



## Umbilical Cord Index and Placental Intervillous Thrombi: Implications for Clinical Management

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### Abstract

In order to evaluate the association of placental pathology findings with umbilical cord index, we reviewed clinical and pathologic findings from 40 placentas. We found that umbilical cord index is associated with placental intervillous thrombi. Intervillous thrombi showed increased prevalence in cases with umbilical cord hypocoiling (83%; 5/6) vs. hypercoiling (50%; 3/6) or normal coiling (26%; 6/23). Other clinical and pathologic parameters showed no differences by umbilical cord index. Intervillous placental thrombi have been shown to be of maternal origin and have classical potential etiologies such as hypercoagulability, including maternal thrombophilias. Therefore, early sonographic identification of abnormally coiled umbilical cords, particularly hypocoiled cords, may serve as a marker for maternal screening of thrombotic risk.

**Keywords:** Umbilical Cord Index; Intervillous Thrombus; Coagulopathy; Thrombophilia; Fetal Ultrasound

### Introduction

Umbilical cord (UC) index (# of coils/UC length) has been correlated with clinical parameters of adverse pregnancy outcomes [1-4] including small for gestational age, mode of delivery, presence of meconium-stained amniotic fluid, presence of nonreassuring fetal status in labor, and Apgar scores at 1 and 5 minutes [5]. Specifically, hypocoiling of the UC is associated with increased incidence of fetal demise, intrapartum fetal heart rate decelerations, operative delivery for fetal distress, anatomic-karyotypic abnormalities and chorioamnionitis. Hypercoiling of the cord is associated with increased incidence of fetal growth restriction and cord stenosis [6]. Medical literature is sparse regarding the UC index and its potential association with placental pathology. We reviewed 40 placentas from second and third trimester pregnancies to evaluate UC index and any association with placental histopathology that may have clinical import. Reports from 60 placenta specimens from 2019-2023 were reviewed for report completeness audit. Twenty cases of covid-positive mothers were omitted for this analysis. Clinical data and histologic findings were anonymously recorded

from previously signed histopathology reports by consultant histopathologists. UC index was calculated in the standard fashion (# of coils/UC length) with hypocoiling defined as a UC index  $\leq 0.12$  and hypercoiling as UC index  $\geq 0.36$ . Placenta histopathology included intervillous thrombi (14), increased villous capillaries (8), calcifications (6), villous edema (5), increased perivillous fibrin (3), acute and chronic villitis (1) and avascular villi (1). Only intervillous thrombi showed increased prevalence in cases with UC hypocoiling (83%; 5/6) vs. hypercoiling (50%; 3/6) or normal coiling (26%; 6/23).

### Methods

Following Co Path electronic archive search using keywords 'placenta' anonymized final diagnosis summary reports from 60 placenta specimens from 2019-2023 were reviewed for report completeness audit. Twenty cases of covid-positive mothers were omitted for this analysis. Clinical data and histologic findings were anonymously recorded from previously signed histopathology reports by consultant histopathologists. UC index was calculated in

the standard fashion (# of coils/UC length) with hypocoiling defined as a UC index  $\leq 0.12$  and hypercoiling as UC index  $\geq 0.36$ , as previously described [7]. Random intervillous thrombi had alpha-fetoprotein immunohistochemistry applied to support maternal versus fetal origin, also as previously reported [8].

### Results and Discussion

Mothers (n=40) ranged in age from 21 to 40 years (m=34). Twenty-three cases had normal UC index, while six showed hypocoiling and six showed hypercoiling. No differences were seen with UC index and maternal age, gestational age (m=32 weeks; range 20-40) or placental weight (m=466g; range 103-629). Pertinent clinical findings were intrauterine growth restriction (5), low-cesarean section (4), haemorrhage (3), premature rupture of membranes (3) and fetal distress during labor (2), and possible infection (2) although no differences were found by UC index. Three UCs showed abnormal insertion including Battledore (2) and velamentous (1). Histologic findings in UC included acute funisitis (2) and intracordal haemorrhage (1). Fetal membranes showed circummarginate insertion (1). Histology of membranes included acute and chronic chorioamnionitis (12), acute amnionecrosis (3), and meconium staining (3). Placenta histopathology included intervillous thrombi (14), increased villous capillaries (8), calcifications (6), villous edema (5), increased perivillous fibrin (3), acute and chronic villitis (1) and avascular villi (1). Only intervillous thrombi showed increased prevalence in cases with UC hypocoiling (83%; 5/6) vs. hypercoiling (50%; 3/6) or normal coiling (26%; 6/23). Alpha-fetoprotein immunohistochemistry in intervillous thrombi was negative, supporting maternal origin.

