Amnioinfusion for potential or suspected umbilical cord compression in labour (Review)

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ABSTRACT

Background
Amnioinfusion aims to prevent or relieve umbilical cord compression or amniotic fluid infection during labour by infusing a solution into the uterine cavity.

Objectives
To assess the effects of amnioinfusion on maternal and perinatal outcome for potential or suspected umbilical cord compression or potential amnionitis.

Search strategy
The Cochrane Pregnancy and Childbirth Group Trials Register (November 2004), the Cochrane Central Register of Controlled Trials (*The Cochrane Library,* Issue 3, 2004) and PubMed (1966 to November 2004).

Selection criteria
Randomized trials of amnioinfusion compared with no amnioinfusion in women with babies at risk of umbilical cord compression; and women at risk of intrauterine infection.

Data collection and analysis
Eligibility and trial quality were assessed by the review author. Data were extracted and analyzed using RevMan software.

Main results
Fourteen studies were included, most with fewer than 200 participants. Transcervical amnioinfusion for potential or suspected umbilical cord compression was associated with the following reductions: fetal heart rate decelerations (four studies, 227 women: relative risk (RR) 0.54; 95% confidence interval (CI) 0.43 to 0.68); caesarean section overall (nine studies, 953 women: RR 0.52; CI 0.40 to 0.69); Apgar score less than seven at five minutes (seven studies, 828 women: RR 0.54; CI 0.30 to 0.97); low cord arterial pH (six studies, 660 women: RR 0.45; CI 0.31 to 0.64); neonatal hospital stay greater than three days (one study, 305 women: RR 0.40; CI 0.26 to 0.62); postpartum endometritis (five studies, 619 women: RR 0.45; CI 0.25 to 0.81); maternal hospital stay greater than three days (two studies, 465 women: RR 0.41; CI 0.27 to 0.63). Transabdominal amnioinfusion showed similar trends, though numbers studied were small. Transcervical amnioinfusion to prevent infection in women with membranes ruptured for more than six hours was associated with a reduction in puerperal infection (one study, 68 women: RR 0.50; CI 0.26 to 0.97).

Authors' conclusions
Amnioinfusion appears useful to reduce the occurrence of variable fetal heart rate decelerations, improve short-term measures of neonatal outcome, and lower the use of caesarean section, mainly for 'fetal distress' diagnosed by fetal heart rate monitoring alone. However, most of the included studies were small, and there were methodological shortcomings. In one trial puerperal infection was reduced. The trials reviewed are too small to address the possibility of rare but serious maternal adverse effects of amnioinfusion. More research is needed to confirm the findings, assess longer-term measures of fetal outcome, and the impact on caesarean section when the diagnosis of fetal distress is more stringent.

PLAIN LANGUAGE SUMMARY

Infusing fluid into the uterus during labour may possibly reduce fetal heart rate abnormalities and reduce caesarean sections

Most women have adequate amniotic fluid to protect their baby during pregnancy and labour. Occasionally the volume of amniotic fluid is reduced, and this may cause compression of the umbilical cord. This in turn might lead to decelerations of the baby's heart rate during labour. Infusing fluid into the uterus through a catheter placed through the cervix, or a needle through the abdomen, may reduce these problems and the incidence of caesarean section. The studies reviewed were of average quality, and too small to measure the risk of rare complications for the mother.

BACKGROUND

Amnioinfusion has been described as a method of preventing or relieving umbilical cord compression during labour (Miyazaki 1983). Saline or Ringers lactate is infused transcervically through a catheter into the uterine cavity, or transabdominally through a 'spinal' needle when membranes are intact. The technique has been used prophylactically in various conditions which are commonly associated with oligohydramnios (reduced volume of amniotic fluid) (Macri 1992), and therapeutically for repetitive variable fetal heart rate decelerations during labour. This heart rate abnormality is considered to be due often to umbilical cord compression, particularly when there is oligohydramnios (Gabbe 1976).

There is considerable variability in the diagnosis of oligohydramnios (clinically or with ultrasound), and in the assessment of the severity of variable fetal heart rate decelerations on cardiotocography. The use of amnioinfusion for these conditions might therefore vary.

Amnioinfusion with antibiotics has been used to treat established amnionitis (Goodlin 1981), and to prevent infection following premature rupture of membranes (Ogita 1988). Saline amnioinfusion has been used to reduce infection in prolonged rupture of membranes, presumably through dilution or irrugation (Monahan 1995).

Transabdominal amnioinfusion has also been used to facilitate external cephalic version at term (Benifla 1995), and antepartum amnioinfusion has been used for various fetal indications such as to reduce the risk of pulmonary hypoplasia and to improve ultrasound visualisation of fetal anomalies (Gramellini 2003). Reassuring fetal heart rate acceleration in response to small-volume amnioinfusion has been described (Wax 2004).

This review deals with amnioinfusion for potential or suspected cord compression and for prevention of amnionitis. 'Prophylactic versus therapeutic amnioinfusion for oligohydramnios in labour' (Hofmeyr 1996a), 'Amnioinfusion for meconium-stained liquor in labour' (Hofmeyr 2002), and 'Amnioinfusion for preterm rupture of membranes' (Hofmeyr 1998) are separate Cochrane reviews in the current edition of The Cochrane Library.

Readers are referred to other reviews of the topic (Hofmeyr 1996; Lameier 1993).

OBJECTIVES

To determine, from the best available evidence, the effects of amnioinfusion for potential or suspected umbilical cord compression in labour, or potential amnionitis, on fetal heart rate characteristics and perinatal and maternal mortality and morbidity.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

Clinical trials comparing the effect of amnioinfusion for potential or suspected umbilical cord compression or intrauterine infection, on clinically meaningful outcomes, with a control group (no amnioinfusion); random allocation to treatment and control groups, with adequate allocation concealment; violations of allocated management and exclusions after allocation not sufficient to materially affect outcomes.

Types of participants

Women whose babies were considered to be at increased risk of, or had fetal heart rate patterns suggestive of, umbilical cord compression; women considered at risk of or with evidence of intrauterine infection.

Types of intervention

Amnioinfusion compared with no amnioinfusion.

Transcervical and transabdominal amnioinfusion have been considered separately because there are fundamental differences between the techniques, which may result in different outcomes.

Types of outcome measures

Intrapartum direct or indirect indicators of oligohydramnios and fetal distress; method of delivery; maternal morbidity; perinatal morbidity and mortality.

Outcomes included if clinically meaningful; reasonable measures taken to minimise observer bias; missing data insufficient to materially influence conclusions; data available for analysis according to original allocation, irrespective of protocol violations; data available in format suitable for analysis.

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: methods used in reviews.

The Trials Search Co-ordinator searched the Cochrane Pregnancy and Childbirth Group Trials Register (November 2004).

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.

No language restrictions were applied.

The Cochrane Central Register of Controlled Trials (*The Cochrane Library*, Issue 3, 2004) and PubMed (1966 to November 2004) were searched using the term 'amnioinfusion'.

METHODS OF THE REVIEW

The author evaluated trials under consideration for appropriateness for inclusion, according to the prestated selection criteria without consideration of their results.

Trials that met the eligibility criteria for quality were evaluated, using the following components: allocation concealment (A = adequate, B = unclear, C = inadequate); blinding of participants; blinding of caregivers; blinding of outcome assessment; completeness of follow-up data; analysis of participants by intention to treat. If a publication did not report analysis of participants in their randomized groups, an attempt to restore them to the correct group would have been made. If necessary, the authors would have been contacted and further data requested.

The author extracted data from the original publications, entered them onto RevMan software (RevMan 2003), and checked the data entry. Data from different trials were combined if they were sufficiently similar for this to be reasonable. Meta-analyses were performed using relative risks as the measure of effect size for binary outcomes, and weighted mean differences for continuous outcome measures, both with 95% confidence intervals.

A fixed-effect meta-analysis for combining study data was used if the trials had been judged to be sufficiently similar. Individual outcome data were included in the analysis if they met the prestated criteria in 'Types of outcome measures'. Included trial data were processed as described in Alderson 2004.

Heterogeneity was investigated by calculating I^2 statistics (Higgins 2002), and if this indicated a high level of heterogeneity among the trials included in an analysis (I^2 greater than 50%), random-effects meta-analysis would be preferred for an overall summary. Where high levels of heterogeneity were found they would have been explored by the prespecified subgroup analyses and by sensitivity analyses excluding the trials most susceptible to bias based on the quality assessment.

DESCRIPTION OF STUDIES

See 'Characteristics of included studies'.

The primary author of the Owen 1990 trial provided additional unpublished data from the trial for inclusion in this review.

