. There were not enough participants to assess the very rare outcome of mortality for the mother, which may be an important aspect. None of the trials addressed important outcomes for women like recovery times, effects on breastfeeding, effects on the mother-child relationship and length of time before mother feels well enough to care for her baby. As there is insufficient evidence on benefits and adverse effects, women are most likely to choose anaesthesia for caesarean section, depending on whether they wish to be awake or asleep for the birth.

BACKGROUND

Caesarean section refers to the procedure where a baby is delivered through an incision on the abdominal wall and uterus of the mother. It is often life-saving and aims to preserve the health of the mother and her baby. Although the operation has become very safe over the years, it is still associated with greater maternal mortality and morbidity (Enkin 2000; Hall 1999). The risk of maternal death with caesarean section is four times that associated with all types of vaginal birth, which is 1 per 10,000 births (Enkin 2000). It is known that there is a greater risk of neonatal respiratory distress with caesarean section than vaginal delivery, regardless of gestational age (Enkin 2000). This has been described as mild and transient (Danforth 1985), however, and caesarean section is usually considered safe for the fetus. Caesarean section is often described as elective (when it is planned) or emergency.

The type of anaesthesia used and the care with which it is administered is an important determinant of the outcome of caesarean section (Andersen 1987; Enkin 2000). Regional and general anaesthesia are commonly used for caesarean section and both have their advantages and disadvantages (Spielman 1985).

General anaesthesia refers to the loss of ability to perceive pain associated with loss of consciousness produced by intravenous or inhalation anaesthetic agents. For caesarean section, this involves the use of thiopentone for induction, tracheal intubation facilitated by suxamethonium, positive-pressure ventilation of the lungs with a nitrous oxide/oxygen mixture plus a volatile agent, and a muscle relaxant (Thorburn 1998). The risks include the aspiration of stomach contents, awareness of the surgical procedure (due to inadequate anaesthesia), failed intubations, and respiratory problems for both mother and baby (Enkin 2000). When supplemented with halogenated volatile agents, general anaesthesia has also been associated with a greater risk of maternal blood loss compared with regional anaesthesia (Andrews 1992). However, it is a more quickly administered procedure and is often preferred in cases where speed is important (Enkin 2000).

Regional anaesthesia refers to the use of local anaesthetic solutions to produce circumscribed areas of loss of sensation. The types of regional anaesthesia used for caesarean section (that is, spinal (subarachnoid) and epidural (extradural) anaesthesia) involve the infiltration of a local anaesthetic agent, usually bupivacaine, into the surroundings of the spinal cord through the lower back of the woman. With spinal anaesthesia, the drug is injected directly into the subarachnoid space while, with epidural, it is injected through a catheter that has been introduced into the extradural space (Thorburn 1998).

Spinal and epidural anaesthesia cause a substantial drop in maternal blood pressure, which may affect both mother and fetus (Dick 1995; Kestin 1991), and may be dangerous when the woman has a bleeding complication (Enkin 2000). They are also contraindicated in women with coagulation (clotting) disorders since the insertion of the block may precipitate a bleed. They may cause a severe post-dural puncture headache although the incidence of this is now reduced with the use of special needles (Kestin 1991). The advantages of regional anaesthesia include the reduction of the incidence of general anaesthetic complications and that of early bonding between the mother and the newborn, since the mother is awake during the procedure (Enkin 2000). Specifically, spinal and epidural anaesthesia are similar in their safety profiles with a few differences. Spinal anaesthesia has a faster onset of action and requires less of the drug, but causes more hypotensive episodes than epidural anaesthesia (Thorburn 1998).

Regional anaesthesia is the preferred method for caesarean section in the United Kingdom and the United States of America (USA) (Gibbs 1986; Hibbard 1996). In the USA in particular, regional anaesthesia was used for caesarean section in over 80% of cases as of 1992, regardless of the indication (Hawkins 1997a), and in over 50% of cases as far back as 1981 (Hawkins 1997a). The reasons for this trend have been attributed to the fact that maternal mortality with regional anaesthesia has been reducing steadily over the years while that of general anaesthesia remains the same (Hawkins 1997b), and to the greater familiarity of anaesthesia residents with the procedure (Hawkins 1997a).

The effect on neonates is less clear with some studies showing no difference in neonatal outcome between the two groups (Fox 1979; Zagorzycki 1982) and others maintaining that neonatal outcome is better with regional than with general anaesthesia (Abboud 1985; Ong 1989). Most of the studies that report no difference are those done on women who had elective operations (Korkmaz 2004) while those done on emergencies tend to report a positive difference in neonatal outcome with regional anaesthesia compared with general (Dyer 2003).

Given the benefits and risks of the different techniques, it is important to clarify what type of anaesthesia is more efficacious in terms of the various maternal and neonatal outcomes for the different types of, and indications for, caesarean section.

OBJECTIVES

To compare the effects of regional anaesthesia with those of general anaesthesia on the outcomes of caesarean section.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

Randomised and quasi-randomised controlled trials.

Types of participants

Mothers having elective or emergency caesarean section for any indication, with the various definitions of elective and emergency taken into consideration.

Types of intervention

Intervention: regional anaesthesia, whether spinal, epidural or any combination of both.
Control: general anaesthesia using any combination of anaesthetic drugs and muscle relaxants.

Types of outcome measures

Maternal outcomes
Maternal death
Mean difference between pre and postoperative haematocrit or haemoglobin levels
Incidence of postoperative wound infection
Incidence of other postoperative infections such as endometritis and urinary tract infection
Incidence of intraoperative pain
Maternal satisfaction with anaesthetic technique
Need for postoperative analgesia
Incidence of postoperative nausea and vomiting
Maternal blood loss greater than 500 ml
Mean maternal blood loss
Amount of blood transfusion received in units (not prespecified in protocol)
Number who received postoperative blood transfusion (not prespecified in protocol)
Time to request analgesia in minutes (not prespecified in protocol)

Neonatal outcomes
Neonatal death
Mean umbilical arterial or venous pH
Mean neonatal neurologic and adaptive score
Time to sustained respiration
Need for oxygen by mask or intubation
Apgar score of four or less at one and five minutes (not prespecified in protocol)
Apgar score of six or less at one and five minutes (not prespecified in protocol)
Mean neonatal Apgar scores at one and five minutes

Adverse events such as anaphylactic reactions, thromboembolic disease and backache. Headache, epigastric pain, blurred vision, convulsions, pruritus, shivering and bradycardia were also measured despite not being prespecified in the protocol.

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: methods used in reviews.

We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (30 December 2005).

The Cochrane Pregnancy and Childbirth Group's Trials Register is maintained by the Trials Search Co-ordinator and contains trials identified from:
(1) quarterly searches of the Cochrane Central Register of Controlled Trials (CENTRAL);
(2) monthly searches of MEDLINE;
(3) handsearches of 30 journals and the proceedings of major conferences;
(4) weekly current awareness search of a further 37 journals.

Details of the search strategies for CENTRAL and MEDLINE, the list of handsearched journals and conference proceedings,

and the list of journals reviewed via the current awareness service can be found in the 'Search strategies for identification of studies' section within the editorial information about the Cochrane Pregnancy and Childbirth Group.

Trials identified through the searching activities described above are given a code (or codes) depending on the topic. The codes are linked to review topics. The Trials Search Co-ordinator searches the register for each review using these codes rather than keywords.

In addition, we searched CENTRAL (*The Cochrane Library* 2005, Issue 1) using the terms general, regional, spinal, epidural, caesarean section, cesarean section.

We also searched MEDLINE (1966 to December, 2005) and EMBASE (1980 to December, 2005) for potentially eligible studies, using the following search strategy:
1. general
2. regional
3. spinal
4. epidural
5. #1 and (#2 or #3 or #4)
6. anaesthesia
7. anesthesia
8. #5 and (#6 or #7)
9. caesarean section
10. cesarean section
11. #8 and (#9 or #10)
12. random*
13. controlled-clinical-trial
14. #12 or #13
15. #11 and #14

We did not apply any language restrictions.

METHODS OF THE REVIEW

Bosede Afolabi (BA) selected potentially relevant trials from those identified by the search strategy and retrieved the full articles. She ensured that multiple publications from the same data set were only used once. BA and Afolabi Lesi (AL) independently assessed each trial for inclusion in the review using the information described in the section 'Criteria for considering studies for this review'. Studies that did not meet the inclusion criteria were excluded and the reason was stated in the table of 'Characteristics of excluded studies'.

BA and AL independently assessed the methodological quality of the included trials. Generation of allocation sequence, allocation concealment, blinding and loss to follow up are the quality components that were used. For each trial, each quality component apart from blinding was classed as adequate, inadequate or unclear (Juni 2001). For allocation concealment, the letters A to D were used: where A = adequate, B = unclear, C = inadequate and D = not used. For loss to follow up, inclusion of 90% of participants was considered adequate. Blinding was assessed using the following criteria: blinding of participants, blinding of caregiver and blinding of outcome assessment. Blinding was assessed as open or single blind. Disagreements were resolved by discussion. Where the method used was unclear, the trialists were contacted to clarify the issue. Nkihu Merah (NM) helped resolve disagreements, commented on and helped revise the draft of the review.

BA and AL extracted data from each included trial independently. BA entered data into Review Manager (RevMan 2003). For binary outcomes we recorded the number of participants experiencing the event in each group of the trial. For continuous outcomes for each group we extracted information to allow calculation of arithmetic means and standard deviations. If the data were reported using geometric means, we extracted information to calculate standard deviations on the log scale. Medians and ranges were extracted and reported in tables. Statistical analyses were carried out using the Review Manager software (RevMan 2003). Binary data were presented as odds ratio. For continuous data, we used the weighted mean difference.

We assessed heterogeneity amongst trials by inspecting the forest plots and using the I-squared test for heterogeneity, where a figure greater than 50% indicates substantial heterogeneity.

We explored the following potential source(s) of heterogeneity using subgroup analysis:
(1) elective and emergency caesarean section;
(2) different criteria for the use of the terms 'elective' and 'emergency' caesarean section;
(3) different indications for caesarean section.

After including all eligible studies in the primary analysis, we conducted sensitivity analyses for each of the quality factors, where possible, using the subgroups adequate, inadequate, or unclear. We also conducted sensitivity analyses for the different outcome criteria.

DESCRIPTION OF STUDIES

There are 16 trials (1586 women) in this review. Details for each trial are in the 'Characteristics of included studies' table.

In 12 of the trials, the indication for caesarean section was non-urgent and the women were healthy and stable. In three of the remaining four trials, the indication for caesarean was severe pre-eclampsia in two, and pre-eclampsia with non-reassuring heart trace in one. In the last trial, women undergoing both elective and emergency caesarean section were studied but they were all healthy term pregnancies with all major obstetric complications excluded.

Bupivacaine was used for regional anaesthesia in ten of the papers, lidocaine was used in five and lidocaine, levobupivacaine and ropivacaine were used in one paper. Thiopentone, suxamethonium and a mixture of nitrous oxide and oxygen were used for the induction of general anaesthesia in 14 of the 16 papers. One paper used propofol and succinylcholine, and one did not report the use of an induction agent. Five of the papers reported the use of halothane as well, five of isoflurane, three of sevoflurane, one of enflurane and two did not report the use of any volatile agent for anaesthesia.

Seven papers were excluded and the details are in the 'Characteristics of excluded studies' table.

METHODOLOGICAL QUALITY

Details for each trial are in the 'Characteristics of included studies' table. Many of the studies were small and most of them did not report their method of randomisation or allocation concealment. Blinding of outcome assessments was done in some studies. Only one study analysed the data in an intention-to-treat manner. Intervention and control groups were comparable in all but one of the studies, in which this was not reported.

RESULTS

Maternal outcomes

Maternal deaths

No trial reported on deaths.

Pre and postoperative haematocrit

One study (Lertakyamanee 1999) reported a significant difference which favoured epidural anaesthesia (weighted mean difference (WMD) 1.70, 95% confidence interval (CI) 0.47 to 2.93, 231 women) and spinal anaesthesia (WMD 3.10, 95% CI 1.73 to 4.47, 209 women) over general anaesthesia.

