

**A STUDY OF UMBILICAL CORD IN  
50 SPECIMENS IN  
TAMIL NADU POPULATION**

Dissertation submitted for the  
degree of **M.S. ANATOMY - BRANCH - V** to the  
**Tamil Nadu Dr. M.G.R. Medical University**  
Chennai



**INDSTITUTE OF ANATOMY  
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## **CERTIFICATE**

This is to certify that this dissertation entitled “**A STUDY OF UMBILICAL CORD IN 50 SPECIMENS IN TAMIL NADU POPULATION 2004 - 2006**)” has been prepared by **Dr. M. ROHINI DEVI** under my overall supervision, in partial fulfillment of the regulations for the award of Degree of **MASTER OF SURGERY IN ANATOMY - BRANCH - V** of Tamil Nadu Dr. M. G. R. Medical University, Chennai.

Date :

Place : Madurai

**Dr.T. HARIHARAN M.S.,**

# DECLARATION

This Dissertation “**A STUDY OF UMBILICAL CORD IN 50 SPECIMENS IN TAMIL NADU POPULATION**” is submitted to the Tamil Nadu Dr. M.G.R. Medical University regulations for the degree of M.S. Anatomy.

This study was carried out by me from 2004 - 2006 under the guidance and supervision of **Dr. T. HARIHARAN, M.S.**, Director and Professor of Anatomy, Institute of Anatomy, Madurai Medical College, Madurai – 20.

This Dissertation has been written in my original work and has not previously formed the basis for the award of any Degree, Diploma, Associateship, Fellowship or other similar title or prizes.

Place : Madurai

Date :

**M. ROHINI DEVI**

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# INTRODUCTION

The umbilical cord is the linkage between the fetus and the mother. It initially presents as the connective stalk at the caudal end of the embryo before folding and later shifted to the ventral surface of embryo to the umbilical ring after the folding of the embryo.

It is lined by fetal membranes the main constituent being the extra embryonic mesoderm containing the extra embryonic coelom, it contains the left umbilical vein with right and left umbilical arteries with differentiation of nerves in the extra embryonic mesoderm. The allantois and the vitello intestinal duct are incorporated in the cord at its fetal end.

The study on umbilical cord has been taken as my dissertation work since umbilical cord is one and only communication between the mother and the fetus and is the only structure through which nutrients and all other metabolic exchanges in the fetus occur. In day to day life it is noted that complications during delivery of the fetus, any malformations in the fetus, perinatal and postnatal complications in mother are attributed to the umbilical cord abnormalities and variations.

Now a days it is said that any variation in the length, pattern of vessels may lead to intrauterine death and even other anomalies like renal aplasia, congenital tracheoesophageal fistulas, chromosomal abnormalities. It is also investigated that hollow organs anomalies may be associated with umbilical arteries variations.

In southern parts, more commonly in the dispensaries, we come across antenatal cases with anaemia and nutritional disorders. Mostly in rural places the women used to do heavy physical work for their living. Since they are not aware of family welfare procedures and the hazards of repeated pregnancies they give more child birth . Even if they are having nutritional disorders, anaemia and hypertension complicating pregnancy with cardio vascular disorders they have a strong belief in having more children. So this work has been undertaken with a view to collect more data's about umbilical cord in cases having the above mentioned lesions.

So, as an, addition to the present data's available, this work has been chosen as my study of the umbilical cord.

## **REVIEW OF LITERATURE**

Berengarius (1521) described the presence of three blood vessels along the whole length of cord.

Hoering (1838) presented a case report of a twenty five year old primi who gave birth to a female child with a double placenta divided in the middle into two fairly equal parts which were connected only by chorion and amnion. There was a split in the umbilical cord, at a distance of 3 inches from the placenta into two branches, each provided with two arteries and one vein and reaching each placenta.

Zollickoffer (1840) published a case report of spontaneous abortion of a three months old fetus and sac, associated with considerable haemorrhage. On examination there were two distinct placentae. The umbilical cord, about 2 inches from the umbilicus, bifurcated with each ramification entering to each placenta. This was the only instance of two placentae with a single fetus in 651 deliveries, of Zollickoffer over a period of 23 years.

Hohl (1851) presented a case of placenta duplex, in which the umbilical cord was 29 inches in length, was inserted on the membranes separating the two discs.

Prottesser Vallette (1858) reported a double placenta with a single fetus. Which were separated by a membranes intervening 3 cm between them. 71 cm long umbilical cord bifurcated near the insertion in to the placenta. There were two arteries and one vein with umbilical cord.

Dr. Joseph B. Delee. Dr. Delee (1910) stated minimal length of the umbilical cord necessary for a term fetus to deliver was 32 cms.

Gude Will (1927) presented a case of placenta duplex and another case of placenta biloba. In the placenta biloba the umbilical cord was inserted at the margin of the larger lobe near its junction with smaller one with vessels proceeding to supply each lobe.

Itzkin (1929) reported a case of placenta biloba in which the umbilical cord was inserted in to the larger lobe and the fetal vessels, ran from one lobe to the other across the membranes.

In American Journal (1941) a paper was published on typical bilobate placenta of equal size. The umbilical cord insertion was at region of the division.

Carlisle (1949) reported a case delivery of a female infant with bilobed placenta with intervening membranes, in a 33 years old primi. The umbilical cord was velamentously inserted in the center of the intervening membrane.

Edmonds (1954) stated the coiling index, in which he divided the total number of coils by the length of the umbilical cord in centimeters, and he called the result as “The Index of Twist”. He also noted that the clockwise coiling of umbilical cord produced positive score and anticlockwise coiling produced negative score. Abnormal umbilical coiling index is associated with adverse fetal outcomes.

Zawisch (1955) observed whartons jelly and stated its salient function as mechanical cushioning effect which protects the umbilical vessels from trauma. The tissue was metabolically very active. He also described the umbilical arteries having well formed media and unusual lack on internal elastic lamina and adventia.

Kan and Eastman (1957) stated that there was coiling of the cord in the fetus around the neck more commonly longer cords. They had also reported one loop nuchal cord in 20-34%, two loops in 2.5 to 5% and three loops in 0.2 to 0.5%.

Percy Malpas M.D (1960) measured the length of 10 umbilical cords and found out that the average length was 61 cm .

Hath Out in (1964) by Monie in (1965) described that either velamentous or marginal insertion of umbilical cord might lead to miscarriage.

S Pellacy and Co. Workors (1966) found an incidence of true knots 1.1 percent. among 17,000 deliveries in the collaborative study on cerebral palsy. There was coiling of the cord usually around the neck associated with longer cords. Several studies have reported one loop in 20 to 34% of deliveries, two loops in 2.5 to 5 percent and three loops in 0.2 to 0.5 percent.

Strong and Corney (1967) noted high incidence of single umbilical artery in twins.

Philippe et al (1968) specifically denied the association between miscarriage and velamentous cord insertion.

Richard Torpin (1969) observed that among 412 discoid placentae in a group of 500 consecutive deliveries, the umbilical cord was attached centrally in 120(29%), eccentrically in 260(63%) and marginally in 32(8%) placenta.

In his study of placenta biloba Richard Torpin had described that the umbilical cord was centrally inserted into the major lobe in about 50 percent of cases, eccentrically in about 18 percent and in the remaining near the dividing line between the lobes.

Boyd and Hamilton (1969) observed that at term the umbilical cord was normally about the same length of the fetus of about 50 cm. It can vary from 10-150 cm. A markedly short cord may cause difficulty during parturition and a long cord may either encircle the child's neck or gets prolapsed. The cord shows a marked spiral torsion due to fetal movement or due to unequal growth of the umbilical vessels.

Meyer WW et al (1969) observed a remnant of either allantois (2/3) or omphalomesenteric (1/3) duct as one of the components in 4 vessel cord. They

also stated the persistence of small vitelline arteries as fourth vessel in 5% of cases

Shanklin (1970) in 5000 placenta noticed velamentous or marginal type of insertion of cord in infants weighing less than 2500 grams.

Quek and Tan (1972) estimated that the complication in velamentous insertion of umbilical cord occur only in 2 percent of his cases.

Bryan and Kohler (1974) stated, Infants with single umbilical artery often had a low birth weight and a high perinatal mortality even in the absence of malformations.

Vyanwah – AK Pom and Fox (1977) observed that marginal or velamentous insertion of the cord was associated with high perinatal mortality. Modern studies had shown that the site of insertion of the cord do not alter the function of the placenta.

Painter D et al (1977) observed increased incidence of congenital anomalies in 4 vessel cord.

Woods and Malan (1978) subsequently concluded the above statement. He also studied 940 placentae and found no correlation between the birth weight and the site of cord insertion in normal term infants.

Bettzieche (1978) stated that the umbilical vessels lack vasa vasorum and the long standing controversy over existence of its innervation is yet to be solved.

