



Original Research Article

Morphological study of placenta in normal and hypertensive pregnancies

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Abstract

Background: Hypertensive disorders complicate 5-10% of all pregnancies and form a dangerous triad with haemorrhage and infection that contribute greatly to maternal morbidity and mortality. The fetus is dependent on placenta for growth and development. Many disorders of pregnancy like hypertension are accompanied by gross pathological changes in placenta.

Aim: The aim of the study was to assess the gross morphology of placentae of women with pregnancy induced hypertension and to compare them with normal pregnancies.

Material and methods: An observational comparative study was carried out in the Department of Anatomy, S. M. S. Medical College, Jaipur, Rajasthan. Total 80 placentae, 40 from pregnancy induced hypertensive pregnancies and 40 from normal pregnancies were studied for the morphology and compared. Gross morphological features of placentae like weight, shape, insertion of umbilical cord, number of cotyledons, diameter, surface area and central thickness in both groups were recorded and analyzed using 'Chi square' and 'Z' test of significance.

Results: The mean placental weight, numbers of cotyledons, diameter, surface area and central thickness were significantly less ($p < 0.05$) in placentae from pregnancy induced hypertensive women. They also showed increased incidence of marginal insertion of umbilical cord ($p < 0.01$), while the shape of placentae did not show significant variation ($p > 0.05$).



Conclusion: The placentae from hypertensive pregnant women showed significant morphological changes as compared to controls which may alter the perinatal outcome.

Key words

Pregnancy induced hypertension, Morphology, Placenta, Pregnancy.

Introduction

The placenta is an organ that connects the developing fetus to the uterine wall to allow nutrient uptake, waste elimination and gas exchange via the mother's blood supply [1]. Normal fetal growth and survival depends on the proper development and function of the placenta. During its development throughout the gestation, placenta undergoes different changes in weight, structure, shape and function continuously [2].

When pregnancy is complicated by a medical problem like, hypertension, diabetes, etc. which affects maternal health, may also affect the architecture and functions of the placenta. Thus, examination of the placenta gives valuable information about the perinatal health of the baby and the mother [3].

Hypertension is one of the common complications met with in pregnancy and diagnosed if maternal blood pressure is more than 140/90 mm Hg. Hypertension in pregnancy may be chronic hypertension (onset before pregnancy) or may be induced due to pregnancy like, gestational hypertension, preeclampsia and eclampsia. These hypertensive disorders causes decreased placental perfusion due to vasospasm of maternal blood vessels. [4].

The present study was undertaken to compare the morphological changes in the placentae of normal and hypertensive mothers. The aim of our study was to assess the adverse effects of maternal hypertension on the morphology of the placentae.

Material and methods

It was an observational comparative study conducted between April 2012 and September 2014 in Department of Anatomy, S. M. S. Medical College, Jaipur (Rajasthan). Due approval was obtained from institutional ethics committee and 40 placentae from pregnancy induced hypertensive women were collected from Department of Obstetrics. An equal numbers of controls were taken from uncomplicated normal pregnancy. All mothers were properly explained about the study and their written consent was taken. Complete medical, social and obstetric history was recorded to identify the confounders. The mothers were examined clinically along with recording of relevant investigation reports. All data were collected in a pre- structured and pre-tested proforma.

Inclusion criteria

Pregnant women aged between 20-38 years, para 1 to 4, gestational age between 37-42 weeks, deliveries by either vaginal route or caesarean section were included.

Exclusion criteria

Pregnant women who did experience any complication during pregnancy like diabetes mellitus, hypothyroidism, anaemia, abruptio placentae, multiple pregnancies, jaundice and maternal malnutrition were excluded from study.

Statistical analysis

The data was entered on Microsoft excel 2010 and analyzed. The results for each parameter



were presented in Tables and Figures. Proportions were compared using 'Chi-square' test of significance, while 'z' test was used for quantitative data to determine whether there was a statistical significant difference between control and study group. A 'P-value' of less than 0.05 was considered to be statistically significant.

