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Brief Communication

MINIMUM CORD LENGTH TO ALLOW SPONTANEOUS VAGINAL DELIVERY

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Running title: Short umbilical cord

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Condensation

The uterine axis and birth canal are not so long to prevent a spontaneous vaginal delivery in the presence of a short umbilical cord.

Abstract

Objective: To determine the shortest umbilical cord length to permit spontaneous vaginal delivery

Methods: This prospective observational study included 166 randomly chosen women, age ≥ 18 years, with no apparent antepartum complications who delivered spontaneously ≥ 37 weeks. The cord was clamped at the maternal introitus immediately at delivery. The cord segment was measured from introitus to placental insertion. We reviewed a recent fetal scan to identify the placental implantation site (fundal or lateral).

Results: The mean cord segment from placental insertion to maternal introitus measured to be 22.4 cm (95% confidence interval, 11 to 32 cm). The segment was 2.1 cm longer (95% confidence interval 0.4 to 3.7 cm) when the placenta was implanted at the uterine fundus rather than laterally ($p < .01$; one-sided t-test). An excessively short cord segment (< 13 cm) was present in two cases (1.2 %) with a lateral placental implantation and no case with a fundal implantation.

Conclusion: The uterine axis and birth canal are not so long to prevent a spontaneous vaginal delivery in the presence of a short umbilical cord. Placental location does not impede delivery except perhaps when fundal in the presence of an excessively short cord.

Key words: umbilical cord, cord length, dystocia, failure to progress, labor

The umbilical cord lengthens in an almost linear manner until the last trimester when there is more intrauterine constraint. This environment explains less fetal movement and less tension or "stretching" of the cord. The average cord is 55 cm long at birth, while a short cord is 35 cm or less.[2] Short cords, found in up to 6% of all deliveries, have been implicated to explain certain intrapartum complications such as a failure to adequately descend or fetal intolerance to labor. According to Kaltenbach in 1893, the cord must be of a certain minimum length to permit delivery of the child – that is, it must be "35 centimeters when the placenta is inserted high up," and "20 centimeters when low down".[3] Although infants with cords less than 35 cm long are often born vaginally, Sornes reported a significantly higher incidence of operative vaginal deliveries.[4]

An explanation as to how certain infants deliver vaginally with either ease or difficulty was also provided by Brickner in 1902.[5] When a placenta is low lying and has a battledore insertion of the cord near the cervix, a 20 cm long cord is ample for delivery of the infant to the umbilicus. A short cord can be suspected in the presence of obstructed descent if the placenta is located higher (fundally) and the umbilical cord is inserted centrally, creating the longest length for delivery. With widespread use of prenatal sonography, we can accurately locate the placenta. The segment of cord can be measured easily at delivery from its insertion in the placenta to the mother's vaginal introitus.

We propose here a novel study to determine the minimum cord length believed necessary to allow a spontaneous vaginal delivery. This prospective observational investigation was approved by our Human Research Review Committee. Approximately one-fifth of placentas are implanted fundally, according to our review of ultrasound examinations performed at our perinatal imaging center. Consultations with our statistician disclosed that a sufficient number of cases should be gathered from 125 or more women (25 with fundally-implanted placentas) who underwent a spontaneous vaginal delivery beyond 37 weeks 0 days gestation. Our sample

population was gathered randomly from consecutive vaginal deliveries at term for women aged 18 years or older and whose delivery was attended by the senior author (WR). In addition, all study cases had a fetal ultrasound with placental localization in late gestation.

As shown in Figure 1, the cord was clamped at the maternal introitus immediately after delivery. The length of this segment from clamp to placenta insertion (central, marginal) was recorded. Also noted was any gross abnormality (placenta abruption, velamentous cord insertion, cord stricture). The placental location was recorded as being either fundal or lateral according to the recent fetal scan. Fetal gender and weight, gestational age at delivery, and one and five minute Apgar scores were reported on a data sheet.

All data were entered into MS Excel (Microsoft, Redmond, WA). Results were reported as a mean $\pm$ SD. The mean and median cord length were calculated, along with 95% confidence intervals and a presumed bell-shaped curve. Differences between cord lengths in relation to placental location (fundal vs. lateral) underwent a one-sided Student t-test analysis. A p value $<$ .05 was considered to be statistically significant.

