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[Intervention Review]

Nasal intermittent positive pressure ventilation (NIPPV) versus nasal continuous positive airway pressure (NCPAP) for preterm neonates after extubation

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ABSTRACT

Background

Previous randomised trials and meta-analyses have shown that nasal continuous positive airway pressure (NCPAP) is a useful method for providing respiratory support after extubation. However, this treatment sometimes 'fails' in infants, and they may require endotracheal re-intubation with its attendant risks and expense. Nasal intermittent positive pressure ventilation (NIPPV) can augment NCPAP by delivering ventilator breaths via nasal prongs. Older children and adults with chronic respiratory failure benefit from NIPPV, and the technique has been applied to neonates. However, serious side effects including gastric perforation have been reported with older methods of providing NIPPV.

Objectives

Primary objective

To compare effects of management with NIPPV versus NCPAP on the need for additional ventilatory support in preterm infants whose endotracheal tube was removed after a period of intermittent positive pressure ventilation.

Secondary objectives

To compare rates of gastric distension, gastrointestinal perforation, necrotising enterocolitis and chronic lung disease; duration of hospitalisation; and rates of apnoea, air leak and mortality for NIPPV and NCPAP.

Search methods

We used the standard search strategy of the Cochrane Neonatal Review Group to search the Cochrane Central Register of Controlled Trials (CENTRAL; 2015, Issue 9), MEDLINE via PubMed (1966 to 28 September 2015), Embase (1980 to 28 September 2015) and the Cumulative Index to Nursing and Allied Health Literature (CINAHL; 1982 to 28 September 2015). We also searched clinical trials databases, conference proceedings and reference lists of retrieved articles for randomised controlled trials and quasi-randomised trials.

Selection criteria

We included randomised and quasi-randomised trials comparing use of NIPPV versus NCPAP in extubated preterm infants. NIPPV included non-invasive support delivered by a mechanical ventilator or a bilevel device in a synchronised or non-synchronised way. Participants included ventilated preterm infants who were ready to be extubated to non-invasive respiratory support. Interventions compared were NIPPV, delivered by short nasal prongs or nasopharyngeal tube, and NCPAP, delivered by the same methods.

Types of outcomes measures included failure of therapy (respiratory failure, rates of endotracheal re-intubation); gastrointestinal complications (i.e. abdominal distension requiring cessation of feeds, gastrointestinal perforation or necrotising enterocolitis); pulmonary air leak; chronic lung disease (oxygen requirement at 36 weeks' postmenstrual age) and mortality.

Data collection and analysis

Three review authors independently extracted data regarding clinical outcomes including extubation failure; endotracheal re-intubation; rates of apnoea, gastrointestinal perforation, feeding intolerance, necrotising enterocolitis, chronic lung disease and air leak; and duration of hospital stay. We analysed trials using risk ratio (RR), risk difference (RD) and the number needed to treat for an additional beneficial outcome (NNTB) or an additional harmful outcome (NNTH) for dichotomous outcomes, and mean difference (MD) for continuous outcomes. We used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach to assess the quality of evidence.

Main results

Through the search, we identified 10 trials enrolling a total of 1431 infants and comparing extubation of infants to NIPPV or NCPAP. Three trials had methodological limitations and possible selection bias.

Five trials used the synchronised form of NIPPV, four used the non-synchronised form and one used both methods. Eight studies used NIPPV delivered by a ventilator, one used a bilevel device and one used both methods. When all studies were included, meta-analysis demonstrated a statistically and clinically significant reduction in the risk of meeting extubation failure criteria (typical RR 0.70, 95% CI 0.60 to 0.80; typical RD -0.13, 95% CI -0.17 to -0.08; NNTB 8, 95% CI 6 to 13; 10 trials, 1431 infants) and needing re-intubation (typical RR 0.76, 95% CI 0.65 to 0.88; typical RD -0.10, 95% CI -0.15 to -0.05; NNTB 10, 95% CI 7 to 20; 10 trials, 1431 infants). We graded evidence for these outcomes as moderate, as all trial interventions were unblinded. Although methods of synchronisation varied (Graseby capsule or pneumotachograph/flow-trigger), the five trials that synchronised NIPPV showed a statistically significant benefit for infants extubated to NIPPV in terms of prevention of extubation failure up to one week after extubation.

Unsynchronised NIPPV also reduced extubation failure. NIPPV provided via a ventilator is more beneficial than that provided by bilevel devices in reducing extubation failure during the first week. When comparing interventions, investigators found no significant reduction in rates of chronic lung disease (typical RR 0.94, 95% CI 0.80 to 1.10; typical RD -0.02, 95% CI -0.08 to 0.03) or death, and no difference in the incidence of necrotising enterocolitis. Air leaks were reduced in infants randomised to NIPPV (typical RR 0.48, 95% CI 0.28 to 0.82; typical RD -0.03, 95% CI -0.05 to -0.01; NNTB 33, 95% CI 20 to 100). We graded evidence quality as moderate (unblinded studies) or low (imprecision) for secondary outcomes.

Authors' conclusions

Implications for practice

NIPPV reduces the incidence of extubation failure and the need for re-intubation within 48 hours to one week more effectively than NCPAP; however, it has no effect on chronic lung disease nor on mortality. Synchronisation may be important in delivering effective NIPPV. The device used to deliver NIPPV may be important; however, data are insufficient to support strong conclusions. NIPPV does not appear to be associated with increased gastrointestinal side effects.

Implications for research

Large trials should establish the impact of synchronisation of NIPPV on safety and efficacy of the technique and should compare the efficacy of bilevel devices versus a ventilator for providing NIPPV.

PLAIN LANGUAGE SUMMARY

Nasal intermittent positive pressure ventilation (NIPPV) versus nasal continuous positive airway pressure (NCPAP) for preterm neonates after extubation

Review question

Does nasal intermittent positive pressure ventilation (NIPPV) confer short-term and long-term benefits without causing harm to premature infants coming off a ventilator? How does it compare with nasal continuous positive airway pressure (NCPAP)?

Background

Evidence suggests that NIPPV increases the effectiveness of NCPAP in preterm babies who no longer need an endotracheal tube (tube in the windpipe). Preterm babies with breathing problems often require help from a machine (ventilator) that provides regular breaths through a tube in the windpipe. The process of extubation or removal of this tube does not always go smoothly, and the tube may need to be re-inserted if the baby cannot manage without assistance. NCPAP and NIPPV are ways of supporting babies' breathing in a minimally invasive way - the tubes are short and reach only to the back of the nose, thus causing minimal damage to the lungs. NCPAP and NIPPV may be used after extubation to reduce the number of babies who need re-insertion of the endotracheal tube. NCPAP provides steady pressure to the back of the nose that is transmitted to the lungs, helping the baby breathe more comfortably. NIPPV provides the same support along with some breaths via the ventilator.

Study characteristics

We searched scientific databases for studies comparing NCPAP versus NIPPV in preterm infants (born before 37 completed weeks of pregnancy) who no longer need an endotracheal tube. We looked at breathing problems, the need for the endotracheal tube to be re-instated and side effects. Evidence is current to September 2015.

Key results

We found ten trials comparing NCPAP versus NIPPV. Six of ten studies that compared NCPAP and NIPPV showed that NIPPV reduced the need for re-insertion of the endotracheal tube. Future studies must determine how NIPPV can best be delivered to infants.

Quality of the evidence

In clinical trials, clinicians and investigators were aware of the intervention received by each infant (NIPPV or NCPAP). Therefore, we graded the quality of evidence for the primary outcome (breathing problems and need for re-insertion of the endotracheal tube) as moderate.