

## MORPHOLOGICAL VARIATIONS OF UMBILICAL CORD IN HUMAN PLACENTA

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### ABSTRACT

**Introduction:** The umbilical cord or Funis forms the connecting link between the fetus and the placenta. Through umbilical cord the fetal blood flows to and from the placenta providing nutrition, gas exchange, waste removal, endocrine function and immune support to the developing fetus. The umbilical cord extends from the fetal umbilicus to the fetal surface of the placenta. Being organs of vital importance for continuation of pregnancy, the placenta and umbilical cord have evolved great interest among the Anatomists, Embryologists, Pathologists and Obstetricians.

**Materials and Methods:** A cross sectional study was conducted on 695 umbilical cords attached to placentae from the Department of Obstetrics and Gynaecology, collected soon after delivery. The morphology of the umbilical cords attached to placenta were studied. Fresh specimens of umbilical cord were examined for attachment to the placenta, cord length, diameter, number of vessels, diameter of vessels, coiling and knotted appearance. Neonatal details within 24 hours after delivery were recorded.

**Results:** Average cord length was 46.04cm (SD 11.8cm) with the shortest cord being 5.8cm and the longest 78.50cm. Majority of the umbilical cords (71.94%) had eccentric attachment to the placentae; (139) 20% had central and 53(7.63%) had marginal and 3(0.43%) had velamentous attachments. Occurrence of furcate insertion of umbilical cord vessels into the placenta was 28% and non-furcate insertion was 501(72%). Morphological variations of umbilical cord showed statistically significant association with maternal Diabetes mellitus, Preeclampsia, Antepartum haemorrhage, twin pregnancy and foetal Intra Uterine Growth Retardation.

**Conclusion:** The study observed that, the morphological variations of umbilical cord show significant effects on maternal and foetal conditions. These quantitative findings may provide baseline information for further investigations.

**KEY WORDS:** Umbilical cord, Placenta, Morphology, Variations.

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### INTRODUCTION

The umbilical cord or Funis extends from the fetal umbilicus to the fetal surface of the placenta. It forms the connecting link between the fetus and the placenta [1]. Through umbilical cord the fetal blood flows to and from the

placenta providing nutrition, gas exchange, waste removal, endocrine function and immune support to the developing fetus [2]. Being organs of vital importance for continuation of pregnancy, the placenta and umbilical cord have evolved great scientific importance among the

Anatomists, Embryologists, Pathologists and Obstetricians. Morphological Variations of umbilical cord is common and may be associated with abnormal maternal as well as fetal conditions [2]. These morphological variations include umbilical cord attachments to the placenta, extreme umbilical cord lengths, Wharton's jelly content, cord tensile strength, shape, cord looping, cord knotting and variations in umbilical cord vessel morphology and number. Recent studies [3-5] on umbilical cord have been directed into other aspects also recording useful information on the subject. Knowledge about the umbilical cord is important because the vessels in the cord are essential part of foetal circulation. The umbilical cord has also been found to be a marker for intrapartum complications. The present study was planned to find the morphological variations of umbilical cord and factors associated with it in a tertiary care centre, in South India.

#### OBJECTIVES

1. To study the morphology of umbilical cords attached to placenta soon after delivery
2. To find morphological variations and factors associated with it among the specimens studied.

#### MATERIALS AND METHODS

A Cross sectional study was conducted among 695 specimens of umbilical cords attached to placentae collected soon after delivery from Department of Obstetrics and Gynaecology, Dr.Somervell Memorial CSI Medical College, Karakonam during the period of six months from July 2016. All the umbilical cords with placentae delivered during the study period were collected and included in the study. The specimens were washed under running tap water, labelled and fixed in 10% formalin. Details of the mothers were recorded. Examination of the umbilical cords with the placentae was carried out. Morphological study of the umbilical cord was done. Fresh specimens of umbilical cord were examined for mode of attachment to the placenta, cord length, diameter, number of vessels, diameter of vessels, coiling and knotted appearance. Neonatal details within 24 hours after delivery were also recorded.

