Amnioinfusion for meconium-stained liquor in labour (Review)

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TABLE OF CONTENTS

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ABSTRACT

Background
Amnioinfusion aims to prevent or relieve umbilical cord compression during labour by infusing a solution into the uterine cavity. It is also thought to dilute meconium when present in the amniotic fluid and so reduce the risk of meconium aspiration. However, it may be that the mechanism of effect is that it corrects oligohydramnios (reduced amniotic fluid), for which thick meconium staining is a marker.

Objectives
The objective of this review was to assess the effects of amnioinfusion for meconium-stained liquor on perinatal outcome.

Search strategy
The Cochrane Pregnancy and Childbirth Group trials register (October 2001) and the Cochrane Controlled Trials Register (Issue 3, 2001) were searched.

Selection criteria
Randomised trials comparing amnioinfusion with no amnioinfusion for women in labour with moderate or thick meconium-staining of the amniotic fluid.

Data collection and analysis
Eligibility and trial quality were assessed by one reviewer.

Main results
Twelve studies, most involving small numbers of participants, were included. Under standard perinatal surveillance, amnioinfusion was associated with a reduction in the following: heavy meconium staining of the liquor (relative risk 0.03, 95% confidence interval 0.01 to 0.15); variable fetal heart rate deceleration (relative risk 0.65, 95% confidence interval 0.49 to 0.88); and reduced caesarean section overall (relative risk 0.82, 95% confidence interval 0.69 to 1.97). No perinatal deaths were reported. Under limited perinatal surveillance, amnioinfusion was associated with a reduction in the following: meconium aspiration syndrome (relative risk 0.24, 95% confidence interval 0.12 to 0.48); neonatal hypoxic ischaemic encephalopathy (relative risk 0.07, 95% confidence interval 0.01 to 0.56) and neonatal ventilation or intensive care unit admission (relative risk 0.56, 95% confidence interval 0.39 to 0.79); there was a trend towards reduced perinatal mortality (relative risk 0.34, 95% confidence interval 0.11 to 1.06).

Authors' conclusions
Amnioinfusion is associated with improvements in perinatal outcome, particularly in settings where facilities for perinatal surveillance are limited. The trials reviewed are too small to address the possibility of rare but serious maternal adverse effects of amnioinfusion.

PLAIN LANGUAGE SUMMARY

Amnioinfusion is beneficial for babies releasing medium to heavy meconium during labour, although further research into the effects on women is needed

A bowel movement (meconium) from the unborn baby during labour can enter the baby's lungs, causing breathing difficulties after birth. Extra liquid can be injected through the woman's vagina or abdomen into the womb (amnioinfusion) to provide more liquid to dilute the meconium and surround the baby. The review of trials found that amnioinfusion with a salt (saline) solution is beneficial for babies releasing medium to heavy meconium during their mother's labour. They are less likely to breathe in meconium or need breathing assistance after birth, and have better heart rates. Further research into the effects on women is needed.

BACKGROUND

Amnioinfusion has been described as a method of preventing or relieving umbilical cord compression during labour (Miyazaki 1983), or of diluting meconium in the amniotic fluid to try to reduce the risk of meconium aspiration. Saline or Ringer's lactate is infused transcervically through a catheter into the uterine cavity, or transabdominally through a 'spinal' needle when membranes are intact. Amnioinfusion has also been used to facilitate external cephalic version at term (Benifla 1995).

Passage of fetal meconium before birth occurs in eight to 16 per cent of pregnancies (Woods 1994). It occurs mainly in term and post-term pregnancies. It may be associated with fetal compromise, but is also common in uncompromised labours. Thick but not thin meconium staining of the amniotic fluid is associated with poor perinatal outcome (Mahomed 1994; Ziadeh 2000). Meconium aspiration may occur before birth, or during the birth process, and is associated with significant mortality. Airways suctioning of the neonate may reduce, but does not eliminate the occurrence of meconium aspiration (Davis 1985). Strategies have therefore been sought to reduce fetal meconium aspiration before birth.

The presence of thick meconium-staining of the amniotic fluid is an indication of oligohydramnios, as meconium passed into a normal volume of amniotic fluid will usually appear thin. Amnioinfusion may thus at the same time dilute the meconium and correct oligohydramnios, relieving umbilical cord compression. It is difficult to distinguish effects of amnioinfusion due to these two mechanisms.

The technique for amnioinfusion has been clearly described in a recent publication (Weismiller 1998). Saline or Ringer's lactate is usually infused through a purpose-designed intrauterine pressure catheter using an infusion pump. However, recent studies from low-income countries where such catheters are unaffordable have demonstrated that amnioinfusion can be successfully achieved using inexpensive infant feeding tubes and gravity infusion (Mahomed 1998; Moodley 1998).

Readers are referred to recent reviews of the subject (Lameier 1993; Hofmeyr 1996; Hofmeyr 2000; Pierce 2000), and to related Cochrane reviews (Hofmeyr 2001a; Hofmeyr 2001b).

OBJECTIVES

To assess the effects of amnioinfusion for meconium-stained liquor in labour on maternal and perinatal morbidity and mortality.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

Clinical trials comparing the effect of amnioinfusion for meconium-stained liquor 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 in labour with moderate or thick meconium-staining of the amniotic fluid.

Types of intervention

Amnioinfusion (the infusion of physiological saline or lactated Ringer's solution into the amniotic cavity) compared with no amnioinfusion.

Types of outcome measures

Method of delivery, neonatal outcome and maternal complications.

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: methods used in reviews.

This review has drawn on the search strategy developed for the Cochrane Pregnancy and Childbirth Group as a whole. The full list of journals and conference proceedings as well as the search strategies for the electronic databases, which are searched by the Group on behalf of its reviewers, are described in detail in the

'Search strategies for the identification of studies section' within the editorial information about the Cochrane Pregnancy and Childbirth Group. Briefly, the Group searches on a regular basis MEDLINE, the Cochrane Controlled Trials Register and reviews the Contents tables of a further 38 relevant journals received via ZETOC, an electronic current awareness service. Date of last search: October 2001.

Relevant trials, which are identified through the Group's search strategy, are entered into the Group's Specialised Register of Controlled Trials. Please see Review Group's details for more detailed information.

In addition, the Cochrane Controlled Trials Register (Issue 3, 2001) was searched using the words 'amnioinfusion and meconium'.

METHODS OF THE REVIEW

Trials under consideration were evaluated for methodological quality and appropriateness for inclusion according to the prestated selection criteria, without consideration of their results. 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 Clarke 2000.

Data were extracted from the sources and entered onto Review Manager (RevMan 2000), checked for accuracy, and analysed as above using the RevMan 2000 software. For dichotomous data, relative risks and 95% confidence intervals were calculated, and in the absence of heterogeneity, results were pooled using a fixed effects model. Continuous data were pooled using weighted mean differences and 95% confidence intervals.

The study of Mahomed (Mahomed 1998) took place in an environment with limited intrapartum surveillance and intervention. Electronic fetal heart rate monitoring was not used. Because these features differed fundamentally from those of other studies and may influence the effect of amnioinfusion on outcome, a sub-group analysis has been included for standard and limited intrapartum surveillance studies. This sub-group analysis was not prespecified in the original protocol for this review.

DESCRIPTION OF STUDIES

Of 18 studies identified, 12 met the predefined criteria for inclusion. See table of 'Characteristics of included studies'.

Blinding of the intervention was not possible, though some of the outcome measures could be assessed in a blinded fashion.

The rate of saline infusion varied between studies. Sadovsky 1989 infused 600ml in one hour, then 180ml per hour continuously. Adam 1989 used a single infusion of 1000ml. Wenstrom 1989 infused 1000ml over 20-40 minutes, repeated six-hourly. Macri 1992 infused 500ml initially, then 250-500ml as required to maintain a four-quadrant amniotic fluid index above 10cm. Ilagan 1992 infused 500ml saline. Cialone et al (Cialone 1994) infused 600ml over one hour followed by 150ml per hour. Eriksen 1994 infused 800ml over one hour, then 180ml per hour. Spong 1994 infused 600ml as a bolus, followed by 3ml per minute. Hofmeyr 1998 infused saline 800ml at 15ml per minute, them 3ml per minute maintenance infusion. Mahomed 1998 infused saline 500ml over 30 minutes then 500ml at 30 drops per minute.

METHODOLOGICAL QUALITY

See 'Tables of included studies', particularly the 'Methods' and 'Notes' sections.

The reports of Adam 1989 and Ilagan 1992 do not specify how participants were 'randomly' assigned to groups. Cialone 1994 and Spong 1994 used computer-generated random numbers. Sadovsky 1989, Wenstrom 1989, Macri 1992, Eriksen 1994, Hofmeyr 1998 and Mahomed 1998 used sealed envelopes randomised by computer.

Comparability of the groups was compromised by the following exclusions after randomisation: Adam 1989 excluded 6/24 (25%) of the women allocated to the control group, who received amnioinfusion; Wenstrom 1989 excluded 5/41 (12%) of women allocated to receive amnioinfusion who did not (four gave birth spontaneously after 30, 45, 60 and 180 minutes, and one required emergency caesarean section for fetal distress - this information has been included in the analysis for this review in respect of delivery outcomes); Cialone 1994 excluded 7/54 (13%) of the study group who had diabetes (three) or requested withdrawal (four) and 1/59 (1.7%) allocated to the control group who requested withdrawal; Eriksen 1994 excluded 9/139 (6%) women whose records were unavailable or incomplete, and 6/71 (8%) randomized to the amnioinfusion group who delivered before they could receive amnioinfusion. In the study of Hofmeyr 1998 one woman in the control group received amnioinfusion (analysis was by intention to treat), and data were missing on about 7% of outcome measures. In Mahomed 1998 four amnioinfusion allocations were missed and could not be traced.

