Velamentous cord insertion caused by oblique implantation after *in vitro* fertilization and embryo transfer

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Abstract

We present a case of a 36-year-old pregnant female after intracytoplasmic sperm injection. Ultrasonographic examination at 8 weeks’ gestation revealed umbilical cord insertion with a viable fetus located on the septum membrane of dichorionic twin pregnancy near the anterior wall, while the other fetus was observed to have vanished. Next, this umbilical cord was seen to connect to the anterior wall and the placenta developed on the posterior wall later in the pregnancy. As a result, velamentous cord insertion with long membranous umbilical vessels developed at the time of delivery. The present case indicates that the assessment of the cord insertion site during the early gestation period is very important to predict any abnormality of the cord insertion site at the time of delivery. Furthermore, this case is valuable to understand the pathophysiological development of the placenta and velamentous cord insertion.

Key words: IVF, trophotropism, twin pregnancy, vasa previa, velamentous cord insertion.

Introduction

Velamentous cord insertion is reported to be associated with multiple pregnancy and pregnancy after artificial reproductive technologies. These etiologies are often explained by two hypotheses. One is the ‘trophotropism theory’, wherein the early placenta migrates with advancing gestation to ensure a better blood supply. The other is the ‘polarity theory’, where the abnormal cord insertion is secondary to oblique orientation of the blastocyst at implantation. We experienced a case where the umbilical cord was detected on the septum membrane over a vanished twin pregnancy, resulting in velamentous cord insertion. The present case is valuable to understand the two theories and the importance of assessing cord insertion during the first trimester.

Case Report

A 36-year-old female, gravida 1 para 0, was referred at 5 weeks’ gestation for pregnancy check up after *in vitro* fertilization and embryo transfer treatment. This pregnancy was assisted by intracytoplasmic sperm injection due to diagnosis of oligozoospermia in her husband. There was no previous history of maternal illness, and no familial history of placental abnormalities. Transvaginal ultrasonography revealed two separated gestational sacs with a white ring in the endometrium, and no evidence of fibroma or ovarian cysts. A diagnosis of a dichorionic twin pregnancy was made. Without any symptom at 8 weeks’ check up, two gestational sacs in the uterine cavity and one viable embryo with normal growth in the gestational sac located on the lower side of the uterus were visualized (Fig. 1). The other embryo

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in the gestational sac located on the fundal side was small for gestational age and the fetal heart beat was not detectable. During the same examination, it was revealed that the umbilical cord insertion of the viable embryo was located on the septum membrane near the anterior wall.

Based on ultrasound examination at 12 weeks' gestation, the diminished gestational sac near the fundal side with the vanished embryo and the viable fetus in which umbilical cord located on the anterior wall were observed (Fig. 2). At this time, the chorion villosus on the posterior wall was found to be thicker than on the anterior wall.

In an ultrasound examination at 20 weeks' gestation, umbilical cord insertion on the anterior wall and location of the placenta on the posterior wall were visualized and the placenta did not cover on the uterine internal os. One long membranous vessel went halfway around on the fundal wall connecting from the umbilical cord insertion site on the anterior wall to the posterior placenta, and the other two velamentous vessels went around on the bilateral wall of the uterus, although vasa previa was not detectable. As a result, an ultrasonographic diagnosis of velamentous cord insertion with long membranous vessels was made (Fig. 3).

We paid attention to the patient's uterine contraction and the dilatation of her cervix during pregnancy. No symptoms in the patient and no fetal heart rate abnormalities on the non-stress test were observed. We considered a rupture of the membrane to be undesirable in cases with long aberrant vessels, similar to those seen in cases demonstrating vasa previa, and we therefore performed an elective cesarean section at 36 weeks of gestation. During surgery, a discoid placenta on the posterior wall, velamentous cord insertion on the anterior wall and connecting some vessels on the membrane between them were observed (Fig. 4). A female infant was delivered, weighing 2542 g, with Apgar scores of 8 and 9 at 1 and 5 min.