The placentae with attached membranes and umbilical cord were collected soon after delivery, washed in running tap water to clean all blood and surface dried between blotting papers and examined for morphological characteristics. The membranes were trimmed and the cord was cut at about 2 cm from its insertion in the placenta. The placenta was then weighed and general shape of placenta was ascertained. The fetal surface was examined for insertion of umbilical cord. The numbers of cotyledons were counted from maternal surface of the placenta. Two diameters of the placenta were measured with the non stretchable measuring tape and the average of the two readings was calculated. The maternal surface area of the placenta was calculated by using the formula πr^2 . Thickness of the placenta was taken at the centre with the long knitting needle inserted in it after applying a guide.

Results

It was observed in present study that mean age was 26.33 ± 4.33 years in control group and 26.73 ± 4.40 years in PIH group (**Table - 1**). Majority of subjects (42.5%) in control group were in the age group 20-24 years followed by 25-29 years (32.5%). Similar pattern was seen in PIH group in which 40% subjects were in the age group 20-24 years followed by 35% subjects in the age group 25-29 years (**Table - 2**).

The mean weight of controls was 54.28 ± 6.10 kilograms and 56.35 ± 5.51 kilograms in PIH group; while the mean height of control and PIH

group was similar (1.57 ± 0.05 meters). The body mass index (BMI) of control group was 22.05 ± 1.80 Kg/m² and 22.76 ± 2.04 Kg/m² in PIH group (**Table - 1**).

In control group majority of subjects were in para-2 (40%) followed by para-1 (37.5%), while in PIH group maximum subjects were in para-1 (47.5%) followed by para-2 (32.5%). Para-3 cases were 17.5% in control and 15% in PIH group; while both groups contained 5% para-4 subjects (**Table - 3**).

In control group 40% placentae were round shaped and 60% were oval shaped, while in PIH group 20% were round and 80% were oval shaped (**Table - 4**). The difference was not significant ($p > 0.05$). The umbilical cord insertion in control group was found as follows: central 27.5%, eccentric 55% and marginal 17.5%; while in PIH group it was 17.5%, 30% and 52.5% respectively (**Table - 5**). The difference was highly significant ($p < 0.01$).

As per **Table - 6**, the mean placental weight in control group was 397.50 ± 42.29 grams, while it was less in PIH group (376.25 ± 39.20 grams). The difference in placental weight was significant ($p < 0.05$). The mean number of cotyledons in control group was 16.93 ± 2.49 , while it was less in PIH group (14.78 ± 2.28). The difference was highly significant ($p < 0.01$). The mean central thickness in control group was 1.96 ± 0.23 cm, while it was less in PIH group (1.82 ± 0.22 cm). The difference was again highly significant ($p < 0.01$). The mean placental diameter in control group was 15.40 ± 1.34 cm, while it was less (14.46 ± 1.81 cm) in PIH group and the difference was highly significant ($p < 0.01$). The mean placental surface area in control group was 187.61 ± 32.73 cm², while it was less (166.64 ± 41 cm²) in PIH group and the difference was significant ($p < 0.05$).



Discussion

Normal placental findings are difficult to define and differentiate from the abnormal, because structure of the placenta is complex and evolution is rapid. Fox (1968) suggested that placental pathology is quantitative rather than qualitative. Benirschke and Fox (1975) stressed the significance of placental findings only when these had a bearing on the fetal outcome [5, 6].

The weight of placenta is an important and functionally significant parameter as it is related to villous area and fetal metabolism. In the present study, the mean placental weight in PIH group was less as compared to control group and this difference was found significant ($p < 0.05$). Similar findings were reported in previous studies by Rath, et al. (2000) [7] in New Delhi, Udania and Jain (2001) [8] in Surat, Majumdar, et al. (2005) [9] in Kolkata, Artico, et al. (2009) [10] in Brasil, Kishwara, et al. (2010) [11] in Dhaka, Bangladesh, Londhe and Mane (2011) [12] in Karimnagar, Andhra Pradesh, Meyur, et al. (2012) [13] in Kolkata, Kaur, et al. (2013) [14] in Patiyala, Zia-ur-rehman, et al. (2013) [15] in Rahim Yar Khan and Bahawalpur, Pakistan, Gowda and Jayanthi (2014) [16] in Bangalore, Devishankar, et al. (2012) [17] in Nellore, Andhra Pradesh and Navbir (2012) [18] in Lucknow.

Fox (1978) reported that placentae tend to be smaller in preeclampsia than those in uncomplicated pregnancies. Although the placenta adopts itself to hypoxia but the compensatory changes are insufficient and result in reduced placental weight [5].