Spong 1994 do not account for a small discrepancy in group size (43 versus 50) despite using computer-generated allocation to create equal sized groups.

As exclusions of the control women of Adam 1989 were because of a perceived need for amnioinfusion, it is unlikely that these exclusions would have led to an exaggeration of the benefits of amnioinfusion.

In none of the studies were obstetricians blinded to the treatment, and only Adam 1989, Wenstrom 1989, Macri 1992, Cialone

1994, Hofmeyr 1998 and Mahomed 1998 specified that the neonatologists evaluating the babies were blind to the assigned group of each baby.

The Cialone 1994 report does not account for a discrepancy in birthweights between the groups.

There are thus several methodological shortcomings in these studies.

RESULTS

Studies with standard peripartum surveillance:
Heavy meconium staining was virtually eliminated (relative risk 0.03, 95% confidence interval 0.01 to 0.15), variable fetal heart rate decelerations were significantly reduced in the three studies in which these outcomes were reported (0.65, 0.49 to 0.88). Amnioinfusion was associated with a reduction in the overall rate of caesarean section (0.82, 0.69 to 0.97), and in the rate specifically for fetal distress. Measures of neonatal condition at birth tended to favour the amnioinfusion groups. One minute Apgar score <7 (0.71, 0.54 to 0.94), umbilical artery pH <7.20 (0.66, 0.50 To 0.87), meconium below vocal cords by laryngoscopy (0.26, 0.18 to 0.36), meconium aspiration syndrome (0.44, 0.25 to 0.78), and neonatal ventilation or neonatal intensive care unit (NICU) admission (0.45, 0.23 to 0.90). In two studies oxytocin augmentation was increased in the amnioinfusion groups (1.51, 1.12 to 2.05). Analgesia use recorded in one trial and first stage of labour duration in two, were not significantly different between groups. The incidence of puerperal infection did not appear to be increased in the amnioinfusion groups in these studies. There were no reported perinatal deaths in those studies which mentioned perinatal mortality.

Studies with limited peripartum surveillance:
In the study of Mahomed 1998, caesarean section rates were low, and did not differ between groups. In the amnioinfusion group there were considerably reduced five minute Apgar score <7 (0.35, 0.17 to 0.72), meconium aspiration syndrome (0.24, 0.12 to 0.48), neonatal hypoxic ischaemic encephalopathy (0.07, 0.01 to 0.56) and neonatal ventilation or neonatal intensive care unit admission (0.56, 0.39 to 0.79); a trend towards reduced perinatal mortality (0.34, 0.11 to 1.06) and no measurable effect on caesarean sections, instrumental delivery or puerperal pyrexia.

DISCUSSION

Studies with standard peripartum surveillance:
Several of the studies reviewed were compromised by exclusion of significant numbers of women from the analyses. In addition, outcomes such as the decision to perform caesarean section might have been influenced by the fact that caregivers were not blind to the group allocation, and may have felt a greater commitment to avoiding caesarean section in those women subjected to amnioinfusion. The reported reduction in caesarean sections for fetal distress must be interpreted in the light of large variations among institutions with respect to threshholds for intervention for 'fetal distress'. Thus, the rates of caesarean section in the control groups ranged from under 10% to 47.5%.

As thick meconium-staining of the amniotic fluid is usually associated with oligohydramnios, some of the apparent beneficial outcomes may have been related to correction of oligohydramnios rather than dilution of amniotic fluid.

The results of the studies reviewed were consistent except for one study (Spong 1994) which showed generally less beneficial results than the other studies. The authors state that computer-generated randomisation was used to achieve similar sized groups, but do not account for a discrepancy in the group sizes (43 amnioinfusion versus 50 control). The use of amnioinfusion in 8/50 of the control group who developed fetal heart rate decelerations may have obscured beneficial effects of amnioinfusion, particularly if it is the case that those most likely to benefit from amnioinfusion are those with complications related to oligohydramnios. This suggestion is in keeping with the finding that prophylactic amnioinfusion for oligohydramnios does not have demonstrable benefits over amnioinfusion used only when fetal heart rate decelerations occur (Hofmeyr 2001b).

Studies with limited peripartum surveillance:
A simplified method of amnioinfusion was shown to be feasible in an underresourced labour ward environment, and was associated with considerable improvement in perinatal outcome.

AUTHORS' CONCLUSIONS

Implications for practice

Units with standard peripartum surveillance:
The reduction in the incidence of the diagnosis of meconium aspiration syndrome after amnioinfusion in these studies is of significance and may possibly be due to a reduction in fetal distress related to oligohydramnios (see Cochrane review 'Amnioinfusion in intrapartum umbilical cord compression (potential, or diagnosed by electronic fetal heart rate monitoring)' (Hofmeyr 1997a)). Whether amnioinfusion influences the outcome in pregnancies with meconium-stained liquor unrelated to the correction of oligohydramnios has yet to be determined. At the least, the evidence shows a benefit of the use of amnioinfusion in pregnancies complicated by meconium-stained amniotic fluid together with oligohydramnios.

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. The benefits shown in the trials reviewed need to be weighed against the theoretical small risk of serious maternal complications (see Hofmeyr 1996; Wegnelius 1996; Wenstrom 1994; Maher 1994; Dibble 1992; Dragich 1991). Larger trials, with fewer exclusions, are needed to address the risk-benefit ratio of amnioinfusion conclusively.

Units with limited peripartum surveillance:
The study of Mahomed 1998 has shown a striking improvement in perinatal outcome with a simplified technique of amnioinfusion. The use of amnioinfusion should be considered for women with meconium stained liquor in units with limited facilities for peripartum surveillance and high rates of meconium aspiration syndrome.

The diagnosis of meconium stained liquor may be limited by a policy of maintaining intact membranes during labour in areas with a high prevalence of HIV infection. Once meconium stained liquor is diagnosed, whether amnioinfusion would increase the risk of vertical HIV transmission to the fetus because of placement of the intrauterine catheter, or reduce the risk by irrigation of the genital tract and dilution of maternal fluids, is not known.

Implications for research

Units with standard peripartum surveillance:
In view of the evidence that amnioinfusion may reduce the incidence of meconium aspiration syndrome, which is a serious clinical problem, large, well controlled trials are of importance to assess with greater certainty the effect of amnioinfusion on serious morbidity and mortality in the newborn, and possible maternal complications. Such a trial is currently in progress (Fraser).

Units with limited peripartum surveillance:
There is need for research on the effect of amnioinfusion in women infected with HIV.

POTENTIAL CONFLICT OF INTEREST

The contact reviewer is an author of two of the studies included in this review.

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* *Indicates the major publication for the study*

TABLES

Characteristics of included studies

Study	**Adam 1989**
Methods	'Random' allocation. Method not specified.
Participants	Inclusion criteria: heavy meconium- stained amniotic fluid in labour.
Interventions	Single amnioinfusion with 1000ml (n = 17) compared with control (n = 18).
Outcomes	Meconium below cords, meconium aspiration syndrome, operative delivery for fetal distress.
Notes	Six control women who received amnioinfusion were excluded. Unlikely to have exaggerated the benefits of amnioinfusion as exclusion of problem cases more likely to produce bias in favour of the control group. Obstetricians not blinded, but neonatologists blinded.
Allocation concealment	C – Inadequate

Study	**Alvarez 1999**
Methods	Allocation according to random number list.
Participants	Inclusion criteria: active phase of labour; meconium stained liquor. Exclusion criteria: presentation other than cephalic; gestation <37 weeks; multiple pregnancy; fetal anomaly incompatible with life; cord prolapse; fetal heart rate abnormality; uterine scar; placenta praevia; placental abruption; transmissable infections.

Characteristics of included studies (*Continued*)

Interventions	Amnioinfusion (normal saline at 37 degrees C, 600ml in one hour then 180ml per hour) versus control group.
Outcomes	See tables. For meconium concentrations >10%, reduced caesarean section (amnioinfusion 5/40 vs control 15/45); Caesarean section for fetal distress (1 vs 8), meconium below cords (4 vs 14); variable decelerations (13 vs 32).
Notes	10ml amniotic fluid centrifuged to measure meconium content. Amniotic fluid index measured; cardiotocography performed.
Allocation concealment	B – Unclear

Study	**Cialone 1994**
Methods	Computerised randomisation.
Participants	Inclusion criteria: labouring term and post-term women; uncomplicated antepartum course; singleton vertex presenting fetus; gestation > 36 weeks; moderate to thick meconium assessed clinically. Exclusion criteria: any obstetric risk factor other than meconium.
Interventions	Amnioinfusion of room temperature normal saline 600ml over 1 hour followed by 150ml per hour (n = 54), compared with control group (n = 59). Pad weight measured hourly. If vaginal effluent < 100ml per hour, ultrasound examination performed to exclude overdistension of the uterus.
Outcomes	'Meconiumcrit', delivery mode, duration of first and second stage, oxytocin, analgesia, 1 minute Apgar < 7, nuchal cord, maternal infection, meconium below cords, meconium aspiration syndrome, neonatal ICU admission.
Notes	Discrepancy in birthweights not accounted for. Neonatologists but not obstetricians blinded to group allocation. Fetal heart rate tracings analyzed in a blind fashion. Seven withdrawals from the study group because of diabetes (3) and request (4). One withdrawal from the control group on request. Meconium below vocal cords in 33/58 controls according to table v, 34/58 according to text, whereas in previous report of same trial [Cialone 1993], reported in 36/58 controls.
Allocation concealment	B – Unclear

