Original Article

Role of placental pathology in stillbirth: A descriptive study

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Abstract

Introduction: Placental pathology is thought to play a significant role in causing stillbirths. Identifying such pathologies can help in preventing stillbirths and improving future pregnancy outcomes. Hence, this study was planned to determine the role of placental pathology in the cases of stillbirth and its association with the risk factors. **Methodology:** A descriptive study was conducted on 42 women with stillbirth, in the Department of Obstetrics and Gynaecology, in collaboration with the Department of Pathology, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow for 18 months. A detailed questionnaire was used to collect data from study participants and their placental samples were sent for histopathological and microbiological examination. Data were analysed using Statistical Package of Social Sciences version 23.0 for Windows. **Results:** Out of 42 women in our study, the majority were primigravida (40.5%) with a mean maternal age of 28.38 ± 4.9 years. Among 42 study participants, 41 (97.6%) had no antenatal checkups, 14 (33.3%) of them had associated comorbidities of which pre-eclampsia was most common (26.2%), 20 (47.6%) showed maternal vascular malperfusion as the commonest histopathological finding and 18 samples (42.9%) had microbial growth. Among the 42 cases, histological findings were seen in 29 placental samples while 13 did not show any histological changes in the placenta. The difference was statistically insignificant ($P < 0.05$). **Conclusion:** In our study, lack of antenatal care, pre-eclampsia/eclampsia, premature rupture of membranes, gestational diabetes and antepartum haemorrhage were found to be the major risk factors for stillbirth. Also, maternal vascular malperfusion and chorioamnionitis along with microbial growth were seen as the major pathological lesions found in placental samples of women with stillbirth.

Keywords: Histopathological findings, placental pathology, risk factors, stillbirth

Introduction

Stillbirth is the death or loss of a baby before or during delivery. It has a tremendous psychological, emotional, physical and social impact on the mother. Stillbirth is defined as 'Fetal death before complete expulsion or extraction of the product of human conception from the womb irrespective of the duration of pregnancy and which, is not an induced termination of pregnancy. The death is indicated by the act that after such expulsion or extraction, the fetus does not breathe or show any other evidence of life such as the beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles'.[1,2] Every year, approximately 2.6 million stillbirths are recorded all over the world, out of which, almost 98% are seen to occur in low- and middle-income countries.[3] As per the data in 2019, more than one-third of the global burden of stillbirths was concentrated in India (17.3%), Pakistan (9.7%) and Nigeria (8.7%).[4,5] Despite a significant reduction in the stillbirth rate over the past decade, from 29.6 in 2000 to 13.9 stillbirths per 1000 births in 2019, India shared almost one-sixth of the global burden in 2019.[3] In India, Odisha, Madhya Pradesh,

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Rajasthan and Chhattisgarh form a contiguous east–west belt of high stillbirth rate.[6]

Depending on the cause, the risk of stillbirths in future pregnancies is increased up to 10-fold.[7] Therefore, an accurate assessment of the cause, based on placental examination and autopsy findings, is required for future stillbirth prevention.[8,9] Though a few studies have addressed the importance of these investigations,[10] 25.0%–60.0% of stillbirths remain unexplained.[11] The high proportion of unexplained stillbirths hinders an accurate understanding of their cause, thus making it difficult for healthcare interventions towards reducing their incidence.[12]

Placenta plays a key role in maintaining a healthy pregnancy, and there is evidence of placental pathology in clinical conditions associated with an increased rate of stillbirths such as foetal growth restriction, pre-eclampsia and placental abruption.[13,14] Although many pathological changes seen in the placentae of such high-risk pregnancies can also be present in normal pregnancy with a healthy outcome, these changes are often more pronounced in placentae of high-risk pregnancies. Identifying these pathologies can help us prevent such adverse pregnancy outcomes in the future.

