Maternal position during caesarean section for preventing maternal and neonatal complications (Review)

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[Intervention Review]

Maternal position during caesarean section for preventing maternal and neonatal complications

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ABSTRACT

Background

During caesarean section mothers can be in different positions. Theatre tables could be tilted laterally, upwards, downwards or flexed and wedges or cushions could be used. There is no consensus on the best positioning at present.

Objectives

We assessed all available data on positioning of the mother to determine if there is an ideal position during caesarean section that would improve outcomes.

Search strategy

We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (September 2009), PubMed (1966 to 14 September 2009) and manually searched the references of retrieved articles.

Selection criteria

Randomised trials of woman undergoing caesarean section comparing different positions.

Data collection and analysis

Two authors assessed eligibility, trial quality and extracted data.

Main results

We identified 17 studies with a total of 683 woman included. We included nine studies and excluded eight studies. Included trials were of variably quality with small sample sizes. Most comparisons had data from single trials. This is a shortcoming and applicability of results is limited.

The incidence of air embolism was not affected by head up versus horizontal position (risk ratio (RR) 0.91; 95% confidence interval (CI) 0.65 to 1.26). We found no change in hypotensive episodes when comparing left lateral tilt (RR 0.11; 95% CI 0.01 to 1.94), right

lateral tilt (RR 1.25; 95% CI 0.39 to 3.99) and head down tilt (mean difference (MD) -3.00; 95% CI -8.38 to 2.38) with horizontal positions or full lateral tilt with 15-degree tilt (RR 1.20; 95% CI 0.80 to 1.79). Hypotensive episodes were decreased with manual displacers (RR 0.11; 95% CI 0.03 to 0.45), a right lumbar wedge compared to a right pelvic wedge (RR 1.64; 95% CI 1.07 to 2.53) and increased in right lateral tilt (RR 3.30; 95% CI 1.20 to 9.08) versus left lateral tilt.

Position did not affect systolic blood pressure when comparing left lateral tilt (MD 2.70; 95% CI -1.47 to 6.87) or head down tilt (RR 1.07; 95% CI 0.81 to 1.42) to horizontal positions, or full lateral tilt with 15-degree tilt (MD -5.00; 95% CI -11.45 to 1.45). Manual displacers showed decreased fall in mean systolic blood pressure compared to left lateral tilt (MD -8.80; 95% CI -13.08 to -4.52).

Position did not affect diastolic blood pressures when comparing left lateral tilt versus horizontal positions. (MD-1.90; 95% CI -5.28 to 1.48). The mean diastolic pressure was lower in head down tilt (MD -7.00; 95% CI -12.05 to -1.95) when compared to horizontal positions.

There were no statistically significant changes in maternal pulse rate, five-minute Apgars, maternal blood pH or cord blood pH when comparing different positions.

Authors' conclusions

There is limited evidence to support or clearly disprove the value of the use of tilting or flexing the table, the use of wedges and cushions or the use of mechanical displacers. Larger studies are needed.

PLAIN LANGUAGE SUMMARY

Comparison of different positions that a mother is placed in during caesarean section to improve outcomes for both the mother and her newborn

Caesarean section is an operation that is performed on many pregnant woman to deliver the baby. During caesarean section the mother can be placed in a number of positions on the theatre table. Cushions and wedges can also be used to alter her position on the table and devices can also be used to displace the uterus laterally. This review aimed to assess the best position for the mother to be in during the surgery.

The review authors identified nine randomised controlled trials with a total of 683 woman included and found that there is little difference from them to support or disprove the use of different positions, cushions, wedges or displacers. No studies assessed the impact of position on the risk of surgical complications.

More studies are needed on this topic.

BACKGROUND

Description of the condition

Caesarean section (CS) is an operation that is performed on a pregnant woman to deliver her baby by a surgical incision through the anterior abdominal wall and uterus. CS is the most common major surgical procedure performed on women and over the past years the rate of CS has dramatically increased. Global estimates indicate a CS rate of 15% worldwide, ranging from nearly 4% in Africa to 29% in Latin America and the Caribbean (Betran 2007). The preliminary data released by the National Center for Health Statistics in the United States report a national caesarean section rate of 31% for 2006. The 2005 World Health Organization global survey which was done in 24 geographic areas and eight countries in Latin America showed a median CS rate of 33% (Villar 2006).

Description of the intervention

During a CS the mother can be placed in a number of positions. For example, the theatre table can be tilted laterally to the right or left and the head can be tilted upwards or downwards or the table can be flexed. Wedges and cushions can also be placed under the

woman to alter the position. These are commonly placed under the left or right side of the mother to tilt her laterally or under her head or legs to tilt the head or legs upwards.

Some obstetricians and anaesthetists believe that adjusting the position of the woman may improve the outcome for both the mother and baby. The theory behind this is based on beliefs that tilting the table laterally may prevent aortocaval compression; tilting the head of the table downwards may reduce the extent to which the bowel descends into the operative field; and tilting the head upwards may reduce the incidence of air embolism. Other practitioners believe that there is no difference and that tilting the bed actually makes the surgery more difficult.

How the intervention might work

Aortocaval compression occurs during late pregnancy when the uterus compresses the aorta or inferior vena cava, or both. Such compression may produce potentially adverse physiological disturbances in both the mother and the baby. Although initially thought to be a problem confined to the supine position, aortocaval compression has also been shown in standing and semirecumbent positions (Kinsella 1992) and following spinal anaesthesia, even a true 15º left table tilt position may be associated with aortic compression (Rees 2002). The effects of such compression are thought to be exacerbated during regional anaesthesia and labour. Obstetricians and anaesthetists have traditionally sought to reduce these disturbances by tilting the mother away from the supine position and in many centres it is routine practice for women to be placed immediately in a left tilted position following insertion of spinal anaesthesia for CS. The tilted position is a compromise between the need for easy surgical access and the avoidance of aortocaval compression, and there is no consensus on whether tilting the table improves maternal or neonatal outcome. Using wedges to tilt the mother may reduce aortocaval compression, but could also be associated with other complications such as reversible sciatic nerve compression neuropathy (Postaci 2006). Tilting and changing the position of the table may make the operation more difficult for the surgeon and could increase the chances of injury to the mother. It may also increase the time it takes to do the surgery and therefore increase the risk of sepsis and other complications for the mother. Venous embolism (most commonly air) can occur during any surgical procedure if the operative field is above the level of the heart. They occur frequently with the woman in the horizontal position during caesarean section (Fong 1991) and theoretically raising the level of the heart above the operative site could decrease the incidence of air entrainment. Some studies have shown that the use of a flexed 5º to 10º head-up tilt did not decrease the incidence of venous embolism (Karuparthy 1989) while others have shown a decrease in the rate of embolism (Robinson 1987). Whether all these air embolisms are clinically significant is still uncertain.

Why it is important to do this review

At present there is no consensus on the best positioning for the mother during CS. The purpose of this review is to assess all available data on positioning of the mother and to determine if there is an ideal position for the mother during CS that will improve the outcome for both the mother and child.

OBJECTIVES

To determine, from the best available evidence, the optimal positioning of the mother during a caesarean section to improve outcomes for both the mother and the baby.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) only. We would have included cluster-randomised trials, but we identified none. We excluded crossover trials and quasi RCTs.

Types of participants

Women undergoing CS.

Types of interventions

Various positions of the mother compared with a neutral supine position or alternative positions, including:

1. lateral tilt;
2. head raised;
3. head lowered;
4. table flexed;
5. wedges and cushions.