Study	**Eriksen 1994**
Methods	Computer randomisation using sealed packets.
Participants	Inclusion criteria: > 36 weeks gestation; active labour; thick meconium fluid. Exclusion criteria: multiple gestation; malpresentation; fetal distress on admission; cervical dilation =/>7 cm; intra-amniotic infection.
Interventions	Amnioinfusion with 800ml normal saline at room temperature over 1 hour followed by 180ml per hour (n = 71), compared with control group (n = 24).
Outcomes	Labour characteristics, fetal distress, operative delivery for fetal distress, meconium below the cords, meconium aspiration syndrome, fetal acid-base status, infectious morbidity.
Notes	Of 139 women who consented to the study, 9 were excluded because of incomplete records and 6 because they were randomised to amnioinfusion but delivered before amnioinfusion could be administered. The latter exclusions could have biased results against the study group by excluding those with more rapid labours. There were also somewhat more primiparous women in the study group (35/65 vs 27/59). This could possibly have been due to exclusion of more multips who had rapid labours. The n value for umbilical artery pH is given as the whole group, yet in the text at least one infant with meconium aspiration syndrome had no cord blood result.
Allocation concealment	B – Unclear

Study	**Hofmeyr 1998**
Methods	Allocation by opaque sealed envelopes in computer-generated random sequence. Blinding not possible.

Characteristics of included studies (*Continued*)

Participants	Inclusion criteria: women in labour; moderate or heavy meconium staining of the liquor; gestation 37 weeks or more; singleton cephalic presentation.
Interventions	Amnioinfusion via an Intran or Nelaton intrauterine catheter: 800ml normal saline at 15ml per minute, then maintenance of 3ml per minute (n = 176), compared with no amnioinfusion (n = 176). Electronic fetal heart rate monitoring in most cases. One woman in the control group received amnioinfusion. Analysis was by intention to treat.
Outcomes	Primary: Caesarean section, meconium aspiration syndrome diagnosed clinically by paediatrician blind to group allocation, perinatal mortality. Secondary outcomes: assisted delivery; 5 minute Apgar score <7; cord pH <7.2; meconium below cords; Xray diagnosis of meconium aspiration syndrome (amnioinfusion 2/163 vs control 3/161); neonatal ICU admission; neonatal ventilation (0/164 vs 2/163); postpartum temperature =/>38 degrees centigrade.
Notes	Four academic hospitals in South Africa.
Allocation concealment	B – Unclear

Study	**Ilagan 1992**
Methods	'Random' allocation. Method not specified.
Participants	Inclusion criteria: thick meconium- stained amniotic fluid. Exclusion criteria: chorioamnionitis; multiple pregnancy; malpresentation.
Interventions	Amnioinfusion with 500ml saline (n= 38) compared with control group (n = 40).
Outcomes	Mode of delivery, 1 minute Apgar < 7, 5 minute Apgar < 7, meconium below cords, meconium aspiration syndrome, ECMO, postpartum endometritis, birthweight.
Notes	Neither obstetricians nor neonatologists stated to have been blinded.
Allocation concealment	C – Inadequate

Study	**Macri 1992**
Methods	Sealed envelopes randomised by computer.
Participants	Inclusion criteria: gestation =/>37 weeks; thick meconium; 4-quadrant amniotic fluid index < 5cm; normal fetal heart rate pattern; vertex presentation; estimated fetal weight =/> 2500g; cervical dilation =/<5 cm; ruptured membranes. Exclusion criteria: vaginal bleeding, chorioamnionitis, fetal anomalies, uterine anomalies, contraindication to labour.
Interventions	Amnioinfusion with 500ml warmed saline over 20-30 minutes followed by 250-500ml as required to maintain a 4-quadrant amniotic fluid index above 10cm (n = 85), compared with control group (n = 85).
Outcomes	Fetal distress, mode of delivery, Apgar scores, umbilical artery pH, meconium in oropharynx, meconium below cords, meconium aspiration syndrome, chorioamnionitis.
Notes	Neonatologists but not obstetricians stated to have been blinded to group allocation. The women in this report are also included in the report of Schrimmer 1991 on amnioinfusion for oligohydramnios (Paul RH, personal communication) (see review Amnioinfusion in intrapartum umbilical cord compression).
Allocation concealment	B – Unclear

Study	**Mahomed 1998**
Methods	Allocation by opaque sealed envelopes in computer-generated random sequence.
Participants	Inclusion criteria: moderate or heavy meconium- stained amniotic fluid; singleton cephalic presentation; in labour; gestation 37 weeks or more. Exclusion criteria: indication for immediate delivery; chorioamnionitis; vaginal bleeding; fetal anomaly; maternal cardiac or pulmonary disease.

Characteristics of included studies (*Continued*)

Interventions	Transcervical amnioinfusion using size 8 nasogastric tube. Normal saline 500ml infused over 30 minutes, then 500ml at 2ml per minute (n = 325). Control group received no amnioinfusion (n = 336). Allocation not blinded. Level of intrapartum surveillance limited by number of midwives in a busy labour ward. fetal heart rate auscultated every 30 minutes using Pinard stethoscope or hand-held doptone fetal heart rate detector. Suctioning of the airways at delivery by attending midwives.
Outcomes	Primary outcomes: Caesarean section; meconium aspiration syndrome diagnosed by a paediatrician blind to the group allocation; perinatal mortality. Secondary outcomes: fetal heart rate abnormality (amnioinfusion 30/320 vs control 34/334); contractions =/>40 seconds at 1 hour (206/323 vs 211/324); Caesarean section for fetal distress; assisted delivery; 1 minute Apgar score <4 (8/324 vs 18/336); 5 minute Apgar score <7; Xray diagnosis of meconium aspiration syndrome (2/319 vs 9/330); neonatal ICU admission; neonatal ventilation (10/320 vs 34/332); pneumothorax (0/320 vs 3/329);hypoxic ischaemic encphalopathy; >4 days in neonatal ICU (5/320 vs 10/329); intrapartum and postpartum pyrexia.
Notes	Four amnioinfusion allocations early in the study unaccounted for. No electronic FHR monitoring. Neonatologist not usually present at the time of delivery.
Allocation concealment	B – Unclear

Study	**Moodley 1998**
Methods	Randomization using sealed envelopes.
Participants	Inclusion criteria: singleton, term, cephalic pregnancies in active labour; Meconium stained amniotic fluid grade 1-3; normal cardiotocograph. Exclusion criteria: medical or surgical conditions; chorioamnionitis; previous caesarean section.
Interventions	Amnioinfusion with normal saline 10-15ml per minute by gravity via a central venous manometer set and a size 8 ansogastric infant feeding tube (1 litre over 4 hours); versus standard care; continuous fetal heart rate monitoring.
Outcomes	Mean umbilical artery pH; mean Apgar scores; caesarean section; instrumental delivery; hypoxic ischaemic encephalopathy.
Notes	Durban, South Africa, January to April 1993.
Allocation concealment	B – Unclear

Study	**Sadovsky 1989**
Methods	'Random allocation' with sealed envelopes.
Participants	Inclusion criteria: singleton; more than a trace of meconium stained liquor; vertex presentation; > 34 weeks; anticipate delivery > 1 hour. Exclusion criteria: malformations; chorioamnionitis; malpresentation; polyhydramnios; cord prolapse; urgent delivery needed; maternal cardiac disease.
Interventions	Amnioinfusion with saline 600ml over 1 hour then 180ml per hour (n = 19), compared with control group (n = 21).
Outcomes	Thick meconium on spectophotometry, labour duration, labour augmentation, analgesia, mode of delivery, umbilical artery pH, meconium below cords, positive pressure ventilation.
Notes	Neither obstetricians nor neonatologists stated to have been blinded.
Allocation concealment	B – Unclear

Study	**Spong 1994**
Methods	'Randomized' by computer-generated random number sequence.
Participants	Inclusion criteria: singleton; vertex presentation; 37 or more weeks; moderate to heavy meconium; no variable fetal heart rate decelerations.

