การใช้ข้อมูลจากการตรวจหัวใจด้วยคลื่นเสียงความถี่สูง เพื่อทำนายผลการดำเนินโรคภาวะความดันในปอดสูงในทารกแรกเกิด

Using Echocardiographic Indices to Predicting the Prognosis of Newborn with Persistent Pulmonary Hypertension

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Background

- Persistent pulmonary hypertension in newborn (PPHN)
- PPHN is characterized by elevated pulmonary vascular resistance, resulting in right-to-left shunting of blood and hypoxemia[1]
- Incidence is about 1.8-2 per 1000 live birth and varies across the centers[2,3]

1. Lakshminrusimha S, Keszler M. Persistent Pulmonary Hypertension of the Newborn. Neoreviews. 2015
2. Steurer MA,et al. Persistent Pulmonary Hypertension of the Newborn in Late Preterm and Term Infants in California. Pediatrics. 2017
3. Bendapudi P,et al. Diagnosis and management of persistent pulmonary hypertension of the newborn. Paediatric Respiratory Reviews. 2015

Background(2)

- Very high mortality rate: 41-78% in Thailand[1-5]
- Modern therapies such as inhaled nitric oxide, high-frequency oscillatory ventilation, extracorporeal membrane oxygenation, and/or other pulmonary vasodilators agents can reduce the mortality rate of PPHN[6]

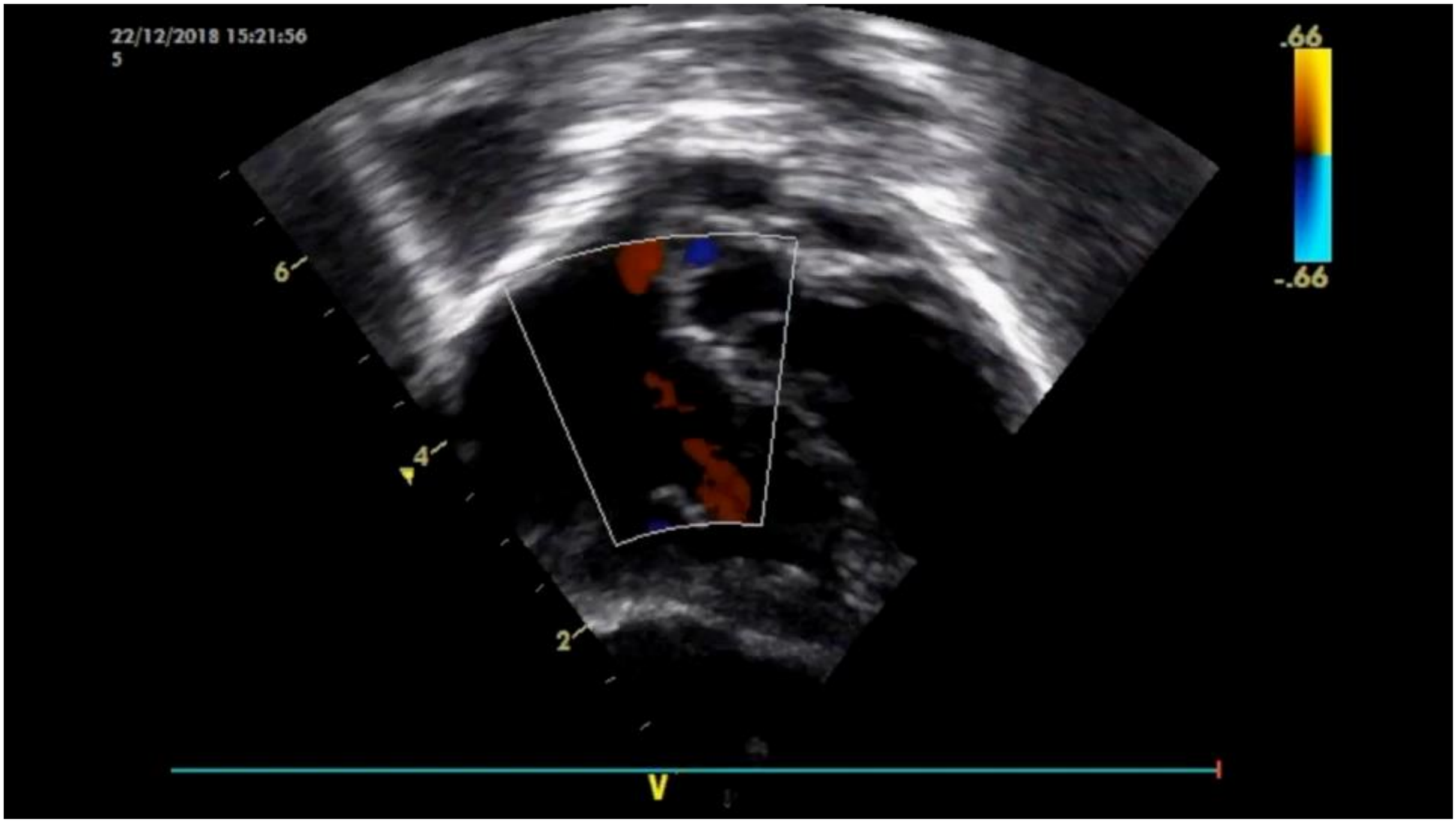
1. สุชาดา ชีวะพฤกษ์. วิชาการสาธารณสุขวารสาร 2551;17:379-389.
2. พิชญา ถนอมสิงห์. โรงพยาบาลมหาราชนครราชสีมาเวชสาร 2554; 35: 31-43.
3. ชรินพร พนาอรุณวงศ์. วารสารโรงพยาบาลนครพนม;4:5-18.
4. นพวรรณ พงศ์โสภา. วารสารวิชาการแพทย์เขต11 2560;31:49-59
5. มนัญญา อภิวัฒนพร.. วารสารการแพทย์ โรงพยาบาลอุดรธานี 2564;29-1
6. Nakwan N. Am J Perinatol. 2018 Dec;35(14):1366–75

