



Original Research Article

Placental pathology in intrauterine growth retardation

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ABSTRACT

Background: Several histopathological features are found more frequently in placentas from pregnancies complicated by foetal growth restriction (FGR), including villous infarction, maternal vascular changes and villous morphological alterations, although around one quarter of placentas associated with FGR lack any morphological abnormality on routine examination. So, our aim is to study various morphometric and morphological changes in placentae of small for gestational age babies. The correlation of various maternal parameters like height, age and parity with the foetal weight, placental weight, foeto-placental ratio (F/P) and placental coefficient (PC) and lastly to know whether each diseases process has any specific change in placentae.

Material and Methods: A prospective randomised control study was conducted from August 2016 to August 2018 in the Department of obstetrics and gynaecology JSS Hospital Mysore Karnataka. The total number of deliveries during this period were 3430. Out of which 397 babies were diagnosed of having Intrauterine growth retardation (IUGR) Total number of 150 cases were studied out of which 100 placenta were from IUGR group (study group) and the remaining 50 placenta from healthy full term pregnancies (Control group).

Results: The incidence of IUGR in our study was 11.6%. The commonest maternal cause for IUGR was anaemia 43%, followed by 18 % cases of preeclampsia and in 37% cases cause was Idiopathic. Maternal characters such as age, parity, and height were studied in relation to foetal outcome. An increase in the birth weight and placental weight was found with an increase in maternal age, height as well as parity. The mean placental weight in IUGR group was 484 grams while in control group was 520 grams. The average surface area in placentae in study group was 200.96 sq.cms. While in control group was 254 sqcms.

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1. Introduction

Scientific interest in human placenta is derived not only from its diverse forms and functions but also from the unique metabolic, endocrine, and immunologic properties of trophoblasts.

Placenta is a vital organ in its function to the developing baby as it serves function of transfer of oxygen and

metabolites between maternal and foetal blood.

Thus, its careful examination may yield information of prognostic significance for the new-born. The placenta is an important potential means of establishing that placental damage causes adverse pregnancy outcome independently of clinical care. All obstetricians serve an important role in the documentation of gross placental features and in procurement of appropriate high-powered light microscopic slides. Pathologic placentae are common. So,

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we can determine whether an abnormal placenta represents the probable cause of adverse pregnancy outcome. Thus placental examination is helpful for clarification of the pathophysiological features and significance of antepartum events detected by modern technology as well as the relative contributions of acute (peripartum) and chronic (antepartum) events of adverse neonatal outcomes, improved management of subsequent pregnancies by diagnosing pathological condition that may have risk of recurrence or may even be preventable or treatable in subsequent pregnancies and assessment of new-born risk of long term neurodevelopment sequelae thus, giving the opportunity to optimize long term outcome by early and timely intervention.

Therefore, there has been increasing interest in defining patterns of placental pathology associated with intrauterine foetal growth restriction (FGR), with progressive clinical refinement of subgroups of foetuses that are small for gestational age (SGA), with and without other features of FGR.

The aim of our study was to evaluate various morphometric and morphological changes in placentae of small for gestational age babies and also to study the correlation of various maternal parameters like height, age and parity with the foetal weight, placental weight, foetoplacental ratio (F/P) and placental coefficient (PC).

2. Materials and Methods

A Prospective randomised control study was conducted from August 2016 to August 2018. In the Department of obstetrics and gynaecology JSS Hospital Mysore Karnataka.

The total number of deliveries during this period were 3430. Out of which 397 babies were diagnosed of having Intrauterine growth retardation (IUGR).

Total number of 150 cases were studied out of which 100 placentae were from IUGR group (study group) and the remaining 50 placentae from healthy full-term pregnancies (Control group).

2.1. Inclusion criteria

An IUGR foetuses whose estimated weight was below the 10th percentile were included in the study. Birth weight percentiles were determined by Hospital published normal curves applied to local population.

Only babies born after 37 completed weeks of gestation were included in the study in both arms.

2.2. Exclusion criteria

Foetuses with known genetic and chromosomal anomalies, multifetal pregnancies, IUGR babies born before 37 completed weeks were not included in the study.

