

Dopamine for prevention of morbidity and mortality in term newborn infants with suspected perinatal asphyxia (Review)

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TABLE OF CONTENTS

ABSTRACT	1
PLAIN LANGUAGE SUMMARY	2
BACKGROUND	2
OBJECTIVES	3
CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW	3
SEARCH METHODS FOR IDENTIFICATION OF STUDIES	3
METHODS OF THE REVIEW	4
DESCRIPTION OF STUDIES	4
METHODOLOGICAL QUALITY	4
RESULTS	4
DISCUSSION	5
AUTHORS' CONCLUSIONS	5
POTENTIAL CONFLICT OF INTEREST	6
ACKNOWLEDGEMENTS	6
SOURCES OF SUPPORT	6
REFERENCES	6
TABLES	8
Characteristics of included studies	8
Characteristics of excluded studies	8
ANALYSES	9
Comparison 01. Dopamine versus control	9
INDEX TERMS	9
COVER SHEET	9
GRAPHS AND OTHER TABLES	10
Analysis 01.01. Comparison 01 Dopamine versus control, Outcome 01 Mortality before hospital discharge (among all randomised)	10
Analysis 01.02. Comparison 01 Dopamine versus control, Outcome 02 Neurodevelopmental disability (among all randomised)	11
Analysis 01.03. Comparison 01 Dopamine versus control, Outcome 03 Death or neurodevelopmental disability (among all randomised)	11
Analysis 01.04. Comparison 01 Dopamine versus control, Outcome 04 Neurodevelopmental disability (among survivors examined)	12

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ABSTRACT

Background

Perinatal asphyxia remains an important condition with significant mortality and long-term morbidity. Multisystem involvement including hypotension and low cardiac output is common in infants with perinatal asphyxia. Dopamine is commonly used for infants with hypotension of any etiology, with the goal of improving cardiac output and preventing its detrimental consequences.

Objectives

To determine if dopamine, compared to placebo, no treatment, volume or another inotrope reduces morbidity and mortality in term newborn infants with suspected perinatal asphyxia.

Search strategy

The standard search strategy of the Neonatal Review Group was used. Searches were conducted of the Oxford Database of Perinatal Trials, Cochrane Controlled Trials Register (The Cochrane Library, Issue 1, 2002), MEDLINE (1966 to March 2002), previous reviews including cross references, abstracts and conference proceedings (Perinatal Society of Australia and New Zealand 1998-2002 and Pediatric Academic Societies meetings 1998-2001).

Selection criteria

Randomised controlled trials comparing dopamine with placebo, no treatment, other inotropic agents, or volume in infants greater than 36 weeks gestation. Perinatal asphyxia could be suspected on the basis of a cord blood pH < 7.0, cord blood base excess < -16 mEq/L or 5 minute Apgar score < 6.

Data collection and analysis

Standard methods of the Cochrane Neonatal Review Group with use of relative risk (RR), risk difference (RD) and weighted mean difference (WMD). The fixed effects model using RevMan 4.1 was used for meta-analysis. Data from individual studies were only eligible for inclusion if at least 75% of participants were followed up.

Main results

Only one study (DiSessa 1981) was eligible. This study compared low dose dopamine at 2.5 mcg/kg/min with placebo (dextrose in water). This study enrolled 14 term infants with a 5 minute Apgar <6 and a systolic BP \geq 50 mmHg at a mean of 10 hours age. Seven infants only were randomised to treatment with dopamine and seven to receive placebo. No significant differences between these two groups were found for mortality or long term neurodevelopmental outcome. Length of hospitalisation was not significantly different between the two groups. No study was found that examined the effect of dopamine in infants with evidence of cardiovascular compromise, nor were any studies identified in which dopamine was compared to other inotropic agents for term infants with suspected asphyxia.

