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Comparison of NIV and IV in Management of ARDS: A Single Center Experience

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ABSTRACT

Introduction: Acute respiratory distress syndrome (ARDS) is a clinically considered by critical onset respiratory failure, diffuse pulmonary opacities, and severe hypoxemia. ARDS is classified as mild, moderate, and severe which is improvement by either invasively (endotracheal airway) or noninvasively (face or nasal mask).

Methods and Materials: In prospective observational study enrolled 50 consecutive cases of ARDS patients from July-2012 to June-2013.Investigation was done of various etiologies of ARDS, diagnostic criteria and need of mechanical ventilation, correlate biochemical factors with the outcome of patients. Diagnostic criteria used for ARDS/ALI were as per AECC guidelines.

Result: The mean age of the study population was 50.58 years; 20(40%) were women. Cough 43(86%) was most common symptom of ARDS. The serum creatinine, HCo_3 to PaO_2/FiO_2 ratio and ventilation duration where significantly higher of NIV to invasive-MV. There were 34 (68%) deaths in the study population. The ROC analysis between survival to Paco2/Fio2 ratio have sensitivity=44.1 and statistically significant ($p<0.001$;95% of CI=0.757(0.615-0.867)).

Conclusion: NIV applied to 60% while Invasive ventilation followed in 40% of ARDS patients, and one-third of patients with mild to moderate ARDS. Mortality rates with Invasive-MV were high.NIV was associated with a worse adjusted ICU mortality than invasive-MV in patients with PaO2/FiO2 <200 mmHg.

Keywords: Acute respiratory distress syndrome, Non invasive ventilation, PaO2/FiO2

INTRODUCTION

Acute respiratory distress syndrome (ARDS) is a clinically considered by critical onset respiratory failure, diffuse pulmonary opacities, and severe hypoxemia, in the absence of evident cardiac dysfunction.[1] On the basis of severity of hypoxemia, ARDS is classified as mild (PaO_2/FiO_2 ratio >200 and ≤300 mmHg), moderate (PaO_2/FiO_2 ratio >100 and ≤200 mmHg), and severe (PaO_2/FiO_2 ratio ≤100 mmHg). With increasing severity of ARDS, the mortality increases up to 45% in severe ARDS.[1] ARDS is also classified as extrapulmonary and pulmonary ARDS depending on the fundamental cause.[2] Apart from treatment of the underlying cause, the management of ARDS involves improvement of hypoxemia whichever by supplemental oxygen or by providing of positive pressure ventilation.

Positive pressure ventilation can be delivered either invasively (endotracheal airway) or noninvasively (face or nasal mask). Invasive mechanical ventilation is the standard of care for the management of ARDS to reduce mortality.[3] However, invasive ventilation is associated to avoid potentially several complications such as higher incidence of ventilator-associated pneumonia, barotrauma, volutrauma, and others.[4] NIV has significant role in the management of acute respiratory failure, spe-

cifically those secondary to acute exacerbations of chronic obstructive pulmonary disease and acute cardiogenic pulmonary edema.[5-7] In hypoxemic respiratory failure, NIV improves oxygenation, reduce dyspnea, unload respiratory muscle, and hence may benefit to avoiding invasive mechanical ventilation.[8,9]

A recent meta-analysis of six randomized controlled trials concerning subjects with ARDS suggested that the use of NIV avoided intubation, but not mortality. However, in the meta-analysis, only three studies (n = 89) involved patients with ARDS and the analysis also included postsurgical subjects with atelectasis.[10] In another meta-analysis involving only subjects with ARDS, it was shown that NIV avoids intubation in approximately 50% of the patients, provided the patients are carefully elected.[9] There is spare data on the role of NIV from the developing world.[7,11,12]

The goal of our study was to assess the efficacy of using ventilation (Non-Conventional Ventilation and Mechanical Ventilation) in Acute Respiratory Distress Syndrome.

METHODS AND MATERIALS:

This observational, prospective study enrolled 50 consecutive cases of ARDS admitted to a medical intensive care unit (MICU) of a tertiary care hospital over a period of 1 year (July 2012-June 2013). This study aimed to assess various etiologies of ARDS, to determine the correlation between the diagnostic criteria and need of mechanical ventilation, and to correlate biochemical factors with the outcome of patients.

