Original Article

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Adrenal Sono-Volumetry in 'Stressed' Neonates

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Abstract

Background: Neonates are exposed to multiple stressors. Adrenals, important organs of stress response, are likely to mirror the stress, neonate is exposed to. This study was done to ascertain if adrenal sonovolumetry reliably assesses presence of stressors in neonates. **Subjects and Methods:** A prospective case-control study was done in a tertiary hospital including all neonates admitted to NICU in study period and healthy full term newborns as controls. Both cases and controls underwent adrenal sonography. Adrenal Volumes were calculated as product of area in coronal and length in perpendicular plane. The volume was divided by neonatal weight to calculate Adrenal volume-index(VI). Mean VI's of cases and controls were compared for any significant difference. **Results:** Forty cases including 25 preterm and 15 term neonates and 80 controls were included in the study. There was negative correlation between neonatal weight and adrenal size among preterm neonates. Mean adrenal VI of cases were significantly higher than controls for both preterm and term cases. Preterm neonates less than 32 weeks at birth had significantly higher adrenal VI than preterm cases more than 32 weeks at birth. **Conclusion:** Sono-volumetry of adrenals can be used as marker of stress in neonates irrespective of term or preterm birth.

Keywords: Adrenal Volumetry; Neonatal distress; Medical stressor; Stress response; Preterm neonates.

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Introduction

Neonates are exposed to multiple stressors both internal and external. In addition, peripartal and intrapartal factors like intrauterine growth restriction, uteroplacental insufficiency, prematurity affect the response of neonates to stressors.[1-3] Many a times, neonates present with acute manifestations with no obvious antecedent stress. Unlike adults, neonates aren't reliably expressive. Adrenal glands play a major role in stress response mechanism. Glucocorticoids, secreted by adrenals are important markers of stress.[4-5] In addition, normal adrenal glands are easy to visualise in neonates on sonography than adults due to relatively larger adrenal size to body weight ratio, superficial in location and meagre surrounding fat.[6] This can be used to an advantage to ascertain whether the neonate is under any active medical stressor. This study was done to ascertain if adrenal volumetry by sonography can be reliably used to assess the presence of any stressor in the neonate.

Subjects and Methods

This prospective case-control study was done in a tertiary care hospital after taking necessary ethical clearance. Sample size was calculated based on NICU admission rates in the institute. To increase the reliability of the findings the number of controls was determined to be twice the number of cases. All neonates admitted to NICU in May 2019 were included as cases and healthy full term newborns, with no significant antecedent antepartal or peripartal history delivered in the same hospital and shifted directly to postpartal ward were included as controls. The Controls were followed up till 28 days to ensure that only healthy controls were included. Controls, with any episode of illness warranting attention of a physician, were excluded. Gestational age at birth, age of neonate on the day of scan, neonatal weight (using digital weighing scale), any antenatal, perinatal or postnatal insult were noted for each neonate. Both cases and controls underwent sonography with a GE Logiq V2 machine using a phased array transducer with a small footprint (5-10 MHz), after taking informed consent of the parents. The neonatal kidneys were imaged and adrenals were localised in 2D scan mode. Longitudinal image of the adrenal was obtained. The area of the adrenal in this plane was measured using a free hand curve tool, by tracing the gland manually [Figure 1], in square cm (sq cm). The perpendicular length of the adrenal was measured in oblique axial plane using curvilinear digitised calipers in cm [Figure 2]. The area obtained was multiplied with length to obtain the volume of the each adrenal gland separately. The volume was further divided by the weight of the neonate to get the Adrenal volume index (VI) in cc per Kg. The mean VI's were calculated for

preterm and term cases and controls and P value was calculated to find if the difference was significant using unpaired T test.

Results

Table 1: Comparison of mean adrenal Volume Indices in Case and control neonates

	Number of neonates	Mean neonatal weight in Kg	Right Adrenal (Volume Index in cc per Kg)	Left Adrenal (Volume Index in cc per Kg)
Controls	80	2.884	0.210	0.214
Cases				
Preterm	25	2.230	0.83	0.89
Term	15	2.757	0.58	0.583

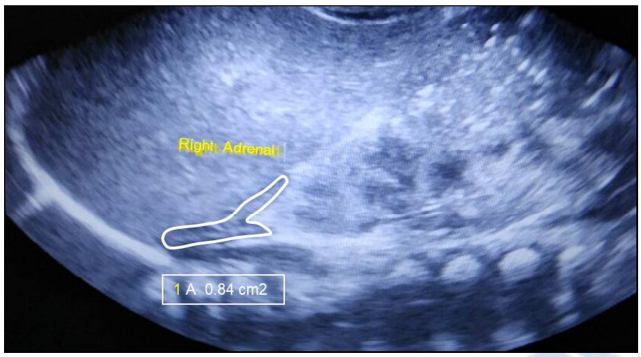

Figure 1: 2D Ultrasonography image in Coronal oblique plane depicting adrenal gland manually traced (white outline) to measure the area of the gland.