METHODOLOGICAL QUALITY

See 'Table: Characteristics of included studies', particularly the 'Methods' and 'Notes' sections.

In seven studies (Amin 2003; Chauhan 1992; Miyazaki 1985; Monahan 1995; Nageotte 1991; Owen 1990; Strong 1990), allocation of participants was according to sealed envelopes. In four (Busowski 1995; MacGregor 1991; Nageotte 1985; Wu 1989), allocation was described as 'random'. One group (Schrimmer 1991) used 'computer' randomization and sealed envelopes in a ratio of 3:2 and one (Vergani 1996) used a 'computer generated randomization table'. Concealment of allocation prior to enrolment was not specified. In one trial report (Puertas 2001), which was a published abstract, allocation was described as 'randomized clinical assay'; data from this trial have not been included in the review as only percentages were given.

Five withdrawals after randomization, for apparently legitimate reasons, were recorded in one study (Nageotte 1985). Results from

women who declined participation and were used as a comparison group in another study (Chauhan 1992) have been excluded from this review. The interpretation of fetal heart rate response to the amnioinfusion in two studies (Chauhan 1992; Miyazaki 1985) may have been subject to bias as tracings were not stated to have been assessed 'blind'. Apgar score assessments may also have been subject to bias. In one study (Owen 1990) the allocations were imbalanced (43 experimental versus 57 control women, of whom 22 and 36 respectively were multiparous), and the estimated gestational age of women with oligohydramnios/suspected impaired fetal growth in the amnioinfusion group was significantly less than that of the control group. Personal communication with the primary author has established that the enrolment discrepancy was in part a chance imbalance in the randomization, and in part the result of exclusion of a few women allocated to the experimental group who, for technical reasons, did not actually receive amnioinfusion. In one study (Nageotte 1991), three women in each group received the non-allocated management, but analysis was according to 'intention to treat'. In another study (Monahan 1995), two women from the amnioinfusion group who received amnioinfusion for less than one hour were analysed with the control group, and two from the control group who received amnioinfusion were analysed with the amnioinfusion group.

The overall methodological quality of the trials reviewed is thus not ideal.

RESULTS

Fourteen studies were included, most with fewer than 200 participants. Amnioinfusion appears to be effective in relieving or preventing fetal heart rate decelerations. One group (Nageotte 1985; Nageotte 1991) showed a reduction in the frequency of variable decelerations per hour in the amnioinfusion groups during the second stage of labour as well.

The use of intrauterine resuscitation, reported in one study (Chauhan 1992), was not significantly different between groups.

The incidence of meconium-stained amniotic fluid was reduced in one study and not in the other in which the outcome was reported.

Umbilical cord prolapse occurred in two women, both of whom were receiving amnioinfusion. In both cases the babies were born in poor condition. Very large studies will be required to determine whether there is an increase in this rare outcome with amnioinfusion.

In one study there was a trend towards more intrapartum maternal pyrexia with amnioinfusion, whereas postpartum endometritis was reduced, and in the study of amnioinfusion for ruptured membranes, maternal infection was reduced.

The most striking finding was the reduction in caesarean sections following amnioinfusion. This effect was most marked for caesarean section performed for fetal distress, but this outcome is subject to reporting bias and should be interpreted with caution. Because mention is not made of the use of scalp blood pH measurement to confirm the diagnosis of fetal distress, it is possible that the difference in caesarean sections is due to the difference in the rate of variable fetal heart rate decelerations, which do not necessarily denote fetal distress. Another possible explanation is that the attending staff would have been reassured that problems relating to oligohydramnios had been attended to by means of amnioinfusion, and therefore less likely to opt for caesarean section.

Several other results may be secondary to the reduced rate of caesarean section with amnioinfusion: the longer rupture of membranes to delivery interval; the reduced rate of low Apgar scores; the reduced rate of endometritis; and the shorter maternal and neonatal hospital stays.

For three of the continuous variables (variable decelerations in the first and second stage of labour, and time from rupture of membranes to delivery), there were large differences in standard deviation between groups. These results should be interpreted with caution.

Undefined 'mild or severe birth asphyxia' was reduced in the amnioinfusion group in one study. Low Apgar scores were reduced with amnioinfusion at one and five minutes. The overall rate of umbilical cord blood pH values below 7.2 was reduced, but there was considerable variation between trials.

The results of the trials of transabdominal amnioinfusion are very similar to those of the trials of transcervical amnioinfusion. Vergani 1996 reported a significant reduction in suspicious/ominous fetal heart rate patterns; both studies together showed a significant reduction in caesarean sections for fetal distress; only Vergani 1996 gave figures for caesarean sections overall, which did not reach statistical significance; and the trend to improved fetal outcomes also did not reach statistical significance.

Monahan 1995 studied the effect of amnioinfusion in women with ruptured membranes for more than six hours, on infection. Maternal infection was significantly reduced without there being a difference in caesarean section rates. The study was too small to address the question of neonatal infection.

DISCUSSION

The results of the trials reviewed are generally consistent, except with respect to cord arterial pH values, and to the results of the study of Chauhan 1992. The lack of positive outcomes in the latter trial may be the result of the small numbers studied or the fact that amnioinfusion was administered on one occasion only.

The results should be interpreted with caution because of the methodological shortcomings identified, and the small numbers in the individual studies.

AUTHORS' CONCLUSIONS

Implications for practice

The evidence available from these trials suggests that amnioinfusion for potential or suspected umbilical cord compression reduces the occurrence of variable fetal heart rate decelerations and improves short-term neonatal outcomes. No important effect on longer-term neonatal outcome has been detected. Of considerable importance is the large reduction in caesarean sections, which is accounted for by a reduction in operations performed for 'fetal distress'. As no mention is made of fetal scalp blood sampling in any of the studies, this diagnosis may have been based on fetal heart rate patterns alone. Extrapolation of the results as a guide to clinical practice should therefore be limited to clinical situations in which caesarean sections are commonly performed for abnormal fetal heart rate patterns alone. Under these circumstances the use of amnioinfusion for potential or suspected umbilical cord compression may be of considerable benefit to the mother, though the methodological limitations of the trials reviewed here need to be kept in mind.

The trials reviewed are too small to address the possibility of rare but serious maternal side-effects of amnioinfusion. Several case reports have been published of cardiac failure or amniotic fluid embolism following amnioinfusion, though a causal relationship has not been established (Dibble 1992; Dragich 1991; Hofmeyr 1996; Maher 1994; Wegnelius 1996; Wenstrom 1994, cited under 'Additional references'). The benefits shown in the trials reviewed need to be weighed against the theoretical small risk of serious maternal complications. Far larger trials are needed to address the risk-benefit ratio of amnioinfusion conclusively.

The trials reviewed are also too small to assess the possibility of rare fetal complications, such as umbilical cord prolapse.

Trials in this review include the use of amnioinfusion both prophylactically for situations such as oligohydramnios, or therapeutically for fetal heart rate decelerations. The limited evidence available suggests that there is no advantage to using amnioinfusion prophylactically as opposed to therapeutically (*see* review Hofmeyr 1996a).

The trials of transabdominal amnioinfusion, though small, suggest that similar results are achieved as with transcervical amnioinfusion. The risk of transabdominal insertion of a needle into the amniotic cavity needs to be weighed against several theoretical advantages of the transabdominal route in women with intact membranes: the membranes do not need to be ruptured to perform amnioinfusion; there is no ongoing leakage of amniotic fluid, so that a single infusion is likely to be effective for several hours; and the discomfort, inconvenience and possible risks of an indwelling intrauterine catheter are avoided.

The single trial of amnioinfusion to reduce infection in women with ruptured membranes for longer than six hours has shown encouraging results, but is too small to be used as a basis for changes in clinical practice.

Implications for research

Larger randomized studies are needed to assess the effect of amnioinfusion for potential or suspected umbilical cord compression on neonatal wellbeing, and on the rate of caesarean sections, when fetal heart rate decelerations alone are not used as an indication for caesarean section, for example when fetal scalp blood sampling is used to confirm the diagnosis of fetal distress.

The use of transabdominal amnioinfusion deserves further research. In particular, a large trial in women with intact membranes comparing transabdominal amnioinfusion with artificial rupture of membranes and transcervical amnioinfusion may help to define possible risks associated with the presence of an indwelling intrauterine catheter.

The use of amnioinfusion to prevent infection in women with ruptured membranes also deserves further research.

POTENTIAL CONFLICT OF INTEREST

None known.

