

Clinical Features and Outcome of Management of Severe Acute Asthma (Status Asthmaticus) in the Intensive Care Unit of a Tertiary Medical Center

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ABSTRACT

Aim of the study: The recognition and management of severe acute asthma have attracted considerable attention since the seventies because of the morbidity and mortality that may accompany the condition. Recognition and appropriate management of severe acute asthma is essential. Admission to intensive care, intubation and ventilation risks versus benefit have been argued. We highlight these controversies by documenting our experience and comparing it to others in the literature

Methodology: We prospectively document our experience over a two-year period in the management of severe asthma in the intensive Care Unit (ICU). Patients were established asthmatics, who came in severe exacerbation. Attention was paid to the duration of onset of acute attack, time to presentation, spirometric and blood gas data, the type of treatment given, factors responsible for complications and mortality were identified. The findings in this study were compared with those in similar studies in the literature.

Results: A total of 30 patients were studied. Twenty-one patients were ventilated and 9 were not. 82% had a history of asthma longer than 5 years. The duration of symptoms before admission to ICU was very short (one day or less in 57%). Hypercapnia was significantly higher in intubated patients. The duration of stay in ICU and hospital was longer for intubated patients ($P < 0.02$). Complications were higher in intubated patients.

Conclusion: ICU care provides an excellent setting for management of acute severe asthma. The reported high morbidity and mortality in ICU can be improved. Without ICU care the mortality and morbidity increases, so physicians should not hesitate to admit asthmatics early to ICU.

Keywords: Asthma, Hypercapnia, Mortality, Morbidity, ICU

INTRODUCTION

The recognition of severe acute asthma (SAA), its management and prevention has attracted considerable attention since the seventies^(1,2,3,4). Immediate and appropriate treatment is essential for survival during a severe asthma exacerbation⁽⁵⁾. Mechanical ventilation may be necessary to support life in the most severely ill patients. However, not all patients who have hypercapnia will need mechanical ventilation^(2,6).

Most patients admitted to the hospital with life threatening asthma in recent times are treated in an intensive care unit (ICU). Such treatment in ICU subjects patients to a number of potential hazards such as invasive instrumentation, intubation, mechanical ventilation and nosocomial infection. In view of this, it has been questioned if the benefits of ICU care for SAA outweigh the potential risks⁽⁷⁾.

A large number of reports on management of SAA in the developed world have appeared in the literature^(5,8,9). However, only a few reports on this condition from the developing world have been documented^(4,10). Facilities in hospitals for management in many of these countries are not readily available. Consequently, the mortality is assumed to be high.

We report our experience of outcome of management of SAA in the ICU in a tertiary medical center in Kuwait over a 2-year period (1996 to 1997) and we compare our findings with that reported from some medical centers in the developed world.

PATIENTS AND METHODS

Thirty patients with severe acute asthma admitted to the ICU of Mubarak Hospital (the university teaching hospital) from January 1996 to December 1997 were included in the study. All the cases fulfilled the criteria for bronchial asthma as specified by the American Thoracic Society⁽¹¹⁾. They were jointly managed by the medical staff of the ICU and the Respiratory unit of the hospital. Cases which were admitted to ICU and which were later diagnosed as COPD were excluded. Data were collected about the duration of asthma, duration of onset of symptoms before admission, previous admission to hospital in acute exacerbation and previous

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medication including maintenance corticosteroid therapy. Indication for ventilation included coma, severe oxygen desaturation, marked hypercapnia, drowsiness and exhaustion. In the case of patients who needed mechanical ventilation, this was accomplished using the volume cycled Servo 900 Ventilator, and appropriate muscle relaxant and hypnotic. Hypercapnic low volume ventilation was used with a tidal volume of 5 to 10 ml/kilogram. Monitoring of patients either continuously for some parameters or at regular intervals, usually included ECG, blood pressure, central venous pressure, pulse oxymetry, fluid balance and arterial blood gases.

All patients were treated with systemic corticosteroids, salbutamol and ipratropium bromide by nebulizers, oxygen and xanthines. Arterial blood gas analysis was carried out on arrival in Emergency room and as required. Other investigations such as chest radiographs, electrocardiographs were done routinely. Hypercapnia was defined as PaCO₂ equal to, or greater than 5.8 kpa (45 mmHg) and Respiratory failure as PaCO₂ greater than 6.5 Kpa (50 mmHg)⁽²⁾.

For statistical comparison, t-test for equality of means was used. Results are presented as means \pm standard deviation, and P<0.05 was accepted as significance.

RESULTS

Thirty patients were admitted to ICU during the study period. There were 11 males and 19 females. Twenty-one patients who had mechanical ventilation have been classified as group I, while the remaining 9 who were not ventilated were classified as group II.

Table I shows the summary of the clinical characteristics of the patients in the two groups.