Mothers were screened in the antenatal period. Those who were diagnosed as cases of IUGR with or without antenatal complication factors like anaemia, Renal diseases, Hypertension etc. were admitted in the ward They were given appropriate treatment after doing relevant investigations, that were followed up to delivery.

Out of the 100 cases selected in the IUGR category 56 cases were on regular antenatal care and the remaining cases (46) were unbooked cases.

After the delivery the placenta was examined in the fresh state. Excess of blood was washed out under running water. Then the placentae was weighed, its shape, dimensions, and colour noted. The attachment of the cord to the placenta was examined and the total cord length was measured. Colour of the cord and the membranes, presence of true and false knots, thinning of the cord and condition of the blood vessels were examined.

Next, the foeto-placental weight ratio was calculated

$F/P = \text{weight of the foetus in grams} / \text{weight of the placenta in grams}$.

Similarly, the placental Coefficient was than calculated

$P.C = \text{placental weight in grams} / \text{foetal weight in grams}$.

The surface area of the placenta was then calculated by formula TTr^2 , where r was the mean placental diameter divided by 2

3. Results

So the total number of cases studied were 150. out of which 100 cases from IUGR group (study group) and 50 cases formed the (control group) which were normal delivered at term.

In our study maximum incidence of small for dates babies were in between maternal age group 20 to 24 years (45%) and only 5% of cases were seen in above age group 30 years.

In our study group maximum number of IUGR cases were found in primipara patients that is 36% and only 16% in para 4 and above.

Regarding the foetal weight, 63% of cases had babies weighing between 1500-2500 grams. 37% cases had babies more than 2000 grams in the study group

Higher incidence of IUGR babies is seen in female babies 54% as compared to 46% in male babies.

The commonest maternal cause was Anaemia – 43%. In 37 cases no obvious maternal complicating factor was found.

Table 1: Maternal factors responsible for IUGR in our study

Maternal causes	Number	Percentage
Mild preeclampsia	10	
Severe preeclampsia	8	
Anemia	43	
Elderly primigravida	2	
Idiopathic	37	

3.1. Observation on placental study

The study group maximum number of placentae weight from 351 to 400 grams, and the smallest placental weight was 310 grams and the heaviest placental weight was 484 grams while the mean placental weight was 484 grams.

In control group maximum number of placentae weight between 451-500 grams and the mean placental weight was 520 grams.

The majority of placental shape in study group was round in 74 cases and oval in 26 cases, while in control group 14 cases had round and 36 cases had oval placenta.

In study group 40% of cases had surface area between 211-230 sq.cms and only 11% cases had surface area between 170-190 sq.cms. The average surface area in placentae in study group was 200.96 sqcms, while the average surface area of placentae in the control group was 254 sqcms.

In study group 59 placentae had cotyledons number ranging from 13 to 16 and in the control group 32 of cases had cotyledons ranging from 13-16.

In study group 61 placentae showed eccentric cord insertion and 37 showed central cord insertion and in only 2% cases cord was inserted marginally, while in control group 35 placentae showed eccentric cord insertion.

In study group 33 cases placentae had cord length measuring between 21 to 25 cms and only 17 of cases placentae had a cord length more than 30 cms. In control group 18 of cases had cord length more than 30 cms.

In the study group 20 cases had thinned cord, 16 had false knots and only 1 showed presence of true knots while in control group, 5 cases had false knots.

Table 2: Gross Macroscopic finding in study group

	Description	Number
Calcification	Mild	24
	Severe	11
Infarction	Mild	32
	Extensive	9
Fibrin deposition	-	27
Retroplacental haematoma	-	3

In the study group 35 placentae had calcification and 41 placentae showed infarcts. In 27 placentae had fibrin deposits while 3 cases were associated with retroplacental clots.

Overall, extensive infarction, villous changes and leucocytic infiltration was statistically significant in IUGR group as compared to control group.

Microscopic findings in placentae of mothers with Anaemia – total number of cases 43.

Microscopic findings in placentae from mothers having mild and severe preeclampsia and giving birth to IUGR babies.

Overall, the placenta changes were more severe in severe preeclampsia than mild preeclampsia.

In the study group the mean foetal weight in booked cases was 2157 grams which was 242.6 grams more than the mean foetal weight recorded in un-booked mothers which was 1914.4 grams. The mean placental weight in booked cases was 414.8 grams and in un-booked cases was 394 grams. The difference between the two was 19.9grams.