Thus, macroscopic and histopathological examination of the placenta is thought to determine the cause of stillbirths and help prevent the risk of stillbirths in future pregnancies. In light of the above situation, this study was planned to determine the role of placental pathology in the cases of stillbirth and its association with the risk factors.

Materials and Methods

Study design, period and area

This was a descriptive study conducted in the obstetric ward of the Department of Obstetrics and Gynaecology, in collaboration with the Department of Pathology, Dr. Ram Manohar Lohia Institute of Medical Sciences, Lucknow, over a period of 18 months from November 2022 to April 2024. A total of 42 women with antepartum or intrapartum foetal death, who consented to participate in the study and met the inclusion criteria were recruited. Convinience sampling was used in this study. Ethical approval for this study was obtained from the Institutions' Ethical Committee (IEC no. 152/22). A structured proforma was used to record the details of the patients and their placentae.

Inclusion and exclusion criteria

The inclusion criteria for the study were all pregnant women with a gestational age of 20 weeks or more with the death of the foetus before or during delivery and who consented to participate in the study.

Conditions like ruptured uterus and cord prolapse or foetuses with apparent congenital anomalies were excluded from the study. Also, families who refused to participate were also not included in the study.

Sample size and study variables

According to the National Family Health Survey-5 (NHFS-5), the proportion of stillbirth babies was found to be 9.7%, and the proportion of stillbirths observed in the Department of Obstetrics and Gynaecology, Dr. Ram Manohar Lohia Institute of Medical Sciences, was 13.7%. A minimum of 42 women with stillbirths was obtained as the sample size required to achieve a confidence interval of 95%, assuming a non-response rate of 10%.

The study variables included the participants' age, education level, marital status, any addictions, medical problems, parity, number of antenatal visits, previous history of stillbirths, any high-risk factors like pre-eclampsia, preterm premature rupture of membranes, antepartum haemorrhage (APH), etc.

Placentae were examined grossly for weight, diameter, number of cotyledons; umbilical cord length, site of attachment, knots, torsion, any retroplacental hematoma etc., They were then preserved in formalin and sent for histopathological analysis. A part of the placenta was also sent for microbiological examination.

Data collection

The details of the study participants were recorded on the structured study proforma, which was in the form of a questionnaire. The structured questionnaire included the socio-demographic details of the study participants, any history of comorbidity, any surgical history, detailed obstetrical history, number of antenatal visits, records of height, weight, body mass index (BMI), blood pressure, random blood sugar and haemoglobin levels, blood group, Rh factor, any previous history of antiD immunization etc., All the pregnant women above 20 weeks of gestation who attended our department and met the inclusion criteria were introduced to the study objectives. Those women who gave informed consent to participate in the study were included. The placentae of the study participants, along with their umbilical cords, were preserved in 10% buffered formalin solution carefully, labelled and sent to the pathology department of our institute for macroscopic and microscopic examination. A part of the placenta was also sent in normal saline to the Department of Microbiology for bacteriological examination and culture.

Statistical analysis

Data were analysed using SPSS version 23.0 for Windows. Quantitative data were presented as arithmetic mean and standard deviation. Qualitative data was presented as frequencies (percentages). The Chi-square test was used to compare categorical variables between the two groups and the analysis of variance test was used to assess intra-group variations. A P value ≤ 0.05 was considered statistically significant.

Results

Among the 42 mothers included in the study, the majority were in the age range of 26–30 years, constituting 40.5% of the sample. The mean maternal age was 28.38 ± 4.90 years. They had a pre-pregnancy mean weight of 58.50 ± 6.85 kg, ranging from a minimum of 48 kg to a maximum of 78 kg. Their mean height was 1.59 ± 0.07 m, ranging from 1.4 to 1.7 m, while the mean BMI was 23.14 ± 2.28 kg/m^2, with a range of 19.03–28.65 kg/m^2. Out of 42 women, seven had tobacco addiction (16.7%), while none had alcohol addiction [Table 1].