Authors' conclusions

There is currently insufficient evidence from randomised controlled trials that the use of dopamine in term infants with suspected perinatal asphyxia improves mortality or long-term neurodevelopmental outcome. The question of whether dopamine improves

outcome for term infants with suspected perinatal asphyxia has not been answered. Further research is required to determine whether or not the use of dopamine improves mortality and long-term morbidity for these infants and if so, issues such as which infants, at what dose and with what co-interventions should be addressed.

PLAIN LANGUAGE SUMMARY

Dopamine to improve outcomes in newborn infants with a suspected lack of oxygen during birth

A lack of oxygen around the time of birth (perinatal asphyxia) can cause death and long-term illness in newborn infants. It is indicated by a low Apgar score five minutes after birth and acidic umbilical cord blood (acidosis). An infant experiencing asphyxia may need urgent resuscitation, oxygen and supported breathing (assisted ventilation). Often they have low blood pressure and poor heart function. The drug dopamine stimulates the heart and is used to improve blood flow to the brain and other organs to reduce brain and other organ damage. Possible adverse events from giving such an agent include damage with the umbilical venous catheter and heart irregularities (arrhythmias). The review authors searched the medical literature and were able to find only one small randomised controlled trial. The 14 infants included in the trial had a birthweight over 2000 g and were enrolled at a mean age of 10 hours. They had received ventilatory support and fluid expansion after birth. Infants treated with low dose dopamine (2.5 microg/kg/min) did not differ from the infants receiving placebo (dextrose water) in the number who died before discharge from hospital. Neurodevelopmental disability was similar in both groups, in all infants randomised and in survivors. The timing of assessments was variable. These findings are limited with only one small study in which three of 12 survivors were lost to follow up.

BACKGROUND

Perinatal asphyxia with encephalopathy occurs in 1.1 to 1.8 / 1000 live births (MacLennan 1999; Badawi 1998). Multisystem organ involvement including renal, pulmonary, cardiac and gastrointestinal impairment occurs in over 80% of infants with encephalopathy due to perinatal asphyxia (Martin-Ancel 1995). Criteria for the recognition of perinatal asphyxia have been set out by the International Cerebral Palsy Task Force (MacLennan 1999). They include a sentinel intrapartum event in labour, abnormal findings on fetal monitoring, fetal or neonatal acidosis, low Apgar scores (<7 at 5 minutes), early onset encephalopathy and multi-system organ involvement. Application of such stringent criteria has only recently occurred in studies of infants with hypoxic-ischaemic encephalopathy (HIE) (Hall 1998), with older studies including any encephalopathic infant regardless of etiology. However, infants born in a depressed state require urgent resuscitation. At the time, diagnostic information concerning the cause of cardiorespiratory depression may be limited. Acidosis on cord blood gas analysis and depressed Apgar scores may confirm the clinical state, but do not identify aetiology. Previously this state was largely attributed to "birth asphyxia". It is now realised that attribution of perinatal hypoxia/ischaemia as the cause of neonatal encephalopathy is difficult and many other conditions, like sepsis or metabolic disease, can masquerade as "asphyxia" (Baumgart 2001). For this reason, this review will take a pragmatic approach to the definition of perinatal asphyxia.

Hypotension (Lou 1977; Walther 1985; Martin-Ancel 1995), reduced left ventricular function (Barberi 1999; Bennhagen 1998;

Tsivyan 1991; Walther 1985) and reduced cardiac output (Van Bel 1990; Walther 1985) have been documented in infants with perinatal asphyxia. However, there is no evidence for a relationship between low cardiac output or hypotension and subsequent neurodevelopment in term infants born with evidence of perinatal asphyxia. Infants with a poor neurodevelopmental outcome have been found to have high cerebral blood flow (Meek 1999), low cerebral blood flow (Lou 1977) and impaired cerebral autoregulation (Pryds 1990) on the first day of life. Despite the difficulties in interpreting cardiovascular parameters, one would assume that minimisation of ongoing end-organ damage may be important to ensure the best possible neurodevelopmental outcome. This raises two questions. The first is, do cardiovascular interventions improve outcomes for these infants? Secondly, if they do, which interventions are best at improving cardiovascular function in newborns with acidosis and low Apgar scores? Interventions with the potential to improve cardiac function include the administration of volume and inotropes.