Again, in study group F/P ratio and P.C in booked cases was 5.2 and 0.192 and in the un-booked cases it was 4.81 and 0.206 respectively. The difference in birth weight of babies between booked and un-booked mothers was found to be statistically insignificant as the value of p was more than 0.05.

In the study group the maternal age group between 15 to 19 years showed the least foetal and placental weight. That is 1830.5 grams and 388.6 grams. In the age group more than 30 years showed the rise in birth weight to 2370 grams and placental weight to 455.7 grams.

The value of P was less the 0.05. This differences in birth weights of babies between younger and older maternal age groups was statistically significant.

Again, in study group the least mean birth weight and placental weight recorded was in mothers whose height was measuring between 130-139 cms. The F/P ratio and PC whose height measuring 130 -139 was 4.78 and 0.209 respectively. This increased to 5.22 and 0.191 as the mother's height became more than 160 cms.

The value of P was less than 0.05. The difference in birth weight of newborns between shorter and taller mothers was statistically significant.

In primiparas the mean foetal and placental weight were the least was 1811 grams and 380 grams respectively which increased significantly with increase in parity with average of 250 grams.

The value of P was less than 0.05. The difference in birth weights of infants born to primiparas and multigravida was statistically significant.

The mean foetal weight and placental weight for male babies was significantly higher than in female babies.

The F/P and P.C for male infants was 5.02 and 0.198 respectively and for female infants it was 4.75 and 0.210 respectively.

The value of p was more than 0.05. The difference in birth weight of male and female infants was not statically significant.

The mean foetal and placental weight for the lower weight of foetus were 1920 gms and 391 grams respectively which was lower than the mean foetal and placental weight in the higher foetal weight group. (2265 grams and 437 grams. The F/P and P.C for the lower weight group was 4.9 and 0.203 and that for the higher weight group was 5.18 and 0.193 respectively.

Table 3: Performa of microscopic examination of placenta which was used during our study

Decidua	Chorionic villi	Intravillous space	Foetal stem vessels
Thrombotic and degenerative change	Fibrinoid necrosis	Thrombi	Fibromuscular sclerosis
Fibrin deposition	Increased syncytial knots	Fibrin deposition	Obliterative endarteritis
Atheroma formation	Deficiency of vasculo-syncytial knots	Inflammatory infiltration	Haemorrhagic endovasculitis
Necrosis	Cytotrophoblastic hyperplasia		
	Basement membrane thickening		
	Villous edema		

Table 4: Microscopic findings in placentae in study group and control group

	Description	Study group (no.)	Control group (no)
1	Infarction		
	Mild	32.43	40
	Extensive	16.20	-
2	Calcification		
	Mild	27.02	50
	Extensive	10.8	5
3	Haemorrhage	None	-
4	Hyaline change	40.5	-
5	Villous changes		
	Avascular villi	18.9	5
	Syncytial knots	48.6	20
	Basement membrane thickening	56.7	-
	Cytotrophoblastic hyperplasia	62.0	20
	Villous fibrosis	40.0	10
6	Leucocytic infiltrations	70.2	-

Table 5:

Description	Percentage
Infarction	
Mild	41.8
Extensive	2.3
Calcification	
Mild	51.1
Extensive	11.6
Haemorrhage	None
Hyaline change	23.2
Villous changed	
Avascular villi	34.8
Syncytial knots	88.0
Cytotrophoblastic Hyperplasia	69.7
Basement membrane thickening	62.7
Villous fibrosis	33.8
Leucocytic infiltrartion	55.8

Table 6: Percentage wise distribution in 18 cases of preeclampsia

Description	Mild preeclampsia %	Severe preeclampsia %
Infarction		
Mild	80	12.6
Extensive	20	87.0
Calcification		
Mild	60	25
Extensive	40	75
Haemorrhage	None	37.5
Hyaline change	60	62
Villous changed		
Avascular villi	80	62
Syncytial knots	60	87.5
Cytotrophoblastic Hyperplasia	70	87.5
Basement membrane thickening	60	100
Leucocytic infiltration	40	12.5

4. Discussion

The placenta provides a paradox as it is one of the most readily available structures for examination but is one of the least known.

