Importance and ways of fetal station measurement: designing and creating fetal station cymbal

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ABSTRACT: Birth includes the period with strong uterine contractions. Accurate diagnosis of fetal station at delivery urinary tract is important for select a delivery method that result in providing health of mother and baby. The present study aims to investigate the methods for determining the fetal station during normal delivery and mistakes of determining fetal head station can result in labor disturbances. In this study, we investigated more than 40 articles in the field of fetal station exam. These articles are available on the scholar indexes such as PubMed and Google Scholar. The present study aims to investigate the methods for determining the fetal station during normal delivery and mistakes of determining fetal head station.

RESULTS AND CONCLUSIONS

Vaginal examination is not a reliable method to assess the delivery status and the amount of descent. The studies have introduced sonography as the gold standard for assessing the status of delivery in the second stage of labor. However, due to the high cost, complexity, and the need for professional personnel to use this method, it is not available everywhere. Therefore, a simple and inexpensive method is required to be designed. The researchers of the present study designed an instrument for assessing fetal station even in disadvantaged and remote areas with little training.

Definition of fetal station

Fetal station at normal vaginal delivery is described by the relationship between the fetus and the ischial spines located in the entrance and outgoing mouths of the pelvis. In the past, the longitudinal axis of the cervical canal at the top and bottom of the ischial spines was divided into to 3 or 5 parts (each about 1 cm). In 1988, The American College of Nurse-Midwives (ACNM) used a new method for fetal station and divided the upper and lower of the ischial spines to 5 parts. When the lowest presenting part of the fetus is in the same level as the ischial spines, fetal station is zero. On the other hand, if the presenting part of the fetus is in the upper part of the ischial spines, fetal station has a negative score from -1 (closer to ischial spines) to -5 (farther from ischial spines). However, in case it is in the lower part of the ischial spines, fetal station has a positive score from +1 (closer to ischial spines) to +5 (farther from ischial spines). +5 station is applied to the situations in which the head of the fetus is visible at the entrance of the vagina (Cunningham, 2010). The term “Descent” is defined as the passage of the fetus in the mother’s pelvis, which is the first prerequisite to vaginal childbirth. Diagnosis of fetal station is essential for understanding the degree of descent (Ghi et al, 2009). In primiparous women, engagement may occur before the beginning of the labor mechanism, eventually stopping the descent process. In multiparous women,
however, descent usually starts with the beginning of engagement. According to ACNM criteria, descent is considered to be prolonged in case it is less than 1 cm/hour in primiparous women and less than 2 cm/hour in multiparous ones. Furthermore, more than 1 hour stop in the descent process is considered as the criterion for diagnosis of descent arrest in both primiparous and multiparous women (Cunningham, 2010).

Importance of accurate measurement

Estimation of the amount of descent is an important part of the clinical examination and one of the important factors in diagnosis of dystocia and early diagnosis of delivery stop (Cunningham, 2010; Buchmann, 2008). Dystocia is one of the most common indications of caesarean section and about 60 percent of caesarean section cases are related to the diagnosis of dystocia in the United States. Therefore, discontinuation of the descent in the second stage of delivery is one of the prevalent indications of caesarean section (Cunningham, 2010; Barbera and Pombar, 2009).

One of the reasons for increase in the amount of caesarean section due to dystocia is wrong diagnosis. Based on many studies, determining the fetal station has an effective role in diagnosis of dystocia and selection of the type of delivery (Barbera and Pombar, 2009; Barbera and Imani, 2009). The statistics indicate an increase in the rate of caesarean section. For example in 2009, 32.9% of all the deliveries in the United States were carried out through the caesarean section. This measure was obtained as 37.7% in South Korea in 2008, 39.8% in Italy in 2007, and 30.6% in Australia in 2007. In Iran, the rate of caesarean section increased from 35% in 2000 to 40.4% in 2005. Studies have shown that this trend continues to grow in this country (Shahraki Sanavi, 2012; Sharifizad, 2012). The rate of caesarean section in Iran is 3 to 4 times higher than the acceptable rate by World Health Organization. Caesarean section is accompanied by a larger number of complications compared normal delivery. Some of these complications include uterine infection, fever, infection in incision site, bleeding, anesthesia complications, urinary system damage, and thromboembolism. The cost and length of hospital stay were also higher in the caesarean section compared to natural childbirth (Cunningham, 2010; Mostafazade, 2006). Moreover, the mortality and disability rate in the caesarean section were respectively 2 to 3 and 5 to 10 times more than natural childbirth (Cunningham, 2010). One of the most important fertility health issues are newborns' and mother's health and mortality. Furthermore, the health indexes of newborns and mothers are related to the health conditions of any society. Therefore, decrease in the rate of c-section is of great importance (Sharifizad, 2012).