	Exclusion criteria: prenatally diagnosed fetal malformations; maternal temperature > 100.4 degrees Fahrenheit; evidence of fetal distress.
Interventions	Amnioinfusion with 600ml saline bolus followed by 3ml per minute (n = 43), compared with standard care which included similar amnioinfusion in 8/50 for variable decelerations (n = 50).
Outcomes	Meconium below cords, meconium aspiration syndrome, Apgar scores, cord pH, neonatal complications, route of delivery, maternal infection.
Notes	Discrepancy in group numbers (43 vs 50), despite use of computer-generated random number sequence to create equal number groups, not accounted for.
Allocation concealment	C – Inadequate

Study	**Wenstrom 1989**
Methods	Sealed envelopes randomised by computer.
Participants	Inclusion criteria: thick meconium-stained amniotic fluid. Exclusion criteria: fetal distress, maternal pyrexia.
Interventions	Amnioinfusion of 1000ml over 20-40 minutes, repeated 6-hourly (n = 41), compared with control group (n = 44).
Outcomes	Mode of delivery, Apgar scores, cord arterial pH, meconium below cords, meconium aspiration syndrome, postpartum endometritis.
Notes	Five study women who did not receive amnioinfusion excluded, of which 4 delivered spontaneously after 30, 45, 60 and 180 minutes and one required emergency Caesarean section for fetal distress. These exclusions have been included in this review with respect to delivery outcomes. Obstetricians not blinded, but neonatologists blinded.
Allocation concealment	B – Unclear

ECMO = extra corporeal membrane oxygenation
FHR = fetal heart rate
ICU = intensive care unit
vs = versus

Characteristics of excluded studies

Study	**Reason for exclusion**
Edwards 1999	Excluded because comparison was between amnioinfusion with and without antibiotics.
Gonzalez 1998	Excluded because no clinically meaningful data. 43 women undergoing amnioinfusion for meconium stained liquor were randomly allocated to receive normal saline or lactate Ringer's solution. There were no significant differences in the umbilical artery electrolytes or pH.
Kirubamani 2000	Excluded because only abstract available, with no figures; discrepancy in group numbers (30 versus 20) not accounted for.
Lembet 1999	Excluded because no data given. Women with thick meconium during labour randomised to transabdominal amnioinfusion (19) versus standard care (20).
Lo 1993	Excluded because allocation was not at random. Of 112 women with moderate or thick meconium-stained liquor, 63 chose to undergo amnioinfusion. In the amnioinfusion group, there were fewer operative deliveries for fetal distress but not overall, and neonatal outcomes were improved.
Nageotte 1991	Nageotte 1991 studied 86 women with oligohydramnios and/or thick meconium-stained liquor. As the reported results relate primarily to problems associated with oligohydramnios, these are considered in the Review 'Amnioinfusion for umbilical cord compression in labour (Hofmeyr 2001a)'. The authors state that there was no significant difference in meconium below the cords, but no figures are given.

Characteristics of excluded studies (*Continued*)

Characteristics of ongoing studies

Study	Fraser
Trial name or title	Amnioinfusion trial.
Participants	Women in labour with thick meconium-staining of the amniotic fluid, cervix less than 6cm (multiparous) or 7cm (nulliparous), no immediate reason for delivery and no major complications.
Interventions	Amnioinfusion with normal saline versus no anmioinfusion.
Outcomes	Measures of perinatal and maternal morbidity including meconium aspiration syndrome.
Starting date	In progress.
Contact information	William D Fraser, Professeur et Directeur, Obstétrique-gynécologie, Professor and Chair of Obstetrics and Gynecology, Université Laval University, Québec, Canada. tel: +1 418 5254456 fax: +1 418 5254194
Notes	

ANALYSES

Comparison 01. Amnioinfusion for meconium-stained liquor in labour

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Heavy meconium staining	2	138	Relative Risk (Fixed) 95% CI	0.03 [0.01, 0.15]
02 Variable decelerations	3	260	Relative Risk (Fixed) 95% CI	0.65 [0.49, 0.88]
03 Caesarean for fetal distress	9	1389	Relative Risk (Fixed) 95% CI	0.38 [0.25, 0.58]
04 Caesarean overall	11	1841	Relative Risk (Fixed) 95% CI	0.82 [0.70, 0.97]
05 1 minute Apgar <4	2	155	Relative Risk (Fixed) 95% CI	0.75 [0.13, 4.31]
06 1 minute Apgar <7	5	526	Relative Risk (Fixed) 95% CI	0.71 [0.54, 0.94]
07 5 minute Apgar <7	8	1567	Relative Risk (Fixed) 95% CI	0.45 [0.27, 0.75]
08 Umbilical artery pH <7.20	6	714	Relative Risk (Fixed) 95% CI	0.66 [0.50, 0.87]
09 Meconium below vocal cords	10	1162	Relative Risk (Fixed) 95% CI	0.26 [0.18, 0.36]
10 Meconium aspiration syndrome	12	1877	Relative Risk (Fixed) 95% CI	0.34 [0.22, 0.52]
11 Neonatal ventilation/NICU admission	4	1125	Relative Risk (Fixed) 95% CI	0.53 [0.39, 0.73]
12 Hypoxic ischaemic encephalopathy	2	709	Relative Risk (Fixed) 95% CI	0.09 [0.02, 0.49]
13 Perinatal death	8	1481	Relative Risk (Fixed) 95% CI	0.34 [0.11, 1.06]
14 Puerperal pyrexia	3	990	Relative Risk (Fixed) 95% CI	1.09 [0.62, 1.91]
15 Puerperal endometritis	6	612	Relative Risk (Fixed) 95% CI	0.91 [0.53, 1.54]
16 Oxytocin augmentation	2	229	Relative Risk (Fixed) 95% CI	1.51 [1.12, 2.05]
17 Narcotic analgesic	1	105	Relative Risk (Fixed) 95% CI	1.07 [0.66, 1.72]
18 Epidural analgesia	1	105	Relative Risk (Fixed) 95% CI	1.34 [0.90, 1.99]
19 first stage labour (minutes)	2	229	Weighted Mean Difference (Fixed) 95% CI	32.46 [-68.78, 133.70]
20 Instrumental vaginal delivery	7	1476	Relative Risk (Fixed) 95% CI	0.79 [0.55, 1.14]
21 Instrumental vaginal delivery for fetal distress	2	220	Relative Risk (Fixed) 95% CI	0.60 [0.18, 1.95]
22 Second stage labour (minutes)	0	0	Relative Risk (Fixed) 95% CI	Not estimable

INDEX TERMS

Medical Subject Headings (MeSH)

*Amnion; Infant, Newborn; *Injections; *Meconium; Meconium Aspiration Syndrome [*prevention & control]; Obstetric Labor Complications [*prevention & control]; Randomized Controlled Trials

MeSH check words

Female; Humans; Pregnancy

COVER SHEET

Title	Amnioinfusion for meconium-stained liquor in labour
Authors	Hofmeyr GJ
Contribution of author(s)	GJH prepared and maintains the review.
Issue protocol first published	1995/2
Review first published	1995/2
Date of most recent amendment	27 October 2004
Date of most recent SUBSTANTIVE amendment	05 October 2001
What's New	Five studies have been assessed, of which two have been included in this version of the review. Inclusion of these studies has not changed the substantive findings of the review.
Date new studies sought but none found	Information not supplied by author
Date new studies found but not yet included/excluded	Information not supplied by author
Date new studies found and included/excluded	05 October 2001
Date authors' conclusions section amended	Information not supplied by author
Contact address	Prof G Justus Hofmeyr Director/Hon. Professor, Effective Care Research Unit Department of Obstetrics and Gynaecology, East London Hospital Complex University of the Witwatersrand, University of Fort Hare, Eastern Cape Department of Health Frere and Cecilia Makiwane Hospitals Private Bag X 9047 East London Eastern Cape 5200 SOUTH AFRICA E-mail: gjh@global.co.za Tel: +27 43 7092483 Fax: +27 43 7092483
DOI	10.1002/14651858.CD000014
Cochrane Library number	CD000014

Editorial group Cochrane Pregnancy and Childbirth Group

Editorial group code HM-PREG

GRAPHS AND OTHER TABLES

Analysis 01.01. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 01 Heavy meconium staining

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 01 Heavy meconium staining

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Cialone 1994	0/46	42/52		76.4	0.01 [0.00, 0.21]
Sadovsky 1989	1/19	13/21		23.6	0.09 [0.01, 0.59]
Subtotal (95% CI)	65	73		100.0	0.03 [0.01, 0.15]
Total events: 1 (Treatment), 55 (Control)					
Test for heterogeneity chi-square=1.44 df=1 p=0.23 I^2 =30.4%					
Test for overall effect z=4.30 p=0.00002					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
Total (95% CI)	65	73		100.0	0.03 [0.01, 0.15]
Total events: 1 (Treatment), 55 (Control)					
Test for heterogeneity chi-square=1.44 df=1 p=0.23 I^2 =30.4%					
Test for overall effect z=4.30 p=0.00002					

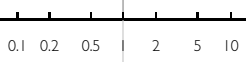
Analysis 01.02. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 02 Variable decelerations

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 02 Variable decelerations

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Alvarez 1999	27/53	42/62		65.5	0.75 [0.55, 1.03]
Cialone 1994	2/47	10/58		15.2	0.25 [0.06, 1.07]
Sadovsky 1989	7/19	12/21		19.3	0.64 [0.32, 1.29]
Subtotal (95% CI)	119	141		100.0	0.65 [0.49, 0.88]
Total events: 36 (Treatment), 64 (Control)					
Test for heterogeneity chi-square=2.44 df=2 p=0.30 I^2 =18.0%					
Test for overall effect z=2.84 p=0.005					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
Total (95% CI)	119	141		100.0	0.65 [0.49, 0.88]
Total events: 36 (Treatment), 64 (Control)					
Test for heterogeneity chi-square=2.44 df=2 p=0.30 I^2 =18.0%					
Test for overall effect z=2.84 p=0.005					