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* *Indicates the major publication for the study*

TABLES

Characteristics of included studies

Study	Amin 2003
Methods	Computer-generated random sequence in sequentially numbered opaque sealed envelopes.
Participants	Women in early labour (cervix < 4 cm); four-quadrant amniotic fluid index < 5 cm; membranes intact or ruptured; singleton term gestation; vertex presentation; normal fetal heart rate pattern. Exclusion criteria: vaginal bleeding; fetal congenital anomalies; fever; symmetrical fetal growth impairment; grand multiparity; uterine anomalies or scars; severe pre-eclampsia; estimated fetal weight < 1500 g; meconium-stained amniotic fluid.
Interventions	Transcervical amnioinfusion of 500 ml normal saline at 37 degrees centigrade over 30 minutes then 500 ml by gravity infusion, then re-evaluation of amniotic fluid index; versus routine care. Continuous fetal heart rate monitoring in both groups.
Outcomes	160/182 women gave consent. There were no exclusions after enrolment. Baseline data were similar between groups. Mean amniotic fluid index in the amnioinfusion group increased from 3.2 (SD 1.3) to 11.8 (1.5) after amnioinfusion. Outcomes: abnormal fetal heart rate patterns; caesarean section; Apgar scores; meconium below cords; umbilical artery pH; need for icu admission; maternal hypertonus; pyrexia and hospital stay.
Notes	February 2000 to September 2001, Assuit University Hospital.
Allocation concealment	A – Adequate

Study	Busowski 1995
Methods	'Prospectively randomized', method not specified.
Participants	Inclusion criteria: decreased amniotic fluid prior to induction of labour. Exclusion criteria: chorioamnionitis; fetal distress; nonvertex presentation; vaginal bleeding.
Interventions	Transabdominal amnioinfusion with 250 ml normal saline over 20 minutes under ultrasound guidance using a 22 gauge needle (n = 16), compared with no amnioinfusion (n = 15).
Outcomes	Caesarean section for fetal distress; cord pH < 7.20; 5 minute Apgar scores < 7. Data on caesarean section rates overall have been requested from the authors.
Notes	Considered separately from transcervical amnioinfusion as is a fundamentally different procedure.
Allocation concealment	C – Inadequate

Study	Chauhan 1992
Methods	Randomization using sealed envelopes drawn from a box.
Participants	Inclusion criteria: amniotic fluid index 5 cm or less; no fetal heart rate tracing abnormalities. Exclusion criteria: multiple pregnancy; ruptured membranes; late FHR decelerations; variable decelerations; non-reactive FHR patterns; chorioamnionitis; thick meconium; inability to place fetal scalp lead and the intrauterine pressure catheter at the time of artificial amniotomy.
Interventions	Amnioinfusion with 250 ml normal saline at room temperature, followed if necessary by repeat infusions of 100 ml until an amniotic fluid index of 5 cm or more achieved (n = 21), compared with control group (n = 17).
Outcomes	Recurrent (5 or more) moderate or severe variable decelerations or bradycardia; caesarean section for fetal distress; caesarean section overall; intrauterine resuscitation with terbutaline; Apgar score < 7 at 1 minute; Apgar score < 7 at 5 minutes; umbilical arterial pH < 7.2; perinatal death.

Characteristics of included studies (*Continued*)

Notes	An additional 15 women who refused participation were included as a comparison group. As they were not subject to random allocation, their results have not been included in this review. The interpretation of fetal heart rate response to the amnioinfusion may have been subject to bias as tracings were not stated to have been assessed 'blind'.
Allocation concealment	C – Inadequate

Study	**MacGregor 1991**
Methods	'Randomized', method not given.
Participants	Inclusion criteria: oligohydramnios (no amniotic fluid pocket measuring > 1 x 1 cm on ultrasound examination); singleton pregnancy; > 26 weeks gestation; cephalic presentation; cervical dilatation < 8 cm; no suspicion of intra-amniotic infection; no vaginal bleeding; no FHR pattern necessitating urgent delivery.
Interventions	Amnioinfusion with Ringer's solution warmed to 37 degrees centigrade at 10 ml per minute for 1 hour and continued if variable decelerations persisted until decelerations ceased or 800 ml had been infused, followed by infusion at 3 ml per minute till delivery (n = 19), compared with control group (n = 16).
Outcomes	Persistent variable decelerations; umbilical cord prolapse; caesarean section for suspected fetal distress; caesarean section overall; perinatal death; postpartum endometritis; umbilical arterial pH < 7.20.
Notes	All but 1 case of postpartum endometritis followed caesarean section. Maternal age higher in the amnioinfusion group (26.4 vs 23.1 years).
Allocation concealment	C – Inadequate

Study	**Miyazaki 1985**
Methods	Allocation by sealed envelopes.
Participants	Women with variable fetal heart rate decelerations during labour. Exclusions included severely abnormal FHR tracings, advanced labour, labour ward too busy and non-participation in the study of some attending staff.
Interventions	Amnioinfusion with normal saline until decelerations resolved plus 250 ml (maximum 800 ml) and repeated if necessary (n = 49), compared with control group (n = 47).
Outcomes	Persistent variable decelerations; umbilical cord prolapse; caesarean section for suspected fetal distress; Apgar score < 7 at 1 minute; Apgar score < 7 at 5 minutes; perinatal death.
Notes	Fetal heart rate tracings not stated to have been assessed 'blind'.
Allocation concealment	C – Inadequate

Study	**Monahan 1995**
Methods	Random allocation using a standard random numbers table with presealed envelopes.
Participants	Women in labour at > 25 weeks' gestation; rupture of membranes for > 6 hours; intrauterine pressure catheter already in place; not expected to deliver within the next 2 hours. Exclusion criteria: febrile women; already receiving amnioinfusion; evidence of fetal distress; known major fetal malformation; receiving broad spectrum antibiotics (group B streptococcal carriers receiving single agent antibiotics, usually ampicillin, were included).
Interventions	Amnioinfusion with a 300-500 ml bolus of room temperature normal saline followed by 100-150 ml per hour constant infusion (n = 36), compared with no amnioinfusion (n = 32).
Outcomes	Puerperal infection: chorioamnionitis (temperature > 38 degrees centigrade in labour with no other source of infection or > 37.5 degrees centigrade with at least one other clinical sign of infection such as uterine tenderness, 1+ or greater leukocyte esterase in the amniotic fluid or fetal tachycardia) and/or endometritis (temperature > 38.2 degrees centigrade more than 12 hours after delivery with uterine tenderness and/or foul lochia).

Characteristics of included studies (*Continued*)

Notes	Analysis was not by intention to treat. Two women allocated to receive amnioinfusion who did so for less than 1 hour were analysed with the control group. Two women in the control group who received amnioinfusion for variable decelerations were analysed in the amnioinfusion group. Further data to enable analysis by intention to treat have been requested from the primary author. This study is reviewed together with studies for potential cord compression because the indication for inclusion (ruptured membranes for more than 6 hours) places the women at risk of oligohydramnios, even though this was not the primary intention of the study. The primary outcome measures (infection) have also been reported in studies of amnioinfusion for potential cord compression.
Allocation concealment	B – Unclear

Study	**Nageotte 1985**
Methods	'Random' allocation (method not specified).
Participants	Women with clinically confirmed spontaneous prelabour rupture of the membranes at 26 to 35 weeks gestation, ultrasound-diagnosed oligohydramnios, vertex presentation and no fetal anomaly or distress.
Interventions	Intrapartum amnioinfusion with normal saline warmed to 37 degrees centigrade at 10 ml per minute for 1 hour (repeated if large fluid loss occurred subsequently), followed by infusion at 3 ml per minute (n = 29), compared with control group (n = 32). All participants had intrauterine pressure catheter inserted as early in labour as possible.
Outcomes	Caesarean section for suspected fetal distress; caesarean section, overall; perinatal death; postpartum endometritis; Apgar score < 7 at 1 minute; incidence of variable decelerations in first and second stage labour; umbilical arterial pH.
Notes	There were 5 withdrawals after randomization, for apparently legitimate reasons.
Allocation concealment	C – Inadequate

Study	**Nageotte 1991**
Methods	Allocation by random number table using sealed envelopes.
Participants	Inclusion criteria: postdates pregnancy (42 or more weeks), or suspected impaired fetal growth (clinical impression confirmed by poor growth on ultrasound measurements and estimated fetal weight below the 10th percentile for gestational age), plus oligohydramnios (amniotic fluid index < 8 cm). Exclusion criteria: previous classical caesarean section; non-vertex presentation; placenta praevia.
Interventions	Comparison between warmed saline (93-96 degrees Fahrenheit) group, room temperature saline (68-72 degrees Fahrenheit) group (together n = 50), and control group (n = 26). Amnioinfusion rate was 10 ml per minute for 1 hour, then 3 ml per minute until delivery, briefly stopped every 30 minutes to evaluate resting tone.
Outcomes	Meconium-stained amniotic fluid; umbilical cord prolapse; ruptured membranes to delivery interval; maximum maternal temperature intrapartum; variable FHR decelerations per hour in first and second stage of labour; caesarean section for suspected fetal distress; caesarean section overall; Apgar score < 7 at 5 minutes; umbilical arteria pH; perinatal death; meconium below the cords; meconium aspiration syndrome.
Notes	Three women in the control group received amnioinfusion and three in the amnioinfusion groups did not, but analysis was in the original groups according to intention to treat. The maternal and neonatal temperatures given are for the control and the warmed saline group. The room temperature saline group temperatures were identical to the control group. For all other analyses, the 2 amnioinfusion groups are grouped together.
Allocation concealment	B – Unclear

Study	**Owen 1990**
Methods	Randomly allocated using sealed envelopes.