Out of 42 study participants, 17 were primigravida (40.5%), followed by G2 (35.7%), and smaller proportions of higher birth order pregnancies. Among the 42 mothers, the majority, 38 (90.5%), had no previous stillbirths, while 4 (9.5%) reported a history of previous stillbirth. Most mothers, 37 (88.1%), had no history of previous abortion, either induced or spontaneous. Forty-one women (97.6%) had no antenatal visits, and only one woman was booked having two antenatal care (ANC) visits.

Out of all 42 women, 14 (33.3%) had no comorbidity. The most common comorbidity was pre-eclampsia, affecting 11 (26.2%) mothers, followed by anaemia, gestational diabetes mellitus (GDM) and premature rupture of membranes (PROM); each reported in 3 (7.1%) cases. Other comorbidities, such as type 2 diabetes mellitus (T2DM), intrahepatic cholestasis of pregnancy (IHCP), hypothyroidism, hepatitis C, APH/placenta previa and previous scar, were less common, each occurring in one to two (2.4%–4.8%) cases [Table 2].

Among the 42 mothers, iso-immunization and fetomaternal haemorrhage were not reported in any of the cases. However, a small proportion of mothers, 4.8% (2), experienced foetal infection, while 2.4% (1) reported non-immune hydrops and twin–twin transfusion, respectively. Foetal growth restriction was observed in 19.0% of cases [Table 3].

Among the 42 placental samples examined, the majority, 95.2%, did not exhibit any overt signs of infection, while 4.8% had evidence of infection. Ischaemia was observed in 9.5% of cases and necrosis was present in only 2.4% of cases [Figure 1]. The mean length of the umbilical cord was found to be 33.07 ± 17.43 cm, ranging from a minimum of 13.5 cm to a maximum of 75.0 cm. Umbilical cord thrombosis and dark-coloured cord were seen in 4.8% of cases each, while non-central attachment was found in 9.5% of the cases. On histopathological examination, 47.6% of placental samples had evidence of maternal vascular malperfusion, while chorioamnionitis was seen in 21.4% of samples [Figures 2 and 3]. Out of 42 samples of placentae, 42.9% had evidence of microbial growth on culture [Table 4].

Out of 42 placental samples examined, morphological changes were found in 14 patients and 28 patients did not show any morphological changes. Among those with morphological changes in the placenta, 5 (35.7%) had no risk factors, 2 (14.3%) had pre-eclampsia and 2 (14.3%) had GDM. PROM, hypothyroidism, hepatitis C infection, APH and previous lower segment caesarean section (LSCS) were found in each of the cases, while anaemia, T2DM and IHCP were found in none of the cases with morphological changes. Out of 28 patients with

Table 1: Socio-demographic characteristics of study participants

Variables		Mean±SD (*n*=42)	Minimum–Maximum
Age (years)		28.38±4.90	20–46
Anthropometric variables	Pre-pregnancy weight (kg)	58.50±6.85	48–78
	Height (m)	1.59±0.07	1.4–1.7
	BMI (kg/m^2)	23.14±2.28	19.03–28.65
Haemodynamic variables	SBP (mmHg)	130.10±19.56	110–170
	DBP (mmHg)	84.19±16.06	70–130
Laboratory test variables	Haemoglobin (gm%)	10.04±1.59	5.0–12.8
	Random blood sugar (mg/dL)	105.36±22.55	72–170
	HbA1c	5.12±0.96	4.1–9.38

Data presented as mean±SD and range

Table 2: Distribution of study participants based on obstetric characteristics and maternal comorbidity

Characteristics	Frequency (*n*=42)	Percentage (%)
Primigravida	17	40.5
History of previous stillbirth	4	9.5
Previous abortion (induced/spontaneous)	5	11.9
Unbooked (no ANC visits)	41	97.6
Obstetric comorbidity		
No comorbidity	14	33.3
Pre-eclampsia	10	23.8
PROM	4	9.5
GDM	3	7.1
Anemia	3	7.1
Antepartum eclampsia	2	4.8
T2DM	2	4.8
IHCP	2	4.8
Previous LSCS	2	4.8
Hypothyroidism	1	2.4
Hepatitis C seropositivity	1	2.4
Antepartum haemorrhage	1	2.4