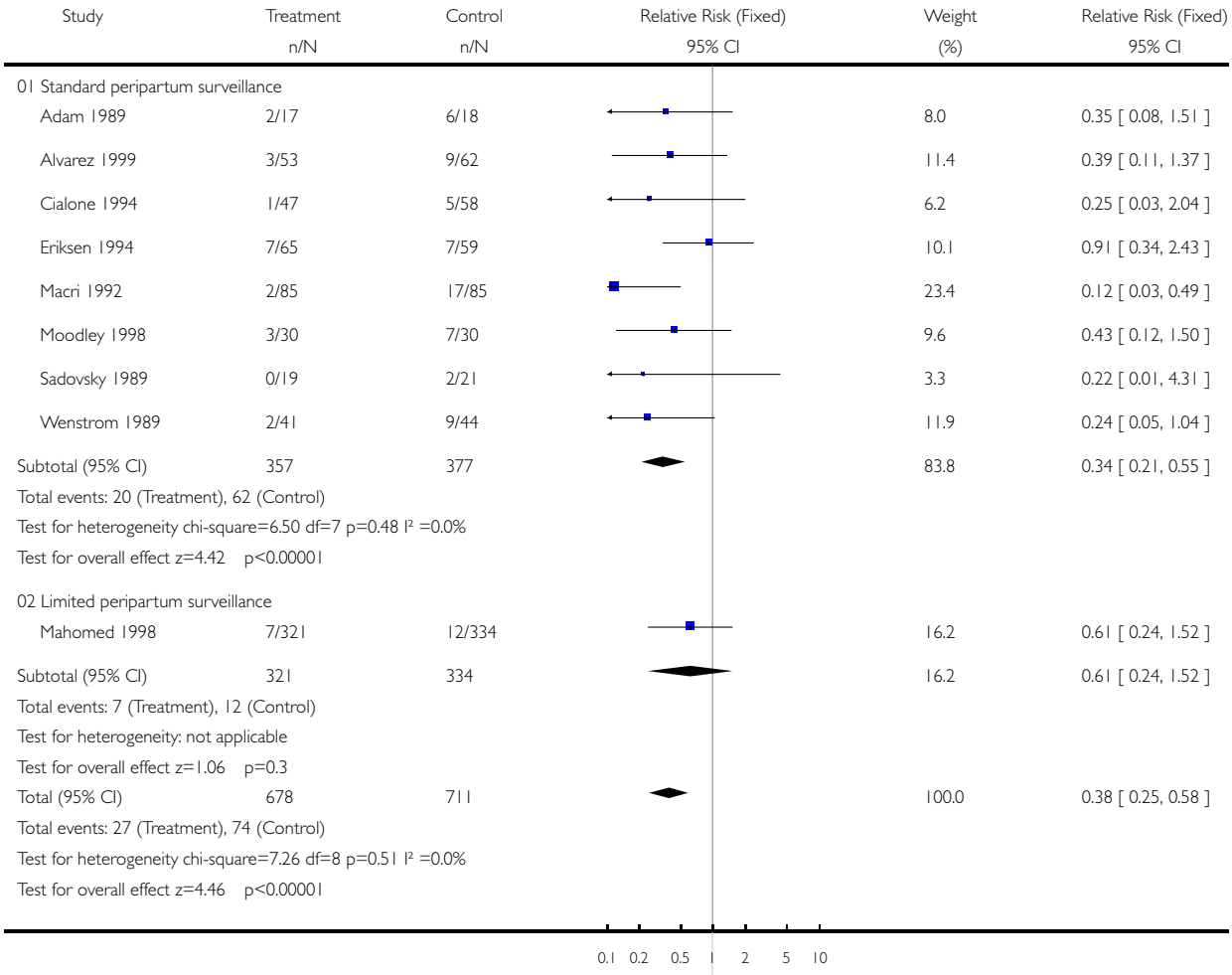


Analysis 01.03. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 03 Caesarean for fetal distress

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 03 Caesarean for fetal distress

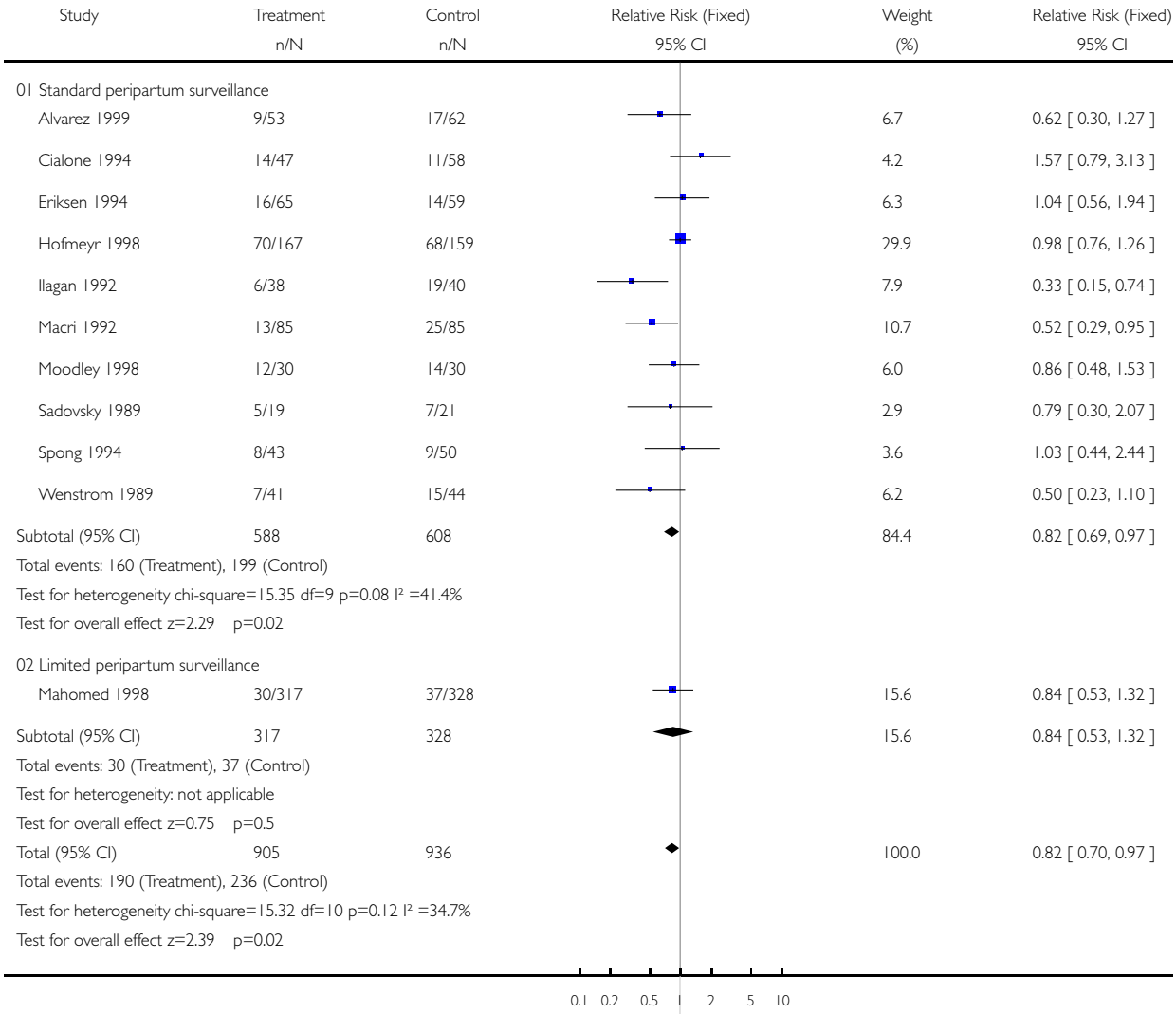


Analysis 01.04. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 04 Caesarean overall

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 04 Caesarean overall

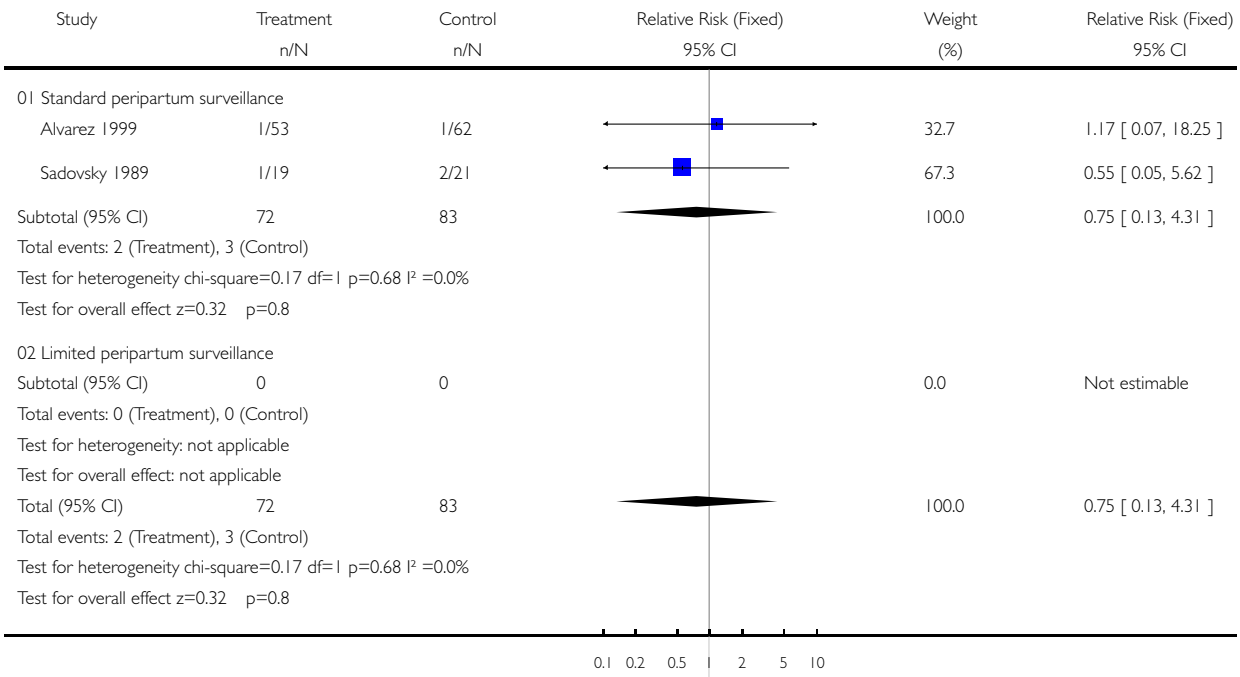


Analysis 01.05. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 05 1 minute Apgar <4

