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Romana Furrer*, Leonhard Schäffer, Nina Kimmich, Roland Zimmermann and Christian Haslinger

Maternal and fetal outcomes after uterine fundal pressure in spontaneous and assisted vaginal deliveries

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Abstract

Aim: This study aimed to evaluate maternal and fetal outcomes after uterine fundal pressure (UFP) in spontaneous and assisted vaginal deliveries.

Methods: In a retrospective cohort study, 9743 singleton term deliveries with cephalic presentation were analyzed from 2004 to 2013. Spontaneous and assisted vaginal deliveries were analyzed separately with and without the application of UFP. Odds ratios were adjusted in a multivariate logistic regression analysis.

Results: Prevalence of UFP was 8.9% in spontaneous and 12.1% in assisted vaginal deliveries. UFP was associated with a higher incidence of shoulder dystocia in both spontaneous (adjusted odds ratio [adj. OR] 2.44, confidence interval [CI] 95% 1.23–4.84) and assisted vaginal deliveries (adj. OR 6.88 CI 95% 3.50–13.53). Fetal acidosis (arterial umbilical pH<7.2) was seen more often after the application of UFP in spontaneous vaginal deliveries (adj. OR 3.18, CI 95% 2.64–3.82) and assisted vaginal deliveries (adj. OR 1.59 CI 95% 1.17–2.16). The incidence of 5′-Apgar<7 (adj. OR 2.19 CI 95% 1.04–4.6) and 10′-Apgar<7 (adj. OR 3.04 CI 95% 1.17–7.88) was also increased after the application of UFP in spontaneous deliveries. A higher incidence of anal sphincter tears (AST) (adj. OR 46.25 CI 95% 11.78–181.6) in the UFP group of spontaneous deliveries was observed.

Conclusions: UFP is associated with increased occurrence of shoulder dystocia and fetal acidosis. In spontaneous deliveries, the risk for lower Apgar scores after 5 and 10 min is increased, as well as the risk for AST.

Keywords: Anal sphincter tear; fetal acidosis; Kristeller maneuver; shoulder dystocia; UFP; uterine fundal pressure.

***Corresponding author: Romana Furrer,** MD, Division of Obstetrics, University Hospital of Zürich, Frauenklinikstrasse 10, 8091 Zürich, Switzerland, Phone: 0041 44 255 5103,
E-mail: romana.furrer@usz.ch
Leonhard Schäffer: Division of Obstetrics, Kantonsspital Baden, Switzerland
Nina Kimmich, Roland Zimmermann and Christian Haslinger: Division of Obstetrics, University Hospital of Zürich, Switzerland

Introduction

Uterine fundal pressure (UFP), also called the “Kristeller maneuver”, is a controversial obstetric technique in which manual pressure is applied to the uppermost part of the uterus towards the birth canal. It is named after the first describer of the procedure, Samuel Kristeller, who worked as a physician in Gniezno and later in Berlin. In 1867, Kristeller published a work about this procedure [1]. UFP is used worldwide even if there is little evidence about its safety in the literature. In the US, a nationwide survey conducted in 1990 revealed that more than 80% of the surveyed institutions used fundal pressure [2]. It is applied in different situations, such as fetal distress, maternal fatigue and failure in progress of the second stage, or in medical conditions where maternal pushing is contraindicated [2]. Expulsive force increases by 86% of the baseline contraction by simultaneously using valsalva and fundal pressure [3]. UFP is more often used in primiparas, in women with increased maternal body weight gain during pregnancy, and in cases of longer duration of labor [4].

Some authors have suggested that UFP may reduce the risks associated with either a prolonged second stage or the resulting operative procedures [3]. Other studies report higher rates of prolonged second stage, third- and fourth degree perineal lacerations, uterine rupture, and neonatal admission rates [2, 4, 5]. However, none of these studies performed a multivariate logistic regression analysis in order to adjust for possible confounders.

The drawback of any observational study is that the application of UFP may represent the consequence of a pathologic situation, such as fetal distress or prolonged

second stage, and not the cause. In any subsequent analysis, UFP would be associated with adverse outcome. Furthermore, in deliveries with indication for the use of vacuum or forceps, a pathologic situation already occurred, and thus, a comparison of deliveries with and without UFP should be more accurate. Thus far, there is no study that analyzes maternal and neonatal outcome in assisted vaginal deliveries with the application of UFP. Thus, we analyzed maternal and fetal outcomes in two groups separately, namely, women with spontaneous vaginal deliveries and women with assisted vaginal deliveries, each group with and without the application of UFP.

Methods

In our retrospective cohort study, data were collected from our electronic database, Perinat (Prof. Kurmanavicius, University Hospital of Zurich, Division of obstetrics, Switzerland). This contains all diagnoses and prospectively collected clinical data about the course of pregnancy, delivery, maternal and infant outcome. All data are recorded immediately after the delivery by the midwife and the attending physician. In our hospital, UFP is performed by a midwife or physician. Pushing force on the uterine fundus in the direction of the birth canal is performed with two palms or one forearm, often from an elevated position.