The patients were mainly chronic asthmatics, with a long history of asthma. Twenty (82%) of the patients gave a history of asthma longer than 5 years. The onset of symptoms prior to admission to ICU was very short, the duration being one day or less in 17 (57%) of the patients. Four patients gave a history of onset of symptoms of 4 days. At presentation, patients were in coma, while 19 were conscious.

The duration of stay in ICU varied from 1 to 22 days. It was much longer in patients in group I, the mean being 6.5 ± 5.1 days compared with 3.8 ± 2.8 days in the patients in group II. The duration of stay in the hospital was much longer in patients in group I compared with those in group II, the difference being statistically significant ($p < 0.002$). There is no statistical difference between the two groups in the number of patients who had previous admission to hospital for asthma (51.1% for group I and 77% for group II) and oral corticosteroid therapy (28.5% for group I and 44.7% for group II). Similarly there is no statistical difference in the precipitating factors between the two groups (71.4%

Table I. Summary of Clinical features of patients in the two groups

Variables*	Group I	Group II	P Value
Age in years	48.4 \pm 17.4	34.3 \pm 16.8	0.53 (NS)
Duration in ICU (days)	6.5 \pm 5.1	3.8 \pm 2.8	0.03
Duration in Hospital (days)	12.6 \pm 7.3	6.1 \pm 2.0	<0.002

* Values expressed as Mean \pm SD NS = not significant

Table II. Arterial Blood Gases at presentation in 30 patients

Variables*	Group I	Group II	P Value
pH (mean)	7.15 \pm 0.2	7.17 \pm 0.15	0.09 (NS)
pH (range)	6.79 \pm 7.45	7.0 – 7.30	
PaCO ₂ (mean)	9.2 \pm 3.5	6.6 \pm 1.5	<0.02
PaCO ₂ (range)	5.19 – 14.42	5.30 – 7.90	

* Values expressed as Mean \pm SD

for group I compared to 77.8% in group II).

Arterial blood gas estimation was done in all the patients at presentation in the emergency room.

Hypercapnia was found in 26 (85%) of cases, 19 cases in group I and 7 in group II. Arterial carbon dioxide pressure (PaCO₂) ranged from 5.19 to 14.2 (Kpa) in group I and 5.3 to 7.9 (Kpa) in group II. The hydrogen concentration (pH) was acidic in 26 (85%) of cases, 19 in group I and 7 in group II. Five patients in group I had a pH of less than 7.0 on admission, 3 of who eventually died.

Table II illustrates the mean pH and PaCO₂ in the two groups. The difference in the value of PaCO₂ between the two groups is statistically significant ($p < 0.02$). Figs. 1 and 2 show the graphical distribution of pH and PaCO₂ in the two groups.

The majority of the complications (80%) were recorded in group I patients and they included lung collapse in 4 patients, cardiac arrhythmia in 2, acute myocardial infarction in one patient and sepsis syndrome with consequent brain damage in one patient. Only 2 patients had complications in group II (one consolidation and one hemiplegia consecutively). There were 3 deaths (10%), all occurring in the patients belonging to the ventilated group (group I). The cause of death was myocardial infarction and hypotension in one case, septic shock, multiple brain infarction with disseminated intravascular coagulopathy in the second, and chronic renal failure with metabolic acidosis in the third. The pH recorded at presentation in these patients was 6.9, 6.7 and 6.95 respectively. The third patient already had established renal failure on regular haemodialysis before he was mechanically ventilated. He died presumably from his existing renal problem.

DISCUSSION

Although asthma prevalence is higher in males, majority of patients who presented with severe acute asthma

