

# Morphological Variations of Umbilical Cord in Normal Pregnancies among Local Population

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## ABSTRACT

Placenta is a unique functional center at the maternal-fetal interface.

**Aim:** To find out the morphological variants of umbilical cord in normal pregnancies was undertaken among local population.

**Study design:** Cross-sectional study.

**Methodology:** Umbilical cords were collected from normal cases of delivery at Services Hospital, Lahore. Simple random sampling (probability) was done to collect hundred placentae. Grossing was done. Tissue samples were taken and processed. Histological observations were undertaken using H&E stained sections. Detailed morphology was studied to find out morphological variant with values  $\leq 5\%$ . Data was analyzed using SPSS version 20.

**Results:** Cords that measured  $< 40\text{cm}$  in length were up to 4%. Cord with no twists was up to 1%, 1% cord with 3.5 twists, 3% cords with 4 twists, and 1% cord with 4.5 twists were present, amount of Wharton's Jelly measured to be  $38.46\text{mm}^2$  (1%),  $132.66\text{mm}^2$  (2%),  $153.85\text{mm}^2$  (2%) and  $176.62\text{mm}^2$  (4%), presence of cysts (4%), the vestigial remnants i.e. vitelline and vascular remnants 3% each and squamous metaplasia in 1% of the umbilical cord.

**Conclusion:** Data concluded the presence of morphological variants in the umbilical cord which may reflect the developmental landmarks or other altered phenomenon during the course of pregnancy.

**Keywords:** Umbilical Cord, Vestigial Remnants and Pregnancy.

## INTRODUCTION

Placenta is a unique functional center at the maternal-fetal interface that works as a transport system.<sup>1</sup> The normal length of umbilical cord at term is 40-70cm but cords  $< 32\text{cm}$  while  $> 100\text{cm}$  are termed short and long respectively<sup>1-4</sup>. Many factors affect its growth as reviewed by previous research<sup>5-7</sup>. It has a uniform diameter i.e. one cm at term throughout its length<sup>7</sup>.

Narrow areas represent a focal deficiency of Wharton's jelly and are associated with torsion and fetal death<sup>2</sup>. During the middle and last phase of pregnancy, structures in earlier umbilical cord include allantoic duct and the intestinal epithelial-lined vitelline duct, with or without its accompanying omphalomesenteric arteries<sup>5-6</sup>. The amnion surfacing the umbilical cord is firmly attached<sup>5</sup>.

Placental variations like insertion at the margin leads to battledore variety (7%) and velamentous (1%) placentae where the cord fails to reach the placenta and ends up in the membranes so that major chorionic vessels traverse the adjacent membranes as aberrant vessel. In furcate insertion, the cord loses Wharton's jelly before insertion, leaving the umbilical vessels unsupported<sup>4,5</sup>. The cord is usually twisted to the left (i.e., the diagonal twists run from upper left to lower right). The average number of coils is 2.1 in 10cm segment of the cord<sup>4,5</sup>. The spiral is established early in the first trimester<sup>8</sup>.

The objective of the study was to find out the morphological variants of umbilical cord in normal pregnancies was undertaken among local population.

## METHODOLOGY

Present study held at Obstetrics and Gynecology Department, Services Hospital, Lahore. We recruit 100 subjects<sup>9</sup>. After permission from IRB an informed consent and socio-demographic information along with antenatal record were obtained. Samples were collected from the labour room immediately after delivery of the placentae and transferred from kidney tray to the container having 12% formalin for fixation, within five minutes of delivery.

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The collected specimens were then transferred to the Department of Anatomy, UHS, Lahore. Grossing was done after samples were fixed. Smaller pieces of umbilical cord from the proximal (fetal) and distal (placental) ends were taken, placed separately with identification mark within the plastic tissue cassettes and processed in an automatic tissue processor and embedded in paraffin. Tissue sections ( $5\mu\text{m}$ ) were stained with Hematoxylin and Eosin and studied under light microscope (Leica DM 1000). The data were recorded and variants were looked for according to the definition below: Variant is defined as relatively unusual morphological / microscopic feature seen in  $\leq 5\%$  of the general population<sup>10</sup>.

