

A comparative study of thymic size in preterm neonates with clinical and with / without radiological evidence of respiratory distress syndrome (RDS) in relation to birth weights and gestational age

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Abstract

Background: Thymus size in neonates is represented by Cardiothymic -Thoracic ratio (CT/T) which can be measured on chest radiograph. Several pre and post natal factors have been shown to affect the thymus size in neonates. Respiratory Distress Syndrome(RDS) is an important cause of mortality in the preterm neonates and CT/T ratio in infants with RDS may be larger, owing to decrease in serum cortisol levels in them. We therefore intend to find out the thymus size in infants diagnosed with RDS. **Aim:** To determine thymic size in preterm neonates with clinical and radiological evidence of RDS and in neonates without radiological evidence of RDS and with birth weights and gestational age into consideration and categorising the sample into 3 groups. **Materials and methods:** The study was conducted with the help and guidance of project (Project to Understand Research Preterm pregnancy Outcomes and Still births in South Asia PURPOSE) team in the NICU of Department of Paediatrics, JJMMC, Davanagere, Karnataka India, over a period of nine months in three hospitals named: 1. Bapuji Child Health Institute and Research Centre 2. Chigateri District General Hospital. 3. Women and Child Hospital. Premature (<37 weeks of gestation) neonates admitted in NICU with clinical evidence of RDS and with a chest radiograph taken within 24 hours suggestive of RDS or normal were included in the study. CT:T ratio was determined on chest radiograph. **Results:** Total 138 neonates were enrolled in the study. The mean CT:T ratio in the study of neonates with clinical and radiological evidence of RDS was 0.39 ± 0.03 . The mean CT:T ratio in the study of neonates with no radiological evidence of RDS was 0.32 ± 0.02 . As the birthweight and gestational age of the baby decreases, the CT/T ratio is increased and they were at high risk with less chances of survival. **Conclusion:** A large CT:T ratio on chest radiograph can be used as a marker for prognosis along with their birth-weights and gestational age. Pre-terms with a CT:T of more than 0.40, birth- weights <1000 grams and gestational age less than 32 weeks have a poorer prognosis in terms of survival.

Keywords: Thymus size, preterm, neonate, respiratory distress syndrome, chest radiograph

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The thymus is an important gland which is closely concerned with development of cell- mediated immunity and its responses. It continues to grow until puberty and then progressively reduces in size thereafter. Thymus size in neonates is represented by the cardiothymic-thoracic ratio (CT/T) as measured on chest radiograph. Thymic size which is measured by CT/T ratio in neonates with RDS may actually be larger, owing to a decrease in serum cortisol levels in those preterm neonates who develop RDS. This could also be explained by the

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decrease in lung volume that accompanies hyaline membrane disease(HMD). Increased cortisol levels causes increase in lymphocytes which also may be a reason for enlarged thymus.² We therefore undertook this study to calculate the thymic size in neonates clinically diagnosed with RDS and with or without radiological evidence of RDS to find out whether it is related to survival and prognosis. In addition, we aimed to find the relation between the CT/T ratio with birth weights and gestational age in assessing the severity of the disease.

This retrospective observational study was conducted with the help and guidance of PROJECT (Project to Understand Research Preterm pregnancy Out comes and Still births South Asia PURPOSE) team on 138 neonates admitted with clinical evidence of RDS in the NICU of Department of Paediatrics in hospitals named

1. Bapuji Child Health Institute and Research Centre
2. Chigateri District General Hospital.
3. Women and child Hospital under JJMMC, Davanagere, Karnataka, India, over a period of nine months from June 2018 to March 2019,

