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RESEARCH ARTICLE

SPO_2 ON ADMISSION AS A PREDICTOR OF OUTCOME IN SWINE FLU PATIENTS ADMITTED TO GOVERNMENT MEDICAL COLLEGE, AURANGABAD (MAHARASHTRA)

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ABSTRACT

Background: Since 2009, Government Medical College, Aurangabad, which is a tertiary care hospital in the region, has been regularly admitting cases of pneumonia and ARDS, that are labeled as swine flu suspects, in the Isolation Ward. Those cases whose report tests positive for H1N1 are retained in the well equipped Ward, whereas the others are shifted to the general MICU or respective wards. This study correlates SpO2 on admission with the outcome in swine flu patients admitted to Government Medical College, Aurangabad from January 2015 to May -2015.

Aims and Objectives: The primary objective was to correlate the SpO2 (Oxygen saturation) at admission with outcome –viz survival or death.

Materials and Methods: 59 cases of swine flu confirmed by PCR were admitted in the swine flu ward from January 2015 to May -2015, of whom 24 died. All the cases who were admitted immediately underwent a thorough clinical examination, including SpO2. ABG, routine CBC, LFT, KFT, HIV testing (after counselling patient or close relative), X-Ray chest were done in all cases. Statistical analysis was done by SPSS, version 20.

Results: A total of 59 PCR-confirmed H1N1-infected patients were included in the study. Of these 31 (53%) were males and 28 (47%) females. All the 8 (100%) HINI positive patients whose SpO2 immediately at the time of admission, while breathing room air, was< 60%, died. 7of the 9 (78%) HINI positive patients whose SpO2 at the time of admission was 61-75% also died. On the other hand, only 9 (21.4%) of the 42 HINI positive patients having SpO2 >76% died (p= 0.00000141)

SpO2	SURVIVED	DEAD	TOTAL
<60	0(0%)	8(100%)	8(100%)
61-75	2(22%)	7(78%)	9(100%)
>76	33(78.6%)	9(21.4)	42(100%)
Total	35	24	59

Conclusion: In H1N1 positive patients, the value of Sp02 at the time of admission by a simple device like pulse oximeter is a significant predictor of mortality. In our study it was observed that if the SpO2 measured immediately at admission was <60, the mortality was 100%, regardless of other factors. All the patients whose Sp02 at admission was 89% or more, survived (100%).In the nine cases in whom the SpO2 was 61-75%, only two (22.2 %) survived. These values are highly significant statistically (p= 0.00000141).

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INTRODUCTION

Pulse oximetry technologies use a sensor with light-emitting diodes and a detector. Usually, the sensor is placed on a finger, or even toe, nose or ear lobe where arterial blood is easily detected. The sensor emits red and infrared light, which penetrates body tissues and passes directly into the capillary membrane to the other side of the detector. Based on the amount of light received by the detector, the sensor analyzes and calculates the oxygen saturation of haemoglobin molecules.

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Oxygenated haemoglobin absorbs more infrared light, whereas deoxygenated haemoglobin absorbs more red light. The SpO_2 value is displayed on a monitor at the bedside or on the portable device itself (Why continuous pulse oximetry is a must in critical care, 2009; Anthony *et al*., 2008). In healthy subjects, changes in PaO2 correlate well with changes in pulse oximetric saturation (SPO2) for O2 saturation in the range of 80 to 100% (Rice *et al*., 2015). H1N1 (Swine Flu) virus was first reported in 2 children in California and many cases in Mexico, followed by multiple countries world-wide, in April 2009. Of these, the cases with ARDS needed ICU care for hypoxemic respiratory failure. Viral pneumonia was the most common respiratory presentation that needed ventilator

support. Department of Medicine, Government Medical College, Aurangabad (which is a tertiary- care hospital in the region), has been regularly admitting cases of pneumonia and ARDS, that are labelled as swine flu suspects, in the Isolation Ward since 2009. The throat swab of each suspect is sent to National Institute of Virology (NIV) Pune and treatment is started immediately in the form of Oseltamivir, respiratory support (wherever needed), antibiotics etc. Those cases whose report tests positive for H1N1 are managed in the well-equipped Swine Flu Ward in the Medicine Department Building, whereas the others are shifted to the general wards or MICU.

59 cases of swine flu H1N1 were admitted in GMC, Aurangabad from the 21st of January 2015 to the 10th of May 2015. The majority were referred from other practitioners or hospitals. ABG (Arterial blood Gas) test is not available to most peripheral health care professionals. Measurement of SpO2 (peripheral oxygen saturation) is a simple non-invasive investigation measured by pulse- oximeter. It can be done by any trained health worker, is more easily available and continuous monitoring is possible. The small portable device is relatively cheap. The aim of this study was to see in cases of swine flu if the SpO2 on admission correlated with the outcome, namely survival or death.