**Statistical Analysis:** Data was collected and entered by using SPSS 24. Percentages and graphs were given for the qualitative variables (position of cord insertion, vestigial remnants and amniotic epithelium lining cord), while, Mean  $\pm$  SD were given for quantitative variables (cord length, diameter, number of twists and amount of Wharton's Jelly) (Table I). 95% Confidence Intervals were given for quantitative as well as qualitative variables.

## RESULTS

Both gross and microscopic morphological characteristics of umbilical cords were included in this study. The results were recorded after thorough examination with particular reference to variables with values  $\leq 5\%$  to be taken as morphological variants. The total length of the cord was taken from the navel of the newborn to its attachment on the placental disc. Four percent of cords measured less than 40cm (between 32cm and 39cm) were taken as variant (Table 1).

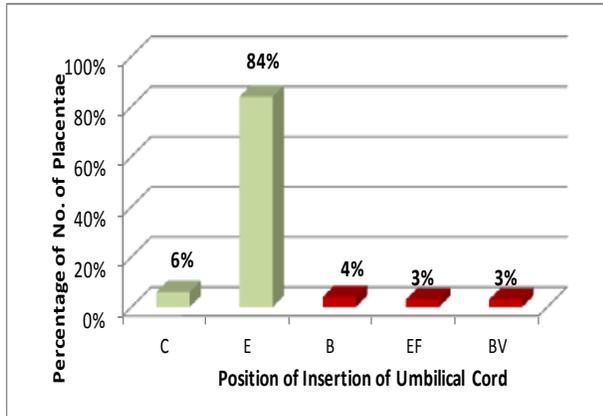
Cords that measured 0.7 cm in diameter were up to 1%, 2% measured 1.3 cm, another 2% measured 1.4cm and 4% measured 1.5cm; all of these were taken as variants. Values given are taken as mean diameter between the fetal and placental ends of the umbilical cord.

Table-1: Quantitative Parameters Among All Subjects

Quantitative Variables	95% CI	Mean $\pm$ SD
Cord length (cm)	54.57 - 59.1	56.84 $\pm$ 11.44
Cord diameter (cm)	1.00 - 1.08	1.04 $\pm$ 0.197
Number of twists	1.93 - 2.17	2.05 $\pm$ 0.626
Amount of Wharton's Jelly ( $\text{mm}^2$ )	75.41 - 87.25	81.33 $\pm$ 29.859

Cords were marginal or battledore up to 4%, 3% cords were eccentric with furcate insertion and another 3% cords were battledore with velamentous insertion. The percentage of normal and morphological variants in the position of insertion of cord is shown in Figure-1.

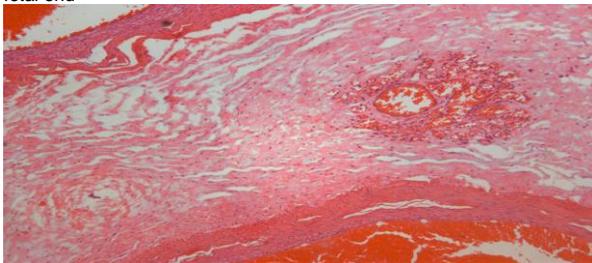
Figure-1: Anatomical variants of position of insertion of umbilical cord.



C=central, E=eccentric, B=battledore, EF=eccentric with furcate, BV=battledore with velamentous.

Results showed a straight cord with no twist (1%), 1% cords with 3.5 twists, 3% cords with 4 twists and 1% cord with 4.5 twists. The amount of Wharton's Jelly is assessed by the cross-sectional dimensions of the cord. It ranged between 50.24mm<sup>2</sup> to 113.04mm<sup>2</sup> in 91% cords. In an umbilical cord (1%), the amount of Wharton's jelly measured 38.46mm<sup>2</sup>, 2% cords were measured with 132.66mm<sup>2</sup>, another 2% cords measured 153.85mm<sup>2</sup> and 4% cords measured 176.62mm<sup>2</sup> as variants. Vestigial remnants of different origins were also seen as variants in histological sections of cords, such as vitelline (3%) and vascular remnants (3%) (Figure-2). The amniotic epithelium lining the umbilical cord was firmly adherent; 1% cords had squamous metaplasia as variant.