Dopamine is an endogenous catecholamine that has been used extensively in the management of shock in both infants and children. Improvements in cardiovascular variables like blood pressure (Padbury 1987), cardiac output and stroke volume (Fiddler 1980, Walther 1985) have been documented with doses of dopamine up to 10 mcg/kg/min. Concerns have been expressed regarding higher doses of dopamine in view of the increases in ventricular afterload which may reduce cardiac output (Seri 1995). Repetto 1999 reported increasing pressor response at doses greater than 20 mcg/kg/min without suppression of urine output. Reported adverse effects of dopamine use in the neonate include severe

vasoconstriction after extravasation, gangrene, cardiac arrhythmias (Seri 1995) and hepatic injury after inappropriately placed umbilical venous catheters (Venkataraman 1984). Dopamine has been administered at doses that correspond to differing renal and cardiovascular responses (Goldberg 1988, Seri 1995). Low infusion rates (0.5 to 5mcg/kg/min) are used to improve renal perfusion and treat oliguria. The medium dose range (6 to 10mcg/kg/min) is used for treatment of heart failure and the high dose range (15 to 20mcg/kg/min) is used for the treatment of shock.

Primary outcomes of this review include mortality and long term disability. Important secondary outcomes include evidence of organ dysfunction in the neonatal period. As clinical predictors of adverse neurodevelopmental outcomes include grade of encephalopathy (Thornberg 1995) and abnormal neurobehaviour at discharge (Aggarwal 1998), these will be included as secondary outcomes. Intervening effects of inotrope treatment such as successful treatment of low cardiac output and low organ blood flow will also be reported. In view of the association between high cerebral blood flow and adverse outcomes (Meek 1999), improvements in cerebral blood flow will only be assessed in infants with low cerebral blood flow. Subgroup analyses will be performed to assess the effects of dopamine according to a) severity of HIE (Sarnat staging, Sarnat 1976) in order to determine which infants benefit most from therapy, b) indicator of poor cardiovascular function (HIE, low blood pressure, low cardiac output) and c) maximal dose of dopamine used (in view of differing dose-response pharmacodynamics).

OBJECTIVES

To determine if dopamine, compared to placebo or no treatment, reduces mortality in term newborn infants with suspected perinatal asphyxia; to determine if dopamine is more effective than other inotropic agents; and to determine if dopamine is more effective than volume. In planned subgroup analyses, to determine the effects of dopamine according to severity of HIE, indicator of poor cardiovascular function, and maximal dose of dopamine used.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

- 1) Randomised controlled trials that compare dopamine with control (placebo or no treatment)
- 2) Randomised controlled trials that compare dopamine with other inotropic agents
- 3) Randomised controlled trials that compare dopamine with volume

Randomised cross-over studies will be included for the short-term secondary outcomes of cardiac output and hypotension only.

Trials should have adequate randomisation and >75% follow up of participants for outcomes measures as described below.

Types of participants

Term infants born after 36 weeks gestation, with suspected perinatal asphyxia as evidenced by cord pH < 7.0 and/or cord base excess < -16 mEq/L and/or 5 minute Apgar score < 6.

Types of intervention

Dopamine infusion at any dosage compared with control (placebo or no treatment). Dopamine infusion compared to infusion of other inotropic agents (eg epinephrine, dobutamine, isoproterenol). Dopamine infusion compared to infusion of volume.

Types of outcome measures

Primary outcome measures included any of the following:

1. Neonatal mortality and mortality to discharge.
2. Neurodevelopmental disability (neurological abnormality including cerebral palsy, developmental delay > 2 standard deviations below population mean or sensory impairment).

