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Effect of simulation-based training on the accuracy of fetal head position determination in labor

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ABSTRACT

Objectives: The objective of this study was to evaluate the effect of simulation-based training on the accuracy of fetal head position determination by junior residents during the second stage of labour.
Study Design: This prospective study was conducted in a tertiary care university hospital. During an initial period of 12 weeks, 13 junior residents were asked to routinely evaluate fetal head position by digital examination during the second stage of labour, in women with term singletons in cephalic presentation. Digital examination was followed immediately by transabdominal ultrasound to confirm fetal head position, performed by an experienced physician. Following this initial period, all participants attended a workshop where simulation-based training of fetal head position determination was provided. A second 12-week period was subsequently completed, with similar characteristics to the initial one. The accuracy of clinical evaluations was assessed by the percentage of exact evaluations, the percentage of correct evaluations within a 45° error margin, and by Cohen's kappa coefficient of agreement.
Results: A total of 83 observations were performed in the initial period of the study and 74 observations were performed in the second period. The accuracy of fetal head position determination during the first period of the study was 59.0% (95% CI 47.7–69.7), k = 0.517 (95%CI 0.391 - 0.635), corresponding to a moderate agreement. Considering a 45° margin of error, accuracy was 71.1% (95% CI 60.1–80.5), k = 0.656 (95% CI 0.538 – 0.763), corresponding to substantial agreement. Following simulation-based training, the accuracy of fetal head position determination was 70.3% (95% CI 58.5–80.3), k = 0.651 (95% CI 0.526 - 0.785), corresponding to a substantial agreement. Considering a 45° margin of error, accuracy was 78.4% (95% CI 67.3–87.1), k = 0.745 (95% CI 0.631 – 0.854), corresponding to a substantial agreement.
Conclusions: Although a trend towards increased accuracy in fetal head position determination was observed after simulation-based training, the difference was not statistically significant. Further studies are needed to clarify the role of simulation-based training for fetal head position determination during residency.

Introduction

Precise determination of fetal head position (occiput anterior/posterior/transverse, left/right) is important for managing the second stage of labour, particularly when operative vaginal delivery is considered. This evaluation is usually conducted by digital transvaginal examination, palpating the fetal head sutures and fontanels. However, previous studies have demonstrated that it is not an accurate method, [1–7] especially when performed by junior staff [2]. For healthcare professionals to gain experience with this procedure, the patient is frequently exposed to additional vaginal examinations, causing discomfort and promoting anxiety in all those involved. There is a clear room for improvement in the training of this technical skill, and a need for an effective alternative to achieve competence.

Simulation-based training in obstetrics has evolved enormously over the last two decades, and is currently accepted as a valuable tool for training several procedures, with proven benefits at all

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levels of the learning process, from medical students to maternal-fetal medicine subspecialists [8]. Nonetheless, it is during residency that simulation-based training seems to have a more robust application [8].

The aim of this study was to evaluate the effect of simulation-based training in determining fetal head position during the second stage of labour by junior residents in Obstetrics and Gynecology.

Materials and methods

This was a prospective study conducted between July 2015 and January 2016 in the labour ward of the Santa Maria University Hospital, a tertiary care centre in Lisbon, Portugal. The study was approved by the institution's Ethics Committee.

A total of 13 residents in Obstetrics and Gynecology participated in the study, all of them in their 1st to 4th year of residency, working regularly (at least once a week) in the labour ward of the Department. During an initial period of 12 weeks, residents were asked to evaluate fetal head position (occiput anterior/posterior/transverse, left/right) by digital vaginal examination in women with singleton cephalic term fetuses, ruptured membranes and full cervical dilation. Immediately after the digital examination, an experienced physician performed a transabdominal ultrasound (Aloka SSD-100, Tokyo, Japan) to identify fetal head position. For the latter, the transducer was positioned horizontally in the lower maternal abdomen: for transverse and anterior occiput positions the identified landmarks were the midline intracranial structures (cavum septum pellucidum, falx cerebri thalami and cerebellar hemispheres), and in some cases, the cervical spine; for occiput posterior positions the identified landmarks were the fetal orbits. Fetal head position was classified into one of the following: occiput anterior, right occiput anterior, left occiput anterior, right occiput transverse, left occiput transverse, occiput posterior, right occiput posterior and left occiput posterior.