Types of outcome measures

Primary outcomes

1. Air embolisms;
2. maternal hypotension as defined by trial author;
3. maternal hypertension as defined by trial authors

Secondary outcomes

1. Maternal morbidity (defined as any Illness or disability occurring as a result of or in relation to pregnancy and childbirth);
2. neonatal morbidity (defined as any illness or disability occurring within the first 28 days of life including any grade of hypoxic Ischaemic encephalopathy and admission to neonatal intensive care);
3. maternal mortality;
4. neonatal mortality:
5. maternal pulse rate changes as defined by trial authors;
6. changes in maternal blood gas values as defined by trial author;
7. cord blood gas pH or pH less than 7.2 or low pH as defined by trial author;
8. five-minute Apgar score less than seven or low Apgar score at five minutes as defined by trial authors;
9. maternal blood loss;
10. postoperative recovery;
11. complications (defined as any maternal complication arising from the delivery up until 6 weeks post partum);
12. breastfeeding;
13. patient satisfaction;
14. caregiver satisfaction;
15. cost.

Search methods for identification of studies

Electronic searches

We contacted the Trials Search Co-ordinator to search the Cochrane Pregnancy and Childbirth Group's Trials Register (September 2009).
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. weekly searches of MEDLINE;
3. handsearches of 30 journals and the proceedings of major conferences;
4. weekly current awareness alerts for a further 44 journals plus monthly BioMed Central email alerts.

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 'Specialized Register' section within the editorial information about the Cochrane Pregnancy and Childbirth Group.
Trials identified through the searching activities described above are each assigned to a review topic (or topics). The Trials Search Co-ordinator searches the register for each review using the topic list rather than keywords.
In addition, we searched PubMed (1966 to 14 September 2009) using the strategy given in Appendix 1.

Searching other resources

We manually searched the reference lists of relevant articles.
We did not apply any language restrictions.

Data collection and analysis

Selection of studies

Two review authors independently assessed for inclusion all the potential studies we identified as a result of the search strategy. We resolved any disagreement through discussion with the third author.

Data extraction and management

We designed a form to extract data. For eligible studies two review authors extracted the data using the agreed form. We resolved any discrepancies through discussion between authors. We entered the data into the Review Manager software (RevMan 2008) and checked them for accuracy.
We did contact authors of the original reports to provide further details.
We identified no studies that had high levels of missing data that could have been included.

Assessment of risk of bias in included studies

Two review authors independently assessed risk of bias for each study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2008). We resolved any disagreement by discussion or by involving the third author.

(1) Sequence generation (checking for possible selection bias)

We described for each included study the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups.
We assessed the method as:

- adequate (any truly random process, e.g. random number table; computer random number generator);
- inadequate (any non-random process, e.g. odd or even date of birth; hospital or clinic record number); or
- unclear.

(2) Allocation concealment (checking for possible selection bias)

We described for each included study the method used to conceal the allocation sequence in sufficient detail and determined whether intervention allocation would have been foreseen in advance of, or during recruitment, or changed after assignment.
We assessed the methods as:

- adequate (e.g. telephone or central randomisation; consecutively numbered sealed opaque envelopes);
- inadequate (open random allocation; unsealed or non-opaque envelopes, alternation; date of birth);
- unclear.

(3) Blinding (checking for possible performance bias)

We described for each included study the methods used, if any, to blind study participants and personnel from knowledge of which intervention a participant received. We judged studies at low risk of bias if they were blinded, or if we judged that the lack of blinding could not have affected the results. We assessed blinding separately for different outcomes or classes of outcomes.
We assessed the methods as:

- adequate, inadequate or unclear for participants;
- adequate, inadequate or unclear for personnel;
- adequate, inadequate or unclear for outcome assessors.

(4) Incomplete outcome data (checking for possible attrition bias through withdrawals, dropouts, protocol deviations)

We described for each included study, and for each outcome or class of outcomes, the completeness of data including attrition and exclusions from the analysis. We stated whether attrition and exclusions were reported, the numbers included in the analysis at each stage (compared with the total randomised participants), reasons for attrition or exclusion where reported, and whether missing data was balanced across groups or was related to outcomes. Where sufficient information was reported, or could be supplied by the trial authors, we re-included missing data in the analyses which we undertook. We assessed methods as:

- adequate; (less than 20% of data is missing);
- inadequate:(more than 20% of data is missing);
- unclear.

(5) Selective reporting bias

We described for each included study how we investigated the possibility of selective outcome reporting bias and what we found. We assessed the methods as:

- adequate (where it was clear that all of the study's pre-specified outcomes and all expected outcomes of interest to the review had been reported);
- inadequate (where not all the study's pre-specified outcomes had been reported; one or more reported primary outcomes were not pre-specified; outcomes of interest were reported incompletely and so could not be used; study failed to include results of a key outcome that would have been expected to have been reported);
- unclear.

(6) Other sources of bias

We described for each included study any important concerns we had about other possible sources of bias.
We assessed whether each study was free of other problems that could put it at risk of bias:

- yes;
- no;
- unclear.

(7) Overall risk of bias

We made explicit judgements about whether studies were at high risk of bias, according to the criteria given in the *Handbook* (Higgins 2008). With reference to (1) to (6) above, we assessed the likely magnitude and direction of the bias and whether we considered it as likely to impact on the findings. We explored the impact of the level of bias through undertaking sensitivity analyses - *see* Sensitivity analysis.

Measures of treatment effect

Dichotomous data

For dichotomous data, we presented results as summary risk ratio (RR) with 95% confidence intervals (CI).

Continuous data

For continuous data, we used the mean difference if outcomes were measured in the same way between trials.

Dealing with missing data

For included studies, we noted levels of attrition. We did not need to explore the impact of including studies with high levels of missing data in the overall assessment of treatment effect by using sensitivity analysis.
For all outcomes, we carried out analyses on an intention-to-treat basis, i.e. we attempted to include all participants randomised to each group in the analyses. The denominator for each outcome in each trial was the number randomised minus any participants whose outcomes are known to be missing.

Assessment of heterogeneity

We identified substantial heterogeneity (exceeding 50%) in one outcome (Analysis 7.1). We would have investigated this by subgroup analysis but, due to the fact that there were only two studies in this analysis, we did not do so. The summary of effects may not be meaningful for this outcome.

Assessment of reporting biases

We did not suspect reporting bias. If we had we would have attempted to contact study authors asking them to provide missing outcome data. Where this was not possible, and the missing data were thought to introduce serious bias, we would have explored the impact of including such studies in the overall assessment of results by a sensitivity analysis**.**

Data synthesis

We carried out statistical analysis using the Review Manager software (RevMan 2008). We used fixed-effect inverse variance meta-analysis for combining data where trials examined the same intervention, and the trials' populations and methods were judged sufficiently similar. We did not suspect clinical or methodological heterogeneity between studies sufficient to suggest that treatment effects may differ between trials, therefore we did not use random-effects meta-analysis.

We identified no substantial heterogeneity in a fixed-effect meta-analysis, therefore we have not repeated the analysis using a random-effects method.

Subgroup analysis and investigation of heterogeneity

We planned to carry out the following subgroup analyses but were unable to due to the small number of trials and the small sample sizes:

1. caesarean section elective, in labour, or mixed or not stated;
2. fetal presentations (breech, transverse and cephalic);
3. single and multiple pregnancies;
4. fetal gestation;
5. anaesthesia, general, regional or mixed or not stated.

For fixed-effect meta-analyses we would have conducted planned subgroup analyses classifying whole trials by interaction tests as described by Deeks 2001. For random-effects meta-analyses we would have assessed differences between subgroups by inspection of the subgroups' confidence intervals; non-overlapping confidence intervals indicate a statistically significant difference in treatment effect between the subgroups.

Sensitivity analysis

We would have excluded trials with inadequate or unclear allocation concealment to assess the effect on the findings if there were more trials with larger sample sizes.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

Results of the search

We identified 17 studies and included nine studies (*see* Characteristics of included studies). We excluded seven studies (*see* Characteristics of excluded studies). The total number of woman included was 683.