Secondary outcome measures include any of the following:

1. Length of stay in
-neonatal intensive care
-hospital.
2. Evidence of organ dysfunction
-Severity and duration of HIE (eg Sarnat staging, Sarnat 1976)
-Neurological abnormality at discharge (eg abnormal neurological examination, abnormal feeding)
-Persistent low cardiac output (defined echocardiographically)
-Persistent hypotension (eg mean blood pressure [mmHg] less than gestational age [wk])
-Failed treatment (need for volume or other inotrope)
-Renal failure (oliguria, ie urine output < 0.5 ml/kg/hr for > 24 hours or creatinine > 120 umol/l)
-Gastrointestinal complications (perforation, necrotising enterocolitis, haemorrhage)
-Respiratory failure defined by the need for rescue measures like ECMO and HFOV (when not routine).
3. Failure to increase low organ blood flow (cardiac output, renal and cerebral blood flow in ml/kg/min)
4. Evidence of adverse event from inotrope infusion
-extravasation
-hepatic injury
-arrhythmias

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: methods used in reviews.

The standard search strategy of the Neonatal Review Group was used. See Neonatal Review Group details for more information. This was supplemented by additional searches of the Oxford

Database of Perinatal Trials, Cochrane Controlled Trials Register (The Cochrane Library, Issue 1, 2002), MEDLINE, previous reviews including cross references, abstracts, conferences and symposia proceedings (Perinatal Society of Australia and New Zealand 1998-2002 and Pediatric Academic Societies meetings 1998-2001). No investigators were contacted about additional studies potentially eligible for inclusion.

The search of MEDLINE 1966 to March 2002 included MeSH searches using the following terms (“[asphyxia neonatorum or perinatal asphyxia or birth asphyxia] and [dopamine or inotrope]”, and text searches using the terms “infant-newborn and [dopamine or inotrop\$]”. Searches were limited to “clinical trials”. No language restrictions were applied.

METHODS OF THE REVIEW

Criteria and methods used to assess the methodological quality of the included trials: Standard methods of the Cochrane Collaboration and its Neonatal Review Group were used. The methodological quality of each trial was reviewed by each author independently. Particular emphasis was placed on allocation concealment, blinding of intervention, completeness of follow-up and blinding of outcome assessment and these were rated as either yes, no or uncertain. No additional information was requested from authors to clarify methodology.

Methods used to collect data from the included trials: Each author extracted data separately, then compared and resolved differences.

In planned subgroup analyses, the effects of dopamine vs placebo or no treatment, dopamine vs other inotropic agents, and dopamine vs volume were to be examined. Planned subgroup analyses also included analysis according to a) severity of HIE according to Sarnat staging, b) indicator of poor cardiovascular function (HIE, low BP, low cardiac output), and c) maximal dose of dopamine used, classified as $</=5$, 6-14, and $=/> 15$ mcg/kg/min.

Methods used to analyse the data: Standard method of the Cochrane Neonatal Review Group using relative risk (RR), risk difference (RD), number needed to treat (NNT), weighted mean difference (WMD) and 95% confidence intervals where appropriate. Meta-analysis, if appropriate, was to be undertaken assuming a fixed effect model.

It was the intention of the reviewers to perform sensitivity analysis including only trials with adequate allocation concealment and no losses to follow up.

DESCRIPTION OF STUDIES

Five studies were identified by the search strategy. However, only one (DiSessa 1981) was eligible for inclusion in this review. Four

studies were excluded (Cason 1999; Padbury 1990; Phillipos 1996; Phillipos 2000). The reasons for exclusion are given in the Table, Characteristics of Excluded Studies.