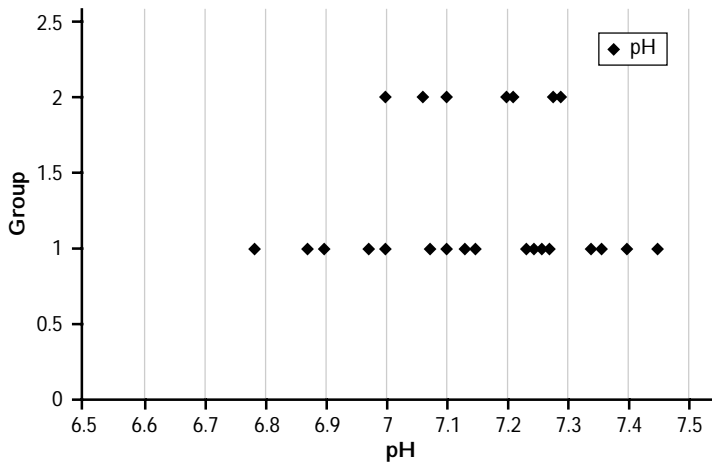


Fig. 1 pH in Ventilated and Non-ventilated patients

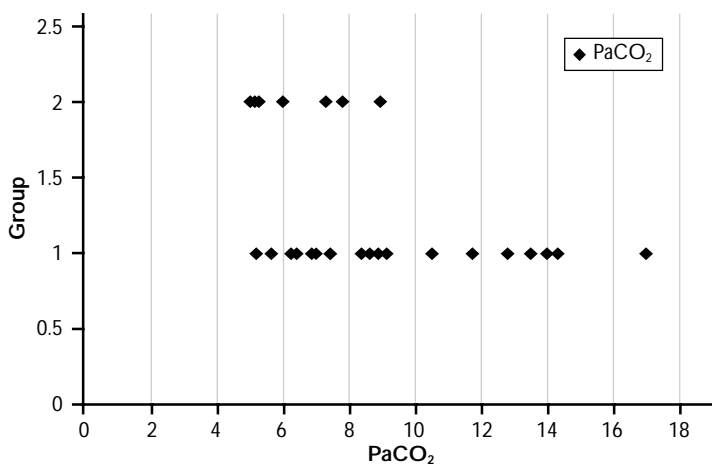


Fig. 2 PaCO₂ in Ventilated and Non-ventilated patients

(SAA) were women. Our findings are in agreement with the findings in some other studies on SAA^(2,3,4). Records from our hospital show that more women attend hospital for treatment than men. This may have been responsible for the larger number of women being admitted to the ICU. However, other factors, such as non-compliance with treatment by women may be responsible for the predominance of females.

Over 80% of our patients were chronic asthmatics who had symptoms for more than 5 years, and most of them have had previous admission to hospital for treatment. This observation has also been made in other series^(4,10). The onset of symptoms prior to admission was relatively short, the majority of our patients presenting to hospital within 24 hours of onset. All the 4 patients, who had onset of symptoms of 4 days or more, had mechanical ventilation.

The mode of presentation in our patients is of interest. Two thirds of our patients arrived in the emergency room either in coma, semi-conscious, or in a restless state, despite the fact that medical services are easily accessible for all patients. In contrast, the onset of symptoms in the series by Luksza et al⁽³⁾ exceeded 24

hours in 88% of their patients. Their symptoms evolved over days rather than hours, with a mean of 8.6 days. Only 5 out of their 32 patients who had mechanical ventilation presented to hospital within 24 hours. Similar observation was made in other series^(12,13).

There is no significant statistical difference in the mean age in the ventilated and non-ventilated group. Similarly, there is no statistical difference between the two groups in the mean duration of stay in the intensive care unit (ICU). However, the difference between the two groups in the mean duration of stay in the hospital is statistically significant. In a similar study, Braman and Kaemmerlen⁽²⁾ found statistically significant difference between ventilated and non-ventilated groups in both the mean duration of stay in ICU and the mean duration of stay in Hospital. The fewer number of patients in the non-ventilated group in our series may be contributory factor to the difference in findings in the duration of stay in the ICU.

Management of patients in the ICU has improved the outcome over the years. ICU provides immediate and appropriate treatment during severe asthma exacerbation. Intubation and mechanical ventilation provide necessary support in the most severely ill patients, salvaging them in many cases. Braman and colleague found that the treatment of the critically ill asthmatic patients in the ICU was highly successful, recording no death in a series of 61 patients. In our study, 70% of the patients, were intubated and ventilated, the indication in most of them being coma, exhaustion and restlessness. It is conceivable that majority of these patients would not have survived without mechanical support. Only 3 (10%) of the patients in our study died, all of them belonging to the ventilated group, but 2 with severe complications developed during treatment. If patients are carefully selected and monitored during mechanical ventilation, mortality can be considerably reduced.

In this study, it was observed that a large number of the patients were hypercapnic and acidotic on arrival in hospital. Not all patients with hypercapnia were ventilated in our series. Other factors such as coma and fatigue in addition, were considered before a decision of mechanical ventilation was taken. This was also the experience of Lee and Colleagues in Singapore⁽¹⁰⁾.

It is noted that the mean value of arterial carbon dioxide concentration (PaCO₂) between the ventilated and non ventilated group in our series is statistically significant (Table II). This difference in the mean values of Hydrogen Ion concentration (pH) in the two groups however, is not statistically significant in our series unlike the finding in the series by Braman and colleague⁽²⁾ in which the difference in mean values of PaCO₂ and pH were statistically significant.

Precipitating factors are found in almost equal

frequency in the ventilated and non ventilated groups. As recorded in other series^(2,10), respiratory tract infection is the most frequently encountered precipitating factor. Similar finding was recorded in our series.