The following observations were noted and recorded:

#### A. Morphology of Umbilical cord:

- 1) Mode of attachment of umbilical cord to the placenta.
- 2) The length of umbilical cord.
- 3) Diameter of the umbilical cord.
- 4) Number of vessels in the umbilical cord.
- 5) Insertion of the umbilical vessels into the placentae.
- 6) Diameter of vessels in the umbilical cord.
- 7) Coiling of umbilical cord.
- 8) Knotted appearance of umbilical cord.
- 9) Looked for cord abnormalities.

**Variations in the morphology of umbilical cord:** Looked for any abnormal cord length, shape, abnormal mode of attachment of umbilical cord with placenta, presence of knots, single umbilical artery or any other variations.

#### B. Maternal Details:

Gestational age, Parity, Weight at delivery, any conditions such as Hypertension, Diabetes, Preterm labor.

**C. Neonatal Details:** Birth weight, Congenital Malformations

#### OPERATIONAL DEFINITIONS:

**Normal length of umbilical cord:** 40 cm ( usual variation of 30-100cm). The cord is described as short, when the length is less than 20cm, Long cord when the length is >40 cm. Very long cord may measure 101-300 cm. Long cord may loop round the neck ( 20-30%).

**Normal Diameter of Umbilical cord:** 1.5 cm (with variation of 1-1.25 cm)

**Thickness** is not uniform, but presents with nodes or swellings at places due to kinking of umbilical vessels or due to local collection of Wharton's jelly. True knots are usually rare (1%).

**Attachment of cord:** Usually umbilical cord is attached between the centre and edge of the placenta ( eccentric). Attachment may be central, marginal or even on the chorion leave at varying distance away from the margin of the placenta called velamentous insertion.

**The insertion of the umbilical vessels into the placenta:** is described as either furcate (when the vessels are separated from each other before their insertion) or non-furcate (when they were covered by a sheath of Wharton’s jelly to their point of insertion).

**Data collection tool:** Pretested proforma

**Data were collected** after obtaining Ethical Committee Clearance from the Institutional Ethics Committee and Informed consent from the pregnant mothers.

**Data entry and analysis:** Data were entered in MS Excel sheet and analysis was done using Statistical software SPSS Trial version 20.0

**RESULTS AND DISCUSSION**

The present study was conducted among 695 fresh specimens of umbilical cords attached to placenta collected soon after delivery during a period of six months from July 2016.

**A. Maternal factors:** The **mean age of pregnant mothers** was 26.13+4.71 with minimum age 19 and maximum age 41 years.

7.19% of the umbilical cords were obtained following preterm labor with prominent maternal risk factors such as Pregnancy Induced Hypertension (60%) and Gestational Diabetes Mellitus (20%). Other risk factors were Low prepregnancy weight of mother 4 (8%), Anemia 2 (4%), Multiple (twin) gestation 1 (2%), Antepartum hemorrhage 1 (2%), Cervical incompetence 1 (2%) and Hypothyroidism 1 (2%).

**Table 1:** Distribution based on term of labor.

Term of pregnancy at delivery	Number (Percentage)
Term labor	645 ( 92.81)
Preterm labor	50 (7.19)
<b>Total</b>	<b>695 ( 100)</b>

**B. Neonatal Details:** ‘Z’ test showed significant association of morphological variations of umbilical cord and adverse fetal outcome ( p value less than 0.05).

Morphological variation of umbilical cord in the form of presence of single umbilical artery showed statistically significant association with maternal Diabetes mellitus, Preeclampsia, Antepartum haemorrhage, twin pregnancy and foetal Intra Uterine Growth Retardation.