DiSessa 1981 - In this trial fourteen infants with birthweight over 2000 gms and gestation > 35 weeks were selected on the basis of Apgar score at 5 minutes less than 6. All infants had received ventilatory support and fluid expansion of 5mls/kg/hour (the total period of which was not reported). Only infants with a systolic blood pressure ≥ 50 mmHg were enrolled. Infants were randomised to receive an infusion of dopamine at 2.5mcg/kg/min or placebo (dextrose water), seven in each group. Blood pressure was monitored invasively and recorded hourly both pre and post infusion. An echocardiogram was performed between six and 12 hours after commencement of infusion. There are no data to suggest that these echocardiograms were standardised in timing or method. From this, a shortening fraction and mean velocity of circumferential fibre shortening were calculated and reported. Mortality and neurodevelopmental follow-up were reported. Neurodevelopmental assessment was not standardised. The only data regarding secondary outcomes as stated above are for duration of hospitalisation in days.

No studies comparing dopamine to other pressors were noted. No potentially relevant on-going trials were identified.

METHODOLOGICAL QUALITY

DiSessa 1981 - The method of randomisation was not reported. Infants were randomised after enrolment and a placebo was used. Allocation concealment is uncertain. It is unclear whether or not there was blinding of follow-up. There were no significant differences between groups in stabilisation time, weight, gestational age, initial pH, or one and five minute Apgar scores. Blood pressure for two infants in each group was not analysed because in each group there was one infant who had received tolazoline and one who had received pancuronium. Follow-up data were reported for five of seven infants in the placebo group (including two deaths), and for six of seven infants in the treatment group, giving a follow-up rate of 79%.

RESULTS

DOPAMINE VERSUS CONTROL

Primary Outcomes: In the only eligible study (DiSessa 1981) there were only seven infants randomised to receive dopamine, and seven randomised to receive placebo. With such small numbers included, the results must be interpreted with caution, as the confidence intervals are wide. There was no significant difference in mortality before discharge from hospital between those infants treated with dopamine and those treated with placebo (RR 0.20, 95% CI 0.01,

3.54). There was no significant difference between groups for neurodevelopmental disability amongst all infants randomised (RR 1.0, 95%CI 0.08, 13.02) or amongst the survivors examined (RR 0.50, 95%CI 0.05, 5.51); when death and neurodevelopmental disability were combined, there was still no statistically significant difference between the two groups (RR 0.33, 95%CI 0.04, 2.48). These results must be interpreted with additional caution in view of the losses to follow-up (three out of a total of twelve survivors), and the variable timing of assessment of subjects within and between the groups.

Secondary Outcomes: DiSessa 1981 reported length of hospitalisation as a mean of 10.8 days for placebo, compared to 12.4 days for dopamine treated infants. No standard deviations are provided and it is unclear whether or not these figures pertain to survivors alone. No information is provided regarding any other of the pre-specified secondary outcomes. DiSessa 1981 reported a significantly higher systolic blood pressure post dopamine infusion (mean increase of 7 mmHg, $p=0.001$), compared to the placebo group who experienced no significant change in blood pressure post-infusion. Two echocardiographic parameters were also reported. Infants receiving dopamine had a significantly greater shortening fraction and mean velocity circumferential fractional shortening compared to pre-infusion. There was no significant difference in the placebo group. However, post-infusion the dopamine and placebo groups were not significantly different.

No sub-group analysis was possible. With only one eligible study, issues of heterogeneity do not apply and sensitivity analysis could not be undertaken.

DISCUSSION

This review examines the evidence from randomised controlled trials for the potential benefits of dopamine in the group of term infants suspected of suffering from perinatal asphyxia. Only one small study was eligible for inclusion that enrolled 'normotensive' term infants on the basis of a low 5 minute Apgar score, which would now be considered to be a loose definition of perinatal asphyxia. This study reported no benefit in terms of mortality or neurodevelopmental outcome for infants treated with dopamine compared to infants treated with placebo. The eligible study, and hence the current systematic review, are limited by very small numbers of patients, and losses to follow-up. These include exclusion of infants from analysis of presented data because of co-treatment with other blood-pressure altering drugs, namely tolazoline and pancuronium. The significance of the increased blood pressure amongst the dopamine treated infants reported in DiSessa 1981 remains uncertain. The relative change in measured systolic blood pressure was small (10%). There was no documented improvement in any clinically important outcome. There was no documentation of improved perfusion of vital target organs like the

brain or reduced end organ damage. The included study was insufficiently powered to detect a clinically important difference in outcomes. In addition, the study enrolled infants with a systolic BP ≥ 50 mmHg, and despite the use of echocardiography as a measure of effect, no attempt was made to measure cardiac output. These limitations imply that the conclusions of this review, as they apply to patient therapy, should be treated with caution.