Our sample population of 166 deliveries had a maternal age of 24.6 $\pm$ 5.4 years and was predominantly Hispanic. The infant's birthweight averaged to be 3184 $\pm$ 439 grams. None had Apgar scores $\leq$ 3 at 1 minute or $\leq$ 6 at 5 minutes. A velamentous cord insertion was found in one case.

The median cord length was 23 cm (range 11 to 32 cm), while the mean was 22.4 $\pm$ 3.7 cm. The placenta was located laterally in 138 (83.1%) cases and fundally in 28 (16.9 %) cases. Figure 2 displays the frequency distribution of cord lengths according to fundal and lateral placental location. The cord was 2.1 cm longer (95% confidence interval 0.4 to 3.7 cm) when the placenta was fundal rather than lateral ($p < .01$; one-sided t-test). These data are consistent with having come from normal distributions. The site of cord insertion into the placenta (central:

138 cases, marginal: 23 cases) did not affect the mean length measurement after controlling for placental location.

With this sample size and mean cord length, it would be 95% certain that 95% of the lengths lie within the interval from 13 to 32 cm (two-sided tolerance interval) or lie above the value 13 cm (lower one-sided tolerance interval).[6] An excessively short cord segment, defined here as being less than 13 cm, was observed in two cases (1.2 %) with a laterally implanted placenta and in no case with a fundally implanted placenta.

In summary, this investigation challenged a century old belief that short cords at delivery are usually sufficiently long to permit the fetus to descend adequately for a vaginal delivery. Our findings from this prospective clinical investigation confirm the uterine axis and birth canal to not be so long as to impede spontaneous vaginal delivery in the presence of a short umbilical cord. We also report that placental location makes no difference unless perhaps the cord is excessively short (< 13 cm). Further investigation is needed to examine the relationship between cord length and fetal intolerance to labor.

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Legends

Figure 1. Measurement of umbilical cord length from insertion into the placenta to clamping at the maternal introitus. The cord segment was clamped promptly at delivery.

Figure 2. Distribution of cord segment lengths at spontaneous vaginal delivery, according to placental location (fundal, lateral).

Figure 1.

