

The Effect of Prone Positioning on the Hemodynamics in Children with Acute Respiratory Distress Syndrome

Thesis

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List of Contents

	Page
Acknowledgment	--
List of Abbreviations	i
List of Figures	ii
List of Tables	iv
Introduction	1
Aim of The Study	5
Review of Literature	6
Chapter 1 : Acute respiratory distress syndrome	6
Chapter 2 : Prone positioning in ARDS.....	33
Chapter 3 : Non-invasive hemodynamic monitoring of critically ill patients	43
Patients and Methods	61
Results	77
Discussion	114
Summary	126
Conclusion	130
Recommendations	131
References	132
Arabic Summary	-

ABSTRACT

Background: Prone positioning (PP) has been used for many years in patients with acute respiratory distress syndrome (ARDS). The initial reason for prone positioning in ARDS patients was improvement in oxygenation. Hemodynamic response to PP has never been studied in a large series of patients with ARDS.

Aim of the study: to determine the effects of prone positioning (PP) on the hemodynamics in children with Acute Respiratory Distress Syndrome (ARDS).

Patients and methods: This is a prospective observational study which was conducted on 50 patients their age ranged 2-48 months admitted to the Pediatric Intensive Care Units (PICUs) of Ain Shams University Hospitals with ARDS. Prone positioning was applied to mechanically ventilated patients with ARDS fulfilling Pediatric Acute Lung Injury Consensus conference 2015(PALICC).The patients were subjected to measuring hemodynamic parameters(cardiac index, systemic vascular resistance index, ejection fraction, pulmonary pressure, IVC distensibility index) and respiratory mechanics (mean airway pressure, respiratory rate, PEEP, tidal volume, compliance, delta P and frequency) and calculating oxygenation indices(oxygenation index, oxygen saturation index) in supine then after 2,6,12and 16hrs prone positioning.

Results: Hemodynamic study revealed a significant increase in pulmonary pressure (21.2 ± 9.4 mmHg) in supine and (23.3 ± 9.5 mmHg) in prone position after 16hrs. There was a significant increase in IVC distensibility index (19.2 ± 16.4) in supine and (27.4 ± 20.3) after 16hrs prone position which indicated fluid resuscitation at that time. Oxygenation indices revealed oxygenation improvement by prone position. There was a significant decrease in FIO₂ in supine ($62.8 \pm 13.1\%$) and ($53.9 \pm 14.5\%$) after 16hrs prone position. A significant improvement in oxygenation index (15.1 ± 8.9) in supine versus (9.4 ± 7.3) after 16hrs prone position was elicited.

Conclusion: In this study, prone position showed oxygenation improvement in children with ARDS. Prone position can be applied safely for extended periods up to (16 hours) with close hemodynamic monitoring.

Key Words: acute respiratory distress syndrome, prone position, hemodynamic monitoring.

List of Abbreviations

ABG	: Arterial blood gases
AECC	: American-European Consensus Conference
AKI	: Acute kidney injury
AKIN	: Acute kidney injury network
ALI	: Acute lung injury
ARDS	: Acute respiratory distress syndrome
AV	: Aortic valve
BP	: Blood pressure
BSA	: Body surface area
CBC	: Complete blood count
CI	: Cardiac index
CO	: Cardiac output
CPAP	: Continuous positive airway pressure
CPR	: Cardiopulmonary resuscitation
CRT	: Capillary refilling time
CSA	: Cross-sectional area
C _{stat}	: Static compliance
CT	: Computed tomography
CV	: Central vein
CVP	: Central venous pressure
CW	: Colour wave
CXR	: Chest X-ray
D _{max}	: Maximum diameter
D _{min}	: Minimum diameter
DIVC	: Inferior vena cava distensibility index
ECG	: Electrocardiography
Echo	: Echocardiography
ECMO	: Extracorporeal membrane oxygenation
EF	: Ejection fraction

ETT	: Endotracheal tube
FIO2	: Fractionated inspired oxygen
FS	: Fraction shortening
GCS	: Glasgow coma scale
Hb	: Hemoglobin
HFOV	: High frequency oscillatory ventilation
HR	: Heart rate
Hrs	: Hours
IAP	: Intra-abdominal pressure
ICP	: Intracranial pressure
ICU	: Intensive care unit
IL-1	: Interlukin 1
IL-6	: Interlukin 6
IL-8	: Interlukin 8
iNO	: Inhaled nitric oxide
IVC	: Inferior vena cava
IVP	: Intravesical pressure
KDIGO	: Kidney disease improving global outcome
LOS	: Length of stay
LV	: Left ventricle
LV	: Left ventricle
LV	: Left ventricle
LVEDD	: Left ventricular end diastolic diameter
LVESD	: Left ventricular end systolic diameter
LVO	: Left ventricular output
LVOT	: Left ventricular outflow tract
MAP	: Mean airway pressure
Max	: Maximum
MV	: Mechanical ventilation
NMB	: Neuromuscular blocker
NS	: Non significant
O2	: Oxygen

