ORIGINAL ARTICLE

ROLE OF VENTILATION IN CASES OF ACUTE RESPIRATORY DISTRESS SYNDROME /ACUTE LUNG INJURY

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ABSTRACT

Introduction: Acute lung injury (ALI) and Acute Respiratory Distress Syndrome (ARDS) are characterized by refractory hypoxemia that develops secondary to high-permeability pulmonary edema. These syndromes are gaining more attention as a means of better comprehending the pathophysiology of ARDS and possiblyfor modifying ventilatory management. In this context a study was done to compare role of invasive and non-invasive ventilation in cases of ARDS/ALI.

Methods: in this study patients of ARDS admitted in intensive care ward due to Pulmonary and Extra Pulmonary Sepsis (Lung Injury) during May 2008 to April 2011were included in the study. All the patients were clinically examined and investigated after taking informed consent. Traumatic patients with ARDS were excluded from study.

Results: In this study of 100 cases of ARDS/ALI admitted in ICU, all 44 cases on non-invasive ventilation were improved. Whereas, out of 44 cases on invasive ventilation only 5 improved and 39 were expired. Rest 12 required no ventilator support.

Conclusion: Early application of Non-invasive ventilation in patients of ARDS/ALI, in form of high PEEP and low Tidal Volume, which helps in clearance of secretion and prevents collapse of alveoli and thereby decreases need of invasive ventilation as well as decreases the mortality due to ARDS/ALI;and thereby 100% chances of improvement. In invasive ventilation, outcome of the patients is not favorable.

Keywords: ARDS, Ventilation, ALI, ICU

INTRODUCTION

Acute lung injury (ALI) and ARDS are characterized by refractory hypoxemia that develops secondary to high-permeability pulmonary edema. These syndromes can occur even without primary damage to the lung parenchyma, and thus they are now more often being classified as ALI/ARDS resulting from pulmonary causes (ALI/ARDS) or extra pulmonary causes (ALI/ARDS) according to the mechanism of lung insult. Lung injuries of different origins may have possible differences in patho-physiology, lung morphology, radiology, respiratory mechanics, and response to different management strategies. Also, this distinction between a direct etiology of lung injury (*i.e.*, ALI/ARDS) and an indirect etiology of lunginjury (*i.e.*, ALI/ARDS) is gaining more attention as a meansof better comprehending the pathophysiology of ARDS and possiblyfor modifying ventilatory management.

Clinical disorders commonly associated with ARDS[4] are classified in direct and indirect disorders leading to lung injury. Clinical disorders commonly associated with direct lung injuries are Pneumonia, Aspiration of gastric contents, Pulmonary contusion, Near-drowning and Toxic inhalation injury. Clinical disorders commonly associated with indirect lung injuries are Sepsis , Severe trauma, Multiple bone fractures, Flail chest, Head trauma, Burns, Multiple transfusions, Drug overdose, Pancreatitis and Post-cardiopulmonary bypass.

Noninvasive ventilation: Because intubation and mechanical ventilation may be associated with an increased incidence of complications, such as barotrauma and nosocomial pneumonia, noninvasive ventilation by means of a full face mask attached to a ventilator delivering continuous positive airway pressure (CPAP) with or without ventilator breaths or inspiratory pressure support (i.e., noninvasive positive pressure ventilation (NIPPV) in patients with milder ARDS may be advantageous.

Mechanical ventilation: The goals of mechanical ventilation in ARDS are to maintain oxygenation while avoiding oxygen toxicity and complications of mechanical ventilation. Generally, maintain oxygen saturations in the range of 85-90%, with a goal of diminishing inspired oxygen concentrations to less than 65% within the first 24-48 hours. This almost always necessitates the use of moderate-to-high levels of PEEP.

Mechanical ventilation may promote the development of acute lung injury. Evidence now indicates that a protective ventilation strategy using low tidal volumes improves survival rates compared with conventional tidal volumes.

Mechanical ventilation with a tidal volume 6 ml/kg predicted body weight is recommended, with adjustment of the tidal volume to as low as 4 ml/kg if needed to limit the inspiratory plateau pressure to 30 cm H2O or less. Increase the ventilator rate and administer bicarbonate as needed to maintain the pH at a near normal level (7.3)

METHODS

This study consists of all cases of ARDS which were admitted in ICU during May 2008 to April 2011. All the patientswere clinically examined thoroughly and necessary laboratory investigationswere carried out.An informed consent was obtained fromall patients or their relatives as per the ICU protocol.All Patient of ARDS admitted in intensive care ward due to Pulmonary and Extra Pulmonary Sepsis (Lung Injury) were included in the study. Traumatic patients with ARDS were excluded from study. In this context a study was done to compare role of invasive and non-invasive ventilation in cases of ARDS/ALI.

