

Severe Asthma

K H Lee, W C Tan, T K Lim

ABSTRACT

Objective: To determine the morbidity and mortality of severe asthmatic patients needing intensive care in Singapore.

Design: Retrospective review of admissions from January 1987 to March 1993.

Setting: Urban teaching hospital.

Patients: Forty-eight patients with forty-nine admissions with severe asthma requiring admission into the medical intensive care unit.

Interventions: None.

Measurements and main results: Forty-eight patients with forty-nine admissions with severe asthma requiring admission into the medical intensive care unit were identified during the study period. The majority (69%) were admitted directly into the intensive care from the emergency room, and 16 cases (33%) had cardiorespiratory arrest, of whom half survived hypoxic brain damage. Mechanical ventilation was needed in 30 cases (61%), with a mean duration of 3.3 days, and 2 pneumothoraces were recorded. Those who needed mechanical ventilation had significantly higher arterial pCO₂ (98 mmHg vs 62 mmHg) and a lower arterial pH (7.1 vs 7.3). However, not all patients with hypercapnia (>50 mmHg) needed mechanical ventilation. Hospital mortality was 12% (6 cases), while two others with hypoxic brain damage died shortly after hospital discharge. Mortality was not predicted by previous need for mechanical ventilation, length of asthma, or age. For the ventilated group alone, hospital mortality was higher at 20%. On an average follow-up of 133 weeks, there was only one death. Mean potassium level was 3.9 mmol/L, with 13 cases (28%) of hypokalemia (<3.6 mmol/L).

Conclusion: Severe asthma was associated with an appreciable mortality. Hypercapnia did not guarantee the need for mechanical ventilation. For those that survived their acute episode, there was one mortality out of 40 survivors after an average of 2 years of follow-up.

Keywords: severe asthma, outcome, intensive care unit (ICU), Singapore, mechanical ventilation

INTRODUCTION

There has been recent concerns about asthma deaths, and whether the incidence is increasing⁽¹⁻⁴⁾. Reports from New Zealand have highlighted the

association with the use of fenoterol⁽⁵⁻⁷⁾, and a study from Saskatchewan, Canada⁽⁸⁾ reported an increased risk of death with regular usage of an inhaled β_2 -agonist. Patients that are admitted to the intensive care unit have severe asthma, and are most at risk of death from asthma^(9,10). They may die from cardiorespiratory arrest⁽¹¹⁻¹³⁾, or suffer from the complications of mechanical ventilation^(14,15), and long-term prognosis may be guarded^(9,10). Not all who have hypercapnia will need mechanical ventilation⁽¹⁶⁻¹⁸⁾. We have therefore reviewed our institution's experience over a 6-year period of severe asthma cases needing intensive care in order to study their morbidity and mortality.

PATIENTS AND METHODS

Patients with asthma who were admitted to the medical intensive care unit at the National University Hospital from January 1987 to March 1993 were identified retrospectively. Asthmatic cases were admitted into the intensive care unit for cardiopulmonary arrest, mechanical ventilation, or severe clinical asthma that was not responsive to initial medical therapies. Care was taken to exclude those with chronic obstructive airways disease (defined as a significant smoking history, or a clinical diagnosis of emphysema or chronic bronchitis). Data was collected about the circumstances of admission, blood investigations, the need for mechanical ventilation, and their immediate and long-term outcome.

All patients were treated with systemic corticosteroids, nebulised salbutamol, xanthines, oxygen, and mechanical ventilation as necessary. Some patients also received subcutaneous adrenaline, and rarely intravenous adrenaline infusion.

Student's unpaired t-test was used for statistical comparison. Results are presented as mean \pm standard deviation, and $p < 0.05$ was accepted as significant.

RESULTS

There were a total of 49 admissions, with one patient having two admissions. Males and females were equally divided, and there were 31 Chinese, 11 Malays, 5 Indians, and 1 Filipino. Their mean age was 44 ± 15 years (range 21 to 81 years), with a mean stay of 3 ± 4 days in the intensive care. The minority of the admissions (76%) had a chronic history of asthma (more than 5 years),

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while 10 (20%) admissions had a history between 2 to 5 years, and only 2 (4%) had a history of less than 2 years. The chronicity of asthma did not predict the likelihood of being intubated for mechanical ventilation. Eight patients had a present or past history of smoking.