Characteristics of included studies (*Continued*)

Participants	Women in spontaneous labour or due for induction of labour with no previous positive contraction stress test, with one of the following: postdates (at least 42 weeks) (5 amnioinfusion and 6 control); recurrent mild to moderate variable decelerations in labour unresponsive to maternal position change, hydration and oxygen therapy (13 and 20); preterm labour (before 37 weeks) (11 and 18); or oligohydramnios and/or suspected impaired fetal growth (14 and 13).
Interventions	Amnioinfusion with saline warmed to 37 degrees centigrade at 10 ml per minute for 1 hour, then 3 ml per minute (n = 43), was compared with a control group (n = 57). All women had intrauterine pressure transducers. Amnioinfusion was performed through a second intrauterine catheter.
Outcomes	Umbilical cord prolapse; caesarean section for suspected fetal distress; caesarean section overall; forceps or vacuum for suspected fetal distress; Apgar score < 7 at 5 minutes; cord arterial pH < 7.2; perinatal death; postpartum endometritis; admission to high-risk nursery. The 4-quadrant amniotic fluid index in 31 cases increased from mean 9.8 cm (SD 3.8) to 14.7 (3.7) after amnioinfusion.
Notes	The treatments were not blinded. There was an unexplained imbalance between the treatment and control group, and within the various enrolment categories which might have influenced results. For example, in the amnioinfusion group there were relatively fewer women enrolled for variable decelerations and preterm labour. Personal communication with the first author revealed that the discrepancies were partly due to chance and partly due to withdrawal of a few women from the amnioinfusion group who for technical reasons did not receive amnioinfusion. These withdrawals may have affected the results.
Allocation concealment	B – Unclear

Study	**Puertas 2001**
Methods	'Randomized clinical assay'.
Participants	Women in labour, intact membranes and oligohydramnios (amniotic fluid index < 8).
Interventions	Intrapartum transcervical amnioinfusion versus no amnioinfusion; continuous monitoring of fetal heart rate, fetal oxygen saturation and intrauterine pressure.
Outcomes	Interventions for fetal distress; neonatal acid-base status.
Notes	University Hospital, Granada. Data not included yet as only percentages given in the abstract.
Allocation concealment	B – Unclear

Study	**Schrimmer 1991**
Methods	Computer randomization with treatment: non-treatment ratio of 3:2, using sealed envelopes.
Participants	Inclusion criteria: women in labour or admitted for induction of labour, with oligohydramnios (4-quadrant amniotic fluid index < 5 cm); singleton vertex presentation; normal FHR baseline and variability. Exclusion criteria: moderate or severe variable decelerations; late decelerations; vaginal bleeding; fetal anomalies; chorioamnionitis.
Interventions	Amnioinfusion of 500 ml saline warmed to 37 degrees centigrade infused by gravity over 20-30 minutes (15 to 25 ml per minute), followed by repeat ultrasound examination after initial infusion and hourly, and reinfusion of 500 ml if AFI < 5 cm, 250 ml if AFI > 5 and < 10 cm (n = 175), compared with control group (n = 130). Women in both groups had intrauterine pressure transducers inserted.
Outcomes	Increase in amniotic fluid index after 500 ml infusion (mean 8.4, standard deviation 1.4 cm); amnionitis (amnioinfusion 18/175 vs control 9/130); caesarean section for suspected fetal distress; caesarean section overall; forceps or vacuum for suspected fetal distress; forceps or vacuum delivery overall; Apgar score < 7 at 1 minute; Apgar score < 7 at 5 minutes; cord arterial pH < 7.2; perinatal death; postpartum endometritis; maternal hospital stay > 3 days; neonatal hospital stay > 3 days.
Notes	Los Angeles, California, USA. August 1989 to September 1990. Study not blinded, but research procedures carried out by researchers not involved in clinical care and clinical decisions. Discrepancy between the number

	of caesarean sections in the amnioinfusion group ascribed to fetal distress, between the preliminary report (Schrimmer 1991) and the final report (Schrimmer 1991) (24/171 vs 14/175). 85 subjects from this study are included in the report of Macri 1992 (Paul RH, personal communication). (See Cochrane review 'Hofmeyr 2002'.)
Allocation concealment	B – Unclear

Study	**Strong 1990**
Methods	Randomized permuted block technique (n = 6) allocation using sealed envelopes.
Participants	Inclusion criteria: labouring women with oligohydramnios (amniotic fluid index < 5 cm); singleton vertex presentation; 4 cm or less cervical dilatation; 37 or more weeks gestation; normal baseline FHR variability; estimated fetal weight > 2500 g. Exclusion criteria: late FHR decelerations; moderate or severe variable decelerations; vaginal bleeding; chorioamnionitis; meconium-stained amniotic fluid; fetal anomalies; uterine anomalies.
Interventions	Amnioinfusion of 250 ml saline warmed to 37 degrees centigrade at 10 to 20 ml per minute, repeated until an amniotic fluid index of 8 cm was reached and if the amniotic fluid index fell below 8 cm on subsequent hourly ultrasound examinations (n = 30), compared with control group (n = 30).
Outcomes	Persistent variable decelerations; meconium-stained amniotic fluid; umbilical cord prolapse; caesarean section for suspected fetal distress; caesarean section overall; forceps or vacuum for suspected fetal distress; forceps or vacuum delivery overall; Apgar score < 7 at 1 minute; Apgar score < 7 at 5 minutes; umbilical cord arterial pH < 7.20; neonatal sepsis; perinatal death; rupture of membranes to delivery interval; intrapartum maternal temperature > 38 degrees centigrade.
Notes	The rupture of membranes to delivery interval was longer in the amnioinfusion group (mean 16.8, SD 12.1 hours) than the control group (10.1, 6.5), and this difference persisted for vaginal deliveries (data not given). This result is difficult to interpret as the incidence of ruptured membranes at admission in the amnioinfusion group was 15/30 compared with 8/30 in the control group. The longer duration of ruptured membranes may thus have been related to a chance difference in the groups rather than an effect of amnioinfusion. The same may apply to the excess of maternal pyrexia in the amnioinfusion group.
Allocation concealment	B – Unclear

Study	**Vergani 1996**
Methods	Allocation by a 'computer generated randomization table'. Not specified whether next allocation concealed prior to enrolment.
Participants	Non-labouring primiparous women at term with ultrasonographic diagnosis of oligohydramnios (largest amniotic fluid pocket < 2 x 2 cm on perpendicular planes); singleton gestation; vertex presentation; gestational age 37+ weeks; ultrasound estimated fetal weight 2500 g+; reactive non-stress test; cervical Bishop score 6 or less; intact membranes. Exclusion criteria: maternal indications leading to an elective caesarean section.
Interventions	Transabdominal amnioinfusion under ultrasonographic guidance: normal saline 500 ml at 37 degrees centigrade infused through a 20 gauge spinal needle at 30 ml per minute. Sulbactam-ampicillin 3 gm given intravenously (n = 39). Compared with no amnioinfusion (n = 40). Labour induction within 1-4 hours of randomization: for Bishop score 4 or less, intracervical prostaglandin E2 0.5 mg, repeated 3 times 6-hourly; for Bishop score 5-6 intravaginal prostaglandin E2 1.5 mg, repeated twice at 8 hour intervals. Membranes were ruptured when Bishop score was > 6 or all the doses of prostaglandins had been given, and oxytocin infusion started after 2 hours if not in labour.
Outcomes	Apgar score at 5 minutes; umbilical artery pH; meconium-stained amniotic fluid; maternal infectious morbidity; neonatal complications.
Notes	Power calculation required 114 participants in each group to show a 75% reduction in caesarean section for fetal distress. The study was suspended when an interim analysis showed that significance had been reached (total 79 participants). Spontaneous onset of labour occurred in 5 women after amnioinfusion.