OI	: Oxygenation index
OSI	: Oxygen saturation index
P/F	: PaO ₂ /Fio ₂
P+	: Pulmonary pressure
PALICC	: Pediatric acute lung injury consensus conference
PaO ₂	: Arterial partial pressure of oxygen
PAP	: Pulmonary artery pressure
PARDS	: Pediatric Acute Respiratory Distress Syndrome.
Paw	: Airway pressure
PEEP	: Positive end expiratory pressure
PICU	: Pediatric intensive care unit
PLAX	: Parasternal long axis
PLT	: Platelet
PP	: Prone position
P _{PLAT}	: Plateau pressure
PSAX	: Parasternal short axis
PVR	: Pulmonary vascular resistance
PW	: Pulse wave
RA	: Right atrium
RAP	: Right atrial pressure
RCT	: Randomized controlled trial
RIFLE	: Risk, Injury, Failure, Loss of function, End stage kidney stage
RR	: Respiratory rate
RV	: Right ventricle
RV	: Right ventricle
RVO	: Right ventricular output
S/F	: SPO ₂ /Fio ₂
S	: Significant
ScVO ₂	: Central venous oxygen saturation
SD	: Standard deviation
Sig.	: Significance

SIMV	: Synchronized intermittent mandatory ventilation
SOFA	: Sequential organ function assessment
SPO2	: Oxygen saturation
SPSS	: Statistical package for social science
SV	: Stroke volume
SVC	: Superior vena cava
SVO2	: Mixed venous oxygen saturation
SVRI	: Systemic vascular resistance index
TLC	: Total leucocytic count
TNF	: Tumor necrosis factor
TR	: Tricuspid regurge
TRALI	: Transfusion related acute lung injury
TV	: Tidal volume
VILI	: Ventilator induced lung injury
VIS	: Vasoactive inotropic score
VTI	: Velocity time integral
V/Q	: Ventilation/perfusion

List of Figures

Fig.	Title	Page
1	Chest x ray of patient with ARDS.	14
2	Chest ultrasound showing various stages of increasing severity in alveolar-interstitial syndrome.	15
3	Chest ultrasound of a case with ARDS.	16
4	CT chest with typical features of ARDS.	18
5	CT chest for evaluation of ARDS.	19
6	Comparison of diagrammatic lung in supine and prone position.	35
7	Pulmonary perfusion in supine and prone position.	36
8	Placing a patient in prone position.	41
9	CT chest of a patient with ARDS in supine and prone position.	42
10	CVP measurement.	51
11	Inferior vena cava (IVC) changes during the respiratory and cardiac cycles	54
12	Assessment of left ventricular output on echocardiography.	56
13	Electrical cardiometry.	57
14	Left ventricular study in PLAX and PSAX.	59
15	Measuring CVP.	64
16	Measuring intra-abdominal pressure indirectly by measuring IVP.	65
17	Hamilton C1 ventilator.	68
18	SLE 5000 high frequency oscillation ventilator.	69
19	Applying patient with ARDS in prone position.	71
20	Samsung HM70A Ultrasound System.	73
21	Ejection fraction(EF) Using single measurements of the LV cavity in the mid-ventricle in both end-diastole and end-systole in (PLAX view) using M-mode.	73

Fig.	Title	Page
22	The IVC was examined sub-costally in longitudinal section.	73
23	Sex distribution among the studied group.	77
24	Etiology of ARDS.	78
25	Subdivision of the studied group.	79
26	Comparison of vital data in supine and prone position (PP) 2,6,12 and 16hrs	87
27	Comparison of Systemic vascular resistance index (SVRI) and cardiac output(COP)in supine and during prone position.	88
28	Comparison of hemodynamic parameters in supine and during PP.	89
29	Comparison of significant vital data and hemodynamic parameters in supine and during PP.	95
30	Comparison of significant oxygenation indices and respiratory mechanics in supine and during PP.	98
31	Success and failure group.	103
32	Failure criteria.	105
33	Significant ABG and oxygenation indices between success and failure group.	108
34	Significant mechanical ventilation parameters between success and failure group.	109
35	Complications during prone position.	110
36	Patients' Co-morbidity.	110
37	Fate and Mortality among the studied group.	111
38	Prevalent organisms in blood and sputum cultures of the studied patients	112