Background(3)

- Echocardiography remains the gold standard for diagnosis of PPHN[1]
- Using echocardiography to definitely rule out congenital cyanotic heart disease and and to monitor the efficacy of specific therapeutic interventions in PPHN[2]
- peak velocity of tricuspid regurgitation jet (TRPG)
- estimate Right ventricular systemic pressure (RVSp)
- Left ventricular ejection fraction (LVEF)
- Right ventricular systolic to diastolic ratio (SD ratio)
- Left ventricular eccentricity index (EI)(systole and diastole)

1. Nakwan N. Am J Perinatol. 2018 Dec;35(14):1366–75
2. Nair J, Lakshminrusimha S. Semin Perinatol [Internet]. 2014 Mar];38(2):78–91.

Echocardiography



Neonatal Echocardiography. (2020, Mar 27). ECHOCARDIOGRAPHIC ASSESSMENT OF PULMONARY ARTERIAL HYPERTENSION IN THE NEWBORN[Video]. YouTube. www.youtube.com/watch?v=9fHocCQzRvA

Background(4)

- No definite indices and cut point to predict prognosis of PPHN
- Aim to using echocardiographic indices to predict prognosis of PPHN

Objective

- To determine the echocardiographic indices that can use to predict prognosis of PPHN

Material and Method

Method

- Study design
  - Retrospective descriptive study
- Setting
  - NICU ward, Udonthani hospital, Thailand

Inclusion criteria

- All neonate treatment with PPHN in Udonthani hospital between June 2020 to July 2021
- Gestational age is more than 32 weeks
- Diagnosis of PPHN by
  - Respiratory distress or respiratory failure
  - Hypoxemia
  - Differential cyanosis (pre-ductal and post-duactal oxygen saturation difference) more than 5%[1]

1. Sharma V et al. Matern Health Neonatol Perinatol [Internet]. 2015

Exclusion criteria

- Multiple congenital anomaly or prenatal diagnosis with chromosomal defect
- Congenital cyanotic heart disease
- Echocardiography is not done for any reason

Data collection

- Baseline patients' characteristic eg. GA birth wieght, Sex, co-morbid diseases

- Important therapeutic and laboratory outcomes eg. Using of HFOV, iNo, Oxygen index and death