MATERIALS AND METHODS

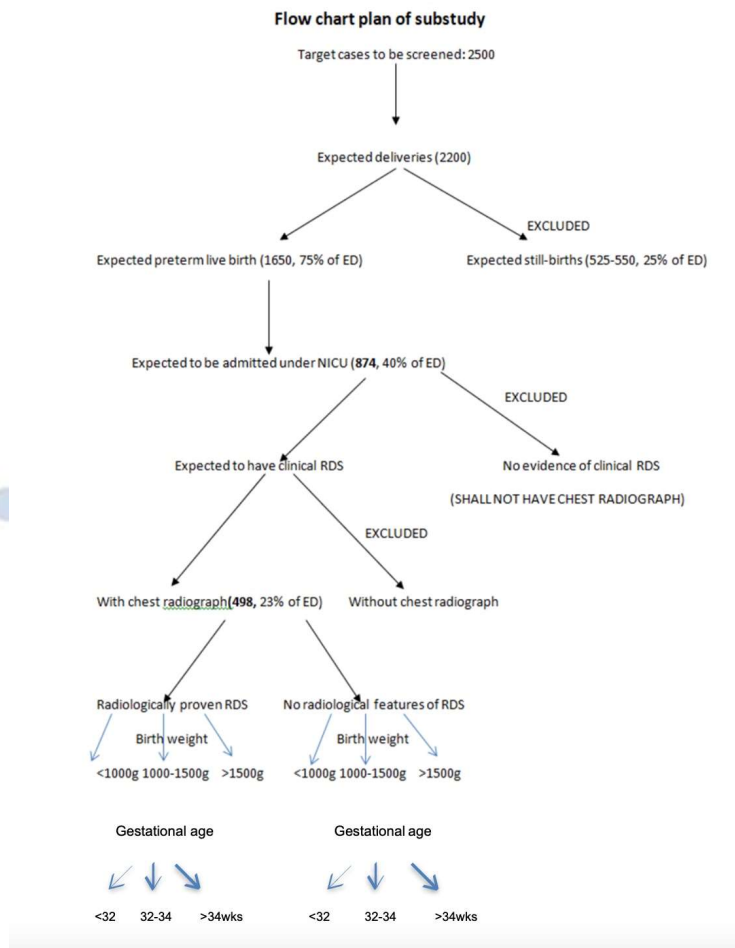
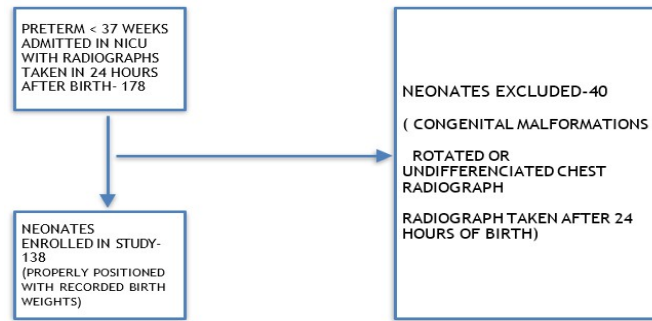


FIGURE 1: SHOWING NEONATES ENROLLED IN THE STUDY

Inclusion Criteria

Premature (<37 weeks gestation) neonates admitted in NICU with clinical evidence of RDS and a chest Radiograph performed within 24 hours of delivery with or without radiological evidence of RDS. The neonates without radiological evidence of RDS were included in the study so that the normal baseline CT/T value can be estimated to compare it with abnormal values of neonates with both clinical and radiological evidence of RDS.

Exclusion criteria:

Rotated or not differentiated chest radiograph or those babies with radiographs taken beyond 24 hours were excluded from my study. Neonates who received surfactant were excluded from my study. Neonates with congenital cardiac or pulmonary malformations were excluded.(Fig-1) Informed and written consent was taken from the parent/ guardian of each neonate prior to enrolment in the study. Thymus size was expressed as CT:T value by measuring the width of the cardio-thymic shadow at the level of carina and dividing it by the width of the thorax at costo-phrenic angles(CP Angles)[Fig-2] by a single radiologist who was blinded to identity the clinical course of the patient. For each Radiograph of chest, three readings were taken and their average was considered as the final CT:T ratio.