Risk of bias in included studies

Kundra 2007 used computer-generated numbers and sealed envelopes. Rees 2002 and Zhou 2008 used number lists with sealed envelopes. Karuparthy 1989 and Matorras 1998 used number tables. Lew 1993 randomised participants by the drawing of lots and Brock-Utne 1978, Miyabe 1997 and Zheng 2001 used the word 'random' to refer to allocation without specifying the mechanism. Concealment of allocation was thus not optimal in most of the trials.

Blinding of the surgeon and anaesthetist after allocation was difficult as it compared different positions. Kundra 2007 blinded the attending anaesthetist to the haemodynamic parameters and the attending paediatrician to the allocated groups. The other studies do not mention any forms of blinding.

Brock-Utne 1978 reported that four patients had severe hypotension and excluded these patients. We re-included these patients in our data extraction in the relevant group.

Two woman were withdrawn after allocation due to anaesthetic complications in the Rees 2002 study. It is unlikely that this affected the results of this trial materially.

See Figure 1 and Figure 2.

Figure 1. Methodological quality graph: review authors' judgments about each methodological quality item presented as percentages across all included studies.

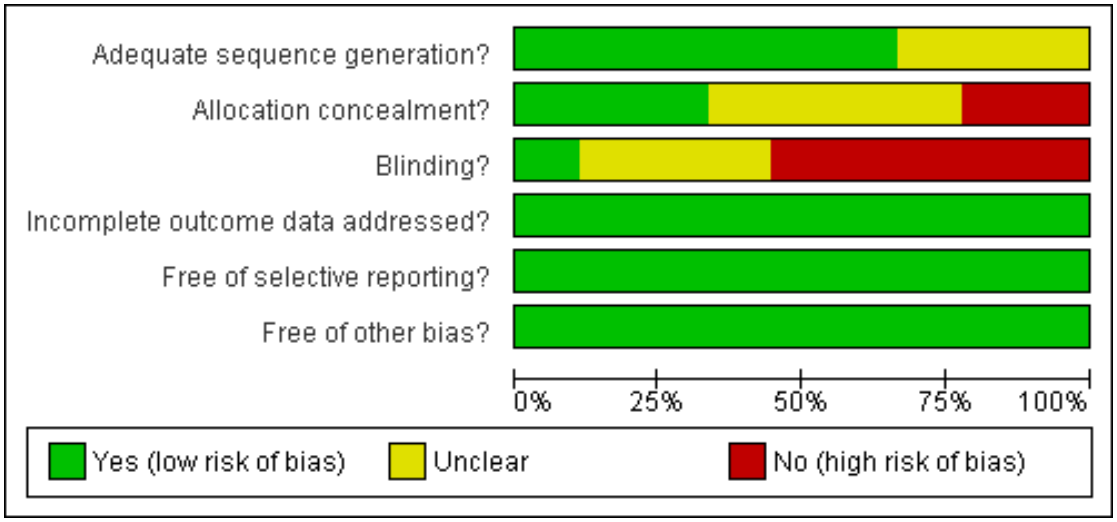
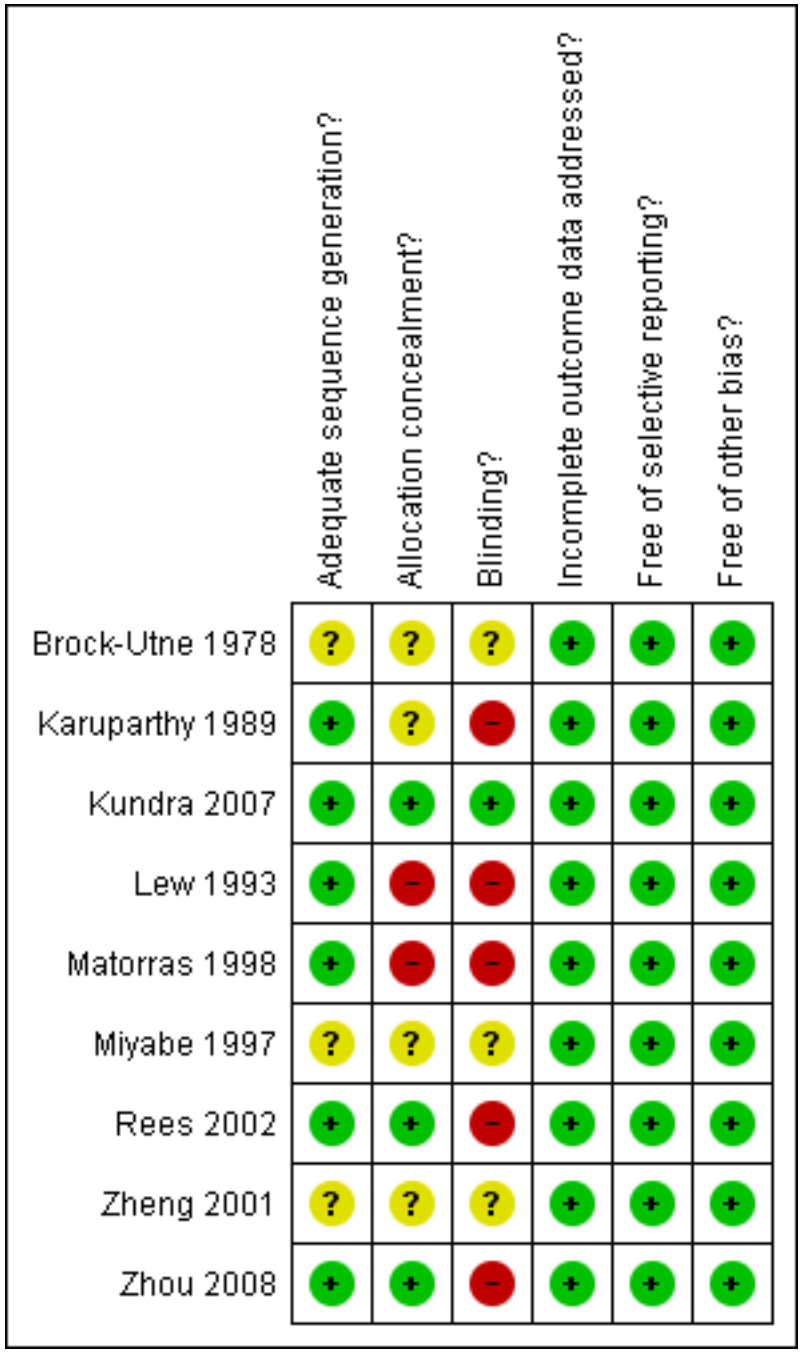


Figure 2. Methodological quality summary: review authors' judgments about each methodological quality item for each included study.



Effects of interventions

20° left lateral tilt versus horizontal position

Maternal position did not influence the incidence of hypotension when comparing a 20° left lateral tilt versus a horizontal position (RR 0.11; 95% CI 0.01 to 1.94, Analysis 1.1).

There were no changes in systolic and diastolic blood pressures when comparing a 20° left lateral tilt versus a horizontal position (mean difference (MD) 2.70 mmHg; 95% CI -1.47 to 6.87, Analysis 1.2) (MD -1.90 mmHg: 95% CI -5.28 to 1.48, Analysis 1.3).

One trial showed no statistical difference when comparing a 20° lateral tilt to the supine position five minutes after spinal anaesthesia for maternal pulse rate changes (MD 2.50; 95% CI -1.86 to 6.86, Analysis 1.4) or five minute Apgar scores (RR 0.98; 95% CI 0.25 to 3.81, Analysis 1.5) or cord blood pH less than 7.2 (RR 1.06; 95% CI 0.66 to 1.69, Analysis 1.6), or in cord blood pH (MD 0.01; 95% CI -0.01 to 0.03, Analysis 1.7) .

Full left lateral tilt versus a 15° left lateral tilt

Maternal position did not influence the incidence of hypotension when comparing a full lateral tilt versus a 15° tilt (RR 1.20; 95% CI 0.80 to 1.79, Analysis 2.1).