Maternal blood loss

Two trials each reported on maternal blood loss and noted that significantly less blood was lost when using either epidural anaesthesia (Hong 2002; Lertakyamanee 1999; WMD -126.98 millilitres, 95% CI -225.06 to -28.90, 256 women) or spinal anaesthesia (Dyer 2003; Lertakyamanee 1999; standardised mean difference (SMD) -0.59 millilitres, 95% CI -0.83 to -0.35, 279 women) when compared with general anaesthesia.

Wound and other infections

No study reported on wound and other infections.

Pain

One study (Lertakyamanee 1999) reported the occurrence of intraoperative pain. It reported that the perception of pain during the caesarean section was less when general anaesthesia was used when compared to spinal anaesthesia or epidural anaesthesia (223 women, *see*Table 03). However, one study (Hong 2002) reported that the time to request for analgesia postoperatively was longer with epidural when compared to general anaesthesia (25 women, *see*Table 02).

Satisfaction

One study (Lertakyamanee 1999) reported on satisfaction using a visual analogue score and noted that there was no difference in the level of satisfaction when general anaesthesia is compared with either spinal anaesthesia (WMD -0.58, 95% CI -1.26 to 0.10, 221 women) or epidural anaesthesia (WMD -0.01, 95% CI -0.63 to 0.61, 223 women). However, when asked which form of analgesia they would prefer for subsequent procedures, one study (Lertakyamanee 1999) reported that women preferred general over epidural (odds ratio (OR) 0.56, 95% CI 0.32 to 0.96, 223 women) or spinal anaesthesia (OR 0.44, 95% CI 0.24 to 0.81, 221 women).

Adverse events

In comparing epidural with general anaesthesia, the results show that nausea was significantly more frequent in women who received epidural anaesthesia (OR 3.17, 95% CI 1.64 to 6.14, I squared = 84.4%, three trials, 286 women), while shivering was significantly commoner in women who received general anaesthesia (OR 0.06, 95% CI 0.01 to 0.60, one trial, 30 women). In the spinal compared with general anaesthesia group, Lertakyamanee 1999 also noted that nausea (OR 23.22, 95% CI 8.69 to 62.03, 209 women) and vomiting (OR 7.05, 95% CI 3.06 to 16.23, 209 women) were significantly more frequent in the spinal group.

Neonatal outcomes

Neonatal deaths

No study reported on neonatal deaths.

Umbilical artery pH

Eight studies (Bengi Sener 2003; Datta 1983; Dick 1992; Hollmen 1978; Pence 2002; Petropoulos 2003; Wallace 1995; Yegin 2003) reported on the mean umbilical artery pH in mothers who had epidural anaesthesia. They noted that when the indications for caesarean section were not urgent (seven out of the eight trials), there was no difference in the pH in babies whose mothers had received epidural anaesthesia compared to general anaesthesia (WMD 0.00, 95% CI -0.01 to 0.02, 397 women). There was also no overall difference when all the eight trials were combined (WMD 0.00, 95% CI -0.02 to 0.01, 454 women). These studies showed a significant degree of heterogeneity both for those with non-urgent indications for caesarean section (I squared = 60.0%), and overall (I squared = 69.9%). Three trials (Datta 1983; Kavak 2001; Mahajan 1992) also reported that there were no significant differences in the mean umbilical artery pH when mothers had received spinal anaesthesia compared to general anaesthesia (WMD -0.01, 95% CI -0.02 to 0.00, 164 women). Dyer 2003 reported a lower median umbilical artery pH when mothers had received spinal compared to general anaesthesia (66 women, *see*

Table 01). Where both spinal and epidural anaesthesia were given in the same woman and compared with general anaesthesia, two studies (Petropoulos 2003; Wallace 1995) found the mean umbilical artery pH to be significantly lower when compared to the general anaesthesia group (WMD -0.03, 95% CI -0.04 to -0.02, 211 women).

Umbilical vein pH

Six studies (Datta 1983; Dick 1992; Hollmen 1978; Kolatat 1999; Mahajan 1992; Yegin 2003) reported on the mean umbilical vein pH in mothers who had epidural anaesthesia. The pH was significantly higher in babies whose mothers had received epidural anaesthesia compared to general anaesthesia (WMD 0.01, 95% CI 0.01 to 0.02, 442 women). Three trials (Datta 1983; Kolatat 1999; Mahajan 1992) also found that the mean umbilical vein pH of children whose mothers had received spinal anaesthesia was higher than those whose mothers had received general anaesthesia, but this difference did not reach statistical significance (WMD 0.01, 95% CI 0.00 to 0.02, p = 0.08, 301 women).

Neonatal neurological adaptive score

Two studies (Bengi Sener 2003; Kolatat 1999) reported on the mean adaptive score at two to four hours and noted that there were no differences in the scores in babies delivered following general anaesthesia when compared to epidural anaesthesia (SMD 1.19, 95% CI -0.98 to 3.36, I squared = 94.8%, 253 women). When looking at the proportion of babies with scores less than 35, Mahajan 1992 noted that there were no differences in the epidural group when compared with the general anaesthesia group at 15 minutes (OR 0.87, 95% CI 0.31 to 2.43, 60 women) and at two hours (OR 0.58, 95% CI 0.18 to 1.91, 60 women). One study (Kolatat 1999) documented the mean adaptive score at two to four hours and noted that there were also no differences in babies whose mothers had received spinal anaesthesia over general (WMD 0.40, 95% CI -0.54 to 1.34, 221 women). On the contrary, Mahajan 1992 reported significantly fewer children with adaptive scores less than 35 were born to women who received spinal anaesthesia compared to general anaesthesia at 15 minutes (OR 0.07, 95% CI 0.02 to 0.30, 60 women) and at two hours (OR 0.04, 95% CI 0.00 to 0.67, 60 women).

Apgar score

Three studies (Hodgkinson 1980; Kolatat 1999; Yegin 2003) documented mean Apgar score at one minute comparing epidural with general anaesthesia. They reported that scores were significantly lower among babies delivered by general anaesthesia (SMD 0.58, 95% CI 0.35 to 0.81, 305 women). However, Kavak 2001 and Kolatat 1999, in comparing spinal with general anaesthesia, noted that there was no difference in mean Apgar score at one minute (SMD 0.67, 95% CI -0.04 to 1.38, I squared = 86.9%, 305 women). A similar trend was noticed with Apgar scores at five minutes where two studies (Hodgkinson 1980; Kolatat 1999; Yegin 2003) comparing epidural with general anaesthesia reported significantly lower scores among babies in the general anaesthesia group (WMD 0.38, 95% CI 0.17 to 0.60, 305 women). However, when comparing spinal with general anaesthesia at five minutes, Kavak 2001 and Kolatat 1999 did not find any differences in the Apgar score in both groups (WMD 0.28, 95% CI -0.31 to 0.87, 305 women). One study (Korkmaz 2004) also did not find any differences in mean Apgar score at one minute (WMD 0.25, 95% CI -0.14 to 0.64, 30 women) or at five minutes (not estimable), when comparing combined spinal and epidural anaesthesia with general anaesthesia.

One study (Dick 1992) reported on the proportion of babies with Apgar score of four or less, comparing epidural with general anaesthesia. The trial did not find any difference in the proportion of children with such low Apgar scores at one minute (OR 0.13, 95% CI 0.01 to 2.68, 47 women) and at five minutes (OR 0.33, 95% CI 0.01 to 8.61, 47 women). Two studies (Petropoulos 2003; Wallace 1995) reported on proportions of babies with Apgar scores six or less in women who received epidural versus general anaesthesia. No difference was found at one minute (OR 0.55, 95% CI 0.19 to 1.58, 209 women) and at five minutes (OR 0.45, 95% CI 0.10 to 2.02, 209 women). In comparing babies with Apgar score of six or less in women who received spinal versus general anaesthesia, one study (Mahajan 1992) also did not find any differences at one minute (OR 0.64, 95% CI 0.10 to 4.15, 60 women). No differences were also seen in the proportion with Apgar score six or less when combined epidural and spinal anaesthesia are used compared with general anaesthesia at one minute (OR 0.71, 95% CI 0.22 to 2.30, two trials, 211 women) and at five minutes (OR 0.84, 95% CI 0.28 to 2.51, 211 women).

Need for oxygen for resuscitation

One study (Petropoulos 2003) reported on the need for oxygen in the epidural versus general anaesthesia group. The study did not find any differences in the need for oxygen (OR 0.85, 95% CI 0.30 to 2.41, 152 women). When epidural and spinal anaesthesia were combined compared with general anaesthesia, no difference was found either (OR 1.16, 95% CI 0.44 to 3.03, two trials, 158 women).

DISCUSSION

No trial reported on maternal or neonatal deaths. This attests to the relative safety of caesarean section, especially in the countries where most of the trials in this review were conducted. Larger sample sizes would be needed to detect such outcomes as a lot of the included studies were underpowered.

From the results, regional anaesthesia (both spinal and epidural) appears to be associated with less blood loss and a higher postoperative haematocrit than general anaesthesia. Although this did not translate into a reduction in the need for blood transfusion, it may be clinically significant especially as anaemia is detrimental to postoperative wellbeing and healing.

The finding of less intraoperative pain with general anaesthesia compared with both forms of regional is not surprising as this method is characterised by the abolishment of all sensation. The time to request analgesia, an index of postoperative pain requirements, appeared longer when mothers were given epidural anaesthesia. This is probably because drugs administered into the epidural space last longer and the epidural catheter can be left in situ and topped up for several hours after surgery. However, there was a big difference between the regional and general anaesthesia groups in standard deviation in both studies. This suggests differing distribution of data and some degree of skewing, rendering the t-test comparisons invalid. Thus, firm conclusions cannot be drawn from these data (*see*Table 02; and Table 03).

One of the big issues in healthcare delivery is client satisfaction; only one trial reported on this and did not find any differences in satisfaction between regional and general anaesthesia. It is clear that this aspect would need to be addressed in the design of new trials. In terms of preference of the same technique again, however, based on the results of one study, women who had general appeared to favour it over regional anaesthesia (both spinal and epidural) for caesarean sections. The reasons for this preference could not be determined from the study.

Regarding neonatal outcomes, umbilical artery pH appeared to be unaffected by method of anaesthesia when the indications for surgery are not urgent. This differs from the findings of a recent meta-analysis that showed that spinal anaesthesia resulted in lower umbilical cord pH results than general, but showed no difference when epidural anaesthesia was compared to general (Reynolds 2005). It, however, included both randomised and non-randomised trials and combined both umbilical artery and vein pH data in its analysis of cord pH. Umbilical blood sampling is one of the parameters used in defining and deciding how aggressively one should resuscitate any baby with severe birth asphyxia. Although umbilical vein pH appeared to be favoured by the use of epidural anaesthesia, the differences in umbilical artery and vein pH found in this review may not be clinically significant as the mean figures were within normal neonatal limits (7.11 to 7.45). They were also well above the cut-off for defining acidosis (pH less than 7.0) (Stoll 2000).

The Apgar score is a composite measure of the clinical and cardiorespiratory status of the baby at birth. It is measured usually at one minute (to determine the extent of resuscitation required) and at five minutes (to determine the response to resuscitation and to diagnose asphyxia). In terms of mean Apgar scores at one and five minutes, it appears that epidural anaesthesia is superior to general. However, a similar proportion of babies in both groups are born with severe asphyxia (Apgar of four or less) or even when less severe forms of asphyxia (Apgar of six or less) are included. We can thus conclude that, practically, one form of anaesthesia has not been shown to be superior to the other.

The neonatal neurological adaptive score is an attempt to measure the neurological status of the babies on the assumption that the drugs used in inducing anaesthesia may depress the central nervous system. Overall, the results suggest that regional anaesthesia conveys a more favourable outcome than general, especially when babies are categorised based on a cut-off point of less than 35 and particularly when spinal anaesthesia is used. However, the study which showed a significant effect with spinal anaesthesia was a small one with 30 participants in each arm (Mahajan 1992). Also, there was significant heterogeneity between the two studies that showed a difference in the mean score within two to four hours using epidural anaesthesia (Bengi Sener 2003; Kolatat 1999), which could be because the latter study (30 women) was much smaller than the former (223 women). The larger study did not show a significant difference in the mean score between epidural and general anaesthesia.

