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ORIGINAL ARTICLE

STUDY AND ULTRASONIC MEASUREMENT OF CEREBELLUM DEVELOPMENT OF HOLSTEIN EMBRYO

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ABSTRACT: Nervous system plays an important role in vital functions and without the proper performance of this system; the animal will not be able to resume normal life. Thus, Knowledge and familiarity with the workings of this system is essential. Cerebellum is one of the components of the nervous system that is responsible for a very sensitive task. The aim of this study was to study and ultrasonic measurement of cerebellum development of Holstein embryo. In this quest by referring to the slaughter house, 10 dead Holstein embryo ageing 3-4 month old were selected. Estimating of embryos age was conducted through measurement of size and diameter of ribs and skull of head by standard mentioned methods by ultrasonography. In this study, internal structure of cerebellum was assayed by unechoic and hyperechoic grooves. Data showed that length, width and area of cerebellum in mean was 1.133, 1.135 and 1.132 respectively. A recent study concluded that ultrasonography can be a good diagnostic tool to assess brain and cerebellum and can be use from ultrasonography components in this field.
KEYWORDS: Ultrasonography, Cerebellum, Holstein Embryo, Development.

INTRODUCTION

Direct visualization of fetal anatomy and internal organ structure, including the supporting vascular network, is an important consideration in any prenatal diagnostic procedure. Ultrasound provides direct visualization of maternal and fetal anatomy while providing flexible viewing orientations in real-time. While many fetal anomalies are readily diagnosed with conventional two-dimensional ultrasound, complex developmental anomalies often make it difficult to form a complete impression of the three-dimensional anatomy. While the flexibility of ultrasound offers significant advantages, it also requires the diagnostician to integrate single or multiple images to develop an accurate understanding of the fetal anatomy (McLeary *et al.*, 1984; Lee *et al.*, 1991). While such practice is routine, significant time is often required to understand completely fetal spatial relationships, particularly when a fetus is abnormal, since organ structures may not be in normal positions or routine planes of reference available. Fetal position occasionally limits the image projection angle so that optimal image planes are not available with conventional two-dimensional ultrasound (Reece *et al.*, 1987). Three-dimensional analysis and display of data in medical imaging have been useful in evaluating many parts of the human anatomy; however, it has not achieved widespread use for fetal imaging due to the time required to obtain high-resolution image data and concerns regarding potential risks from ionizing radiation. Magnetic resonance imaging has been used for fetal imaging, although long acquisition times and expense historically have precluded its use for routine purposes. Recent work with echo planar magnetic resonance imaging shows promise for fetal evaluation for the future. On the other hand, ultrasound image acquisition is flexible and permits observation of complex fetal structures with considerable freedom and no apparent biological effects. Early papers have explored the potential of three-dimensional ultrasound for evaluation of the carotid artery and the heart (ACOG, 1993; Zecevic and Rakic, 1976). More recently, several preliminary reports applying three-dimensional ultrasound to the fetus have appeared.

Ultrasound images are topographic in nature and do not require the use of traditional 'reconstruction' algorithms (e.g. back projection) as do computed topography and magnetic resonance imaging, permitting them to be stacked in a manner similar to other modalities to develop a volume data set. Initial efforts in developing three-dimensional ultrasound imaging techniques have utilized the real-time capability, data acquisition speed and positioning flexibility of ultrasound for the rapid acquisition of three-dimensional data, much of

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the effort has been directed toward integrating transducer position information with the gray-scale sonogram (Rakic and Sidman, 1970). Recently, the evaluation of the posterior fossa of the fetal cranium has been accepted as part of the routine obstetric ultrasonographic (US) examination (ACOG, 1993). With this evaluation, structural anomalies in the central nervous system such as Arnold-Chiari malformations and Dandy-Walker malformations can be detected. In addition, the size of the cerebellum or transverse cerebellar diameter (TCD) is also important because it is a useful biometric parameter in estimating gestational age (GA) in the second trimester (McLeary *et al.,* 1984). Indeed, in some cases with dolichocephaly or brachycephaly, TCD may be a more reliable predictor than biparietal diameter, since the posterior fossa is not affected by external pressure, which may induce distortion of the fetal head (McLeary *et al.,* 1984).