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 05 1 minute Apgar <4



Analysis 01.06. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 06 1 minute Apgar <7

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 06 1 minute Apgar <7

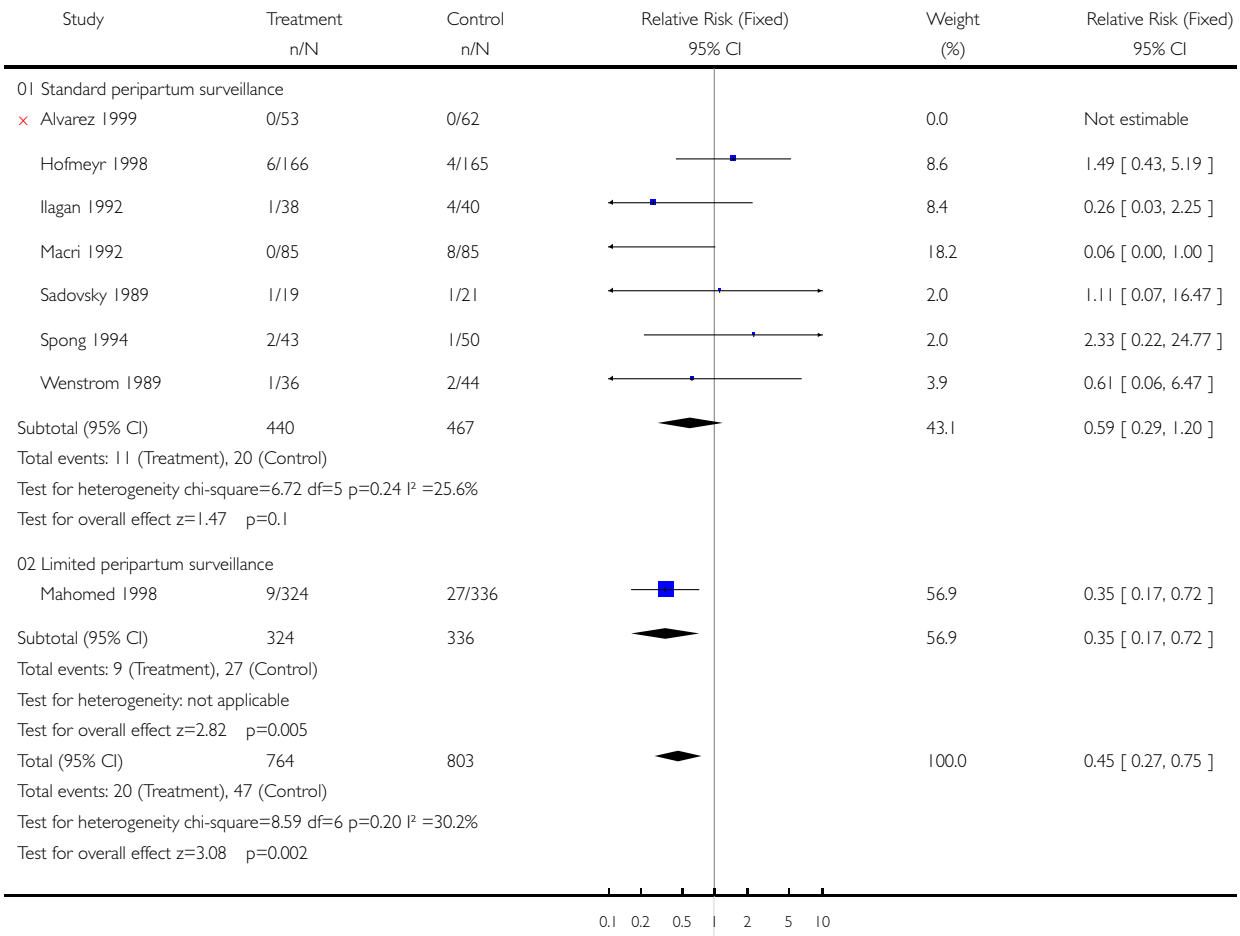
Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Cialone 1994	21/47	22/58		23.3	1.18 [0.75, 1.86]
Ilagan 1992	6/38	13/40		15.0	0.49 [0.21, 1.15]
Macri 1992	6/85	26/85		30.7	0.23 [0.10, 0.53]
Spong 1994	12/43	6/50		6.6	2.33 [0.95, 5.67]
Wenstrom 1989	11/36	23/44		24.5	0.58 [0.33, 1.03]
Subtotal (95% CI)	249	277		100.0	0.71 [0.54, 0.94]
Total events: 56 (Treatment), 90 (Control)					
Test for heterogeneity chi-square=19.62 df=4 p=0.0006 I^2 =79.6%					
Test for overall effect z=2.37 p=0.02					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
Total (95% CI)	249	277		100.0	0.71 [0.54, 0.94]
Total events: 56 (Treatment), 90 (Control)					
Test for heterogeneity chi-square=19.62 df=4 p=0.0006 I^2 =79.6%					
Test for overall effect z=2.37 p=0.02					

Analysis 01.07. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 07 5 minute Apgar <7

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 07 5 minute Apgar <7



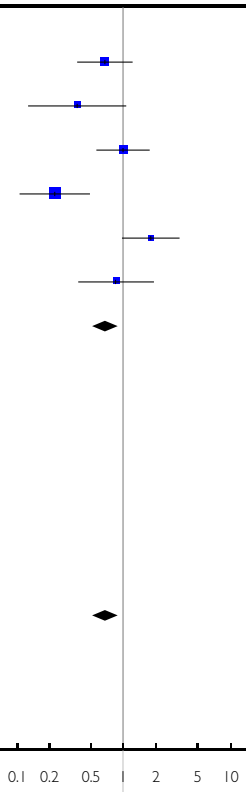
Analysis 01.08. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 08 Umbilical artery pH <7.20

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 08 Umbilical artery pH <7.20

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Alvarez 1999	12/53	21/62		19.6	0.67 [0.36, 1.23]
Cialone 1994	4/45	12/50		11.5	0.37 [0.13, 1.07]
Hofmeyr 1998	18/96	20/105		19.4	0.98 [0.55, 1.75]
Macri 1992	7/85	31/85		31.4	0.23 [0.11, 0.48]
Sadovsky 1989	13/19	8/21		7.7	1.80 [0.96, 3.36]
Spong 1994	8/43	11/50		10.3	0.85 [0.37, 1.91]
Subtotal (95% CI)	341	373		100.0	0.66 [0.50, 0.87]
Total events: 62 (Treatment), 103 (Control)					
Test for heterogeneity chi-square=20.79 df=5 p=0.0009 I^2 =75.9%					
Test for overall effect z=2.94 p=0.003					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
Total (95% CI)	341	373		100.0	0.66 [0.50, 0.87]
Total events: 62 (Treatment), 103 (Control)					
Test for heterogeneity chi-square=20.79 df=5 p=0.0009 I^2 =75.9%					
Test for overall effect z=2.94 p=0.003					



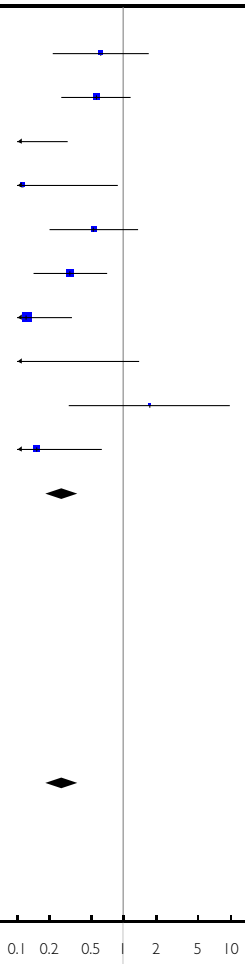
Analysis 01.09. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 09 Meconium below vocal cords

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 09 Meconium below vocal cords

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Adam 1989	4/17	7/18		4.6	0.61 [0.22, 1.70]
Alvarez 1999	8/53	17/62		10.7	0.55 [0.26, 1.17]
Cialone 1994	2/47	33/58		20.1	0.07 [0.02, 0.30]
Eriksen 1994	1/65	8/59		5.7	0.11 [0.01, 0.88]
Hofmeyr 1998	6/158	12/164		8.0	0.52 [0.20, 1.35]
Ilagan 1992	6/38	20/40		13.2	0.32 [0.14, 0.70]
Macri 1992	4/85	33/85		22.4	0.12 [0.04, 0.33]
Sadovsky 1989	0/19	6/21		4.2	0.08 [0.01, 1.41]
Spong 1994	3/43	2/50		1.3	1.74 [0.31, 9.96]
Wenstrom 1989	2/36	16/44		9.8	0.15 [0.04, 0.62]
Subtotal (95% CI)	561	601		100.0	0.26 [0.18, 0.36]
Total events: 36 (Treatment), 154 (Control)					
Test for heterogeneity chi-square=20.43 df=9 p=0.02 I^2 =56.0%					
Test for overall effect z=7.82 p<0.00001					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
Total (95% CI)	561	601		100.0	0.26 [0.18, 0.36]
Total events: 36 (Treatment), 154 (Control)					
Test for heterogeneity chi-square=20.43 df=9 p=0.02 I^2 =56.0%					
Test for overall effect z=7.82 p<0.00001					