The acceptability of a procedure is often defined not only by its safety profile but by the occurrence of adverse events to the drugs used and whether these events are tolerable. Nausea (with or without vomiting) occurred significantly more often in women who received regional anaesthesia while shivering occurred significantly more often with general anaesthesia. The question as to whether they are acceptable adverse events can only be answered by the individual woman as tolerance level to various events differ with individuals and their past experiences. There was significant heterogeneity in the epidural versus general studies which analysed nausea and this was probably due to the difference in sample sizes. Two out of the three studies had very small numbers but the largest one had an effect in the same direction as the overall effect. There was only one study which analysed shivering however, and the sample size was rather small (30 women).

AUTHORS' CONCLUSIONS

Implications for practice

There is not enough evidence from this review to show that either regional or general anaesthesia is superior to the other in terms of major maternal or neonatal outcomes. Thus, the choice of one over the other lies with other criteria such as estimated blood loss which appears to be reduced with the use of regional anaesthesia, and client satisfaction and nausea and vomiting which appear to be reduced with general anaesthesia. Any of these may assume greater importance depending on the context in which one is operating. In low- and middle-income countries, the least expensive method should be chosen.

Implications for research

Trials measuring outcomes such as maternal and newborn morbidity, maternal satisfaction with techniques and adverse events are necessary.

POTENTIAL CONFLICT OF INTEREST

None known.

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SOURCES OF SUPPORT

External sources of support

- No sources of support supplied

Internal sources of support

- No sources of support supplied

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** Indicates the major publication for the study*

TABLES

Characteristics of included studies

Study	Bengi Sener 2003
Methods	Women said to have been randomly divided into groups but method not stated. Blinding of intervention: not stated. Blinding of outcome assessment: maternal and neonatal assessments were made by blinded observers. No women were excluded from this study. Intention-to-treat analysis: not stated but women remained in their allocated groups.
Participants	30 women. Inclusion criteria: ASA I /II women undergoing elective caesarean section for breech presentation, CPD and previous caesarean section, who had not used regional anaesthesia or analgesia before the study. Exclusion criteria: women with pre-eclampsia, eclampsia, morbid obesity, diabetes mellitus, anaemia, fetal anomaly, heart disease, marked airway problems, fetal distress, gestational age below 37 weeks. Setting: Turkey, University Hospital.
Interventions	Regional group had epidural anaesthesia with bupivacaine. General anaesthesia group had thiopental, succinyl choline, mixture of nitrous oxide and oxygen, isoflurane and vecuronium.
Outcomes	Outcomes measured: study outcomes were maternal systolic arterial pressure, heart rate, peripheral oxygen saturation, uterine incision-delivery interval, Apgar scores, neonatal NACS, umbilical arterial blood gases, first breastfeeding interval and complications such as nausea, vomiting and allergic reactions. Review measured neonatal NACS, umbilical arterial pH, Apgar scores, and adverse events.

Notes	
Allocation concealment	B – Unclear

Study	**Datta 1983**
Methods	Randomisation was said to be by formal randomisation. Blinding of intervention and outcome: not stated. There was no loss to follow-up. Intention-to-treat analysis: not stated (but all women remained in their allocated groups).
Participants	30 women. Inclusion criteria: healthy parturients, elective caesarean section. Exclusion criteria: none stated. Setting: USA, University Hospital.
Interventions	Two types of regional anaesthesia were used in this study - spinal anaesthesia which had 0.5% tetracaine. General anesthesia group had thiopental with 50% nitrous oxide in oxygen.
Outcomes	Outcomes measured: I-D interval, UI-D interval, Apgar score < 7, maternal pH, neonatal acid-base values. Outcomes studied: neonatal umbilical arterial and venous pH, Apgar score less than 7 at 1 minute.
Notes	
Allocation concealment	B – Unclear

Study	**Dick 1992**
Methods	Women said to have been randomised but method not stated. Blinding of intervention: not stated. Blinding of outcome assessment: the paediatrician was blind to the type of anaesthesia used. No loss to follow up. Intention-to-treat analysis: not stated (but all women remained in their allocated groups).
Participants	47 women. Inclusion criteria: elective caesarean section for breech presentation or disproportion following a normal uncomplicated pregnancy. Exclusions: none stated. Setting: Germany, University Hospital.
Interventions	Regional anaesthesia group had epidural anaesthesia with 12-15 ml of bupivacaine. General anaesthesia group had thiopentone, succinylcholine, nitrous oxide/oxygen and halothane.
Outcomes	Outcomes measured: study measured maternal heart rate, blood pressure, blood gases and haematocrit. Induction-delivery and incision-delivery interval were also measured. Neonatal Apgar scores, umbilical arterial and venous blood gases and acid-base balance and a full set of neurological observations were also measured. Review measured neonatal umbilical arterial and venous pH and Apgar scores of 4 or less at 1 and 5 minutes.
Notes	The outcomes measured in the review were those that were reported clearly in the results.
Allocation concealment	B – Unclear

Study	**Dyer 2003**
Methods	Women were said to have been randomised by sealed envelopes. Blinding of intervention: not stated. Blinding of outcome assessment: the paediatrician was blinded to the type of anaesthesia used. No mothers were excluded but there were no data for 1 neonate in the general anaesthesia group as its mother suffered a stillbirth. Intention to treat: not stated (but all women remained in their allocated groups).
Participants	70 women. Inclusion criteria: pre-eclampsia with non-reassuring fetal heart trace. Exclusion criteria: participant refusal; any other relative contraindication to general or spinal anaesthesia, in particular oral intake other than clear fluids within 4 hours of the intended surgery; body mass index

	greater than 35 kg/m2; Mallampati score greater than 2; clinical signs of hypovolaemia; abruptio placentae; placenta praevia; coagulation abnormality; thrombocytopenia; local or generalised sepsis; spinal deformity; cord prolapse; less than 30 weeks' gestation; or twin pregnancy. Setting: South Africa.
Interventions	Regional group had spinal anaesthesia using 1.8 ml hyperbaric bupivacaine 0.5% with 10 ug fentanyl. General anaesthesia group had thiopentone, suxamethonium, nitrous oxide/oxygen, isoflurane and magnesium sulphate to control the pressor response to tracheal intubation.
Outcomes	Outcomes measured: study primary outcomes were umbilical arterial base deficit, umbilical arterial pH, Apgar scores, requirements for resuscitation, and complications. Secondary outcome measures were maternal pulse rate and non-invasive blood pressure. Review measured umbilical arterial pH, need for oxygen by face mask or intubation, and maternal blood loss.
Notes	
Allocation concealment	B – Unclear

Study	**Hodgkinson 1980**
Methods	Women were said to be randomly allocated to groups but the method was not stated. Blinding of intervention: not stated. Blinding of outcome assessment: not stated. No women were excluded. Intention-to-treat analysis: not stated (but all women remained in their allocated groups).
Participants	20 women. Inclusion criteria: severe gestational hypertension (pre-eclampsia or hypertension with superimposed pre-eclampsia) requiring emergency caesarean section for delivery. Exclusion criteria: not stated. Setting: USA, University Health Science Centre.
Interventions	Regional group had epidural anaesthesia with 12-20 ml of bupivacaine 0.75%. General anaesthesia group had thiopentone, succinyl choline, nitrous oxide and halothane.
Outcomes	Outcomes measured: study primary outcomes were systemic and pulmonary blood pressures before, during and after surgery. Review measured maternal adverse events and neonatal Apgar scores at 1 and 5 minutes.
Notes	
Allocation concealment	B – Unclear

Study	**Hollmen 1978**
Methods	Inadequate randomisation as women were allocated to groups alternately. Blinding of intervention: not stated. Blinding of assessment: the examiner who performed the neonatal neurologic assessment was blinded to the obstetric and anaesthetic management. No women were excluded. Intention-to-treat analysis: not stated (but all women remained in their allocated groups).
Participants	30 women. Inclusion criteria: healthy women with uncomplicated full-term pregnancies, requiring elective caesarean section. Three women in each group had mild toxemia, diabetes or hypertension and one person in the general anaesthesia group had partial placenta previa and transverse lie. All the women had intact membranes and were not in labour. Exclusion criteria: not stated. Setting: Finland; type of hospital not stated.
Interventions	Regional group had epidural anaesthesia with lidocaine and epinephrine. General anaesthesia group had thiopentone, 1:1 mixture of nitrous oxide and oxygen, and succinyl choline.

Characteristics of included studies (*Continued*)

Outcomes	Outcomes measured: study outcome measures were maternal and fetal blood gases, neonatal Apgar scores and neurological assessment. Review measured neonatal umbilical vessel pH and neurological assessment.
Notes	
Allocation concealment	D – Not used

Study	**Hong 2002**
Methods	Study was said to be a randomised trial but the method was not stated. Blinding of intervention: not stated. Blinding of outcome assessment: an anesthesiologist blinded to the anaesthetic technique measured the estimated blood loss, volume of intravenous fluids and blood given, and the Apgar scores of the newborn. No women were excluded. Intention-to-treat analysis: not stated (but all women remained in their allocated groups).
Participants	25 women. Inclusion criteria: women with grade 4 placenta previa without bleeding, scheduled for elective caesarean section. Exclusion criteria: not stated. Setting: South Korea, University Hospital.
Interventions	Regional anaesthesia group had epidural anaesthesia with lidocaine (20 ml of 2%), plus epinephrine (1 in 200,000) and morphine (2 mg in 4 ml). General anaesthesia group had thiopentone, succinyl choline, vecuronium, mixture of nitrous oxide and oxygen and enflurane.
Outcomes	Outcomes measured: study outcome measures were maternal blood pressure and heart rate, estimated blood loss at surgery, and neonatal Apgar scores, haemoglobin and hematocrit levels at admission and 24 hours after surgery, need for postoperative transfusion, request for analgesics and adverse events. Review measured amount of blood received, need for postoperative blood transfusion, maternal estimated blood loss, need for postoperative analgesia, time to request analgesia, adverse events and Apgar scores.
Notes	
Allocation concealment	B – Unclear

Study	**Kavak 2001**
Methods	Women were said to have been allocated randomly to groups but the method of randomisation was not stated. Blinding of intervention: not stated. Blinding of outcome assessment: not stated. 20 women were excluded; 19 due to incomplete data on their infants and 1 due to congenital malformation in her infant. Intention-to-treat analysis: not stated but women remained in their allocated groups.
Participants	104 women. Inclusion criteria: healthy women with uncomplicated singleton cephalic pregnancies undergoing elective repeat caesarean section after 37 weeks' gestation. Exclusion criteria: pregnancies with obstetric or medical complications. Setting: Turkey, hospital not stated.
Interventions	Regional anaesthesia group had spinal anaesthesia with 12.5 mg of 0.5% heavy bupivacaine and morphine. General anaesthesia group had thiopental sodium, succinyl choline, mixture of nitrous oxide and oxygen, sevoflurane and vecuronium.
Outcomes	Outcomes measured: study primary endpoints were respiratory depression, perinatal asphyxia, readmission and duration of hospital admission of the infants. Review measured umbilical arterial pH, need for neonatal oxygen therapy and Apgar scores.

