Original Article

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A Study of Microscopic Abnormalities of Human Umbilical Cord

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ABSTRACT

Background: *Umbilical cord act ascable that links the fetus to the placenta. Fetal wellbeing depends much on the normal structure andfunction of umbilical cord. Blood vessels in it connect the uterine vasculature and the fetal vascular tree and are essential part of fetal circulation. A number of structural abnormalities, macroscopic and microscopic, can affect the umbilical cord and the ultimate effect is disturbance of the lifeline & derangement of blood flow to the fetus. Hence, structural changes of umbilical cord have been found to be a marker of intrauterine complications of fetus. The aim of the study is to find out the microscopic abnormalities of human umbilical cord in normal pregnancies.*

Materials and methods: *A descriptive cross sectional study was done in the Department of Anatomy, Chittagong Medical College on 60 human umbilical cord sample from August 2012 to January 2013.*

Results: *Among the 60 samples endothelial erosion was found in 11.7% cases, extravasation of blood within Wharton's Jelly area was found in 1.7% cases, disruption of muscle layer in tunica media was found in 5% cases, grossly dilated umbilical vein was found in 20% cases, vacuolated space within Wharton's Jelly area was found in 3.3% cases.*

Conclusion: *In normal pregnancies histological abnormalities of umbilical cord may be present but to a lesser extent.*

Key words: Microscopic abnormalities; Umbilical cord; Normal pregnancy; Wharton's Jelly.

Introduction

During fetal life umbilical cord acts as a lifeline for the fetus. It consists of two arteries;they are helically arranged around a unique umbilical vein. The umbilical vein is longer than the artery giving umbilical cord a twisted appearance.[1] The arteries convey deoxygenated blood from the foetus to the chorionic villi of the placenta. They are thick muscular walled and spirally arranged. The umbilical veins convey oxygenated blood from the placenta to the foetus. Umbilical vessels contribute to the formation of amniotic fluid by the process of transudation and thus differ from major vessels of same diameter. Both the vessels areembedded in a hydrated extracellular matrix, a mucoid connective tissue, known as Wharton's Jelly and covered by a glistening amniotic membrane.[2]

Microsocopic abnormalities of the vessels and extra cellular matrix may affect the normal growth and development of foetus in the uterus and may result in perinatal death. A considerable number of still birth that are thought to be unexplained may be attributable to cord abnormalities.[3] In past few years various macroscopic and microscopic abnormalities of umbilical cord has been documented but detailed knowledge of them is very poor. The present study will help us in establishing baseline data in this respect.

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Material and methods

It was a descriptive cross sectional study. After collecting 60 umbilical cord samples from the Department of Obstetrics and Gynocology of Chittagong Medical College Hospital from August 2012 to July 2013, they were prepared for microsocopic study which includes fixation, dehydration, clearing, embedding, sectioning, staining and mounting on the slide. Hematoxylin and Eosin stain was applied for the staining of the tissues. A light microsocopic observation was done under 4x, 10x, 40x and 100x objectives to identify the presence of the following abnormalities.

IAHS Medical Journal
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- ***Endothelial erosion and endothelial rupture:*** Clumped thrombogenic cells with denuded endothelial cells over the intact basement membrane were regarded as endothelial erosion and total denudation of basement membrane as endothelial rupture.

- ***Complete rupture of the umbilical vessels:*** Total loss of continuity of a vessel wall (e.g. Tunica intima, media and adventitia) was regarded as total rupture of the umbilical vessel.

- ***Extravasation of blood within the Wharton's Jelly area:*** Appearance of blood cells or blood clot within the Wharton's Jelly area was regarded as extravasations of blood.

- ***Disruption of muscle layers in the tunica media of vessel wall:*** Loss of the normal arrangement of muscle layers in the tunica media, distortion and degeneration of the individual muscle cells, and separation of muscles fibers or appearance of wide gap within the tunica media was regarded as disruption of muscle layer.

- ***Grossly dilated umbilical vein:*** Normally all vein become fully visualized under 4x objective of the light microscope. When any vein remains beyond the focus of 4x objective then it seemed to be regarded as grossly dilated vein.

