Research Paper

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Changes in Wharton's Jelly in Hypertensive Pregnancy: An Original Study from Rural Indian Population

Anatomy

KEYWORDS : Wharton`s jelly; hypertension; umbilical cord; amniotic fluid; rural population

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ABSTRACT

Objective:
The aim of this study was to determine the characteristic features of the morphology of the Wharton's jelly in selected cases of pregnancy with hypertension in north Indian rural population.
Materials and methods:
60 umbilical cords were included in the study. Each of them underwent pathological examination after routine processing to assess the morphological parameters of the umbilical cord and Wharton's jelly.
Results:
Significant differences between the control group and the hypertensive group in terms of the diameter of the umbilical cord and diameter of the Wharton's jelly - smaller diameters in the hypertensive group than in the control group.
Conclusions:
1.The areas as well as content of Wharton's jelly are considerably reduced in pregnancy with hypertension. 2. The assessment of umbilical cord morphology should become an integral part of ultrasound exam in all pregnancies especially, if complicated by hypertension.
This study is being presented on account of its rarity; to the best of author's knowledge, such study on rural population of North India has not been done previously.

Introduction:
In placental mammals the umbilical cord (funiculus umbilicalis) is the connecting link between embryo and mother. Since it possesses organ like property, foetal well being depends much on normal structure and function of cord. In view of this, macroscopic and microscopic properties of cord are important assets to be explored in understanding of functional relationship between foetus and mother.

The umbilical cord is responsible for maternal-fetal blood flow. Normally, it is composed of two arteries and a vein, cushioned by a special type of mucous connective tissue known as Wharton's jelly (WJ) and by remnants of the allantoids.

WJ is an important constituent of cord as it is the metabolically active tissue involved in exchange between amniotic fluid and umbilical vessels and is vital to the outcome of pregnancy. Systemic diseases affecting mother can impose serious impacts on WJ content thus affecting the cord architecture and finally the outcome of pregnancy.

Wharton's jelly (WJ) and its Significance:
Wharton's jelly (*substantia gelatinea funiculi umbilicalis*) is a gelatinous substance within the umbilical cord also present in vitreous humor of the eyeball, largely made up of mucopolysaccharides (hyaluronic acid and chondroitin sulfate). It also contains some fibroblasts and macrophages. It is derived from extra-embryonic mesoderm.

As a mucous tissue it protects and insulates umbilical blood vessels. WJ, when exposed to temperature changes, collapses structures within the umbilical cord and thus provides a physiological clamping of the cord (an average of) 5 minutes after birth. It is named for the English physician and anatomist Thomas Wharton (1614–1673) who first described it in his publication *Adenographia*, or "The Description of the Glands of the Entire Body", first published in 1656.[1]

- The Wharton's jelly binds and encases the umbilical vessels, protecting them from twisting and compression during pregnancy and delivery. It is composed of collagen fibers forming a network of interconnected cavities, cavernous and perivascular spaces in which the ground substance of the jelly is stored.
- Both pediatricians and pathologists have known for many years that the amount of Wharton's jelly is a good predictor of perinatal complications.
- In fact, WJ is the major component of the umbilical cord in the second and third trimesters; therefore, if the area of the umbilical cord reaches its peak at around 31-32 weeks, the area of WJ would be expected to follow the same pattern.
- The most common macroscopic finding of the modifications of WJ composition is variation in umbilical cord size.
- A reduced amount of Wharton's jelly in an otherwise normal cord has been associated with an increased perinatal mortality (fetal distress, growth restriction and oligohydramnios).
- Changes or alterations of any of the WJ components have been described or postulated in various pathological conditions like hypertensive disorders, fetal distress, gestational diabetes and fetal growth restriction.

Hypertension is very common in our society therefore; studies on pregnant mother for its effect should be a very considerable interest for research worker specially because of its mortal effect on baby.

Despite of these alarming facts, there is a remarkable scarcity of relevant studies, particularly in India. The trend and tradition of a clinical entity changes with time. Though, efforts have been devoted in the study of hypertension in the Indian population.

However, till date such an analysis in rural India has not been performed.

Study presented here, aims to evaluate the effects of hypertension on the WJ and foetal well being. Authors try to outline the harmful effects of hypertension on the WJ, in this rural area and compare it with the pattern seen in other parts of the world.

Material and Methods:
This work was carried out in UP RIMS & R, Saifai; a tertiary care hospital in rural region of north India. The study material was comprised of 60 umbilical cords obtained from the department of Obstetrics & Gynaecology. The samples were divided into two groups controls GP I, (n=30), hypertensives GP II, (n=30). Umbilical cords were collected were immediately after delivery and kept in 10% formalin solution for 48hrs. Later on samples were subjected to routine processing. After haematoxylin and eosin staining the slides were observed and required measurements were done using Magnus Pro IPS software. SPSS statistical analysis was applied to interpret results.

