Global Journal of Medical Research: D
Radiology, Diagnostic Imaging and Instrumentation
Volume 14 Issue 3 Version 1.0 Year 2014
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

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Abstract- Background: Diagnostic criteria for acute lung injury(ALI) and ARDS requiring acute onset of disease, chest radiograph demonstrating bilateral pulmonary infiltrates, lack of significant left ventricular dysfunction and $\frac{Pao_2}{Fio_2}$ (PF) ratio ≤ 300 for ALI or ≤ 200 for ARDS. recent criteria is requiring invasive arterial sampling.

The pulse oximetric saturation Spo_2/Fio_2 (SF) ratio may be a reliable non invasive alternative to the PF ratio.

Methods: In this cross sectional study, Enrolled 70 patient ALI or ARDS that Admitted in Tabriz children's hospital PICU. Included in the analysis were corresponding measurement of Spo_2, Fio_2, Pao_2, charted within 5 min of each other And computed SF and PF to determine the relationship between SF and PF ratio.

Keywords: *ARDS, A ALI, $\frac{pao_2}{Fio_2}$, pulse oximetry.*

GJMR-D Classification : *NLMC Code: WS 280, WF 651*

COMPARISONOFTHESPO2FIO2 RATIOANDTHEPAO2FIO2 RATIOINPATIENTSWITHACUTELUNGINJURYORACUTERESPIRATORYDISTRESSSYNDROME

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Nemat Bilan [α], Azar Dastranji [σ] & Afshin Ghalehgolabbehbahani [ρ]

Abstract- Background: Diagnostic criteria for acute lung injury(ALI) and ARDS requiring acute onset of disease, chest radiograph demonstrating bilateral pulmonary infiltrates, lack of significant left ventricular dysfunction and $\frac{Pao_2}{Fio_2}$ (PF) ratio $\leq$300 for ALI or $\leq$200 for ARDS. recent criteria is requiring invasive arterial sampling.

The pulse oximetric saturation Spo_2/Fio_2 (SF) ratio may be a reliable non invasive alternative to the PF ratio.

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Results: The relationship between SF and PF ratio was described by the following regression equation SF=57+0/61PF (P<0/001). SF ratios of 181 and 235 corresponded of PF ratio 300 and 200. The ALI SF cutoff of 235 had 57% sensitivity and 100% specificity, and ARDS, SF cutoff of 181 had 71% sensitivity and 82% specificity.

Conclusion: SF ratio is a reliable noninvasive marker for PF ratio to identify children with ALI or ARDS and can be replaced pulse oximetry by arterial blood sampling.

Keywords: *ARDS, ALI,* $\frac{pao_2}{Fio_2}$ *, pulse* oximetry.

Abbreviations: ***Pao₂**: Arterial partial pressure of oxygen* , ***Spo₂**: pulse Oximetric oxygen saturation,* ***ARDS:** Acute Respiratory Distress syndrome,* ***ALI:** Acute lung injury,* ***Fio₂**: Fraction of inspiratory oxygen,* ***SF**=* $\frac{spo_2}{Fio_2}$ *ratio ,* ***PF**=* $\frac{Pao_2}{Fio_2}$ *ratio ,**ABG**= Arterial blood gas analysis,* ***PICU**=Pediatric Intensive Care unit,* ***Paco₂**. Arterial partial pressure of carbon dioxid,* ***Sao₂**= Arterial oxygen saturation.*

I. Introduction

Acute lung injury and ARDS are terrible syndromes with high mortality and morbidity [1-2]. It is estimated that 30 to 60% of all PICU admitted patient require mechanical ventilation and of these patient up to 25% may have ALI and 5 to10% may have ARDS. With the implementation of lung-protective ventilation strategies overall morbidity and mortality have improved signify-cantly for both adult and children with ALI and ARDS[3-4]. Based on American European consensus conference (AECC) in 1994: Diagnostic criteria for acute lung injury(ALI) and ARDS requiring acute onset of disease, chest radiograph demonstrating bilateral pulmonary infiltrates, lack of significant left ventricular dysfunction and $\frac{Pao_2}{Fio_2}$ (PF) ratio $\leq$300 for ALI or $\leq$200 for ARDS[5]. The first three components can be established with clinical history or noninvasively tools such as chest radiograph or echocardiography. However PF criteria require arterial blood sampling [6-7]. Concerns about anemia following blood sampling and a movement to minimally invasive approaches have led to reduction blood gas measurements in critically ill patient[8-9]. however studies in ARDS and ALI patient are lacking .Furthermore SF threshold values could be used for diagnosing ARDS and ALI[6-10].

Pulse oximetry is the most commonly utilized technique to monitor Oxygenation.Noninvasive and safe. It indirectly measures arterial hemoglobin O_2 Saturation by differentiating oxy hemoglobin form deoxygenated hemoglobin using their respective light absorption at wave lengths of 660 nm (red) and 940 nm (infra red)[11-12]. Pulse oximetry is used:1-detection of hypoxia.2-preven tion of hyperoxia. 3-for weaning from mechanical ventilation 4-titration of Fio_2[9-13].