In present study, majority of placentae in both groups were oval in shape followed by round shaped. The shape of placentae did not found any significant association ($p > 0.05$). As all subjects were apparently healthy and there was no evidence of malnutrition, may be the cause

for normal shape of placentae. Similar findings were observed by Ashfaq, et al. (2005) [19] in Karachi, Pakistan where they found that shape of placentae in hypertensive and control groups were roughly oval or round. Zia-ur-rehman, et al. (2013) [15] in Rahim Yar Khan and Bahawalpur, Pakistan almost equally found oval, circular and irregular shaped placentae in both control and hypertensive groups and the difference was found not significant ($p > 0.05$). Navbir P (2012) [18] in Lucknow reported various shape of placenta in control and hypertensive group but the difference was found not significant ($p > 0.05$).

Present study showed that majority of placentae in PIH group had marginal insertion of umbilical cord while in control group majority of placentae had eccentric insertion of umbilical cord followed by central insertion. This difference was found highly significant ($p < 0.01$). Similar results were observed in previous studies by Rath et al (2000) [7] in New Delhi, Majumdar et al (2005) [9] in Kolkata and Londhe and Mane (2011) [12] in Karimnagar, Andhra Pradesh.; While contrary findings were seen in studies conducted by Ashfaq et al (2005) [19] in Karachi, Pakistan and Navbir (2012) [18] in Lucknow, where they observed only central or eccentric insertion of umbilical cord in control as well as in hypertensive groups.

In the present study, the mean numbers of cotyledons in PIH group were less as compared to control group and this reduction was found highly significant ($p < 0.01$). Similar results were found in earlier studies by Majumdar, et al. (2005) [9] in Kolkata, Londhe and Mane (2011) [12] in Karimnagar, Andhra Pradesh, Zia-ur-rehman, et al. (2013) [15] in Rahim Yar Khan and Bahawalpur, Pakistan and Gowda and Jayanthi (2014) [16] in Bangalore, where mean numbers of cotyledons were reduced in hypertensive group but few studies [12, 15] found this



reduction was significant ($p < 0.05$) as in present study while others [9, 16] found the reduction was not significant ($p > 0.05$).

In the present study, the mean central thicknesses of placentae in PIH group were less as compared to control group and this reduction was found highly significant ($p < 0.01$). Similar results were seen in earlier studies by Anmed and Daver (2013) [20] in Mumbai, Zia-ur-rehman, et al. (2013) [15] in Rahim Yar Khan and Bahawalpur, Pakistan and Gowda and Jayanthi (2014) [16] in Bangalore, where significant reduction ($p < 0.05$) was observed in mean central thickness of placenta in hypertensive group, while in an another study by Devishankar, et al. (2012) [17] in Nellore, Andhra Pradesh also showed the reduction in central thickness but this was found not significant ($p > 0.05$). Contrary findings were observed in a study by Ashfaq, et al. (2005) [19] in Karachi, Pakistan where they reported higher value of mean central thickness of placenta in hypertensive pregnancies but this was found not significant ($p > 0.05$).

In the present study, the mean placental diameter in PIH group was less as compared to control group and this reduction was found highly significant ($p < 0.01$). Similar results were found in earlier studies by Kajantie, et al. (2010) [21] in Finland, Raghavendra, et al. (2013) [22] in Mangalore, Karnataka and Zia-ur-rehman, et al. (2013) [15] in Rahim Yar Khan and Bahawalpur, Pakistan, where significant reduction ($p < 0.05$) was observed in mean placental diameter in hypertensive group, while an another study by Devishankar, et al. (2012) [17] in Nellore, Andhra Pradesh also showed the reduction in placental diameter but this was found not significant ($p > 0.05$). Contrary findings were observed in a study by Ashfaq, et al. (2005) [19] in Karachi, Pakistan where they reported higher value of mean placental diameter in hypertensive

pregnancies but this was found not significant ($p > 0.05$).

In the present study, the mean placental surface area in PIH group was less as compared to control group and this reduction was found significant ($p < 0.05$); similar results were found in earlier studies by Udainia, et al. (2004) [23] in Surat, Rath, et al. (2000) [7] in New Delhi, Majumdar, et al. (2005) [9] in Kolkata, Kajantie, et al. (2010) [21] in Finland, Londhe and Mane (2011) [12] in Karimnagar, Andhra Pradesh, Meyur, et al. (2012) [13] in Kolkata, Raghavendra, et al. (2013) [22] in Manglore and Gowda and Jayanthi (2014) [16] in Bangalore.