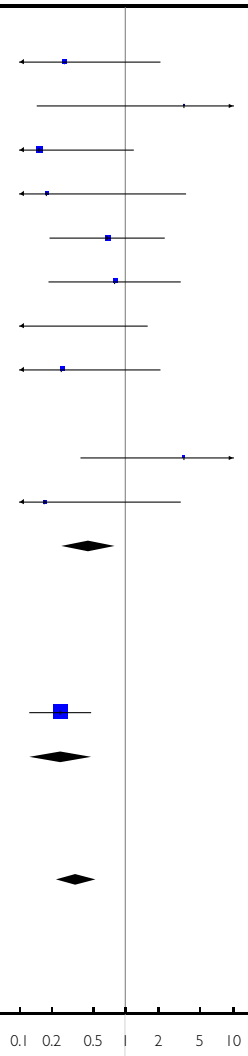
Analysis 01.10. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 10 Meconium aspiration syndrome

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 10 Meconium aspiration syndrome

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Adam 1989	1/17	4/18		4.9	0.26 [0.03, 2.14]
Alvarez 1999	1/53	0/62		0.6	3.50 [0.15, 84.16]
Cialone 1994	1/47	8/58		9.0	0.15 [0.02, 1.19]
Eriksen 1994	0/65	2/59		3.3	0.18 [0.01, 3.71]
Hofmeyr 1998	4/162	6/163		7.6	0.67 [0.19, 2.33]
Ilagan 1992	3/38	4/40		4.9	0.79 [0.19, 3.30]
Macri 1992	0/85	5/85		6.9	0.09 [0.01, 1.62]
Moodley 1998	1/30	4/30		5.1	0.25 [0.03, 2.11]
× Sadovsky 1989	0/19	0/21		0.0	Not estimable
Spong 1994	3/43	1/50		1.2	3.49 [0.38, 32.32]
Wenstrom 1989	0/36	3/44		4.0	0.17 [0.01, 3.26]
Subtotal (95% CI)	595	630		47.5	0.44 [0.25, 0.78]
Total events: 14 (Treatment), 37 (Control)					
Test for heterogeneity chi-square=9.41 df=9 p=0.40 I^2 =4.3%					
Test for overall effect z=2.82 p=0.005					
02 Limited peripartum surveillance					
Mahomed 1998	10/323	42/329		52.5	0.24 [0.12, 0.48]
Subtotal (95% CI)	323	329		52.5	0.24 [0.12, 0.48]
Total events: 10 (Treatment), 42 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=4.13 p=0.00004					
Total (95% CI)	918	959		100.0	0.34 [0.22, 0.52]
Total events: 24 (Treatment), 79 (Control)					
Test for heterogeneity chi-square=11.61 df=10 p=0.31 I^2 =13.9%					
Test for overall effect z=4.95 p<0.00001					



Analysis 01.11. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 11 Neonatal ventilation/NICU admission

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 11 Neonatal ventilation/NICU admission

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Cialone 1994	4/47	11/58		10.0	0.45 [0.15, 1.32]
Hofmeyr 1998	3/164	4/163		4.1	0.75 [0.17, 3.28]
Sadovsky 1989	3/19	10/21		9.7	0.33 [0.11, 1.03]
Subtotal (95% CI)	230	242		23.8	0.45 [0.23, 0.90]
Total events: 10 (Treatment), 25 (Control)					
Test for heterogeneity chi-square=0.73 df=2 p=0.70 I^2 =0.0%					
Test for overall effect z=2.28 p=0.02					
02 Limited peripartum surveillance					
Mahomed 1998	41/321	76/332		76.2	0.56 [0.39, 0.79]
Subtotal (95% CI)	321	332		76.2	0.56 [0.39, 0.79]
Total events: 41 (Treatment), 76 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=3.29 p=0.001					
Total (95% CI)	551	574		100.0	0.53 [0.39, 0.73]
Total events: 51 (Treatment), 101 (Control)					
Test for heterogeneity chi-square=1.04 df=3 p=0.79 I^2 =0.0%					
Test for overall effect z=3.99 p=0.00007					

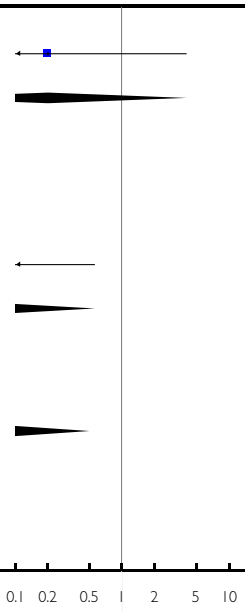
Analysis 01.12. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 12 Hypoxic ischaemic encephalopathy

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 12 Hypoxic ischaemic encephalopathy

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Moodley 1998	0/30	2/30		15.3	0.20 [0.01, 4.00]
Subtotal (95% CI)	30	30		15.3	0.20 [0.01, 4.00]
Total events: 0 (Treatment), 2 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.05 p=0.3					
02 Limited peripartum surveillance					
Mahomed 1998	1/320	14/329		84.7	0.07 [0.01, 0.56]
Subtotal (95% CI)	320	329		84.7	0.07 [0.01, 0.56]
Total events: 1 (Treatment), 14 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=2.53 p=0.01					
Total (95% CI)	350	359		100.0	0.09 [0.02, 0.49]
Total events: 1 (Treatment), 16 (Control)					
Test for heterogeneity chi-square=0.30 df=1 p=0.58 I^2 =0.0%					
Test for overall effect z=2.80 p=0.005					



Analysis 01.13. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 13 Perinatal death

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 13 Perinatal death

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
× Adam 1989	0/17	0/18		0.0	Not estimable
× Cialone 1994	0/47	0/58		0.0	Not estimable
× Hofmeyr 1998	0/164	0/163		0.0	Not estimable
× Macri 1992	0/85	0/85		0.0	Not estimable
× Moodley 1998	0/30	0/30		0.0	Not estimable
× Sadovsky 1989	0/19	0/21		0.0	Not estimable
× Wenstrom 1989	0/41	0/44		0.0	Not estimable
Subtotal (95% CI)	403	419		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
02 Limited peripartum surveillance					
Mahomed 1998	4/324	12/335		100.0	0.34 [0.11, 1.06]
Subtotal (95% CI)	324	335		100.0	0.34 [0.11, 1.06]
Total events: 4 (Treatment), 12 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.86 p=0.06					
Total (95% CI)	727	754		100.0	0.34 [0.11, 1.06]
Total events: 4 (Treatment), 12 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.86 p=0.06					

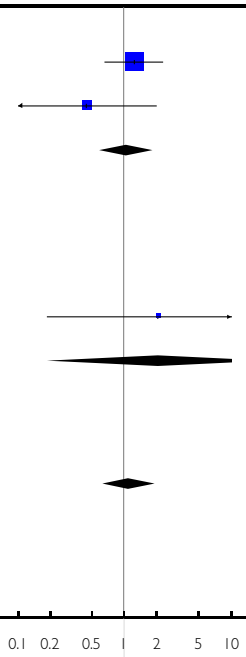
Analysis 01.14. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 14 Puerperal pyrexia

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 14 Puerperal pyrexia

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Hofmeyr 1998	19/149	15/145		72.6	1.23 [0.65, 2.33]
Sadovsky 1989	2/19	5/21		22.7	0.44 [0.10, 2.02]
Subtotal (95% CI)	168	166		95.3	1.04 [0.59, 1.86]
Total events: 21 (Treatment), 20 (Control)					
Test for heterogeneity chi-square=1.49 df=1 p=0.22 I^2 =33.0%					
Test for overall effect z=0.15 p=0.9					
02 Limited peripartum surveillance					
Mahomed 1998	2/321	1/335		4.7	2.09 [0.19, 22.91]
Subtotal (95% CI)	321	335		4.7	2.09 [0.19, 22.91]
Total events: 2 (Treatment), 1 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.60 p=0.5					
Total (95% CI)	489	501		100.0	1.09 [0.62, 1.91]
Total events: 23 (Treatment), 21 (Control)					
Test for heterogeneity chi-square=1.78 df=2 p=0.41 I^2 =0.0%					
Test for overall effect z=0.31 p=0.8					