Following diagnostic criteria were used for ALI and ARDS.[4]

Oxygenation ALI:Pa_{O2}/FI_{O2} <300 mmHg; ARDS: Pa_{O2}/FI_{O2} <200 mmHg
Onset: Acute
Chest Radiograph: Bilateral alveolar or interstitial infiltrates
Absence of Left Atrial Hypertension: PCWP <18 mmHg *or* no clinical evidence of increased left atrial pressure

RESULTS

Total 100 cases were included in the study. Following tables shows characteristics of the patients.

In our study most common causes of direct lung injury was 57 % pneumonia, 42% Swine Flu, 32% Leptospirosis, and others include aspiration pneumonia 4%.

Most common causes of Indirect lung injury was 43 % Septicemia, 5% P. Viavax, 2% Hepatitis E, 1% P. Falciparum and 1% HIV.

In our study 100% of patients with ARDS/ALI had Breathlessness, 99% had Fever. Cough was a predominant symptom, observed in 99%. Myalgia was also common, seen in 32%, Hemoptysis, Jaundice, Running Nose observed in 30% of patients & Decreased Urine was seen in 28% of patients. Throat pain & Chest pain was observed in 24% & 21% of patients respectively. Only 2 patients had altered conscious.

Table 1: Causes of ARDS/ALI in study participants (n=100)

	Cases
Direct Causes of ARDS/ALI	
Infective Pneumonia	57
Swine Flu(H1N1)	42
Leptospirosis	32
Aspiration Pneumonia	4
Indirect Causes of ARDS/ALI	
Septicemia	43
P. Viavax	5
P.Falciparum	1
Hepatitis E	2
HIV	1

Table 2: Clinical Features in cases of ARDS/ALI (n=100)

Clinical features	Cases in Percentage
Breathlessness	100%
Fever	99%
Cough	99%
Myalgia	32%
Hemoptysis	30%
Jaundice	30%
Running Nose	30%
Oliguria	28%
Throat pain	24%
Chest Pain	21%
Altered Conscious	2%

Table 3: Co-Morbid Factors in study cases (n=100)

Co-Morbid Factors	Cases
Alcoholic	27
Smoker	12
Pregnancy	5
Diabetes Mellitus	4
PLWA	1
Others	13
No Risk factors	38

Above table shows 27 no. of cases are Alcoholic, 12 no. of cases are Smoker, 5 no. of cases are Pregnant, 4 no. of cases are Diabetes mellitus.1 no. of cases are PlWA, others are IHD, HT, TB.

Table 4: Relation to risk factor and Ventilator (Invasive / Non Invasive) with Outcome (n=100)

Risk factor	IPPV	NIV	O2	Expired	Improved	Total
Alcoholic	21	5	1	19	8	27
Smoker	0	10	2	0	12	12
Pregnancy	3	1	1	3	2	5
DM	1	2	1	1	3	4
PLWA	1	0	0	0	1	1
Others(HT,IHD,TB)	1	7	5	0	13	13

As mentioned in above table, highest mortality seen in alcoholic and pregnant patient. About CO2 level – that is only for COPD patient or History of smoking, in that patient Co2 level decide type of ventilator. In our study patient started on NIV, then if required then only put on invasive ventilation.

Table 5: Systemic Examination of study patients (n=100)

	Cases in %
RS Auscultation	
Bil Creps +	81%
Lt. Creps +	5%
Rt. Creps +	13%
Bil Rhonchi +	1%
CVS Auscultation: S1 S2 Heart Sounds	
Tachycardia	56
Normal	44
Abdominal System: Palpationof Organ	
Liver	30
Spleen	15
CNS Examination	
Consciousness	98
Unconsciousness	2

In this study vital parameters of study cases showed that 87% had Tachypnea, 56% had Tachycardia and 25% had Hypotension.

In this study it was found on general examination that 98 cases was Conscious, 30 cases had Icterus, 13 cases had Pallor and 2 cases had unconsciousness. No one pt. had on general examination like Cyanosis, Raised JVP, Pedal edema and Clubbing.

Above table shows on RS Auscultation 81% pt. had Bilateral Creps +, 13% pt. had Rt.Creps +, 5% pt. had Lt. Creps+, Only 1% pt. had Bilateral Rhonchi +. S1S2 heart sounds revealed that Tachycardia was in 56% cases and normal in44%. There was no finding suggestive of Pericardial effusion, Myocarditis. Liver was palpable in 30% and Spleen on 15% cases. CNS Examination revealed that 98% were conscious patients and 2% unconscious. So, systemic examination revealed that RS system was most commonly affected.

