The predicting value of Pao2/Fio2 ratio in survival of neonates with Congenital Diaphragmatic Hernia

Mohammad Hadi Rafeie[1]   Mahdi Musavi[2]

Bahareh Ahmadi[3]   Mehrdad Hosseinpour[1*]

[1]Pediatric surgery department, Medical University of Isfahan, Isfahan, Iran.

[2] Medical University of Isfahan, Isfahan, Iran.

[3]Clinical Research and Development department of Imam Hossein children hospital, Isfahan, Iran.

*Address for Corresponder Dr Mehrdad Hosseinpour, Pediatric surgery department, Medical University of Isfahan, Isfahan, Iran
(e-mail: meh_hosseinpour@yahoo.com)

How to cite this article:
M-H Rafeie, Musavi M, Ahmadi B, Hosseinpour M. The predicting value of Pao2/Fio2 ratio in survival of neonates with Congenital Diaphragmatic Hernia. Iranian Journal of Pediatric Surgery 2016;2(2):66-70

Abstract

Introduction: Respiratory failure is one of the most important related factors in morbidity and mortality of neonates with congenital diaphragmatic hernia (CDH). Determining indexes that could ultimately and perceivably predict the disease severity and its prognosis is crucial. This study aimed to evaluate the predictive value of Pao2/Fio2 ratio (P/F ratio) in neonates with CDH.

Materials and methods: In this retrospective study, medical records of all neonates with CDH admitted to Alzahra (Isfahan, Iran) hospital from 2005 to 2015 were checked. Thirty-five neonates with CDH were studied. Data collected were: gestational age, sex, weight, Pao2, Fio2 and clinical outcome.

Results: In this survey 24 neonates with CDH were studied. The mean P/F ratio in the survival group was 2.12±0.90 and in the non-survival group, 1.38 ±0.48. According to these results the P/F ratio in the survival group was higher than the other group and this difference was statistically significant (P= 0.02). Based on the ROC curve, the specificity of P/F ratio in predicting survival is 72.2 percent and its sensitivity in predicting death is 80 percent.

Conclusion: P/F ratio is a useful index for predicting the outcome of neonates with CDH.

Keywords

- Neonate
- Survival
- Pao2/Fio2 ratio,
- Congenital diaphragmatic hernia

Introduction

Respiratory failure due to lung hypoplasia and pulmonary hypertension is one of the most important related factors to morbidity and high mortality in neonates with congenital diaphragmatic hernia (CDH).[1] Determining indexes that could ultimately and perceivably predict the disease severity and prognosis is crucial.[2, 3] So far, several prenatal and postnatal criteria have been presented to predict the outcome and survival of neonates with CDH, such as: diagnosis before 25th weeks of pregnancy, lung –head ratio, lung-chest ratio, abdomen to thorax area ratio, gestational age and O2 saturation, body temperature, location of liver and stomach, mean atrial blood pressure, Apgar 1' and 5', oxygenation index and alveolar- atrial O2 gradient[1, 4- 10] among others.

One of indexes that can be used to predict mortality of patients with Acute Respiratory Distress Syndrome (ARDS) is P/F ratio.[11] This ratio is a prognostic risk factor for acute lung injuries and acute respiratory distress.[4, 9] As regards, CDH comprehends about 15.9 percent of cases of acute respiratory failure[12] and there is not a study focused solely on P/F ratio as a predictive criteria for CDH. This study was performed with the aim of the evaluating predictive value of P/F ratio in CDH survival.

Materials and Methods

In this retrospective study, medical charts of all neonates with CDH admitted to Alzahra (Isfahan, Iran) hospital, from 2010 to 2015 were checked. Data such as gestational age, sex, weight, Pao2, Fio2, location of liver and the outcome of the neonate were collected. Neonates who had perinatal respiratory failure were excluded. Twenty four neonates with CDH were studied. The ABG test in the first 24 hours of life, O2 flow, kind of oxygen therapy (cannula mask, NR mask) were gathered and P/F ratio was estimated. Data were analyzed with SPSS-20 through descriptive analysis, T student test. The Receiver Operating Characteristic (ROC) was applied for evaluating the predictive value of P/F ratio. P value<0.05 was considered significant.

Results

In this study 24 neonates with CDH were selected to be studied. Eighteen (62.9%) neonates were male and 18 (62.9%) neonates were alive. The mean age and weight were 35.8±1.7 weeks and 2952±479.69 grams. The liver of one neonate in live group and 1 neonate in dead group was located in the chest.

