NON-INVASIVE VENTILATION IN ADULT POPULATION IN INTENSIVE CARE UNIT HOSPITAL UNIVERSITI SAINS MALAYSIA: A RETROSPECTIVE STUDY

BY

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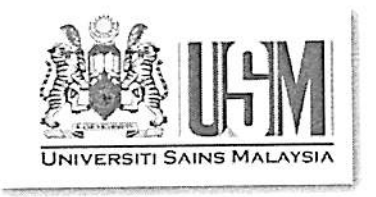

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ABBREVIATIONS

ABG	Arterial Blood Gas
ACPO	Acute Cardiogenic Lung Oedema
APACHE II	Acute Physiology and Chronic Health Evaluation II
ARDS	Acute Respiratory Distress Syndrome
BiPAP	Bilevel Positive Airway Pressure
CICU	Cardiac Intensive Care Unit
CABG	Coronary Artery Bypass Graft
CPAP	Continous Positive Airway Pressure
CPR	Cardiopulmonary resuscitation
CSA	Central Sleep Apnoea
ePAP	Expiratory Positive Airway Pressure
FRC	Functional Residual Capacity
FVC	Forced Vital Capacity
HIV-AIDS	Human Immunodeficiency Virus - Acquired Immune Deficiency Syndrome
HUSM	Hospital Universiti Sains Malaysia
ICU	Intensive Care Unit
iPAP	Inspiratory Positive Airway Pressure
IPPB	Intermittent Positive-Pressure Breathing
NIV	Non-invasive ventilation
OHS	Obesity-Hypoventilation Syndrome
OSA	Obstructive Sleep Apnoea

PCP	*Pneumocystis jiroveci (carinii)* Pneumonia
PEEP	Positive End Expiratory Pressure
P/F ratio	PaO2 over FiO2 ratio
SAPS II	Simplified Acute Physiology Score II
SMT	Standard Medical Therapy
SpO_2	Oxygen saturation
TURP	Trans-urethral Resection of the Prostate

DEFINITIONS

1. Non-invasive ventilation

   Application of artificial ventilation through the patient's upper airway to the lungs using positive pressure techniques via nose, mouthpiece, facemask (oronasal mask), facial mask, or helmet, as opposed to invasive ventilation via an endotracheal (or supraglottic) airway.

2. Respiratory failure

   A failure to maintain adequate gas exchange and is characterised by abnormalities of arterial blood gas tensions.

3. *de novo* respiratory failure.

   A group of acute hypoxaemic respiratory failures which is characterized by severe hypoxaemia and respiratory distress in non-COPD patients and not exacerbating a chronic lung disease or cardiac insufficiency.

4. Acute on chronic respiratory failure

   Acute deterioration superimposed on a stable chronic lung disease, commonly a chronic obstructive pulmonary disease (COPD).

5. Positive end expiratory pressure (PEEP)

   Positive alveolar pressure at the end of expiration.

6. Continuous positive airway pressure (CPAP)

   A single level of positive pressure is applied continuously throughout the whole respiratory cycle

7. Bilevel positive airway pressure (BiPAP)

   A system of ventilation in which two levels of airway pressure are applied: expiratory positive airway pressure (EPAP) and inspiratory positive airway pressure (IPAP). The lower pressure, EPAP, is applied during expiration.

When the patient makes an inspiratory effort the device senses a small drop in pressure that triggers a flow of gas at the higher IPAP.

8. Pressure support ventilation

   In non-invasive ventilation, it is the difference between the inspiratory and expiratory airway pressures, that is, amount of extra "help" the patient is receiving during inspiration.

9. Chronic obstructive pulmonary disease (COPD)

   A condition in which there is chronic obstruction to airflow due to chronic bronchitis and/or emphysema.

10. Acute cardiogenic pulmonary oedema (ACPO)

    Accumulation of liquid in the tissue and airways of the lungs, due to increased in pulmonary venous pressure, most commonly caused by left ventricular failure.

11. SAPS II

    A severity of disease classification system (Le Gall *et al.*, 1993). It stands for "Simplified Acute Physiology Score", and is one of several ICU scoring systems.

ABSTRACT

Title: Non-invasive ventilation in General ICU Hospital Universiti Sains Malaysia: a retrospective study.

Objectives: The aims of this study were to review the practice of application of NIV in adult patients admitted in general ICU HUSM and to investigate factors that contributed to its success and failure.

