Table 1

Author, date and country	Patient group	Study type	Outcomes	Key results	Study weaknesses
Rodrigo GJ and Castro-Rodriuez JA, 2005, Uruguay and Chile	16 RCTs	Meta-analysis	NNT to prevent one admission (1786 children in 10 trials) SMD of Improvement in pooled spirometric parameters	13 −0.54 (−0.28–−0.81) p<0.0001	Significant heterogeneity in spirometric analysis

including admission criteria. Three well designed papers and a Cochrane review showed variably modest benefits in adding inhaled anti-cholinergics to â2-agonist in the standard treatment of moderate to severe asthma in children. There is little to suggest that the side effects of adding ipratropium that would preclude its use.

► CLINICAL BOTTOM LINE

Adding inhaled anti-cholinergics to beta 2-agonists in the treatment of acute asthma in children presenting to the Emergency Department reduces time to recovery and discharge and may reduce admissions for moderate to severe groups.

Rodrigo GJ, Castro-Rodriguez JA. Anticholinergics in the treatment of children and adults with acute asthma: a systematic review. *Thorax* 2005;**60**:740–6.

Delivery of bronchodilators in acute asthma in children

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Abstract

A short cut review was carried out to establish whether delivery of bronchodilators to children was better by spacer device or nebuliser. 1456 papers were found using the reported searches, of which four presented the best evidence to answer the clinical question. The author, date and country of publication, patient group studied, study type, relevant outcomes, results and study weaknesses of these best papers are tabulated. It is concluded that in most cases where a child presents with moderate to severe asthma beta-2-agonists could be delivered via a spacer device in place of a nebuliser.

Clinical scenario

A seven year old child with a known history of asthma presents with a 24 hour history of exacerbation of wheeze. He has been using his salbutamol inhaler with little benefit. You prescribe a ß-agonist by nebuliser but wonder if it would have been cheaper and more effective to administer this drug via a spacer (holding chamber).

Three-part question

In [children with acute asthma] does administration of a bronchodilator [by nebuliser or spacer device] best [decrease admission rate and improve airway function].

Search strategy

Medline 1966 to March Week 4 2006 [exp asthma OR asthma.mp OR bronchodilator.mp OR exp bronchodilator agents OR exp adrenergic beta-agonists OR beta-agonist.mp OR exp receptors, adrenergic, beta] AND [exp aerosols OR exp ''nebulizers and vapourisers'' OR exp cholinergic antagonists OR nebuliser.mp OR spacer.mp OR administrat$ OR holding chamber$.mp] AND [acute.mp OR exp acute disease] AND [BestBETs paediatric filter] LIMIT to human and English language. Embase 1980–2006 week 13, CINAHL 1982 to March Week 4 2006 [asthma.mp OR exp extrinsic asthma OR exp asthma OR wheez$.mp OR bronchodilatOR.mp OR bronchodilating agent OR salbutamol OR salbutamol.mp OR exp salbutamol sulfate OR albuterol.mp OR exp terbutaline sulfate OR exp terbutaline OR terbutaline.mp OR isoproterenol.mp OR exp isoprenaline OR beta-agonist.mp. OR exp beta adrenergic receptor stimulating agent] AND [exp aerosol OR aerosol$.mp OR nebuliser$.mp OR exp nebulizer OR exp medical nebulizer OR nebulizer$.mp OR vaporizer$.mp OR exp vaporizer OR exp inhalational drug administration OR spacer.mp OR exp inhalation spacer OR exp beta adrenergic receptor stimulating agent OR exp drug delivery system OR holding chamber.mp OR exp metered dose inhaler] AND [adult children.mp OR exp adult child OR exp infant OR preschool child OR newborn OR minors.mp OR exp juvenile OR adolescent OR youth.mp OR pediatrics.mp OR exp pediatrics OR child OR paediatric$.mp OR pediatric$.mp OR perinat$.mp OR neonat$.mp OR newborn infan$.mp OR bab$.mp OR toddler$.mp OR boy$.mp OR girl$.mp OR kid$.mp OR schoolage.mp OR underage.mp OR teen$.mp OR offspring.mp OR youth$.mp OR pubescen$.mp OR adolescen$.mp] AND [exp acute drug administration OR acute.mp OR exp acute disease] LIMIT to human and English language. The Cochrane Library Issue 1 2006 [Child [MeSH] AND holding chamber [All fields]] OR [Inhalation spacers [MeSH]] 31 articles.

Search outcome

Altogether 1456 papers were found including one systematic review and one systematic review with meta-analysis. A further RCT was found that was not mentioned in either review and one RCT had been published subsequent to both reviews. These are shown in table 2.

Comment(s)

Nebulisers are commonly used in the emergency setting for the treatment of acute asthma in children despite recent research suggesting that administration by a holding chamber or spacer is at least as effective. These review articles and the two papers not included in these articles all concur with this view and tend to show a slight improvement in out-come with use of a spacer device. This research is limited to patients with moderate or severe asthma as patients with life-threatening asthma have been excluded from all of the studies. Spacer devices are faster and easier to use and may also be cheaper than nebulisers. The cost is less of a factor in patients attending hospital compared with community use due to availability of piped oxygen. They also have less maintenance involved and reduce the potential risk of cross infection.