The mean Pao2 in the survival group was 67.82±22.30 and in the non-survival group 57.00±31.74 (p=NS). The mean Fio2 in the survival and non-survival group were 38.82±20.22 and 48.00±20.49 (P=NS) respectively. The mean P/F ratio in the survival group was 2.12±0.90 and in the non-survival group 1.38±0.48 (P=0.02). According to these results the P/F ratio in the survival group was higher than the other group and this difference was statistically significant **Table 1**.

Table 1: comparative analysis of sex, Pao2, Fio2, P/F ratio and the location of liver between the two groups

		Live group	Dead group	P value
Sex	Male	15 (83.3 %)	3 (16.7 %)	0.6
	Female	3 (75%)	1 (25%)	
P/F ratio		2.12 ± 0.90	1.38 ± 0.48	0.02
Pao2		67.82 ± 22.30	57.00 ± 31.74	0.6
Fio2		38.82 ± 20.22	48.00 ± 20.00	0.9
Location of liver		1	1	-

Table 2 shows the sensitivity and specificity of various cutoff points of P/F ratio as a predictor of mortality in groups.

Figure 1 shows the performance of ROC model in groups. The area under the ROC curve was 0.761. This figure shows correct performance of the model regarding mortality risk stratum.
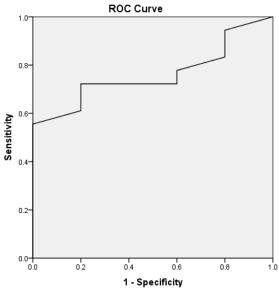
Based on ROC curve, the cutoff value was point 1.65 and the area under the curve was 0.761 **Figure 1**. The P/F ratio in 18 (72.2%) surviving neonates was higher than 1.65 and this ratio in 4 (80%) non-surviving neonates was lower than 1.65. Results showed that the specificity of P/F ratio in predicting survival was 72.2% and its sensitivity in predicting death was 80%.

Table 2: sensitivity and specificity of various Cutoff points

Positive if Greater Than or Equal To[a]	Sensitivity	1- Specificity
-.400	1.000	1.000
.700	94.4%	20%
1.000	88.9%	20%
1.250	83.3%	20%
1.350	77.8%	40%
1.450	72.2%	40%
1.550	72.2%	60%
1.650	72.2%	80%
1.750	66.7%	80%
1.850	61.1%	80%
1.950	55.6%	.000
2.050	44.4%	.000
2.250	38.9%	.000
2.550	33.3%	.000
2.750	27.8%	.000
2.950	22.2%	.000
3.150	16.7%	.000
3.300	11.1%	.000
3.600	5%.	.000
4.800	.000	.000

Figure 1: the ROC curve

Diagonal segments are produced by ties

Discussion

The aim of this study was to evaluate the predictive value of P/F ratio in the survival of neonates with CDH. Neonates with CDH experience decreased tissue perfusion and degrees of respiratory distress due to lung hypoplasia.[1,9,11] Newborns with CDH comprehend about 15.9% of cases with ARDS.[12] One of indexes that can be used for evaluating patient outcome, prognosis and treatment progress in patients with ARDS is P/F ratio.[13] Based on the results of the current study the surviving neonates had higher P/F ratio than the non-surviving ones. Our results are confirmed by Wong and Yehya. Their results showed that in ARDS, there is a relation between P/F ratio and mortality in children with ARDS 24 hours after the diagnosis. Edriss showed that in patients above 50 years, P/F ratio in the second day of using ventilator could help predict mortality and treatment outcomes.[14] The result of a systematic review was that the P/F ratio can predict mortality as a sole factor. In this research, validity of some predictive outcome models for neonates with CDH like SNAP 2, WILFORD-HALL, SANTA–ROSA were studied. One of their indices was P/F ratio. The results were P/F ratio with the other criteria can predict the outcomes of neonates with CDH.[14] Moreover, this ratio can predict the need of ventilation in obstructive pulmonary disease[15] as well as prognosis,[2,9] severity, degree of lung injury and outcome in ARDS patients.[3,11] In a survey, the best oxygenation index on first day of CDH neonates (BOI-d1) and some othercriteria like gestational age, birth weight and liver location were studied to evaluate the survival of CDH. Results showed that BOI-d1 (28 day survival) was sensitivity (73-91%) and specificity (92-80%) and the other criteria were effective in these neonates outcome.[16] In another study oxygenation index had sensitivity=0.9 and specificity=0.8 to predict outcomes of these neonates.[1]

Conclusion

P/F ratio can be a useful index for predicting the outcome of neonates with CDH. This study was done in one medical center and the documentations of 10 years were studied. Although, the mean P/F ratio was significantly higher in the live group, but a study with more samples or a multi center study is required to get more reliable results.