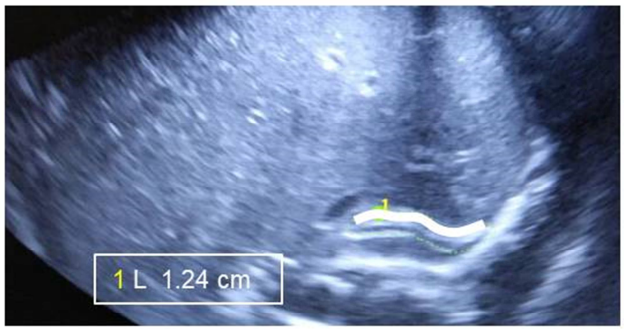

Figure 2: 2D Ultrasonography image in Axial oblique plane depicting the measurement of adrenal gland length (white curvilinear line).

A total of 40 cases and 80 controls were included in the study. Of the 40 cases, 25 were preterm (born prior to 37 completed weeks of gestation by LMP) and 15 were term (born at or after 37 completed weeks of gestation) deliveries. The mean gestational age at birth for preterm cases was 35 weeks (32 to 36 completes weeks); for term cases, it was 38 weeks (37 to 40 completed weeks) and controls, it was 38 weeks (37-40 completed weeks). There was negative correlation between the neonatal weight and adrenal size among preterm neonates. Of the preterm cases, 8 had various degrees of respiratory distress, 4 had neonatal jaundice. Among term cases, 9 were admitted to NICU with respiratory distress and 3 were admitted with neonatal sepsis. The mean neonatal weights and mean adrenal volume indices for right and left glands are depicted in [Table 1]. The mean adrenal VI of cases were significantly higher than that of controls with a P value of <0.03 for both preterm and term cases. Another observation was that the preterm neonates less than 32 weeks at birth had significantly higher adrenal VI than preterm cases more than 32 weeks at birth.

Discussion

In the present study, adrenal gland size and VI correlated well with the stress encountered. The preterm neonates had higher VI's as compared to term cases or controls, as they were exposed to more stressors due to low birth weight, lung immaturity etc. Even term neonates admitted in NICU had significantly larger adrenals than the controls irrespective of their body weights. Similarly the controls, who were term born healthy neonates lying beside mother, at the time of scan, in a comfortable surroundings, were exposed to least possible stress and had relatively smaller adrenal glands compared to the cases. This is consistent with the findings of Karsli et al, who found that the adrenal gland size was significantly related to period of gestation, chorioamnionitis, germinal matrix haemorrhage etc and went on to suggest that adrenal size in neonates can be used to predict outcome.[3]

Turan et al, measured the adrenal gland volume using 3D ultrasonography using computer aided technology and concluded that the fetal weight directly correlated with the adrenal size and can potentially identify women at risk of preterm birth.[7] Similarly Iijima et al, found that the adrenal sizes correlated with the birth weight. However, they found no correlation with the gestational age in newborns born after 30 weeks of gestation.[8] In the present study also, there was a correlation of neonatal weight and adrenal size with preterm neonates possessing more voluminous adrenals. However, among term neonates, the cases and controls did not show any such correlation. Term born neonates in NICU had larger adrenals than controls, irrespective of their body weights. This can be due to the illness, which acts as a stressor, resulting in adrenal hyperfunction and enlargement.

Various measurements have been used to assess the size of adrenals like length, width and area however,[3,8-13] only few studies have determined the volume.[7,14-15] The method employed in the present study to calculate the volume is unique, wherein the area was manually traced similar and multiplied by the thickness of the gland. This method is simple, cost effective and readily available in most currently used sonography machines and obviates the need for additional sophisticated softwares. This is a reliable method of measuring volume of irregular shaped objects by sonography and has been used to measure volumes of ovaries, mass lesions and prostate.

This study highlights the ease with which sonography can locate and measure the neonatal adrenal glands which can

mirror any possible active stressor the neonate is facing. Similary, It is suggested that prospective studies on both neonatal and fetal adrenal measurements can be undertaken to assess if it can predict any future stressor and outcome. Sonography is relatively safe in late fetal and neonatal life and can easily be used as a screening modality to scan the adrenals and help develop preventive strategies to reduce the neonatal morbidity and mortality.

Conclusion

Simple measurement of size of adrenal glands by USG can be used as an important marker of stress in neonates irrespective of term or preterm birth. The adrenal volume relative to body weight correlates well with degree of stress the neonate is exposed to. Therefore, the adrenal glands size helps us to predict whether the neonate is in stress and its severity.

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