Allocation concealment	C – Inadequate

Study	**Wu 1989**
Methods	'Randomized'. Method not specified.
Participants	Hospitalised women in labour, full-term or post-term, vertex presentation, amniotic area =/< 2 cm on ultrasound or < 100 ml obtained at rupture of membranes.
Interventions	Amnioinfusion with normal saline warmed to 37 degrees centigrade, 500 ml at 15-20 ml per minute followed by slow or intermittent infusion (n = 60), compared with controls (n = 58).
Outcomes	'Mild or severe birth asphyxia'; caesarean section for suspected fetal distress; caesarean section overall; perinatal death; postpartum endometritis.
Notes	'Postpartum morbidity' interpreted as postpartum endometritis.
Allocation concealment	C – Inadequate

AFI: amniotic fluid index
FHR: fetal heart rate
icu: intensive care unit
SD: standard deviation
vs: versus

Characteristics of excluded studies

Study	**Reason for exclusion**
McEvoy 1991	No difference was found in pulmonary mechanics or oxygen saturation in a subset of 18 neonates born to mothers who had been enrolled in a randomized trial of amnioinfusion for oligohydramnios at their institution. They do not state how the subset of 18 infants studied was derived from the larger trial. In a subsequent publication by the same authors in 1995, results of 42 infants, presumably from the same study, are given. No significant differences in pulmonary mechanics or oxygenation were found between infants whose mothers had received amnioinfusion (n = 22) or the controls (n = 20). The study is excluded because, without information on how the subset of infants studied was derived from the larger trial, it is not possible to be sure that selection bias was excluded. It is also not stated whether the subset was derived from the larger study from the same unit included in this review (Schrimmer 1991).
Muse 1997	Randomized comparison of the effect of cold versus body temperature amnioinfusion on fetal TSH levels. The difference (13.12 SD 5.02 versus 7.67 SD 0.75 respectively) was not statistically significant, but the numbers studied were small (total n = 13).
Pressman 1996	No randomized comparison with a control group. Thirty-nine women receiving amnioinfusion were randomized by sequential sealed envelopes to receive lactated Ringer's solution plus 5 ml/L physiologic glucose (n = 18) or normal saline (n = 21). Infusates were warmed to 39 degrees centigrade and 500 ml infused over 30 minutes, followed by a continuous infusion at 200 ml/hour. The groups were not well matched for nulliparity (Ringer's 22% vs saline 52%). There were no differences in neonatal electrolyte or acid-base status. There were no statistically significant differences in length of labour (10.9 (SD 8.9) vs 12.1 (5.4) hours); length of ruptured membranes (7.7 (9.4) vs 9.8 (5.1) hours); caesarean sections (39% vs 33%); operative deliveries (55% vs 36%); chorioamnionitis (5.6 vs 19%); postpartum endometritis (17% vs 19%); or Apgar scores < 7 at 5 minutes (5.5 vs 4.8%).
Washburne 1996	No randomized comparison with control group. Sixty-seven women receiving amnioinfusion were randomized by computer-generated cards in sealed envelopes to receive lactated Ringer's solution (n = 30) or normal saline (n = 37). Warmed solution was infused in 500 ml increments to a volume of 500-1500 ml.

Characteristics of excluded studies (*Continued*)

There were no statistically significant differences with respect to amnioinfusion to delivery time (Ringer's lactate 3.9 hours (SD 2.5) vs saline 5.9 hours (3.6)); or maternal or neonatal electrolyte levels.

SD: standard deviation
TSH: thyroid stimulating hormone
vs: versus

ANALYSES

Comparison 01. Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Persistent variable decelerations	4	227	Relative Risk (Fixed) 95% CI	0.54 [0.43, 0.68]
02 Variable fetal heart rate decelerations per hour in first stage of labour	2	137	Weighted Mean Difference (Fixed) 95% CI	-4.37 [-6.09, -2.64]
03 Variable fetal heart rate decelerations during second stage of labour	1	20	Relative Risk (Fixed) 95% CI	0.78 [0.49, 1.23]
04 Variable fetal heart rate decelerations per hour in second stage of labour	2	137	Weighted Mean Difference (Fixed) 95% CI	-8.12 [-10.77, -5.48]
05 Intrauterine resuscitation used	1	36	Relative Risk (Fixed) 95% CI	0.30 [0.03, 2.60]
06 Meconium-stained amniotic fluid	2	136	Relative Risk (Fixed) 95% CI	0.73 [0.49, 1.09]
07 Umbilical cord prolapse	6	527	Relative Risk (Fixed) 95% CI	2.94 [0.31, 27.63]
08 Rupture of membranes to delivery interval (hours)	2	136	Weighted Mean Difference (Fixed) 95% CI	2.24 [0.50, 3.98]
09 Intrapartum maternal temperature > 38 centigrade	1	60	Relative Risk (Fixed) 95% CI	3.00 [0.66, 13.69]
10 Caesarean for suspected fetal distress	9	889	Relative Risk (Fixed) 95% CI	0.35 [0.24, 0.52]
11 Caesarean section, overall	9	953	Relative Risk (Fixed) 95% CI	0.52 [0.40, 0.69]
12 Forceps/vacuum-suspected fetal distress	3	465	Relative Risk (Fixed) 95% CI	0.50 [0.27, 0.94]
13 Forceps or vacuum delivery, overall	2	365	Relative Risk (Fixed) 95% CI	0.72 [0.47, 1.10]
14 Apgar score < 7 at 1 minute	5	652	Relative Risk (Fixed) 95% CI	0.32 [0.22, 0.45]
15 Apgar score < 7 at 5 minutes	7	828	Relative Risk (Fixed) 95% CI	0.54 [0.30, 0.97]
16 'Mild' or 'severe' birth asphyxia	1	118	Relative Risk (Fixed) 95% CI	0.32 [0.15, 0.70]
17 Low cord arterial pH (< 7.2 or as defined by trial authors)	6	660	Relative Risk (Fixed) 95% CI	0.45 [0.31, 0.64]
18 Neonatal sepsis	1	60	Relative Risk (Fixed) 95% CI	3.00 [0.13, 70.83]
19 Perinatal death	8	584	Relative Risk (Fixed) 95% CI	0.51 [0.11, 2.24]
20 Postpartum endometritis	5	619	Relative Risk (Fixed) 95% CI	0.45 [0.25, 0.81]
21 Umbilical cord arterial pH	5	577	Weighted Mean Difference (Fixed) 95% CI	0.03 [0.02, 0.05]
22 Admission to high-risk nursery	2	260	Relative Risk (Fixed) 95% CI	0.69 [0.41, 1.17]
23 Meconium below vocal cords	2	236	Relative Risk (Fixed) 95% CI	0.66 [0.34, 1.28]
24 Meconium aspiration syndrome	1	76	Relative Risk (Fixed) 95% CI	Not estimable
25 Maternal hospital stay > 3 days	2	465	Relative Risk (Fixed) 95% CI	0.41 [0.27, 0.63]
26 Neonatal hospital stay > 3 days	1	305	Relative Risk (Fixed) 95% CI	0.40 [0.26, 0.62]

Comparison 02. Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor)

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Persistent variable decelerations	0	0	Relative Risk (Fixed) 95% CI	Not estimable
02 Suspicious/ominous fetal heart rate pattern	1	70	Relative Risk (Fixed) 95% CI	0.13 [0.03, 0.52]
03 Meconium stained liquor	1	79	Relative Risk (Fixed) 95% CI	1.37 [0.52, 3.58]
04 Umbilical cord prolapse	0	0	Relative Risk (Fixed) 95% CI	Not estimable
05 Caesarean for suspected fetal distress	2	110	Relative Risk (Fixed) 95% CI	0.20 [0.05, 0.74]
06 Caesarean section, overall	1	79	Relative Risk (Fixed) 95% CI	0.43 [0.17, 1.10]
07 Forceps/vacuum - suspected fetal distress	0	0	Relative Risk (Fixed) 95% CI	Not estimable
08 Forceps/vacum delivery, overall	1	79	Relative Risk (Fixed) 95% CI	Not estimable
09 Apgar < 7 at 1 minute	0	0	Relative Risk (Fixed) 95% CI	Not estimable
10 Apgar score < 7 at 5 minutes	2	110	Relative Risk (Fixed) 95% CI	0.64 [0.18, 2.31]
11 Low cord pH (< 7.20 or as defined by trialists)	2	75	Relative Risk (Fixed) 95% CI	0.20 [0.04, 1.06]