**Table 2:** Comparison of Pregnancy outcome and morphological variations of Umbilical cord.

Foetal outcome	Component	Number (percentage)		Significance
		Variations present	Normal cord	
Mode of delivery	Vaginal	Nil	645 (92.81)	P value >0.05
	LSCS	50 (7.19)	Nil	
Baby at birth	Live	48 (6.9)	645 (92.81)	
	Dead	2 (0.28)	Nil	
NICU admissions	Yes	39 ( 5.6)	1 (0.14)	
	No	41 (5.9)	643 (92.5)	
Congenital anomalies	Yes	9 (1.3)	Nil	
	No	2 (0.28 )	Nil	

**C. Findings in the Umbilical cord:**

**Length of umbilical cord:** Mean length of the cord was 46.04cm (SD 11.8cm) with the shortest cord being 5.8cm and the longest 78.50cm. Using the mean cord length ( $\geq 40$  cm) as a marker, the distribution of short and long cords were 20.56% and 79.44% respectively. This difference in mean cord length was statistically significant.

Long cords were associated with cord prolapse and cord entanglement round the neck or body leading to compression of cord vessels and fetal distress.

Peter Kwabena Appiah (2009) [6], studied 265 umbilical cords and reported the average length of the cord as 44.8cms  $\pm$  12.0. The study done by Gupta. S, et al [7] reported the average length of the cord as 44.3cms  $\pm$  9.2 .

**The diameter** of the cords was in the range of 1.50 cm to 3.20 cm. Mean cord diameter was 2.1cm (SD 0.004), with a 95% confidence interval.

**Mode of attachment of cord to the placenta:** In the present study, majority of the umbilical cords 500 (71.94%) had eccentric attachments to the placenta; (139) 20% had central and 53(7.63%) had marginal and 3(0.43%) had velamentous attachments.

Umbilical cords of placenta with Pregnancy Induced Hypertension, showed abnormal insertion of cord. Among them, most of them showed marginal insertion and three specimens showed velamentous insertion of umbilical cord. There was insignificant association between insertion of umbilical cord and PIH (P > 0.05).

Peter Kwabena Appiah [8] found the site of insertion of umbilical cord on placenta was eccentric in 21.14%, central in 60.75% and marginal in 18.11% .

Many authors Udaina et al [9], Majumdar and Dasgupta [10], Yousuf M S et al [11] and Vijayalakshmi B Kittali [12] observed that marginal insertion of cord was significantly associated with hypertensive placentae.

**Number of vessels in the umbilical cord:** In the present study it was found that umbilical cord had 2 arteries and 1 vein in 648 specimens which includes 639 normal pregnancies, 6 hypertensive pregnancies and in 2 multiple pregnancies. Persistence of the right umbilical vein results in a 4 vessel umbilical cord (2 veins and 2 arteries) is seen in conjoint twins [13].

The **single umbilical artery** and single umbilical vein were observed only in 6 umbilical cords. Presence of single umbilical artery showed statistically significant association with maternal Diabetes mellitus, Preeclampsia, Antepartum haemorrhage, twin pregnancy and foetal Intra Uterine Growth Retardation.

**Insertion of the umbilical vessels into the placenta:** Occurrence of furcate insertion of umbilical cord vessels into the placenta was 28% and non-furcate insertion was 501(72%).

**Coiling of umbilical cord:** This coiling arises as the longer umbilical vein twists around the umbilical arteries providing strength to the umbilical vessels. Non-coiled cords and poorly coiled cords are less able to resist compressive forces. This may lead to preterm delivery, fetal distress and intrauterine death. Over coiled cords may lead to foetal demise, intrauterine growth retardation, thrombosis of chorionic vessels and umbilical veins and stenosis of the umbilical cord [14].

**Knotted appearance of umbilical cord:** The umbilical cord can become knotted. If the knot is loose, fetal circulation is maintained. If the knot is tightened during the foetal descent through the birth canal, can occlude the placental circulation and lead to intrauterine death of the foetus [15]. In the present study, the umbilical cord of one of the demised babies showed knots.

## CONCLUSION

The morphological variations of umbilical cord showed significant effects on maternal and foetal conditions. These quantitative findings may

provide baseline information to the researchers for further investigations

**Conflicts of Interests: None**

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