

Comparing placentas from normal and abnormal pregnancies

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A healthy placenta is essential for a normal outcome of pregnancy. The human placenta is described as a discoid organ approximately 3cm thick. The human placenta consists of a villous tree which is bathed in maternal blood. The villous tree contains fetal vessels, carrying fetal blood into terminal villi where it is brought into close proximity with maternal blood to optimise the transfer of nutrients and oxygen from mother to fetus and waste products in the opposite direction. As a result the function of the human placenta is very closely related to its structure. A number of microscopic differences have been noted between normal placentas and those from intra-uterine growth restriction (where a baby does not meet its growth potential) and pre-eclampsia (where the mother develops high blood pressure and loses protein in her urine). These include changes in the branching structure.

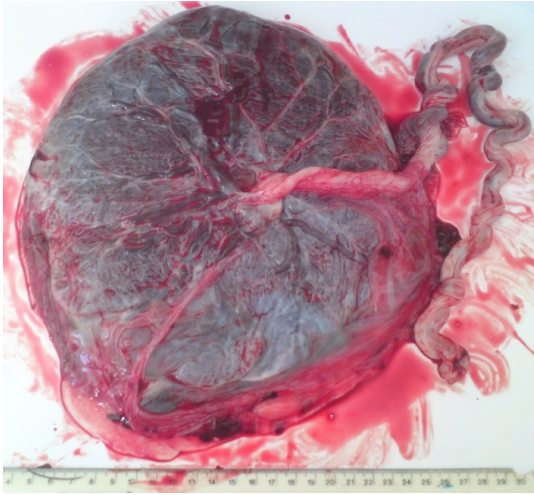
We have collected data on placentas from women with normal pregnancies and from pregnancies complicated by reduced fetal movements (RFM). Women with reduced fetal movements are at increased risk of stillbirth and intra-uterine growth restriction, so represent a group with a high possibility of abnormal placental structure. Our preliminary data show that women with RFM have lighter, smaller placentas than women with normal pregnancies. We have taken images of the fetal and maternal surfaces of the placenta. Using these images we have been able to show that women with RFM have a larger proportion of infarction (dead tissue) in the placenta. Looking at the images we have collected there seems to be a greater number of non-discoid placentas with non-central umbilical cord insertion in women presenting with RFM. Surprisingly, few studies have addressed macroscopic differences in placental structure and the outcome of pregnancy so we have little to compare our data with, and there are few mathematical studies (2 papers from Salafia and Yampolovsky).

To enable us to compare placentas from normal and RFM pregnancies, we are specifically interested in developing measures of:

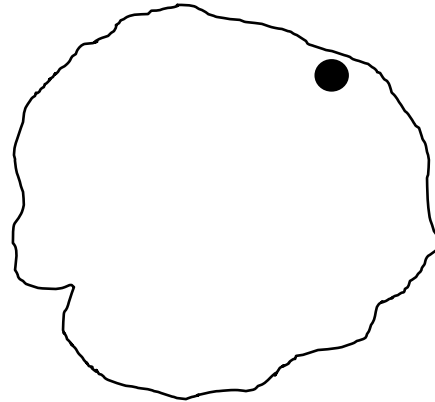
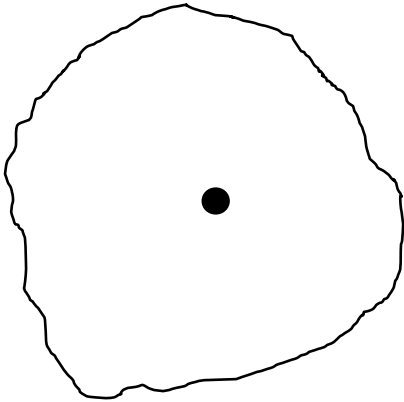
1. The circularity of the placenta
2. The centrality of the umbilical cord insertion
3. The network of vessels on the fetal surface of the placenta

If this is successful we can then use these formulas to compare other pregnancy complications such as preterm labour and stillbirth. Placental images are shown below. The left hand column shows normal placental images, the right hand one a pregnancy complicated by RFM. The first row shows the crude image, the second shows a trace around the edge of the placenta and the site of cord insertion. The third row shows the branching structure of the vessels on the fetal surface. We would like to find a means / basis to compare the images second and third rows of the figure.

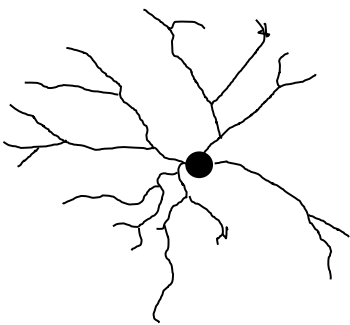
Normal



DFM



Shape & Cord Insertion



Fetal arterial network