Because TCD seems unaffected by intrauterine growth restriction (IUGR), measuring TCD is especially advantageous when IUGR is suspected or when GA is uncertain. In contrast to the progressive increase in dimension, however, the US appearance of the fetal cerebellum in normal and abnormal pregnancies has not been well described. The human cerebellum changes its histologic morphology in utero and after birth. In rhesus monkeys, water content of the fetal cerebellum has been shown to decrease progressively (Selzer *et al.,* 1972). Theoretically, these processes can be monitored with serial US examination throughout pregnancy, and preliminary observations in our laboratory indicate that the human fetal cerebellum changes its appearance with advancing gestation. Therefore, the goal of the present study was to evaluate the change in the US appearance of the fetal cerebellum with advancing gestation. The aim of this study was to ultrasonic measurement of cerebellum development of Holstein embryo.

MATERIALS AND METHODS

In this quest by referring to the slaughter house, 10 dead Holstein embryo ageing 3-4 month old were selected. Estimating of embryos age was conducted through measurement of size and diameter of ribs and skull of head by standard mentioned methods by ultrasonography. Animals were restricted. To achievement of good images we were used of jell and appropriate standoff. Imaging was conducted by a 6-8 MHz linear array and some times by a 5-7.5MHz Convex array probe in B-mode. In this study, ultrasound machine was Pie Medical made in Holland. Data obtained were mentioned as mean±SEM and achieved data f from different views were analyzed by t-test and SPSS ver. 17.

RESULTS

The sample of obtained images is shown in Figure 1. Statistical description of data was completely mentioned in table 1.

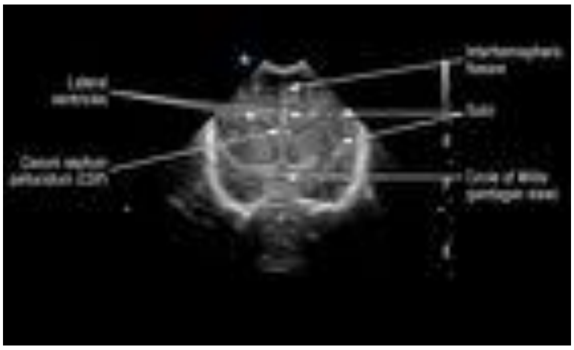

Figure 1: sample of images from embryo cerebellum

Table 1: statistical description of achieved data

Understudy area	Mean of cerebellum (cm)	Standard deviation
Length	1.133	0.052
Width	1.135	0.052
Area	1.132	0.053

In this study, internal structure of cerebellum was assayed by unechoic and hyperechoic grooves.

DISCUSSION

Direct visualization of the internal anatomy of the fetus and the fetal surface is important in evaluating high-risk pregnancies. Fetal imaging is one of the most litigated areas of diagnostic imaging because of the difficulty in visualizing small fetal structural defects and the heightened emotional implications of accurate fetal assessment. A goal of this paper was to evaluate the capability of three-dimensional ultrasound to visualize important fetal structures and compare them to the fetus directly. The selection of fetal specimens permitted direct comparison between images and specimens and demonstrated the high degree of correlation between specimen and displayed surface features and internal structures that is possible with three-dimensional ultrasound volume data. Acquisition of high quality three-dimensional ultrasound volume data from patients is feasible, although continued improvement in transducer performance and visualization analysis algorithms will be essential for complete integration into the clinical setting (Rakic and Sidman, 1973; Kornguth *et al.,* 1968).