In most PICU daily arterial blood sampling to calculate the PF ratio often impossible,then calculate the SF ratio and replacement by PF ratio for diagnose ARDS or ALI is non invasive and affordable [14]. Using SF ratio determine the degree of hypoxemianon invasively without the need for arterial blood sampling[7].

In this study we computed the relationship between SF and PF ratio in critically ill patient with ALI and ARDS. We hypothesize that the continuously available and noninvasively SF ratio can be used instead the PF ratio in diagnosis of ALI and ARDS.

II. Methods

In this cross sectional study 70 children with ARDS or ALI that admitted in Tabriz children's hospital

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PICU, Iran between 2012 and 2013 were studied. In Patient with ARDS or ALI under Mechanical ventilation with same Fio_2, Pao_2measared with Arterial blood sampling and Spo_2 measured with pulse oximetry and charted with in 5 min of each other.Computed SF and PF ratio.

Inclusion criteria were children with ARDS or ALI and acute onset of disease and chest radiograph demonstrating bilateral pulmonary infiltrates, consistent with pulmonary edema.

Exclusion criteria were children with pulmonary edema due to heart failure and congenital heart disease and Anatomic anomalies of lung or air ways.

III. Statistical Analysis

Statistical analyses were performed using the Statistical Package for Social Sciences, version 17.0 (SPSS,Chicago,Illinois). Quantitative data were pre sented as mean ± standard deviation (SD), while qualitative data were demonstrated as frequency and percent (%). The categorical parameters were compared by (χ^2) tests, and the continuous variables were compared by independent t test. A p value of <0.05 was considered statistically significant. Relationship between SF and PF, described by linear regression equation. ROC curves were plotted to determine the sensitivity and Specificity of the SF threshold values correlating with PF of 200 (ARDS) and 300 (ALI).

IV. Results

Of 70 children enrolled in this study, included 38 patient female (54.3%) and 32 patient male (45.7%) with a mean age of 32± 5 months (mini mum 2 and maximum 144 months).

A total of 70 data pairs 56 (80%) met the PF ratio criteria for RADS and 14(20%) met the PF criteria for ALI. The median time difference between charted values of Spo_2 and Pao_2 pairs was 5 min . Table (1) demonstrates baseline findings of the patients enrolled in the study.

Age was no significantly relationship with SF ratio. Pvalue = 0.81 and was no significantly relationship with PF ratio Pvalue=0.99.

Sex was no significantly relationship with SF ratio Pvalue = 0.77 and was no significantly relationship with PF ratio Pvalue =0.06.

In general , SF ratio could be predicted well from PF ratio, described by the linear regression equation SF =57+0.61 PF. Based on this equation a PF ratio of 300 corresponds to an SF ratio of 235 and PF ratio of 200 to an SF ratio of 181. Pvalue <0.001[Fig1] The ALI SF cut off of 235 had 57% sensitivity and 100% specificity and ARDS cut off of 181 had 71% sensitivity and 82% specificity.

In general, the SF ratio had excellent discrimination ability for ARDS(AUC=0.86) [Fig2] and good discrimination ability for ALI and ARDS (AUC=0.89) [Fig3].

Table 1 : demonstrates base line findings of the patients

	MAX-MIN	MNAE
Pao_2/ Fio_2	298-46	155±61
Spo2/Fio_2	248-77	152±47
Spo_2	99-71	94±4
Fio_2	100-40	67±18
Pao_2	176-41	96±25
age	144-2	32±5

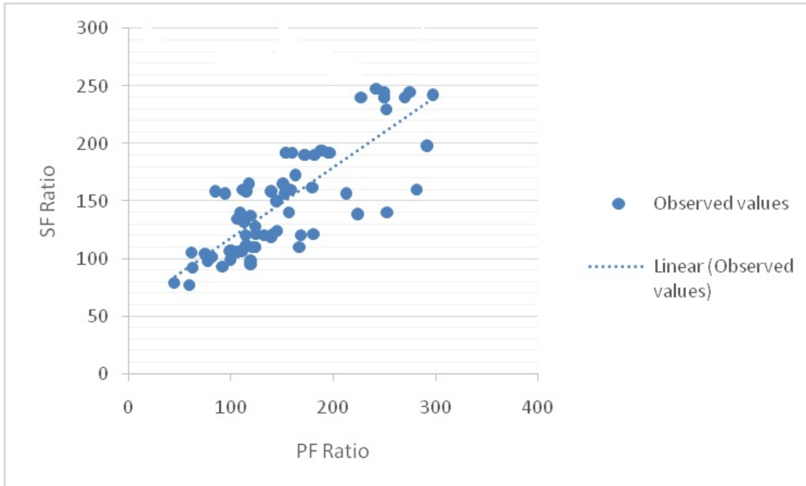

Figure 1 : S/F ratio vs P/F ratio scatterplot for the derivation data set. The line represents the best fit linear relationship SF=57+0/61PF (P<0/001)