Data presented as percentage (%), PROM=Premature rupture of membranes, GDM=Gestational diabetes mellitus, T2DM=Type 2 diabetes mellitus, IHCP=Intrahepatic cholestasis, LSCS=Lower segment caesarean section

Table 3: Distribution of mothers based on the foetal causes of stillbirths

Foetus-related complication	Frequency (*n*=42)	Percentage (%)
No foetal complications	30	71.4
Foetal growth restriction	8	19.0
Infection	2	4.8
Non-immune hydrops	1	2.4
Twin–twin transfusion	1	2.4
Rh iso-immunization	0	0.0
Fetomaternal haemorrhage	0	0.0

Data presented as percentage (%)

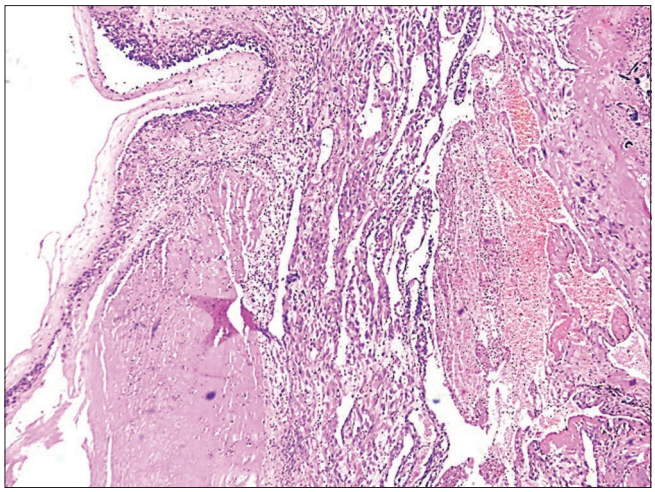

Figure 1: Placenta with necrosis of villi associated with inflammation (H and E × 100)

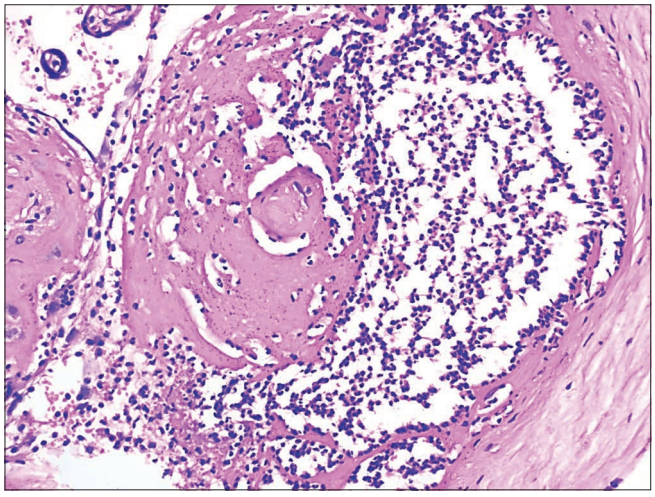

Figure 2: Chorioamnionitis characterized by the presence of dense inflammatory infiltrate in the placental membranes (H and E × 200)