Fox (1978) observed the following in his studies.

### **1. LENGTH OF THE CORD:**

He had stated that the average length of the cord was between 54 and 61 cms. The minimum length of the cord for a normal cephalic delivery at term was 32 cms and the maximum length cord as 100 cms.

### **2. VENOUS REMNANT :**

He has reported a venous remnant in 5 percent of cases.

### **3. ATTACHMENT OF CORD :**

He has stated that the insertion of the cord to the placenta was clinically not significant.

Perceival (1980) reported the site of insertion of umbilical cord to be eccentric in 73% of cases and this attachment of umbilical cord was most common in normal placentae.

Miller and Associates (1981) identified shortening of the cord appreciably in chronic fetal constraint from oligohydramnios or decreased fetal movement with down's syndrome or limb dysfunction.

Moessinger et al (1982) had stated that the fetal movement appeared to have a stimulatory effect on the longitudinal growth of the cord.

Mills et al (1983) have formulated standard tables for cord length based on measurements of over 18,000 cords from fetuses ranging in gestational age from 34 weeks. The tables indicated that the cord continued to grow in length up to and beyond term. He had observed that greater intrauterine movements of fetuses associated with longer cords in male than females and restriction of fetal activity from a short cord.

Heifetz (1984) has reported infants with single umbilical artery in 1% of his cases.

Naeye (1985) had correlated unduly short cord with increased frequency of subsequent childhood mental and motor impairment, with diminished fetal movement.

Hibbard (1986) observed that the umbilical cord in placenta praevia was marginally inserted.

Hankins and Collegues (1987) reported 20 percent of fetuses with a nuchal cord associated moderate or severe heart rate decelerations, with low umbilical artery PH.

Smith (1987) stated that complete cord compression would result in the development of respiratory and metabolic acidosis within 10 or 20 minutes.

Kochler (1987) stated that in velamentous insertion of the cord, the unprotected umbilical vessels were exposed to the risk of mechanical injury before reaching the placenta and the risk is greater when the vessels overlie the internal os of cervix during delivery.

Lacro RV et al (1987) observed the incidence of cords without coil in 5%.

Giacomello.F (1988) Am.J.obstet Gynaecol classified the nuchal cord into 2 types.

Type A- nuchal loop that encircles the neck in a freely sliding pattern.

Type B – nuchal loop that encircles the neck in a locked pattern.

Jauniaux et al (1989) observed the presence of allantoic remnants in 14.5% among 1000 umbilical cord and omphalomesenteric duct in 1.4 percent. The remnants situated along the margin of the cord.

He also stated that allantoic remnant was present between the two umbilical arteries and appeared either as a solid cord or duct lined by transitional epithelium.

Leung and Robson (1989) stated that the single umbilical artery was associated with fetalmalformations.

Lurie et al (1990) studied that the rupture of the cord could occur either during early stages of labor or before labor for which no cause could be attributed .

Benirschke K (1990) reported that in velamentous insertion the cord was not connected to placental plate, but its vessels traveled between the membranes before attaching eccentrically to the placenta. It happened in 1.1% singleton pregnancies and 8.7% of twins. Associated anomalies were found in 5.9 – 8.5% of cases.

Adinma JI (1990) Journal of Gynaecol obstet stated nuchal cord loops slightly more common in male fetuses.

Hart and Draw (1991) revealed that entanglement of the umbilical cords could occur in 70% of the cases in monoamniotic twins. In such cases the umbilical cords might become twisted around each other to form multiple true knots and the cord of the second twin might become entangled around the neck or trunk or limbs of the first twin.

Skibo LK et al (1992) stated that the cysts in the cord were mostly located at the fetal end.

Strong TH Jr et al (1993) stated an incidence of non coiled cords in 4 to 5%.

Strong and Colleagues (1993) observed a significant increase in various outcomes of fetuses with meconium staining, perterm birth and fetal distress with hypocoiled cords.

Gupta et al (1993) found more than three vascular profiles, on cut section, in 6% of the umbilical cord among 644 specimens. The sections were taken at fetal end mid portion and placental end of the umbilical cord.

Bertnard et al (1993) studied morphometric characteristics of umbilical cord and chorionic plate vessels in preeclamptic and normal pregnancies and found no clinical significance.

Strong et al (1994) simplified the clockwise and anticlockwise coiling scores as “The umbilical coiling Index”.

Ertan A.K. Schmidt W. (1994) stated single umbilical cord loops in 20-33% of normal term pregnancies.

Rana et al (1995) observed an incidence of 4.9% cords with out coil also noted and they have stated that hyper coiled cords were associated with premature delivery and low birth weight.

Rana and Associates (1995) found a higher incidence of preterm delivery in a cocaine abuse with hypercoiled cords.

Catanzarite (1995) described two vessel cord, in 46 fetuses during ultrasonography. He found that Chromosomal abnormalities and tracheo esophageal fistula were common in 2 vessel pattern.

Int. J. Gynaecol Obstet. Ship TD et al (1995) published clear cysts in 4 cases complex masses in 8 cases and complete cystic encasement in one case of his prenatal sonographic study in 13 cases in 46 months.

The first postpartum screening program (1995) for single umbilical artery stated that the pathogenesis secondary to vessel atrophy of a previously normal cord in the mid trimester was equal in both male and female fetuses . The overall incidence for isolated single umbilical artery was 0.26% to 0.32 % of Live births.

The incidence of single umbilical artery associated with malformations or fetal loss was 0.63-1.0%. A single umbilical artery was 3 to 4 times more common in twins.

Berg and Rayburn (1995) observed an unusually long cord with 80 cm length.

Shen-Schwarz and Associates (1996) reported an association between absent cord twisting with marginal and velamentous cord insertion.

Turnbulls obstetrics (1996) stated umbilical cord prolapse occur about one in every 300 deliveries.

Fox (1997) stated the average length of the normal umbilical cord between 54 and 61 cm and cord length of 32 cm or less considered as abnormally short.

Fox (1997) also observed that a single umbilical artery was accompanied very often by fetal malformations, in 25-50%. He also stated that marginal insertion was less common than an eccentrically placed cord.

The vessels of the velamentously inserted cord were only susceptible to damage during labor and there were reports of bleeding from such vessel during the antepartum period.

Nelson and Grether (1998) stated coiling of the cord around the neck was an uncommon cause of antepartum fetal death or neurological damage.

Pavlopoulos and Colleagues (1998) observed that a two vessel cord was associated with anomalies like renal aplasia, limb reduction defects and atresia of hollow organs, attributing a vascular etiology to those anomalies.

Selvakumar Vettivel et al (1998) Anatomical Adjuncts Vol.2 no.4. pp1-12 study on “Human umbilical cord structures in pregnancy included hypertension and normotensive pregnancy” stated that except for birth weight and umbilical vein outer diameter, the umbilical cord parameters do not significantly differ between the hypotensive and normotensive possibly due to compensatory mechanisms.

Jones I (1998) reported four true cord knots.

Henry Gray (1999) 38<sup>th</sup> Edition the standard text book of Anatomy stated that the average length of fully developed, umbilical cord was 50 cms and diameter was 1-2 cms, the length varying 20-120 cms with false or true knots.

False Knots were sharp variation which might accompany abnormally pronounced looping of one of the umbilical vessels or might be due to total accumulation of whartons jelly.

True Knots might embarrass the circulatory flow in the umbilical cord.

Raio and Colleagues (1999) reported an association between a single umbilical artery and a reduction of whartons jelly.

‘Forty Ninth Annual Conference of the Anatomical Society of India’ (1999) A study of placental morphology in the normal and hypertensive pregnancies and its correlation with fetal outcome showed that length of the cord was not significantly different in two groups.

Heifetz (1999) found spontaneous haematoma of the cord in 1-2 percent deliveries.

Raio L et al (1999) found thin cords associated with oligohydrammis and fetal distress

Benirschke and Kufman (2000) observed the following in their study.

1. Incidence of single umbilical artery was about 1 percent in twins.
2. Velamentous insertion in about one percent of singleton but is significantly more common in multiple pregnancies. Reviewed almost 1,95,000 deliveries and found an average incidence of 1.1 percent velamentous insertion. The umbilical vessels separate in the membranes at a distance from the placental margin, which they reach surrounded only by a fold of amnion.
3. Haematoma associated with short cords, trauma and entanglement.

Lee and Co Workers (2000) attempted to view the internal cervical os with sonography in nearly 94,000 women, in second trimester and observed vasa praevia in 18, an incidence of 1 in about 5200 pregnancies. About half were associated with velamentous insertion and the rest between marginal cord insertions and bilobed placenta or succenturiata.

Rath G et al (2000), Journal of the Anatomical Society of India Vol. 49 study was done in 218 placentae and revealed an increase in birth weight with the ascending surface area of the placenta. The fetoplacental ratio was found to be almost constant in normal and hypertensive disorders. In severe hypertensive cases the marginal attachment of the umbilical cord percentage

was the highest with 42%. This high percentage may be responsible for the low birth weight.

Collins and Collins (2000) reported one percent incidence of potentially harmful cord complications.

In his another study, he has estimated 6 percent incidence of still births with true knots.

Machin GA et al (2000) reported hyper coiled cords in 21%.

Cunningham F.G. et al (2001) reported that 25% of babies were born with their umbilical cords wrapped one or more times around neck.

Baergen and Colleagues (2001) in their study described that in 9% of women the excessively long cord was a heredity factor. Reported a mean length of 37 cm. in a study of more than 20,000 placentas

Budorick and Co Workers (2001) found no abnormal karyotypes and only one echocardiographic abnormality in 31 fetuses with a two vessel cord as

an isolated finding. When a two vessel cord is a non isolated finding as many as half of fetuses are aneuploid.

Williams Obstetrics 21<sup>st</sup> edition (2001) illustrated the following.

1. Cord length at term had appreciable variation and extreme range from no cord (achordia) to length up to 300 cm.
2. About one fourth of all infants with only one umbilical artery had associated congenital anomalies.
3. The umbilical cord usually was inserted at or near the center of the fetal surface of the placenta.

Blick Stein I et al (2001) observed that increase in coiling was found at the fetal end when compared with the placental and middle segment.

Herskovitz R et al (2001) reported that true knots were associated with advanced maternal age, multiparity, obesity, long cord, maternal anaemia and hydramnios

Airas U(2002) observed true cord knots in 1.25% of the umbilical cords.

Feldman and Associates (2002) Identified velamentous insertion more frequently with twins.

Philippe Jeanty (2002) found single umbilical artery as the most common anatomical abnormality of the umbilical cord, in 0.2 – 1% of singleton pregnancies and in 6-11% of multiple pregnancies. It was frequently found in association with stillbirths, intra uterine growth retardation, fetal structural anomalies and aneuploides.

Van Dijk CC et al (2002) stated the total number of coils for any particular cord was believed to be established early in gestation. The pattern of coiling developed during the second and third trimesters is due to snarls in the cord, and there could be changes in coiling as the pregnancy advances.

Pregnancy Institute, Pre natal Umbilical cord Project (2002) observed the following.

## **I LENGTH OF CORD :**

The umbilical cord stretch or elongate depending on the activity of fetus and have average length of 61cm. Active fetuses are believed to have longer cords on the whole than less active fetuses. Boys have longer cords than girls.

Rare instances exist in which no cord develops at all and the fetus being attached directly to the placenta of the umbilicus. Reports in Chinese and French Literature cite cords as long as 300cm in length.

Short cord has a length of less than 32cm and very short cords less than 20cm are and these are associated with genetic malformations.

Estimated that 30% of births had some type of umbilical cord finding and every third to fourth delivery had an identifiable umbilical abnormality or anomaly.

The umbilical cord is traditionally thought to stretch or elongate depending on the activity of the fetus.

Short umbilical cords less than 35cm are predisposed to rupture and they are responsible for prevention of fetal descent during labor. They are usually associated with genetic malformations.

Long umbilical cords longer than 70cm are associated with a number of circumstances which produce impact in the fetal life. Leonardo davinci studied cord length and believed that there was a proportional / natural relationship of 1:1 i.e. cord length = fetal age in weeks.

## **II VESSEL PATTERN :**

One of the rare developmental changes which can occur to the embryonic umbilical cord is the persistence of right vitelline vein creating a four vessel cord with two arteries and two veins. There could be two vessel cord with one artery and one vein with the incidence of 1% of births.

Umbilical cord vessels may multiply and branch under stressful conditions. For example, heavy smoking is associated with “multiple channels” in the umbilical cord.

There also exists a description of a double cord with duplication of vessels.

### **III. ATTACHMENT OF UMBILICAL CORD :**

This may be either central or sub-central or marginal or in the membranes.

In furcate cord the cord is not connected to the placenta but its vessels ramify on the placenta in 0.5 to 1% of all births.

### **IV. UMBILICAL CORD DESIGN :**

Umbilical cords may be helical with either spiral or coiled or curled-types occurring in 95% and straight in 5%.

Helical pattern may predispose the fetus to blood flow changes and straight may be susceptible to compression

A type of architectural defect called umbilical cord vessel segmental thinning, occur in 1% of the cases and this may be associated with fetal anomalies and perinatal problems.

Machin G.A et al (2003) pediatric dev pathol stated the coiled umbilical cord acted like a semierectile organ that is more resistant to snarling, torsion / stretch and compression than non coiled ones. This is referred to as spontaneous internal ballotement.

Haines and Taylor (2003) in obstetrical and gynecological pathology, 5<sup>th</sup> edition have stated that an abnormally long cord predisposes to knotting, torsion and prolapse.

Torsion may affect the whole cord or it may be localised and the later was usually associated with multiple twists.

Clapp and Colleagus (2003) stated that coiling of the cord around the neck was an uncommon cause of antepartum fetal death or neurological damage.

Krakowiak and Associates (2004) observed that short umbilical cords may be associated with adverse perinatal outcomes, such as, fetal growth restriction, congenital malformations, intrapartum distress and a two fold risk of death. Excessively long cords are more likely to cause complication such as prolapse.

Predanic M et al J. ultrasound Med (2005) Assessed umbilical cord coiling during the routine fetal sonographic anatomic survey in the second trimester. They had stated that abnormal coiling index was an indication for the fetus at risk. The sensitivity values of antenatal sonography to predict hypocoiling was 78.9% and rest was hypercoiling.

Shalu Gupta et al (2006) J. obstet Gynecol India Vol.56 No.4. July / August studied umbilical coiling index in Indian babies and its relationship with antepartum and intrapartum outcomes in 107 cords.

They have stated that a coil was defined as a complete 360 degree spiral course of the umbilical vessels around the Wharton's jelly. They have also found out that the vessels of the cord are prone to torsion, compression, tension, and subsequent interruption of blood flow. Which are minimised by the helical disposition of the cord in their study in 107 cords at birth they have formulated

that the mean umbilical cord length was  $44.3 \pm 9.2$  cm and the mean number of coils as  $5.8 \pm 3.8$ . No umbilical cord coiling was seen in 5.6% cases. anticlockwise coils in 76.6% and clockwise coils were seen in 17.8% all umbilical cords had three blood vessels.

They have concluded low umbilical coiling index as an indicator of adverse perinatal outcome associated with low apgar score, meconium staining and pregnancy induced hypertension.

## **MATERIALS AND METHODS**

The study was conducted at Madurai Medical College.

### **VENUE OF STUDY**

1. Institute of Anatomy, Madurai Medical College, Madurai.
2. Institute of Obstetrics and Gynecology, Govt. Rajaji Hospital, Madurai.

### **SAMPLE OF STUDY**

50 Human placentae with umbilical cord without any damage were collected from the labor ward including operation theatre in obstetrics and Gynecology Department.

The Specimens were collected without any socioeconomic status, religion, educational and pathological bias.

## **AGE DISTRIBUTION**

Placenta with umbilical cord specimens were collected from the mother in the age group between 19 to 32 years as follows.

1. > 20 years old 2 specimens.
2. Between 21 – 30 years 47 specimens.
3. Above 30 years one specimen.

## **PARITY DISTRIBUTION :**

Parity distribution of 50 specimens was as follows.

1. 30 Placentae with umbilical cord specimens were collected from primigravida.
2. 12 specimens from second gravida.
3. 8 specimens from third gravida.

In the present study soon after delivery uniformly 10 cm of umbilical cord was left at fetal end and then cord was clamped, cut and numbered serially.

The following observations were made from the specimens, by using forceps, scissors, scalpel, thread and measuring tape.

1. Nuchal cord.

2. Length of the cord.
3. Diameter of the cord.
4. Cord coiling.
5. Presence of knots
6. Presence of cysts and Haematoma.
7. Attachment of umbilical cord.

### **1. NUCHAL CORD :**

The babies born with their umbilical cords wrapped one or more times around the neck was observed and noted.

### **2. LENGTH OF THE UMBILICAL CORD :**

Length of the cord was measured from the cut end of the cord upto its placental attachment by using thread and then the Length of the thread was measured by using measuring tape in centimeters. With this reading 10 cm was added for the umbilical cord which was left towards fetal end.

### **3. DIAMETER OF THE UMBILICAL CORD :**

The transverse diameter of the cord was measured by taking one reading at fetal end and another reading at placental end.

### **4. CORD COILING :**

The presence of cord coiling was studied and following observations were made.

1. Hypo coiled cord.
2. Hyper coiled cord
3. Straight cord.

### **COILING INDEX**

The number of coils present in each umbilical cord were counted. The coiling index was calculated as

$$\text{Coiling Index} = \frac{\text{Total number of coils}}{\text{Length of Umbilical Cord}}$$

### **5. PRESENCE OF KNOTS IN UMBILICAL CORD :**

The cord were searched for the presence of true and false knots.

## **6. PRESENCE OF CYSTS AND HAEMATOMA :**

Along the course of umbilical cord the presence of cysts and haematoma were observed.

## **7. ATTACHMENT OF UMBILICAL CORD :**

Placental attachment of umbilical cord was studied as follows.

1. Central attachment
2. Eccentric attachment.
3. Marginal attachment.

The above datas were taken from the fresh specimens. Then the placentae with umbilical cord were washed well in tap water and stored in 10% formalin solution for 15 days.

## **METHODS**

1. Manual dissection was done in 45 umbilical cord specimens.
2. Indian ink was injected in 5 umbilical cord specimens to study the vascular pattern.
3. Histological examination of the blood vessels was done in four among the 50 placentas.

## **MANUAL DISSECTION :**

The umbilical cord were dissected to find out the presence of number of vessels at its attachment with the placenta. The vessels were traced further to observe the vascular pattern in the placenta.

## **INDIAN INK INJECTION METHOD**

Five specimens were washed well by using Heparin and then Indian ink was injected in the blood vessels of umbilical cord and stored in 10% formalin for 15 days. Then manual dissection was done to study the vascular pattern.

## **HISTOLOGY**

Four specimens of umbilical cord with placentae were taken. Pieces of tissue about half to one cm length, one at the fetal end another at placental end were taken. After fixing and hardening, paraffin block was prepared. Section cutting was done, floated on warm water and smeared in a slide.

## **REQUIREMENT FOR STAINNING**

Ehrlich's haematoxylin stain tested for 5 to 7 minutes and water soluble eosin stain tested for ½ to 1 minute, coplin jars containing xylol, absolute alcohol, 100% alcohol, 90% alcohol, 70% alcohol, 1% acid alcohol, canada balsam, slide rack, burner, coverslip, tap water and blotting paper etc.

## **PROCEDURE**

Before proceeding with staining, the side of the tissue on the slide was determined.

### **1. REMOVAL OF PARAFFIN**

- a) The slide was warmed on the reverse side of the tissue on a burner to dissolve the paraffin completely.
- b) The slide was dipped in xylol for 2-3 minutes to remove the paraffin.

### **2. HYDRATION OF THE TISSUE**

The slide was dipped in descending series of alcohol i.e absolute alcohol, 100% alcohol, 90% alcohol, 70% alcohol and water for one minute each.

### **3. STAINING OF THE SLIDE**

- a) The slide was placed on the slide rack and covered with drops of haematoxylin stain for 5 to 7 minutes, to stain the nucleus and the cytoplasm of the tissue.
- b) Stained with few drops of water soluble eosin solution for ½ to 1 minute and washed.

### **4. DEHYDRATION OF TISSUE**

The slide was passed through the ascending grades of alcohol, i.e 70% alcohol, 90% alcohol, 100% alcohol and absolute alcohol for one minute each. Then the slide was dipped in xylol and blotted .

### **5. MOUNTING THE SLIDE**

One drop of Canada Balsam was put on the slide, a clean coverslip was placed and dried for microscopic examination.

# OBSERVATIONS

The following observations were made from the present study of the fifty umbilical cord specimens under different methods.

## I. NUCHAL CORD

In the present study nuchal cord were present in 16% of cases.

- |                          |   |   |
|--------------------------|---|---|
| 5 in Primi               | – | were the average length of cord was 63.7 cms. |
| 2 in Second Gravida      | – | with the average length as 60.7 cms           |
| and one in Third Gravida | – | with the length of 60 cms.                    |

## II. LENGTH OF UMBILICAL CORD

In the present study the total length of the umbilical cord from the fetal end to the placental end was measured in centimeters of which Maximum length was 73.4 cms. (Fig. No.1) and the Minimum 43.4 cms. with an average length of 54.5 cms.

### **III. DIAMETER OF THE UMBILICAL CORD**

In the present work the diameter was calculated in centimeters at fetal and placental ends.

#### **DIAMETER AT FETAL END.**

Maximum diameter of the cord was – 1.4 cms and Minimum – 0.7 cms with an average of – 1.1cms.

#### **THE DIAMETER AT PLACENTAL END**

Maximum Diameter of the cord 1.7 cms and Minimum was 1.2 cms. with an average of 1.5 cms.

### **IV. CORD COILING**

It was observed (Fig No.2) that there was hypocoiling in 70%, hyper coiling in 24% and the umbilical cord was straight in 6%.

## **COILING MANNER**

There was anticlockwise coiling in 78%, the clockwise coiling in 16% and the coiling was absent in 6%.

## **COILING INDEX**

In all fifty specimens the coiling index was calculated by, dividing number of coils by the length of umbilical cord and following observation were made.

### **IN HYPO COILING UMBILICAL CORD**

Maximum Coiling Index was	-	0.12	and
Minimum Coiling Index was	-	0.08	with a
Mean umbilical cord Coiling Index of	-	0.01	

### **IN HYPER COILING UMBILICAL CORD**

Maximum Coiling Index was	-	0.18	and
Minimum Coiling Index was	-	0.14	with a
Mean Coiling Index of	-	0.014	

## **V. KNOTS :**

The presence of knots were studied in all fifty specimens (Fig. No.3) and observed that false knots were present in 32% with absence of knots in 68%. There were no true knots.

## **VI. CYSTS AND HAEMATOMA**

It is observed that cyst and haematoma were not present in all the specimens.

## **VII. ATTACHMENT OF UMBILICAL CORD**

It was observed that there was eccentric attachment in 80% (Fig. No.4).

Among which

- (a) 48% were from Primigravida.
- (b) 20% from second gravida
- (c) 12% from third gravida.

1. Central attachment was observed in 12% (Fig. No.5).

Among which

- (a). 8% from primigravida
- (b) 2% from second gravida. and

(c) 2% from third gravida.

(3) Marginal attachment was noted in 8% (Fig. No.6).

Among which

(a) 4% from primigravida.

(b) 2% from second gravida.

(c) And 2% (one case) from third gravida which was placenta biloba. (Fig. No.7) With the cord attached to the margin of the larger lobe.

## **VIII. VASCULAR PATTERN**

In the present study 3 vessel pattern was observed in all the fifty umbilical cord specimens. (Fig. No.8)

### **UMBILICAL VESSELS IN THE PLACENTAL SURFACE.**

Both magistral and dispersed type were observed.

1. Magistral Type in 62% and
2. Dispersed type in 38%.

## **HISTOLOGY**

The histological study of the Cord both at the fetal and placental end was studied. The structure of the artery and veins coincide with the standard textbook descriptions. (Fig. No.9)

(Fig. No.10) Shows 50 specimens of umbilical cord study.

# DISCUSSION

Morphometric analysis of the present work is discussed under following headings.

## **I. NUCHAL CORD : (Chart No.1)**

1. Kan and Eastman (1957) stated presence of one loop 20-30%, two loops in 2.5-5% and three loops in 0.2 - 0.5% of his study.
2. Spellacy and Co Workers (1966) observed coiling of the cord usually around the neck associated with longer cords.
3. Hankins and Colleagues (1987) reported 20% of fetuses with a nuchal cord associated with moderate or severe heart rate decelerations with low umbilical artery PH.
4. Adinma JI(1990) Jr. of Gynecol obstet stated nuchal cord loops slightly more common in male fetuses.

5. Hart and Draw (1991) revealed that entanglement of umbilical cords could occur in 70% of the cases of monoamniotic twins.
6. Nelson and Grether (1998) stated coiling of the cord around the neck was an uncommon cause of antepartum fetal death or neurological damage.
7. Cunningham F.G. et al (2001) reported 25% of babies were born with nuchal cords.
8. Clapp and Colleagues (2003) stated coiling of the cord around the neck was an uncommon cause of antepartum fetal death or neurological damage.

In the present study nuchal cord was observed in 16% and this coincides with the study of Hankins and Colleagues.

Among 8 cases the nuchal cord was observed in 7 male fetuses and in one female fetus and this coincides with the statement of Adinma JI (1990).

**(Table No.1)**

## **II. LENGTH OF UMBILICAL CORD (Table No.2)**

1. As per Dr. Joseph B. Delee Dr. Delee the minimum length of umbilical cord was 32cms and 51cms as per Percy Malpas M.D.
2. The average length of the cord was 54 and 61cms with the maximum length of 100cms and minimum length of 32 cms as per Fox.
3. Henry Gray 38<sup>th</sup> Edition it was 50 cms and the length was varying from 20 – 120 cms as reported by Henry Gray.
4. A mean length of 37cms has been reported by Baergen and Colleagues.
5. The average length was observed to be 61 cms. With short cord less than 32cms and shortest cord less than 20 cms by Pregnancy Institute.

In the present study the maximum length of the cord was 73.4.cm, minimum length was 43.4cm and average length was 54.5 cm which coincides with the study of Fox (1978) and Henry Gray (1999) 50cms.

### **III. DIAMETER OF THE CORD (Table No. 3)**

1. According to Raio L et al thin cords were associated with oligohydramnios and fetal distress.
2. And as per Henry Gray diameter of the cord was 1-2cms.

In the present study the average diameter was 1.3 cms which almost coincide the study of Henry Gray.

### **IV. CORD COILING (Chart No. 2)**

1. Boyd and Hamilton(1969) observed a long cord with marked spiral torsion and according to Lacro Rv et al the incidence of cords without coil in 5%.
2. The study of Strong and Colleagues revealed significant increase in various outcomes of fetuses with meconium staining, preterm birth and fetal distress with hypocoiled cords.
3. There were non coiled cords in 4 - 5% as per Strong TH et al.
4. Cocaine abuse with hypercoiled cords associated with higher incidence of preterm delivery has been reported by Rana.

5. And they have observed an incidence of 4.9% of the cords without coil and hypercoiled cords with premature delivery and low birth weight.
6. Shen-Schwarz and Associates (1996) reported an association between absent cord twisting with marginal and velamentous cord insertion.
7. Machin GA et al (2000) reported hypercoiled cords in 21%.
8. Blic Stein I et al(2001) observed that increase in coiling was found at the fetal end when compared with the placental and middle segment.
9. Pregnancy Institute (2002) stated umbilical cords may be helical in 95% and straight in 5%.
10. Predanic M et al (2005) observed the sensitivity values of antenatal sonography to predict hypocoiling was 78.9%.
11. Shalu Gupta et al (2006) studied umbilical coiling index in 107 cords. In their study there was no umbilical cord coiling in 5.6%. Anticlockwise coils in 76.6%. Clockwise coils in 17.8% with Mean umbilical cord Index as  $0.08 \pm 0.05$ .

In the present study coiling was observed in 94% of cases and it was absent in 6% cases.

Present study coincides with the study of Lacro RV et al, Rana et al, Strong TH et al and Pregnancy institute.

In the present study anticlockwise coils was observed in 78%, clockwise in 16% and absence of coils in 6%.

This study coincides with the study of Shalu Gupta et al. (**Chart No.3**)

#### **COILING INDEX (Chart No. 4 and 5)**

In present study mean coiling index in hypocoiling cord was 0.01 and 0.014 in hyper coiling cord.

The present study coincides with the study of Shalu Gupta et al.

#### **V. PRESENCE OF KNOTS**

1. S Pellacy and co workers (1966) found an incidence of true knots among 17000 deliveries.
2. Jones I (1998) reported four true cord knots.

3. Herny Gray (1999) stated the presence of cords with true or false knots.
4. Collins and Collins (2000) in his study had estimated the incidence of 6% still births with true knots.
5. Hershkovitz R et al (2001) reported that true knots were associated with advanced maternal age, multiparty, obesity, long cord, maternal anaemia and with hydramnios.
6. Haines and Taylor (2003) stated that an abnormally long cord predisposes to knots, torsion and prolapse.

In the present study false knots were found in 32% of cases.

True knots were not observed.

## **VI. PRESENCE OF CYSTS AND HAEMATOMA**

1. As per Skibo LK et al (1992) the cysts in the cord were mostly located at the fetal end and according to Int. J. Gynecol obstet there were clear cysts in 4 cases and complete cystic encasement in one case.

2. There were spontaneous haematoma of the cord in 1-2% deliveries as reported by Heifetz (1999) and haematoma associated with short cords, trauma and entanglement as per Benirschke and Kufman(2000).

In the present study cyst and haematoma were not present.

## **VII. ATTACHMENT OF UMBILICAL CORD (Table No. 4)**

1. Itzkin (1929) reported a case of biloba in which the umbilical cord was inserted into the larger lobe and the fetal vessels run from one lobe to the other across the membranes.
2. In American journal (1941) a paper was published on placenta biloba of equal size. The umbilical cord insertion was at the region of division.
3. Carlisle (1949) reported a case of bilobed placenta in that the umbilical cord was velamentously inserted in the center of intervening membranes.
4. Hathout (1964) by Monie in (1965) described that either velamentous or marginal insertion of umbilical cord might lead to miscarriage.

5. Richard Torpin (1969) observed that the umbilical cord was inserted centrally in 29% of cases eccentrically in 63% and marginally in 8% of cases.

In his study of placenta Biloba the cord was centrally inserted with major lobe in about 50% of cases, eccentrically in about 18% and in the remaining case near the dividing line between the lobes.

6. Shanklin (1970) noticed in 5000 placenta velamentous or marginal type of insertion of cord in infants weighing less than 2500 grams.
7. Quek and Tan (1972) estimated the complication in velamentous insertion of umbilical cord in 2% of his study.
8. Woods and Malan (1978) had studied 940 placentas and found no correlation between the birth weight and the site of cord insertion in normal term infants.
9. Perceival (1980) reported the site of insertion of umbilical cord to be eccentric in 73% of cases.

10. Hibbard (1980) observed that the umbilical cord in placenta praevia was marginally inserted .
11. Kochler (1987) stated that in velamentous insertion of the cord the vessels were exposed to the risk of mechanical injury.
12. Rath G et al (2000) observed 42% of the marginal attachment mainly in pregnancy associated with severe hyper tension.
13. Feld man and Associates (2002) identified velamentous insertion more frequently in twins.
14. Pregnancy institute (2002) observed the furcate cord insertion in 0.5 to 1% of births.

In the present study (**Chart No.6**) the attachment of the cord was eccentric in 80% which coincides with study by Perceival, central in 12% which is less when compared to the study by Richard Torpin and marginal in 8% which coincides with Richard Torpin (**Chart No.7**)

In the present study one placenta biloba was observed and in it the cord was attached to the margin of the larger lobe and the vessels were crossing the membranes to enter into the other lobe and this coincides with the study of Itzkin (1929).

In the present study among 8% of the marginal attachment of placenta, in 2 cases the birth weight of the infant was less than 2.5kg which coincides with the study of Shanklin(1970). **(Table No.5)**

The velamentous insertion and furcate attachment were not observed.

### **VIII. VASCULAR PATTERN**

1. Strong and Corney (1967) noted high incidence of single umbilical artery in twins.
2. Meyer WW et al (1969) observed either an allantoic (2/3) or omphalomesenteric (1/3) duct remnants present on a 4 vessel cord.

They also stated persistence of small vitelline artery as a 4<sup>th</sup> vessel in 5% of cords.

3. Bryan and Kohler (1974) stated Infants with single umbilical artery were with a low birth weight.
4. Painter D et al (1977) observed increased incidence of congenital anomalies in 4 vessel cord.
5. Fox (1978) reported a venous remnant in 5% of cases.
6. Heifetz (1984) had reported infants with single umbilical artery in 1% of his cases.
7. Jauniaux et al (1989) observed the presence of allontoic remnants in 14.5%.
8. Leung and Robson (1989) stated that the single umbilical artery was associated with the fetal malformations.
9. Catanzarite (1995) described two vessel cord in 46 Fetuses noted in ultrasonography. He had reviewed that chromosomal abnormality and tracheo esophageal fistula were common in 2 vessel pattern.

10. The first postpartum screening programme (1995) for single umbilical artery stated an incidence of 0.26% to 0.32% of live births. He also stated it was 3 to 4 times more common in twins.
11. Fox (1997) observed that a single umbilical artery was accompanied very often by fetal malformations in 25-50%.
12. Pavlopolos and Colleagues (1998) observed that a two vessel cord was associated with anomalies like renal aplasia, limb reduction defects and atresia of hollow organs attributing a vascular etiology.
13. Raio and Colleagues (1999) reported an association between a single umbilical artery and a reduction of whartons jelly.
14. Benirschke and Kufman (2000) observed the incidence of single umbilical artery in 1% of the twins.
15. Philippe Jeanty (2002) found single umbilical artery inn 0.2-1% of singleton pregnancies and in 6-11% multiple pregnancies.

16. In Pregnancy Institute, (2002) prenatal umbilical cord project has stated two vessel cord with the incidence of 1% of births.

They also described a double cord with duplication of vessels.

In the present study three vessel pattern was observed in all 50 specimens (100%).

## CONCLUSION

At the outset it is concluded that as per the regular teaching that longer cords are usually associated with presentation of cord around neck which leads to intrauterine death of the fetus. But from the previous literature it is deduced that cord around the neck was an uncommon cause of antepartum fetal death. Short cords, as remarked usually, are associated with difficulty in the delivery of the placenta. But in the previous literature, no comments on short cord associated with complications in the delivery of the placenta has been given as an important complication. But it is given that short cords are associated with adverse prenatal outcome such as fetal growth restriction, congenital malformation, intrapartum distress and a twofold risk of death.

If hypocoiled we could expect pre term birth and fetal distress. It is concluded from the previous study that hypocoiled cords are associated with pre term delivery and low birth weight. It is brought into light that low umbilical coiling index associated with low apgar score, meconium staining and pregnancy induced hypertension.

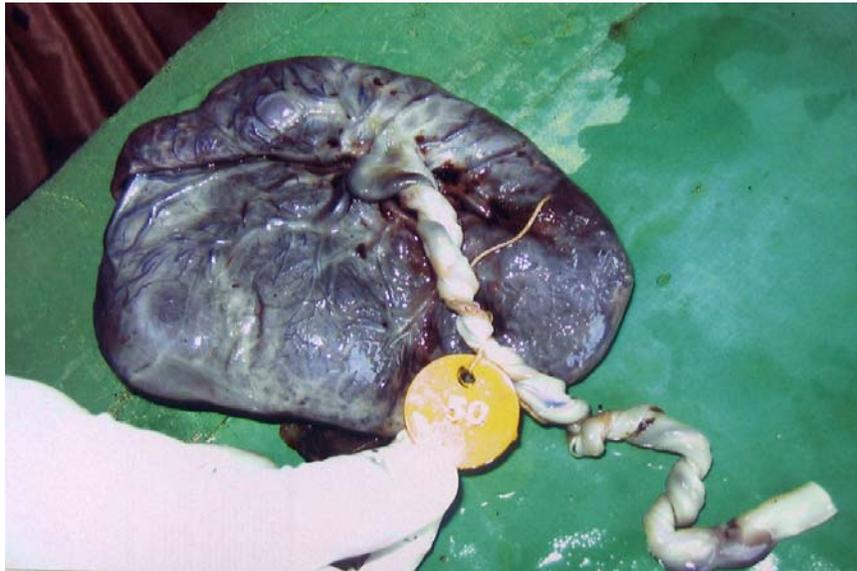
It could be also said that in the cords cysts and haematomas may be present. It is clear from the present collection that whatever may be the attachment of the cord to the placenta, it need not be associated with complications. It has been arrived from the previous literature that single umbilical artery may be associated with malformation and low birth weight. If two vessel pattern, we have to look for chromosomal abnormality and tracheo esophageal fistula. In the same cases we have to investigate for renal aplasia, limb reduction defects and atresia of hollow organs. As per the previous literatures single vessel pattern may be associated with twinning.

Finally it has to be stated, that there may be hidden facts, in relation to umbilical cord study. Which have to be brought into light so as to enlighten and enrich the statistical data available at present.

**Fig. No :1 Shows Long Umbilical Cord**



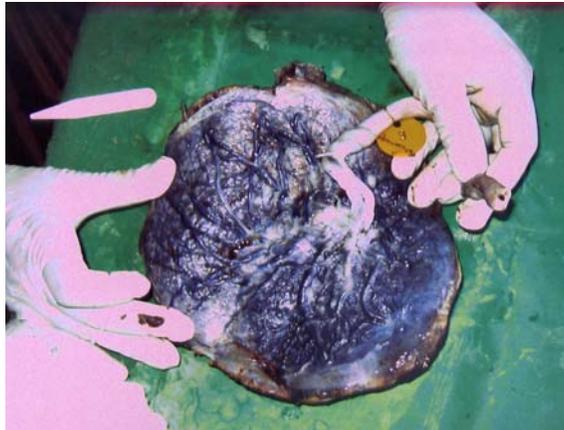
**Fig No :2 Shows Umbilical Cord Coiling**



**Fig No :3 Shows False Knot**



**Fig No : 4 Shows Eccentric Attachment of Umbilical Cord**



**Fig No : 5 Shows Central Attachment of Umbilical Cord**

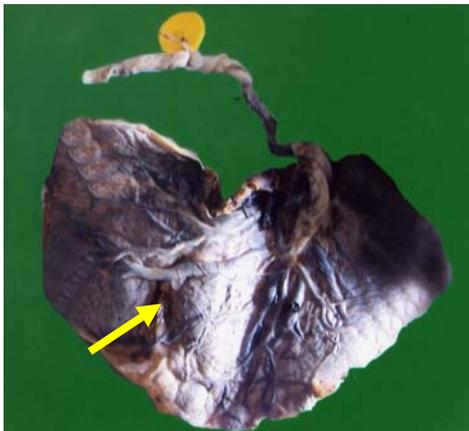


**Fig No : 6 Shows Marginal Attachment of Umbilical Cord**



**Fig No : 7 Placenta Biloba**

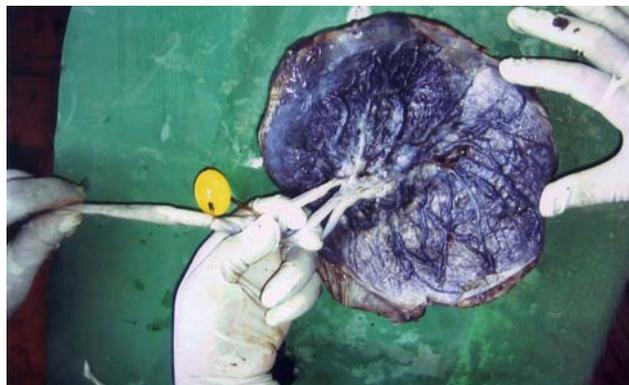
**Fetal Surface**



**Maternal Surface**



**Fig No : 8 Shows Umbilical Vessels**



**Fig No : 9 Histology**

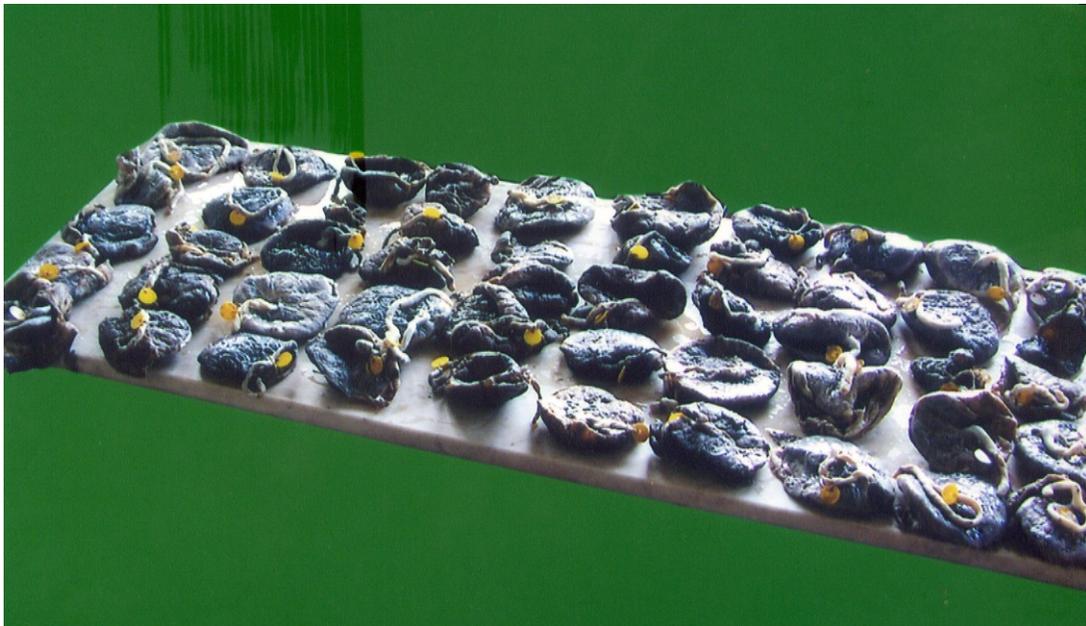
**Fetal End**



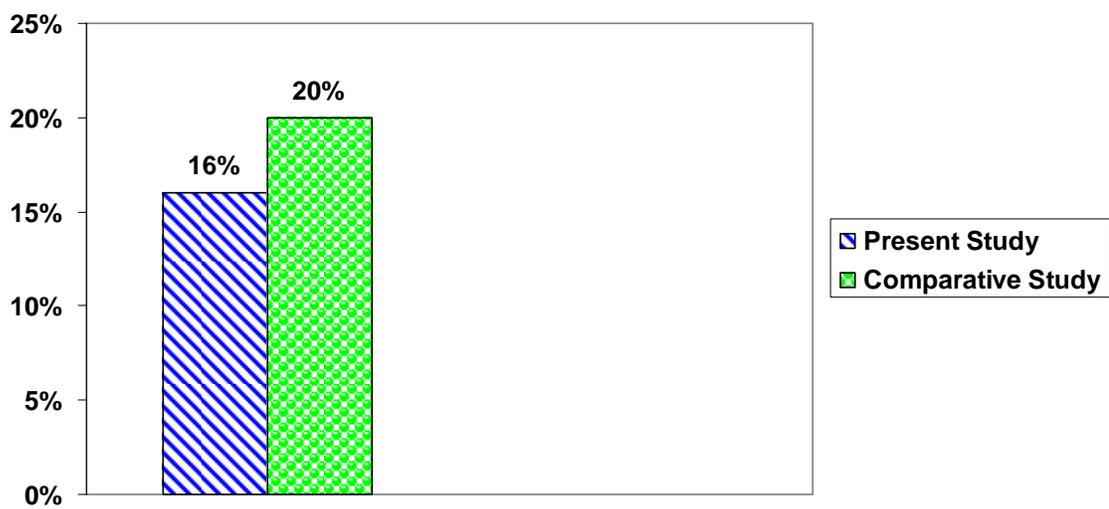
**Placental End**



**Fig No : 10 Shows 50 Specimens of Present Study**



**NUCHAL CORD CHART NO.1**



**NUCHAL CORD TABLE NO. 1**

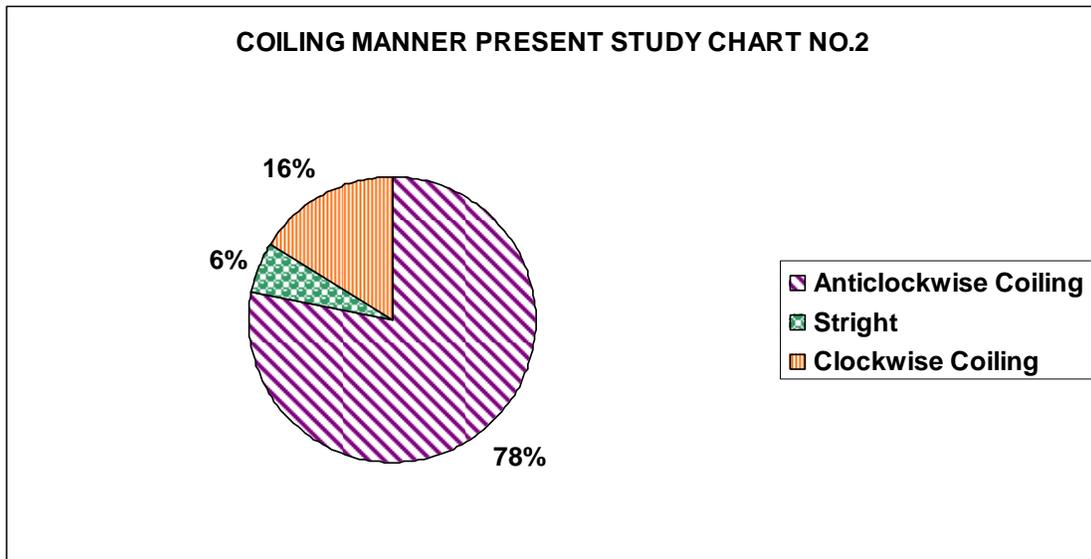
<b>S. No.</b>	<b>Length of the Cord</b>	<b>Gravida</b>	<b>Sex of the Fetus</b>
1.	73.4	I	M
2.	69	I	M
3.	61.4	II	M
4.	60	II	M
5.	60	III	M
6.	59.2	I	F
7.	59	I	M
8.	58	I	M

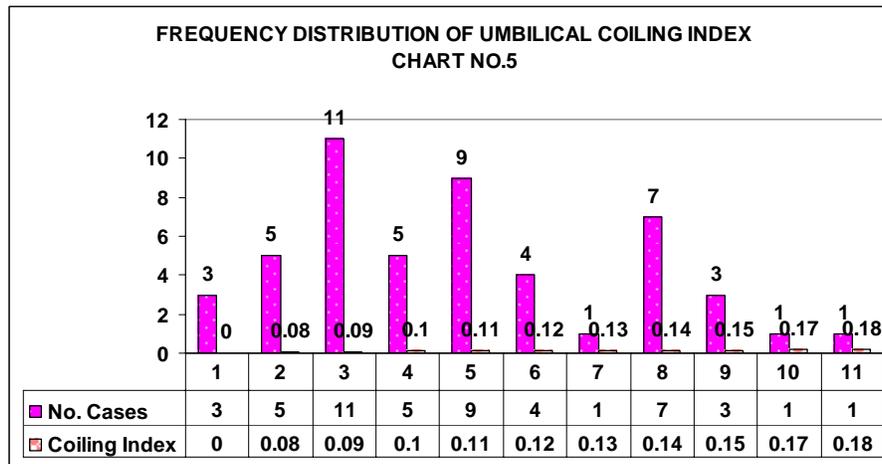
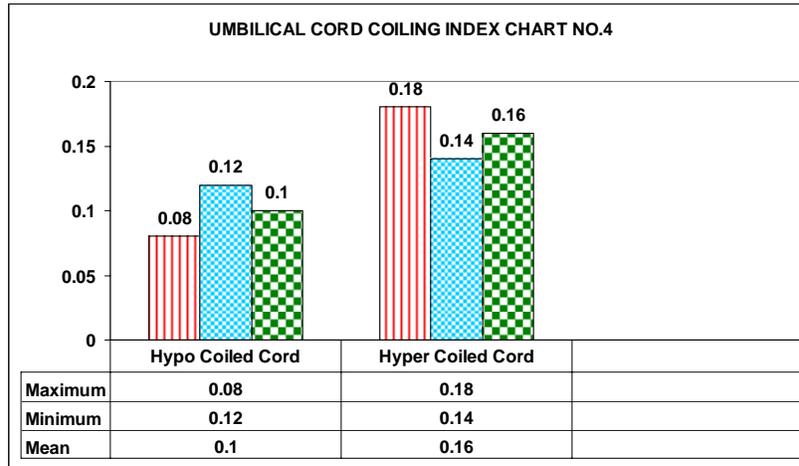
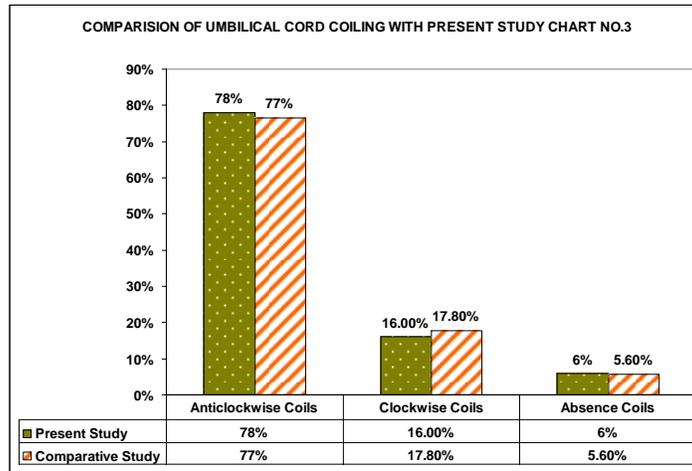
**UMBILICAL CORD LENGTH  
PRESENT STUDY TABLE NO.2**

<b>Umbilical Cord Length</b>	<b>in cms.</b>
Maximum	73.4
Minimum	43.4
Average	54.5

### DIAMETER OF THE UMBILICAL CORD TABLE NO. 3

Diameter of the Cord	At Fetal End	Placenta End
Maximum	1.4 cm	1.7
Minimum	0.7 cm	1.2
Average	1.1 cm	1.5

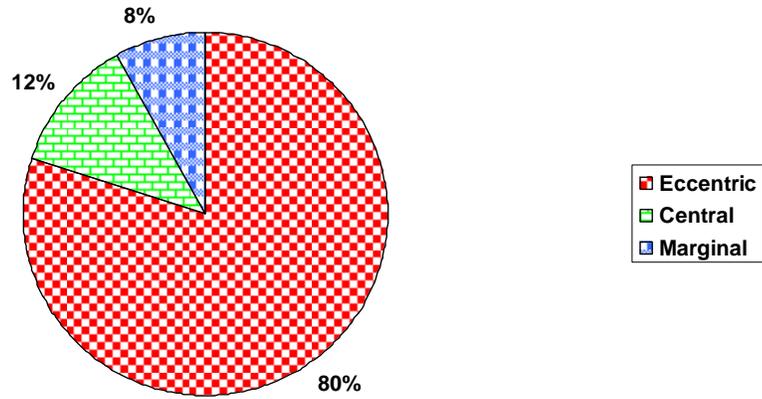




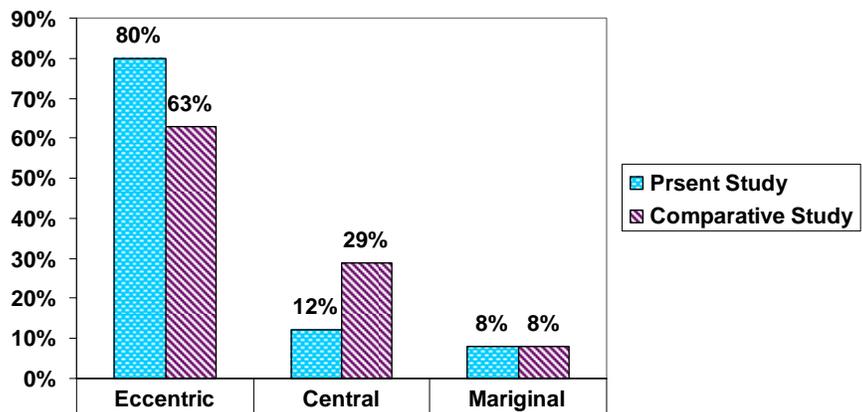
**COMPARISON OF UMBILICAL CORD ATTACHMENT  
BETWEEN THE STUDY OF RICHARD TORPIN AND  
PRESENT STUDY TABLE NO. 4**