Discussion

Velamentous cord insertion is an abnormal cord insertion in which the umbilical vessels diverge as they traverse between the amnion and chorion before reaching the placenta. The rate of velamentous cord developed had been reported to be between 0.5 and 1.69% for single pregnancies, with the prevalence of velamentous cord insertion being 10-fold higher in multiple pregnancies. Several reports have suggested that pregnancies resulting from artificial reproductive technologies are strongly associated with the occurrence of velamentous cord insertion.

There are two theories about the mechanism underlying the development of velamentous cord insertion. One theory is the trophoblast theory, in which the chorion villosus or the early placenta migrates with
Development of velamentous insertion

Figure 3 Transabdominal ultrasonography at 26 weeks' gestation. (a) The umbilical cord insertion site was located on the anterior wall, and the placenta was located on the posterior wall. (b) The placenta on the posterior wall and velamentous vessel went half-way around the fundal wall. (c) The long velamentous vessel on the anterior circled along the anterior wall.

Figure 4 Photograph showing velamentous cord insertion and the placenta during the cesarean section. The discoloid placenta on the posterior wall, velamentous cord insertion on the anterior wall and connecting aberrant vessels on the membrane between them were investigated.

advancing gestation to ensure a better blood supply from a more richly vascularized area. The other is the polarity theory, in which abnormal cord insertion is secondary to oblique orientation of the blastocyst at the nidation. When the embryo does not face the implantation base, the umbilical vessels have to extend between the connecting stalk (umbilical cord insertion site) and the placenta in order to reach the endometrium where the placenta can develop appropriately, thus resulting in either marginal or membranous insertion. Delbaere et al. reported a higher incidence of abnormal cord insertion to exist in artificial reproductive technology pregnancies, thus supporting the trophoblast hypothesis, since the exact chronological succession of biological events necessary for proper blastocyst implantation is disturbed at more than one phase in the case of assisted reproduction.

We previously demonstrated that cord insertion in abnormal locations of the uterus, such as lower uterine segments, was significantly associated with the development of velamentous cord insertion. With regard to the umbilical cord and placental development, the umbilical cord insertion site is determined prior to placental development, and the placenta therefore grows preferentially toward better vascularized fields regardless of the umbilical insertion site. Since the thicknesses of the placenta from the chorion villosum is better in the uterine corpus than in the uterine isthmus, velamentous cord insertions were frequently observed in cases with cord insertion located in the lower uterine segment. We further proved that aberrant vessels in the cases of lower velamentous cord insertion were longer than those in cases of middle and upper insertion. We believe that the umbilical cord insertion site visualized at the first trimester indicates the direction of implantation (embryo and connecting stalk). These studies support both of the aforementioned hypotheses.
In the present case, we observed that the umbilical cord inserted into the septum membrane of an embryo from a twin pregnancy resulting from in vitro fertilization and embryo transfer. Thereafter, one embryo aborted at 8 weeks' gestation, and the gestational sac diminished with advancing gestation. The umbilical cord insertion on the septum of the other viable embryo therefore attached on the anterior wall, whereas the placenta developed on the posterior wall of the uterus from the chorion villosum, regardless of the umbilical cord insertion site. We believe that such an observation might have been due to the oblique orientation of the blastocyst at implantation. Even though selection mechanisms for the placental location from the chorion villosum are unknown, the oblique location of the umbilical cord often appears to be associated with the occurrence of velamentous cord insertion.

Finally, we believe that the accurate assessment of an abnormal location of the umbilical cord insertion site during the early gestation period could clinically enable us to predict the risk of placental and umbilical cord abnormalities at later periods of gestation. More precise ultrasonographic evaluations should therefore be performed longitudinally when abnormal locations of cord insertion, such as in the lower part of the uterus and the septum of the membrane between twins, are observed in the first trimester of pregnancy.

References