Constant and accurate monitoring of clinical symptoms, such as measurement of fetal station, can correct the diagnosis of birth disorders and reduce the rate of c-section (Sallam, 1999). Physicians’ information about fetal station can also help diagnose abnormal childbirth patterns and make appropriate interferences (Nizard et al, 2009). Dupuis and his colleagues investigated the clinical reliability of “fetal station diagnosis”, according to ACNM criteria, by a birth simulator. They reported that the results of the clinical examinations were wrong in one third of the cases (Dupuis et al, 2005).

MEASUREMENT METHODS

Vaginal exam

Vaginal exam is a common method for measuring fetal station. Theoretical and practical evidences have indicated the fetal exam through individual finger check to be completely subjective (Crichton, 1974) and difficult (Roshanfekr, 1999). Also, the result of fetal station exam is misleading in some cases with Molding or Caput succedaneum (Cunningham, 2010).

Olah investigated 32 vaginal examinations which were performed by a resident in the second stage of delivery and those performed again by an expert gynecologist after 15 minutes in a 5-year period. The study results revealed considerable disagreement between the resident and the gynecologist regarding the fetal station (81%). In addition, Molding or Caput succedaneum had not been reported in most cases (94%) (Olah, 2005).

To date, controversial definitions exist for fetal station among the health service providers. These differences can affect the decision for selection of the type of delivery (Barbera and Pombar, 2009; Dupuis et al, 2005).

In one study which was conducted in 5 educational centers at Denver, residents, nurses, and faculty members were required to clarify their definitions of fetal station. Surprisingly, they presented 4 different definitions for this term. In addition, only a few personnel who provided medical services were aware of different definitions of fetal station (Carollo, 2004).

Buchmann et al. conducted a study in order to estimate the rate of agreement regarding fetal station during delivery. In this study, the researcher and the physician checked the fetal station, dilatation, molding, caput succedaneum, fetus position, and amount of head flexion through vaginal examination. They examined the fetal
station of 446 cases (88%) and agreed on 166 ones (37%). Disagreement in 1 and more than 2 cm was observed in 208 (47%) and 72 (16%) individuals, respectively. The highest agreement between the researcher and the physician (50%) was related to the 1cm position. They agreed on detection of engaged and unengaged fetal head in 37% (166) and 33% (149) of the cases, respectively. However, they disagreed regarding the engagement detection in 29% (131) of the cases. They came to the conclusion that approximate estimation of the fetal station was not associated with the knowledge and experience of the examiner or midwifery factors and that vaginal exam could not provide correct and transparent reports (Buchmann, 2008). In another study, Akmal et al. checked the accuracy of vaginal exam and sonography in diagnosis of fetus head position. They reported 26% error in diagnosis of fetus head position in the vaginal exam. Also, they showed that in cases undergoing instrumental delivery, vaginal exam was only able to diagnose 25% of the cases correctly (Akmal and Kametas , 2003).

Dupuis et al. assessed the clinical reliability of “fetal station diagnosis” (according to ACNM criteria) by a birth simulator. A total of 32 residents and 25 expert gynecologists participated in that study. The gynecologists’ and residents’ rate of error in determining the fetal station was 36%-80% and 50%-88%, respectively. Besides, the mean of error in the diagnosis of correct fetal station by the gynecologists and residents was 30% and 34%, respectively. Moreover, the highest rates of diagnosis error were in up and middle positions (classified according to ACNM criteria). Also, 12% error was shown in diagnosis of engaged and unengaged fetal head. Furthermore, this study showed that vaginal physical exam was not reliable for diagnosis of fetal station. When the middle position is diagnosed, vaginal instrumental delivery is not recommended because a high position might have not been diagnosed (Dupuis et al, 2005). In addition, estimation of the fetal station by repeated vaginal exams during childbirth may hamper mother’s relaxation and increase the risk of uterine infection by early rupture of the fetal membranes (Haberman, 2011).

**Sonography**

Considering the unreliability of vaginal exam for clinical decision, many studies have shown that sonography can eliminate the problems of vaginal exam by providing objective information (Molina, 2010). Therefore, sonography-based methods were designed by Wolfson et al. (Barnea, 2009), Sallam et al. (Sallam, 1999), and Sharaf et al. (Sharf, 2007) for investigation of fetal descent. Up to now, numerous studies have compared vaginal exam to sonography for diagnosis of fetal station. These studies have reported the rate of vaginal exam error to vary from 27% to 76% (Akmal and Kametas , 2003; Akmal and Tsoi, 2002; Kreiser, 2001; Sherer and Miodovnik, 2002; Dupuis et al, 2005 ). The study conducted by Sherer and colleagues in 2001-2003 was very interesting. In 2001, they evaluated the fetal head position in 102 pregnant women using vaginal exam and trans-abdominal sonography (the examiners were attendants and senior residents). The accuracy of vaginal exam was 47% and it was not associated with the examiners’ experiences. Sonography is a reliable tool for detection of fetal position and station (Sherer and Miodovnik, 2002). In another study in 2003, they assessed the fetal engagement by trans-abdominal sonography and vaginal physical exam. The study participants included 222 pregnant women with singleton pregnancy, over 37 weeks gestational age, fetal position, and healthy or ruptured fetal membranes. Among the participants, 119 were primiparous and 103 were multiparous. Vaginal exam and sonography were performed by expert gynecologists and a single individual, respectively. In vaginal examination, when the fetal head could be palpated at the level of ischial spine, it was considered as zero station. However in sonography when the fetal biparietal diameter had passed the pelvic inlet it was considered to be engaged. The rate of agreement between the vaginal exam and sonography was 85.6%. Maternal age, parity, BMI, fetal membrane status, the fetal status on sonography, type of delivery, and birth weight had no significant effects on the rate of agreement between the vaginal exam and sonography. That study showed great agreement between vaginal and abdominal sonography regarding the diagnosis of engagement. Moreover, diagnosis of fetal station by sonography was indicated as a gold standard for precise measurement (Sherer and Abulafia, 2003).

