Use of dexamethasone and prednisone in acute asthma exacerbations in pediatric patients

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ABSTRACT

QUESTION Children frequently present to my rural emergency department with asthma exacerbations. Should I prescribe systemic corticosteroids? If so, which systemic corticosteroid should I prescribe?

ANSWER A short course of steroids is indicated in the treatment of asthma exacerbations. Both prednisone (1 to 2 mg/kg daily for 5 days) and dexamethasone (0.3 to 0.6 mg/kg daily for 1 to 5 days) are effective in reducing hospital admissions and unscheduled return to care, with minimal side effects.

RÉSUMÉ

QUESTION Au service des urgences en milieu rural où je travaille, je vois souvent des enfants qui font un épisode d'exacerbation de l'asthme. Devrais-je leur prescrire des corticostéroïdes systémiques? Dans l'affirmative, quel corticostéroïde convient le mieux?

RÉPONSE Il est indiqué de prescrire un traitement de courte durée aux stéroïdes dans les cas d'exacerbation de l'asthme. Le prednisone (1 à 2 mg/kg par jour pendant 5 jours) et le dexaméthasone (0,3 à 0,6 mg/kg par jour pendant 1 à 5 jours) sont tous 2 efficaces pour réduire le nombre d'admissions à l'hôpital ou les visites d'urgence et ont peu d'effets secondaires.

Asthma is one of the most common presentations to adult and pediatric emergency departments (EDs), accounting for approximately 10 to 15 of every 1000 visits.[1]

There are various triggers of acute exacerbation of asthma. Bronchospasm and airway inflammation with edema and mucus production are key physiologic factors leading to clinical symptoms. β-Agonists and other bronchodilators target bronchospasm while corticosteroids reduce the inflammatory response by inhibiting the activation of inflammatory cells and by reducing mediator production, microvascular leakage, and mucus formation.[2]

Corticosteroids have been used to treat asthma for approximately 50 years. Their benefit in the ED treatment of asthma exacerbations was first demonstrated in 1986.[3] In 1990, Tal et al[4] showed a similar benefit in children.

Treatment guidelines of the Canadian Thoracic Society, Canadian Association of Emergency Physicians, British Thoracic Society, and American National Asthma Education and Prevention Program recommend the use of systemic corticosteroids for moderate to severe exacerbations of asthma and for mild exacerbations not responsive to bronchodilator therapy.[5-7] These published guidelines were developed primarily for use in acute care settings and are helpful in EDs; however, there is very little information available on the use of systemic steroids in ambulatory care settings.

Systemic corticosteroids in asthma exacerbations

The Cochrane Collaboration maintains numerous ongoing systematic reviews of randomized controlled trials of systemic steroids versus placebo in acute exacerbations of asthma in children and adults. In one Cochrane Review, patients who were treated with short courses (ie, 3 to 10 days) of steroids required significantly less care as defined by relapse to additional care within 7 to 10 days (relative risk 0.38, 95% confidence interval [CI] 0.20 to 0.74), fewer hospitalizations (relative risk 0.35, 95% CI 0.13 to 0.95), and less need of β-agonist use (-3.3 activations per day of inhaler; 95% CI -5.6 to -1.0). In addition, patient symptom scores improved with steroid therapy; however, no significant comparisons could be made owing to a lack of standardization in the use and reporting of scores between the studies. The overall incidence of side effects, such as vomiting and headache, was reported as rare, with no significant differences between the groups; this might be partly due to the limited information provided in these studies. No significant differences were identified between different routes of administration. The review concludes that a short course of systemic steroids is beneficial in moderate to severe asthma exacerbations. Mild exacerbations can be treated with β-agonist therapy and inhaled corticosteroids, with the addition of systemic steroids if a patient's symptoms do not improve.[8]

In another Cochrane Review, children and adults who were given corticosteroids within 1 hour of presentation were significantly less likely to be admitted to hospital (odds ratio 0.50, 95% CI 0.31 to 0.81; number needed to treat = 8, 95% CI 5 to 21) than those not given steroids. Maximal benefit was observed within 4 to 6 hours of administration of corticosteroids. A benefit in peak expiratory flow rate with a standard mean difference at the end of therapy of 0.54 (95% CI 0.01 to 1.1) was suggested in the treated group.[9]