There were no changes in systolic and diastolic blood pressures when comparing a full lateral tilt to a 15° tilt (MD -5.00 mmHg; 95% CI -11.45 to 1.45, Analysis 2.2).

Right lateral tilt versus horizontal position

Maternal position did not influence the incidence of hypotension when comparing a right lateral tilt versus a horizontal position (RR 1.25; 95% CI 0.39 to 3.99, Analysis 3.1).

Right lateral tilt versus left lateral tilt

When a right lateral tilt was compared to a left lateral tilt the number of hypotensive events was higher in the right lateral tilt group (RR 3.30; 95% CI 1.20 to 9.08, Analysis 4.1). There was no statistical difference in the incidence of hypertensive events in this trial (RR 3.52; 95% CI 0.41 to 30.14, Analysis 4.2).

There was a statistical difference in maternal blood gas pH values (MD -0.40; 95% CI -0.72 to -0.08, Analysis 4.3).

There was a statistically significant difference in umbilical artery cord blood gas pH (MD 1.80; 95% CI 1.34 to 2.26, Analysis 4.4) and in umbilical venous cord blood gas pH values (MD 2.90; 95% CI 2.33 to 3.47, Analysis 4.5) when a left lateral tilt was compared to a right lateral tilt.

Manual displacer versus 15° left lateral tilt

When a manual displacer was compared with a 15° left lateral tilt it was found that the incidence of hypotensive events was lower in the manual displacer group (two events versus 18 events) (RR 0.11; 95% CI 0.03 to 0.45, Analysis 5.1) and that there was a lower fall in mean systolic blood pressure in the manual displacer group (MD -8.80 mmHg; 95% CI -13.08 to -4.52, Analysis 5.2). There were no maternal mortalities in either group.

10° head down tilt versus horizontal position

When a 10° head down tilt was compared with the horizontal position there was no difference in the incidence of hypotension (RR 1.07; 95% CI 0.81 to 1.42, Analysis 6.1) or in changes in systolic blood pressure (MD -3.00 mmHg; 95% CI -8.38 to 2.38, Analysis 6.2), but there was a statistically significant difference in diastolic blood pressure. The mean diastolic pressure was lower in the head down tilt group (MD -7.00 mmHg; 95% CI -12.05 to -1.95, Analysis 6.3).

5° to 10° head up tilt versus horizontal position

The incidence of air embolisms was not affected by a head up tilt versus a horizontal position. (RR 0.91; 95% CI 0.65 to 1.26), *see* Analysis 7.1. There is significant heterogeneity in this analysis. This may be due to how an episode of an air embolism was diagnosed.

12 cm right pelvic wedge versus 12 cm right lumbar wedge

There were fewer hypotensive events when using a 12 cm lumbar wedge compared to a 12 cm pelvic wedge (RR 1.64; 95% CI 1.07 to 2.53 Analysis 8.1).

There was no statistical difference in cord blood pH values (MD -0.00; 95% CI -0.01, 0.00, Analysis 8.2).

Secondary outcomes

No studies reported on maternal morbidity, neonatal morbidity, neonatal mortality, maternal blood loss, postoperative recovery, complications, breastfeeding, patient satisfaction, caregiver satisfaction or cost.

DISCUSSION

Summary of main results

The review is based on limited evidence and this limits the applicability of the results. We assessed only 17 studies for inclusion, of which we included only nine. The total number of women included in this review is 713.

The methodological quality of the included studies was satisfactory, although the data reported in the included trials were limited.

No studies reported on maternal morbidity, neonatal morbidity, neonatal mortality, maternal blood loss, postoperative recovery, complications, breastfeeding, patient satisfaction, caregiver satisfaction or cost.

All the analyses are based on a small number of women and only one analysis is based on more than one study.

There were two studies that compared a 20º left lateral tilt versus horizontal position. One study with only 20 participants showed that maternal position did not influence the incidence of hypotension. The other study with 204 participants showed that there were no statistically significant changes in systolic and diastolic blood pressures.

One study with 28 participants compared a full left lateral tilt to a 15º left lateral tilt. Here maternal position did not influence the incidence of hypotension and there were no statistically significant changes in systolic and diastolic blood pressures.

When a right lateral tilt was compared to a horizontal position, one trial with 40 participants found that maternal position did not influence the incidence of hypotension.

When a right lateral tilt was compared to a left lateral tilt the number of hypotensive events was higher in the right lateral tilt group and there was no statistical difference in the incidence of hypertensive events in this single trial of 79 woman.

A single trial with 90 participants compared a manual displacer compared with a 15º left lateral tilt. The incidence of hypotensive events was lower in the manual displacer group (two events versus 18 events) and that there was a lower fall in mean systolic blood pressure in the manual displacer group. More trials are needed before this intervention can be recommended.

When a 10º head down tilt was compared with the horizontal position there was no difference in the incidence of hypotension or in changes in systolic blood pressure but there was a statistically significant difference in diastolic blood pressure. The mean diastolic pressure was lower in the head down tilt group (MD -7.00 mmHg; 95% CI -12.05 to -1.95, Analysis 6.3).

Two studies, with a total number of 130 participants, evaluated the incidence of air embolisms. The incidence of air embolisms was not affected by a head up tilt versus a horizontal position. There was significant heterogeneity in this analysis and this is most likely due to the method used to diagnose an air embolism. One study (Karuparthy 1989) with 100 participants used a Doppler ultrasound transducer to diagnose air embolisms. The second trial (Lew 1993) with 30 participants diagnosed air embolisms by an increased expired nitrogen concentration.

One study with 60 participants compared a 12cm right pelvic wedge versus a right lumbar wedge. There were fewer hypotensive events when using a 12 cm lumbar wedge compared to a 12 cm pelvic wedge but again this was a very small sample size and based on only one trial.

No studies have assessed the impact of position on the risk for surgical complications.

There were insufficient studies to do the planned subgroup analyses.

Overall completeness and applicability of evidence

Small sample size is a serious shortcoming in all of the outcomes, particularly as most of the results were 'No difference'. It is quite possible that important differences were missed because of inadequate sample sizes. For this reason applicability of the results is limited.

The effect of position may also vary with different clinical situations, for example aortocaval compression may be more problematic in woman with multiple pregnancy, macrosomia or polyhydramnios.

Quality of the evidence

The findings must be interpreted with care because of variable trial quality, small numbers studied and each comparison had data from a single trial only.

Potential biases in the review process

None known.

Agreements and disagreements with other studies or reviews

No other reviews or studies on this topic have been identified.

AUTHORS' CONCLUSIONS

Implications for practice

There is limited evidence to support or clearly disprove the value of the use of left lateral tilt, right lateral tilt, head up or head down position, the use of wedges and cushions, flexion of the table or the use of a mechanical displacer.

Implications for research

Larger studies are needed to determine possible benefits and risk for various positions with greater certainty.

ACKNOWLEDGEMENTS

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We thank Richard Sidaway for the translation of Amaro 1998, and Lixia Dou, for the translation of Zheng 2001.

As part of the pre-publication editorial process, this review has been commented on by two peers (an editor and referee who is external to the editorial team), a member of the Pregnancy and Childbirth Group's international panel of consumers and the Group's Statistical Adviser.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Brock-Utne 1978

Methods	Randomly allocated.
Participants	79 participants (42 intervention, 37 in control) who underwent elective CS.
Interventions	Intervention: 15º tilt to the right with a wedge. Control: 15º tilt to the left with a wedge.
Outcomes	Maternal hypertension and hypotension.
Notes	Data have been revised to include 4 woman who were initially excluded due to the fact that they developed hypotension. Included term patients with good placental function and intact membranes with singleton pregnancies. Excluded obese patients.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Author emailed, no response.
Allocation concealment?	Unclear	Author emailed, no response.
Blinding? All outcomes	Unclear	Author emailed, no response.
Incomplete outcome data addressed? All outcomes	Yes	
Free of selective reporting?	Yes	
Free of other bias?	Yes	

Karuparthy 1989

Methods	Randomised controlled trial.
Participants	100 participants (50 intervention, 50 control) undergoing elective or emergent CS.
Interventions	Intervention: 5° to 10° head up tilt. Control: horizontal. All patients had a 15° left lateral tilt.
Outcomes	Incidence of air embolisms.