References

1. Basiewicz-Slaczka E, Wotoszczuk-Gebicka B, Yaqoub S, et al: The value of the oxygenation index in the prediction of postnatal outcome in neonates with congenital diaphragmatic hernia. Prelimainary report. Dev period med 2015;3:283- 288.

2. Gentili A, De Rose R, Inannella E, et al: Is the Time Necessary to Obtain Preoperative Stabilization a Predictive Index of Outcome in Neonatal Congenital Diaphragmatic Hernia? IJP 2012; 2012:1-7.

3. Michal Rygl K, Pycha Z, StranakJ, et al: Congenital diaphragmatic hernia: onset of respiratory distressand size of the defect. Pediatr Surg Int 2007;23:27–31.

4. Bilan N, Dastanji A, Behbahani Ghalegolab A: Validity of Spo2/Fio2 Ratio in Detection of Acute Lung Injury and Acute Respiratory Distress Syndrome. Int J Pediatr 2015;3:429-434.

5. Gentili A, Pasini A, Iannella E, et al: Predictive outcome indexes in neonatal Congenital Diaphragmatic Hernia. J Matern Fetal Neonatal Med 2015;28:1602- 1607.

6. Usui N, Kitano Y, Okuyama H, et al: The reliability of the lung to thorax transverse area ratio as a predictive parameter in fetus with congenital diaphragmatic hernia. Ped surg int 2011;27:39- 45.

7. Yeon Lee J, Kwan Jun J, Ho Lee J: Prenatal prediction of neonatal survival in cases diagnosed with congenital diaphragmatic hernia using abdomen-to-thorax ratio determined by ultrasonography. J Obstet Gynaecol Res 2014;40:2037–2043.

8. Cruz-Martinez R, Hernandez-Andrade E, Moreno- Alvarez O, et al: Prognostic Value of Pulmonary Doppler to Predict Response to Tracheal Occlusion in Fetuses with Congenital Diaphragmatic Hernia. Fetal Diagn Ther 2011;29:18-24.

9. Ju-MingWong J, Foong Loh T, Testoni D, et al: Epidemiology of pediatric acute respiratory distress syndrome in Singapore: risk factors and predictive respiratory indices for mortality. Front Pediatr 2014;2:78.

10. Mann PC, Morriss FH JR, Klein JM: Prediction survival in infants with congenital diaphragmatic hernia

based on stomach position, surgical timing, and oxygenation index. Amer J Perinatol 2012; 29:383- 390.

11. Yehya N, Sarvaes S, Thomas N J: Characterizing Degree of Lung Injury in Pediatric Acute Respiratory Distress Syndrome. Crit Care Med. 2015;43:937- 946.

12. Patry C, Hlen S, demiracka S, et al: Adjunctive Therapies for Treatment of Severe Respiratory Failure in Newborns. Klin Padiatr 2015;227: 28–32.

13. Bhadade R, DE Souza R, Harde M, et al: Mortality Predictors of ARDS in Medical Intensive Care Unit of a Tertiary Care Centre in a Tropical Country. J Assoc Physicians India 2015;63:16-22.

14. Morse Sh, Greor M, Shelton M M, et al: A systematic review. The Utility of the Revised Version of the Score for Neonatal Acute Physiology among Critically Ill Neonates. J Perinat Neonat Nurs 2015; 29: 315- 344.

15. Sung Ko B, Ahn Shin, Soo Lim K, et al: Early failure of noninvasive ventilation in chronic obstructive pulmonary disease with acute hypercapnic respiratory failure. Intern Emerg Med 2015;10:855–860

16. Ruttenstock E, Wright N, Barrena S, et al: Best Oxygenation Index on Day 1: A Reliable Marker for Outcome and Survival in Infants with Congenital Diaphragmatic Hernia. Eur J Pediatr Surg 2015; 25: 3-8. [Abstract]