No study was found that examined the effect of dopamine in infants with evidence of cardiovascular compromise. Studies are warranted in term infants with evidence of cardiovascular compromise (either low blood pressure, low cardiac output or low organ perfusion) to determine the best approach to the cardiovascular support of term infants with suspected perinatal asphyxia. Until there are more data available from larger and better designed studies, the questions posed by this review will remain unanswered.

AUTHORS' CONCLUSIONS

Implications for practice

There is no evidence from randomised trials to support the routine use of dopamine in infants with suspected perinatal asphyxia with or without cardiovascular compromise as a therapy for improving mortality and neurodevelopmental outcome. The continued use of dopamine in this group to support blood pressure, improve myocardial contractility and end organ perfusion, with the expectation of improving mortality and long-term outcome, must be tempered with the knowledge that as yet there is no evidence of effect from human randomised trials that such therapy achieves either improvement in mortality or long-term outcome.

Implications for research

The question of whether dopamine improves outcome for term infants with suspected perinatal asphyxia has not been answered. Further research is required to determine whether or not the use of dopamine improves mortality and long-term morbidity for these infants. If so, issues such as which patients, at what dose and with what co-interventions should be addressed. Specifically, the role of dopamine in treating infants with suspected asphyxia and co-existing cardiovascular compromise should be explored. This would require a randomised controlled trial of dopamine versus another commonly used inotrope like dobutamine, designed to explore the outcomes as outlined in this review. Particularly, some measure of cardiac output and end-organ perfusion should be employed so that short-term benefits can be measured. This will allow better interpretation of the more important longer term outcomes like mortality and neurodevelopmental outcome. The use of inotropes, whilst unproven, is now so common that few researchers are likely to contemplate a trial of dopamine versus placebo.

POTENTIAL CONFLICT OF INTEREST

None

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- No sources of support supplied

Internal sources of support

- No sources of support supplied

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*Indicates the major publication for the study

TABLES

Characteristics of included studies

Study	DiSessa 1981
Methods	<p>Random study: yes, method not stated.</p> <p>Allocation concealment: uncertain.</p> <p>Blinding of intervention: yes (placebo used).</p> <p>Blinding of measurement: uncertain.</p> <p>Losses to follow-up: yes, two infants excluded from each group for BP data as one received tolazoline and one received pancuronium in each group. Echocardiographic data only available for 6/7 infants in each group. Neurodevelopmental follow-up data available for 3/5 survivors in placebo group, and 6/7 survivors in treatment group.</p>
Participants	<p>Infants > 2000gms, >35 weeks gestation, with 5' Apgar < 6.</p> <p>Inclusion criteria: systolic BP > 50 mmHg.</p> <p>Mean gestation: Treatment group - 41.1 weeks (sd 1.5); Control group - 39.8 weeks (sd 0.89).</p> <p>Mean birthweight: Treatment group: 2960gms (sd 490); Control group: 3460gms (sd 340).</p>
Interventions	<p>Treatment group (n=7): Dopamine 2.5ug/kg/min - further dose increases and titration endpoint unstated. No explanation of measure of effect of treatment, or mechanism for dealing with failed treatment.</p> <p>Placebo (n=7): dextrose and water.</p> <p>Co-intervention: Both groups received volume expansion with either colloid or blood (5ml/kg/hr - for unstated total period).</p>
Outcomes	<p>Stated primary outcome: "cardiovascular effects of low dose dopamine in the severely asphyxiated newborn".</p> <p>Other outcomes: None stated. Mortality and neurodevelopmental disability reported.</p> <p>Echocardiographic data reported not standardised; examination took place 6-12 hours post infusion.</p> <p>Method of neurodevelopmental assessment neither stated or standardised.</p> <p>No adverse events reported.</p>
Notes	
Allocation concealment	B – Unclear