Comparison 03. Amnioinfusion for suspected or potential intrauterine infection

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Persistent variable decelerations	0	0	Relative Risk (Fixed) 95% CI	Not estimable
02 Meconium stained liquor	0	0	Relative Risk (Fixed) 95% CI	Not estimable
03 Epidural analgesia in labour	1	68	Relative Risk (Fixed) 95% CI	1.00 [0.75, 1.35]
04 Caesarean section, overall	1	67	Relative Risk (Fixed) 95% CI	1.21 [0.43, 3.42]
05 Forceps/vacuum delivery overall	0	0	Relative Risk (Fixed) 95% CI	Not estimable
06 Apgar score < 7 at 5 minutes	0	0	Relative Risk (Fixed) 95% CI	Not estimable
07 Umbilical artery blood pH < 7.20	0	0	Relative Risk (Fixed) 95% CI	Not estimable
08 Puerperal infection	1	68	Relative Risk (Fixed) 95% CI	0.50 [0.26, 0.97]
09 Neonatal infection	1	68	Relative Risk (Fixed) 95% CI	Not estimable

INDEX TERMS

Medical Subject Headings (MeSH)

*Amnion; Chorioamnionitis [*prevention & control]; *Injections; Obstetric Labor Complications [*prevention & control]; Umbilical Cord

MeSH check words

Female; Humans; Pregnancy

COVER SHEET

Title Amnioinfusion for potential or suspected umbilical cord compression in labour

Authors Hofmeyr GJ

Contribution of author(s)	GJ Hofmeyr prepared and maintains the review.
Issue protocol first published	1996/2
Review first published	1996/2
Date of most recent amendment	21 February 2005
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What's New	November 2004: Search updated. One new trial identified which has been included (Amin 2003). The title has changed from 'Amnioinfusion for umbilical cord compression in labour' to 'Amnioinfusion for potential or suspected umbilical cord compression in labour'.
Date new studies sought but none found	Information not supplied by author
Date new studies found but not yet included/excluded	01 November 2004
Date new studies found and included/excluded	Information not supplied by author
Date authors' conclusions section amended	Information not supplied by author
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GRAPHS AND OTHER TABLES

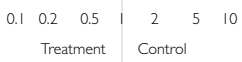
Analysis 01.01. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 01 Persistent variable decelerations

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 01 Persistent variable decelerations

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Chauhan 1992	5/19	8/17		9.6	0.56 [0.23, 1.38]
MacGregor 1991	4/19	12/16		14.7	0.28 [0.11, 0.70]
Miyazaki 1985	24/49	45/47		52.0	0.51 [0.38, 0.69]
Strong 1990	16/30	21/30		23.8	0.76 [0.51, 1.15]
Total (95% CI)	117	110		100.0	0.54 [0.43, 0.68]
Total events: 49 (Treatment), 86 (Control)					
Test for heterogeneity chi-square=4.81 df=3 p=0.19 I^2 =37.7%					
Test for overall effect z=5.26 p<0.00001					



Analysis 01.02. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 02 Variable fetal heart rate decelerations per hour in first stage of labour

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 02 Variable fetal heart rate decelerations per hour in first stage of labour

Study	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Nageotte 1985	29	2.40 (2.40)	32	7.90 (5.60)		65.6	-5.50 [-7.63, -3.37]
Nageotte 1991	50	1.50 (2.10)	26	3.70 (7.50)		34.4	-2.20 [-5.14, 0.74]
Total (95% CI)	79		58			100.0	-4.37 [-6.09, -2.64]
Test for heterogeneity chi-square=3.17 df=1 p=0.07 I^2 =68.5%							
Test for overall effect z=4.96 p<0.00001							

Analysis 01.03. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 03 Variable fetal heart rate decelerations during second stage of labour

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 03 Variable fetal heart rate decelerations during second stage of labour

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
MacGregor 1991	7/10	9/10		100.0	0.78 [0.49, 1.23]
Total (95% CI)	10	10		100.0	0.78 [0.49, 1.23]
Total events: 7 (Treatment), 9 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.08 p=0.3					

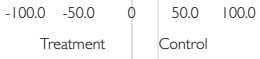
Analysis 01.04. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 04 Variable fetal heart rate decelerations per hour in second stage of labour

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 04 Variable fetal heart rate decelerations per hour in second stage of labour

Study	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Nageotte 1985	29	7.20 (7.00)	32	18.00 (6.00)		64.8	-10.80 [-14.09, -7.51]
Nageotte 1991	50	9.00 (2.10)	26	12.20 (11.50)		35.2	-3.20 [-7.66, 1.26]
Total (95% CI)	79		58			100.0	-8.12 [-10.77, -5.48]
Test for heterogeneity chi-square=7.23 df=1 p=0.007 I^2 =86.2%							
Test for overall effect z=6.02 p<0.00001							



Analysis 01.05. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 05 Intrauterine resuscitation used

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 05 Intrauterine resuscitation used

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Chauhan 1992	1/19	3/17		100.0	0.30 [0.03, 2.60]
Total (95% CI)	19	17		100.0	0.30 [0.03, 2.60]
Total events: 1 (Treatment), 3 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.09 p=0.3					

Analysis 01.06. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 06 Meconium-stained amniotic fluid

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 06 Meconium-stained amniotic fluid

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Nageotte 1991	27/50	15/26		64.2	0.94 [0.62, 1.42]
Strong 1990	4/30	11/30		35.8	0.36 [0.13, 1.01]
Total (95% CI)	80	56		100.0	0.73 [0.49, 1.09]
Total events: 31 (Treatment), 26 (Control)					
Test for heterogeneity chi-square=3.13 df=1 p=0.08 I^2 =68.0%					
Test for overall effect z=1.54 p=0.1					

Analysis 01.07. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 07 Umbilical cord prolapse

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 07 Umbilical cord prolapse

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
× Amin 2003	0/80	0/80		0.0	Not estimable
× MacGregor 1991	0/19	0/16		0.0	Not estimable
Miyazaki 1985	1/49	0/47		50.5	2.88 [0.12, 68.98]
× Nageotte 1991	0/50	0/26		0.0	Not estimable
× Owen 1990	0/43	0/57		0.0	Not estimable
Strong 1990	1/30	0/30		49.5	3.00 [0.13, 70.83]
Total (95% CI)	271	256		100.0	2.94 [0.31, 27.63]

Total events: 2 (Treatment), 0 (Control)

Test for heterogeneity chi-square=0.00 df=1 p=0.99 I^2 =0.0%

Test for overall effect z=0.94 p=0.3

Analysis 01.08. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 08 Rupture of membranes to delivery interval (hours)

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

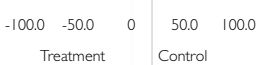
Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 08 Rupture of membranes to delivery interval (hours)

Study	Treatment N	Treatment Mean(SD)	Control N	Control Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
Nageotte 1991	50	8.60 (4.50)	26	7.00 (3.60)		87.4	1.60 [-0.26, 3.46]
Strong 1990	30	16.80 (12.10)	30	10.10 (6.50)		12.6	6.70 [1.78, 11.62]
Total (95% CI)	80		56			100.0	2.24 [0.50, 3.98]

Test for heterogeneity chi-square=3.62 df=1 p=0.06 I^2 =72.3%

Test for overall effect z=2.52 p=0.01



Analysis 01.09. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 09 Intrapartum maternal temperature > 38 centigrade

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 09 Intrapartum maternal temperature > 38 centigrade

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Strong 1990	6/30	2/30		100.0	3.00 [0.66, 13.69]
Total (95% CI)	30	30		100.0	3.00 [0.66, 13.69]
Total events: 6 (Treatment), 2 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.42 p=0.2					

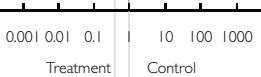
Analysis 01.10. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 10 Caesarean for suspected fetal distress

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 10 Caesarean for suspected fetal distress

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Chauhan 1992	2/21	1/17		1.4	1.62 [0.16, 16.37]
MacGregor 1991	6/19	6/16		8.1	0.84 [0.34, 2.10]
Miyazaki 1985	9/49	12/47		15.1	0.72 [0.33, 1.55]
Nageotte 1985	1/29	7/32		8.2	0.16 [0.02, 1.21]
Nageotte 1991	2/50	4/26		6.5	0.26 [0.05, 1.33]
Owen 1990	2/43	9/57		9.6	0.29 [0.07, 1.29]
Schrimmer 1991	7/175	25/130		35.5	0.21 [0.09, 0.47]
Strong 1990	1/30	4/30		4.9	0.25 [0.03, 2.11]
Wu 1989	0/60	8/58		10.7	0.06 [0.00, 0.96]
Total (95% CI)	476	413		100.0	0.35 [0.24, 0.52]
Total events: 30 (Treatment), 76 (Control)					
Test for heterogeneity chi-square=12.68 df=8 p=0.12 I^2 =36.9%					
Test for overall effect z=5.23 p<0.00001					



