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Original Research Article

## Morphological changes in placenta in cases of oligohydramnios

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### ABSTRACT

**Background:** There are gross and microscopic changes in placenta and umbilical cord in complicated pregnancies. The objective of this study was to study pathological (gross and microscopic) changes in placenta, membrane and umbilical cord in cases with oligohydramnios and to study relationship between changes in placenta, membranes and umbilical cord with severity of oligohydramnios.

**Methods:** A total of 50 patients were selected and their placentas were collected after delivery and sent to pathology department in 10 % formalin for histopathological examination. Patients were divided into three groups and the results were compared. Statistical calculations were performed using the SPSS 16.0. In order to detect differences between subjects students t-test was used for continuous variables, while, for categorical variables, the X<sup>2</sup> test was used. A p-value of less than 0.05 was considered statistically significant.

**Results:** A total of 50 patients were studied for a period of one year and following observations were made, discoid shape placenta in 45 (90.0%), oval in 5 (10.0%), central attachment of umbilical cord in 16 cases (32.0%), eccentric in 33 (66.0%), marginal in 1 (2.0%) case following variables were compared and p value detected, placental maximum diameter (p < 0.0001), placental minimum diameters (p = 0.041), mean of cord length (p < 0.0001) placental weight (p = 0.273), placental thickness (p = 0.253), acute chorioamnionitis (p < 0.0001), chronic chorioamnionitis (p < 0.0001), focal squamous metaplasia (p < 0.0001), bacterial colonies in subamnion (p < 0.0001), meconium staining (p < 0.0001), amnion nodosum (p < 0.0001), intra amniotic haemorrhage (p = 0.090), membranous deciduitis with chorioamnionitis (p = 0.081), focal haematoma (p = 0.010), acute inflammatory infiltrate in Wharton's jelly (p = 0.012), single umbilical artery (p = 0.010), intervillous fibrin deposition (p < 0.0001), calcification (p < 0.0001), chorangiomas (p < 0.0001), syncytial knots (p < 0.0001), avascular villi (p = 0.011), villous edema (p = 0.090) and infarct (p = 0.090).

**Conclusions:** There are alterations in placental morphology associated with oligohydramnios hence placenta should be examined, which may be useful in predicting perinatal morbidity and mortality.

**Keywords:** Placenta, Oligohydramnios, Umbilical cord

### INTRODUCTION

The term placenta is derived from Greek word 'Plakous-Flat cake' on the basis of its anatomical appearance. It carries out the function that the fetus is not able to perform during intrauterine life (functions of lungs, liver, endocrine organs and kidneys), the core function being the transport of nutrition.<sup>1</sup> It is normally 15-22 cm in diameter, 2-4 cm in thickness, weighs 400-600 gm, blue

red in colour and discoid in shape.<sup>2</sup> It has two parts fetal and maternal. Maternal surface is rough and spongy, dull red in colour. It has 15-20 lobes or cotyledons.<sup>3</sup> Umbilical cord is formed from fetal membranes. It is about 55-65cms in length and 2-2.5cms in thickness.<sup>4</sup> Outer surface is covered by amnion and it contains two arteries and one vein.<sup>5</sup> There are gross and microscopic changes in placenta and umbilical cord in complicated pregnancies. Grossly there is change in shape, size,

weight, thickness of placenta and in umbilical cord there is change in length, thickness, amount of Wharton's jelly and number of vessels in it.<sup>6</sup>

Placenta in pre-eclampsia is triangular or kidney shaped; placenta is biparita or succenturiata in gestational diabetes mellitus; it is heart shaped in anemia and circumvallate or triangle shaped in preterm placenta.<sup>7</sup> Grossly, characteristic lesion amnion nodosum is seen in cases of oligohydramnios.<sup>8</sup> Amnion nodosum is characteristic lesion of oligohydramnios, fetal renal agenesis and pulmonary hypoplasia.<sup>9</sup>

On microscopic examination of placenta, basement membrane thickening, haemorrhagic vasculitis, thrombotic vasculopathy, syncytial knots are seen in cases of oligohydramnios.<sup>10</sup> Fetal thrombotic vasculopathy is a placental lesion characterised by regionally distributed avascular villi and is often accompanied by upstream thrombosis in fetal vessels. It is associated with six times increased risk of oligohydramnios.<sup>11</sup>