They were assessed, investigated, and treated as per the existing practices without disturbing their routine protocol. Institute's Ethics committee approval was obtained for this study. After the valid written consent, the following data were recorded: Name, age, sex, address, diagnosis, general, and clinical examination, investigations namely complete blood count, liver function tests, renal function tests, arterial blood gas analyses, chest radiographs, details of ventilatory mode and weaning methods for patients needing mechanical ventilation, development of ventilator-associated pneumonia (VAP), and stay in the MICU. Diagnostic criteria used for ARDS/ALI were as per AECC guidelines.[13]

The parameters defined for organ failure were: Circulatory failure as systolic BP<90 mmHg, hematologic involvement as platelet count <100000, hemoglobin of <8.0 mg/dl, renal failure as serum creatinine >2 mg/dl, acidosis (pH < 7.25, bicarbonate <20 meq/l), and hepatic failure as total bilirubin >2 mg/dl.[14] We included all patients with ARDS in the study and excluded patients with cardiac failure, chronic kidney diseases with fluid overload states and age below 18 years.

Statistical Analysis

The data was analyzed using SPSS 22.0. The data was analysed using descriptive statistics and statistical inferences were expressed in the form of tables. P-values were calculated using chi- square test for comparing the outcomes in different drug groups. The level of statistical significance was set at p-value < 0.05.

RESULT

Since its recognition in 1967, a lot of clinical studies and trials have been conducted in the field of ARDS. This study attempts to establish the correlation between the clinical profile and outcome of patients with ARDS in an Indian perspective. We enrolled 56 patients, had a diagnosis of ARDS at presentation. Six patients were excluded (cardiogenic pulmonary edema, n = 2; severe ARDS, hypotension or poor mental status, n = 4) and 50 patients were included in the study. The mean age of the study population was 50.58 ± 9.36 years; 20 (40%) were women. Symptoms such as Cough 43 (86%) followed by Fever 36 (72%) were the most common symptoms of ARDS. The mean duration of illness prior to ICU presentation was 8.04 days.

Table 1: Clinical and demographic profile of the study population

Clinical and demographic profile	Total (n = 50)
Age (mean± SD; years)	50.58 ± 9.36
Female (n;%)	20 (40%)
Symptoms	
Cough (n;%)	43 (86%)
Fever (n;%)	36 (72%)
Headache (n;%)	08 (16%)
Wheezing (n;%)	11 (22%)
Biochemical Test	
Hemoglobin (mean± SD; mg/dl)	12.07 ± 2.14
Total Count (mean± SD; mm^3)	11310 ± 3949.4
Platelet Count (mean± SD; mm^3)	261600 ± 64992.6
Serum creatinine (mean± SD; mg/dl)	0.98 ± 0.29
Serum Bilirubin (mean± SD; mg/dl)	0.88 ± 0.36
ABG Report	
pH	7.28 ± 0.09
PCo_2 (mean± SD; mmHg)	50.34 ± 3.97
HCo_3 (mean± SD; mmHg)	22.85 ± 2.30
FiO_2 (mean± SD; mmHg)	72.34 ± 1.66
PaO_2/FiO_2 ratio (mean± SD)	232.83 ± 1.29
ARDS	
Extra pulmonary (n;%)	38 (76%)
Pulmonary (n;%)	12 (24%)
ICU Stay (mean± SD; days)	8.04 ± 4.01
Death (n;%)	34 (68%)