Methodology: A retrospective study was done to review the NIV practice in HUSM. We defined the characteristics of adult patients 18 years old and over who were admitted in ICU in the period of 1 January 2008 to 31 December 2008 (1 year), who had been put on NIV in any course of their staying in ICU. Data were collected from patient's medical record, including the patient's ICU chart. Parameters taken were demographic, diagnosis, patients' co-morbidity, SAPS II point, length of ICU stay, and patients' condition when discharged from ICU: survived or not survived. The SAPS II point was generated from the first 24 hour of patient's ICU admission. At the time when the NIV were being applied, specific data such as arterial blood gas analysis (ABG) values, status of organ failure and kind of supports (inotropes and vasopressors, haemodialysis etc.) that patients received were recorded. Subsequent evaluation on NIV setting and the ABG were looked at certain interval: at 1^{st}, 6^{th}, 12^{th} and 24^{th} hour of NIV application. If there was no ABG taken during those specific hours, the previous or next ABG within 2 hours duration was taken, or if there was none, was recorded as missing data. The duration of NIV in hours and the final outcome of each patient were documented. Any deleterious events happened during the course of NIV and the action taken by the attending doctors were also recorded.

Deeper look on the attending doctors' note was taken for the patients who had failed NIV and needed intubation or reintubation. Descriptive analysis was used to describe the patients' characteristics. Relevant data were analysed using non-parametric test: Kruskal-Wallis test, Chi-Square test or Mann-Whitney test, which ever appropriate.

Results: We categorized 54 patients into either *de novo* respiratory failure (*de novo*), acute on chronic respiratory failure (AOC) or acute cardiogenic pulmonary oedema (ACPO). The proportion of *de novo* was high (74.1%) when the other two were low (14.8% for AOC and 11.1% for ACPO). Among those three groups, there were no significant differences in survival rates (77.5%, 87.5% and 83.3% in *de novo*, AOC and ACPO respectively). ICU stay was significantly longer in *de novo* groups (11.5±8.04 days vs. 4.9±1.46 days in AOC and 6.8±5.19 days in ACPO; *p*-value = 0.029). When we looked further at patients in *de novo* group who were diagnosed as pneumonia, the mortality and the NIV failure rate were significantly higher than the non-pneumonia patients (50% vs 10.7% mortality rate; *p*-value = 0.004, and 66.7% vs. 39.3% NIV failure rate; *p*-value = 0.017). In addition, when patients failed NIV and need intubation/re-intubation, the ICU stay would be doubled (15.1±8.5 days vs. 7.5±5.83 days). The overall mortality rate didn't deviate from the predicted mortality rate calculated from the SAPS II point, and it was clearly shown that there was a significant difference in SAPS II point between the survivors and non survivors (SAPS II point 35.7±13.39 vs. 46.1±15.63 ; *p*-value = 0.036). However, there is no correlation between SAPS II point and NIV failure rate.

Conclusion: In our ICU, most patients treated with NIV were *de novo* respiratory failure. There were no significant differences in mortality and NIV failure rates among different groups of respiratory failure, although ICU stay was clearly

longer in *de novo* group. ICU stay would also be longer in those who failed NIV and need intubation/re-intubation. SAPS II point accurately predicted mortality rate but not NIV failure rate. Pneumonia patients in *de novo* group had significantly higher mortality rate as well as NIV failure rate compared to non-pneumonia patients. Indeed, among all of the analysed variables, pneumonia was the only one that had strong association with NIV failure. We concluded that our NIV practice results were not consistent with some reports in other clinical trials, except that pneumonia was a contributing factor for NIV failure and that those who failed NIV would have longer ICU stay. But we also emphasized that differences might exist between controlled clinical trials and real clinical practice as this retrospective study basically was. From this retrospective study alone, it was not possible to determine whether our NIV practice had complied with the best standard practices. The NIV utilization was low and it was expected that had the medical officers (MOs) been more confident, more patients should have been treated with NIV. Implementation of "Immediate NIV" and "alternate NIV" were considered as good practices, but the high proportion of *de novo*, including pneumonia patients treated with NIV suggested that the MOs might not be aware about the results from the previous studies which encouraged careful selection for that kind of patients. The presence of patients who died while on NIV would also speculate that intubation should have been taken earlier. The absence of NIV guidelines in our institution might leave improper decisions to be widely opened, and the status as a teaching hospital might become a disadvantage as new MOs with less experience would come and those experienced ones would go. Therefore, we believed that the availability of standard protocol and proper training were essential for future improvement in NIV application in our institution.