Due to peculiar link between placenta and fetus any abnormality of cord, be it in the length, amount of wharton's jelly, number of vessels or its amniotic epithelium lead to abnormal fetal outcome.<sup>6</sup> short cord is associated with oligohydramnios, fetal malformations, Down's syndrome, myopathies, neuropathies, less fetal activity, prolonged second stage of labour, cord rupture, breech presentation and placental abruption.<sup>12</sup> Long cords are associated with cord thrombosis, entanglement, torsion as well as knot formation.<sup>2</sup> Inadequate Wharton's jelly could lead to fetal death.<sup>12,2</sup>

Abnormalities in placental shape may be associated with APH, preterm labour, retained placental tissue, fetal haemorrhage or oligohydramnios. In extreme circumvallate placenta the size of amniotic cavity may be restricted; leakage of amniotic fluid and oligohydramnios are sequelae and these in turn lead to compression abnormalities of fetus and pulmonary hypoplasia.<sup>13</sup>

Sonographic diagnosis of oligohydramnios is single largest pocket less than 2 cm and AFI less than 5 cm.<sup>14,15</sup> Amniotic fluid is generated from maternal plasma and passes through the fetal membranes by osmotic and hydrostatic forces and fetal vessels on placental surface. When fetal kidneys begin to function at about 8-11 weeks, fetal urine also contributes to the fluid.

Causes of oligohydramnios are divided into maternal, fetal and placental. Maternal causes are dehydration, diabetes, pre-eclampsia or chronic hypertension, collagen vascular disease and use of drugs like ACE inhibitors, ARBs. Fetal causes are growth restriction, gastrointestinal abnormalities, post-term pregnancy, fetal demise, PROM or PPROM, congenital anomalies and chromosomal abnormality such as Down's syndrome. Placental causes include placental abruption, placental

thrombosis and infarction, uteroplacental insufficiency and twin-twin transfusion syndrome.

Many congenital anomalies are associated with oligohydramnios. Most cases of severely decreased amniotic fluid are secondary to genitourinary abnormalities. Anomalies may be unilateral or bilateral renal agenesis, bilateral multicystic dysplastic kidneys, bladder outlet obstruction, potter syndrome and pulmonary hypoplasia.<sup>16</sup> Oligohydramnios may be associated with placental abnormalities and so this study was planned to know the morphological changes in placenta in cases of oligohydramnios.

## METHODS

The present study was conducted in Department of Obstetrics and Gynaecology in collaboration with Department of Pathology, Government Medical College Jammu for a period of one-year November 2015 to October 2016. A total of 50 patients were selected according to inclusion criteria (singleton pregnancy, gestational age 28-40 weeks, intact membranes, no fetal anomalies on Ultrasonography and AFI < 5 cm on ultrasonography) and excluding all maternal and fetal causes of oligohydramnios (post-term pregnancy, multiple pregnancy, maternal intake of ace inhibitors, NSAIDS, PROM, Diabetes, pre-eclampsia and other hypertensive disorders, collagen vascular disease, TORCH infections, IUD fetus, renal disease).

Their placentas were collected after delivery and sent to Pathology Department in 10% formalin. Membranes examined for inflammation, decidual vasculopathy, exogenous substances, meconium, haemosiderin, various other pathological changes like fibrin deposits, calcification, and haemorrhagic cells. Umbilical cord was seen for number of arteries and veins, vasculitis, thrombosis and Wharton's jelly, fibrin, calcification, infarct. Parenchyma was seen for villous pattern, vasculopathy, thrombosis, infarcts, syncytial knots, calcification, infarct and fibrin deposition. Patients were divided into three groups based on AFI; mild with AFI >4.1 cm, moderate with 2.1-4.0 cm and severe with  $\leq$  2 cm and the results were compared.

Statistical calculations were performed using the SPSS 16.0. Mean and standard deviation were determined for continuous variables. Categorical data were presented with absolute and relative frequencies. In order to detect differences between subjects students t-test was used for continuous variables, while, for categorical variables, the  $X^2$  test was used. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

A total of 50 patients were studied based on inclusion and exclusion criteria for a period of one year and following observations were made, majority (56%) were in age

group of 21-25 years (Mean = 24.98±3.96), 62.0 % were primigravida and 38.0 % were multigravida, majority (46.0%) were with gestational age of 38±40 weeks (Mean = 37.78±1.77). The mean AFI was 3.77±1.05cm. 40% of placenta had a size of about 201-400 cm<sup>2</sup>, 8.0% cases had size ≤ 200 cm<sup>2</sup> (mean = 462.84±223.71). 40% placentas had a weight of 301-400 gm and 4.0% had weight >600 gm (mean = 388.40±100.98). 26 cases had cord length

>31 cm and only 7 cases had ≤20 cm (mean = 29.04±7.06).