Analysis 01.11. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 11 Caesarean section, overall

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 11 Caesarean section, overall

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Amin 2003	5/80	17/80		14.2	0.29 [0.11, 0.76]
Chauhan 1992	4/21	3/17		2.8	1.08 [0.28, 4.18]
MacGregor 1991	10/19	7/16		6.3	1.20 [0.60, 2.42]
Nageotte 1985	2/29	7/32		5.5	0.32 [0.07, 1.40]
Nageotte 1991	7/50	7/26		7.7	0.52 [0.20, 1.32]
Owen 1990	8/43	17/57		12.2	0.62 [0.30, 1.31]
Schrimmer 1991	25/175	36/130		34.4	0.52 [0.33, 0.81]
Strong 1990	4/30	6/30		5.0	0.67 [0.21, 2.13]
Wu 1989	4/60	14/58		11.9	0.28 [0.10, 0.79]
Total (95% CI)	507	446		100.0	0.52 [0.40, 0.69]

Total events: 69 (Treatment), 114 (Control)

Test for heterogeneity chi-square=10.17 df=8 p=0.25 I^2 =21.3%

Test for overall effect z=4.67 p<0.00001

Analysis 01.12. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 12 Forceps/vacuum-suspected fetal distress

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 12 Forceps/vacuum-suspected fetal distress

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Owen 1990	6/43	10/57		32.5	0.80 [0.31, 2.02]
Schrimmer 1991	7/175	9/130		39.1	0.58 [0.22, 1.51]
Strong 1990	0/30	7/30		28.4	0.07 [0.00, 1.12]
Total (95% CI)	248	217		100.0	0.50 [0.27, 0.94]

Total events: 13 (Treatment), 26 (Control)

Test for heterogeneity chi-square=2.98 df=2 p=0.23 I^2 =32.9%

Test for overall effect z=2.15 p=0.03

Analysis 01.13. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 13 Forceps or vacuum delivery, overall

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 13 Forceps or vacuum delivery, overall

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Schrimmer 1991	28/175	28/130		80.1	0.74 [0.46, 1.19]
Strong 1990	5/30	8/30		19.9	0.63 [0.23, 1.69]
Total (95% CI)	205	160		100.0	0.72 [0.47, 1.10]
Total events: 33 (Treatment), 36 (Control)					
Test for heterogeneity chi-square=0.09 df=1 p=0.76 I^2 =0.0%					
Test for overall effect z=1.51 p=0.1					

Analysis 01.14. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 14 Apgar score < 7 at 1 minute

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 14 Apgar score < 7 at 1 minute

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Amin 2003	8/80	32/80		31.4	0.25 [0.12, 0.51]
Chauhan 1992	1/19	5/12		6.0	0.13 [0.02, 0.95]
Miyazaki 1985	11/49	9/47		9.0	1.17 [0.53, 2.57]
Schrimmer 1991	14/175	45/130		50.6	0.23 [0.13, 0.40]
Strong 1990	1/30	3/30		2.9	0.33 [0.04, 3.03]
Total (95% CI)	353	299		100.0	0.32 [0.22, 0.45]
Total events: 35 (Treatment), 94 (Control)					
Test for heterogeneity chi-square=13.12 df=4 p=0.01 I^2 =69.5%					
Test for overall effect z=6.34 p<0.00001					

Analysis 01.15. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 15 Apgar score < 7 at 5 minutes

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 15 Apgar score < 7 at 5 minutes

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Amin 2003	2/80	11/80		36.7	0.18 [0.04, 0.79]
Chauhan 1992	1/19	0/12		2.0	1.95 [0.09, 44.32]
Miyazaki 1985	4/49	4/47		13.6	0.96 [0.25, 3.62]
Nageotte 1991	2/50	2/26		8.8	0.52 [0.08, 3.48]
Owen 1990	1/43	1/57		2.9	1.33 [0.09, 20.60]
Schrimmer 1991	6/175	9/130		34.4	0.50 [0.18, 1.36]
Strong 1990	1/30	0/30		1.7	3.00 [0.13, 70.83]
Total (95% CI)	446	382		100.0	0.54 [0.30, 0.97]

Total events: 17 (Treatment), 27 (Control)

Test for heterogeneity chi-square=5.03 df=6 p=0.54 I^2 =0.0%

Test for overall effect z=2.07 p=0.04

Analysis 01.16. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 16 'Mild' or 'severe' birth asphyxia

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 16 'Mild' or 'severe' birth asphyxia

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Wu 1989	7/60	21/58		100.0	0.32 [0.15, 0.70]
Total (95% CI)	60	58		100.0	0.32 [0.15, 0.70]

Total events: 7 (Treatment), 21 (Control)

Test for heterogeneity: not applicable

Test for overall effect z=2.86 p=0.004

Analysis 01.17. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 17 Low cord arterial pH (< 7.2 or as defined by trial authors)

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 17 Low cord arterial pH (< 7.2 or as defined by trial authors)

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Amin 2003	2/80	13/80		17.1	0.15 [0.04, 0.66]
Chauhan 1992	2/19	1/12		1.6	1.26 [0.13, 12.46]
MacGregor 1991	3/19	3/16		4.3	0.84 [0.20, 3.61]
Owen 1990	13/39	10/55		10.9	1.83 [0.90, 3.75]
Schrimmer 1991	14/175	39/130		59.0	0.27 [0.15, 0.47]
Strong 1990	0/17	5/18		7.1	0.10 [0.01, 1.61]
Total (95% CI)	349	311		100.0	0.45 [0.31, 0.64]
Total events: 34 (Treatment), 71 (Control)					
Test for heterogeneity chi-square=22.87 df=5 p=0.0004 I^2 =78.1%					
Test for overall effect z=4.33 p=0.00002					

Analysis 01.18. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 18 Neonatal sepsis

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 18 Neonatal sepsis

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Strong 1990	1/30	0/30		100.0	3.00 [0.13, 70.83]
Total (95% CI)	30	30		100.0	3.00 [0.13, 70.83]
Total events: 1 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.68 p=0.5					

Analysis 01.19. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 19 Perinatal death

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 19 Perinatal death

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
× Chauhan 1992	0/21	0/17		0.0	Not estimable
× MacGregor 1991	0/19	0/16		0.0	Not estimable
× Miyazaki 1985	0/49	0/47		0.0	Not estimable
Nageotte 1985	1/29	2/32		37.3	0.55 [0.05, 5.77]
Nageotte 1991	1/50	0/26		12.8	1.59 [0.07, 37.68]
× Owen 1990	0/43	0/57		0.0	Not estimable
× Strong 1990	0/30	0/30		0.0	Not estimable
Wu 1989	0/60	2/58		49.9	0.19 [0.01, 3.94]
Total (95% CI)	301	283		100.0	0.51 [0.11, 2.24]

Total events: 2 (Treatment), 4 (Control)

Test for heterogeneity chi-square=0.90 df=2 p=0.64 I^2 =0.0%

Test for overall effect z=0.90 p=0.4

Analysis 01.20. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 20 Postpartum endometritis

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 20 Postpartum endometritis

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
MacGregor 1991	4/19	1/16		3.3	3.37 [0.42, 27.18]
Nageotte 1985	1/29	3/32		8.6	0.37 [0.04, 3.34]
Owen 1990	1/43	11/57		28.7	0.12 [0.02, 0.90]
Schrimmer 1991	7/175	10/130		34.8	0.52 [0.20, 1.33]
Wu 1989	3/60	8/58		24.6	0.36 [0.10, 1.30]
Total (95% CI)	326	293		100.0	0.45 [0.25, 0.81]

Total events: 16 (Treatment), 33 (Control)

Test for heterogeneity chi-square=5.46 df=4 p=0.24 I^2 =26.8%

Test for overall effect z=2.63 p=0.008

Analysis 01.21. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 21 Umbilical cord arterial pH

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

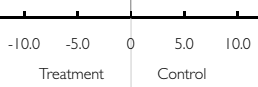
Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 21 Umbilical cord arterial pH

Study	Treatment		Control		Weighted Mean Difference (Fixed)	Weight	Weighted Mean Difference (Fixed)
	N	Mean(SD)	N	Mean(SD)	95% CI	(%)	95% CI
MacGregor 1991	19	7.25 (0.07)	16	7.24 (0.07)		6.8	0.01 [-0.04, 0.06]
Nageotte 1985	29	7.34 (0.05)	32	7.23 (0.08)		13.4	0.11 [0.08, 0.14]
Nageotte 1991	50	7.28 (0.07)	26	7.28 (0.10)		8.0	0.00 [-0.04, 0.04]
Owen 1990	43	7.24 (0.07)	57	7.25 (0.06)		21.7	-0.01 [-0.04, 0.02]
Schrimmer 1991	175	7.27 (0.05)	130	7.23 (0.09)		50.1	0.04 [0.02, 0.06]
Total (95% CI)	316		261			100.0	0.03 [0.02, 0.05]