Table 6 shows that 95 cases had PaO2/fiO2 <300, 5 cases had PaO2/fiO2 <200. Total 43 cases had patchy infilterates, 30 cases had bilateral Consolidation, 18 cases had Rt. lung Consolidation, 7 cases had Lt. lung Consolidation and 2 cases had Paracardiac Consolidation.

Hemogram (CBC): The study showed that 54 cases had Hemoglobin between 8 to 12 gm/dl, 43 cases had WBC count between 4000-10500/cmm, 50 cases had platelet count between 150000-450000/cmm and 58 cases had s.creatinine less that 1.2 mg/dl.

Other Investigation: In our study shows 83 no. of cases had RBS between 60-140 mg/dl, 4 no. of cases had RBS <60 mg/dl, 13 no. of cases had RBS >140 mg/dl. The study shows 63 no. of cases had S. Bilirubin <1.0 mg/dl, 12 no. of cases had S. Bilirubin between 1.-10.0mg/dl, 15 no. of cases had S. Bilirubin between 10-20 mg/dl, 10 no. of cases had S. Bilirubin >20 mg/dl. Our study shows 94 no. of cases absent Malaria parasite on peripheral smear, 5 no. of cases P. Vivax on peripheral smear, 1 no. of cases P. Falciparum on peripheral smear. Our study shows 56 no. of cases had Sinus Tachycardia, 42 no. of cases had WNL, 1 no. of cases had LVH, 1 no. of Cases had QS V1-V4.

Table 6: Investigation of Study cases (n=100)

	Cases
Arterial Blood Gas Analysis(ABGA)	
PaO2/fiO2 <300	95
PaO2/fiO2 <200	5
Chest X- Ray Finding	
Patchy infiltrates	43
Bilateral Consolidatiom	30
Rt. Lung Consolidation	18
Lt. Lung Consolidation	7
Paracardiac consolidation	2
Hemoglobin level	
4-8 gm/dl	13
8-12 gm/dl	54
12-15 gm/dl	32
>15 gm/dl	1
White Blood Cell count	
<4000/cmm	17
4000-10500/cmm	43
10500-20000/cmm	25
>20000/cmm	15
Platelet Count	
<50000/cmm	14
50000-100000/cmm	16
100000-150000/cmm	17
150000-450000/cmm	50
>450000/cmm	3
S. Creatinine level	
<1.2 mg/dl	58
1.2-2.0 mg/dl	13
2.0-5.0 mg/dl	18
>5.0 mg/dl	11

Table 7: Types of Ventilation versus Outcome

	Expired	Improved	Total
Invasive	39	5	44
Non – invasive	0	44	44
Oxygen	0	12	12

P value <0.001 (by using x^2 test)

Table 7 shows that out of 44 Cases on Invasive ventilation 39 no. of cases was Expired, out of 44 no. of Cases on Non - Invasive ventilation all were improved, out of 12 no. of Cases on Oxygen were Improved.

DISCUSSION

In our stydy majority of cases causes of ALI/ARDS was direct lung injury i.e. Pneumonia was 57 %. & this observation was correlated by Marya D., Zilberberg, Scott K. Epstein.[13] Was 49%, Ritesh Agrawal, Asutosh N. Agrawal[7] was 68%, Aljendro C. Arroliga., Ziad W. Ghamra.[14] was 75% & also by Andrew D. Bersten,

Cyrus Edibam[15] was 57%. Pneumonia most common cause of Direct lung injury. In our study majority of cases causes of ALI/ARDS was not direct lung injury & this observation was correlated by Marya D.,Zilberberg,Scott K. Epstein.[13] Was 51%, RiteshAgrawal,Asutosh N. Agrawal[7] was 32%, Aljendro C. Arroliga., ZiadW.Ghamra.[14] was 25% and also by Andrew D.Bersten, Cyrus Edibam[15] was 45%. Septicemia was most common cause of indirect lung injury. In our study, 99% of patients with ALI/ARDS had fever. It is corelated by study Thomas W. K. Lew, Tong-KiatKwek.[16] with fever as a major clinical feature in 95.7% of patients. Study by Siau C, Law J, Tee A.[8] also shows fever in 92% of his cases.

In our study, 99% of patients with ALI/ARDS had cough. It is corelated by study by Siau C, Law J, Tee A.[8] also shows fever in 100% of his cases. Study by Thomas W. K. Lew, Tong-KiatKwek.[16] with cough as a major clinical feature in 50% of patients.

In our study, 100% of patients with ALI/ARDS had breathlessness. It is correlated by study by Siau C, Law J, Tee A.[8] also shows fever in 64% of his cases. Study by Thomas W. K. Lew, Tong-KiatKwek.[16] with breathlessness as a major clinical feature in 34.8% of patients.

In our study, 32% of patients with ALI/ARDS had myalgia. It is correlated by study Thomas W. K. Lew, Tong-Kiat Kwek.[16] with myalgia as a major clinical feature in 26.1% of patients.