Speckle noise patterns resulting from imaging a highly coherent wave, scattered and reflected by complex tissues; reduce image signal-to-noise ratios. Long-range structure due to organ surfaces and internal structure benefits from three-dimensional filtering by using neighborhood information and spatial compounding resulting from multiple image planes being combined. On the other hand, speckle will be removed since it has no long-range structure. Three-dimensional filters operating on the original data, as part of condensing the data to the final matrix size, will have minimal degradation effect on the final image detail, since the resolution of the image display exceeds that of the ultrasound scanner. There was, however, some resolution loss resulting from reducing the volume matrix to manageable dimensions (Altman, 1972; Rakic, 1971).

The finite resolution of the ultrasound scanner, particularly out of the focal zone, will blur image detail. As a result, regions of signal void will be filled in, appearing smaller than actual size, and regions of strong echoes will be broadened, appearing larger than actual size. Thus, the orbits appeared smaller than expected, while the digits appeared thicker and slightly fused (Rakic *et al.*, 1974; Wisniewski *et al.*, 1984).

Imaging of the fetus under in vitro conditions assisted in identifying the fetal surface for rendering, whereas isolation of the intrauterine region containing the fetus and amniotic fluid in vivo will require additional efforts where there is fetal-maternal contact. Patients in whom there is oligohydramnios will pose a greater challenge, and will require careful definition of fetal placental uterine boundaries. Other display methods, such as planar slices of variable transparency, may be more appropriate than requiring operator identification of interfaces, and similarly for internal organ surfaces which do not have uniquely different ultrasound signal characteristics. Surface rendering may be less important than other display techniques in these situations, since it requires either isolated surfaces or surfaces that have been clearly defined by the reviewer (Rees and Harding, 1988; Petit *et al.*, 1984).

Although many fetal anomalies are easily diagnosed with conventional two-dimensional ultrasound, there remain complex cases for which it is extremely difficult to form a mental impression of the three-dimensional anatomy of the fetus in the examiner's head. Fetal anomalies can be extremely complex and certain anomalies such as the Limb-Body Wall complex, amniotic band syndrome, scoliosis, and cleft palate lip are generally difficult to understand and demonstrate on film or videotape. Approximately 25% of fetuses with an anomaly identified on sonography actually have multiple anomalies, with 37% of the associated anomalies missed, even though the primary sonographic diagnosis is generally accurate. While sonographic imaging capabilities have developed significantly over the last 10 years, three-dimensional ultrasound represents a major advancement in improving our ability to put the entire picture together (Hill *et al.*, 1991).

The improved visualization of organ spatial relation-ships made possible by three-dimensional ultrasound can assist in making the definitive diagnosis, particularly in cases involving complex fetal anomalies where the standard landmarks may be distorted or missing. Additionally, since maternal body habits or fetal position often precludes obtaining the optimal image plane, three-dimensional ultrasound permits the diagnostician to review the volume images interactively, including orientations not available during patient scanning. Such flexibility should provide an increased understanding of underlying anatomical relationships. More accurate measurement of fetal organ volumes, including fetal weight correlation, should be possible using volume data sets (Rakic and Sidman, 1973).

Three-dimensional ultrasound represents an alternative method to invasive procedures such as fetoscopy39.40, which are not commonly performed outside the academic setting for evaluating the fetal surface. While the fetal face can certainly be evaluated with two-dimensional ultrasound, certain abnormalities may be extremely subtle, especially when an abnormality is not suspected, and the advantages of three-dimensional compared to two dimensional ultrasound can be readily appreciated in the figures. Three-dimensional ultrasound surface rendering programs should also assist in evaluation of the abdominal wall, neck, genitalia, and extremities (Selzer *et al.*, 1972).

Three-dimensional ultrasound fetal imaging offers potential for improved assessment of the fetus at risk for anomalies. Visualization of the fetal surface should improve our confidence in demonstrating a normal fetus, particularly when at risk for a specific anomaly. Identification of normal fetal structures is extremely valuable to parents who have had a previous child with a major anomaly.

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