While numerous studies have discussed the clinical associations with UC abnormalities including abnormal UC index, the correlation of cord abnormalities and placental pathology is comparatively unstudied [9]. In order to evaluate the association of placental pathology findings with UC index, we reviewed clinical and pathologic findings from 40 placentas. Prior studies have found UC index correlated with clinical parameters of adverse pregnancy outcomes [1-4] including small for gestational age, mode of delivery, presence of meconium-stained amniotic fluid, presence of non-reassuring fetal status in labor, and Apgar scores at 1 and 5 minutes [5]. Specifically, hypocoiling of the UC is associated with increased incidence of fetal demise, intrapartum fetal heart rate decelerations, operative delivery for fetal distress, anatomic-karyotypic abnormalities and chorioamnionitis. Hypercoiling of the cord is as-

sociated with increased incidence of fetal growth restriction and cord stenosis [6]. Other UC abnormalities such as cord entrapment, knots, torsions, or strictures and cord prolapse have been associated with stillbirths, gestational diabetes and pre-eclampsia [10]. These UC abnormalities have also been associated with sonographic pathology of thrombosis of chorionic plate vessels and umbilical vein thrombosis [1]. While the process of defining abnormal coiling lacks uniformity across the existing literature, UC index is often calculated as # of coils/UC length with hypocoiling defined as a UC index  $\leq 0.12$  and hypercoiling as UC index  $\geq 0.36$ .

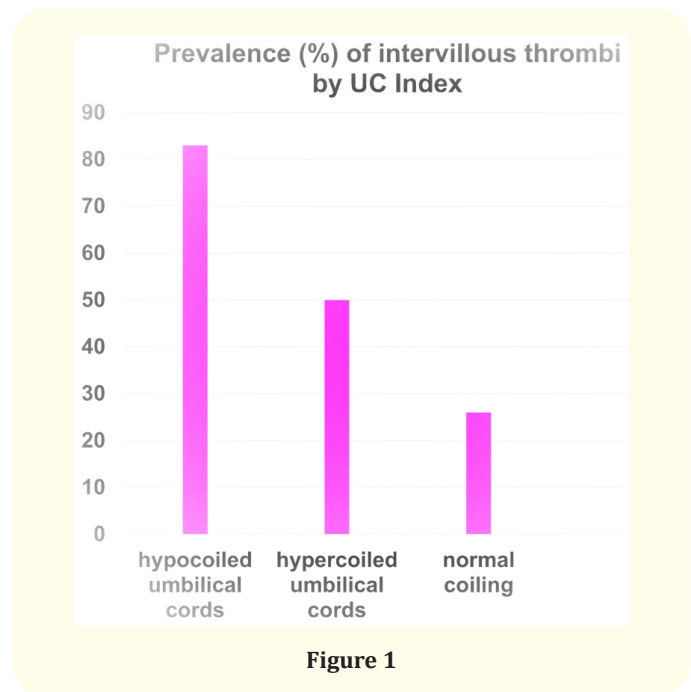


Figure 1

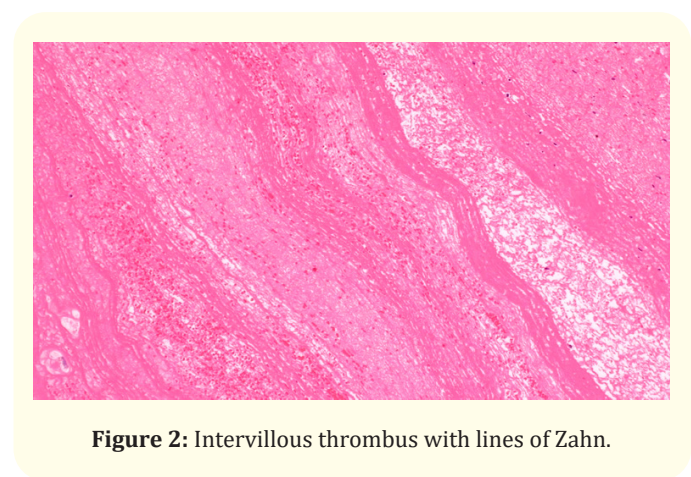


Figure 2: Intervillous thrombus with lines of Zahn.



**Figure 3:** Negative alpha-fetoprotein immunohistochemistry in intervillous thrombi supporting maternal origin.

### Conclusions

Intervillous placental thrombi showed the highest prevalence in cases with UC hypocoiling, over 3x that of normal cords. As intervillous placental thrombi have been shown to be of maternal origin and have classical potential etiologies such as hypercoagulability, including maternal thrombophilias, early sonographic identification of abnormally coiled UCs, particularly hypocoiled cords, may serve as a marker for additional maternal screening of thrombotic risk.

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