



## Antenatal Umbilical Coiling Index in Fetal Growth Restriction - Study Reviews

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Type of Publication: Original Research Paper

Conflicts of Interest: Nil

### Abstract

The aim and objective of this study review is to incorporate the umbilical coiling index in routine obstetric ultrasound practice along with Doppler studies to predict possible poor pregnancy outcomes

**Keywords:** Umbilical cord, hypercoiling, Hypocoiling, fetal growth restriction

### Introduction

#### Umbilical Coiling Index:

Umbilical cord serves as vital organ for the transport of nutrients and gaseous exchange between mother and fetus. It serves as the bridge connecting the maternal and fetal circulation and serves as the pillar of uteroplacental circulation.

At birth, the umbilical cord has an average length of 55cm. Leonardo da Vinci mentioned that the umbilical cord length is on average as long as the fetus itself at any gestational age.<sup>2</sup>

Umbilical cord is believed to be protected by the Wharton's Jelly, Helical nature of umbilical vessels and amniotic fluid.<sup>6</sup>

The umbilical vessels helical nature can be visualised as soon as 28 days after conception and is well seen after 7 weeks of conception.

An umbilical coil is one complete spiral turn of 360 degrees of umbilical vessels around each other.

Wharton's Jelly is semisolid in nature and is proposed to contain thyrotoxic properties. This semisolid nature gets liquefied when there is pressure on the cord. The amount of Wharton's Jelly

contributes to the umbilical cord diameter and the reduced amount of this Jelly correlates with the diameter of this umbilical cord. There are studies showing that less than 10<sup>th</sup> centile of cord diameter is associated with small for gestational fetus, intrapartum and perinatal complications.

Umbilical cord stretching decreases the diameter of arteries, thereby causing increase in diameter of veins along with negative pressure effect relatively on veins

Negative pressure draws the blood flow inside the veins. The more the negative pressure, more is the venous blood flow. Pulsations in the arteries impact the veins by changing the venous pressure alternatively. More coils cause the arteries to surround the veins and cause significant pulsations effect on the veins and thereby increasing blood flow. From this concept, it can be assumed that the umbilical vein reduction or obliteration might be due to promote this beneficial effect by the arteries as the effect of two arteries causing on a single vein will be higher than the two arteries causing effect on two veins.

In uncomplicated singleton pregnant mothers, antenatal and postnatal UCI had no correlation and adverse perinatal outcomes did not correlate with second trimester UCI.<sup>8</sup>

Hypercoiling of cord is also believed to have genetic abnormalities, but a case series report says that there is no such association but some genetic abnormalities may exist in a subset of long hypercoiled blood vessels.<sup>9</sup>

It was assumed that number of coils in first trimester correlated with gestational age at any point of time and it is the same in late trimester also. But report says that the UCI measurements obtained easily in second trimester did not match with those measured in late trimester and this may be due to the snarls and other factors.<sup>10</sup>

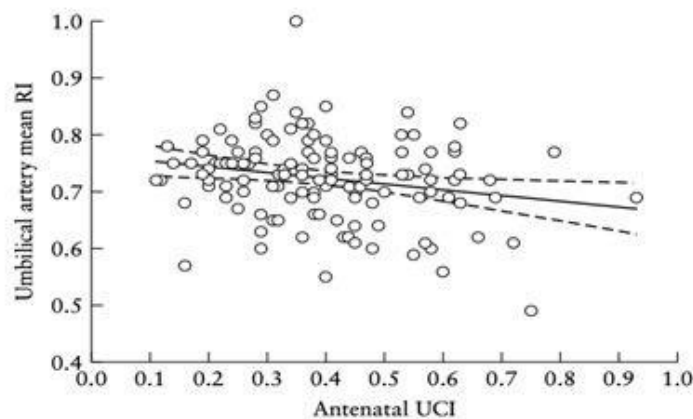
But the antenatal UCI and postnatal UCI difference may be due to the USG errors while taking measurements at different segments and may be due to the progressing coiling as pregnancy advances.<sup>11</sup>

Placental and middle segments UCI did not show any differences when compared in late trimester, but there was a difference when measured at fetal end. So

it is better to use these 2 segments, but the UCI measured antenatally did not correlate with the birth weight.<sup>12</sup>

It is also postulated that the amniotic fluid makes the embryo freely move and as a result, more fluid makes the embryo to move freely. The movement of the embryo makes the umbilical cord coil around itself, the more movements make more coiling. So polyhydramnios is associated with hypercoiling. But due to reduced renal perfusion, amniotic fluid is reduced in fetal growth restriction, which happens in late stages of FGR. Hence the concept of hypercoiling in polyhydramnios does not correlate significantly with fetal growth restriction.

There are studies indicating that non coiling is associated with adverse perinatal complications as noncoiling is prone for damage due to direct pressure as it is more fragile compared to the coiled cord vessels.<sup>7</sup> Many cases of meconium stained amniotic fluid, emergency LSCS are reported in noncoiled cord vessels along with adverse perinatal outcomes. Fetal demise has been seen in association with hypo coiling and hypercoiling with late onset fetal growth restriction.



**Figure 1** Scattergram showing correlation of umbilical artery mean resistance index (RI) and antenatal umbilical cord index (UCI).