- Echocardiographic indices including TRPG, RVSp, systolic to diastolic ratio(SD ratio), eccentricity index(EI), PDA shunt direction

Categorized group

- Dividing severity of PPHN into two groups, severe and non-severe PPHN
- PPHN patients then group into severe PPHN if either of these present
  - Death
  - Oxygen index more than 25

Statistical analysis

- Descriptive analysis using number and percentage
- Continuous data were presented with the mean ± SD or median and interquartile range
- Categorical data were compared using either the Chi square test or the Fisher’s exact test when appropriate
- Continuous data were compared using either the student t test test or Mann Whitney U test when appropriate

Result

Baseline Characteristic

ตัวแปร	PPHN รุนแรง(N=16)	PPHN ชนิดไม่รุนแรง (N=9)	P value
อายุครรภ์	38.4(1.67)	37.56(2.16)	0.30*
น้ำหนักแรกเกิด	2988.33(298.90)	3003.438(446.75)	0.93*
เพศชาย	10(62.50%)	1(11.11%)	0.033**
Oxygen index(median(IQR))	29.8 (20-37.5)	11(6.2 -15)	0.0013#
Death	15(93.75%)	0(0%)	<0.001**

***student-t**
**** Fisher exact**
#Mann Whitney U

Co-morbidities

ตัวแปร	PPHN รุนแรง (N=16)	PPHN ชนิดไม่รุนแรง(N=9)	P value (Fisher exact)
โรคร่วม			
Meconium aspiration syndrome(%)	3(18.75%)	3(33.33%)	0.630
Pneumonia(%)	8(50%)	2(22.22%)	0.229
Sepsis(%)	11(68.75%)	8(88.88%)	0.364
Pneumothorax(%)	4(25%)	3(33.33%)	0.673
Congenital diaphragmatic hernia(%)	3(18.75%)	0(0%)	0.280
Respiratory distress syndrome(%)	1(0.06%)	0(0%)	1.000

Result

- Mortality rate of PPHN in this study was 60%
- 16 from 25 (64%) is defined as severe PPHN

Echocardiographic parameters

Parameters	PPHN รุนแรง	PPHN ชนิดไม่รุนแรง	P value Mann Whitney U
RVSp (mean(SD))	59 (14.15)	58.22 (30.54)	0.93*
RV systolic to diastolic ratio (median(IQR))	1.79 (1.48- 2.06)	1.78 (1.30 – 2.24)	0.83
Eccentricity index systole (median(IQR))	1.42 (1.31- 1.44)	1.49 (1.29- 1.86)	0.83
Eccentricity index diastole (median(IQR))	1.35 (1.27 -1.51)	1.36 (1.18 – 1.70)	0.88