List of Tables

Table	Title	Page
1	Oxygenation index and outcome.	9
2	Interpretation of oxygen saturation index and oxygenation index.	9
3	Definition of Pediatric ARDS.	10
4	Current evidence and recommendations for Pediatric respiratory distress syndrome therapies.	30
5	Diagnostic criteria and main difference between RIFLE, AKIN and KDIGO systems.	46
6	The pediatric Glasgow coma scale.	47
7	Clinical correlation of SVO2.	50
8	The severity of the hypoxemia defines the severity of the ARDS	62
9	Pediatric SOFA score.	66
10	Interpretation of SOFA score.	67
11	48hrs SOFA score trend.	67
12	Gender distribution among the studied group.	77
13	Demographic data of the studied population.	78
14	Degree and causes of ARDS and incidence of septic shock in the studied population.	78
15	Vital parameters of the studied group were done initially in supine position.	79
16	Mechanical ventilation parameters among patients initially in supine position.	80
17	Initial ABG parameters and Oxygenation indices.	80
18	Hemodynamic parameters initially in supine position.	81
19	Vital data and hemodynamic parameters after 2hrs prone position.	81
20	Vital data and hemodynamic parameters in prone position 6hrs.	82

Table	Title	Page
21	Vital data and hemodynamic parameters in prone position 12hrs.	82
22	Vital data and hemodynamic parameters in prone position 16hrs.	83
23	Mechanical ventilation, ABG parameters and oxygenation indices after 2hrs prone position.	84
24	Mechanical ventilation, ABG parameters and oxygenation indices after 6hrs prone position.	85
25	Mechanical ventilation, ABG parameters and oxygenation indices after 12hrs prone position.	85
26	Mechanical ventilation, ABG parameters and oxygenation indices after 16hrs prone position.	86
27	Vital data in supine and prone position 2, 6, 12 and 16hrs.	87
28	Hemodynamic parameters in supine and during prone position.	88
29	Comparison among significant vital and hemodynamic parameters in supine and 2hrs prone position.	90
30	Comparison among significant vital and hemodynamic parameters in supine and 6hrs prone position.	90
31	Comparison among significant vital and hemodynamic parameters in supine and 12hrs prone position.	91
32	Comparison among significant vital and hemodynamic parameters in supine and 16hrs prone position.	91
33	Comparison among significant vital and hemodynamic parameters in 2hrs and 6hrs prone position.	92

Table	Title	Page
34	Comparison among significant vital and hemodynamic parameters in 2hrs and 12hrs prone position.	92
35	Comparison among significant vital and hemodynamic parameters in 2hrs and 16hrs prone position.	93
36	Comparison among significant vital and hemodynamic parameters in 6hrs and 12hrs prone position.	93
37	Comparison among significant vital and hemodynamic parameters in 6hrs and 16hrs prone position.	94
38	Comparison among significant vital and hemodynamic parameters in 12hrs and 16hrs prone position.	94
39	Mechanical ventilation parameters in supine and during prone position.	96
40	ABG parameters and oxygenation indices in supine and during prone position.	97
41	Comparison among significant respiratory mechanics and oxygenation parameters in supine and 2hrs prone position.	98
42	Comparison among significant respiratory mechanics and oxygenation parameters in supine and 6hrs prone position.	99
43	Comparison among significant respiratory mechanics and oxygenation parameters in supine and 12hrs prone position.	99
44	Comparison among significant respiratory mechanics and oxygenation parameters in supine and 16hrs prone position.	100
45	Comparison among significant respiratory mechanics and oxygenation parameters in 2hrs & 6hrs prone position.	100

Table	Title	Page
46	Comparison among significant respiratory mechanics and oxygenation parameters in 2hrs & 12hrs prone position.	101
47	Comparison among significant respiratory mechanics and oxygenation parameters in 2hrs & 16hrs prone position.	101
48	Comparison among significant respiratory mechanics and oxygenation parameters in 6hrs & 12hrs prone position.	102
49	Comparison among significant respiratory mechanics and oxygenation parameters in 6hrs & 16hrs prone position.	102
50	Comparison among significant respiratory mechanics and oxygenation parameters in 12hrs & 16hrs prone position.	103
51	Comparison between success and failure group as regard demographic data.	104
52	Comparison between success and failure group as causes of ARDS and comorbidities.	104
53	Initial severity of illness (SOFA score) and laboratory findings.	106
54	Comparison among initial vital data between success and failure group.	106
55	Comparison among initial hemodynamic parameters between success and failure group	107
56	Initial ABG and oxygenation indices in success and failure group.	107
57	Initial respiratory parameters between success and failure group.	108
58	Complications during Prone position	109
59	Patients' fate and mortality.	111
60	Length of stay (LOS) in PICU.	111