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Original Research Paper

Anatomy

STUDY OF CORRELATION OF FOETAL BRAIN WEIGHT TO FOETAL TOTAL BODY WEIGHT TO ASSESS THE DEVELOPMENT OF BRAIN

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ABSTRACT

Background: Owing to the present-day usage of advanced development of ultrasonographic technique with high resolution scanning, one is able to identify, analyse and report the congenital abnormalities of developing foetuses in their intrauterine life with great specificity. As the development of neural tube begins very early as 3rd week of intrauterine period, a clinician is able to detect neural tube defects at a very early stage. The normal growth of the brain during the intrauterine period can be estimated by assessing the ratio of foetal brain weight to the total body weight of the foetus by measuring the various parameters of the foetuses. The weight of the foetal brain varies in various conditions like congenital heart defects, intrauterine growth retardation, microcephaly, neural tube defects associated with folic acid deficiency and due to various teratogenic factors. So, studying the ratio of foetal brain to total body weight is useful tool to diagnose various conditions. **Methodology:** A total of about 100 foetuses of different gestational ages were collected from the Gynaecology and Obstetrics department in King George Hospital and Victoria General Hospital, Visakhapatnam. It was ensured that the foetuses are properly embalmed as soon as they are procured and foetal height, weight and other important parameters required for the study were taken. **Results:** The ratios were calculated for gestational ages from 13 to 40 weeks. The ratio for brain declined very slowly throughout the period examined. An observation of practical importance of the brain weight/bodyweight ratios was virtually constant after 30 weeks of gestation. **Conclusion:** In this study foetal body weight is compared with the brain weight to correlate the subsequent brain development according to the weight of the foetus. By this study we can understand the foetal brain growth and compare results attained with the readings of foetal brain vol / weights got by non-invasive techniques like ultrasound, MRI scanning and identify the affected brain development in various conditions like congenital heart defects, intrauterine growth retardation, syndromes with associated microcephaly, zika virus infections and genetic anomalies etc

KEYWORDS : foetal brain weight, total foetal body weight, ratio, congenital heart defects, microcephaly, Intrauterine growth retardation.

INTRODUCTION:

The basic science of growth, organ weight and development are important tools in foetal, perinatal pathology, paediatrics, radiology and forensic medicine and we should be familiar with the normal patterns so that we can recognize overt deviations from the normal ranges. Typically, growth is evaluated by comparing individual measurements to reference standards. Birth weight is recognized as a reliable indicator of intrauterine growth and one of the major factors determining child survival and future growth. Brain weight determines the development of brain in each week.

Central nervous system malformations are some of the most common of all congenital abnormalities. Neural tube defects are the most frequent malformations and amount to about 1–2 cases per 1000 births [(1)]. Conditions like Microcephaly may be diagnosed during pregnancy with ultrasound. Microcephaly is easily diagnosed by ultrasound late in the second trimester or early in the third trimester of pregnancy, but these findings can be detected as early as 18-20 weeks of gestation. The main causes of microcephaly include genetic conditions like Downs syndrome, Edwards syndrome etc and exposure to viruses like Zika, drugs and toxins. Congenital microcephaly, also referred to as primary microcephaly due to its presence in utero or at birth, is a descriptive term for a structural defect in which a foetus or infant's head circumference is smaller than expected when compared to other foetuses or infants of the same gestational age, sex and ethnic group [(2)]. More recent data estimate congenital microcephaly rates from 2 to 12 cases per 10,000 livebirths[(3)]

Congenital heart disease (CHD) is associated with in utero brain dysmaturation, abnormal cerebral vasculature and decreased brain size. Congenital heart defects (CHDs) are the most common major birth defects worldwide, present in 6 per 1000 live births, and a leading cause of neonatal mortality.[(4)]

IUGR leads to abnormal and delayed brain development. SGA is associated with decreased levels of intelligence and various cognitive problems, although the effects are mostly subtle. The overall outcome of each child is the result of a complex interaction between intrauterine and extrauterine factors.[(5)]

The main aim of the study the ratio of foetal brain weight to the foetal body weight and to compare the brain weights of foetuses at different gestational ages. This study can be useful for the clinicians who assess the development of brain in utero by using non-invasive techniques like ultrasound and MRI techniques, to make a comparision.

