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ORIGINAL ARTICLE

Snapshot of acute asthma: treatment and outcome of patients with acute asthma treated in Australian emergency departments

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*For the Snapshot of Asthma Study Group 2000 and 2001.

Abstract

Aims: To characterize presentations due to acute asthma at Australian emergency departments (ED), including their severity, treatment and disposition.

Methods: This prospective, observational study involved 38 departments of emergency medicine throughout Australia participating in the Snapshot of Asthma Study Group project 2000 and 2001. Data were collected for patients presenting with acute asthma between 21 August 2000 and 3 September 2000, and 20 August 2001 and 2 September 2001 and included demographics, severity classification, treatment and disposition.

Results: There were 1340 acute asthma presentations in the study periods. Of these presentations, 67% were for children aged <15 years. Asthma severity (according to the Australian National Asthma Guidelines classification) was 'mild' in 49% of cases; 'moderate' in 45% of cases; and 'severe' in 6% of cases. Treatment administered included: (i) salbutamol to 90%, (ii) ipratropium bromide to 59% and (iii) corticosteroids to 71%. Only six patients received aminophylline. Spacer use for salbutamol was rare (1%) in adults and only moderate (43%) in children. Sixty-five percent of patients were discharged home from the ED. Less than 1% of patients required ventilatory assistance, of which half was provided non-invasively. One percent of patients were admitted to the intensive-care unit or high-dependency unit.

Conclusion: Overall adherence to treatment guidelines was good. There appears to be underuse of spacers and corticosteroids in some groups and overuse of ipratropium bromide. The majority of patients are treated and discharged from the ED. (Intern Med J 2003; 33: 406–413)

Key words: asthma, management, outcome, guidelines.

INTRODUCTION

Asthma is common in Australia and can be life-threatening. The National Asthma Campaign (Australia) has been working for some years to provide patients, their families and health professionals with information to improve the standard of asthma care. As part of this process, The National Asthma Campaign has facilitated the development of asthma management guidelines.[1] This document covers all aspects of asthma

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management, including the assessment and management of acute attacks. In particular, it sets down guidelines for the management of patients presenting to emergency departments (ED), stratified according to the severity of the episode. Evidence from the United Kingdom[2,3] and a small, single-centre Australian study[4] suggest that compliance with asthma management guidelines is highly variable.

The primary aim of the present study was to compare reported actual patient management with that recommended by the National Asthma Guidelines (NAG). A secondary aim was to characterize presentations due to acute asthma to Australian ED with respect to demographics, severity, disposition and outcome. This is the first multicentre study of its type conducted in Australia.

METHODS

This prospective, observational study was conducted in 38 Australian ED between 21 August 2000 and 3 September 2000, and 20 August 2001 and 2 September 2001 (not all hospitals participated in both data-collection periods). All ED accredited for training by the Australasian College for Emergency Medicine were contacted by mail and invited to participate. The 38 participating hospitals volunteered and data were collected locally. This project was considered an audit by most centres and was hence exempted from the requirement for ethics committee approval. Ethics committee approval was obtained for those centres where it was required.

The subjects included patients aged 1–60 years (in the 2000 study) and 1–55 years (in the 2001 study) with a physician-confirmed diagnosis of acute asthma. Patients aged >55 years (2001) and >60 years (2000) were excluded to minimize overlap with chronic obstructive airways disease. Patients aged <1 year were excluded to minimize overlap with bronchiolitis.

Data collected included: (i) demographic information, (ii) duration of attack, (iii) classification of the severity of the attack according to medical officer assessment and the NAG (Australia) (Tables 1 and 2), (iv) treatment, (v) disposition (home; ward; intensive-care unit (ICU)/high-dependency unit; transfer) and (vi) length of stay.

Actual treatment and disposition was compared to the recommendations in NAG (Tables 3 and 4).

Data were collected by clinical staff at each hospital, entered onto a specifically designed form and analysed using descriptive statistics. Quality checks on the data

Table 1 Initial assessment of severity of acute asthma in children†

Symptoms	Mild	Moderate	Severe and life-threatening
Altered consciousness	No	No	Yes
Physical exhaustion	No	No	Yes, may have paradoxical chest-wall movement
Talks in	Sentences	Phrases	Words
Pulsus paradoxus	Not palpable	May be palpable	Palpable
Pulse rate	<100	100–200	>200
Central cyanosis	Absent	Absent	Likely to be present
Wheeze intensity	Variable	Moderate – loud	Often quiet
Peak expiratory flow	>60%	40–60%	<40% or <100 L per min
FEV1‡	>60%	40–60%	<40% or <1 L
Oximetry on presentation (SaO2)	>94%	94–90%	<90%
Arterial blood gases	Test not necessary	If initial response is poor	Yes

†Adapted from the *Asthma Management Handbook* (page 12).[1] ‡% predicted.