Table 2

Author, date and country	Patient group	Study type	Outcomes	Key results	Study weaknesses
Schuh S *et al*, 1999, Canada	90 children between 5 and 17y presenting to the Emergency Department with an exacerbation of asthma and a FEV1 between 50 and 79% of the predicted value for that child. Exclusion criteria included first presentation with wheeze and use of albuterol (salbutamol) within 4 h prior to presentation. Randomised to low dose via spacer, weight determined dose by spacer or weight determined dose by nebuliser.	Single-dose, double-blinded, randomized, triple-dummy controlled trial with 3 treatment arms	Difference of percentage change in FEV1 after treatment Admission rate Heart rate following treatment. Relapse requiring unscheduled medical visit	No significant difference on basis of drug administration. 3 children in low dose group, 1 in high dose group and 2 in the nebuliser group admitted. Significantly higher in nebuliser group. p=0.005 1 in the low dose group, 2 in the high dose group and 2 in the nebuliser group.	Primary outcome was difference in mean improvement of FEV1 following treatment. Not clear where predicted FEV1 values derived from. Study powered to find 8% or greater difference between groups, not powered to find differences in other outcomes such as admission rate or relapse rate. Children with very mild or moderate to severe asthma excluded. Children presenting with first episode of wheeze excluded.
Cates CJ, *et al*, 2003, UK	Adults and children (but not infants) with acute asthma presenting for medical assistance in the community or hospital emergency department. Included studies on patients with asthma and COPD as long as separate results could be obtained for asthma patients. Randomised to holding chambers (spacers) *v* nebulisers.	Review of randomised controlled trials. 28 trials involving 1076 children over the age of 2y.	Hospital admission rate Time spent in the Emergency Department Peak flow & FEV1 at 30 min and end of study Pulse rate.	No significant difference on basis of drug administration. RR 0.65; 95% CI:0.56 to 1.38 Less time in spacer group. Weighted mean difference −0.47 hours (95% CI −0.58 to −0.37) No significant difference shown. Lower in spacer group. WMD=−7.59% baseline, 95% CI −9.94 to −5.24%	Review of adults and children over 2y of age but results and findings given separately.
Castro-Rodriguez JA, *et al*, 2004, Chile	Review of 6 studies giving a total of 491 children between 1 and 60 months of age presenting with an acute exacerbation of wheezing or asthma. Randomized to spacer *v* nebuliser for administration of bronchodilators.	Systematic review with meta-analysis.	Admission rate Clinical severity score	Lower in spacer group. Odds Ratio 0.42, 95% CI 0.24–0.72. p=0.002. NNT=10. Lower in spacer group. Standardised Mean Difference=−0.44, 95% CI −0.68 to −0.20, p=0.0003	Only six studies involved but all of reasonable quality.
Deerojanawong J *et al*, 2005, Thailand	47 children under the age of 5y presenting with acute wheeze randomized to metered dose inhaler-spacer *v* jet nebuliser for salbutamol administration.	Prospective, randomised, double-blind, placebo-controlled trial.	Change in ratio of Volume to Peak Tidal Expiratory Flow against Time to Peak Tidal Expiratory Flow Reduction in resistance of respiratory system Change in heart rate	No significant difference on basis of drug administration. p=0.004. No significant difference. p=0.025. Increased in nebuliser group. p=0.004.	Although other studies have validated VPEF/TPEF as a useful measurement in estimating obstructive airway disease in young children the clinical outcomes of the children in this study are not documented.

► CLINICAL BOTTOM LINE

In most cases where a child presents with moderate to severe asthma beta-2-agonists could be delivered via a spacer device in place of a nebuliser.

Schuh S, Johnson DW, Stephens D, *et al*. Comparison of Albuterol Delivered by a Metered Dose Inhaler with a Spacer Versus a Nebulizer in Children With Mild Acute Asthma *The Journal of Pediatrics* **135**(1);22–27.

Cates CJ, Bara A, Crilly JA, *et al*. Holding chambers versus nebulisers for beta-agonist treatment of acute asthma (Review). The Cochrane Database of Systematic Reviews 2003, Issue 2. Art No.: CD000052. DOI: 10:1002/14651858.CD000052.

Castro-Rodriguez JA, Rodrigo GJ. ß-Agonists Through Metered-Dose Inhaler with Valved Holding Chamber Versus Nebulizer for Acute Exacerbations of Wheezing or Asthma in Children Under 5 Years of Age *Journal of Pediatrics* Aug 2004:172–177.

Deerojanawong J, Manuyakorn W, Prapphal N, *et al*. Randomized Controlled Trial of Salbutamol Aerosol Therapy Via Metered Dose Inhaler-Spacer vs. Jet Nebulizer in Young Children With Wheezing *Pediatric Pulmonology* 2005;**39**:466–472.

Lorazepam or diazepam in paediatric status epilepticus

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Abstract

A short cut review was carried out to establish whether lorazepam is better than diazepam at stopping fits in children with status epilepticus. 65 papers were found using the reported searches, of which two presented the best evidence