In our study, 99% of patients with ALI/ARDS had fever. Fever is due to septicaemia, infection. In our study, 99% of patients with ALI/ARDS had cough. Cough is due to secretion in bronchial tree.

In our study, 100% of patients with ALI/ARDS had breathlessness. Breathlessness is due to underlying structural lung disease.

In our study, 27% of patients with ALI/ARDS had histoy of Alcohol drinking. It is supported by study by Marc moss, Beckibucher. [10] Was 43%. A also shows Study by Carlos Iribarren, David R. Jacobs.[11]& Terri Ten Hoor, David M. Manino.[12] 57% & 19.4% respectively.

In our study, 12% of patients with ALI/ARDS had histoy of Smoking. It is supported by study Carlos Iribarren, David R. Jacobs.[11]& Terri Ten Hoor, David M. Manino.[12] 18% & 33% respectively.

In our present study shows 4% had DM which is similar to Chacko J.,Gagan B.,Radha M. [6] shows 9.7% had DM.

In our present study shows 5% had Pregnant which is similar to Chacko J.,Gagan B.,Radha M. [6] shows 9.7% had Pregnant.

In our study, 27% of patients with ALI/ARDS had histoy of Alcohol drinking. Alcohol abuse is associated hepatic dysfunction, and liver is key organ in several host-defence system relevant to pathogenesis and perpetuation of acute lung injury. This study demonstrates that prior history of chronic alcohol abuse significantly increases the risk of ARDS.[10]

In our study, 12% of patients with ALI/ARDS had histoy of Smoking. The main finding of the study was an independent dose-response association between current cigarette smoking and the subsequent hospital presentation of ARDS.[11] This predictive association may be here, are more likely to develop acute precipitating factor of ARDS such as pneumonia, sepsis syndrome, or injury, and/or to undergo digestive or cardiopulmonary surgery.[17,18] These causal pathways are also supported by evidence of impaired immunocompetence in smokers.[18]

In our present study shows 4% had Diabetes Mellitus & 5% had Pregnant. Diabetes mellitus & Pregnancy both are immunocompromised condition. So, higher risk of development of ARDS/ALI.

In our study shows 95 no. of cases had PaO2/fiO2 <300, 5 no. of cases had PaO2/fiO2 <200. Other study shows Ritesh Agrawal, Asutosh N. Agrawal[7] 68% had ALI (PaO2/fiO2 <300) and 32% had ARDS (PaO2/fiO2 <200).

On this study we conclude that initial part of ARDS spectrum was ALI that progress to ARDS. In our study shows in Chest X-Ray finding is Patchy infiltrate 43% and consolidation is 57%. Other study shows CxR finding by Siau C, Law J, Tee A.[8] was 100% consolidation &Russell R. Miller III, Boaz A. Markewitz.[9] was 91% patchy infiltrates.

That shows in ALI/ARDS lung involvement is 100% and Direct lung injury causes consolidation & Indirect lung injury causes patchy infiltrates. Both findings on CxR are responsible for Hypoxia & Tachypnea. In our study mean Hb was 10.86 gm/dl. In one study Chacko J.,Gagan B.,Radha M. [6]mean Hb was 13.5 g,/dl.

Low Hb are associated with poor outcome. In our study 10% cases expired with low Hb due to septicaemia, hemolysis due to infections. As compared by Chacko J.,Gagan B.,Radha M.[6] in which TC<4000/cmm was 29% & TC>11000/cmm was 22.6%, A study by Alan M. Fein, Michael Lippmann[20] in which TC<4000/cmm was 10% & TC>11000/cmm was 48%.

On this our conclude that 57% had septicaemia one the most important cause of indirect lung injury.In our study mean platelet count was 178000/cmm. That was correlated by Chacko J.,Gagan B.,Radha M.[6] in which mean platelet count was 158000/cmm. In our study 30 % had platelet count <100000/cmm. In that study Alan M. Fein, Michael Lippmann[20] had platelet count <100000/cmm was 62%.

This shows Thrombocytopenia is due to septicaemia. Platelet transfusion not given to any patient because no pt. had any bleeding and platelet count increase on after treatment. In our study observation is 44% pt. on Non Invasive Ventilation(NIV), 44% pt. on Invasive ventilation & 12% pt. on Oxygen.

CONCLUSION

We conclude that early application of Non invasive ventilation decreases chances of invasive ventilation as well as decreases the mortality due to ARDS/ALI.

With the application of High PEEP and Low Tidal volume increases survival rate in ARDS/ALI.In our study most common reason shift NIV to Invasive ventilation was that pt. not maintaining SpO2, next was poor respiratory effort, less reason was pt. not tolerate with Non-Invasive ventilation.

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