Table 2 Initial assessment of severity of acute asthma in adults†

Symptoms	Mild	Moderate	Severe and life-threatening
Physical exhaustion	No	No	Yes, may have paradoxical chest-wall movement
Talks in	Sentences	Phrases	Words
Pulse rate	<100/min	100–120/min	>120/min
Pulsus paradoxus	Not palpable	May be palpable	Palpable
Central cyanosis	Absent	May be present	Likely to be present
Wheeze intensity	Variable	Moderate – loud	Often quiet
Peak expiratory flow‡	>75%	50–75%	<50% or <100 L/min
FEV1‡	>75%	50–75%	<50% or <1 L
Oximetry on presentation	>95%	92–95%	<92%; cyanosis may be present
Arterial blood gases	Test not necessary	If initial response is poor	Yes

†Adapted from the *Asthma Management Handbook* (page 12).[1] ‡% predicted.

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Table 3 Initial management of acute asthma in children[†]

Treatment	Mild attack	Moderate attack	Severe and life-threatening attack
Admission necessary	Probably not	Probably	Yes (consider ICU)
Oxygen	Probably not	Monitor with SaO_2	May need arterial blood gases
Nebulized β2–agonist[‡]	Salbutamol or terbutaline 2.5 mg if aged <5 years 5 mg if aged >5 years	5 mg nebuliser unit. If initial response is inadequate, then repeat at 20-min intervals for two further doses. Doses every 1–4 h thereafter.	Salbutamol or terbutaline 5 mg every 20 min (three doses or continuously). Give IV when no response to aerosol salbutamol 5 μg/kg over 10 min, then 1–5 mcg/kg 1 min thereafter.
β2-agonist via MDI and spacer	Two to four puffs via spacer	Four to ten puffs via spacer	Possible use, if nebuliser not available (6–12 puffs via spacer).
Nebulized ipratropium bromide	Not necessary	Optional	250 μg added to salbutamol or terbutaline 5 mg each 20 min for three doses, then not more than every 4 h
Steroids	Yes (consider)	Oral prednisolone (1 mg/kg per dose daily) 1; every 12 h for day 2, then daily thereafter.	Oral prednisolone (1 mg/kg per dose daily) or IV methylprednisolone 1 mg/kg: every 6 h for day
Aminophylline	No	No	Only in ICU: loading dose 10 mg/kg Maintenance: 1.1 mg/kg per h if aged <9 years 0.7 mg/kg per h if aged >9 years Monitor blood level every 6 h, as appropriate
Chest X-ray	Not necessary unless focal signs present	Not necessary unless focal signs present	Necessary if no response to initial therapy or suspected pneumothorax
Observations	Regular	Frequent	Continuous

[†]Adapted from the *Asthma Management Handbook* (page 12).[1] [‡] Such as salbutamol. ICU, intensive care unit; IV, intravenous; MDI, metered dose inhaler.

Table 4 Initial management of acute asthma in adults[†]

Treatment	Mild attack	Moderate attack	Severe and life-threatening attack
Admission necessary	Probably not	Probably	Yes (consider ICU)
Oxygen	High flow of at least 8 L/min to achieve an inspired oxygen concentration of approximately 50%. Monitor effect by oximetry. Frequent measurement of arterial blood gases in severe asthma and those not responding.		
Nebulized β2-agonist (i.e. salbutamol or terbutaline, with 8 L/min O_2)	5 mg salbutamol in 2.5 mL or 1 mL 0.5% salbutamol + 3 mL saline.	Salbutamol 5 mg x 2 or 2 mL 0.5% + 2 mL saline every 1–4 h.	2 mL 0.5% salbutamol + 2 mL saline nebulized every 15–30 min. Give IV if no response to aerosol (i.e. salbutamol 250 μg IV bolus and then 5–10 μg/kg per h).
Nebulized ipratropium bromide	Not necessary	Optional	1 mL 0.05% (500 μg) ipratropium bromide with salbutamol every 2 h.
Oral corticosteroids (i.e. prednisolone)	Yes (consider)	Yes	Give IV steroids initially; oral later.
IV steroids (i.e. hydrocortisone or equivalent)	Not necessary	200 mg stat	200 mg every 6 h for 24 h, then review.
Theophylline/aminophylline	Uncertainty exists regarding the benefits of this drug in the presence of maximal doses of β2-agonist.		IV aminophylline 5 mg/kg then 0.5 mg/kg per h IV is an alternative to IV salbutamol.
Adrenaline	Not indicated	Not indicated	Adrenaline 0.5 mL of 1 : 1000 (0.5 mg) solution IM for anaphylaxis. For respiratory arrest, 5 mL of 1 : 10 000 solution slowly.
Chest X-ray	Not necessary unless focal signs present	Not necessary unless focal signs present	Necessary if no response to initial therapy or suspect pneumothorax
Observations	Regular	Continuous	Continuous
Other investigations	Not required	May be required	Check for hypokalaemia and treat if present