Karuparthy 1989 (*Continued*)

Notes	Excluded patients who needed immediate CS. Included singleton pregnancy, patients were normovolemic.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Random number tables.
Allocation concealment?	Unclear	Unlikely.
Blinding? All outcomes	No	
Incomplete outcome data addressed? All outcomes	Yes	
Free of selective reporting?	Yes	
Free of other bias?	Yes	

Kundra 2007

Methods	Randomised controlled trial.
Participants	90 pregnant woman (45 intervention, 45 control) undergoing elective or emergency CS under a subarachnoid block.
Interventions	Intervention: supine with no lateral tilt with manual displacement of the uterus. Control:15° lateral tilt.
Outcomes	Maternal hypotension, death, fall in systolic blood pressure.
Notes	Full term pregnancies, ASA physical status 1 or 2.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Computer-generated randomised numbers.
Allocation concealment?	Yes	Sealed envelopes.
Blinding? All outcomes	Yes	Anaesthetist and paediatrician blinded.
Incomplete outcome data addressed? All outcomes	Yes	

Free of selective reporting?	Yes	
Free of other bias?	Yes	

Lew 1993

Methods	Randomised controlled trial.
Participants	30 participants (15 intervention, 15 control) undergoing elective CS under general anaesthesia.
Interventions	Control: placed in the horizontal position. Intervention: 10° reverse Trendelenburg tilt. In both groups a left lateral tilt was maintained.
Outcomes	Incidence of venous air embolisms.
Notes	Patients were ASA physical status 1 or 2, singleton pregnancy.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	Drawing of lots.
Allocation concealment?	No	
Blinding? All outcomes	No	
Incomplete outcome data addressed? All outcomes	Yes	
Free of selective reporting?	Yes	
Free of other bias?	Yes	

Matorras 1998

Methods	Randomised controlled trial.
Participants	204 participants (103 intervention, 101 control) undergoing elective or emergency CS.
Interventions	Intervention: 20° table tilt to the left. Control: supine position.
Outcomes	Neonatal Apgar scores, maternal blood pressure, maternal pulse rate, cord blood gas values.

Matorras 1998 (*Continued*)

Notes	Excluded multiple pregnancies, included if gestational age of over 36 weeks, patients had to have a longitudinal lie, excluded congenital abnormalities, excluded patients in which internal monitoring was contraindicated (infectious risk or placenta praevia). 177 patients had general anaesthesia, 27 patients had spinal anaesthesia.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Number table.
Allocation concealment?	No	
Blinding? All outcomes	No	
Incomplete outcome data addressed? All outcomes	Yes	
Free of selective reporting?	Yes	
Free of other bias?	Yes	

Miyabe 1997

Methods	Randomised controlled trial.
Participants	34 participants (17 control, 17 intervention) under going elective CS with spinal anaesthesia.
Interventions	Intervention: head down 10° tilt. Control: horizontal. In both groups a wedge was placed under the right hip or the table was rotated in a counterclockwise direction to provide a left uterine displacement.
Outcomes	Hypotension and maternal blood pressure.
Notes	Term singleton pregnancies.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	No response from author via email.
Allocation concealment?	Unclear	No response from author via email.

Miyabe 1997 (*Continued*)

Blinding? All outcomes	Unclear	No response from author via email.
Incomplete outcome data addressed? All outcomes	Yes	
Free of selective reporting?	Yes	
Free of other bias?	Yes	

Rees 2002

Methods	Randomised controlled trial.
Participants	60 participants (31 control, 29 intervention) undergoing elective CS under spinal anaesthesia.
Interventions	Intervention: full left lateral position. Control: 15° left lateral tilt.
Outcomes	Hypotension, maternal systolic blood pressure
Notes	2 patients withdrawn due to problems with spinal anaesthesia. Singleton term pregnancies (36 completed weeks). Excluded patients with pre-eclampsia, obesity, intrauterine growth restriction or fetal distress.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	Number list.
Allocation concealment?	Yes	Sealed envelopes.
Blinding? All outcomes	No	
Incomplete outcome data addressed? All outcomes	Yes	
Free of selective reporting?	Yes	
Free of other bias?	Yes	

Zheng 2001

Methods	Randomised controlled trial.
Participants	60 participants (20 supine, 20 intervention 1, 20 intervention 2).
Interventions	Control: supine. Intervention 1: left oblique. Intervention 2: right oblique.
Outcomes	Hypotension, changes in maternal blood pressure and pulse.
Notes	Translated article. Singleton pregnancy.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Described as randomised but no details given on how the patients were randomised.
Allocation concealment?	Unclear	Not stated but unlikely.
Blinding? All outcomes	Unclear	Not stated but unlikely.
Incomplete outcome data addressed? All outcomes	Yes	
Free of selective reporting?	Yes	
Free of other bias?	Yes	

Zhou 2008

Methods	Randomised control trial.
Participants	60 term patients undergoing elective CS under spinal anaesthesia.
Interventions	Control: 12 cm right lumbar wedge. Experimental: 12 cm right pelvic wedge.
Outcomes	Hypotension, cord blood gas values, time of incision to closure, time of incision to delivery.
Notes	

Risk of bias

Item	Authors' judgement	Description

Zhou 2008 (*Continued*)

Adequate sequence generation?	Yes	Random digit table.
Allocation concealment?	Yes	Sealed envelopes.
Blinding? All outcomes	No	
Incomplete outcome data addressed? All outcomes	Yes	
Free of selective reporting?	Yes	
Free of other bias?	Yes	

ASA: American Society of Anesthesiologists
CS: caesarean section

Characteristics of excluded studies *[ordered by study ID]*

Abouleish 1980	Both a uterine displacement device and a wedge were used on each patient.
Alahuhta 1994	Not randomised. No information on how 14 patients were randomised and another 8 patients were added to the study who were not randomised and were put in the experimental group.
Amaro 1998	No information about randomisation.
Buley 1977	Quasi-randomisation using hospital numbers.
Clemetson 1973	Randomisation not adequate. (Alternate woman were placed in control and experimental group.)
Crawford 1972	No information about randomisation or patient selection. Data on infants are not complete.
Downing 1974	Quasi-randomisation using odd versus even hospital numbers or alternate days.
Sanchez 1985	Not randomised.

DATA AND ANALYSES

Comparison 1. 20º left lateral tilt versus horizontal position

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hypotension	1	40	Risk Ratio (IV, Fixed, 95% CI)	0.11 [0.01, 1.94]
2 Maternal systolic pressure at 5 minutes after spinal anaesthesia was administered	1	204	Mean Difference (IV, Fixed, 95% CI)	2.70 [-1.47, 6.87]
3 Maternal diastolic pressure at 5 minutes after spinal anaesthesia was administered	1	204	Mean Difference (IV, Fixed, 95% CI)	-1.90 [-5.28, 1.48]
4 Maternal pulse rate at 5 minutes after spinal anaesthesia was administered	1	204	Mean Difference (IV, Fixed, 95% CI)	2.5 [-1.86, 6.86]
5 Neonatal Apgar score less than 7 at 5 minutes	1	204	Risk Ratio (M-H, Fixed, 95% CI)	0.98 [0.25, 3.81]
6 Cord blood gas pH less than 7.2	1	204	Risk Ratio (M-H, Fixed, 95% CI)	1.06 [0.66, 1.69]
7 Umbilical artery cord blood gas pH values	1	204	Mean Difference (IV, Fixed, 95% CI)	0.01 [-0.01, 0.03]