The incidence of IUGR in our study is 11.6% which is fairly similar as quoted by different authors Kenneth & Usher¹ 1996 9.7%. Robert C. Vandenbosch et al from USA around 10%.

Maternal characters such as age, parity, and height were studied in relation to foetal outcome. An increase in the birth weight and placental weight was found with an increase in maternal age, height as well as parity.

The commonest maternal cause for IUGR was anaemia 43%, followed by 18% cases of preeclampsia. And in 37% cases no obvious antenatal complicating factor was found.

The mean placental weight in the IUGR group was 404.5gms. This was 74.5gms less than the weight recorded in placenta of control group. Similarly, the mean placental surface area in the IUGR group was 200.96sq.cms, which was 54.04 sq.cms, less than in control group.

On gross examination of the placenta, apart from meconium staining, other findings noted in majority of the cases were infarcts, calcification, fibrin deposits and retroplacental haemorrhages.

On the microscopic study, marked changes were seen in the villous structure. As a response to hypoxic injury, as in anaemia, increased syncytial knots, cytotrophoblastic proliferation was seen. Where the injury to the villous was ischemic in nature, as in pregnancy complicated by hypertension, the response was one of basement membrane thickening and delayed villous maturation. Along with the above changes, nonspecific chronic inflammation was found in placenta of IUGR infants without any maternal cause. The percentage wise distribution was as follows.

Of the 43% cases of anemia, syncytial knots were present in 88% of cases.

Of the 18% cases with preeclampsia avascular villi were present in 88% cases and 60 cases showed basement membrane thickening.

F/P ratio was directly proportional and PC ratio was inversely proportional to the maternal age, height and parity to a statistically significant extent.

The macroscopic and microscopic findings are fairly similar to various studies carried out by H. Fox et al² in 1978, Gershan and Strauss in 1961, Sushan-Shen-Schwartz³ in 1988 and many more.

Desai, Modi and Parik⁴ in 1994 studied placenta of anaemic patients which showed young mothers delivered low birth weight babies and had low birth weight placentae.

Maulik et al,⁵ found placental weights to be 631g in the control group and 409g in the IUGR group with the differences being statistically significant.

The findings are comparable to a study by Sharma and Mardi⁶ where placental infarction on macroscopic and microscopic surfaces as well as ischemic necrosis was higher in the IUGR placenta compared to those normal.

5. Conclusions

A well-nourished newborn is the best evidence of adequate placental function. However, placental inadequacy as related to small for gestational age infants has been very difficult to demonstrate because of its multifactorial origin. Though maternal, foetal, and placental causes have been blamed in turn as etiological factors for IUGR, all of them are so closely interlinked that it is not possible to implicate any factor alone as the causative agent.

The pre-pregnancy nutritional and environmental factors are influencing the ultimate foetal outcome. Hence the maternal age alone cannot be held responsible for IUGR.

It is well established that pregnancy with anemia or hypertension causes changes in the placenta and that these changes lead to growth retardation.

In the early weeks of gestation, when the placenta is in the developing state, minor insult in the form of mild anaemia or short-lived maternal infection might hamper placental maturity. Though there is sufficient time for maternal recovery, in few cases the placental injury may persist throughout pregnancy. Thus, it is suggested that such minor ailments in early gestational period should never be overlooked. This will ultimately help in improving the quality of life in the modern era of a two-child norm

Pathological examination of the placenta remains subject to technological as well as cost and time limitations. It is quite challenging to interpret the significance of lesions in placenta with imperfectly defined functional reserve.

Pathological findings should be correctly reported in standardised manner based on criteria which include maternal vascular under perfusion, foetal vascular obstructive lesions and amniotic fluid infection

The histological placental findings in FGR are therefore varied, from morphologically unremarkable through to severe uteroplacental vasculopathy, with no single pathological feature associated with high sensitivity or specificity.

Future research using histopathological assessment of aggregated data from multiple studies into larger datasets with centralised pathology review will allow delineation of distinctive clinicopathological associations and further understanding of pathophysiology.

Thus, early identification of various maternal, foetal, and placental problems and prompt treatment can avoid the placental insufficiency and ultimate resulting in mother giving birth to healthy baby.

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None.

7. Conflict of Interest

None.

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