[†]Adapted from the *Asthma Management Handbook* (page 13).[1] ICU, intensive care unit; IM, intramuscular; IV, intravenous.

collected were not performed. Descriptive analysis was used.

RESULTS

There were 1340 acute asthma presentations recorded for the 38 participating ED during the study period. Sixty-seven percent of patients were aged ≤15 years. The age distribution is shown in Fig. 1. The severity distribution was different between the adult and child groups, with the adult group having higher severity distribution ($P = 0.0015$).

Treatment given to children is summarized in Table 5. Of note, nebulisers are used much more commonly than spacers for the delivery of aerosol β-agonists. Ipratropium bromide (IB) was commonly used in all severity groups, despite the guideline recommendation that it is not needed in mild and moderate severity groups. There is underuse of corticosteroids, particularly for the severe group. Two patients received aminophylline (0.2%) and only one child required ventilatory support (0.1%).

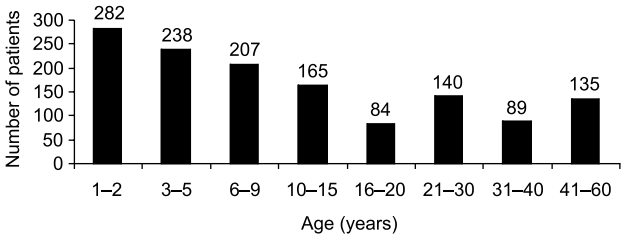

Figure 1 Age distribution of the study sample.

Treatment given to adults is summarized in Table 6. Ipratropium bromide was again commonly administered in all severity groups. There is some underuse of corticosteroids in the moderate group. Four patients received aminophylline (1%) and four patients received parenteral adrenaline (1%). Nine patients required ventilatory support (2%). For five of these, non-invasive ventilatory support was used.

Overall, 62% of children and 70% of adults were treated and discharged from the ED.

DISCUSSION

NAG[1] provide recommendations for the assessment and treatment of acute asthma in Australia. This is the first study to examine how well these guidelines are followed in a cohort of ED.

Overall adherence to the guidelines with respect to treatment was quite good.

Corticosteroids have been shown to reduce admission rates, relapse rates and the need for additional β-2 agonists.[5–7] In the present study there was some underuse of corticosteroids in both adults and children who were classified as having moderate or severe asthma. The reason for this is unclear. Possible explanations include documentation errors (i.e. steroids were given but not recorded), and an under-classification of severity compared with the NAG by the treating doctor.

Oxygen also appears to be under-administered in the severe group for both adults and children. This is, however, very likely to be a documentation effect. The vast majority of these patients received inhaled β-agonists by nebuliser, which is commonly oxygen-driven in Australasian ED.

Table 5 Treatment given to children (<16 years of age) stratified by National Asthma Guidelines (NAG) severity classification combined for 2000 and 2001 for all presentations (892 presentations, 52 missing NAG severity data)