Comparison 2. Full left lateral tilt versus a 15º left lateral tilt

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hypotension	1	58	Risk Ratio (M-H, Fixed, 95% CI)	1.20 [0.80, 1.79]
2 Mean systolic maternal blood pressure	1	58	Mean Difference (IV, Fixed, 95% CI)	-5.0 [-11.45, 1.45]

Comparison 3. Right lateral tilt versus horizontal position

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hypotension	1	40	Risk Ratio (M-H, Fixed, 95% CI)	1.25 [0.39, 3.99]

Comparison 4. Right lateral tilt versus left lateral tilt

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hypotension	1	79	Risk Ratio (M-H, Fixed, 95% CI)	3.30 [1.20, 9.08]
2 Hypertension	1	79	Risk Ratio (M-H, Fixed, 95% CI)	3.52 [0.41, 30.14]
3 Maternal blood gas pH values	1	75	Mean Difference (IV, Fixed, 95% CI)	-0.40 [-0.72, -0.08]
4 Umbilical artery cord blood gas pH values	1	75	Mean Difference (IV, Fixed, 95% CI)	2.90 [2.33, 3.47]
5 Umbilical venous cord blood gas pH values	1	75	Mean Difference (IV, Fixed, 95% CI)	1.80 [1.34, 2.26]

Comparison 5. Manual displacer versus 15º left lateral tilt

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hypotension	1	90	Risk Ratio (M-H, Fixed, 95% CI)	0.11 [0.03, 0.45]
2 Amount of fall in systolic blood pressure mmHg	1	90	Mean Difference (IV, Fixed, 95% CI)	-8.8 [-13.08, -4.52]
3 Maternal mortality	1	90	Risk Ratio (M-H, Fixed, 95% CI)	Not estimable

Comparison 6. 10º head down tilt versus horizontal position

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hypotension	1	34	Risk Ratio (M-H, Fixed, 95% CI)	1.07 [0.81, 1.42]
2 Maternal systolic blood pressure	1	34	Mean Difference (IV, Fixed, 95% CI)	-3.0 [-8.38, 2.38]
3 Maternal diastolic blood pressure	1	34	Mean Difference (IV, Fixed, 95% CI)	-7.0 [-12.05, -1.95]

Comparison 7. 5º to 10º head up tilt versus horizontal position

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Air embolisms	2	130	Risk Ratio (M-H, Fixed, 95% CI)	0.91 [0.65, 1.26]

Comparison 8. 12 cm right pelvic wedge versus 12 cm right lumbar wedge

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Hypotension	1	60	Risk Ratio (M-H, Fixed, 95% CI)	1.64 [1.07, 2.53]
2 Cord blood gas pH values	1	60	Mean Difference (IV, Fixed, 95% CI)	-0.00 [-0.01, 0.00]

Analysis 1.1. Comparison 1 20° left lateral tilt versus horizontal position, Outcome 1 Hypotension.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 1 20 left lateral tilt versus horizontal position

Outcome: 1 Hypotension

Study or subgroup	Lateral Tilt n/N	Supine Position n/N	Risk Ratio IV,Fixed,95% CI	Weight	Risk Ratio IV,Fixed,95% CI
Zheng 2001	0/20	4/20		100.0 %	0.11 [0.01, 1.94]
Total (95% CI)	**20**	**20**		**100.0 %**	**0.11 [0.01, 1.94]**
Total events: 0 (Lateral Tilt), 4 (Supine Position)					
Heterogeneity: not applicable					
Test for overall effect: Z = 1.51 (P = 0.13)					

Analysis 1.2. Comparison 1 20º left lateral tilt versus horizontal position, Outcome 2 Maternal systolic pressure at 5 minutes after spinal anaesthesia was administered.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 1 20 left lateral tilt versus horizontal position

Outcome: 2 Maternal systolic pressure at 5 minutes after spinal anaesthesia was administered

Study or subgroup	Lateral Tilt N	Mean(SD)	Supine Position N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Matorras 1998	103	130.9 (15.8)	101	128.2 (14.6)		100.0 %	2.70 [-1.47, 6.87]
Total (95% CI)	**103**		**101**			**100.0 %**	**2.70 [-1.47, 6.87]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.27 (P = 0.20)

Analysis 1.3. Comparison 1 20º left lateral tilt versus horizontal position, Outcome 3 Maternal diastolic pressure at 5 minutes after spinal anaesthesia was administered.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 1 20 left lateral tilt versus horizontal position

Outcome: 3 Maternal diastolic pressure at 5 minutes after spinal anaesthesia was administered

Study or subgroup	Lateral Tilt N	Mean(SD)	Supine Position N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Matorras 1998	103	75 (11.2)	101	76.9 (13.3)		100.0 %	-1.90 [-5.28, 1.48]
Total (95% CI)	**103**		**101**			**100.0 %**	**-1.90 [-5.28, 1.48]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.10 (P = 0.27)

Analysis 1.4. Comparison 1 20° left lateral tilt versus horizontal position, Outcome 4 Maternal pulse rate at 5 minutes after spinal anaesthesia was administered.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 1 20 left lateral tilt versus horizontal position

Outcome: 4 Maternal pulse rate at 5 minutes after spinal anaesthesia was administered

Study or subgroup	Lateral Tilt N	Mean(SD)	Supine Position N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Matorras 1998	103	99 (14.7)	101	96.5 (17)		100.0 %	2.50 [-1.86, 6.86]
Total (95% CI)	**103**		**101**			**100.0 %**	**2.50 [-1.86, 6.86]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.12 (P = 0.26)

Analysis 1.5. Comparison 1 20° left lateral tilt versus horizontal position, Outcome 5 Neonatal Apgar score less than 7 at 5 minutes.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 1 20 left lateral tilt versus horizontal position

Outcome: 5 Neonatal Apgar score less than 7 at 5 minutes

Study or subgroup	Lateral Tilt n/N	Supine Position n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Matorras 1998	4/103	4/101		100.0 %	0.98 [0.25, 3.81]
Total (95% CI)	**103**	**101**		**100.0 %**	**0.98 [0.25, 3.81]**

Total events: 4 (Lateral Tilt), 4 (Supine Position)

Heterogeneity: not applicable

Test for overall effect: Z = 0.03 (P = 0.98)

Analysis 1.6. Comparison 1 20° left lateral tilt versus horizontal position, Outcome 6 Cord blood gas pH less than 7.2.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 1 20 left lateral tilt versus horizontal position

Outcome: 6 Cord blood gas pH less than 7.2

Study or subgroup	Lateral Tilt n/N	Supine Position n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Matorras 1998	27/103	25/101		100.0 %	1.06 [0.66, 1.69]
Total (95% CI)	**103**	**101**		**100.0 %**	**1.06 [0.66, 1.69]**
Total events: 27 (Lateral Tilt), 25 (Supine Position)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.24 (P = 0.81)					

Analysis 1.7. Comparison 1 20° left lateral tilt versus horizontal position, Outcome 7 Umbilical artery cord blood gas pH values.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 1 20 left lateral tilt versus horizontal position

Outcome: 7 Umbilical artery cord blood gas pH values

Study or subgroup	Lateral Tilt N	Mean(SD)	Supine Position N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Matorras 1998	103	7.24 (0.06)	101	7.23 (0.06)		100.0 %	0.01 [-0.01, 0.03]
Total (95% CI)	**103**		**101**			**100.0 %**	**0.01 [-0.01, 0.03]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.19 (P = 0.23)							

Analysis 2.1. Comparison 2 Full left lateral tilt versus a 15° left lateral tilt, Outcome 1 Hypotension.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 2 Full left lateral tilt versus a 15 left lateral tilt

Outcome: 1 Hypotension

Study or subgroup	Full lateral tilt n/N	15 tilt n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Rees 2002	19/28	17/30		100.0 %	1.20 [0.80, 1.79]
Total (95% CI)	**28**	**30**		**100.0 %**	**1.20 [0.80, 1.79]**
Total events: 19 (Full lateral tilt), 17 (15 tilt)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.88 (P = 0.38)					