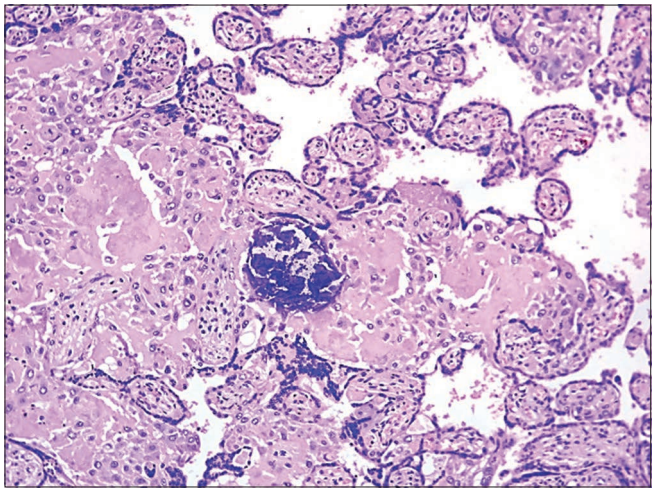

Figure 3: Placenta with the presence of calcifications (H and E × 200)

no morphological changes in their placental samples, 9 (32.1%) had no risk factors, 9 (32.1%) had pre-eclampsia, 3 (10.7%) had anaemia, 2 (7.1%) patients each had PROM, T2DM and IHCP; 1 case (3.6%) had GDM, while none had hypothyroidism, hepatitis C infection, APH or history of previous LSCS. The difference in each was found to be statistically insignificant ($P > 0.05$).

Table 4: Findings on examination of the placentae

Finding	Frequency (n=42)	Percentage (%)
Histopathological findings		
Maternal vascular malperfusion on histology	20	47.6
Evidence of chorioamnionitis on histology	9	21.4
Ischaemia	4	9.5
Non-central cord attachment	4	9.5
Umbilical cord thrombosis	2	4.8
Overt presence of infection	2	4.8
Dark-coloured cord	2	4.8
Necrosis	1	2.4
Evidence of microbial growth	18	42.9

Data presented as percentage (%)

Among the 42 cases, histological findings were seen in 29 placental samples while 13 did not show any histological changes in the placenta. Out of those 29 patients with histological changes, 9 (31.0%) had no risk factors, 9 (31.0%) had pre-eclampsia and 3 (10.3%) had anaemia. GDM, PROM, T2DM and IHCP were seen in 2 (6.9%) cases each, while hypothyroidism, hepatitis infection, APH and previous LSCS were seen in none of the cases with histological changes. Among those 13 cases which did not have any histological changes, 5 (38.5%) had no risk factors, 2 (15.4%) had pre-eclampsia, 1 (7.7%) each had GDM, PROM, hypothyroidism, hepatitis C infection, APH and previous LSCS, whereas none had anaemia, T2DM and IHCP. The difference was not statistically significant ($P > 0.05$).

Bacterial growth was seen in placental samples of 18 patients while 24 did not show growth of any microbes. With microbial growth in 18 patients, 5 (27.8%) were without risk factors, 7 (38.9%) had pre-eclampsia and 1 (5.6%) each had anaemia, GDM, PROM, T2DM and IHCP; however, none had hypothyroidism, hepatitis C infection, APH and previous LSCS. Out of 24 patients without any growth, 9 (37.5%) had no risk factors, 4 (16.7%) had pre-eclampsia, 2 (8.3%) each had anaemia, GDM and PROM; T2DM, IHCP, hypothyroidism, APH and previous LSCS was found in 1 (4.2%) case each and none of them had hepatitis C infection. There was no significant difference statistically ($P > 0.05$) [Table 5].

Discussion

Our study found that most of the women with stillbirth were in the age group 26–30 years, and the mean age was 28.38 ± 4.90 years. Many studies including that of Waldenstrom *et al.*[15] found that advanced maternal age is an independent risk factor for stillbirth. However, the current investigation found no link between stillbirths and age. The age group of study participants varies from 20 to 46 years in our study. The results might imply that other established risk factors that arise with age

Table 5: Correlation of maternal risk factors with morphology, histological findings and microbiological findings in placenta of study population