Characteristics of included studies (*Continued*)

Notes	
Allocation concealment	B – Unclear

Study	**Kolatat 1999**
Methods	Randomisation was said to be by random numbers. Blinding of intervention: not stated. Blinding of outcome assessment: the assessors of the Neurologic and Adaptive Capacity Scores were blinded to the mode of anaesthesia used. There were no women excluded. Intention-to-treat analysis: not stated but 39 women were changed to another intervention group due to technical difficulty.
Participants	341 women. Inclusion criteria: women with uncomplicated pregnancies who would be delivered at term. Exclusion criteria: women with obstetric conditions that were a contraindication to any of the anaesthetic techniques. Setting: Department of Obstetrics and Gynaecology, Thailand, University Hospital.
Interventions	Two types of regional anaesthesia were used in this study - spinal anaesthesia which used 5% lidocaine. The general anaesthesia group had halothane, a mixture of nitrous oxide and oxygen and pancuronium bromide.
Outcomes	Outcomes measured: study outcome measures were Apgar scores, umbilical vein gases, neurologic adaptive capacity scores, and maternal systolic blood pressure. Review measured maternal systolic blood pressure, umbilical venous pH, neonatal neurologic and adaptive capacity scores and Apgar scores at 1 and 5 minutes.
Notes	
Allocation concealment	B – Unclear

Study	**Korkmaz 2004**
Methods	Study was said to be a randomised trial but the method was not stated. Blinding of intervention: not stated. Blinding of outcome assessment: not stated. No other method was stated. This was an abstract.
Participants	30 women. Inclusion criteria: women who had elective caesarean section. Exclusion criteria: not stated. Setting: Turkey, Education and Research Hospital.
Interventions	Regional group had combined spinal and epidural anaesthesia with 5 mg of 0.5% bupivacaine and fentanyl, with additional ropivacaine top-ups if necessary. The general anaesthesia group had sevoflurane.
Outcomes	Outcomes measured: study outcome measures were heart rate, mean blood pressure, systolic and diastolic blood pressure, Apgar scores at 1 and 5 minutes and umbilical blood gases. Review measured Apgar scores at 1 and 5 minutes. Blood gas levels were not reported in the abstract.
Notes	
Allocation concealment	B – Unclear

Study	**Lertakyamanee 1999**
Methods	Randomisation was adequate (done with random-number tables). Blinding of intervention: not stated. Blinding of outcome assessment: estimated blood loss and hematocrit levels were assessed by people who were blinded to the type of anaesthesia used. There were no women excluded.

	Intention-to-treat analysis: this was not explicitly stated but women were analysed for some outcomes both according to their initial randomisation group and to the actual anaesthetic technique they received.
Participants	341 women. Inclusion criteria: term normal women scheduled to have elective or emergency caesarean section. Exclusion criteria: women with abruptio placenta, bleeding placenta praevia, fetal distress, diabetes mellitus, moderate to severe hypertension of pregnancy, severe cardiac or respiratory disease, pregnancy with more than one fetus and coagulopathy. Setting: Thailand, University Hospital.
Interventions	Two types of regional anaesthesia were used in this study - spinal anaesthesia group which used 5% lidocaine. The general anaesthesia group had halothane, a mixture of nitrous oxide and oxygen and pancuronium bromide.
Outcomes	Outcomes measured: study outcome measures were estimated blood loss, intravenous fluid and blood transfusion, pre and postoperative haematocrit, intraoperative complications, hypo and hypertension, satisfaction towards anaesthetic technique and total pain scores. Review measured difference between pre and postoperative hematocrit, number who had blood transfusion, hypo and hypertension, maternal satisfaction with technique, intraoperative pain, nausea and vomiting.
Notes	
Allocation concealment	B – Unclear

Study	**Mahajan 1992**
Methods	Randomisation was adequate (done with a random chart). Blinding of intervention: not stated. Blinding of outcome assessment: the paediatrician who assessed the neonatal NACS was blinded to the anaesthetic technique used. No women were excluded. Intention-to-treat analysis: not stated but all women remained in their allocated groups.
Participants	90 women. Inclusion criteria: healthy women presenting for elective caesarean section, at a gestational age greater than 36 weeks, with infants of a birthweight greater than 2.5 kg, with no evidence of placental insufficiency. Exclusion criteria: not stated. Setting: India; type of hospital not stated.
Interventions	Two types of regional anaesthesia were used in this study - epidural anaesthesia which used 0.5% bupivacaine. General anaesthesia group had thiopentone, suxamethonium, nitrous oxide and oxygen, halothane and pancuronium.
Outcomes	Outcomes measured: study outcome measures were maternal blood pressure and heart rate, maternal blood gases, umbilical arterial and venous blood gases, time intervals to delivery, Apgar scores and neonatal NACS. Review measured umbilical arterial and venous pH, neonatal NACS and Apgar scores.
Notes	
Allocation concealment	B – Unclear

Study	**Pence 2002**
Methods	Study was said to be a randomised trial but the method was not stated. Blinding of intervention: not stated. Blinding of outcome assessment: not stated. No women were excluded. Intention-to-treat analysis: not stated (but all women remained in their allocated groups).
Participants	56 women. Inclusion criteria: women with a cephalic presentation, having elective caesarean section. Exclusion criteria: women with medical diseases, fetal distress and medication apart from iron.

Characteristics of included studies (*Continued*)

	Setting: Turkey.
Interventions	Regional group had epidural anaesthesia with 50 mg bupivacaine and fentanyl. General anaesthesia group had isoflurane with propofol and succinylcholine.
Outcomes	Outcomes measured: study outcome measures were umbilical artery blood gas levels and malondealdehyde and glutathione levels.
Notes	
Allocation concealment	B – Unclear

Study	**Petropoulos 2003**
Methods	Randomisation was done with a random-number table and numbered sealed envelopes were used to conceal allocation. Blinding of intervention: not stated. Blinding of outcome assessment: not stated. There was no loss to follow up. Intention-to-treat analysis: not stated (but all women remained in their allocated groups).
Participants	230 women. Inclusion criteria: pregnant women presenting for planned elective caesarean section after 38 weeks' gestation. Exclusion criteria: multiple gestation, gestational age < 38 weeks and > 42 weeks, placental or cord abnormalities, premature rupture of membranes, abnormal fetal heart tracings, obstetric or medical complications, congenital malformations and incomplete data. Setting: Greece, University Hospital.
Interventions	Two types of regional anaesthesia were used in this study - epidural anaesthesia which used ropivacaine after a test dose of xylocaine. General anaesthesia group had thiopentone, suxamethonium,nitrous oxide and oxygen, sevoflurane and vecuronium.
Outcomes	Outcomes measured: study outcomes were maternal blood gases, neonatal blood gases, Apgar scores and need for oxygen or mask ventilation. Review measured neonatal umbilical artery pH, Apgar scores at 1 and 5 minutes less than 7, and need for oxygen or mask ventilation of the neonate.
Notes	
Allocation concealment	A – Adequate

Study	**Wallace 1995**
Methods	Randomisation was by a random-number table and numbered sealed envelopes were used to conceal allocation. Blinding of intervention: not stated. Blinding of outcome assessment: not stated. 1 woman was excluded from the study after randomisation. Intention-to-treat analysis: not stated. All the remaining women stayed in their allocated groups.
Participants	80 women. Inclusion criteria: women undergoing elective or emergency caesarean section for severe pre-eclampsia. Exclusion criteria were thrombocytopenia with a platelet count of less than 100,000/mm3, eclampsia or medical conditions such as heart disease, diabetes mellitus or chronic renal disease, and non-reassuring fetal heart trace. Setting: Labor and Delivery Unit, USA, University Hospital.
Interventions	Two types of regional anaesthesia were used in this study - epidural anaesthesia which used 2% lidocaine or 3% chloroprocaine.

	General anaesthesia group had pentothal, succinylcholine, mixture of nitrous oxide and oxygen, isoflurane and atracurium or vecuronium. Lidocaine and nitroglycerin were also administered before intubation to prevent hypertension from tracheal stimulation.
Outcomes	Outcomes measured: study outcomes were maternal systolic and diastolic blood pressures, time intervals of preparation for anesthesia, and surgical and delivery events, IV fluid volumes administered and urine output, neonatal gestational age, birthweight, Apgar scores, umbilical artery blood gases, admission to special care nursery, incidence of small-for-gestational-age infants, those with respiratory distress requiring mechanical ventilation and those with intracranial haemorrhage. Review measured highest and lowest intraoperative blood pressures, umbilical artery pH and Apgar scores.
Notes	
Allocation concealment	A – Adequate

Study	**Yegin 2003**
Methods	Study was said to be a randomised trial but the method was not stated. Blinding of intervention: not stated. Blinding of outcome assessment: not stated. No women were excluded. Intention-to-treat analysis: not stated (but all women remained in their allocated groups).
Participants	62 women. Inclusion criteria: uncomplicated women who were to give birth at term and classified as ASA I or II. Exclusion criteria: not stated. Setting: Turkey; hospital not stated.
Interventions	Regional group had epidural anesthesia with 15 ml of 0.5% bupivacaine. The general group had isoflurane with vecuronium, thiopental and suxamethonium.
Outcomes	Outcomes measured: study measured umbilical arterial and venous blood gases and mean Apgar scores at 1 and 5 minutes. Review measured umbilical arterial and venous pH and mean Apgar scores at 1 and 5 minutes.
Notes	
Allocation concealment	B – Unclear

ASA: American Society of Anaesthesiologists classification
CPD: cephalopelvic disproportion
I-D: incision-delivery
IV: intravenous
kg/m2: kilogram per metre squared
NACS: neurologic and adaptive capacity scoring
ug: microgram
UI-D: uterine incision-delivery

Characteristics of excluded studies

Study	**Reason for exclusion**
Abboud 1985	Randomisation was not done; the women were divided into three unequal groups.
Akturk 1995	Randomisation was not done; women were assigned to either group according to their individual preference.
Gambling 1995	Randomisation was confined only to the general anaesthesia groups; the women in the spinal anaesthesia group were assigned on request.
Navarro 2000	Randomisation was confined to the general anaesthesia groups; the women in the spinal anaesthesia group were assigned on request.
Qublan 2001	No randomisation done; the type of anesthesia was chosen by the woman in consultation with the anesthesiologist.

Characteristics of excluded studies (*Continued*)

Ratcliffe 1992	No randomisation done; women were allowed to choose between regional and general anaesthesia.
White 1962	Participating obstetricians requested that all the women have spinal anaesthesia towards the end of the study, resulting in an unequal distribution of cases.

ADDITIONAL TABLES

Table 01. Umbilical artery pH

Study ID	(Spinal) Number	Median	Range	(GA) Number	Median	Range
Dyer 2003	34	7.2	6.93-7.34	32	7.23	7.05-7.4

Table 02. Time to request analgesia in minutes (prespecified in protocol)

Study ID	Epidural (N)	Mean	SD	General (N)	Mean	SD
Hong 2002	13	690	30	12	190	238

Table 03. Intraoperative pain score on visual analogue scale

Study ID	Epidural (N)	Mean	SD	Spinal (N)	Mean	SD	General (N)	Mean	SD
Lertakyamanee 1999	120	0.91	2.15	118	0.76	2.04	103	0.07	0.34

ANALYSES

Comparison 01. Epidural versus general anaesthesia

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Mean umbilical arterial pH	8	454	Weighted Mean Difference (Random) 95% CI	-0.00 [-0.02, 0.01]
02 Mean umbilical venous pH	6	442	Weighted Mean Difference (Fixed) 95% CI	0.02 [0.01, 0.02]
03 Apgar score of 4 or less at 1 minute	1	47	Odds Ratio (Fixed) 95% CI	0.13 [0.01, 2.68]
04 Apgar score of 4 or less at 5 minutes	1	47	Odds Ratio (Fixed) 95% CI	0.33 [0.01, 8.61]
05 Apgar score of 6 or less at 1 minute (not prespecified in protocol)	2	209	Odds Ratio (Fixed) 95% CI	0.55 [0.19, 1.58]
06 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)	2	209	Odds Ratio (Fixed) 95% CI	0.45 [0.10, 2.02]
07 Mean Apgar score at 1 minute	3	305	Standardised Mean Difference (Fixed) 95% CI	0.58 [0.35, 0.81]
08 Mean Apgar score at 5 minutes	3	305	Weighted Mean Difference (Fixed) 95% CI	0.38 [0.17, 0.60]
09 Neonatal neurologic and adaptive capacity score at 2-4 hours	2	253	Standardised Mean Difference (Random) 95% CI	1.19 [-0.98, 3.36]
10 Amount of blood transfusion received in units (not prespecified in protocol)	1	25	Weighted Mean Difference (Fixed) 95% CI	-0.70 [-1.73, 0.33]
11 Number who received postoperative blood transfusion (not prespecified in protocol)	2	256	Odds Ratio (Random) 95% CI	0.73 [0.15, 3.62]