Table 2: Clinical characteristics of the NIV and IV population

Characteristics	NIV (30)	IV (20)	P value
Age (mean± SD; years)	53.66 ± 8.58	48.8 ± 10.36	0.0765
Female (n;%)	9 (30%)	11(55%)	0.1407
Biochemical Test			
Hemoglobin (mean± SD; mg/dl)	12.25 ± 1.94	11.75 ± 2.43	0.4239
Total Count (mean± SD; mm^3)	11406 ± 4141.8	11165 ± 3742.5	0.8351
Platelet Count (mean± SD; mm^3)	260500 ± 65640.4	263250 ± 65668.9	0.8852
Serum creatinine (mean± SD; mg/dl)	1.12 ± 0.33	0.93 ± 0.22	**0.0285**
Serum Bilirubin (mean± SD; mg/dl)	0.94 ± 0.43	0.79 ± 0.21	0.1547
ABG Report			
pH	7.27 ± 0.89	7.29 ± 0.30	0.9234
PCo_2 (mean± SD; mmHg)	49.56 ± 4.40	51.55 ± 4.08	0.1135
HCo_3 (mean ± SD; mmHg)	21.37 ± 3.06	23.08 ± 1.59	**0.0261**
FiO_2 (mean ± SD; mmHg)	72.26 ± 1.74	72.45 ± 1.63	0.6986
PaO_2/FiO_2 ratio (mean ± SD)	234 ± 40.5	206.2 ± 46.37	**0.0295**
ARDS			
Extra pulmonary (n;%)	24 (80%)	14 (70%)	0.6361
Pulmonary (n;%)	6 (20%)	6 (30%)	0.6361
Duration of Ventilation (mean ± SD; days)	2.71 ± 0.98	4.29 ± 2.86	**0.0073**
ICU Stay (mean± SD; days)	6.95 ± 3.13	8.73 ± 4.50	0.1311
Death (n;%)	16 (53.3%)	18 (90%)	**0.0158**

Extrapulmonary ARDS (*n* = 38, 76%) was encountered in the vast majority. The use of NIV was successful in 30 (60%) patients, while 20 (40%) patients used the invasive ventilation and required endotracheal intubation. The indications for intubation were refractory hypoxemia (*n* = 8; 16%), hypotension (*n* = 6; 12%), altered sensorium (*n* = 3; 6%), and uncorrected respiratory acidosis (*n* = 1; 2%). Overall, there were 34 (68%) deaths in the study population.

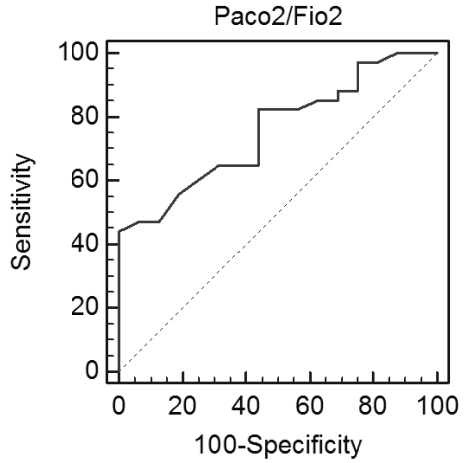

Figure 1: ROC-curve analysis have between survivals to Paco2/Fio2 ratio

The subjects were divided into two groups namely those with NIV and those IV. There was no difference in terms of age, gender distribution, symptoms between two groups. The Serum creatinine (1.12 vs. 0.93; $P < 0.05$) as a biochemical parameter; HCo_3 (21.37 vs. 23.08; $P < 0.05$) and PaO_2/FiO_2 ratio (234 vs. 206; $P < 0.05$) ABG parameters and ventilation duration (2.71 vs. 4.29; $P < 0.001$) where significantly higher of NIV to invasive mechanical ventilation. There was no difference in the ICU stay between the two groups.(Table 2).

The ROC-curve analysis have between survival to Paco2/Fio2 ratio have sensitivity = 44.1 and statistically significant (p<0.001; 95% of CI= 0.757 (0.615 to 0.867)). (Figure - 1)

DISCUSSION

Our study had focused on the etiology of ARDS and prognostic factors in such patients. As this study began before the Berlin Definition came into use, the AECC criteria had been used to enroll and classify our patients.[1] Mean ages of our study subjects was 50.58 ± 9.36 years in men and women which is closer to other studies respectively.[15-17]In this study, this would be higher environmental exposure in working males, causing more vector borne tropical infections such as malaria, leptospirosis, dengue, and undiagnosed febrile illnesses-in them with ARDS as a complication.