Risk factors	Morphology				Histological findings				Microbiological findings (growth of microbes)			
	Present (*n*=14)	Absent (*n*=28)	χ^2	*P*	Present (*n*=29)	Absent (*n*=13)	χ^2	*P*	Present (*n*=18)	Absent (*n*=24)	χ^2	*P*
No	5 (35.7%)	9 (32.1%)	0.054	0.816	9 (31.0%)	5 (38.5%)	0.223	0.636	5 (27.8%)	9 (37.5%)	0.437	0.508
Pre-eclampsia	2 (14.3%)	9 (32.1%)	1.54	0.216	9 (31.0%)	2 (15.4%)	1.137	0.286	7 (38.9%)	4 (16.7%)	2.628	0.104
Anaemia	0 (0.0%)	3 (10.7%)	1.615	0.203	3 (10.3%)	0 (0.0%)	1.448	0.228	1 (5.6%)	2 (8.3%)	0.12	0.729
GDM	2 (14.3%)	1 (3.6%)	1.615	0.203	2 (6.9%)	1 (7.7%)	0.009	0.924	1 (5.6%)	2 (8.3%)	0.12	0.729
PROM	1 (7.1%)	2 (7.1%)	0	1.00	2 (6.9%)	1 (7.7%)	0.009	0.924	1 (5.6%)	2 (8.3%)	0.12	0.729
T2DM	0 (0.0%)	2 (7.1%)	1.05	0.305	2 (6.9%)	0 (0.0%)	0.941	0.332	1 (5.6%)	1 (4.2%)	0.044	0.833
IHCP	0 (0.0%)	2 (7.1%)	1.05	0.305	2 (6.9%)	0 (0.0%)	0.941	0.332	1 (5.6%)	1 (4.2%)	0.044	0.833
Hypothyroidism	1 (7.1%)	0 (0.0%)	2.049	0.152	0 (0.0%)	1 (7.7%)	2.285	0.130	0 (0.0%)	1 (4.2%)	0.768	0.380
Hepatitis C +	1 (7.1%)	0 (0.0%)	2.049	0.152	0 (0.0%)	1 (7.7%)	2.285	0.130	1 (5.6%)	0 (0.0%)	1.366	0.242
Antepartum haemorrhage	1 (7.1%)	0 (0.0%)	2.049	0.152	0 (0.0%)	1 (7.7%)	2.285	0.130	0 (0.0%)	1 (4.2%)	0.768	0.380
Previous LSCS	1 (7.1%)	0 (0.0%)	2.049	0.152	0 (0.0%)	1 (7.7%)	2.285	0.130	0 (0.0%)	1 (4.2%)	0.768	0.380

Data is presented as percentage. Chi-square value and *P* value are mentioned for each column (morphology, histological and microbiological findings). Chi-square test is used to calculate the *P*. A $P<0.05$ is considered as significant. PROM=Premature rupture of membranes, GDM=Gestational diabetes mellitus, T2DM=Type 2 diabetes mellitus, IHCP=Intrahepatic cholestasis, LSCS=Lower segment caesarean section

have little impact on the relationship between maternal age and stillbirths. Our findings were similar to that of Tiwari *et al.*,[16] who reported that the mean age of patients was similar in stillbirths and live birth groups (29.5 and 30.0 years, respectively).

In this study, 9.5% of women had a previous history of stillbirth, 11.9% had a previous abortion and 50.0% of cases were primigravidae. In the study conducted by Patel *et al.*,[17] it was found that 29.0% of cases had a history of stillbirth as against 14.0% of the controls. It was slightly higher than what was found in our study. Also, 59.5% of women with stillbirth were primiparous; a result similar to that of ours. Out of all 42 women with stillbirth, 41 (97.65%) had no ANC visits and one woman had only 2 ANC visits. Thus, lack of antenatal visits was shown to be strongly related to the increased risk of stillbirths in our study. In another study performed by Lema *et al.*,[18] 13.5% had a history of stillbirth, and 47.9% were primiparous; a result similar to our study.