	Mild *n* = 430 (50.6%)	Moderate *n* = 382 (44.9%)	Severe *n* = 38 (4.5%)
Oxygen	40/425 (9.4%)	116/373 (31.1%)	30/37 (81.1%)
Salbutamol	338/426 (79.3%)	366/380 (96.3%)	38/38 (100%)
	178 nebuliser (52.7%)	225 nebuliser (61.5%)	29 nebuliser (76.3%)
	160 spacer (47.3%)	140 spacer (38.3%)	5 spacer (13.2%)
		1 IV (0.2%)	4 IV (10.5%)
Ipratropium	160/422 (37.9%)	247/377 (65.5%)	28/38 (73.7%)
	122 nebuliser (76.2%)	192 nebuliser (77.7%)	23 nebuliser (82%)
	38 spacer (23.8%)	55 spacer (22.3%)	5 spacer (18%)
Steroids	249/422 (59%)	323/378 (85.4%)	31/38 (81.6%)
	247 oral (99.2%)	303 oral (93.8%)	20 oral (64.5%)
	2 IV (0.8%)	20 IV (6.2%)	11 IV (35.5%)
Adrenaline	0	2/379 (0.5%)	1/38 (2.6%)
Magnesium	0	1/382 (0.3%)	1/38 (2.6%)
Aminophylline	0	0	2/38 (5.3%)
Ventilation	0	0	1/38 (2.6%)
Disposition	Ward 71/422 (16.8%)	Ward 209/382 (54.7%)	Ward 26/38 (68.4%)
	Home 350/422 (82.9%)	Home 168/382 (44%)	Home 7/38 (18.4%)
	Transfer 1/422 (0.2%)	Transfer 3/382 (0.8%)	Transfer 2/38 (5.3%)
		HDU/ICU 2/382 (0.5%)	HDU 3/38 (7.9%)

NAG recommend IB administration be reserved for patients with severe asthma for both adults and children. Studies in children and adolescents with severe asthma (forced expiratory volume in 1 second (FEV_1) or peak expiratory flow (PEFR) <50%), suggest that multiple doses, administered in the first hour of treatment along with β-2 agonists, may have an influence on admission rate.[8] They may also have an impact on cost.[9] There is good evidence that ipratropium does not have a role in mild to moderate asthma when sufficient β-2 agonists are used.[10] Further, a meta-analysis of four trials including severe asthma (FEV_1 <35%) in adults, concludes that there appears to be a modest, statistically significant benefit with the use of IB, but raises doubts about whether the effect size found is clinically significant.[11] This is supported by a recent randomized controlled trial (RCT) involving 180 people with severe acute asthma (FEV_1 <50%) which demonstrated that ipratropium significantly improved lung function and that, after 3 h, subjects were more likely to be discharged home (20% *vs.* 39%; $P < 0.01$).[12] Given the evidence and the cost of routine use of IB, the NAG position is justifiable. Our data confirm unnecessary use of ipratropium. Given the unit cost of IB of approximately $A18 per dose, elimination of its use in the mild and moderate groups could translate into considerable drug-cost savings per year. Unfortunately this study's methodology does not allow us to estimate the potential cost savings.

The finding of a low rate of spacers to deliver β-agonist was somewhat surprising; particularly in the treatment of children, where there has been a significant push for change to spacer use recently. Published evidence suggests that delivery via this method is as effective as delivery by nebuliser.[13] In paediatrics, many centres have already changed over to the use of spacers for acute asthma.[14,15] There are data suggesting that treatment with spacers has less side-effects,[16,17] a shorter period of time in ED,[17] quicker response to treatment,[18] a reduced hospital-admission rate and possible reduced morbidity.[19,20] There are concerns about cost and this has yet to be addressed in an Australian population, however some data suggest that spacers are cheaper.[19,20] In adults, the case for spacers is less compelling. The study of Cates and Rowe suggests that the choice of delivery method should reflect patient preference, practice situations and formal economic evaluation.[13]

The low rate of aminophylline use is concordant with the guidelines and current evidence in adult studies.[21] In paediatrics, some doubt about the role of aminophylline persists. One RCT, including 163 children with severe asthma, demonstrated that, in asthma that was unresponsive to initial treatment, aminophylline may still have a role in reducing the intubation rate.[22]

The use of therapies not included in the current guidelines – in particular intravenous (IV) adrenaline and non-invasive ventilation (NIV) – is interesting. There is no published evidence supporting the use of IV adrenaline rather than IV salbutamol. That said, adrenaline has the potential advantage of bronchial vasoconstriction as well as bronchodilation and potentially greater efficacy in sudden onset (anaphylactoid) asthma. This is an area

Table 6 Treatment given to adults (>15 years of age) stratified by National Asthma Guidelines (NAG) severity classification classification combined for 2000 and 2001 for all presentations (448 presentations, 27 missing NAG severity data, complete data-set 421 adults)