In present study, 86% of patients with ARDS had cough which is half of patients while fever in 100% of patients.[18,19]

A lot of controversies exist about the use of PaO_2/FiO_2ratio and its prognostic markers of the outcome in patients with ARDS. In our study, mean PaO_2/FiO_2 ratio was 232 among discharged and 187.2 among those who expired. Out of 50 patients with PaO_2/FiO_2<200, 11 expired (22%), while 23 (46%) patient out of 39 with PaO_2/FiO_2>200 expired. Among 20 patients who needed Invasive mechanical ventilation, 8 had PaO_2/FiO_2<200, whereas out of 3 patients with PaO_2/FiO_2>200, 8

patients who were primarily given a trial of NIV, ultimately progressed to ARDS with deteriorating arterial saturation, and increasing PaO_2/FiO_2ratio, eventually requiring mechanical ventilation. Hence PaO_2/FiO_2< 200 is a significant predictor of mortality and need of mechanical ventilation.[16]On the other hand, the KCLIP study confirmed significantly less mortality (P<0.001) in patients with PaO_2/FiO_2>200 (28.6%) as compared to those with the ratio <200 (41.1%).[20]

NIV use should be sensible in patients with ARDS. In a highly selected group of patients with ARDS, that is, only those with mild to moderate ARDS with two or less organ system involvement and the absence of shock at presentation, NIV accomplished success in only 44%. In addition, in the present study, 16 of the 30 subjects in the NIV group died, while there were 18 deaths in the Invasive mechanical ventilation group. This finding is reliable with previously reported experience where the hospital mortality was significantly higher in the Invasive mechanical ventilation group (53.8-100%) in comparison to the NIV group.[2,21,22] The most important reason for high mortality in ARDS patients managed with NIV, separately from refractory hypoxemia is the severe systemic illness as reflected by higher severity disease.[23] However, one cannot rule out the possibility that overzealous use of NIV led to an inadvertent delay in invasive mechanical ventilation and might have contributed to a higher mortality in this subgroup of patients.

The successful use of NIV results in the improvement of oxygenation in subjects with ARDS. EPAP with NIV, similar to positive end-expiratory pressure opens collapsed alveoli with subsequent increase in functional residual capacity and reduction of right to left shunt. This causes improvement in oxygenation, relief in dyspnea, and reduction in the respiratory muscle workload.[7,11] In a recent study describing the early use of NIV in mild ARDS, only one of the 21 patients in the NIV arm required intubation.[21] Although in a meta-analysis of thirteen studies describing the use of NIV in mild-to-moderate ARDS, NIV prevented intubation in 50% of the patients.[9]

Tropical infections followed by abdominal sepsis were the most common causes of ARDS in the current study. The predominant type of ARDS was extrapulmonary ARDS, although the type of ARDS (extrapulmonary or pulmonary) did not affect the outcome of NIV use in the current study, similar to a previous report.[24] In another study with pulmonary ARDS secondary to H1N1, NIV was successful in avoiding intubation in 48% of the subjects.[25] This suggests that irrespective of the type of ARDS (extrapulmonary or pulmonary), the use of NIV helps in avoiding intubation in roughly half of the patients.

LIMITATION

The main limitation of the study is a single center observational study comprising a small sample size and hence the results of the current study need to be confirmed in a multicenter study with a larger sample size. The study comprised predominantly of extrapulmonary ARDS and did not include subjects with severe ARDS (PaO_2/FiO_2 ratio ≤100). However, a randomized trial may not be feasible in patients with moderate-to-severe ARDS as they are likely to need some form of ventilatory support (noninvasive or invasive) rather than oxygen supplementation alone.

CONCLUSION

The major implications of our results are to easily identify hypoxemic patients who may benefit from NIV. NIV applied to 60% of ARDS while Invasive ventilation occurred in 40% of ARDS patients, and in almost one-third of patients with mild to moderate ARDS. Mortality rates in patients that Invasive ventilation were high. Of concern, NIV was associated with a worse adjusted ICU mortality than invasive-MV in patients in patients with a PaO2/FiO2 lower than 200 mmHg. These findings raise further concerns regarding NIV use in this patient group.