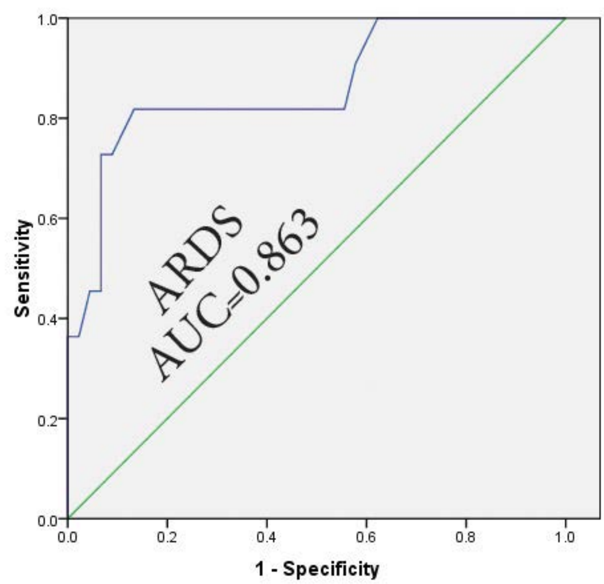

Figure 2 : ROC curves for S/F vs P/F ratios of ≤200 (ARDS)

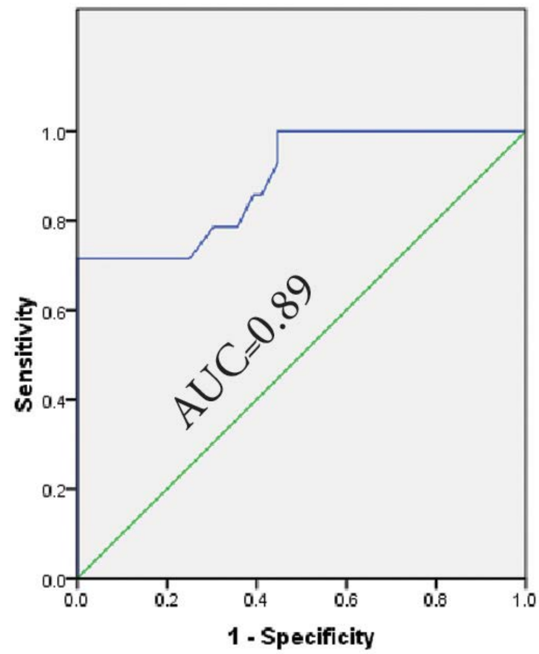

Figure 2 : ROC curves for S/F vs P/F ratios of≤200 (ARDS) and S/F vs P/F ratios of ≤ 300 (ALI) for the derivation data set

V. Discussion

Acute lung injury (ALI) and ARDS significant causes of morbidity and mortality for patients admitted to PICU[15]. The routine use of pulse oximetry and capnography has led to reduce ABG measurements. In most PICU[16], Pulse oximetry a is now available in most children's hospital and used routinely and shows oxygenation status, easier and continuously than Arterial blood sampling[17-18]. Pulse oximetry prevents Arterial blood sampling and cost for ABG analysis[19]. Using SF ratio for diagnose of ALI and ARDS lead to identification of undiagnosed cases of these syndromes [20].

SF ratio may be useful in many organ failure scores, such as lung injury scores[21], multi organ dysfunction score[22],sequential organ failure assessment [23],instead PF ratio to estimate the degree of hypoxemia.

In this study Included 70 patient with ALI or ARDS Pao_2 and Spo_2 measured with the same Fio_2 computed SF and PF ratio. We seen the relationship between SF and PF ratio was described following equation SF=57+0.61 PF and SF ratio threshold value for ALI was 235 and for ARDS was 181 corresponded of PF ratio 300 and 200.

In the similar study khemani et al who used pediatric data. They found than an SF cutoff of 201 could predict PF criteria for ARDS with 84% sensitivity and 78% specificity and an SF of 263 could predict ALI with 93% sensitivity and 43% specificity[24].

In adult patients, the one study by Rice et al They found than an SF cut off of 235 could predict for ARDS with 85% sensitivity and 85% specificity and SF cut off of 315 could predict for ALI with91% sensitivity and 56 % specificity[25]. In this study, we assessed relationship between age and sex with PF and SF ratio. we measured Pao_2 and Spo_2 in maximum 5 min. The SF ratio thresholds determined in this study were based on PF ratio proposed by the AECC.

There are certainly limitation to the this study:

First, ABG and pulse oximetry measurements were close in time to each other (median 5min). Given that changes in Spo_2 and Pao_2 may happen quickly. Second, we did not control for PH, Hemoglobin, $Paco_2$, temperature,that maybe influenced by the relationship between $Spo_2$and Pao_2 .

However non invasively SF ratio can be used for Diagnosis of ALI or ARDS.

VI. Conclusion

According to this study SF ratio is a reliable non invasive and continuously available marker for PF ratio for diagnose children with ALI or ARDS. Then can be replaced pulse oximetry by Arterial blood sampling. According to complication of Arterial blood sampling such as Anemia, Bleeding, in critical illness, Pulse oximetry can be used instead Arterial blood sampling.

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