Analysis 2.2. Comparison 2 Full left lateral tilt versus a 15° left lateral tilt, Outcome 2 Mean systolic maternal blood pressure.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 2 Full left lateral tilt versus a 15 left lateral tilt

Outcome: 2 Mean systolic maternal blood pressure

Study or subgroup	Full lateral tilt N	Mean(SD)	15 tilt N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Rees 2002	28	120 (13)	30	125 (12)		100.0 %	-5.00 [-11.45, 1.45]
Total (95% CI)	**28**		**30**			**100.0 %**	**-5.00 [-11.45, 1.45]**
Heterogeneity: not applicable							
Test for overall effect: Z = 1.52 (P = 0.13)							

Analysis 3.1. Comparison 3 Right lateral tilt versus horizontal position, Outcome 1 Hypotension.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 3 Right lateral tilt versus horizontal position

Outcome: 1 Hypotension

Study or subgroup	Right lateral tilt n/N	Horizontal position n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Zheng 2001	5/20	4/20		100.0 %	1.25 [0.39, 3.99]
Total (95% CI)	**20**	**20**		**100.0 %**	**1.25 [0.39, 3.99]**
Total events: 5 (Right lateral tilt), 4 (Horizontal position)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.38 (P = 0.71)					

Analysis 4.1. Comparison 4 Right lateral tilt versus left lateral tilt, Outcome 1 Hypotension.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 4 Right lateral tilt versus left lateral tilt

Outcome: 1 Hypotension

Study or subgroup	15 tilt to the right n/N	15 tilt to the left n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Brock-Utne 1978	15/42	4/37		100.0 %	3.30 [1.20, 9.08]
Total (95% CI)	**42**	**37**		**100.0 %**	**3.30 [1.20, 9.08]**
Total events: 15 (15 tilt to the right), 4 (15 tilt to the left)					
Heterogeneity: not applicable					
Test for overall effect: Z = 2.32 (P = 0.020)					

Analysis 4.2. Comparison 4 Right lateral tilt versus left lateral tilt, Outcome 2 Hypertension.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 4 Right lateral tilt versus left lateral tilt

Outcome: 2 Hypertension

Study or subgroup	15 tilt to the right n/N	15 tilt to the left n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Brock-Utne 1978	4/42	1/37		100.0 %	3.52 [0.41, 30.14]
Total (95% CI)	**42**	**37**		**100.0 %**	**3.52 [0.41, 30.14]**
Total events: 4 (15 tilt to the right), 1 (15 tilt to the left)					
Heterogeneity: not applicable					
Test for overall effect: Z = 1.15 (P = 0.25)					

Analysis 4.3. Comparison 4 Right lateral tilt versus left lateral tilt, Outcome 3 Maternal blood gas pH values.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 4 Right lateral tilt versus left lateral tilt

Outcome: 3 Maternal blood gas pH values

Study or subgroup	15 tilt to the right N	Mean(SD)	15 tilt to the left N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Brock-Utne 1978	38	39.3 (0.8)	37	39.7 (0.6)		100.0 %	-0.40 [-0.72, -0.08]
Total (95% CI)	**38**		**37**			**100.0 %**	**-0.40 [-0.72, -0.08]**
Heterogeneity: not applicable							
Test for overall effect: Z = 2.45 (P = 0.014)							

Analysis 4.4. Comparison 4 Right lateral tilt versus left lateral tilt, Outcome 4 Umbilical artery cord blood gas pH values.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

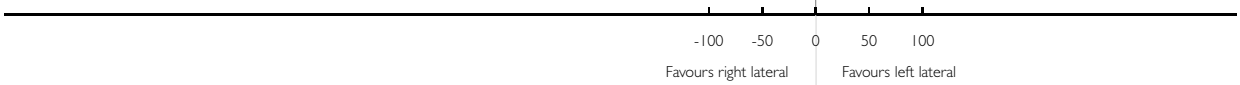
Comparison: 4 Right lateral tilt versus left lateral tilt

Outcome: 4 Umbilical artery cord blood gas pH values

Study or subgroup	15 tilt to the right N	Mean(SD)	15 tilt to the left N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Brock-Utne 1978	38	55.2 (1.1)	37	52.3 (1.4)		100.0 %	2.90 [2.33, 3.47]
Total (95% CI)	**38**		**37**			**100.0 %**	**2.90 [2.33, 3.47]**

Heterogeneity: not applicable

Test for overall effect: Z = 9.96 (P < 0.00001)



Analysis 4.5. Comparison 4 Right lateral tilt versus left lateral tilt, Outcome 5 Umbilical venous cord blood gas pH values.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

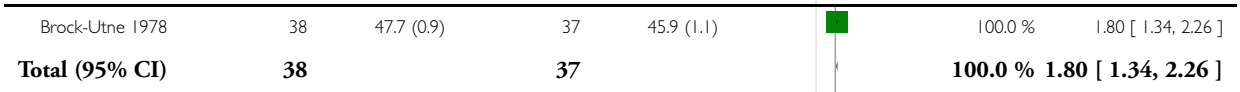
Comparison: 4 Right lateral tilt versus left lateral tilt

Outcome: 5 Umbilical venous cord blood gas pH values

Study or subgroup	15 tilt to the right N	Mean(SD)[pH]	15 tilt to the left N	Mean(SD)[pH]	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Brock-Utne 1978	38	47.7 (0.9)	37	45.9 (1.1)		100.0 %	1.80 [1.34, 2.26]
Total (95% CI)	**38**		**37**			**100.0 %**	**1.80 [1.34, 2.26]**

Heterogeneity: not applicable

Test for overall effect: Z = 7.74 (P < 0.00001)



Analysis 5.1. Comparison 5 Manual displacer versus 15° left lateral tilt, Outcome 1 Hypotension.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 5 Manual displacer versus 15 left lateral tilt

Outcome: 1 Hypotension

Study or subgroup	manual displacer n/N	lateral tilt n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Kundra 2007	2/45	18/45		100.0 %	0.11 [0.03, 0.45]
Total (95% CI)	**45**	**45**		**100.0 %**	**0.11 [0.03, 0.45]**
Total events: 2 (manual displacer), 18 (lateral tilt)					
Heterogeneity: not applicable					
Test for overall effect: Z = 3.07 (P = 0.0021)					

Analysis 5.2. Comparison 5 Manual displacer versus 15° left lateral tilt, Outcome 2 Amount of fall in systolic blood pressure mmHg.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 5 Manual displacer versus 15 left lateral tilt

Outcome: 2 Amount of fall in systolic blood pressure mmHg

Study or subgroup	manual displacer N	Mean(SD)	lateral tilt N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Kundra 2007	45	20 (12.7)	45	28.8 (7.3)		100.0 %	-8.80 [-13.08, -4.52]
Total (95% CI)	**45**		**45**			**100.0 %**	**-8.80 [-13.08, -4.52]**
Heterogeneity: not applicable							
Test for overall effect: Z = 4.03 (P = 0.000056)							

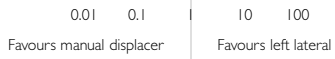
Analysis 5.3. Comparison 5 Manual displacer versus 15° left lateral tilt, Outcome 3 Maternal mortality.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 5 Manual displacer versus 15 left lateral tilt

Outcome: 3 Maternal mortality

Study or subgroup	manual displacer n/N	lateral tilt n/N	Risk Ratio M-H,Fixed,95% CI	Risk Ratio M-H,Fixed,95% CI
Kundra 2007	0/45	0/45		0.0 [0.0, 0.0]
Total (95% CI)	**45**	**45**		**0.0 [0.0, 0.0]**
Total events: 0 (manual displacer), 0 (lateral tilt)				
Heterogeneity: not applicable				
Test for overall effect: Z = 0.0 (P < 0.00001)				



Analysis 6.1. Comparison 6 10° head down tilt versus horizontal position, Outcome 1 Hypotension.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 6 10 head down tilt versus horizontal position