12 Maternal estimated blood loss in ml	2	256	Weighted Mean Difference (Fixed) 95% CI	-126.98 [-225.06, -28.90]
13 Difference between pre and postoperative haematocrit (%)	1	231	Weighted Mean Difference (Fixed) 95% CI	1.70 [0.47, 2.93]
14 Satisfaction score on visual analogue scale	1	223	Weighted Mean Difference (Fixed) 95% CI	-0.01 [-0.63, 0.61]
15 Number who would prefer the same technique again	1	223	Odds Ratio (Fixed) 95% CI	0.56 [0.32, 0.96]
16 Neonatal neurologic and adaptive capacity score of < 35 at 15 minutes	1	60	Odds Ratio (Fixed) 95% CI	0.87 [0.31, 2.43]
17 Neonatal neurologic and adaptive capacity score of < 35 at 2 hours	1	60	Odds Ratio (Fixed) 95% CI	0.58 [0.18, 1.91]
18 Adverse events			Odds Ratio (Fixed) 95% CI	Subtotals only
19 Need for oxygen therapy or mask ventilation of the neonate	1	152	Odds Ratio (Fixed) 95% CI	0.85 [0.30, 2.41]

Comparison 02. Spinal versus general anaesthesia

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Umbilical arterial pH	3	164	Weighted Mean Difference (Fixed) 95% CI	-0.00 [-0.02, 0.01]
02 Umbilical venous pH	3	301	Weighted Mean Difference (Fixed) 95% CI	0.01 [-0.00, 0.02]
03 Neonatal neurologic and adaptive capacity score at 2-4 hours	1	221	Weighted Mean Difference (Fixed) 95% CI	0.40 [-0.54, 1.34]
04 Neonatal neurologic and adaptive capacity score of < 35 at 15 minutes	1	60	Odds Ratio (Fixed) 95% CI	0.07 [0.02, 0.30]
05 Neonatal neurologic and adaptive capacity score of < 35 at 2 hours	1	60	Odds Ratio (Fixed) 95% CI	0.04 [0.00, 0.67]
06 Neonatal neurologic and adaptive capacity score of < 35 at 24 hours	1	60	Odds Ratio (Fixed) 95% CI	Not estimable
07 Mean Apgar score at 1 minute	2	305	Standardised Mean Difference (Random) 95% CI	0.67 [-0.04, 1.38]
08 Mean Apgar score at 5 minutes	2	305	Weighted Mean Difference (Random) 95% CI	0.28 [-0.31, 0.87]
09 Apgar score of 6 or less at 1 minute (not prespecified in protocol)	1	60	Odds Ratio (Fixed) 95% CI	0.64 [0.10, 4.15]
10 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)	1	60	Odds Ratio (Fixed) 95% CI	Not estimable
11 Maternal estimated blood loss in ml	2	279	Standardised Mean Difference (Fixed) 95% CI	-0.59 [-0.83, -0.35]
12 Difference between pre and postoperative haematocrit	1	209	Weighted Mean Difference (Fixed) 95% CI	3.10 [1.73, 4.47]
13 Number who received postoperative blood transfusion (not prespecified in protocol)	1	209	Odds Ratio (Fixed) 95% CI	0.28 [0.06, 1.38]

14 Number who would prefer the same technique again	1	221	Odds Ratio (Fixed) 95% CI	0.44 [0.24, 0.81]
15 Satisfaction score on visual analogue scale	1	221	Weighted Mean Difference (Fixed) 95% CI	-0.58 [-1.26, 0.10]
16 Adverse events			Odds Ratio (Fixed) 95% CI	Subtotals only

Comparison 03. Combined spinal-epidural versus general anaesthesia

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Umbilical arterial pH	2	211	Weighted Mean Difference (Fixed) 95% CI	-0.03 [-0.04, -0.02]
02 Apgar score of 6 or less at 1 minute (not prespecified in protocol)	2	211	Odds Ratio (Fixed) 95% CI	0.71 [0.22, 2.30]
03 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)	2	211	Odds Ratio (Fixed) 95% CI	0.84 [0.28, 2.51]
04 Need for oxygen therapy or mask ventilation of neonate	1	158	Odds Ratio (Fixed) 95% CI	1.16 [0.44, 3.03]
05 Mean Apgar score at 1 minute	1	30	Weighted Mean Difference (Fixed) 95% CI	0.25 [-0.14, 0.64]
06 Mean Apgar score at 5 minutes	1	30	Weighted Mean Difference (Fixed) 95% CI	Not estimable

INDEX TERMS

Medical Subject Headings (MeSH)

*Anesthesia, Conduction; *Anesthesia, General; Anesthesia, Obstetrical [*methods]; *Cesarean Section; Randomized Controlled Trials

MeSH check words

Female; Humans; Pregnancy

COVER SHEET

Title	Regional versus general anaesthesia for caesarean section
Authors	Afolabi BB, Lesi FEA, Merah NA
Contribution of author(s)	Bosede Afolabi developed and wrote the protocol. She also extracted data from relevant trials, entered the data into Review Manager, and co-wrote the review. Afolabi Lesi commented on and revised the draft of the protocol during its development. He also extracted data and co-wrote and revised the review. Nkihu Merah commented on and revised the draft of the review.
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What's New	Information not supplied by author
Date new studies sought but none found	Information not supplied by author

Date new studies found but not yet included/excluded	Information not supplied by author
Date new studies found and included/excluded	30 December 2005
Date authors' conclusions section amended	Information not supplied by author
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GRAPHS AND OTHER TABLES

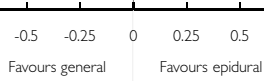
Analysis 01.01. Comparison 01 Epidural versus general anaesthesia, Outcome 01 Mean umbilical arterial pH

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 01 Mean umbilical arterial pH

Study	Epidural anaesthesia N	Epidural anaesthesia Mean(SD)	General anaesthesia N	General anaesthesia Mean(SD)	Weighted Mean Difference (Random) 95% CI	Weight (%)	Weighted Mean Difference (Random) 95% CI
01 Non-urgent indication for caesarean section							
× Bengi Sener 2003	15	7.27 (0.00)	15	7.26 (0.00)		0.0	Not estimable
Datta 1983	10	7.31 (0.03)	10	7.32 (0.03)		15.4	-0.01 [-0.04, 0.02]
Dick 1992	23	7.30 (0.04)	24	7.27 (0.04)		17.0	0.03 [0.01, 0.05]
Hollmen 1978	15	7.29 (0.03)	15	7.29 (0.04)		15.8	0.00 [-0.03, 0.03]
Pence 2002	26	7.36 (0.18)	30	7.35 (0.17)		2.8	0.01 [-0.08, 0.10]
Petropoulos 2003	72	7.28 (0.03)	80	7.29 (0.02)		23.7	-0.01 [-0.02, 0.00]
Yegin 2003	31	7.27 (0.08)	31	7.25 (0.07)		11.0	0.02 [-0.02, 0.06]



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Study	Epidural anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Random) 95% CI	Weight (%)	Weighted Mean Difference (Random) 95% CI
Subtotal (95% CI)	192		205			85.7	0.00 [-0.01, 0.02]
Test for heterogeneity chi-square=12.50 df=5 p=0.03 I² =60.0%							
Test for overall effect z=0.46 p=0.6							
02 Urgent indication for caesarean section: severe pre-eclampsia							
Wallace 1995	31	7.26 (0.06)	26	7.30 (0.05)		14.3	-0.04 [-0.07, -0.01]
Subtotal (95% CI)	31		26			14.3	-0.04 [-0.07, -0.01]
Test for heterogeneity: not applicable							
Test for overall effect z=2.75 p=0.006							
Total (95% CI)	223		231			100.0	0.00 [-0.02, 0.01]
Test for heterogeneity chi-square=18.14 df=6 p=0.006 I² =66.9%							
Test for overall effect z=0.25 p=0.8							

Analysis 01.02. Comparison 01 Epidural versus general anaesthesia, Outcome 02 Mean umbilical venous pH

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 02 Mean umbilical venous pH

Study	Epidural anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Datta 1983	10	7.37 (0.06)	10	7.36 (0.03)		4.4	0.01 [-0.03, 0.05]
Dick 1992	23	7.30 (0.07)	24	7.30 (0.04)		7.2	0.00 [-0.03, 0.03]
Hollmen 1978	15	7.34 (0.03)	15	7.33 (0.04)		12.0	0.01 [-0.02, 0.04]
Kolatat 1999	120	7.31 (0.06)	103	7.29 (0.05)		36.9	0.02 [0.01, 0.03]
Mahajan 1992	30	7.34 (0.04)	30	7.33 (0.05)		14.7	0.01 [-0.01, 0.03]
Yegin 2003	31	7.33 (0.03)	31	7.31 (0.04)		24.8	0.02 [0.00, 0.04]
Total (95% CI)	229		213			100.0	0.02 [0.01, 0.02]
Test for heterogeneity chi-square=1.95 df=5 p=0.86 I² =0.0%							
Test for overall effect z=3.45 p=0.0006							

Analysis 01.03. Comparison 01 Epidural versus general anaesthesia, Outcome 03 Apgar score of 4 or less at 1 minute

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 03 Apgar score of 4 or less at 1 minute

Study	Epidural anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Dick 1992	0/23	3/24		100.0	0.13 [0.01, 2.68]
Total (95% CI)	23	24		100.0	0.13 [0.01, 2.68]

Total events: 0 (Epidural anaesthesia), 3 (General anaesthesia)

Test for heterogeneity: not applicable

Test for overall effect z=1.32 p=0.2

Analysis 01.04. Comparison 01 Epidural versus general anaesthesia, Outcome 04 Apgar score of 4 or less at 5 minutes

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 04 Apgar score of 4 or less at 5 minutes

Study	Epidural anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Dick 1992	0/23	1/24		100.0	0.33 [0.01, 8.61]
Total (95% CI)	23	24		100.0	0.33 [0.01, 8.61]

Total events: 0 (Epidural anaesthesia), 1 (General anaesthesia)

Test for heterogeneity: not applicable

Test for overall effect z=0.66 p=0.5

Analysis 01.05. Comparison 01 Epidural versus general anaesthesia, Outcome 05 Apgar score of 6 or less at 1 minute (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 05 Apgar score of 6 or less at 1 minute (not prespecified in protocol)

Study	Epidural anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
01 Non-urgent indication for caesarean section					
Petropoulos 2003	3/72	5/80		48.0	0.65 [0.15, 2.83]
Subtotal (95% CI)	72	80		48.0	0.65 [0.15, 2.83]
Total events: 3 (Epidural anaesthesia), 5 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.57 p=0.6					
02 Urgent indication for caesarean section: severe pre-eclampsia					
Wallace 1995	3/31	5/26		52.0	0.45 [0.10, 2.10]
Subtotal (95% CI)	31	26		52.0	0.45 [0.10, 2.10]
Total events: 3 (Epidural anaesthesia), 5 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.02 p=0.3					
Total (95% CI)	103	106		100.0	0.55 [0.19, 1.58]
Total events: 6 (Epidural anaesthesia), 10 (General anaesthesia)					
Test for heterogeneity chi-square=0.12 df=1 p=0.73 I^2 =0.0%					
Test for overall effect z=1.11 p=0.3					

Analysis 01.06. Comparison 01 Epidural versus general anaesthesia, Outcome 06 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 06 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)

Study	Epidural anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
01 Non-urgent indication for caesarean section					
Petropoulos 2003	2/72	3/80		50.9	0.73 [0.12, 4.52]
Subtotal (95% CI)	72	80		50.9	0.73 [0.12, 4.52]
Total events: 2 (Epidural anaesthesia), 3 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.33 p=0.7					
02 Urgent indication for caesarean section: severe pre-eclampsia					
Wallace 1995	0/31	2/26		49.1	0.16 [0.01, 3.39]
Subtotal (95% CI)	31	26		49.1	0.16 [0.01, 3.39]
Total events: 0 (Epidural anaesthesia), 2 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.18 p=0.2					
Total (95% CI)	103	106		100.0	0.45 [0.10, 2.02]
Total events: 2 (Epidural anaesthesia), 5 (General anaesthesia)					
Test for heterogeneity chi-square=0.73 df=1 p=0.39 I^2 =0.0%					
Test for overall effect z=1.04 p=0.3					