Systemic steroids for treating asthma

Oral prednisone and dexamethasone are the currently recommended systemic steroids for moderate to severe asthma exacerbations. Formulations such as hydrocortisone and methylprednisolone can be given parenterally. Studies have found these routes to be equally effective, with the oral route being less painful and invasive.[10,11] Prednisone is given for 5 days at a dose of 1 to 2 mg/kg daily (maximum 50 mg/d). Dexamethasone can be given for 1 to 5 days at a dose ranging from 0.3 to 0.6 mg/kg daily. Dexamethasone is a long-acting glucocorticoid with a half-life of 36 to 72 hours, and is 6 times more potent than prednisone. Prednisone is shorter acting, with a half-life of 18 to 36 hours.[12]

Recognizing the debate in choice and dose of corticosteroids, the Cochrane Database generated a protocol to investigate this issue in hospitalized patients with asthma, but a review has not yet been published.[13]

Prednisone vs dexamethasone

Few trials compare oral dexamethasone head-to-head with oral prednisone. In 2001, Qureshi et al[14] compared 2 days of dexamethasone (0.6 mg/kg daily; maximum 16 mg/d) to 5 days of prednisone (1 mg/kg daily; maximum 60 mg/d). Dexamethasone had a similar efficacy as measured by relapse rates (7.4% vs 6.9%, $P = .84$), hospitalization rates (11% vs 12%), and the persistence of symptoms at 10 days (22% vs 21%). The patients treated with dexamethasone had increased compliance (99.6% vs 96%, $P = .004$) and fewer side effects, such as vomiting (0.3% vs 3%, $P = .008$). Part of the increased compliance in the dexamethasone group was believed to be owing to patients being discharged from EDs with the medication, whereas prednisone required a prescription to be filled at a pharmacy. Although dispensing medication is feasible in some EDs, it is often not an option in the ambulatory practice setting. Furthermore, dexamethasone is given at a smaller volume and can be mixed with better-tasting syrups to allow for better palatability and therefore compliance.

When dexamethasone (0.6 mg/kg daily) was compared with a higher dose of prednisone (2 mg/kg daily), no statistically significant differences were found in relapse rates (16% vs 8%, $P = .27$) or in the incidence of vomiting in pediatric patients with asthma exacerbations (10% vs 18%, $P = .24$).[15] However, this study was limited owing to a small sample size and a change in hospital protocol in midstudy.

Because dexamethasone has a long half-life, Altamimi et al[16] attempted to determine if a single dose of dexamethasone (0.6 mg/kg) was equal to 5 days of prednisolone (2 mg/kg daily). The single dose of dexamethasone demonstrated no difference in any of the following: hospital admission rates (13.4% dexamethasone vs 14.9% prednisolone), additional β-agonist therapy, return to baseline of patient self-assessment scores (5.21 days vs 5.22 days, respectively, mean difference -0.01; 95% CI -0.70 to 0.68), and mean pulmonary index scores (0.4 vs 0.3, mean difference 0.1; 95% CI -0.25 to 0.45) in children 2 to 16 years of age with mild to moderate asthma.[16]

In summary, these studies showed that slight differences exist in vomiting and compliance favouring dexamethasone; however, more studies are needed to further investigate these effects. To date, studies support using either prednisone or dexamethasone.

Safety

One of the greatest challenges in using systemic corticosteroids is physicians', parents', and patients' concern regarding potential side effects.[17] Short bursts of prednisone at a dose of 1 to 2 mg/kg daily for 5 days showed no effect on bone density, height, and adrenal function at 30 days, but transient decreases were noted in bone deposition and adrenal function.[17] Cochrane Reviews fail to identify significant increases in side effects such as nausea, tremor, and headache when compared with placebo, while other potential side effects such as hypertension, hyperglycemia, and behavioural disturbances have not been sufficiently reported.

Conclusion

Short courses of systemic corticosteroids are indicated in the treatment of moderate and severe asthma exacerbations as well as mild exacerbations unresponsive to increased doses of β-agonist therapy and inhaled corticosteroids. Prednisone (1 to 2 mg/kg daily for 5 days) and dexamethasone (0.3 to 0.6 mg/kg daily for 1 to 5 days) are appropriate choices, with some evidence suggesting that dexamethasone might be better tolerated and requires shorter duration of therapy. Side effects of short corticosteroid treatments appear minimal and clinically insignificant. More studies are needed to ascertain the optimal dose, duration, and choice of systemic steroids, especially in the ambulatory care setting.

Competing interests
None declared

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