Results:

Histomorphometric parameter	Controls mean± s.d.	Hypertensives mean± s.d.	p-value
Cross sectional area of Wharton's jelly	48.56±4.69	30.67±3.95	<0.0001*

Discussion:
Wharton's jelly provides mechanical support and structural protection for the umbilical vessels. It also has angiogenic and metabolic roles for the umbilical circulation. WJ consists of a fundamental amorphous substance containing glycosaminoglycans, proteoglycans and, predominantly, hyaluronic acid. The presence of a thin cord identified during pregnancy places the fetus at risk of restricted growth and birthweight, classified as small for gestational age. This appears to be a consequence of a reduction in the area of WJ.

As a result of decrease in Wharton's jelly area lean umbilical cords are a usual feature in hypertensive pregnant females and are accompanied by torsion and fibrosis of wharton's jelly and thickening of vascular wall thereby obstructing fetoplacental circulation leading to anoxia and foetal death[2]. Reduction in wharton's jelly area can lead to foetal starvation as it is important in exchange of fluids. Present study shows decrease in cross sectional area of wharton's jelly. There is significant reduction in diameter and volume of umbilical cord in hypertensives and the observation is attributed to wharton's jelly. All these conditions lead to limitation of foetal growth and thus IUGR is common in this group. Wharton's jelly undergoes significant reduction until its complete disappearance. Bruch *et al.* reported that growth retarded foetuses with or without umbilical artery Doppler abnormalities have a smaller umbilical cord cross sectional area at delivery than do normal foetuses[3]. Di Naro found that the diameters and areas of umbilical cords changed during gestation and these differences depended on the reduction of Wharton jelly rather than the umbilical vessels themselves4. In hypertensives edema of wharton's jelly can be clearly seen and is due to accumulation of fluid within matrix. Inter-endothelial junctional protein complexes are responsible for metabolic diffusion of fluid and protein from lumen to wall of blood vessels and to the wharton's jelly. In hypertensives permeability of endothelial cells is increased thus disturbing endothelial junctional protein complexes leading to edema of wharton's jelly. Shanklin(1989) also reported similar theory. It can be concluded that reduction in Wharton jelly area is due to hypoplasia or decreased hydration. It is reported that accumulation of sulphated glycosaminoglycans (GAGs) in extracellular matrix of Wharton's jelly affect the biology of umbilical cord tissue. High concentrations of GAGs and proteoglycans surrounding the collagen fibers affect the solubility of this protein5. Such changes may make the collagen less soluble and jelly more compact and affect the umbilical cord's mechanical properties and macroscopic appearance

Alterations in the area of WJ have been described in various conditions such as hypertensive disease5,6, tobacco smoking6, prematurity and fetal distress during labor7. The absence of WJ around vessels of the umbilical cord has been found in cases of perinatal mortality8, whereas the presence of a large area of WJ has been described in cases of diabetes mellitus9.

Hypertension is fairly common in Indians, and most of the time it goes unnoticed as the practice of routine health checkups is not in vogue due to various reasons. It is a cause of significant morbidity in women of reproductive age group and when complicated could be a significant cause of mortality. It is mostly asymptomatic, especially when mild or moderate in nature.

This is a big challenge to community health especially in rural areas where health care facilities are sorely lacking. Moreover in case of females, whose living condition and social status is already miserable in most of the middle to low income developing countries, including India.

The scenario is further dreadful in rural and remote localities where they are the most neglected members of the family and their problems and illnesses are not properly attended. They had to suffer till the extremes before getting medical advices. Most of the women who reported to our hospital were from the peripheral, rural and remote areas. They belonged to lower socioeconomic class; most of them were illiterate and had not been going to any local general practitioners, Primary health centres or lady health visitors for their routine prenatal checkups.

If Hypertension could be timely detected and properly managed, the complications of pregnancy and their adverse consequences can be avoided. In addition, the importance of preventive measures and public awareness also cannot be ignored in saving precious lives and should be implemented at different levels.

A possible strength of the present study is that it has the largest sample size study described up to the present time in rural population and the results obtained are in agreement with previous studies. Our parameters should serve as a reference, mainly in cases in which diseases such as diabetes, arterial hypertension, and intrauterine growth restriction are suspected that may interfere with fetal development, and in which there may be changes in the morphology and in the function of the umbilical cord and in the area of WJ.

Keeping in view these facts; this study is being presented to add in the existing volume of knowledge regarding Hypertension in pregnancy and foetal well being.

Competing interests:
The authors declare that they have no competing interests.

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Fig.-1: Wharton jelly of normal cord

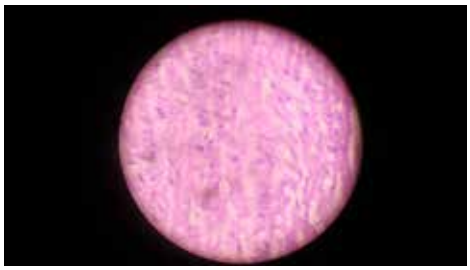

Fig.-2: Edema in Wharton jelly along with umbilical artery in hypertensive cord

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