Analysis 01.07. Comparison 01 Epidural versus general anaesthesia, Outcome 07 Mean Apgar score at 1 minute

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 07 Mean Apgar score at 1 minute

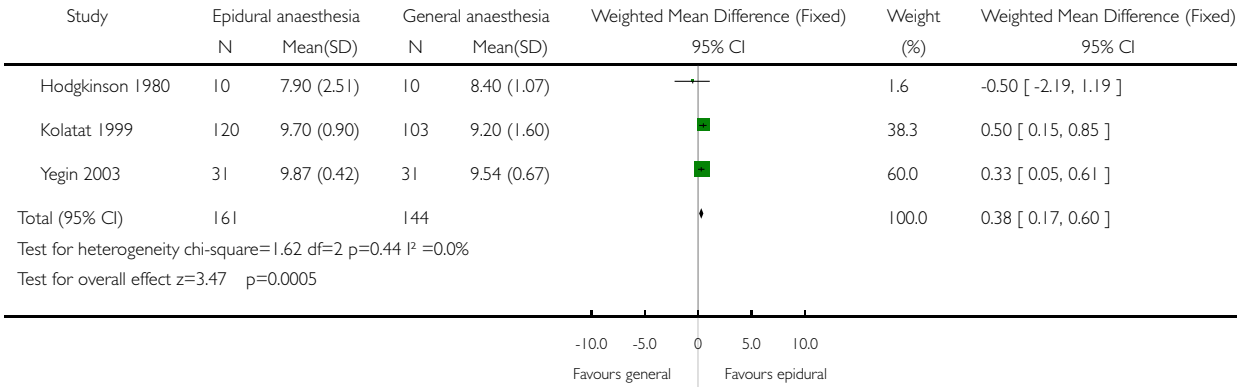
Study	Epidural anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Standardised Mean Difference (Fixed) 95% CI	Weight (%)	Standardised Mean Difference (Fixed) 95% CI
Hodgkinson 1980	10	6.80 (2.90)	10	5.70 (2.31)		6.7	0.40 [-0.49, 1.29]
Kolatat 1999	120	8.30 (1.90)	103	6.70 (2.80)		72.2	0.68 [0.41, 0.95]
Yegin 2003	31	7.38 (0.55)	31	7.19 (0.70)		21.1	0.30 [-0.20, 0.80]
Total (95% CI)	161		144			100.0	0.58 [0.35, 0.81]
Test for heterogeneity chi-square=1.86 df=2 p=0.40 I^2 =0.0%							
Test for overall effect z=4.92 p<0.00001							

Analysis 01.08. Comparison 01 Epidural versus general anaesthesia, Outcome 08 Mean Apgar score at 5 minutes

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 08 Mean Apgar score at 5 minutes

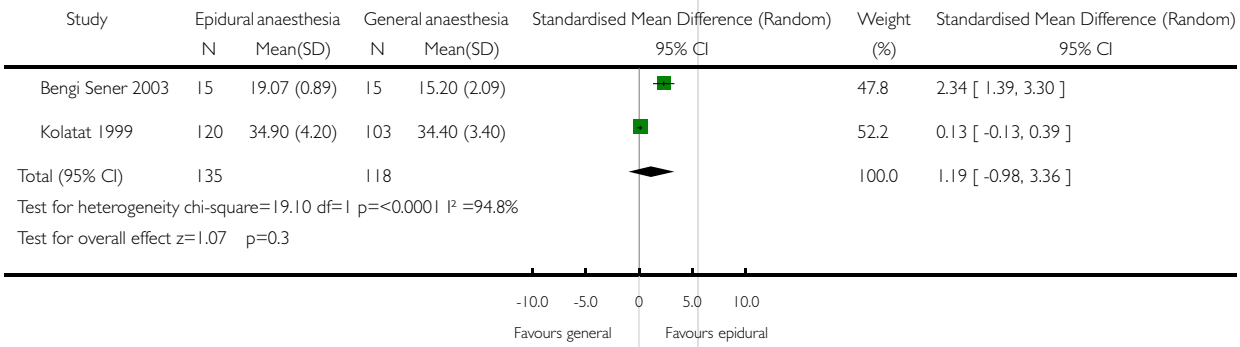


Analysis 01.09. Comparison 01 Epidural versus general anaesthesia, Outcome 09 Neonatal neurologic and adaptive capacity score at 2-4 hours

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 09 Neonatal neurologic and adaptive capacity score at 2-4 hours



Analysis 01.10. Comparison 01 Epidural versus general anaesthesia, Outcome 10 Amount of blood transfusion received in units (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 10 Amount of blood transfusion received in units (not prespecified in protocol)

Study	Epidural anaesthesia		General anaesthesia		Weighted Mean Difference (Fixed)	Weight	Weighted Mean Difference (Fixed)
	N	Mean(SD)	N	Mean(SD)	95% CI	(%)	95% CI
Hong 2002	13	0.38 (0.90)	12	1.08 (1.60)		100.0	-0.70 [-1.73, 0.33]
Total (95% CI)	13		12			100.0	-0.70 [-1.73, 0.33]
Test for heterogeneity: not applicable							
Test for overall effect z=1.33 p=0.2							

Analysis 01.11. Comparison 01 Epidural versus general anaesthesia, Outcome 11 Number who received postoperative blood transfusion (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 11 Number who received postoperative blood transfusion (not prespecified in protocol)

Study	Epidural anaesthesia	General anaesthesia	Odds Ratio (Random)	Weight	Odds Ratio (Random)
	n/N	n/N	95% CI	(%)	95% CI
Hong 2002	2/13	5/12		37.7	0.25 [0.04, 1.69]
Lertakyamanee 1999	11/117	8/114		62.3	1.38 [0.53, 3.55]
Total (95% CI)	130	126		100.0	0.73 [0.15, 3.62]
Total events: 13 (Epidural anaesthesia), 13 (General anaesthesia)					
Test for heterogeneity chi-square=2.44 df=1 p=0.12 I^2 =59.0%					
Test for overall effect z=0.39 p=0.7					

Analysis 01.12. Comparison 01 Epidural versus general anaesthesia, Outcome 12 Maternal estimated blood loss in ml

Review: Regional versus general anaesthesia for caesarean section

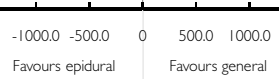
Comparison: 01 Epidural versus general anaesthesia

Outcome: 12 Maternal estimated blood loss in ml

Study	Epidural anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Hong 2002	13	1418.00 (996.00)	12	1623.00 (775.00)		2.0	-205.00 [-901.71, 491.71]
Lertakyamanee 1999	117	748.20 (363.50)	114	873.60 (403.10)		98.0	-125.40 [-224.46, -26.34]
Total (95% CI)	130		126			100.0	-126.98 [-225.06, -28.90]

Test for heterogeneity chi-square=0.05 df=1 p=0.82 I^2 =0.0%

Test for overall effect z=2.54 p=0.01



Analysis 01.13. Comparison 01 Epidural versus general anaesthesia, Outcome 13 Difference between pre and postoperative haematocrit (%)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 13 Difference between pre and postoperative haematocrit (%)

Study	Epidural anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Lertakyamanee 1999	117	-3.40 (4.80)	114	-5.10 (4.70)		100.0	1.70 [0.47, 2.93]
Total (95% CI)	117		114			100.0	1.70 [0.47, 2.93]

Test for heterogeneity: not applicable

Test for overall effect z=2.72 p=0.007

Analysis 01.14. Comparison 01 Epidural versus general anaesthesia, Outcome 14 Satisfaction score on visual analogue scale

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 14 Satisfaction score on visual analogue scale

Study	Epidural anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Lertakyamanee 1999	120	8.06 (2.52)	103	8.07 (2.22)		100.0	-0.01 [-0.63, 0.61]
Total (95% CI)	120		103			100.0	-0.01 [-0.63, 0.61]
Test for heterogeneity: not applicable							
Test for overall effect z=0.03 p=1							

Analysis 01.15. Comparison 01 Epidural versus general anaesthesia, Outcome 15 Number who would prefer the same technique again

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 15 Number who would prefer the same technique again

Study	Epidural anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Lertakyamanee 1999	65/120	70/103		100.0	0.56 [0.32, 0.96]
Total (95% CI)	120	103		100.0	0.56 [0.32, 0.96]
Total events: 65 (Epidural anaesthesia), 70 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=2.09 p=0.04					

Analysis 01.16. Comparison 01 Epidural versus general anaesthesia, Outcome 16 Neonatal neurologic and adaptive capacity score of < 35 at 15 minutes

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 16 Neonatal neurologic and adaptive capacity score of < 35 at 15 minutes

Study	Epidural anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Mahajan 1992	17/30	18/30		100.0	0.87 [0.31, 2.43]
Total (95% CI)	30	30		100.0	0.87 [0.31, 2.43]

Total events: 17 (Epidural anaesthesia), 18 (General anaesthesia)

Test for heterogeneity: not applicable

Test for overall effect z=0.26 p=0.8

Analysis 01.17. Comparison 01 Epidural versus general anaesthesia, Outcome 17 Neonatal neurologic and adaptive capacity score of < 35 at 2 hours

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

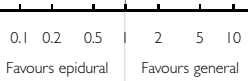
Outcome: 17 Neonatal neurologic and adaptive capacity score of < 35 at 2 hours

Study	Epidural anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Mahajan 1992	6/30	9/30		100.0	0.58 [0.18, 1.91]
Total (95% CI)	30	30		100.0	0.58 [0.18, 1.91]

Total events: 6 (Epidural anaesthesia), 9 (General anaesthesia)

Test for heterogeneity: not applicable

Test for overall effect z=0.89 p=0.4

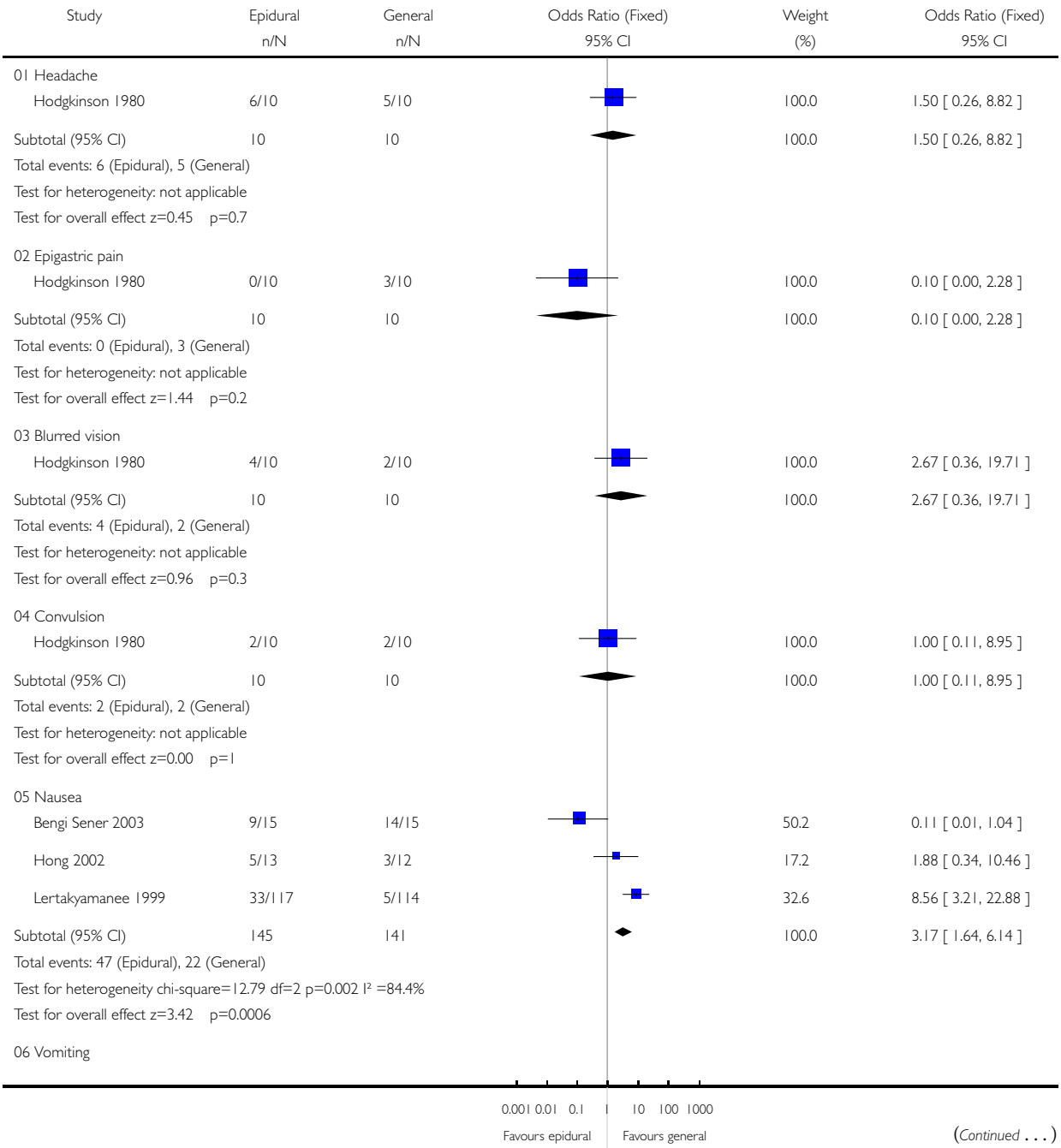


Analysis 01.18. Comparison 01 Epidural versus general anaesthesia, Outcome 18 Adverse events