- ***Appearance of empty spaces within the Wharton's Jelly area:*** Wharton's Jelly is a mucoid jelly like substance present within the umbilical cord surrounding the umbilical vessels. Normally it has a homogenous appearance. Loss of this homogeneousity, decreased cellularity, degeneration of connective tissue fiber and more over presence of honeycomb appearance seemed to be regarded as appearance of empty spaces within the Wharton's Jelly.

The collected data were recorded and statistical analysis was done.

Results

In the present study among the 60 samples endothelial erosion was found in 11.7% cases, extravasation of blood within Wharton's Jelly area was found in 1.7% cases, disruption of muscle layer in tunica media was found in 5% cases, grossly dilated umbilical vein was found in 20% cases, vacuolated space within Wharton's Jelly area was found in 3.3% cases.

Table I Distribution of histomorphological data of umbilical cord among the study subjects (n=60)

	Variables	Frequency	Percentage (%)
Endothelial Erosion	Present	07	11.7
	Absent	53	88.3
Endothelial Rupture	Present	00	0.0
	Absent	60	100.0
Complete Rupture of Vessel Wall	Present	00	0.0
	Absent	60	100
Extravasation of Blood within WJ Area	Present	01	1.7
	Absent	59	98.3
Disruption of Muscle Layer in Tunica Media	Present	03	5.0
	Absent	57	95.0
Grossly dilated Umbilical Vein	Present	12	20.0
	Absent	48	80.0
Vacoulated space within WJ Area	Present	02	3.3
	Absent	58	96.7
	Total	60	100.0·

- WJ=Wharton's Jelly.

Discussion

In the present study rupture and erosion of endothelium of the umbilical arteries, unduly dilated umbilical vein, disruption and degeneration of smooth muscle in the tunica media appearance of empty spaces among the Wharton's Jelly area were searched for.Among the 60 samples endothelial erosion was found in 11.7% cases, extravasation of blood within Wharton's Jelly was found in 1.7% cases, disruption of muscle layer in tunica media was found in 5% cases grossly dilated umbilical vein was found in 20% cases, vacuolated space within Wharton's Jelly area was in 3.3% cases.

According to Ghezzi et al the ratio of the Wharton's Jelly area of the umbilical cord to the total umbilical cord area decrease significantly with advancing gestation.[4] This is because the water content of the Wharton's Jelly reduces towards the end of pregnancy.

Fadda GM et al studied the functional aspects of the vessels. They showed that in 34% of diabetic pregnancies without hypertension there was increased resistence within umbilical vessels causing higher perinatal complications resulting from reduction of uteroplacental circulation.[5] Weissman A et al found that Wharton's Jelly content was significantly increased in gestational diabetes.[6]

Fritz MA et al showed that thrombosis of the umbilical vessels may be primary or secondary to localized increased resistance in the umbilical circulation.[7] Mäyränpää MI et al suggested that loss of endothelial cells leads to the exposure of thrombogenic subendothelial surface causing clamping of thrombogenic cells with the denuded endothelial cells.[8]

IAHS Medical Journal
Volume 05 Issue 01 June 2022; 91-93

In three cases reported by Laberre et al the Wharton's Jelly was completely absent around the umbilical arteries but present around the vein and all three cases were associated with perinatal death.[9] In a study of Kumar S the mentioned microscopic abnormalities were more in gestational diabetes.[10] Alam MR showed the mentioned microscopic abnormalities were more in gestational diabetes.[11]

In a light microscopic study of umbilical cord from 18 cases of gestational diabetes, Sing showed rupture and erosion of endothelium of the umbilical arteries resulting in increase permeability and haemorrhage.[9,10] He also noticed unduly dilated umbilical vein, disruption and degeneration of smooth muscles in the tunica media, alteration in the pattern of distribution of fibres of the Whartons Jelly and appearance of empty spaces among them were the most striking features, Sing added.[1,12] No satisfactory explanation can be given for the presence of some of these finding in present study as gestational diabetes mellitus, hypertension cases were excluded in this study. Further studies may be done to explore the real causes.

Conclusion

Present study was done on 60 human umbilical cord sample of normal pregnancy to find any microsocpic abnormalities. Some microsocopic abnormal findings were observed. No satisfactory explaination can be given for the presence of some of these finding in the present study as gestational diabetis malitis, hypertension cases were exclueded in the study. Further studies may be done to explore real cause.

Disclosure

All the authors declared no competing interest.

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