Complications are more frequent in the ventilated group compared with the non ventilated group in our study. Several workers^(2,14) have reported the frequent occurrence of complications in patients with severe acute asthma following mechanical ventilation. However, with proper monitoring of patients on ventilation, fewer complications are being reported⁽¹⁵⁾. In our series, no complication of barotrauma was observed when compared with findings in other series. Careful attention to the functioning of the ventilators is probably responsible for this. It is of interest that Lee and Colleagues⁽¹⁰⁾ in Singapore reported no complication in their recent series of 48 patients managed over a 6-year period.

The mortality in our series is 10%. The rate is comparable to that reported in other series (Table III). Our mortality compared favourably with that reported by Lee et al. Their study, like ours, was conducted in a developing country. Table III shows the published series of mortality rate in patients treated with mechanical ventilation. No mortality was recorded in the series by Braman and Kaemmerlaen⁽²⁾, Mountain and Sahn⁽¹⁵⁾. It was observed that the 3 patients who died in our series were critically ill on arrival to hospital and could not however be salvaged. They died from their complications. One of the three, died as a result of a pre-existing chronic renal failure and was regularly dialysed while on admission. The other two died from complications developed while on mechanical ventilation.

Although it has been reported that mechanical ventilation may be associated with a high rate of complications and death, yet, it is a fact that without mechanical ventilation, many of the patients admitted in coma and severe exhaustion and cyanosis could not have survived on conservative measures only. In our series, we believe that the number of deaths would have been higher, especially among the patients admitted moribund, if they had not been mechanically ventilated. In the long run, the decision to intubate and mechanically ventilate, will depend on the clinical state of patients on arrival in emergency room and the altered physiological state, as determined by arterial blood gas and spirometric measurements.

CONCLUSION

This study has shown that the management of patients in severe acute asthma in the intensive care unit provides an excellent setting, enabling patients to be successfully treated and transferred to the general wards much quicker. The reported high morbidity and mortality rates in earlier studies can be reduced to acceptable level with

Table III. Comparison of mortality rates in patients treated with mechanical ventilation in published reports and this study

Authors	No. of Patients ventilated	Deaths	Mortality %
Braman & Kaemmelaeln ⁽²⁾	64	0	0
Westerman et al ⁽⁴⁾	34	4	12
Marchand & Van Hasselt ⁽⁷⁾	14	3	21
Lee et al ⁽¹¹⁾	30	6	20
Present study	21	3	14

proper handling of the patients and the machine. Equally, for those asthmatics who require ventilatory support, a low morbidity and mortality can be achieved even in the countries with developing economy, when meticulous care and monitoring, available in the modern intensive care unit, are fully utilized.

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REFERENCES

- Cooke NJ, Crompton CK, Grant IWB. Observations on the management of acute bronchial asthma. *Brit J Dis. Chest.* 1979; 73:157-163.
- Braman SS, Kaemmerlen JT. Intensive care of status asthmaticus. *JAMA* 1990; 264:366-368.
- Luksza AR, Smith P, Coackley J, Gordan JJ, Atherton ST. Acute severe asthma treated by mechanical ventilation: 10 years experience from a district general hospital. *Thorax* 1986; 41:459-463.
- Westerman DE, Benatar SR, Potgieter PD, Ferguson AD. Identification of the high risk asthmatic patient. *Am. J Med.* 1979; 66:565-572.
- Santiago SN, Klauster Meyer WB. Mortality in status asthmaticus. A nine year experience in a respiratory intensive care unit. *J Asthma Res* 1980; 1:75-79.
- Lim TK. Status asthmaticus in a medical intensive care. *Singapore Med J* 1989; 30:334-338.
- Marchand P, Van Hessel H. Last resort treatment of status asthmaticus. *Lancet* 1966; 1:227-230.
- Zimmerman JL, Dellinger RP, Shah AN, Taylor RW. Endotracheal intubation and mechanical ventilation in severe asthma. *Crit care Med* 1993; 21:1727-1730.
- Higgins R, Greening AP, Crompton GK. Assisted Ventilation in severe acute asthma. *Thorax* 1986; 41:464-467.
- Lee KH, Tan WC, Lim TK. Severe asthma. *Singapore Med J* 1997; 38:238-243.
- American Thoracic Society. Lung function testing. Selection of reference values and interpretation strategies. *Am Rev Respir Dis* 1991; 144:1202.
- Ormerod LP, Stableforth DE. Asthma mortality in Birmingham 1975-1977. *Br Med J* 1980; 1:1493-1495.
- BTA Report. Death from asthma in two regions of England. *Br Med J* 1982; 285:1251-1255.
- Molfini NA, Nannini LJ, Martelli AN, Slutsky AS. Respiratory arrest in near - fatal asthma *N Engl J Med* 1991; 324:285-288.
- Mountain RD, Sahn SA. Clinical features and outcome in patients with acute asthma presenting with hypercapnia. *Am Rev Respir Dis* 1988; 138:535-539.