	Mild (192) (45.6%)	Moderate (189) (44.9%)	Severe (40) (9.5%)
Oxygen	63/186 (33.9%)	132/184 (71.6%)	32/39 (82.1%)
Salbutamol	175/192 (91.1%)	185/188 (98.4%)	40/40 (100%)
	166 nebuliser (94.9%)	183 nebuliser (98.9%)	36 nebuliser (90%)
	9 spacer (5.1%)	2 spacer (1.1%)	4 IV (10%)
Ipratropium	122/190 (64.2%)	156/188 (83%)	32/39 (82.1%)
	119 nebuliser (97.5%)	155 nebuliser (99.4%)	32 nebuliser (100%)
	3 spacer (2.5%)	1 spacer (0.6%)	
Steroids	104/187 (55.6%)	150/189 (79.4%)	38/40 (95%)
	89 oral (85.6%)	87 oral (58%)	9 oral (23.7%)
	13 IV (12.5%)	63 IV (42%)	29 IV (76.3%)
	2 nebuliser (1.9%)		
Adrenaline	0	1/184 (0.5%)	3/39 (7.7%)
Magnesium	0	1/182 (0.5%)	2/40 (5%)
Aminophylline	0	2/185 (1.1%)	2/39 (5%)
Ventilation	0	1/189 (0.5%)	8/39 (20.5%)
		1 CPAP	4 CPAP
			4 intubation
Disposition	Ward 20/192 (10.4%)	Ward 71/187 (38%)	Ward 19/39 (48.7%)
	Home 171/192 (89.1%)	Home 113/187 (60.4%)	Home 10/39 (25.6%)
	HDU 1/192 (0.5%)	Transfer 2/187 (1.1%)	Transfer 1/39 (2.6%)
		ICU 1/187 (0.5%)	HDU/ICU 9/39 (23.1%)

ICU, intensive care unit; IV, intravenous; HDU, high-dependency unit; CPAP, non-invasive ventilation using continuous positive airway pressure.

requiring further study. With respect to NIV, there is some evidence that it results in rapid correction of gas exchange abnormalities,[23] and assists inspiratory muscles.[24] Although there are case reports/small series reporting its successful use,[25,26] there is currently no conclusive evidence that it reduces the requirement for endotracheal intubation.

An important finding of the present study was that severity classification based on initial assessment was not a good predictor of the need for hospital admission. The NAG state that patients with moderate asthma 'will probably need admission' and that 'ICU should be considered' for those in the severe group. This study found that 60% of adults and 44% of children in the moderate severity classification and 26% of adults and 18% of children in the severe classification could be discharged home after a period of treatment in the ED. Data were not, however, collected on whether any of these patients represented requiring admission as part of the same asthma episode. Given that the NAG recommendations provide a potential avenue for litigation if they are not followed, this finding may lead to a reconsideration of the strength of the recommendation regarding disposition of this group of patients. It is possible that the NAG guideline recommendations were based on old or incomplete information about ED asthma management or that asthma management in ED has improved since this section of the guidelines was written.

The present study has some limitations that should be considered when interpreting the results. The ED that participated did so voluntarily. They may represent ED with a particular interest in asthma management and generalisability to the broader range of ED might therefore be questioned. Patients were identified prospectively, however some data were collected retrospectively and are therefore subject to documentation weakness. Although every attempt was made to include all eligible patients, some may have been missed. The diagnosis of asthma was based on physician judgement rather than objective measures of lung function, thus some of the patients included may not have been suffering from asthma. The sample does, however, represent a 'real world' sample and thus we consider the treatment patterns found to be valid. The sample has an over-representation of children. This is partly explained by the prevalence of the condition among children and the participation of several children's hospitals. There may also be an element of parental behaviour in seeking asthma care. This is supported by the higher severity classification distribution in the adult group.

Future directions for this research include: (i) exploring whether there are different phenotypes of acute asthma with different patterns of response to treatment, (ii) evaluating whether an assessment after 1 h of treatment is a better indicator of need for admission than initial assessment, (iii) determining the characteristics of patients who re-present to the ED and how this might be avoided and (iv) evaluating whether participation in this study process affects asthma management in the study ED.

CONCLUSION

Although most cases presenting to EDs are moderate, 6% of patients have severe asthma. The overall compliance with the treatment guidelines was good. There appears to be underuse of spacers and corticosteroids and overuse of IB. The majority of patients are treated and discharged from the ED.

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