MATERIAL AND METHODS

Study Period and Population: 59 cases of swine flu, confirmed by PCR, were admitted in the swine flu ward from January 2015 to May 2015, of whom 24 died. All the cases who were admitted immediately underwent a thorough clinical examination, including SpO2. Routine blood count, blood gas analysis, liver and kidney functions, blood sugar, HIV testing (after counselling patient or close relative), X-Ray chest were also done in all the patients.

Data Collection- Cross Sectional Study

Clinical data was recorded immediately from time to time on case papers as well as in the proforma and compiled.

Data Analysis - All analyses were carried out utilizing SPSS version 20.

RESULTS

A total of 59 PCR-confirmed H1N1-infected patients were included in the study. Of these 31 (53%) were males and 28 (47%) females. All the 8 (100%) HINI positive patients whose SpO2 immediately at the time of admission, while breathing room air, was < 60%, died .7 of the 9(78%) HINI positive patients whose SpO2 at the time of admission was 61-75% also died. Only 9 (21.4%) of the 42 HINI positive patients having SpO2 >76% died (p= 0.00000141)

SpO2	SURVIVED	DEAD	TOTAL
<60	0(0%)	8(100%)	8(100%)
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Total	35	24	59

DISCUSSION

This year, from the 21st of Jan to the 10th of May, we have had 152 suspected swine flu admissions of whom 59 were confirmed to be positive by PCR. Of these, 35(59 %) survived and 24 (41 %) died (Swine flu clinical management protocol and infection control guidelines, 2009). Majority of these swine flu patients presented with rapid progression of hypoxemia and bilateral alveolar infiltrates on chest x-ray. Other respiratory presentations were exacerbations of asthma or COPD, exacerbations of other underlying disease like CCF and secondary bacterial pneumonia (Matthay, 2012). PaO_2 measured by ABG machine is not routinely available in peripheral health care units. Pa02 requires arterial puncture hence it is not ideal for office use or for frequent measurements. It also gives intermittent rather than continuous data about the patients oxygenation and is not ideal for monitoring unstable patients continuously (Anthony *et al*., 2008).

There are certain issues about the use of pulse oximeter. When cutaneous perfusion is decreased (e.g. low cardiac output or use of vasoconstrictors) the signal from oximeter is unreliable. PaO2 is the amount of oxygen in arterial blood, as measured by blood gas analysis. SpO2 is the saturation of oxygen in peripheral blood, as measured by a pulse oximeter. FiO2 is the fraction of oxygen in the air that is inhaled. When we recorded the SpO2 of swine flu patients at admission, they were breathing room air, that has a FiO_2 of 0.21.

When the blood gas analysis of arterial blood is done with the patient breathing room air, the FiO_2 will again be 0.21. 2013 Berlin definition of ARDS is an acute diffuse, inflammatory lung injury, leading to increased pulmonary vascular permeability, increased lung weight, and loss of aerated lung tissue…[with] hypoxemia and bilateral radiographic opacities, associated with increased venous admixture, increased physiological dead space and decreased lung compliance.

Key components

- Acute, meaning onset over 1 week or less
- Bilateral opacities consistent with pulmonary edema must be present and may be detected on CT or chest radiograph
- PF ratio <300mmHg with a minimum of 5 cmH20 PEEP (or CPAP)
- "Must not be fully explained by cardiac failure or fluid overload," in the physician's best estimation using available information — an "objective assessment" (e.g. echocardiogram) should be performed in most cases if there is no clear cause such as trauma or sepsis (Calfee *et al*., 2014).

Severity

ARDS Severity	PaO2/FiO2*	Mortality**
Mild	200 – 300	27%
Moderate	100 – 200	32%
Severe	< 100	45%

*on PEEP 5+; **observed in cohort

Note : Berlin definition of ARDS does not include SpO2

The lung injury score (Murray score)

1. Chest roentgenogram score		Score
No alveolar consolidation		0
Alveolar consolidation confined to 1 quadrant		1
Alveolar consolidation confined to 2 quadrant		2
Alveolar consolidation confined to 3 quadrant		3
Alveolar consolidation in all 4 quadrants		4
2. Hypoxemia score		Score
PaO_2/FiO_2	300	0
PaO_2/FiO_2	225-299	1
PaO_2/FiO_2	175-224	2
PaO_2/FiO_2	100-174	3
PaO_2/FiO_2	＜ 100	4
3.PEEP score (when ventilated)		Score
PEEP	5 cm H_2O	0
PEEP	6 -8 cm H_2O	1
PEEP	9 -11 cm H_2O	2
PEEP	12 -14 cm H_2O	3
PEEP	15 cm H_2O	4
4. Respiratory system compliance score (when available)		Score
Compliance	80 ml/cmH_2O	0
Compliance	60-79 ml/cmH_2O	1
Compliance	40-59 ml/cmH_2O	2
Compliance	20-39 ml/cmH_2O	3
Compliance	19 m l/cmH_2O	4

The final value is obtained by dividing the aggregate sum by the number of components that were used (Calfee *et al.*, 2014)

	Score
No lung injury	0
Mild-to-moderate lung injury	0.1-2.5
Severe lung injury (ARDS)	＞ 2.5

*PEEP ＝ positive end-expiratory pressure.