Characteristics of excluded studies

Study	Reason for exclusion
Cason 1999	Subjects infants < or = 34 weeks with RDS.
Padbury 1990	Descriptive study exploring pharmacokinetics of dopamine in sick neonates.
Phillipos 1996	RCT of dopamine vs epinephrine, however subjects not asphyxiated infants.
Phillipos 2000	Subjects infants < 1750 grams with hypotension.

ANALYSES

Comparison 01. Dopamine versus control

Outcome title	No. of studies	No. of participants	Statistical method	Effect size
01 Mortality before hospital discharge (among all randomised)	1	14	Relative Risk (Fixed) 95% CI	0.20 [0.01, 3.54]
02 Neurodevelopmental disability (among all randomised)	1	14	Relative Risk (Fixed) 95% CI	1.00 [0.08, 13.02]
03 Death or neurodevelopmental disability (among all randomised)	1	14	Relative Risk (Fixed) 95% CI	0.33 [0.04, 2.48]
04 Neurodevelopmental disability (among survivors examined)	1	9	Relative Risk (Fixed) 95% CI	0.50 [0.05, 5.51]

INDEX TERMS

Medical Subject Headings (MeSH)

Asphyxia Neonatorum [*prevention & control]; Cardiotoxic Agents [*therapeutic use]; Dopamine [*therapeutic use]; Infant, Newborn; Randomized Controlled Trials

MeSH check words

Humans

COVER SHEET

Title	Dopamine for prevention of morbidity and mortality in term newborn infants with suspected perinatal asphyxia
Authors	Hunt R, Osborn D
Contribution of author(s)	Information not supplied by author
Issue protocol first published	2002/1
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Date of most recent amendment	07 February 2007
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What's New	Information not supplied by author
Date new studies sought but none found	Information not supplied by author
Date new studies found but not yet included/excluded	Information not supplied by author
Date new studies found and included/excluded	Information not supplied by author
Date authors' conclusions section amended	Information not supplied by author

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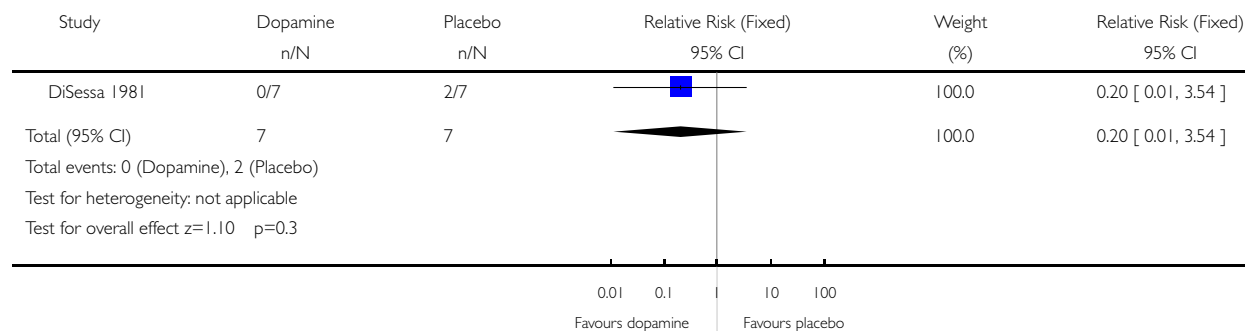
GRAPHS AND OTHER TABLES

Analysis 01.01. Comparison 01 Dopamine versus control, Outcome 01 Mortality before hospital discharge (among all randomised)

Review: Dopamine for prevention of morbidity and mortality in term newborn infants with suspected perinatal asphyxia