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 18 Adverse events



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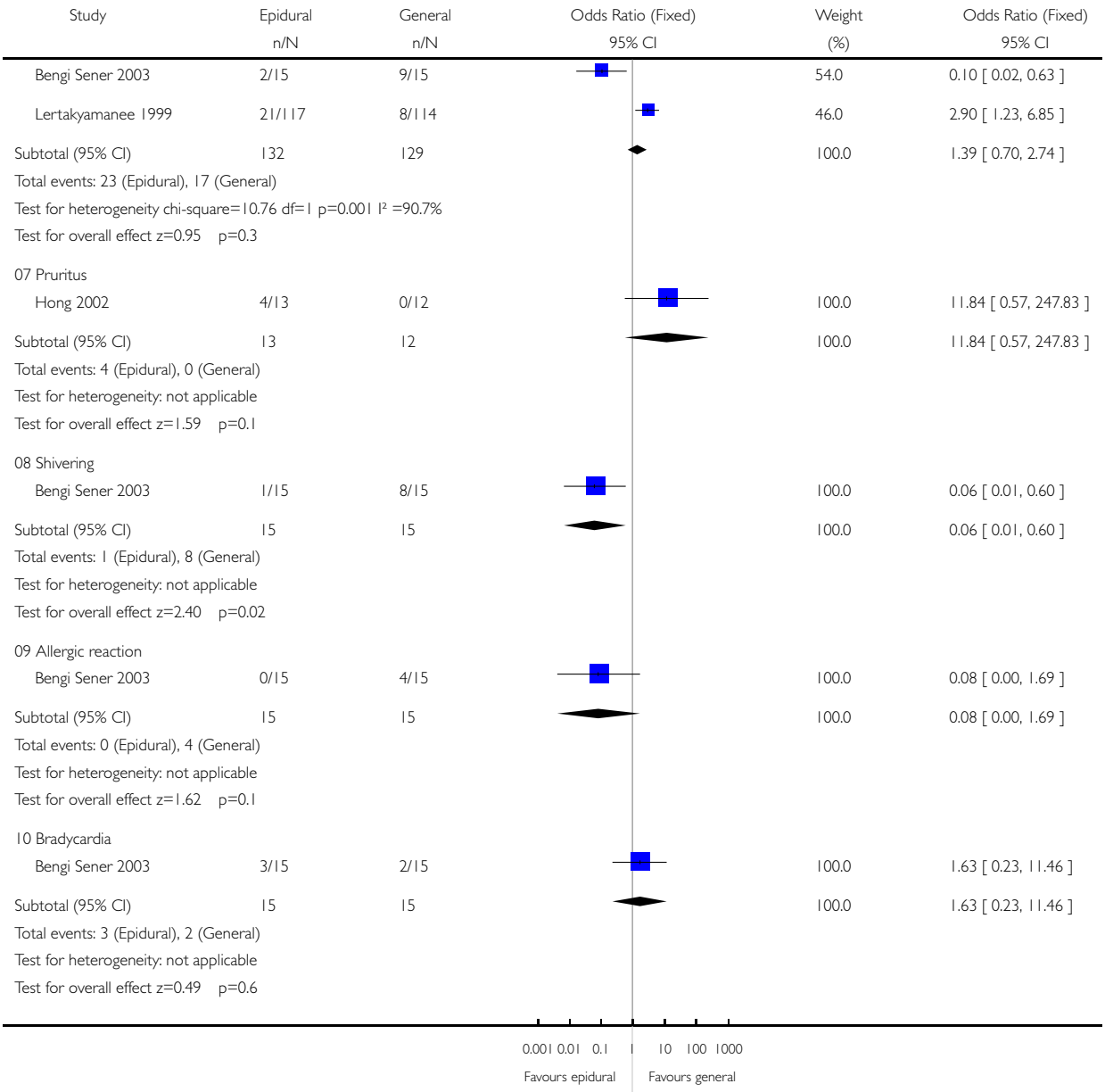
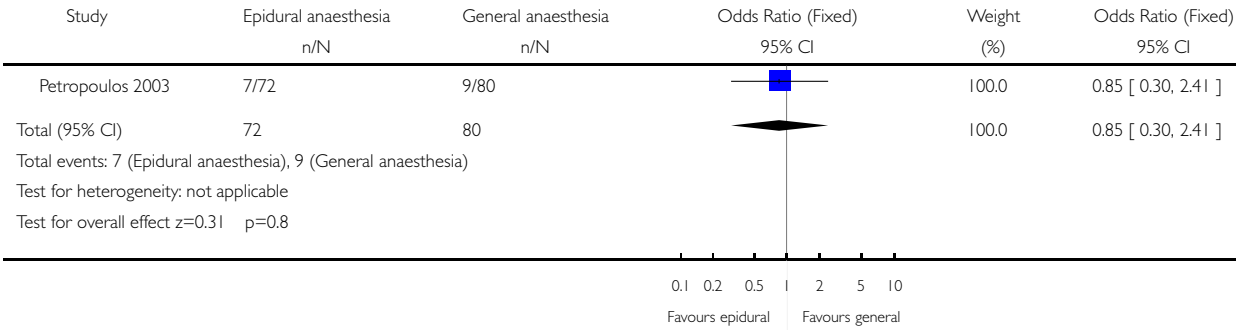


Analysis 01.19. Comparison 01 Epidural versus general anaesthesia, Outcome 19 Need for oxygen therapy or mask ventilation of the neonate

Review: Regional versus general anaesthesia for caesarean section

Comparison: 01 Epidural versus general anaesthesia

Outcome: 19 Need for oxygen therapy or mask ventilation of the neonate

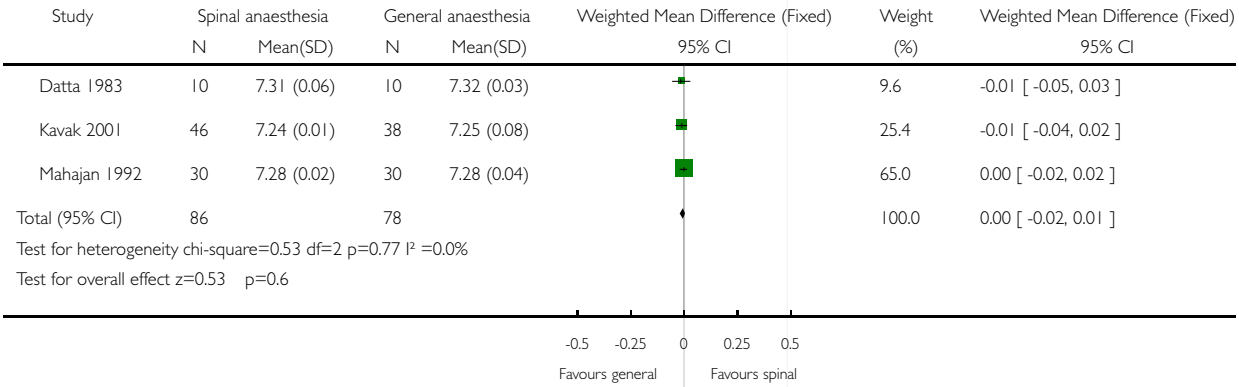


Analysis 02.01. Comparison 02 Spinal versus general anaesthesia, Outcome 01 Umbilical arterial pH

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 01 Umbilical arterial pH



Analysis 02.02. Comparison 02 Spinal versus general anaesthesia, Outcome 02 Umbilical venous pH

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 02 Umbilical venous pH

Study	Spinal anaesthesia		General anaesthesia		Weighted Mean Difference (Fixed)	Weight	Weighted Mean Difference (Fixed)
	N	Mean(SD)	N	Mean(SD)	95% CI	(%)	95% CI
Datta 1983	10	7.37 (0.03)	10	7.36 (0.03)		18.6	0.01 [-0.02, 0.04]
Kolatat 1999	118	7.30 (0.06)	103	7.29 (0.05)		61.2	0.01 [0.00, 0.02]
Mahajan 1992	30	7.34 (0.05)	30	7.33 (0.05)		20.1	0.01 [-0.02, 0.04]
Total (95% CI)	158		143			100.0	0.01 [0.00, 0.02]

Test for heterogeneity chi-square=0.00 df=2 p=1.00 I^2 =0.0%

Test for overall effect z=1.73 p=0.08

Analysis 02.03. Comparison 02 Spinal versus general anaesthesia, Outcome 03 Neonatal neurologic and adaptive capacity score at 2-4 hours

Review: Regional versus general anaesthesia for caesarean section

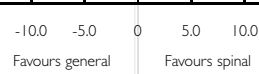
Comparison: 02 Spinal versus general anaesthesia

Outcome: 03 Neonatal neurologic and adaptive capacity score at 2-4 hours

Study	Spinal anaesthesia		General anaesthesia		Weighted Mean Difference (Fixed)	Weight	Weighted Mean Difference (Fixed)
	N	Mean(SD)	N	Mean(SD)	95% CI	(%)	95% CI
Kolatat 1999	118	34.80 (3.70)	103	34.40 (3.40)		100.0	0.40 [-0.54, 1.34]
Total (95% CI)	118		103			100.0	0.40 [-0.54, 1.34]

Test for heterogeneity: not applicable

Test for overall effect z=0.84 p=0.4



Analysis 02.04. Comparison 02 Spinal versus general anaesthesia, Outcome 04 Neonatal neurologic and adaptive capacity score of < 35 at 15 minutes

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 04 Neonatal neurologic and adaptive capacity score of < 35 at 15 minutes

Study	Spinal anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Mahajan 1992	3/30	18/30		100.0	0.07 [0.02, 0.30]
Total (95% CI)	30	30		100.0	0.07 [0.02, 0.30]

Total events: 3 (Spinal anaesthesia), 18 (General anaesthesia)

Test for heterogeneity: not applicable

Test for overall effect z=3.65 p=0.0003

Analysis 02.05. Comparison 02 Spinal versus general anaesthesia, Outcome 05 Neonatal neurologic and adaptive capacity score of < 35 at 2 hours

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 05 Neonatal neurologic and adaptive capacity score of < 35 at 2 hours

Study	Spinal anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Mahajan 1992	0/30	9/30		100.0	0.04 [0.00, 0.67]
Total (95% CI)	30	30		100.0	0.04 [0.00, 0.67]

Total events: 0 (Spinal anaesthesia), 9 (General anaesthesia)