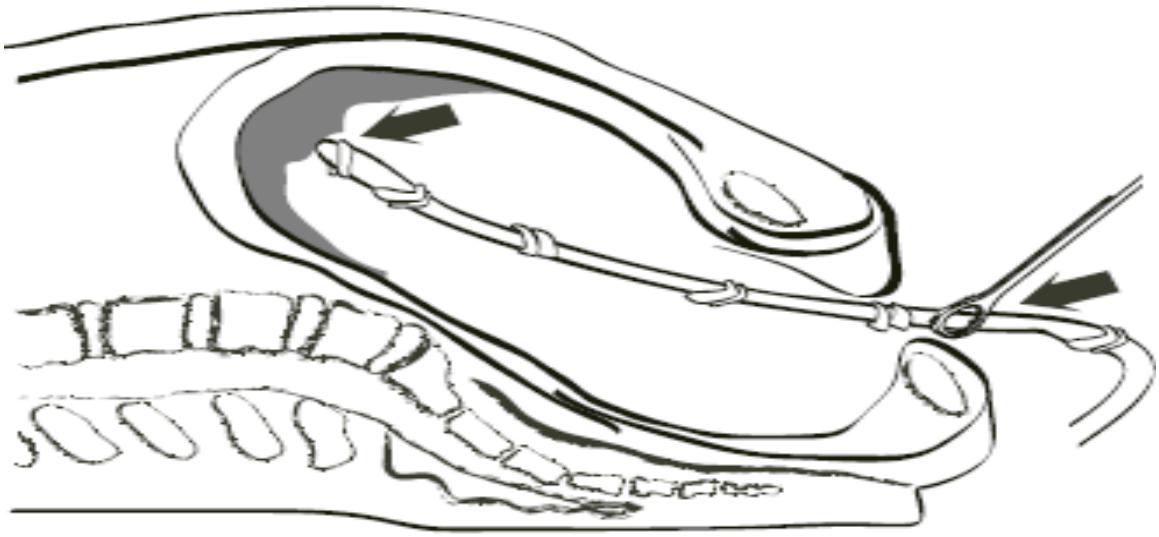
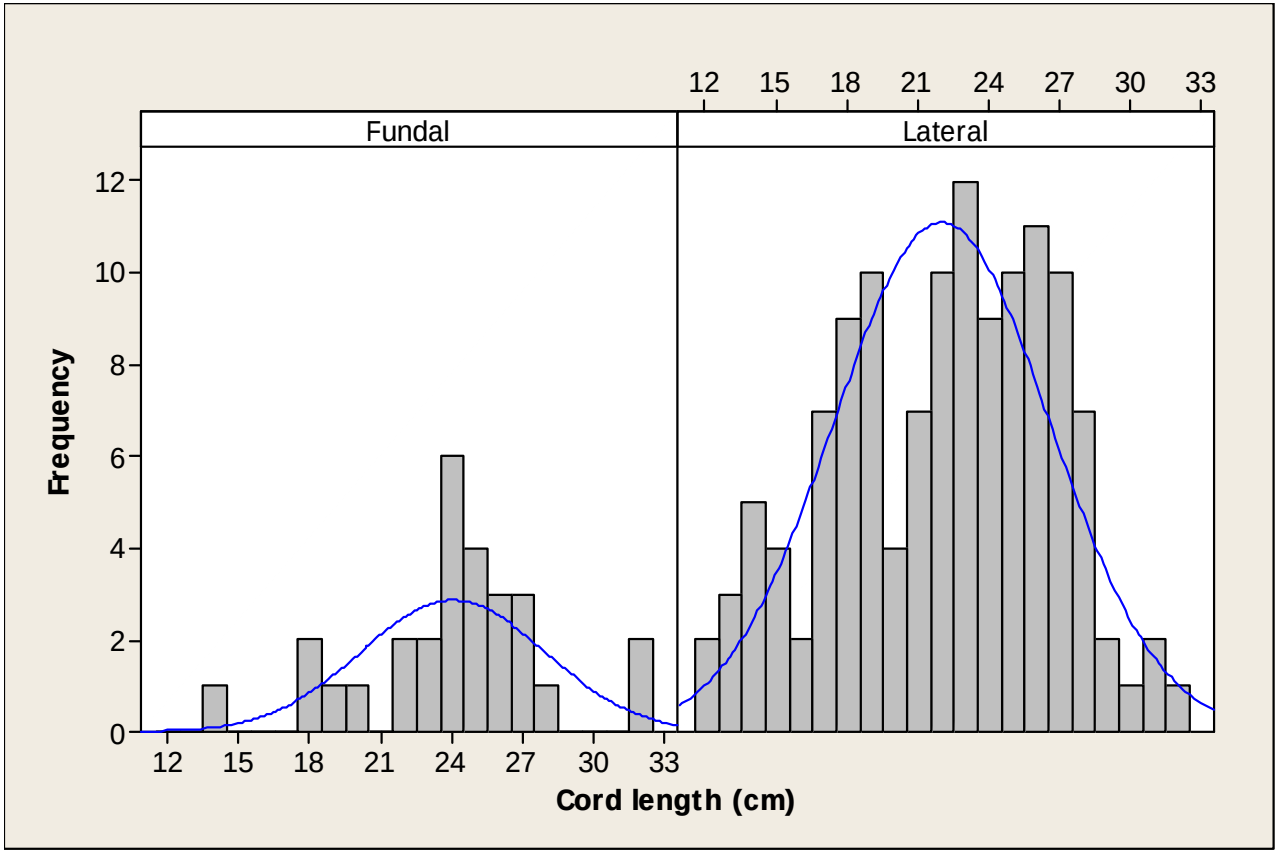


Figure 2.


12 15 18 21 24 27 30 33
Fundal
Lateral
Frequency
0
2
4
6
8
10
12
12 15 18 21 24 27 30 33
Cord length (cm)