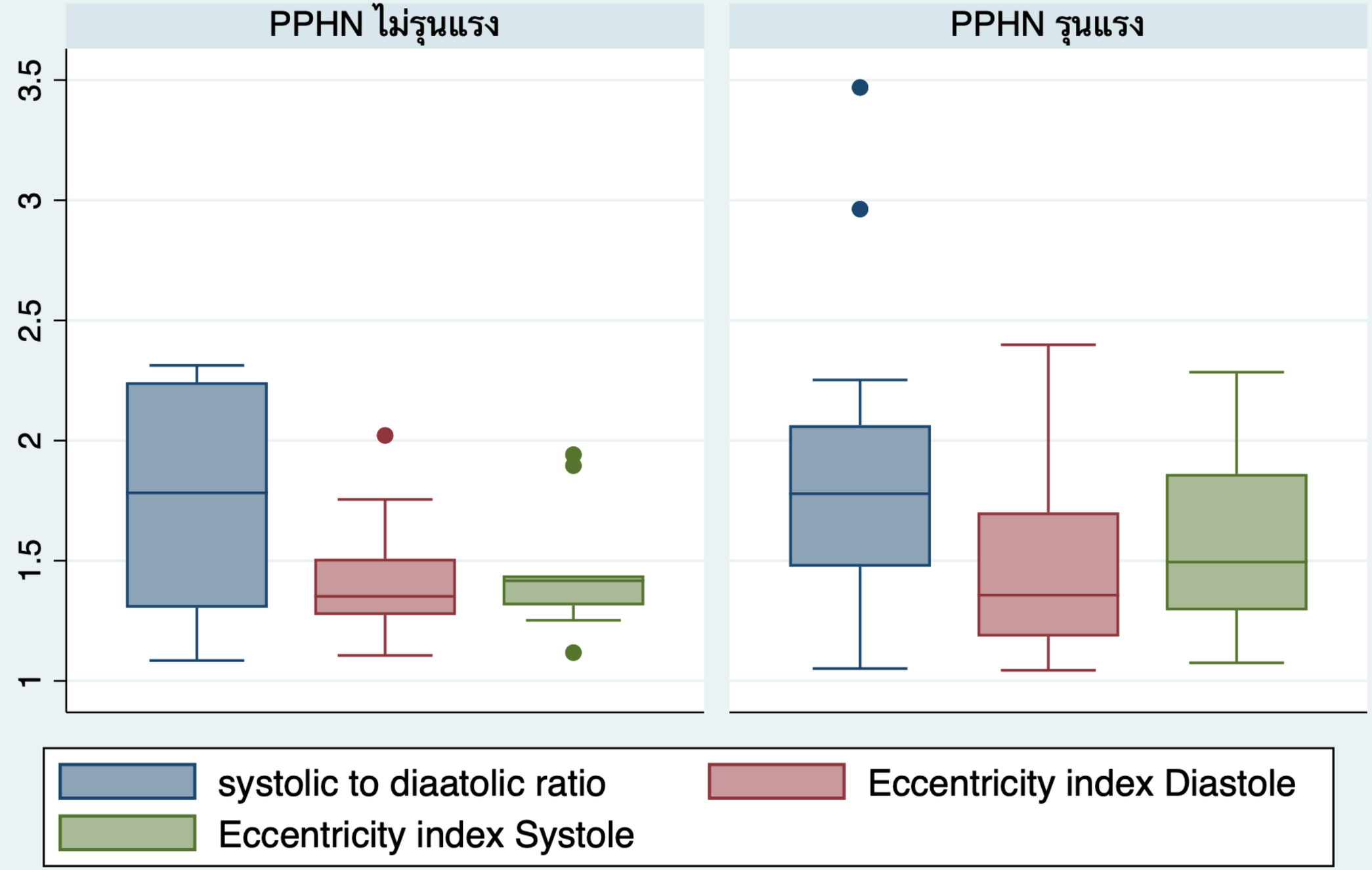
***t-test**

Echocardiographic parameters

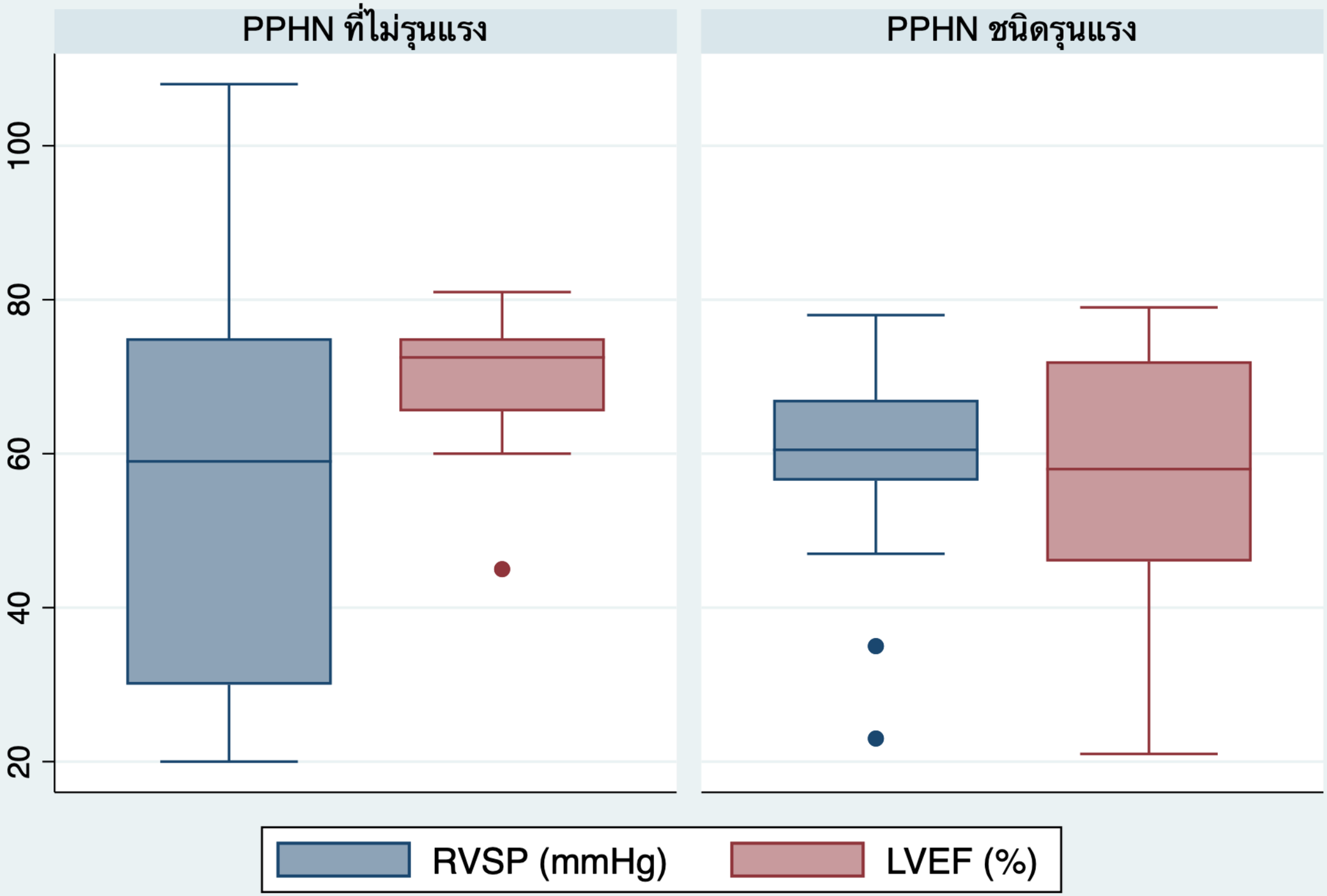
Parameters	PPHN รุนแรง	PPHN ชนิดไม่รุนแรง	P value Mann Whitney U
PDA size (median(IQR))	2.67 (2.3 – 3.02)	3.4 (2 – 4.63)	0.27
PDA shunt direction Left to right N(percent)	2(14.27%)	1(11.11%)	1.00**
PDA shunt direction bidirection N(percent)	12 (85.73%)	8 (88.89)	1.00**
LVEF(%) (median(IQR))	58 (46 – 72)	72.5 (65.5 – 75)	0.14

**** Fisher exact test**

กราฟแสดงค่าechocardiographic parameters ในกลุ่ม PPHN รุนแรงและไม่รุนแรง



แผนภูมิแสดงค่า RVSp และ LVEF ในกลุ่ม PPHN ชนิดรุนแรงและไม่รุนแรง



Discussion

Discussion(1)

- Mortality rate in this study is 60%, comparable to previous mentioned study in Thailand which are 41-78%

- Comorbidity are same as previous study, mainly MAS, pneumonia and sepsis

Discussion(2)

- The basic echocardiographic parameters are nearly equal in both groups, including RVSp, LVEF, direction of PDA shunt without statistical significant

- Thus, the echocardiographic indices of this study are not different, including Systolic to diastolic ratio, eccentricity index which are not comply to previous study

Discussion (3)

- SD ratio if value more than 1.3 had 93% sensitivity to predict death or ECMO in PPHN[1]

- In this study both group of PPHN has considerably high SD ratio at 1.78 to 1.79

- Same as EI which if value more than 1.3 will predict impairment of RV function of more than half of RV to systemic pressure[2]

1. Aggarwal S, et al. Early Hum Dev. 2015
2. Abraham S, et al. Echocardiography. 2016

Discussion(4)

- Invert direction of PDA flow usually represent more than systemic pressure of pulmonary artery, which are occurred in about 85% of all patients in this study

Limitation

- Retrospective study
- Referral bias of basic population
- Number of population

Thank you