BIBLIOGRAPHY

1. Ranieri VM, Rubenfeld GD, Thompson BT, Ferguson ND, Caldwell E, et al. ARDS Definition Task Force. Acute respiratory distress syndrome: The Berlin Definition. JAMA. 2012;307:2526–33
2. Agarwal R, Aggarwal AN, Gupta D, Behera D, Jindal SK. Etiology and outcomes of pulmonary and extrapulmonary acute lung injury/ARDS in a respiratory ICU in North India. Chest. 2006;130:724–9.
3. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. The Acute Respiratory Distress Syndrome Network. N Engl J Med. 2000;342:1301–8.
4. Brochard L, Mancebo J, Elliott MW. Noninvasive ventilation for acute respiratory failure. EurRespir J. 2002;19:712–21.
5. Brochard L, Mancebo J, Wysocki M, Lofaso F, Conti G, Rauss A, et al. Noninvasive ventilation for acute exacerbations of chronic obstructive pulmonary disease. N Engl J Med. 1995;333:817–22.
6. Agarwal R, Gupta R, Aggarwal AN, Gupta D. Noninvasive positive pressure ventilation in acute respiratory failure due to COPD vs other causes: Effectiveness and predictors of failure in a respiratory ICU in North India. Int J Chron Obstruct Pulmon Dis. 2008;3:737–43.

7. Sharma S, Agarwal R, Aggarwal AN, Gupta D, Jindal SK. A survey of noninvasive ventilation practices in a respiratory ICU of North India. Respir Care. 2012;57:1145–53.

8. Agarwal R, Aggarwal AN, Gupta D, Jindal SK. Non-invasive ventilation in acute cardiogenic pulmonary oedema. Postgrad Med J. 2005;81:637–43.

9. Agarwal R, Aggarwal AN, Gupta D. Role of noninvasive ventilation in acute lung injury/acute respiratory distress syndrome: A proportion meta-analysis. Respir Care. 2010;55:1653–60.

10. Luo J, Wang MY, Zhu H, Liang BM, Liu D, Peng XY, et al. Can non-invasive positive pressure ventilation prevent endotracheal intubation in acute lung injury/acute respiratory distress syndrome? A meta-analysis. Respirology. 2014;19:1149–57.

11. Agarwal R, Handa A, Aggarwal AN, Gupta D, Behera D. Outcomes of noninvasive ventilation in acute hypoxemic respiratory failure in a respiratory intensive care unit in north India. Respir Care. 2009;54:1679–87.

12. Agarwal R, Nath A, Gupta D. Noninvasive ventilation in Plasmodium vivax related ALI/ARDS. Intern Med. 2007;46:2007–11.

13. Bernard GR, Artigas A, Brigham KL, Carlet J, Falke K, Hudson L, et al. The American-European Consensus Conference on ARDS. Definitions, mechanisms, relevant outcomes, and clinical trial coordination. Am J RespirCrit Care Med 1994;149:818-24

14. Members of the American College of Chest Physicians/Society of Critical Care Medicine Consensus Conference Committee. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. Crit Care Med 1992;20:864-74.

15. Estenssoro E, Dubin A, Laffaire E, Canales H, Sáenz G, Moseinco M, Pozo M, Gómez A, Baredes N, Jannello G, Osatnik J. Incidence, clinical course, and outcome in 217 patients with acute respiratory distress syndrome. Critical care medicine. 2002;30(11):2450-6.

16. Zilberberg MD, Epstein SK. Acute lung injury in the medical ICU: comorbid conditions, age, etiology, and hospital outcome. American journal of respiratory and critical care medicine. 1998 Apr 1;157(4):1159-64.

17. Irish Critical Care Trials Group. Acute lung injury and the acute respiratory distress syndrome in Ireland: a prospective audit of epidemiology and management. Critical care. 2008;12(1):R30.

18. Siau C, Law J, Tee A, Poulose V, Raghuram J. Severe refractory hypoxaemia in H1N1 (2009) intensive care patients: initial experience in an Asian regional hospital. Singapore Med J. 2010 Jun 1;51(6):490-5.

19. Thomas W. K. Lew et al. Acute Respiratory Distress Syndrome in Critically Ill Patients With Severe Acute Respiratory Syndrome, JAMA. 2003;290(3):374-380.

20. Rubenfeld GD, Caldwell E, Peabody E. Incidence and outcomes of acute lung injury. N Engl J Med 2005;353:1685-93