MATERIALS AND METHODS:

A total of 100 foetuses of different gestational ages were collected from the Gynaecology and Obstetrics department in KGH and VGH, Visakhapatnam. The study period was from 2015 March to 2018 April. The foetuses underwent proper embalming and were fixed in 10% formalin. The important parameters that were studied are weight of the foetuses, weight of the brains, crown rump length, gestational age using a digital weighing machine and tape. Foetus with anomalies were excluded. Among the 100 foetuses, 6 were excluded because of anomalies and the remaining 94 foetuses were studied. The values are plotted in graphs for better assessment.

RESULTS: -

The ratios were calculated for gestational ages from 13 to 40 weeks. The ratio for brain declined gradually, throughout the period examined. An observation of practical importance of the brain weight/body weight ratios was virtually constant after 30 weeks of gestation. The mean of the ratio is 11.28. Fig 1 showing the graph of Brain weight plotted against total body weight of the foetus which shows a gradual growth of the brain weight along with the increase in the total body weight of the

foetus. Fig 2 showing the graph of Brain weight plotted against age of the foetus in weeks which shows the proportional growth of the brain along with increase in the gestational age of the foetus. Fig 3 showing the graph of Ratio of brain weight to body weight plotted against age of the foetus in weeks which gives an inference that ratio is gradually decreasing with increase in the gestational age.

DISCUSSION: -

Mathematical models like graphs were viewed as representing the principles or laws of growth. More recently, they have come to be seen as tools for biological analysis.[6] So the values from present study has been plotted on graphs for better assessment of the growth curve. This study was done on 94 foetuses from gestational age of 13 to 40 weeks weighing from 25g to 3085g. The graph of Brain weight plotted against total body weight of the foetus which shows a gradual growth of the brain weight along with the increase in the total body weight of the foetus. The graph of Brain weight plotted against age of the foetus in weeks which shows the proportional growth of the brain along with increase in the gestational age of the foetus. The graph of Ratio of brain weight to body weight plotted against age of the foetus in weeks which gives an inference that ratio is gradually decreasing with increase in the gestational age. Previous study done by Dobbing, J.et al[7] on 118 foetuses with gestational age ranging from 10 to 40 weeks showed similar growth curves when plotted on graphs. According to a study by Mason Barr et al [8]which was done on 1014 foetus weighing from 5g to 4000g, the graph of predicted means and 95% prediction intervals for weights of brain for body weight was similar to our graph. According to a study done by Theo kingdom at el [9] on 218 intrauterine foetuses using MRI technique Normal foetuses have largest brains then CHD, then IUGR brains. Normal foetuses are larger than IUGR foetuses, but are similar size to CHD foetuses. In terms of brain weight to body weight ratio, IUGR babies have the largest brains for their body size, then normal foetuses and, then followed by CHD foetuses.

Figure 1: brain weight plotted against total body weight of the foetus

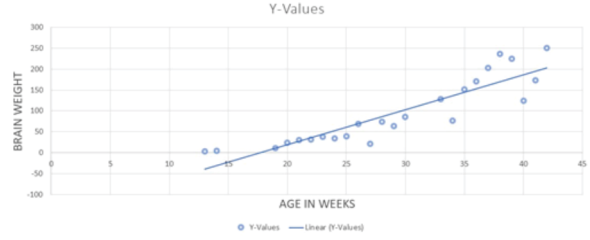

Figure 2: Brain weight plotted against age of the foetus in weeks

Figure 3: Ratio of brain weight to body weight plotted against age of the foetus in weeks

CONCLUSION:-

In this study foetal weight is compared with the brain weight to correlate the subsequent brain development according to the weight of the foetus. A humble attempt is made to study the Ratio of foetal brain weight/ body weight. Any disturbances in this ratio suggests the defective development of the brain. Deviations in the ratio can be because of improper intake of folic acid, neurotoxic drugs or mutations due to other teratogens. By this we can assess the foetal brain growth in the intrauterine uterine life by non-invasive techniques like ultrasound and MRI Techniques to detect the abnormalities earlier.

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