After the initial period of the study, all participants attended a workshop with a 20-minute lecture on the principles of determining fetal occiput position based upon theoretical knowledge [9], followed by practical training on a simulator (PROMPT Flex Birthing Simulator®, Limbs & Things Ltd, Bristol, United Kingdom). Residents were asked to determine three different fetal head positions by vaginal examination, and immediate feedback and repetition was promoted. After the workshop, a second 12-week period was started, with similar objectives to the initial one.

A sample size of 74 observations was calculated, considering an improvement in agreement from 30% to 60% [2], and a power of 90%. In addition to the exact accuracy of vaginal examinations in identification of fetal head position, a similar evaluation was performed after allowing a 45° margin of error. Cohen's kappa coefficient was also used to evaluate agreement between clinical and ultrasound evaluations. Kappa values ranging from 0 to 0.20 were interpreted as corresponding to slight agreement, those between 0.21 and 0.40 as corresponding to fair agreement, those between 0.41 and 0.60 as corresponding to moderate agreement, those between 0.81 and 0.80 as corresponding to substantial agreement and those between 0.81 and 1 as corresponding to almost perfect agreement [10]. For all analyses, 95% confidence intervals (95% CI) were calculated. Statistical analysis was performed using SPSS statistics version 25 (IBM Corp., Armonk, NI, USA).

Results

A total of 83 observations were performed by the 13 residents during the initial period of the study, in an equal number of labouring women. During the second part of the study, 74 observations were performed by the same residents. The distribution of the observations by year of residency is displayed in Fig. 1. In both periods of the study, the majority of observations were performed by 3rd and 4th year residents (67% and 58%, respectively).

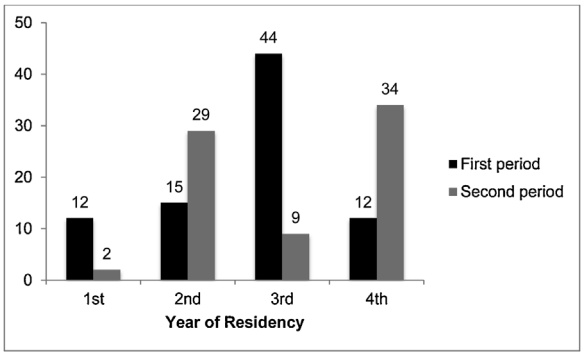

Fig. 1. Distribution of the frequency of observations by year of residency.

The distribution of fetal head positions (as determined by ultrasound) in the initial and second periods of the study is displayed in Table 1. The distribution of fetal head positions was similar in the two study periods. Anterior positions were most frequent in both periods, particularly left occiput anterior, followed by right occiput posterior.

The accuracy of vaginal examinations in determining fetal head position during the first and second periods of the study is displayed in Table 2, considering the exact accuracy and when allowing a 45° margin of error. Although a trend towards increased accuracy in fetal head position determination was observed after simulation-based training, the difference did not reach statistical significance ($p = 0.142$ for exact determination of fetal head position and $p = 0.360$ considering a 45° margin of error).

Comment

A high accuracy was observed in the determination of fetal head position in labour by junior residents. After attending a simulation-based training course, a trend towards higher accuracy was observed, but the difference did not reach statistical significance. When allowing a ± 45° margin of error, a higher accuracy was also observed after simulation-based training, but again the difference did not reach statistical significance.

Other studies have reported a lower accuracy in determination of fetal head position [1–7], with values as low as 31% for residents [2]. In the present study, observations were mainly performed by 3rd and 4th year residents, which may justify the higher accuracy observed.

Table 1
Fetal head position determined by residents (digital evaluation) and by transabdominal ultrasound (TU) evaluation, in the first and second periods of study.