Comparison: 01 Dopamine versus control

Outcome: 01 Mortality before hospital discharge (among all randomised)

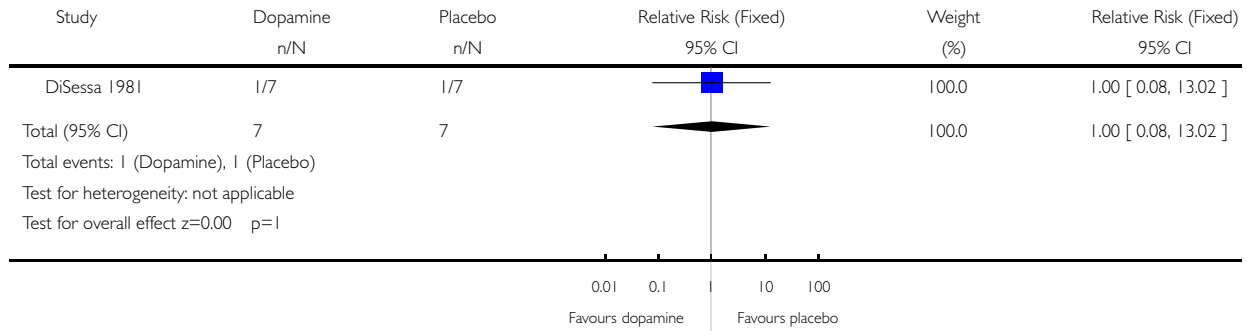


Analysis 01.02. Comparison 01 Dopamine versus control, Outcome 02 Neurodevelopmental disability (among all randomised)

Review: Dopamine for prevention of morbidity and mortality in term newborn infants with suspected perinatal asphyxia

Comparison: 01 Dopamine versus control

Outcome: 02 Neurodevelopmental disability (among all randomised)

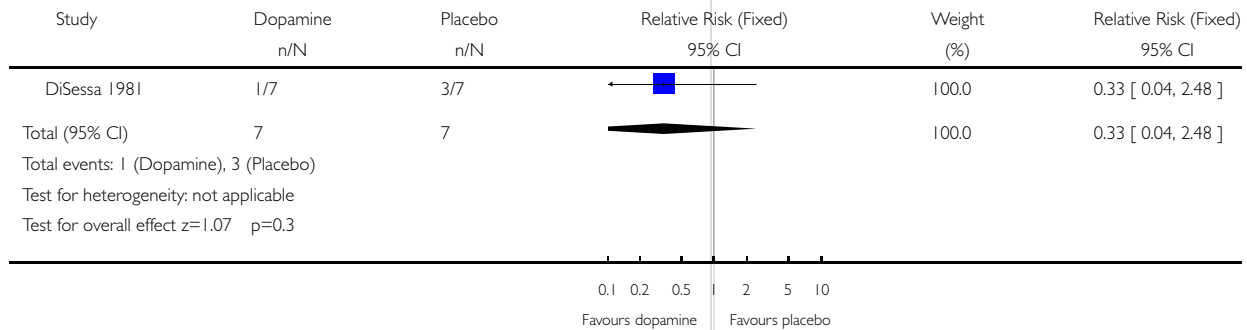


Analysis 01.03. Comparison 01 Dopamine versus control, Outcome 03 Death or neurodevelopmental disability (among all randomised)

Review: Dopamine for prevention of morbidity and mortality in term newborn infants with suspected perinatal asphyxia

Comparison: 01 Dopamine versus control

Outcome: 03 Death or neurodevelopmental disability (among all randomised)



Analysis 01.04. Comparison 01 Dopamine versus control, Outcome 04 Neurodevelopmental disability (among survivors examined)

Review: Dopamine for prevention of morbidity and mortality in term newborn infants with suspected perinatal asphyxia

Comparison: 01 Dopamine versus control

Outcome: 04 Neurodevelopmental disability (among survivors examined)