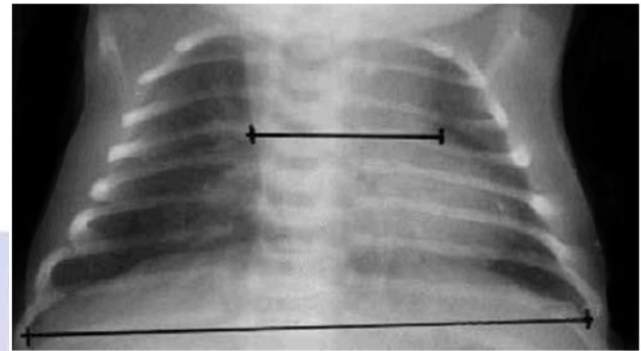


Figure 2 : Chest radiograph showing how to measure CT/T Ratio

RESULTS

A total of 138 neonates were enrolled in the study [Fig-1] irrespective of their gender and mode of delivery. Their birth weights and gestational ages were recorded. The mean CT:T ratio in the study of neonates with no radiological evidence but clinical evidence of RDS was 0.32 ± 0.02 . The mean cardio-thymic by thoracic ratio (CT:T) in the study of neonates with radiological evidence of RDS was 0.43 ± 0.02 . The CT:T ratio in neonates who had better prognosis was small (0.37 ± 0.01) and in those who had bad prognosis, CT/T ratio was more (0.41 ± 0.01). A neonate with a CT:T of more than 0.40 had a bad prognosis. The mean CT:T in neonates with a birth weight of less than 1000 grams was higher (0.42) as compared to those with a birth weight of more than 1000 grams like wise the CT/T ratio in neonates with gestational age <32 weeks was slighter higher (0.38) than in neonates with gestational age >32 weeks. However based on birth-weights the severity and prognosis was better made when compared to gestational age of the neonates.

TABLE 1: SHOWING CORRELATION OF CT/T RATIO WITH WEIGHTS and GA OF THE PRETERM NEONATES

WEIGHTS(IN GRAMS)	Total no of babies	CT/T Ratio in babies with radiological evidence of RDS	CT/T ratio in babies without radiological evidence of RDS
> 1500 grams	55	0.36	0.32 +/- 0.02
1000 – 1500 grams	57	0.37	0.32 +/- 0.02
< 1000 grams	26	0.42	0.32 +/- 0.02
GESTATIONAL AGE(IN WEEKS)			
<32 weeks	24	0.38	0.32 +/- 0.02
32-34 weeks	56	0.37	0.32 +/- 0.02
>34 weeks	58	0.36	0.32 +/- 0.02

DISCUSSION

Thymus involution at birth is related to prenatal stress and the grade of involution is related to the duration of illness.⁶ Stress involution appears to be mediated by activation of the hypothalamic-pituitary- adrenal axis with gluco-corticosteroids causing a thymocytolytic effect with lymphocyte apoptosis in the thymic cortex.⁷ RDS is an important cause of neonatal respiratory failure and deaths and prematurity is the single most important risk factor associated with RDS. A positive correlation was found between birth weights, gestational age and thymic size when measured on chest radiograph. In our study, CT/T ratio was slightly higher in neonates of birth-weights <1000 grams indicating high severity of disease with poor prognosis. However, in neonates with birth-weights >1000grams there was a lower CT:T value with better prognosis and good survival rate CT/T ratio was slightly lower with good prognosis in neonates with gestational age of >32 weeks with less severity of the disease. However, in neonates with GA of <32 weeks there was a higher CT:T value with high severity of the disease and bad prognosis. The higher CT:T ratio in neonates with severe RDS may be due to decrease in lung volume that is associated with Respiratory distress syndrome. Prolonged intrauterine stress (pre-eclampsia or chorio-amnionitis) has been shown to cause involution of the thymus. This stress related involution of thymus appears to be mediated by the activation of hypothalamic-pituitary-adrenal axis(HPA).The activation of HPA leads to a rise in serum corticosteroids which has been shown to have thymocytolytic effect.⁸ Neonates who are ELBW and more preterm have bad prognosis and higher mortality rate. chest radiograph which is relatively cheap and easily available

investigation can be done with in 24 hours of life and CT:T ratio should be measured which does not require much expertise and can even be used in small clinics for identification of high risk cases like neonates with larger CT:T ratio having poorer prognosis and for estimating severity. This can be helpful in decision making regarding early referral of the neonate to higher centre which helps reduction in mortality.

CONCLUSION

CT/T ratio when determined within 24 hours on chest radiograph after delivery appears to be a useful indicator to help predict severity and survival in preterm infants with respiratory distress based on their weights and gestational age. Chest radiograph being relatively cheap and easily available investigation, a larger CT:T value can be used as a prognostic marker. Pre-terms with a CT:T ratio of more than 0.40 should be closely monitored for any worsening of symptoms and they should be referred early to centres which are well equipped in managing RDS. This will help in significantly reducing the mortality associated with RDS and prematurity.

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