Test for heterogeneity chi-square=34.99 df=4 p=<0.0001 I^2 =88.6%

Test for overall effect z=5.38 p<0.00001



Analysis 01.22. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 22 Admission to high-risk nursery

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

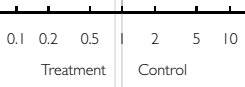
Outcome: 22 Admission to high-risk nursery

Study	Treatment	Control	Relative Risk (Fixed)	Weight	Relative Risk (Fixed)
	n/N	n/N	95% CI	(%)	95% CI
Amin 2003	15/80	18/80		63.6	0.83 [0.45, 1.54]
Owen 1990	4/43	12/57		36.4	0.44 [0.15, 1.28]
Total (95% CI)	123	137		100.0	0.69 [0.41, 1.17]

Total events: 19 (Treatment), 30 (Control)

Test for heterogeneity chi-square=1.04 df=1 p=0.31 I^2 =4.3%

Test for overall effect z=1.38 p=0.2



Analysis 01.23. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 23 Meconium below vocal cords

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 23 Meconium below vocal cords

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Amin 2003	5/80	11/80		58.2	0.45 [0.17, 1.25]
Nageotte 1991	11/50	6/26		41.8	0.95 [0.40, 2.29]
Total (95% CI)	130	106		100.0	0.66 [0.34, 1.28]
Total events: 16 (Treatment), 17 (Control)					
Test for heterogeneity chi-square=1.20 df=1 p=0.27 I^2 =16.6%					
Test for overall effect z=1.23 p=0.2					

Analysis 01.24. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 24 Meconium aspiration syndrome

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 24 Meconium aspiration syndrome

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
× Nageotte 1991	0/50	0/26		0.0	Not estimable
Total (95% CI)	50	26		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					

Analysis 01.25. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 25 Maternal hospital stay > 3 days

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 25 Maternal hospital stay > 3 days

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Amin 2003	5/80	17/80		28.6	0.29 [0.11, 0.76]
Schrimmer 1991	23/175	37/130		71.4	0.46 [0.29, 0.74]
Total (95% CI)	255	210		100.0	0.41 [0.27, 0.63]
Total events: 28 (Treatment), 54 (Control)					
Test for heterogeneity chi-square=0.71 df=1 p=0.40 I^2 =0.0%					
Test for overall effect z=4.11 p=0.00004					

Analysis 01.26. Comparison 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM), Outcome 26 Neonatal hospital stay > 3 days

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 01 Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by EFM)

Outcome: 26 Neonatal hospital stay > 3 days

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Schrimmer 1991	24/175	45/130		100.0	0.40 [0.26, 0.62]
Total (95% CI)	175	130		100.0	0.40 [0.26, 0.62]
Total events: 24 (Treatment), 45 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=4.12 p=0.00004					

Analysis 02.02. Comparison 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor), Outcome 02 Suspicious/ominous fetal heart rate pattern

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor)

Outcome: 02 Suspicious/ominous fetal heart rate pattern

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Vergani 1996	2/37	14/33		100.0	0.13 [0.03, 0.52]
Total (95% CI)	37	33		100.0	0.13 [0.03, 0.52]
Total events: 2 (Treatment), 14 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=2.87 p=0.004					

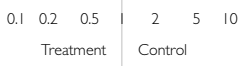
Analysis 02.03. Comparison 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor), Outcome 03 Meconium stained liquor

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor)

Outcome: 03 Meconium stained liquor

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Vergani 1996	8/39	6/40		100.0	1.37 [0.52, 3.58]
Total (95% CI)	39	40		100.0	1.37 [0.52, 3.58]
Total events: 8 (Treatment), 6 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.64 p=0.5					



Analysis 02.05. Comparison 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor), Outcome 05 Caesarean for suspected fetal distress

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor)

Outcome: 05 Caesarean for suspected fetal distress

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Busowski 1995	0/16	2/15		20.7	0.19 [0.01, 3.63]
Vergani 1996	2/39	10/40		79.3	0.21 [0.05, 0.88]
Total (95% CI)	55	55		100.0	0.20 [0.05, 0.74]
Total events: 2 (Treatment), 12 (Control)					
Test for heterogeneity chi-square=0.00 df=1 p=0.96 I^2 =0.0%					
Test for overall effect z=2.41 p=0.02					

Analysis 02.06. Comparison 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor), Outcome 06 Caesarean section, overall

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor)

Outcome: 06 Caesarean section, overall

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Vergani 1996	5/39	12/40		100.0	0.43 [0.17, 1.10]
Total (95% CI)	39	40		100.0	0.43 [0.17, 1.10]
Total events: 5 (Treatment), 12 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.76 p=0.08					

Analysis 02.08. Comparison 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor), Outcome 08 Forceps/vacum delivery, overall

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor)

Outcome: 08 Forceps/vacum delivery, overall

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
× Vergani 1996	0/39	0/40		0.0	Not estimable
Total (95% CI)	39	40		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					

Analysis 02.10. Comparison 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor), Outcome 10 Apgar score < 7 at 5 minutes

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor)

Outcome: 10 Apgar score < 7 at 5 minutes

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Busowski 1995	0/16	1/15		28.1	0.31 [0.01, 7.15]
Vergani 1996	3/39	4/40		71.9	0.77 [0.18, 3.22]
Total (95% CI)	55	55		100.0	0.64 [0.18, 2.31]
Total events: 3 (Treatment), 5 (Control)					
Test for heterogeneity chi-square=0.26 df=1 p=0.61 I^2 =0.0%					
Test for overall effect z=0.68 p=0.5					

Analysis 02.11. Comparison 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor), Outcome 11 Low cord pH (< 7.20 or as defined by trialists)

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 02 Transabdominal amnioinfusion for cord compression (potential, or diagnosed by fetal heart rate monitor)

Outcome: 11 Low cord pH (< 7.20 or as defined by trialists)

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Busowski 1995	0/16	3/15		47.4	0.13 [0.01, 2.40]
Vergani 1996	1/22	4/22		52.6	0.25 [0.03, 2.06]
Total (95% CI)	38	37		100.0	0.20 [0.04, 1.06]
Total events: 1 (Treatment), 7 (Control)					
Test for heterogeneity chi-square=0.12 df=1 p=0.73 I^2 =0.0%					
Test for overall effect z=1.89 p=0.06					

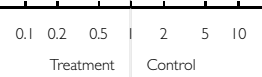
Analysis 03.03. Comparison 03 Amnioinfusion for suspected or potential intrauterine infection, Outcome 03 Epidural analgesia in labour

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 03 Amnioinfusion for suspected or potential intrauterine infection

Outcome: 03 Epidural analgesia in labour

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Monahan 1995	26/36	23/32		100.0	1.00 [0.75, 1.35]
Total (95% CI)	36	32		100.0	1.00 [0.75, 1.35]
Total events: 26 (Treatment), 23 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.03 p=1					



Analysis 03.04. Comparison 03 Amnioinfusion for suspected or potential intrauterine infection, Outcome 04 Caesarean section, overall

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 03 Amnioinfusion for suspected or potential intrauterine infection

Outcome: 04 Caesarean section, overall

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Monahan 1995	7/36	5/31		100.0	1.21 [0.43, 3.42]
Total (95% CI)	36	31		100.0	1.21 [0.43, 3.42]
Total events: 7 (Treatment), 5 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.35 p=0.7					

Analysis 03.08. Comparison 03 Amnioinfusion for suspected or potential intrauterine infection, Outcome 08 Puerperal infection

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 03 Amnioinfusion for suspected or potential intrauterine infection

Outcome: 08 Puerperal infection

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Monahan 1995	9/36	16/32		100.0	0.50 [0.26, 0.97]
Total (95% CI)	36	32		100.0	0.50 [0.26, 0.97]
Total events: 9 (Treatment), 16 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=2.05 p=0.04					

Analysis 03.09. Comparison 03 Amnioinfusion for suspected or potential intrauterine infection, Outcome 09 Neonatal infection

Review: Amnioinfusion for potential or suspected umbilical cord compression in labour

Comparison: 03 Amnioinfusion for suspected or potential intrauterine infection

Outcome: 09 Neonatal infection

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
× Monahan 1995	0/36	0/32		0.0	Not estimable
Total (95% CI)	36	32		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable