

Morphological and histological study of umbilical cord at delivery

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الخلاصة:

خلفية البحث: يعتبر الحبل السري هو الخط الحيوي للاتصال بين الجنين والأوعية الدموية وهو أكثر الأجزاء الحساسة في الجانب التشريحي للجنين.

الهدف: الغاية من الدراسة الحالية هو تمييز موقع اندغام الحبل السري و دراسة نسيجه للحبل السري لفترات حمل مختلفة.

النتائج: اظهرت الدراسة ان اتصال الحبل السري بالمشيمة في 64.99 % من العينة المدروسة هو اتصال قرب المركز و في 28.33 % هو اتصال مع مركز المشيمة وفي 6.66 % اتصال جانبي.

الاستنتاج: الدراسة المجهرية بينت بأن قياس سمك الطبقة العضلية (الطبقة الوسطى) لشريان الحبل السري ازداد من 0.6 مايكروميتر في الشهر الثالث من الحمل الى 9.2 مايكروميتر في الشهر التاسع (عند الولادة). هذه النتائج قد تفسر القوة والمطاطية للحبل السري ضد الالتواء والانضغاط مع تقدم مراحل الحمل.

Abstract:

Background: The umbilical cord is the life line of fetus and its vital blood vessels are the most vulnerable part of the fetal anatomy.

Objectives: The objective of the current study was to recognize the insertion site and to study the histological appearance of the cord at different gestational periods.

Results: The study revealed that eccentric site of location was 64.99% the central insertion 28.33% and marginal insertion 6.66%.

Conclusion: Microscopic study of umbilical artery revealed that the measurements of thickness of muscular layer (tunica media) was increased from 0.6µm at the third month of gestation to 9.2µm at ninth month (at delivery) which may explain the increase in strength and elasticity of the cord against torsion and compression as the fetus became near the term.

Introduction

The umbilical cord is a narrow tube-like structure that connect the developing baby to the placenta. The umbilical cord begins to form at five weeks after conception .It becomes progressively longer until 28 weeks of pregnancy, reaching an average length of 55-65 cm long with outer amniotic epithelium, bulk is composed of mucoïd Wharton's jelly, The cord contains three blood vessels: two arteries and one vein .The cord diameter was 1cm or more (1). The deoxygenated fetal blood leaves the fetus in two umbilical arteries that pass through the umbilical cord .When they reach the fetal surface of the placenta, these vessels divided into many branches which enter the chorionic villi. The oxygenated blood returns to the fetus via the venules and veins in the choronic villi. These join to form the umbilical vein in the umbilical cord (2).

The insertion of the umbilical cord to the placenta was central insertion into placenta at midgestation; insertion may become more eccentric as gestation proceeds (3). Microscopically the umbilical arteries composed of double layered muscular wall, no internal elastic lamina. The umbilical vein larger in diameter, thin wall with single layer of disorganized circular smooth muscle and an internal elastic lamina. A number of abnormalities can affect the umbilical cord. The cord may be too long or too short .It may connect improperly to placenta or become knotted or compressed (4,5) .Cord abnormalities can lead to problems during prolapsed or labor and delivery like: single umbilical artery ,umbilical cord prolapsed vasaprevia, punchal cord umbilical cord knots and umbilical cyst(6). The aim of the present work was to recognize the site of umbilical cord insertion and to study the histological appearance of the cord at different gestational periods to develop a better understanding of the causes of birth defects.

Materials and Methods:

In this prospective study 60 term placenta with a mean weight of 359.32-485.12 gm of babies were studied. Out of these 28(46.6%) were of female and 33(55.0%) of male babies. The random samples were collected from unit of obstetrics and gynecology in Al-Hilla Teaching Hospital. All subjects included in this study were healthy looking mothers aged between 25-35 years and the parity from one to five. All cords obtained were of normal vaginal deliveries and aborted fetuses. Gross observation of cords was noted these features include shape, length and site of attachment of umbilical cord included in this study. For histological examination, two cm. of tissue was taken from each cord and fixed in 10% formalin for one week. The tissue was dehydrated and followed by embedding in paraffin and serial sections were generated with the help of rotatory microtome. The tissue sections were stained with hematoxyline and eosin. Histological appearance of cords was assessed. The results of gross observation of the insertion sites were expressed as percentage.

Results:

Grossly the attachment of umbilical cord to the placenta was observed which is shown in table-1, fig.1: the eccentric site of insertion was 64.99%, the central insertion 28.33% and the marginal insertion 6.66% from the total observed placenta.

Table-1: Gross observation of umbilical cord

Site of umbilical cord insertion	Number	Percent %
Eccentric	39	64.99
Central	17	28.33
Marginal insertion	4	6.66

The low and high field light microscopic findings (at 4X and 40X magnification) of the umbilical artery at different gestational stages are summarized in figure-2. Tunica intima consist of endothelium with out internal elastic membrane the thickness of this layer was ($0.1\mu\text{m}$, $0.2\mu\text{m}$ and $0.6\mu\text{m}$) at three, five and seven month respectively. Thick tunica media made up mainly of concentric layers of elastic lamellae, between which are thin layers of smooth muscle. The measurements of this layer were ($0.6\mu\text{m}$, $1.4\mu\text{m}$ and $3.6\mu\text{m}$) at three, five and seven month of gestation respectively. The tunica adventitia is a thin layer of collagenous fiber. Thickness of this layer at three, five and seven months of gestation was ($0.2\mu\text{m}$, $0.4\mu\text{m}$ and $1.8\mu\text{m}$) respectively. Figure-3 shows the histological appearance of umbilical artery at delivery (9-month). The measurements of thickness of umbilical artery layers were of tunica intima (1.2mm), the tunica media (9.2mm and the tunica adventitia (3.0mm).

A



B



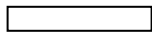
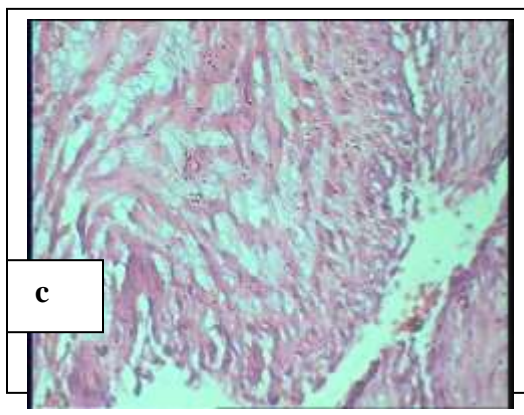
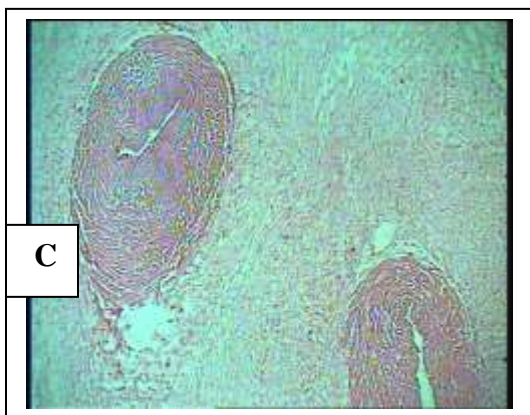
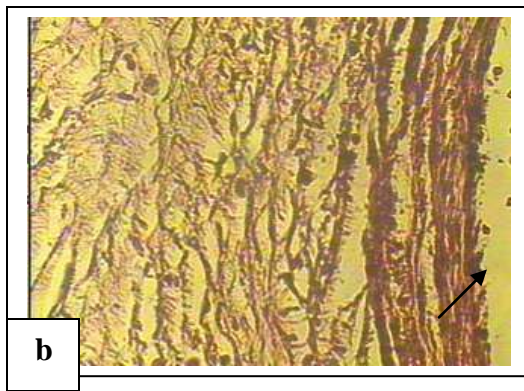
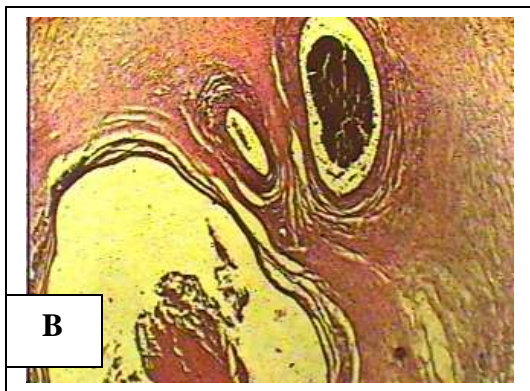
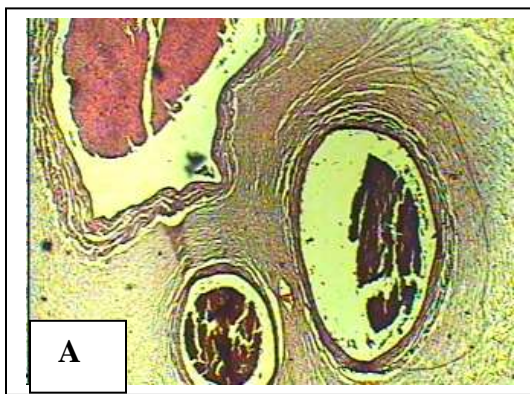


Figure-1: Site of insertion of umbilical cord

A-Eccentric

B-Central

C-Marginal



F

Figure-2: Cross section of normal umbilical cord at different gestational periods(left plates) and umbilical artery (right plate) at :
Three months (A-a).Stain H&E 4X-40X.
Five months (B-b).Stain H&E 4X-40X.
Seven months (C-c). Stain H&E 4X-40X

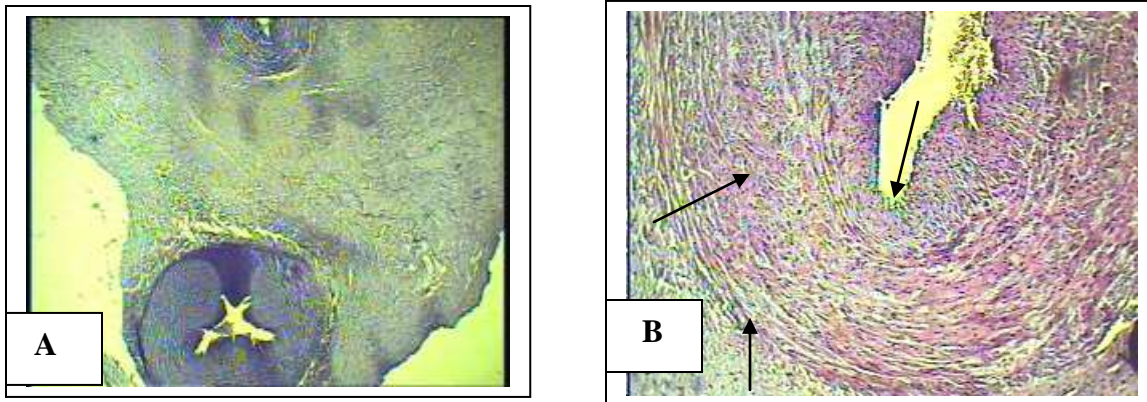


Figure-3: Histological appearance of umbilical cord at delivery (9 months) arrow marked from internal :tunica intima, tunica media &tunica adventitia.

A- The artery. Stain:Hematoxylin-eosin 4X

B- the artery . Stain: Hematoxylin-eosin 10X

Discussion:

The umbilical cord is the lifeline between the fetus and placenta. It is formed by the fifth week of development and it functions throughout pregnancy to protect the vessels that travel between the fetus and the placenta. Compromise of the fetal blood flow through the umbilical cord vessels can have serious deleterious effects on the health of the fetus and newborn (7). The attachment of umbilical cord in this study (table-1 &fig.-1) was eccentric and rarely marginal. The abnormal attachment of umbilical cord has been reported by previous workers. (4,5,8) Strong *et al*

(1993) revealed that the umbilical cord normally inserted near the center of placenta. However, in approximately 7% of single births the insertion point occurs at the very edge of the placenta and in about 1% of cases. When the umbilical cord inserts into chorionic plate of the placenta the fetal vessels are stabilized, thus protected from torsional and shear forces (9). The histological appearance of the cord in this study shows in fig.-2, 3 the umbilical cord normally contains two arteries and one umbilical vein .At early gestational periods three and five month the microscopic field at 4X magnification all umbilical vessels (two artery and one vein) can be seen under the field, but these vessels not appeared together at 4X magnification in the late gestational stages seven and nine month (at delivery). The umbilical vessels are embedded within a loose proteoglycan rich matrix known as Wharton's jelly this jelly has physical properties as resistance to twisting and compression. (4, 10). Due to abnormal umbilical cord development 1% of cords contain one artery . Although many infants born with a single umbilical artery have no obvious anomalies in 15-20% of such cases these anomalies could be the results of genetic factors alone or environmental factors(11).Other studies suggest that babies with single umbilical artery have an increase risk for birth defects, including heart, central nervous system and urinary-tract defects and chromosomal abnormalities(12,13).From the low and high power light microscopic study fig.2,3 we can conclude that the measurement of thickness of muscular layer (tunica media) increased from $0.6\mu\text{m}$ at the third month of gestation to $9.2\mu\text{m}$ at ninth month(at term) which may be lead to increase the strength and elasticity of the cord against torsion and compression as the fetus became near the delivery time. Other reports mentioned that the walls of the arteries are muscular and contains many elastic fibers, which contribute to a rapid constriction and contraction of umbilical vessels after the cord is tied off (14). In recommendation further study should be performed on ultrastructure of the cord at different gestational periods.

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