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

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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±9.4mmHg) in supine and (23.3±9.5mmHg) 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±13.1%) and (53.9±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	:	PaO2/Fio2
P+	:	Pulmonary pressure
PALICC	:	Pediatric acute lung injury consensus conference
PaO2	:	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	:	SPO2/Fio2
S	:	Significant
ScVO2	:	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

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