Intensive care mortality was 12% (6 out of 49 admissions). Another 2 patients suffered from hypoxic brain damage. Both of them subsequently died: one after discharge at home, and the second one after transfer to another hospital. For those needing ventilation, the combined hospital mortality and severe hypoxic brain damage rate was 27%. Arterial pCO₂ was significantly higher, and arterial pH was significantly lower in those who died (pCO₂: 202 ± 32 mmHg vs 74 ± 30 mmHg, p=0.0001; pH: 6.7 ± 0.14 vs 7.2 ± 0.16, p=0.001). However, there was no significant difference for age, sex, and duration of asthma. Only one of those who died had a previous history of mechanical ventilation, and all except one were admitted directly from the emergency room after arriving in a moribund condition. Those who died had an average stay of 2.7 ± 2.4 days in the intensive care unit.

There were 34 direct admissions (69%) from the emergency room into the intensive care unit. Nine were admitted into the intensive care after less than 24 hours in the general wards, and the remaining 6 admissions were after 24 hours. Sixteen admissions (33%) were from cardiorespiratory arrest requiring intubation and mechanical ventilation. Overall, 30 admissions (61%) needed mechanical ventilation, with a mean length of ventilation of 3.4 ± 4.4 days. There were 2 pneumothoraces. Note that 6 patients had previously needed mechanical ventilation, and 5 of them needed mechanical ventilation again. There was no significant difference in age between those needing mechanical ventilation versus those that

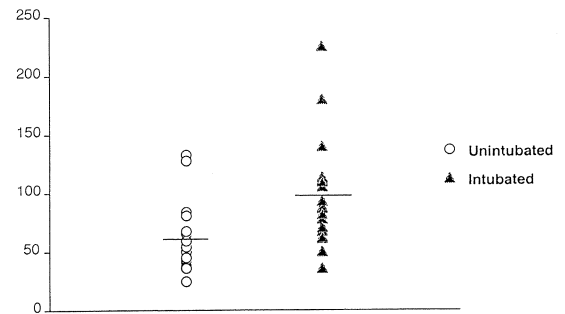


Fig 1 - Arterial pCO₂ of 37 admissions after excluding 9 post-intubation values, and 3 values were not available. The mean pCO₂ for patients not needing mechanical ventilation was 62 mmHg, while mean pCO₂ was 98 mmHg for those that required mechanical ventilation (p<0.01 on unpaired t-test).

did not, even though there was a trend towards more elderly cases needing mechanical ventilation (47 ± 16 years vs 39 ± 12 years, p=0.06 on unpaired t-test). The sex of the patient did not affect the likelihood of mechanical ventilation.

The mean pCO₂ was 76.4 ± 38.8 mmHg (range 24 to 225 mmHg), and mean arterial pH was 7.16 ± 0.18 (range 6.7 to 7.6). The results of three admissions were not available, and 9 values were taken after intubation. After excluding the post-extubation values, admissions needing mechanical ventilation had significantly higher pCO₂ (Fig 1) and lower arterial pH (98 ± 45 mmHg vs 62 ± 29 mmHg, p<0.01, and 7.1 ± 0.17 vs 7.3 ± 0.13, p<0.001). There was no significant difference between males and females for pCO₂ values, or the incidence of hypercapnia (pCO₂>50 mmHg). Note that 10 of the admissions had hypercapnia and yet did not need mechanical ventilation.

Mean total white count was 15 x 10⁹/L ± 6 x 10⁹/L, and mean potassium level was 3.9 ± 0.59 mmol/L. Thirteen (28%) patients had hypokalemia (<3.6 mmol/L). There was no significant difference in the number of patients with hypokalemia who survived versus those that died, and no fatal arrhythmias were recorded after admission to the intensive care.

Everyone except one who had survived without hypoxic brain damage was still alive on an average follow-up period of 133 weeks (range 0 to 299 weeks).

DISCUSSION

Overall mortality in our series was low (12%), but was higher for those needing mechanical ventilation (20%). Morbidity consisted of 2 pneumothoraces (4%), and 2 cases of hypoxic brain damage that did not die in our hospital. The mortality rate of severe asthma has varied from series to series, along with the complication rates (Table I). Some series even had no mortality^(13,18,19,21) or any associated barotrauma^(20,21). We had no reported complications during intubation, although a significant complication rate of 33.3% was reported by Zimmerman et al⁽²³⁾.