Outcome: 1 Hypotension

Study or subgroup	10 head down tilt n/N	Horizontal position n/N	Risk Ratio M-H,Fixed,95% CI	Weight	Risk Ratio M-H,Fixed,95% CI
Miyabe 1997	15/17	14/17		100.0 %	1.07 [0.81, 1.42]
Total (95% CI)	**17**	**17**		**100.0 %**	**1.07 [0.81, 1.42]**
Total events: 15 (10 head down tilt), 14 (Horizontal position)					
Heterogeneity: not applicable					
Test for overall effect: Z = 0.48 (P = 0.63)					

Analysis 6.2. Comparison 6 10° head down tilt versus horizontal position, Outcome 2 Maternal systolic blood pressure.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 6 10 head down tilt versus horizontal position

Outcome: 2 Maternal systolic blood pressure

Study or subgroup	10 head down tilt N	Mean(SD)	Horizontal position N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Miyabe 1997	17	120 (8)	17	123 (8)		100.0 %	-3.00 [-8.38, 2.38]
Total (95% CI)	**17**		**17**			**100.0 %**	**-3.00 [-8.38, 2.38]**

Heterogeneity: not applicable

Test for overall effect: Z = 1.09 (P = 0.27)

Analysis 6.3. Comparison 6 10° head down tilt versus horizontal position, Outcome 3 Maternal diastolic blood pressure.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

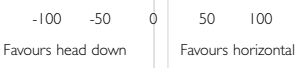
Comparison: 6 10 head down tilt versus horizontal position

Outcome: 3 Maternal diastolic blood pressure

Study or subgroup	10 head down tilt N	Mean(SD)	Horizontal position N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Miyabe 1997	17	68 (8)	17	75 (7)		100.0 %	-7.00 [-12.05, -1.95]
Total (95% CI)	**17**		**17**			**100.0 %**	**-7.00 [-12.05, -1.95]**

Heterogeneity: not applicable

Test for overall effect: Z = 2.72 (P = 0.0066)

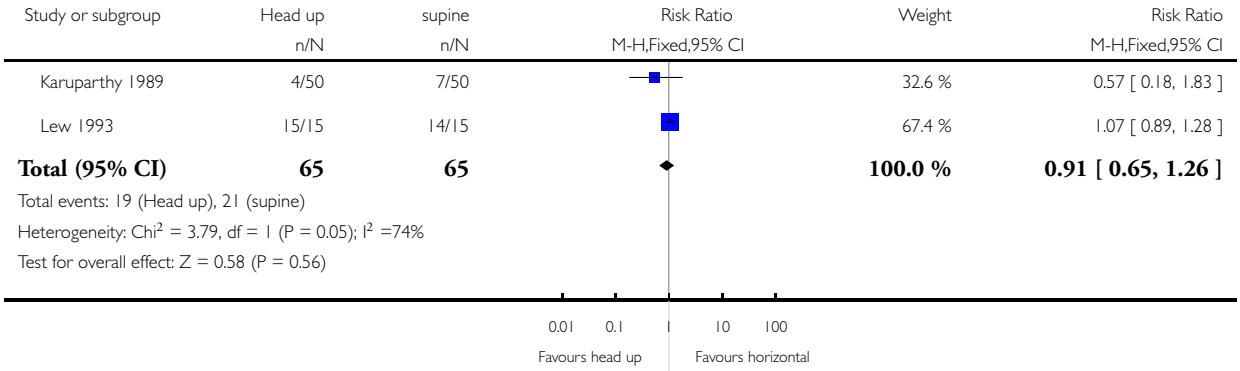


Analysis 7.1. Comparison 7 5° to 10° head up tilt versus horizontal position, Outcome 1 Air embolisms.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 7 5 to 10 head up tilt versus horizontal position

Outcome: 1 Air embolisms

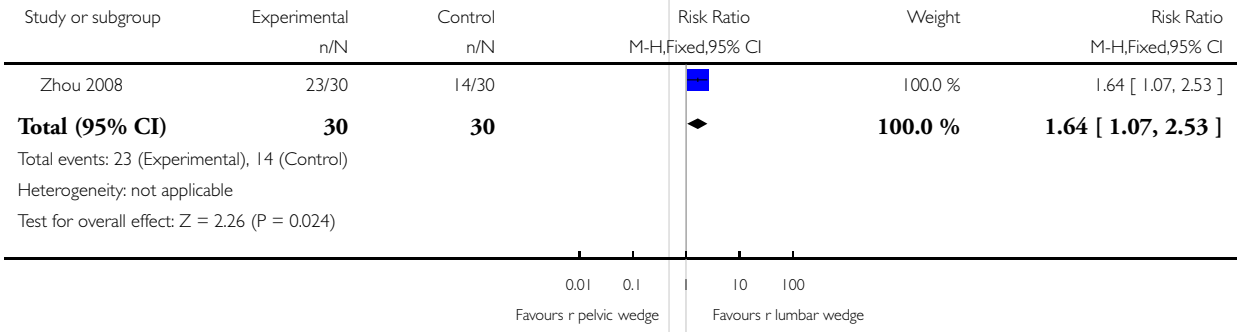


Analysis 8.1. Comparison 8 12 cm right pelvic wedge versus 12 cm right lumbar wedge, Outcome 1 Hypotension.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 8 12 cm right pelvic wedge versus 12 cm right lumbar wedge

Outcome: 1 Hypotension



Analysis 8.2. Comparison 8 12 cm right pelvic wedge versus 12 cm right lumbar wedge, Outcome 2 Cord blood gas pH values.

Review: Maternal position during caesarean section for preventing maternal and neonatal complications

Comparison: 8 12 cm right pelvic wedge versus 12 cm right lumbar wedge

Outcome: 2 Cord blood gas pH values

Study or subgroup	Experimental N	Mean(SD)	Control N	Mean(SD)	Mean Difference IV,Fixed,95% CI	Weight	Mean Difference IV,Fixed,95% CI
Zhou 2008	30	7.289 (0.015)	30	7.292 (0.015)		100.0 %	0.00 [-0.01, 0.00]
Total (95% CI)	**30**		**30**			**100.0 %**	**0.00 [-0.01, 0.00]**
Heterogeneity: not applicable							
Test for overall effect: Z = 0.77 (P = 0.44)							

APPENDICES

Appendix 1. PubMed search strategy

PubMed (1966 to 14 September 2009)
(position OR tilt) AND (caesarean OR cesarean)

Appendix 2. ASA definition

The **ASA physical status classification system** is a system for assessing the fitness of patients before surgery. In 1963 the American Society of Anesthesiologists (ASA) adopted the five-category physical status classification system; a sixth category was later added. These are:

1. A normal healthy patient.
2. A patient with mild systemic disease.
3. A patient with severe systemic disease.
4. A patient with severe systemic disease that is a constant threat to life.
5. A moribund patient who is not expected to survive without the operation.
6. A declared brain-dead patient whose organs are being removed for donor purposes

HISTORY

Protocol first published: Issue 1, 2009

Review first published: Issue 6, 2010

CONTRIBUTIONS OF AUTHORS

Catherine Cluver drafted the protocol, assessed trials for eligibility, helped draw up the data extraction form. She extracted, entered the data and checked that the data was correctly extracted. She wrote the review and is the guarantor for the review.

Natalia Novikova assisted in drawing up the data extraction form and for extracting data and checking that the data was correctly extracted. She helped edit the review.

Justus Hofmeyr supervised the drafting of the protocol and review. He was responsible for identifying the topic for the review.

David Hall helped to supervise the review.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Walter Sisulu University, South Africa.
- East London Health Complex, South Africa.
- University of Stellenbosch, South Africa.

External sources

- (GJH) World Health Organization (long-term Institutional Development Grant), Switzerland.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Changes in maternal blood gas values were added as a primary outcome.