<b>S. No.</b>	<b>Attachment of Umbilical Cord</b>	<b>Richard Torpin</b>		<b>Present Study</b>	
		<b>No. of Cases</b>	<b>%</b>	<b>No. of Cases</b>	<b>%</b>
1.	Eccentric	260	63	40	80
2.	Central	120	29	6	12
3.	Marginal	32	8	4	8
4.	Total	412	100%	50	100%

**UMBILICAL CORD ATTACHMENT CHART NO.6**



**COMPARISION OF UMBILICAL CORD ATTACHMENT WITH PRESENT STUDY CHART NO.7**



Present Study	80%	12%	8%
Comparative Study	63%	29%	8%

**BIRTH WEIGHT OF FETUSES IN MARGINAL ATTACHMENTS  
OF CORD - PRESENT STUDY TABLE NO. 5**

<b>S. No.</b>	<b>Gravida</b>	<b>Birth Weight of Fetus in Kg.</b>
1.	I	2.3
2.	I	3.3
3.	II	2.25
4.	III	3.2

## A STUDY OF UMBILICAL CORD

S. No.	Length	Diameter		False Knots	Attachment	Cord Coiling	Para	Nuchal Cord	Coiling Index	Birth Weight in kg	SEX
		FE	PE								
1.	61.4	1.2	1.5	NP	EC	HYPER	II	P	0.14	3	M
2.	45.2	0.8	1.5	NP	MAR	HYPO	I	NP	0.12	2.3	M
3.	54.5	1.3	1.5	NP	EC	HYPO	III	NP	0.12	3	M
4.	58	1.1	1.5	NP	EC	HYPO	I	P	0.11	3.7	M
5.	54.5	1.2	1.5	P	EC	HYPER	I	NP	0.14	2.75	M
6.	56.2	1.2	1.5	NP	EC	HYPO	II	NP	0.11	3.75	F
7.	57.5	0.8	1.4	NP	EC	HYPO	I	NP	0.11	2.7	F
8.	48.9	1.2	1.5	NP	EC	HYPO	III	NP	0.11	3.7	M
9.	47	0.8	1.4	NP	MAR	HYPO	I	NP	0.11	3.3	M
10.	69	0.9	1.5	NP	EC	HYPER	I	P	0.14	2.8	M
11.	55	1.3	1.5	NP	EC	HYPO	II	NP	0.11	3	M
12.	43.4	1.1	1.5	P	EC	HYPO	I	NP	0.08	3.25	M
13.	47.2	0.8	1.4	P	MAR	HYPO	II	NP	0.11	3.2	M
14.	52.2	0.9	1.5	NP	EC	HYPO	I	NP	0.09	3	F
15.	59.2	0.8	1.4	P	EC	HYPO	I	P	0.08	2.75	F
16.	55.4	0.8	1.3	NP	MAR	HYPER	III	NP	0.14	3.5	M
17.	49.6	1.2	1.5	NP	EC	HYPO	II	NP	0.13	3	F
18.	48.8	1.4	1.5	NP	EC	HYPO	III	NP	0.10	2.7	F
19.	56	1.3	1.5	NP	CENT	HYPO	I	NP	0.08	2.75	M
20.	54	1.2	1.6	P	EC	HYPO	I	NP	0.09	3	M
21.	48	1.3	1.5	NP	EC	STRAIGHT	II	NP	-	2.75	F
22.	52	1.2	1.5	NP	EC	HYPO	I	NP	0.09	2.5	F
23.	54	1.2	1.6	P	EC	HYPER	II	NP	0.14	3.75	M
24.	56	1.2	1.5	NP	EC	HYPO	I	NP	0.08	2.75	F
25.	55	0.7	1.2	NP	CENT	STRAIGHT	I	NP	-	2.75	F
26.	54.5	1.2	1.6	NP	EC	HYPER	II	NP	0.14	3	M
27.	50.5	1.1	1.4	NP	EC	HYPO	I	NP	0.10	2.9	F
28.	52	1.2	1.5	NP	EC	HYPO	II	NP	0.09	3	M
29.	53.5	1.1	1.4	NP	EC	HYPO	I	NP	0.09	3.1	M
30.	54	1.2	1.6	P	EC	HYPER	III	NP	0.17	4	F
31.	58.5	1.3	1.5	P	EC	HYPER	I	NP	0.15	2.8	F
32.	56	1.2	1.6	P	EC	HYPO	I	NP	0.11	2.7	F
33.	53	0.8	1.4	P	EC	HYPER	III	NP	0.15	3.7	F
34.	58	1.2	1.6	P	EC	HYPER	II	NP	0.14	2.5	F
35.	53	1.3	1.6	NP	EC	HYPO	I	NP	0.12	2.7	F

S. No.	Length	Diameter		False Knots	Attachment	Cord Coiling	Para	Nuchal Cord	Coiling Index	Birth Weight in kg	SEX
36.	45.3	1.2	1.4	NP	EC	HYPO	I	NP	0.12	3.3	F
37.	48.2	1.2	1.6	NP	CENT	HYPO	I	NP	0.11	2.6	F
38.	53.4	1.2	1.5	NP	EC	STRAIGHT	I	NP	-	3.2	F
39.	54.3	1.2	1.4	NP	CENT	HYPO	I	NP	0.09	3.3	M
40.	56	0.9	1.4	P	EC	HYPO	I	NP	0.11	2.8	M
41.	53.5	1.2	1.6	NP	EC	HYPER	III	NP	0.15	3.3	M
42.	54.8	1.3	1.5	P	EC	HYPO	I	NP	0.09	2.8	M
43.	60	1.2	1.6	P	EC	HYPO	II	P	0.1	3	M
44.	59	1.3	1.5	NP	EC	HYPO	I	NP	0.09	2.7	M
45.	58.4	1.3	1.5	NP	EC	HYPO	I	NP	0.09	3.2	M
46.	54.5	1.3	1.6	P	CENT	HYPO	II	NP	0.09	3	F
47.	60	1.3	1.6	P	CENT	HYPO	III	P	0.10	2.6	M
48.	73.4	1.4	1.7	NP	EC	HYPER	I	P	0.18	2.75	M
49.	59	1.3	1.6	NP	EC	HYPO	I	P	0.1	3.5	M
50.	54	1.3	1.6	NP	EC	HYPO	I	NP	0.09	3	M

**DIAMETER**

FE – Fetal End  
PE – Placental End

**FALSE KNOTS**

P – Present  
NP – Not Present

**ATTACHMENT**

EC – Eccentric  
CENT – Central  
MAR - Marginal

**CORD COILING**

HYPO – Hypo Coiling  
HYPER – Hyper Coiling  
STRAIGHT – Cord with no Coiling

**PARA**

I – Primi  
II – Second Gravida  
III – Third Gravida

**NUCHAL CORD**

P – Present  
NP – Not Present

## UMBILICAL CORD LENGTH COMPARATIVE STUDY

<b>Author</b>	<b>Year of Study</b>	<b>Length of in cms.</b>
Fox	1978	54-61
Henry Gray	1999	20-120
Present Study	2006	43.4 - 73.4

## UMBILICAL CORD COILING

<b>Coiling of Cord</b>	<b>No. of Specimens</b>
Hypo Coiling	35
Hyper Coiling	12
Straight	3

## COILING MANNER

<b>Coiling Manner</b>	<b>No. of Specimens</b>	<b>%</b>
Anti Clockwise	39	78%
Clockwise Coils	8	16%
Absence Coils	3	6%

### **CORD COILING**

<b>Coiling Index</b>	<b>Hypo Coiled Cord</b>	<b>Hyper Coiled cord</b>
Maximum	0.12	0.18
Minimum	0.08	0.14
Mean	0.01	0.014

### **ATTACHMENT OF UMBILICAL CORD**

<b>Attachment of Umbilical Cord</b>	<b>No. of Specimens</b>
Eccentric	40
Central	6
Marginal	4