Table I - Comparison of different studies on severe asthma with the number of patients needing ventilatory support, mortality rate, and complications

Study	Year	Number of patients ventilated	Deaths (%)	Barotrauma
Scoggin CH et al ⁽¹⁴⁾	1977	19	8(42)	7 pneumothoraces
Westerman DE et al ⁽¹⁰⁾	1979	39	4(10)	5 pneumothoraces
Dariolo R et al ⁽¹⁹⁾	1984	34	0	1 pneumomediastinum
Luksza AR et al ⁽¹⁵⁾	1986	34	3(9)	6 pneumothoraces
Higgins B et al ⁽²⁰⁾	1986	48	1(2)	none
Lim TK ⁽¹⁷⁾	1989	19	2(11)	1 pneumothorax
Braman SS et al ⁽¹⁸⁾	1990	80	0	3 pneumomediastinums
Wasserfallen JB et al ⁽¹³⁾	1990	34	0	don't know
Molfino NA et al ⁽²¹⁾	1991	10	0	none
Marquette CH et al ⁽⁹⁾	1992	147	24(16)	don't know
Lam KNSF et al ⁽²²⁾	1992	19	5(26)	1 pneumomediastinum
Zimmerman JL et al ⁽²³⁾	1993	69	4(6)	3 tension pneumothoraces
Current study	1993	30	6(20)	2 pneumothoraces

Table II - Studies with long-term follow-up of severe asthma needing intensive care

Study	Year	Length of follow-up	Mortality rate (%)
Marquette et al ⁽⁹⁾	1992	6 years	15
Wasserfallen JB et al ⁽¹³⁾	1990	Up to 7 ¹ / ₂ years	28

Note that prior to the days when assisted ventilation was part of the therapeutic armamentarium for severe asthma, mortality rates was even higher⁽²³⁾. In our series, only one patient who was not admitted directly to the intensive care unit died. She was in the general ward for 14 hours before she suddenly collapsed. All the other cases had arrived in a moribund condition to the emergency room, where they were resuscitated and intubated. They survived an average of 2.7 days in the intensive care unit. It would therefore be difficult to alter the prognosis of such patients even with the best of intensive care. Instead these patients should have been educated about the consequences of severe asthma, had the emphasis placed on control of their asthma with steroids, while discouraging excessive use of inhaled β_2 -agonists, and the need to seek urgent attention once they fail to derive relief from their standard medication. As expected, those that perished had significantly higher arterial pCO₂ and lower arterial pH.

Those who needed mechanical ventilation and survived without hypoxic brain damage usually had a rapid resolution of their asthma allowing early extubation, as the majority (77%) were extubated after less than 48 hours of mechanical ventilation.

The mode of death in our series could not be elicited as the patients had arrived in a moribund condition and no necropsy studies were performed. Therefore, whether our patients died from respiratory asphyxia rather than cardiac arrhythmias remains unresolved.

As noted by previous investigators⁽¹⁶⁻¹⁸⁾, hypercapnia per se does not necessitate mechanical ventilation, as opposed to the orthodox textbook teaching, even though the cases that needed mechanical ventilation had significantly higher arterial pCO₂. In our series, 19 episodes were associated without mechanical ventilation, and 10 of these episodes (53%) had associated hypercapnia. There was no difference in arterial pCO₂ values between males and females, as opposed to other studies that claimed that males were more likely to have hypercapnia than women⁽¹⁶⁻¹⁸⁾.

Long-term follow-up of those patients that survived without hypoxic brain damage (40 patients) is encouraging. Only one patient died subsequently (60 weeks later), with an average follow-up period of 133 weeks for the whole group. Two other studies have higher mortalities from a longer follow-up (Table II).

Hypokalemia was evidenced in 28% of cases, with no association with outcome. Furthermore, there was no recorded fatal arrhythmia. This may be due to a β_2 -agonist effect⁽²⁴⁾, and its presence has been reported in other series^(21,22).

In conclusion, our 6-year retrospective study has demonstrated that there is an associated mortality with severe asthmatics that need mechanical ventilation. However, good intensive care and prompt resuscitation allowed 50% of those that presented with cardiorespiratory collapse to survive without hypoxic brain damage. Overall their long-term survival was excellent. Patients with severe hypercapnia were more likely to need mechanical ventilation, but a substantial number of patients with arterial pCO₂>50 mmHg were managed without resorting to mechanical ventilation. To make any further impact on asthma deaths, patient education remains paramount in the Singapore context.

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INSTITUTE OF MENTAL HEALTH
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Date : Sunday, 5th October 1997
Time : 8.30 am to 5.00 pm
Venue : Singapore International Convention and Exhibition Centre, Suntec City
Theme : 'NEW FRONTIERS IN PSYCHIATRY'

Highlights

- I. PLENARY LECTURE:
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 Key-note speaker: Professor Kua EH, National University of Singapore
- II. SYMPOSIA:
- New Frontiers in Psychopharmacology
 - Psychiatry and the Law
 - Psychiatry in the IT Age
 - Advances in Psychological Management
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- 'Unmasking Melancholia'— Depression in the Elderly
 - 'Surviving Violence'— a symposium on domestic violence
 - 'After the Storm'— Cognitive Behavioural Techniques in the treatment of the suicidal
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