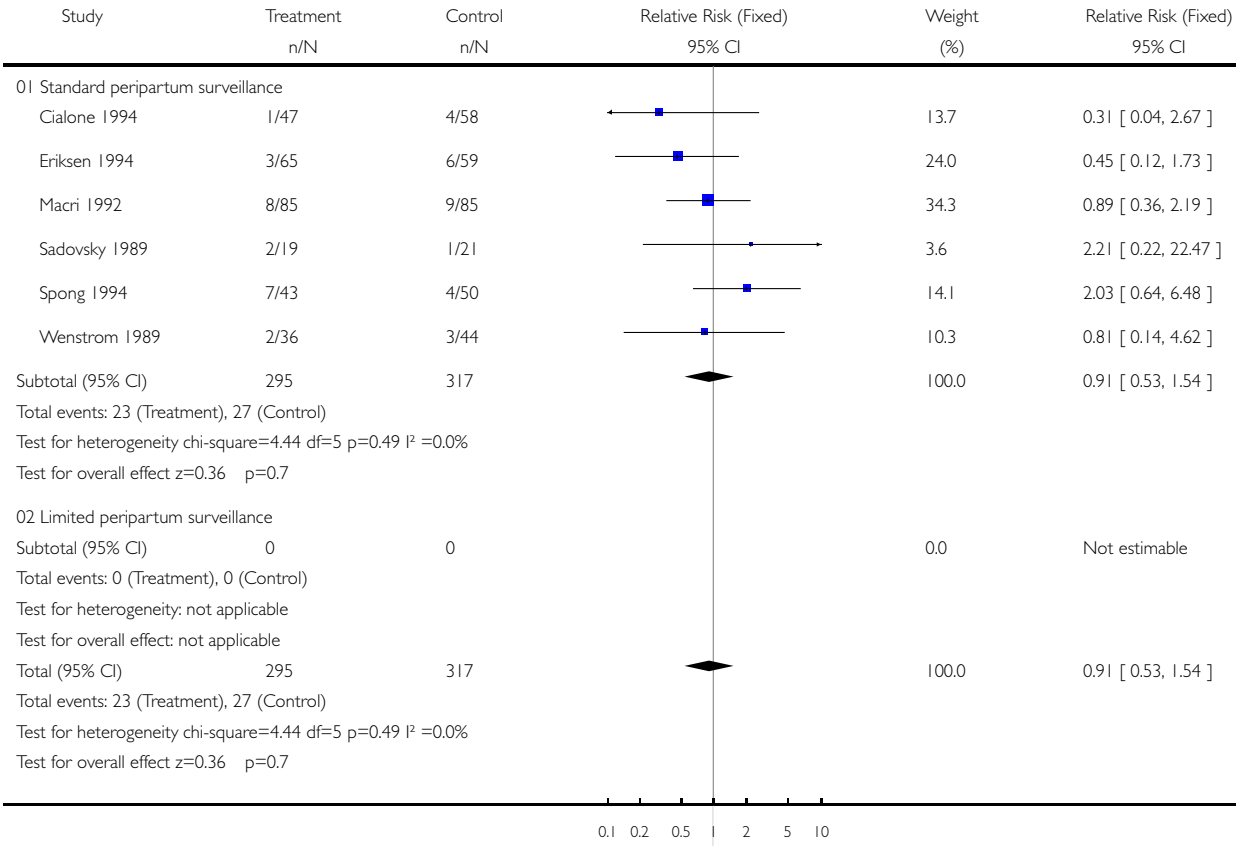


Analysis 01.15. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 15 Puerperal endometritis

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 15 Puerperal endometritis



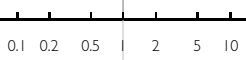
Analysis 01.16. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 16 Oxytocin augmentation

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 16 Oxytocin augmentation

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Cialone 1994	16/47	6/58		14.6	3.29 [1.40, 7.74]
Eriksen 1994	40/65	30/59		85.4	1.21 [0.88, 1.66]
Subtotal (95% CI)	112	117		100.0	1.51 [1.12, 2.05]
Total events: 56 (Treatment), 36 (Control)					
Test for heterogeneity chi-square=5.09 df=1 p=0.02 I^2 =80.3%					
Test for overall effect z=2.68 p=0.007					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
Total (95% CI)	112	117		100.0	1.51 [1.12, 2.05]
Total events: 56 (Treatment), 36 (Control)					
Test for heterogeneity chi-square=5.09 df=1 p=0.02 I^2 =80.3%					
Test for overall effect z=2.68 p=0.007					



Analysis 01.17. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 17 Narcotic analgesic

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 17 Narcotic analgesic

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Cialone 1994	19/47	22/58		100.0	1.07 [0.66, 1.72]
Subtotal (95% CI)	47	58		100.0	1.07 [0.66, 1.72]
Total events: 19 (Treatment), 22 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.26 p=0.8					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
Total (95% CI)	47	58		100.0	1.07 [0.66, 1.72]
Total events: 19 (Treatment), 22 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.26 p=0.8					

Analysis 01.18. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 18 Epidural analgesia

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 18 Epidural analgesia

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Cialone 1994	26/47	24/58		100.0	1.34 [0.90, 1.99]
Subtotal (95% CI)	47	58		100.0	1.34 [0.90, 1.99]
Total events: 26 (Treatment), 24 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.42 p=0.2					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					

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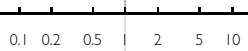
Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
Total (95% CI)	47	58		100.0	1.34 [0.90, 1.99]
Total events: 26 (Treatment), 24 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=1.42 p=0.2					



Analysis 01.19. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 19 first stage labour (minutes)

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 19 first stage labour (minutes)

Study	Treatment N	Mean(SD)	Control N	Mean(SD)	Weighted Mean Difference (Fixed) 95% CI	Weight (%)	Weighted Mean Difference (Fixed) 95% CI
01 Standard peripartum surveillance							
Cialone 1994	47	401.50 (296.80)	58	399.40 (284.10)		81.7	2.10 [-109.91, 114.11]
Eriksen 1994	65	884.00 (850.00)	59	716.00 (452.00)		18.3	168.00 [-68.65, 404.65]
Subtotal (95% CI)	112		117			100.0	32.46 [-68.78, 133.70]
Test for heterogeneity chi-square=1.54 df=1 p=0.21 I² =35.2%							
Test for overall effect z=0.63 p=0.5							
02 Limited peripartum surveillance							
Subtotal (95% CI)	0		0			0.0	Not estimable
Test for heterogeneity: not applicable							
Test for overall effect: not applicable							
Total (95% CI)	112		117			100.0	32.46 [-68.78, 133.70]
Test for heterogeneity chi-square=1.54 df=1 p=0.21 I² =35.2%							
Test for overall effect z=0.63 p=0.5							

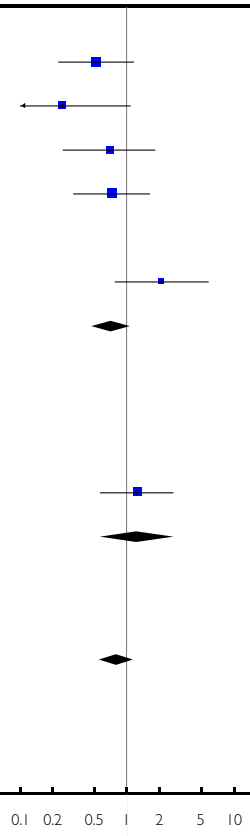
Analysis 01.20. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 20 Instrumental vaginal delivery

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 20 Instrumental vaginal delivery

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Alvarez 1999	7/53	16/62		24.7	0.51 [0.23, 1.15]
Cialone 1994	2/47	10/58		15.0	0.25 [0.06, 1.07]
Eriksen 1994	6/65	8/59		14.0	0.68 [0.25, 1.85]
Hofmeyr 1998	9/167	12/159		20.6	0.71 [0.31, 1.65]
× Moodley 1998	0/30	0/30		0.0	Not estimable
Spong 1994	9/43	5/50		7.7	2.09 [0.76, 5.77]
Subtotal (95% CI)	405	418		82.0	0.69 [0.46, 1.05]
Total events: 33 (Treatment), 51 (Control)					
Test for heterogeneity chi-square=7.01 df=4 p=0.14 I^2 =42.9%					
Test for overall effect z=1.74 p=0.08					
02 Limited peripartum surveillance					
Mahomed 1998	13/320	11/333		18.0	1.23 [0.56, 2.70]
Subtotal (95% CI)	320	333		18.0	1.23 [0.56, 2.70]
Total events: 13 (Treatment), 11 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect z=0.51 p=0.6					
Total (95% CI)	725	751		100.0	0.79 [0.55, 1.14]
Total events: 46 (Treatment), 62 (Control)					
Test for heterogeneity chi-square=8.42 df=5 p=0.13 I^2 =40.6%					
Test for overall effect z=1.28 p=0.2					



Analysis 01.21. Comparison 01 Amnioinfusion for meconium-stained liquor in labour, Outcome 21 Instrumental vaginal delivery for fetal distress

Review: Amnioinfusion for meconium-stained liquor in labour

Comparison: 01 Amnioinfusion for meconium-stained liquor in labour

Outcome: 21 Instrumental vaginal delivery for fetal distress

Study	Treatment n/N	Control n/N	Relative Risk (Fixed) 95% CI	Weight (%)	Relative Risk (Fixed) 95% CI
01 Standard peripartum surveillance					
Alvarez 1999	3/53	3/62		38.2	1.17 [0.25, 5.55]
Cialone 1994	1/47	5/58		61.8	0.25 [0.03, 2.04]
Subtotal (95% CI)	100	120		100.0	0.60 [0.18, 1.95]
Total events: 4 (Treatment), 8 (Control)					
Test for heterogeneity chi-square=1.39 df=1 p=0.24 I^2 =27.8%					
Test for overall effect z=0.85 p=0.4					
02 Limited peripartum surveillance					
Subtotal (95% CI)	0	0		0.0	Not estimable
Total events: 0 (Treatment), 0 (Control)					
Test for heterogeneity: not applicable					
Test for overall effect: not applicable					
Total (95% CI)	100	120		100.0	0.60 [0.18, 1.95]
Total events: 4 (Treatment), 8 (Control)					
Test for heterogeneity chi-square=1.39 df=1 p=0.24 I^2 =27.8%					
Test for overall effect z=0.85 p=0.4