ABSTRACT

Gestational Diabetes Mellitus (GDM) is a condition in which women, without previously diagnosed diabetes exhibit high blood glucose levels during pregnancy. Diabetes Mellitus, when untreated, complicates the pregnancy by affecting the growth of the placenta. The complications include intra-uterine growth retardation, placental abruption and even fetal demise. Placenta is a membranous vascular organ through which the embryo is attached to the wall of the uterus. The nutrients and oxygen are supplied to the fetus in the uterus through the placenta. The elimination of waste and exchange of respiratory gases are also the functions of placenta. It plays a vital role in the healthy development of the fetus.

In India, the placenta is usually observed in a casual manner during the routine ultrasound examination. Further, these scans are of low resolution making it difficult to identify many of the important characteristics. In the scans taken during the later stages of gestation, the fetus in the uterus hides the placenta, making it difficult to observe the features of the placenta or measure its size with accuracy. Since the placenta plays an extremely important role in the growth and health of the fetus, it needs to be studied in more detail using better techniques during the early stages of pregnancy.

The aim of this research is to employ Wavelet Image Fusion Approach for the classification of Ultrasound Placenta Complicated by GDM. Diabetic pregnancy shows increase in the size of the placenta. This affects the growth of the fetus which may even lead to the death of the fetus. Considering the placenta, size alone may be sufficient to identify the onset of complications at the initial ultrasound examination. The primary objective of this study is to identify the placental complications in women with Gestational Diabetes Mellitus by revealing the important features that distinguish normal and
abnormal placenta, using wavelet image fusion technique. The secondary objective is to understand the risk of miscarriages associated with untreated GDM and to explore the influence of GDM on placental growth.

The ultrasound images of placenta obtained from the B-mode ultrasound scanner is usually low in resolution. The characteristic feature of the placenta, which plays an important role in classification, is lost because of poor resolution. There is a need for a technique to retain the finer details of the placenta in the ultrasound. In this research, the multi-view placenta images (transverse scans of placenta ultrasound images captured at the right and left of the monitor) are subjected to wavelet decomposition. The essential attribute of the ultrasound placenta is retained, when wavelet-decomposition is employed, since it is an efficient tool to extract the features of an image. When an ultrasound placenta is subjected to wavelet decomposition, the image is decomposed into different frequencies. The prominent features in these frequencies are fused into a synthesized image. The ultrasound images of placenta are then reconstructed using image fusion and it is used to study the complications rendered by GDM on the growth of the placenta. The Haralick features are extracted from the fused placenta ultrasound image which is already decomposed using wavelet decomposition.

The pelvic ultrasound image taken during the first and second trimester of pregnancy shows the fetus, placenta and the cervix. It is essential to segment the region of interest, which is the placenta, from the ultrasound. The wavelet decomposed placenta ultrasound is segmented to extract the area of focus, placenta. The statistical measures to estimate the volume of the placenta, are obtained from this segmented placenta ultrasound. The relevant image features are then extracted from the segmented placenta. Neural Network is an efficient tool that can capture and represent complex input and output relationship. The reconstructed placenta ultrasound is later classified as either normal placenta or abnormal placenta, using the extracted features.
The present research also evaluates the influence of GDM on adverse outcomes of pregnancy by an estimation of volume of the placenta during the early stages of pregnancy. During the course of pregnancy, ultrasound screenings are done in early pregnancy which is from six to fourteen weeks of gestation. The mid pregnancy is from fourteen to twenty six weeks of gestation. The late pregnancy is from twenty six to forty weeks of gestation. In the later stages of gestation, the fetus in the uterus hides the placenta and therefore makes it difficult to get it captured in the ultrasound. The focus of this research is the ultrasound placenta with 10 weeks, 15 weeks, 17 weeks and more than 20 weeks as the gestational age. The placenta needs to be screened in the initial stages, which can avoid miscarriages due to GDM. The standard common obstetric diagnostic mode is 2D scanning. The estimation of placental volume is not a regular practice in the case of 2D ultrasound. The results of the work have effectively identified the changes in the ultrasound placenta under diabetic conditions.

The findings of the research are that the Haralick features extraction showed significant characteristics of abnormal placenta. These features played an important role in the identification of abnormal placenta. It is found that there is an increase in classification accuracy when placenta ultrasound is subjected to wavelet decomposition and image fusion.

The study concludes that the application of wavelet decomposition reduces the speckle in the ultrasound placenta. The fusion of such decomposed wavelet improves the characteristics of the essential features which in turn, enhances the classification accuracy. The Haralick features obtained for the ultrasound image of placenta plays a significant role in the classification process. There is also an increase in the contrast of ultrasound placenta which is complicated by GDM.
The outcome of the research is that, multi-view scans can be fused to identify the influence of GDM on the early stage of placental growth by employing wavelet decomposition and image fusion technique. This research also suggests that, the evaluation of the volume of placenta during the routine ultrasound screening at fifteen to twenty weeks of gestation using wavelet fusion of multi-view of the ultrasound placenta can identify the influence of diabetes mellitus which otherwise can lead to the severe risk of fetal demise.