Test for heterogeneity: not applicable

Test for overall effect z=2.23 p=0.03

Analysis 02.06. Comparison 02 Spinal versus general anaesthesia, Outcome 06 Neonatal neurologic and adaptive capacity score of < 35 at 24 hours

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 06 Neonatal neurologic and adaptive capacity score of < 35 at 24 hours

Study	Spinal anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
× Mahajan 1992	0/30	0/30		0.0	Not estimable
Total (95% CI)	30	30		0.0	Not estimable
Total events: 0 (Spinal anaesthesia), 0 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					

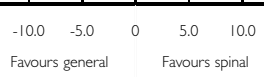
Analysis 02.07. Comparison 02 Spinal versus general anaesthesia, Outcome 07 Mean Apgar score at 1 minute

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 07 Mean Apgar score at 1 minute

Study	Spinal anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Standardised Mean Difference (Random) 95% CI	Weight (%)	Standardised Mean Difference (Random) 95% CI
Kavak 2001	46	8.86 (0.50)	38	8.70 (0.60)		47.3	0.29 [-0.14, 0.72]
Kolatat 1999	118	8.70 (0.60)	103	6.70 (2.80)		52.7	1.02 [0.74, 1.30]
Total (95% CI)	164		141			100.0	0.67 [-0.04, 1.38]
Test for heterogeneity chi-square=7.64 df=1 p=0.006 I^2 =86.9%							
Test for overall effect z=1.85 p=0.06							



Analysis 02.08. Comparison 02 Spinal versus general anaesthesia, Outcome 08 Mean Apgar score at 5 minutes

Review: Regional versus general anaesthesia for caesarean section

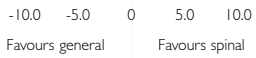
Comparison: 02 Spinal versus general anaesthesia

Outcome: 08 Mean Apgar score at 5 minutes

Study	Spinal anaesthesia		General anaesthesia		Weighted Mean Difference (Random)	Weight	Weighted Mean Difference (Random)
	N	Mean(SD)	N	Mean(SD)	95% CI	(%)	95% CI
Kavak 2001	46	9.90 (0.20)	38	9.90 (0.30)		53.6	0.00 [-0.11, 0.11]
Kolatat 1999	118	9.80 (0.70)	103	9.20 (1.60)		46.4	0.60 [0.27, 0.93]
Total (95% CI)	164		141			100.0	0.28 [-0.31, 0.87]

Test for heterogeneity chi-square=11.16 df=1 p=0.0008 I^2 =91.0%

Test for overall effect z=0.93 p=0.4



Analysis 02.09. Comparison 02 Spinal versus general anaesthesia, Outcome 09 Apgar score of 6 or less at 1 minute (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 09 Apgar score of 6 or less at 1 minute (not prespecified in protocol)

Study	Spinal anaesthesia	General anaesthesia	Odds Ratio (Fixed)	Weight	Odds Ratio (Fixed)
	n/N	n/N	95% CI	(%)	95% CI
Mahajan 1992	2/30	3/30		100.0	0.64 [0.10, 4.15]
Total (95% CI)	30	30		100.0	0.64 [0.10, 4.15]

Total events: 2 (Spinal anaesthesia), 3 (General anaesthesia)

Test for heterogeneity: not applicable

Test for overall effect z=0.46 p=0.6

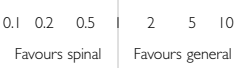
Analysis 02.10. Comparison 02 Spinal versus general anaesthesia, Outcome 10 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 10 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)

Study	Spinal anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
× Mahajan 1992	0/30	0/30		0.0	Not estimable
Total (95% CI)	30	30		0.0	Not estimable
Total events: 0 (Spinal anaesthesia), 0 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					



Analysis 02.11. Comparison 02 Spinal versus general anaesthesia, Outcome 11 Maternal estimated blood loss in ml

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 11 Maternal estimated blood loss in ml

Study	Spinal anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Standardised Mean Difference (Fixed) 95% CI	Weight (%)	Standardised Mean Difference (Fixed) 95% CI
Dyer 2003	35	394.00 (64.00)	35	446.00 (126.00)		25.5	-0.51 [-0.99, -0.04]
Lertakyamanee 1999	95	648.00 (312.00)	114	873.60 (403.10)		74.5	-0.62 [-0.90, -0.34]
Total (95% CI)	130		149			100.0	-0.59 [-0.83, -0.35]
Test for heterogeneity chi-square=0.13 df=1 p=0.72 I^2 =0.0%							
Test for overall effect z=4.81 p<0.00001							

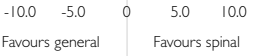
Analysis 02.12. Comparison 02 Spinal versus general anaesthesia, Outcome 12 Difference between pre and postoperative haematocrit

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 12 Difference between pre and postoperative haematocrit

Study	Spinal anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Lertakyamanee 1999	95	-2.00 (5.30)	114	-5.10 (4.70)		100.0	3.10 [1.73, 4.47]
Total (95% CI)	95		114			100.0	3.10 [1.73, 4.47]
Test for heterogeneity: not applicable							
Test for overall effect z=4.43 p<0.00001							



Analysis 02.13. Comparison 02 Spinal versus general anaesthesia, Outcome 13 Number who received postoperative blood transfusion (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 13 Number who received postoperative blood transfusion (not prespecified in protocol)

Study	Spinal anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Lertakyamanee 1999	2/95	8/114		100.0	0.28 [0.06, 1.38]
Total (95% CI)	95	114		100.0	0.28 [0.06, 1.38]
Total events: 2 (Spinal anaesthesia), 8 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.56 p=0.1					

Analysis 02.14. Comparison 02 Spinal versus general anaesthesia, Outcome 14 Number who would prefer the same technique again

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 14 Number who would prefer the same technique again

Study	Spinal anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Lertakyamanee 1999	76/118	83/103		100.0	0.44 [0.24, 0.81]
Total (95% CI)	118	103		100.0	0.44 [0.24, 0.81]
Total events: 76 (Spinal anaesthesia), 83 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=2.64 p=0.008					

Analysis 02.15. Comparison 02 Spinal versus general anaesthesia, Outcome 15 Satisfaction score on visual analogue scale

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 15 Satisfaction score on visual analogue scale

Study	Spinal anaesthesia N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Lertakyamanee 1999	118	7.49 (2.95)	103	8.07 (2.22)		100.0	-0.58 [-1.26, 0.10]
Total (95% CI)	118		103			100.0	-0.58 [-1.26, 0.10]
Test for heterogeneity: not applicable							
Test for overall effect z=1.66 p=0.1							

Analysis 02.16. Comparison 02 Spinal versus general anaesthesia, Outcome 16 Adverse events

Review: Regional versus general anaesthesia for caesarean section

Comparison: 02 Spinal versus general anaesthesia

Outcome: 16 Adverse events

Study	Spinal anaesthesia n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
01 Nausea					
Lertakyamanee 1999	49/95	5/114		100.0	23.22 [8.69, 62.03]
Subtotal (95% CI)	95	114		100.0	23.22 [8.69, 62.03]
Total events: 49 (Spinal anaesthesia), 5 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=6.27 p<0.00001					
02 Vomiting					
Lertakyamanee 1999	33/95	8/114		100.0	7.05 [3.06, 16.23]
Subtotal (95% CI)	95	114		100.0	7.05 [3.06, 16.23]
Total events: 33 (Spinal anaesthesia), 8 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=4.59 p<0.00001					

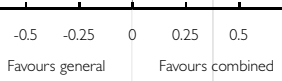
Analysis 03.01. Comparison 03 Combined spinal-epidural versus general anaesthesia, Outcome 01 Umbilical arterial pH

Review: Regional versus general anaesthesia for caesarean section

Comparison: 03 Combined spinal-epidural versus general anaesthesia

Outcome: 01 Umbilical arterial pH

Study	Combined regional N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Petropoulos 2003	78	7.26 (0.06)	80	7.29 (0.02)		78.7	-0.03 [-0.04, -0.02]
Wallace 1995	27	7.27 (0.05)	26	7.30 (0.05)		21.3	-0.03 [-0.06, 0.00]
Total (95% CI)	105		106			100.0	-0.03 [-0.04, -0.02]
Test for heterogeneity chi-square=0.00 df=1 p=1.00 I^2 =0.0%							
Test for overall effect z=4.73 p<0.00001							



Analysis 03.02. Comparison 03 Combined spinal-epidural versus general anaesthesia, Outcome 02 Apgar score of 6 or less at 1 minute (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 03 Combined spinal-epidural versus general anaesthesia

Outcome: 02 Apgar score of 6 or less at 1 minute (not prespecified in protocol)

Study	Combined regional n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Petropoulos 2003	4/78	5/80		70.5	0.81 [0.21, 3.14]
Wallace 1995	1/27	2/26		29.5	0.46 [0.04, 5.42]
Total (95% CI)	105	106		100.0	0.71 [0.22, 2.30]

Total events: 5 (Combined regional), 7 (General anaesthesia)

Test for heterogeneity chi-square=0.15 df=1 p=0.69 I^2 =0.0%

Test for overall effect z=0.57 p=0.6

Analysis 03.03. Comparison 03 Combined spinal-epidural versus general anaesthesia, Outcome 03 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)

Review: Regional versus general anaesthesia for caesarean section

Comparison: 03 Combined spinal-epidural versus general anaesthesia

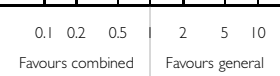
Outcome: 03 Apgar score of 6 or less at 5 minutes (not prespecified in protocol)

Study	Combined regional n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Petropoulos 2003	2/78	3/80		41.0	0.68 [0.11, 4.16]
Wallace 1995	5/27	5/26		59.0	0.95 [0.24, 3.78]
Total (95% CI)	105	106		100.0	0.84 [0.28, 2.51]

Total events: 7 (Combined regional), 8 (General anaesthesia)

Test for heterogeneity chi-square=0.09 df=1 p=0.77 I^2 =0.0%

Test for overall effect z=0.31 p=0.8



Analysis 03.04. Comparison 03 Combined spinal-epidural versus general anaesthesia, Outcome 04 Need for oxygen therapy or mask ventilation of neonate

Review: Regional versus general anaesthesia for caesarean section

Comparison: 03 Combined spinal-epidural versus general anaesthesia

Outcome: 04 Need for oxygen therapy or mask ventilation of neonate

Study	Combined regional n/N	General anaesthesia n/N	Odds Ratio (Fixed) 95% CI	Weight (%)	Odds Ratio (Fixed) 95% CI
Petropoulos 2003	10/78	9/80		100.0	1.16 [0.44, 3.03]
Total (95% CI)	78	80		100.0	1.16 [0.44, 3.03]
Total events: 10 (Combined regional), 9 (General anaesthesia)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.30 p=0.8					

Analysis 03.05. Comparison 03 Combined spinal-epidural versus general anaesthesia, Outcome 05 Mean Apgar score at 1 minute

Review: Regional versus general anaesthesia for caesarean section

Comparison: 03 Combined spinal-epidural versus general anaesthesia

Outcome: 05 Mean Apgar score at 1 minute

Study	Combined regional N	Mean(SD)	General anaesthesia N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Korkmaz 2004	15	8.25 (0.62)	15	8.00 (0.45)		100.0	0.25 [-0.14, 0.64]
Total (95% CI)	15		15			100.0	0.25 [-0.14, 0.64]
Test for heterogeneity: not applicable							
Test for overall effect z=1.26 p=0.2							

Analysis 03.06. Comparison 03 Combined spinal-epidural versus general anaesthesia, Outcome 06 Mean Apgar score at 5 minutes

Review: Regional versus general anaesthesia for caesarean section

Comparison: 03 Combined spinal-epidural versus general anaesthesia

Outcome: 06 Mean Apgar score at 5 minutes

Study	Combined regional		General anaesthesia		Weighted Mean Difference (Fixed)	Weight	Weighted Mean Difference (Fixed)
	N	Mean(SD)	N	Mean(SD)	95% CI	(%)	95% CI
× Korkmaz 2004	15	10.00 (0.00)	15	9.91 (0.30)		0.0	Not estimable
Total (95% CI)	15		15			0.0	Not estimable
Test for heterogeneity: not applicable							
Test for overall effect: not applicable