Figure 1 shows that antenatal UCI and mean RI of umbilical arteries appears to be inversely correlated significantly. Antenatal UCI increases when the mean RI of umbilical arteries decreases.<sup>2</sup>

The effect of arterial Doppler values seems no correlation with UCI as the flow in arteries is an active process.

It is believed that venous and arterial flow is promoted by this coiling. Decreased arterial resistance increases the velocities in blood flow and increases blood flow in veins.<sup>2</sup>

The exact change of coiling in pregnancy and as it advances is still unknown, and this fact when discovered may help in correlating the hypercoiling seen in FGR, as it can be assumed that there is adaptation of blood flow increase by this coiling.

### Procedure To Measure Umbilical Coiling Index2

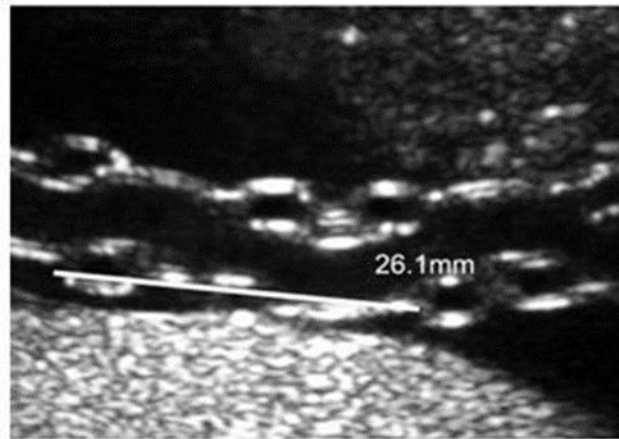


Figure 2 Ultrasound image along the axis of a normocoiled umbilical cord with an antenatal umbilical coiling index (UCI) of 0.35, and intercoil distance of 2.61 cm.

Antenatal UCI is measured as the reciprocal value of the distance between a pair of coils.

$$UCI = 1/\text{Distance in cm.}$$

From the wall of an arterial or venous inner edge, the distance is measured upto the next coil outer edge on the same side of umbilical cord. This gives the distance between one pair of coils.

A study states that normal UCI as  $0.10 \pm 0.009$ . 10<sup>th</sup> percentile is 0.007 and 0.30 is 90<sup>th</sup> percentile and any values above 90<sup>th</sup> or below 10<sup>th</sup> percentile is said to be hypercoiled and hypocoiled and it was found that

#### Case 1 :

Here, Distance = 3.76cm

$$UCI = 1/3.76 = 0.26$$

hypercoiling is seen in many cases of fetal growth restriction.<sup>13</sup>

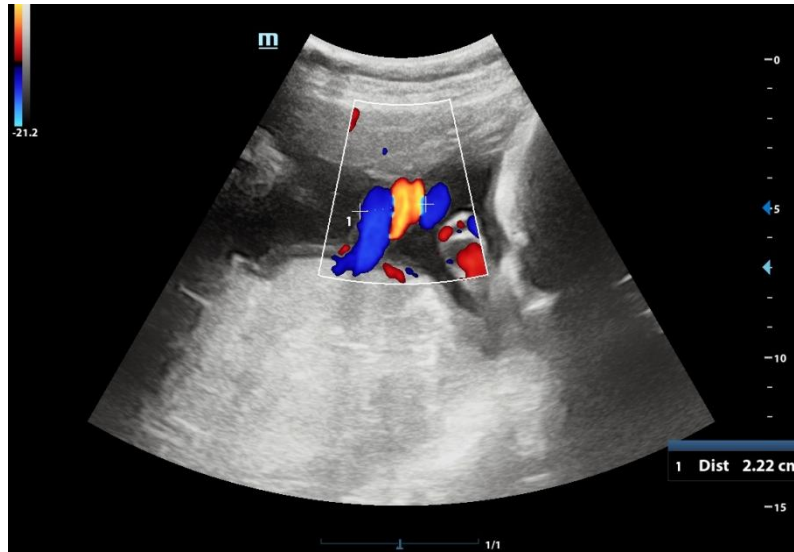
With 0.35 – 0.37 95 % confidence interval, the UCI mean value was set as  $0.35 + 0.07$ . 0.26 was fixed as 10<sup>th</sup> percentile and 0.46 coils per cm was set as 90<sup>th</sup> percentile and any measurements below was reported as hypo and above 90<sup>th</sup> as hypercoiled.<sup>1</sup>

The mean UCI was 0.20 with standard deviation of 0.09 as per one study and it did not show any correlation with perinatal outcome<sup>12</sup>

These are two sample cases of fetal growth restriction



Case 2:



Here, UCI = 1/ Distance between coils in cm

$$1 / 2.2 = 0.45$$

Values indicate that it is Hypercoiled

**Conclusion:**

Apart from the routine evaluation of umbilical vessel number structural, insertion site anomalies, entanglements of cord ,measuring umbilical coiling index, the pattern of coiling, amount of Wharton's Jelly might be useful in prediction of adverse or pregnancy complications. Due to insufficient data base evidences, the umbilical coiling index in FGR is still a debatable topic and more research studies are needed to substantiate the correlation of hypercoiling in fetal growth restriction.

**Abbreviations Used:**

FGR = Fetal growth restriction

UCI= Umbilical coiling index

RI = Resistive index

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