On gross examination, shape of placenta was discoid in 45 cases (90.0%) and oval shape in 5 (10.0%). Umbilical cord attachment was central in 16 cases (32.0%), eccentric in 33 cases (66.0%) and marginal in 1 (2.0%) case.

**Table 1: Association between placental morphometric variables with severity of oligohydramnios.**

Variables	Mild AFI (n=23)	Moderate AFI (n=20)	Severe AFI (n=7)	p-value
Placental weight (g)	387.83± 84.58 (200-600)	407.50±110.50 (300-800)	335.71±118.02 (200-500)	
Placental max. diameter (cm)	16.30 ± 1.89 (14-20)	14.03±1.14 (12-16)	10.60±0.38 (10-11)	<0.0001
Placental min. diameter (cm)	12.59 ± 3.10 (5-16)	11.39±2.03 (8-15)	9.86±1.35 (7-11)	0.041
Placental thickness (cm)	2.52 ± 0.85 (1-4)	3.33±0.63 (2-4)	3.29 ± 0.76 (2-4)	0.253
Cord length (cm)	33.76 ± 5.33 (21-42)	27.33±4.73 (18-35)	18.43 ± 2.37 (15-21)	<0.0001

**Table 2: Association between microscopic examinations (placental membranes) with severity of oligohydramnios.**

Microscopic examination	No. of cases (%)						p-value
	Mild AFI (n = 23)		Moderate AFI (n = 20)		Severe AFI (n = 7)		
	No.	%	No.	%	No.	%	
Intraamniotic haemorrhage	1	4.35	1	5.00	0	0.00	0.090
Membranous deciduitis with chorioamnionitis	4	17.39	3	15.00	2	28.57	0.081
Chronic chorioamnionitis	0	0.00	1	5.00	1	14.29	<0.0001
Focal squamous metaplasia	0	0.00	3	15.00	0	0.00	<0.0001
Bacterial colonies in sub amnion	0	0.00	1	5.00	1	14.29	<0.0001
Acute chorioamnionitis	0	0.00	2	10.00	2	28.57	<0.0001
Meconium staining	0	0.00	2	10.00	2	28.57	<0.0001
Amnion nodosum	1	4.35	1	5.00	2	28.57	<0.0001

**Table 3: Association between microscopic examinations (membrane) with severity of oligohydramnios.**

Microscopic examination	No. of cases (%)						p-value
	Mild AFI (n = 23)		Moderate AFI (n = 20)		Severe AFI (n = 7)		
	No.	%	No.	%	No.	%	
Focal haematoma	0	0.00	1	5.00	0	0.00	0.010
Acute inflammatory infiltrate in Wharton's jelly	1	4.35	0	0.00	0	0.00	0.012
Single umbilical artery	0	0.00	1	5.00	0	0.00	0.010

**Table 4: Association between microscopic examinations (membrane) with severity of oligohydramnios.**

Microscopic examination	No. of cases (%)						p-value
	Mild AFI (n=23)		Moderate AFI (n=20)		Severe AFI (n=7)		
	No.	%	No.	%	No.	%	
Intervillous fibrin deposition	11	47.83	16	80.00	6	85.71	<0.0001
Avascular villi	1	4.35	0	0.00	0	0.00	0.011
Calcification	6	26.09	8	40.00	4	57.14	<0.0001
Chorangiosis	1	4.35	2	10.00	2	28.57	<0.0001
Syncytial knots	7	30.34	9	45.00	5	71.23	<0.0001
Villous edema	1	4.35	1	5.00	0	0.00	0.090
Infarct	0	0.00	1	5.00	1	14.29	0.090

On comparing placental morphometric variables (Table 1), placental maximum diameter (p value <0.0001), placental minimum diameters (p value = 0.041) and the mean of cord length (p value <0.0001) was found statistically significant while Placental weight (p value = 0.273) and placental thickness (p value = 0.253) was found statistically insignificant.