Fetal head position	First Period		Second Period	
	Residents	TU	Residents	TU
Occiput anterior	14 (16.9%)	13 (15.7%)	17 (23.0%)	11 (14.9%)
Left occiput anterior	21 (25.3%)	18 (21.7%)	20 (27.0%)	15 (20.3%)
Right occiput anterior	14 (16.9%)	9 (10.8%)	15 (20.3%)	9 (12.2%)
Occiput posterior	8 (9.6%)	5 (6.0%)	5 (6.8%)	7 (9.5%)
Left occiput posterior	5 (6.0%)	11 (13.2%)	4 (5.4%)	7 (9.5%)
Right occiput posterior	13 (15.7%)	18 (21.7%)	5 (6.8%)	12 (16.2%)
Left occiput transverse	4 (4.8%)	3 (3.6%)	3 (4.1%)	2 (2.7%)
Right occiput transverse	4 (4.8%)	6 (7.2%)	5 (6.8%)	11 (14.9%)

TU Transabdominal ultrasound.

Table 2
Values of accuracy and agreement (Cohen's kappa) between digital determination of fetal head position by participating residents and ultrasound evaluation, considering exact determination and allowing a ±45° margin of error, in the first and second periods of study.

	Exact determination		± 45º error	
	1st Period	2nd Period	1st Period	2nd Period
Accuracy, % (95% CI)	59.0% (47.7–69.7)	70.3% (58.5–80.3)	71.1% (60.1–80.5)	78.4% (67.3–87.1)
Agreement, k (95% CI)	0.517 (0.391–0.635)	0.651 (0.526–0.785)	0.656 (0.538–0.736)	0.745 (0.631–0.854)

To the best of our knowledge, this is the first study to evaluate the effect of simulation-based training on clinicians' ability to determine fetal head position in labour. Previous studies mainly assessed self-reported confidence levels and comfort after simulation-based training of vaginal delivery [11–13]. In the largest study evaluating training of vaginal delivery skills using simulators, self-reported confidence was again the parameter evaluated [13]. Although this is a relevant factor, it is not the major determinant of usefulness for simulation-based training. Nitsche et al. [14] investigated the duration of simulation-training needed for medical students to obtain minimal competency in vaginal delivery skills, and concluded that two to three sessions were required.

Currently, there is limited data on how competency can be achieved using simulation-based training of basic procedures in labour [14–16].The present study evaluated changes in performance after training, a more objective and higher level effect of the learning process. Since fetal head position determination is one of the skills that need to be mastered before conducting vaginal deliveries, it is important to determine which measures are more effective when learning this procedure. The use of transabdominal ultrasound as a gold standard for evaluation of fetal head position is in line with previous research, [1–7] demonstrating that it is the most accurate diagnostic tool for this purpose.

One of the limitations of the study is that we could not ascertain the value of continued practice occurring before and during the study, not directly related to simulation-based training. The accuracy of fetal head position determination observed during the initial period of the study was higher than that reported in previous research, namely in the paper used for sample size estimation [2]. This may have been the main reason behind the negative results obtained in this study, as the observed trend was not statistically significant. It is possible that a higher number of participants or observations would have resulted in significant differences. It is also possible that exclusion of the more experienced observers (3rd and 4th year residents) would have had a similar effect.

We are also aware that the birthing simulator used does not allow an accurate replication of all real life situations. Namely, head *moulding* or *capput succedaneum*, both frequent in the second stage of labour, are not accurately represented.

For junior healthcare professionals to gain competence with vaginal examinations during labour, and the particularly demanding task of fetal head position determination, there is an urgent need to find learning alternatives that reduce patient anxiety and discomfort associated with repeated vaginal examinations. The present study demonstrates that simulation-based training is associated with a trend towards an improved performance with this procedure. Further research is required to demonstrate whether an increased study sample size or whether evaluation performed by less experienced residents may lead to significant differences. Until new data are available, and because it is harmless and does not have a negative effect on accuracy, we believe that simulation-based training of vaginal examination in labour, with a specific focus on fetal head position determination may be used during the early years of residency.

Declaration of Competing Interest

Concerning the Original Article untitled Effect of simulation-based training on the accuracy of fetal head position determination in labor, the authors report no conflict of interest.

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