Figure 2: vascular remnant in the umbilical cord as anatomical variant at fetal end



**DISCUSSION**

In the present study morphological variants of umbilical cord are described; these were considered to be occurring in ≤ 5% of normal pregnancies. Yetter (1998) and Hargiti et al. (2004) described those cords which are 40 to 70cm long as normal. They considered cords less than 32cm or more than 100cm to be abnormally short and long, respectively.<sup>2,4</sup>

Results of this study are consistent with those of Benirschke (2004), where most cords at term were 1 cm in diameter.<sup>7</sup> In this study, the cord diameter ranged from 0.8cm to 1.2cm in 91% cases. Cords with diameter 0.7cm (1%), 1.3cm (2%), 1.4cm (2%) and 1.5cm (4%) were taken as variants. Yetter (1998), reported 7% marginal and 1% velamentous insertion of umbilical cord to placental disc.<sup>2</sup> Benirschke (2004), observed same frequency (1%) for velamentous insertion.<sup>9</sup> It appears that frequency reported in

the current investigation is higher than those published in earlier works. In this study, 84% cords were found eccentric in position and 6% were central, whereas, 4% cords were marginal or battledore, 3% cords were furcate and 3% cords included battledore with velamentous insertion on placentae as variants. Results in line with previous study<sup>11</sup>.

Results are consistent with those of Benirschke (2004), who gave average 2.1 twists per 10cm segment of umbilical cord and also with that of de Laat et al (2006), who described < 0.7 twist per 10cm of cord to be under-coiled while > 3 twists per 10cm of the cord to be over-coiled<sup>12-14</sup>. Gupta et al (2006) had given an average value of 5.8±3.8 twists, while straight cords were present in 5.6% cases<sup>15</sup>.

In this study, the method of Kraus et al. (2004), was adopted to assess the amount of Wharton's Jelly to determine cross-sectional dimensions of cord. In present study, amount of Wharton's Jelly ranging from 50.24 to 113.04mm<sup>2</sup> were present in 91% umbilical cords, whereas, it was 38.46mm<sup>2</sup> in 1%, 132.66mm<sup>2</sup> in 2%, 153.85mm<sup>2</sup> in another 2% and 176.62mm<sup>2</sup> in 4% umbilical cords as variant.

Remnants of vitelline duct (6.6%) and those of embryonic vessels were reported by Jauniaux et al (1989)<sup>16,17</sup>. In this study, 30% of vestigial remnants persisted to term. Out of these 28% were shown to have allantoic source, 1% had vitelline duct remnant and another 1% cord had vascular remnants.

**CONCLUSION**

The data confirmed that there were morphological variants including quantitative and qualitative variables, in the umbilical cord at term in healthy pregnancies. Any variant that exists in isolation appeared to be clinically non-significant. However, variants are markers of altered phenomenon that may occur from the time of implantation till parturition and it needs further study for changes in progression in relevance to internal environment. Therefore, a long-term study be undertaken which should describe the variants of cords and its relationship with the abnormal pregnancy or neonatal pathology seen in children born with these abnormalities.

**Authors' Contribution: AC & MSA:** Conceptualized the study, analyzed the data, and formulated the initial draft, **SI & NI:** Contributed to the histomorphological evaluation, **SI:** Contributed to the analysis of data and proofread the draft, **TL:** Contributed to the proofreading the manuscript for intellectual content.

**Limitations:** Our study had limitations like financial constraints, lack of resources and lack of genetic workup.

**Conflict of Interest:** None to declare

**Financial Disclosure:** None

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