Among the obstetric conditions in our study participants, pre-eclampsia was found in 11 (26.2%) mothers, followed by anaemia, GDM and PROM, in 3 (7.1%) cases each. The risk of pre-eclampsia in stillbirth cases could be explained by uteroplacental ischaemia which is seen as an inherent pathology in such cases. Similar findings were seen in the study by Patel *et al.*,[17] who reported that pre-eclampsia was seen in 59.5% of cases, 27.8% of cases had APH, 11.4% had diabetes mellitus, 5.0% had malaria and 2.5% cases of stillbirth were HIV positive.

In this study, only 2 (4.8%) women with stillbirth had an infection, while one (2.4%) each had non-immune hydrops and twin–twin transfusion syndrome. Foetal growth restriction was observed in 19.0% of cases of stillbirth. A total of 28.6% of cases had foetal causes of stillbirth. Our findings were similar to those of Sofiya *et al.*,[19] who reported that 34.5% had foetal causes of stillbirth, and they were more common in second-trimester stillbirths. In another study, Fatima *et al.*[20] analysed 14 foetal autopsies and discovered that 35.7% of cases had causes of foetal origin while 43.6% of cases had placental causes of stillbirth.

In this study, examination of the placenta revealed overt presence of infection in 2 (4.8%) cases, ischaemia in 4 (9.5%) and necrosis in 1 (2.4%) case. Among the 42 umbilical cords examined, the majority, 90.5% had a normal appearance. However, non-central attachment was seen in 9.5% of cases, while dark-coloured cord and thrombosis were found in 2.4% of cases each. It is seen that cord abnormalities of the insertion site and appearance may compromise foetal circulation, posing a risk of stillbirth. Sofiya *et al.*[19] reported that the majority of placental causes are associated with placental infarcts, apart from other causes such as disruption, fetomaternal haemorrhage, cord accidents, placental insufficiency, intrapartum hypoxia, placenta previa, twin–twin transfusion and chorioamnionitis. However, after a thorough autopsy, 13.8% of cases of stillbirth did not reveal any pathology.

Out of all the 42 placental samples examined, 31.0% exhibited normal morphology, whereas 47.6% had evidence of maternal vascular malperfusion. Also, 21.4% showed evidence of chorioamnionitis. These findings were similar to those of Patel *et al.*,[17] who reported that chronic inflammation, uteroplacental vascular pathology acute chorioamnionitis, cord edema, coagulation-related lesions, calcific alterations and retroplacental clots were among the placental diseases associated with stillbirth. Man *et al.*[21] reported that maternal vascular malperfusion was the largest category of placental abnormalities (70.0%) in stillbirths, a finding similar to that of our study. Based on microbiological findings, in our study, it was seen that 42.9% of placental samples had evidence of bacterial growth, while 57.1% of samples were sterile.

As a secondary outcome, it was observed that no statistically significant association existed between any of the examined maternal risk factors and the presence of microbes

(*P* value > 0.05). Also, there was no significant association of risk factors with morphology and histological findings in the placental samples (*P* value > 0.05). This was the novel finding of our study that has not been documented previously in the literature.

Conclusion

In our study, we observed that the most common placental abnormalities linked to stillbirth were chorioamnionitis and maternal vascular malperfusion. Pre-eclampsia, a history of stillbirths and fewer prenatal visits were the main risk factors for stillbirth among the maternal medical disorders and obstetric features that were evaluated. Attending prenatal clinics regularly offers the chance to assess for potential risk factors that could lead to stillbirth. These women can be counselled and high-risk pregnancies can be managed optimally within time to get a favourable pregnancy outcome. It is also advised to examine the placentae of unexplained stillbirths histopathologically, to get some information useful in developing preventive strategies for reduction in stillbirth.

Limitations of the study

This study had a relatively smaller sample size. Also, being a single-centric hospital-based study from Lucknow, the results of this study cannot be generalized to the entire population.

Future recommendations

A similar study with a larger sample size is required to conclusively understand the role of pathological changes in the placenta in cases of stillbirth.

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Conflicts of interest

There are no conflicts of interest.

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