Conclusion

Morphological examination of placenta in pregnancy induced hypertension (PIH) showed significant decrease in mean placental weight, number of cotyledons, central thickness, diameter and surface area. They also showed increased incidence of marginal insertion of umbilical cord, while the shape did not show significant variation. Thus, the study has conclusively shown that placentae of hypertensive women show significant morphological changes that can be associated with impaired function of placenta, leading to adverse fetal outcome.

Recommendations

Early registration of pregnancy, proper antenatal, intra natal and post natal care, early identification of hypertension and timely referral to tertiary care hospital, institutional deliveries and health education of couple are recommended for a favourable fetal outcome.

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Table – 1: Distribution of characteristics of subjects.

| Characteristic | Controls N=40 (Mean ± SD) | PIH N=40 (Mean ± SD) |
|-----------------------------|---------------------------------|----------------------------|
| Age (in years) | 26.33 ± 4.33 | 26.73 ± 4.40 |
| Weight (in Kg) | 54.28 ± 6.10 | 56.35 ± 5.51 |
| Height (in meters) | 1.57 ± 0.05 | 1.57 ± 0.05 |
| BMI (in Kg/m ²) | 22.05 ± 1.80 | 22.76 ± 2.04 |

(SD- Standard deviation)

Table – 2: Distribution of subjects according to age.

| Age (in years) | Controls N=40 n (%) | PIH N=40 n (%) |
|-------------------|---------------------------|----------------------|
| 20-24 | 17 (42.5) | 16 (40) |
| 25-29 | 13 (32.5) | 14 (35) |
| 30-34 | 7 (17.5) | 7 (17.5) |
| 35 and above | 3 (7.5) | 3 (7.5) |
| Total | 40 (100) | 40 (100) |

Table – 3: Distribution of subjects according to parity.

| Parity | Controls N=40 n (%) | PIH N=40 n (%) |
|--------|---------------------------|----------------------|
| Para-1 | 15 (37.5) | 19 (47.5) |
| Para-2 | 16 (40) | 13 (32.5) |
| Para-3 | 7 (17.5) | 6 (15) |
| Para-4 | 2 (5) | 2 (5) |
| Total | 40 (100) | 40 (100) |

Table – 4: Comparison of placental shape between control and PIH groups.

| Placental shape | Controls N=40 | PIH N=40 | χ^2 (df) | 'p' value |
|-----------------|------------------|-------------|---------------|-----------|
| Round n (%) | 16 (40) | 8 (20) | 2.917 (1) | 0.088 |
| Oval n (%) | 24 (60) | 32 (80) | | |

Table – 5: Comparison of umbilical cord insertion between placentae of control and PIH groups.

| Umbilical cord insertion | Controls N=40 | PIH N=40 | χ^2 (df) | 'p' value |
|--------------------------|------------------|-------------|---------------|-----------|
| Central n (%) | 11 (27.5) | 7 (17.5) | 10.830 (2) | 0.004 |
| Eccentric n (%) | 22 (55) | 12 (30) | | |
| Marginal n (%) | 7 (17.5) | 21 (52.5) | | |

Table – 6: Morphological parameters of placentae between control and PIH groups.

| Parameter | Controls N=40 (Mean \pm SD) | PIH N=40 (Mean \pm SD) | 'Z' value | P value |
|--|-------------------------------------|--------------------------------|-----------|---------|
| Placental Weight (in grams) | 397.50 \pm 42.29 | 376.25 \pm 39.20 | 2.331 | 0.020 |
| Number of Cotyledons | 16.93 \pm 2.49 | 14.78 \pm 2.28 | 4.028 | 0.000 |
| Central thickness (in cms) | 1.96 \pm 0.23 | 1.82 \pm 0.22 | 2.782 | 0.005 |
| Placental Diameter (in cms) | 15.40 \pm 1.34 | 14.46 \pm 1.81 | 2.640 | 0.008 |
| Placental Surface area (in cm ²) | 187.61 \pm 32.73 | 166.64 \pm 41 | 2.528 | 0.012 |

(SD – Standard deviation)