Chou et al. investigated 88 pregnant women in the second stage of delivery. Vaginal examination was performed by a resident and an expert attendant. Then, trans-abdominal and trans-perineal sonography were performed by a sonographer who was unaware of the results of physical examination. In comparison to sonography, the rate of vaginal examination error was 28% (Chou et al, 2004). In another study, the error rates of abdominal and perineal sonography and vaginal examination were 6% and 29%, respectively (Kreiser, 2001).

In a similar study, 166 women were examined through vaginal examination and sonography. The results of that study also indicated the high accuracy of sonography (Nizard et al, 2009). Up to now, several studies have used trans-abdominal and translabial sonography to detect the fetal station (Akmal and Kametas, 2003; Akmal and Tsoi, 2002; Kreiser, 2001; Sherer and Miodovnik, 2002; Dupuis et al, 2005; Rayburn, 1989; Souka, 2003; Gardberg, 1998).
Dietz and Lanzarone assessed the engagement of the fetal head by translabial ultrasound, abdominal palpation of the fetal head, and vaginal examination. In that study, translabial ultrasound was introduced as the gold standard, but the results of the three methods were consistent with each other (p<0.001). Furthermore, the researchers believed that the use of the three methods might be necessary for detecting the status of the fetus head during labor (Dietz and Lanzarone, 2005).

One other study showed translabial sonography to be a good predictor of success in instrumental delivery (Henrich, 2006). Tutschek and colleagues found that translabial sonography could accurately distinguish normal and abnormal labor by determining the progress of labor and station, position, and angle of fetal head (Tutschek, 2011). Overall, translabial sonography has been reported to be more reliable compared to vaginal examination (Ghi et al, 2009). In 2009, Barbera and Pombar evaluated the accuracy of perineal sonography in comparison to vaginal examination and assessed their effects on instrumental and C-section deliveries. They found that perineal sonography was a good prognostic method for predicting the type of delivery (Barbera and Pombar, 2009).

**Computed Tomography (CT) scan and Magnetic Resonance Imaging (MRI)**

In a study by Imani and Barbera in 2009, CT scans were performed in 70 non-pregnant women to determine the geometric algorithm of fetal station in pregnant women. Trans-Perineal Ultrasound (TPU) angles were then assigned for other clinical stations. In this way, they designed a consistent model for fetal stations measurement by TPU. In this model, station 0 is equal to 99 degrees (Barbera and Imani, 2009). Henrich et al. used translabial sonography to detect fetal head station during labor and used CT scan to support their findings (Henrich et al, 2006).

Moreover, Bamberg et al. evaluated the relationship between the findings of MRI and trans-perineal sonography for estimation of fetal head station during labor. They found that both methods led to very similar results (Bamberg et al, 2012).

**OTHER METHODS**

Fifths abdominal palpation method is a common method for estimating the fetal station in the United Kingdom (Studd, 2002), South Africa (Department of Health. Guidelines for maternity care in South Africa, 2002; Cilliers, 2003), and Australia (Knight, 1993). In this method, the fetus’ occiput and sinciput are touched from the suprapubic region. When the fetus head has free ballottement, the fifth grade is considered as 5. Degree 2 or less is considered when the fetal head is engaged.

**CONCLUSION**

In conclusion, vaginal examination is not recommended for estimation of fetal station and descent process. Because of lower accuracy of this method, it is difficult to perform decision and selection between instrumental and C-section deliveries based on vaginal examination. In other words, vaginal examination is not a reliable method to assess the delivery status. On the other hand, several studies have confirmed the accuracy of sonography with various techniques for estimation of fetal station and the amount of descent.

Almost all these studies have introduced sonography as the gold standard for assessing the status of delivery in the second stage of labor. However, due to the high cost, complexity, and the need for professional personnel to use this method, it is not available everywhere. In disadvantaged and remote areas for instance, a midwife perhaps is the only trained person who can help the mother during the delivery process without any excess instruments. Therefore, a simple and inexpensive method is required to be designed (Awan, 2009). The researchers of the present study designed an instrument for assessing fetal station even in disadvantaged and remote areas with little training.


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