On microscopic examination of placental membranes (Table 2), umbilical cord (Table 3) and placental disc (Table 4), acute chorioamnionitis (p value <0.0001), Chronic chorioamnionitis (p value <0.0001), Focal squamous metaplasia (p value <0.0001), bacterial colonies in subamnion (p value <0.0001), Meconium staining (p value <0.0001) and amnion nodosum (p value <0.0001) was found significant while intra amniotic haemorrhage (p value = 0.090) and membranous deciduitis with chorionitis (p value = 0.081) was found insignificant, focal haematoma (p value = 0.010), acute inflammatory infiltrate in Wharton's jelly (p value=0.012) and single umbilical artery (p value = 0.010) was found significant, intervillous fibrin deposition (p value <0.0001), calcification (p value <0.0001), chorangiosis (p value <0.0001), syncytial knots (p value <0.0001) and avascular villi (p value 0.011) was found statistically significant while villous edema (p value=0.090) and infarct (p value = 0.090) was found insignificant.

## DISCUSSION

On comparing placental morphometric variables among 3 groups following observations were made, maximum diameter of placenta (p value <0.0001), minimum diameters of placenta (p value = 0.041) and umbilical cord length was found significant (p value < 0.0001) which was consistent with study conducted by Spinillo A et al, (p value <0.0001) placental thickness (p value = 0.253) Spinillo A et al, 2015 (p value = 0.06) and mean weight of placenta (p value = 0.273) was found insignificant.<sup>17</sup>

In the present study, on gross examination 90.0 % cases had discoid shaped and 10.0 % cases had oval shaped placenta which was consistent with study of Hamdany MZ, in which discoid shape was seen in all cases of oligohydramnios.<sup>18</sup>

On microscopic examination of placental membranes following findings were found significant in the present study, chronic chorioamnionitis (p value <0.0001), acute chorioamnionitis (p value < 0.0001), meconium staining (p value <0.0001) which was consistent with Spinillo A et al, (p value < 0.0001) and with Nath J et al, who found that 30.76% (24) cases had meconium stained liquor in patients with oligohydramnios, amnion nodosum (p value <0.0001) consistent with study conducted by Devi H et al and by Adeniran AJ et al who found that amnion nodosum was present in 22.2% cases in study group compared to 4.4% cases in control group, focal squamous

metaplasia (p value <0.0001) and bacterial colonies in subamnion (p value <0.0001) while membranous deciduitis with chorioamnionitis (p value = 0.081) and intraamniotic haemorrhage (p value = 0.090) was found insignificant.<sup>19,10,20</sup>

On microscopic examination of umbilical cord, only 1 case had single umbilical artery (p value = 0.010). It may be associated with malformation and when malformation excluded, may be associated with low birth weight (Deborah I et al).<sup>21</sup> Focal haematoma was seen in only 1 case (p value 0.010) It is associated with increased perinatal mortality to the extent of 40-50% when ruptures with significant fetal haemorrhage (Deborah I et al).<sup>21</sup> acute inflammatory infiltrate in Wharton's jelly was seen only in 1 case (p value = 0.012).

On microscopic examination of placental disc following findings were found significant in our study, Intervillous fibrin deposition (p value <0.0001) which was consistent with Spinillo A et al, (p value <0.0001) and with Hamadany MZ, in which extensive stromal fibrin deposition was seen with statistically significant difference between study and control group, syncytial knots (p value <0.0001) consistent with Hamdany A, in which 55% of cases had syncytial knots compared to 25% control, Devi H et al in which 53% cases of oligohydramnios had syncytial knots and with Spinillo et al, 2015 (p value <0.0001), calcification (p value <0.0001) consistent with Zhang L et al, who found that incidence of oligohydramnios was 26.67% compared to control group 6.49%, p-value <0.05 in placentas with premature aging, chorangiosis (p value <0.0001) and Avascular villi (p value = 0.011) consistent with Redline RW et al, who found association of avascular villi to increased rate of IUGR and oligohydramnios.<sup>18,10,17,22,23</sup>

Villous edema (p value = 0.090) and infarct (p value = 0.090) consistent with Spinillo A et al, 2015 in which infarct (early) was found in 15.6 % cases in mild, 13.6% cases in moderate and 11.2% cases in severe oligohydramnios group (p value = 0.25) was found insignificant.<sup>17</sup>

## CONCLUSION

The study concluded that in cases of oligohydramnios, there was reduction in weight, size of placenta and length of umbilical cord although shape of placenta and cord attachment was not affected. On microscopic examination, various lesions were found depicting increased maturity of placenta, inflammation, abruption, meconium staining and amnion nodosum. All of them were associated with increasing severity of oligohydramnios and the association was statistically significant in the present study. This indicates that there are alterations in placental morphology associated with oligohydramnios hence placenta should be examined, which may be useful in predicting perinatal morbidity and mortality.

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