Acute lung injury score and Berlin definition do not include SpO2 in their scoring system

Normal oxygen saturation values are 97% to 99% in a healthy individual. An oxygen saturation value of 95% is clinically accepted in a patient with a normal haemoglobin level (Sandra and Schut, 2001).

Portable Pulse Oximeter

Based on American European Consensus Conference (AECC) in 1994, diagnostic criteria for Acute lung injury (ALI) and Acute respiratory distress syndrome (ARDS) require acute onset of disease, chest radiograph demonstrating bilateral pulmonary infiltrates, lack of significant left ventricular dysfunction and arterial partial pressure of carbon dioxide/Fraction of inspiratory oxygen (PaO_2/FiO_2) (PF) ratio ≤300 for ALI or ≤200 for ARDS (Sandra and Schut; Bewick *et al*., 2010). It is observed in three studies in adults and children that the simple SpO2 / FiO2 (SF ratio) reasonably matches with the (PaO_2/FiO_2) (PF) ratio (Bewick *et al*., 2010). SF ratio threshold values for ALI was 235 and for ARDS was 181, corresponding to PF ratio 300 and 200. A similar study was conducted by Khemani *et al*. on paediatric population, they report that a cut-off of 201 for SF could predict PF for ARDS with 84% sensitivity and 78% specificity and a cut-off of 263 for SF could predict ALI with 93% sensitivity and 43% specificity (Nemat Bilan *et al*., 2015). Considering complications of arterial blood sampling such as anemia, and bleeding in critical care patients, pulse oximetry is a desirable replacement for arterial blood sampling.

We decided to use the SpO2 reading at admission with patient breathing room air (Fi02=o.21) as a surrogate marker for PaO2 and see whether the SpO2 value at admission before the patient was ventilated or given oxygen could predict the outcome, viz. survival or death.

Table 1. Age and sex distribution of swine flu cases

Age group	Male	Female	Total
<10 years	1	0	1
11-20	1	2	3
21-30	2	6	8
31-40	11	7	18
41-50	11	9	20
51-60	5	2	7
61-70	1	0	1
71-80	0	1	1
Total	32	27	59

In our study most (64.4%) of the patients were in the age group of 31-50. The youngest was 10 months old and oldest was 75 years of age. In our study it was observed that if the SpO2 immediately at admission was <60, the mortality was 100%, regardless of other factors.

Table 2. Correlation of SPO2 at admission and outcome

SPO2	No. of Deaths	No. of Survivals	Total
31-40	3	0	3
41-50	2	0	2
51-60	5	1	6
61-70	4	0	4
71-80	6	2	8
81-90	4	12	16
90-100	0	20	20
TOTAL	24	35	59

All the patients whose SpO_2 at admission was 89% or more, survived(100%).In the nine cases in whom the SpO_2 was 61-75%, only two (22.2 %) survived. In our study, only one patient survived at the lowest SpO_2 of 60 %. In spite of having a SpO2 of 88% at admission, one patient died, otherwise all 22 patients whose SpO2 was above 89% survived (37.22% of total). Of the 24 deaths, 8(33%) patients did not have any risk factor. In those 8 patients 4 (50%) had SpO_2 at the time of admission of <40%.

Table 3. Statistical analysis correlating spo2 with survival or death

SpO2	SURVIVED	DEAD	TOTAL
<60	0(0%)	8(100%)	8(100%)
61-75	2(22%)	7(78%)	9(100%)
>76	33(78.6%)	9(21.4)	42(100%)
Total	35	24	59

SPSS version 20 – P value (p= 0.00000141)

The lowest SpO_2 we recorded was 36%. Between 76% to 88% SpO2, 9 patients died. Of these, 7 had risk factors (HIV positivity, IHD, Rheumatic heart disease, pregnancy, obesity, uncontrolled hypertension). The SpO2 at admission was a predictor of mortality even when it rose for some time after the patient was put on a ventilator. This shows that, the more the lung damage at admission, less is the is efficacy of rescue management.

Since very few private hospitals in the city or neighbourhood admit swine flu cases and of these, even fewer admit serious cases, the apparent mortality (40.67%) in this study is high. Another reason for the apparent high mortality has been that, this year, we had instructions from the NIV to send throat swabs for RT-PCR of serious patients on ventilators or having high risk factors like pregnancy, diabetes or HIV infection, only Hence, though we treated all suspected cases as cases of H1N1, we could not test the milder cases though may have been cases of swine flu.

Conclusion

In H1N1 positive patients, the value of SpO_2 at the time of admission by a simple device like pulse oximeter is a significant predictor of mortality. In our study it was observed that if the SpO_2 immediately at admission was <60, the mortality was 100%, regardless of other factors. All the patients whose Sp02 at admission was 89% or more, survived (100%). In the nine cases in whom the SpO_2 was 61-75%, only two (22.2 %) survived. These values are highly significant statistically (p= 0.00000141).

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