The study obtained ethical approval from the Institutional Review Board decision for the use of anonymized patient data for medical research (April 13th 2000 and March 1st 2012). Inclusion criteria were all singleton term deliveries with cephalic presentation at our University Hospital from November 2004 to December 2013. A total of 10,990 women fulfilled these inclusion criteria; however, 1247 women had to be excluded due to uncompleted documentation (11.3%), in which important data (e.g. variables for the multivariate analysis) were missing. In the end, 9743 women were included in the study.

To minimize selection bias, UFP during spontaneous and assisted vaginal deliveries (vacuum or forceps) were analyzed separately. The idea behind this study design is to form comparable situations as stated in the discussion.

Data about the following obstetric parameters were collected: parity, body mass index (BMI), perineal laceration, anal sphincter tears (AST), episiotomy, duration of the second stage of labor, shoulder dystocia, uterine rupture, and previous cesarean section. Obtained neonatal information included admission to neonatal care unit, infant birth weight, arterial umbilical cord pH, and 5 and 10 min Apgar scores.

Statistical analysis was performed with SigmaPlot 12.0 (Systat Software Inc., CA, USA). Baseline characteristics were compared using the χ^2-test for categorical data and the unpaired *t*-test for continuous data, the level of statistical significance was set at $P<0.05$. Prevalence of UFP was calculated as proportions of women with UFP among all women within a certain group. Odds ratios with 95% confidence interval (CI) for the occurrence of shoulder dystocia, AST, intact perineum, 5 min Apgar<7, 10 min Apgar <7, pH<7.20, pH<7.10, and admission to neonatal care unit were calculated for women with UFP in both spontaneous and assisted vaginal deliveries. A multivariate logistic regression analysis was conducted for the following parameters as established risk factors: occurrence of shoulder dystocia was adjusted for infant birth weight >4 kg, BMI >30 kg/m^2, prolonged second stage of labor >2 h, and primiparity. Occurrence of intact perineum and AST was adjusted for prolonged second stage of labor >2 h, infant birth weight >4 kg, shoulder dystocia, and primiparity. Neonatal outcome parameters (pH and Apgar scores) were adjusted for prolonged second stage of labor >2 h, shoulder dystocia, and induced labor.

Results

A total of 9743 vaginal deliveries were analyzed, including 7995 spontaneous deliveries and 1748 assisted vaginal deliveries. The prevalence rates of uterine fundal pressure were 8.9% (n=708) in the spontaneous delivery group and 12.1% (n=211) in the assisted vaginal delivery group ($P<0.01$).

Within the excluded women (n=1247), a prevalence of 7.2% of UFP in spontaneous deliveries was noted (comparable to the 8.9% of our included patients), and that in assisted vaginal deliveries was 10.3% (comparable to the 12.1% in our included patient collective).

In the spontaneous delivery group, women who experienced UFP were significantly more often primiparas and had a prolonged second stage of labor >2 h significantly more often than women without UFP. In the group of women with assisted vaginal deliveries with the application of UFP, more infants had a birth weight >4 kg than in the group of women with assisted vaginal deliveries without UFP. The mean age of women in the spontaneous delivery group without the application of UFP was significantly higher than in the UFP group. However, the clinical relevance appeared to be rather low at a mean difference in age of about 6 months. Other baseline characteristics were generally comparable. Baseline characteristics are shown in Table 1.

In spontaneous deliveries (Table 2), a higher incidence of shoulder dystocia after the application of UFP was observed (1.6% vs. 0.9%, P=0.14). After adjustment for other possible risk factors, the difference became significant with an adjusted OR of 2.44 (CI 95% 1.23–4.84). UFP was significantly associated with fetal acidosis, defined as arterial umbilical pH<7.2 (31.5% vs. 15.1%, P<0.01; adj. OR 3.18 CI 95% 2.64–3.82) and arterial umbilical pH<7.1 (4.5% vs. 1.29%, P<0.01; adj. OR 4.13 CI 95% 2.68–6.46). The incidence of lower Apgar scores (5 min- and 10 min-Apgar<7) increased after the application of UFP (10′-Apgar<7: 0.8% vs. 0.3%, P=0.02; adj. OR 3.04 CI 95% 1.17–7.88; 5 min-Apgar <7: 1.2% vs. 0.6%, P=0.08, adj. OR 2.19 CI 95% 1.04–4.6) (Table 2). There was no significant difference concerning neonatal care admission rates.

Table 1: Baseline characteristics.

	Spontaneous deliveries (n=7995)			Assisted vaginal deliveries (n=1748)		
	Without UFP (n=7287)	With UFP (n=708)	P-value	Without UFP (n=1537)	With UFP (n=211)	P-value
Multiparity[a]	59% (4322)	18.2% (129)	<0.01	17.3% (266)	14.7% (31)	0.40
Previous cesarean section[a]	2.4% (178)	2.4% (17)	0.95	4.2% (65)	1.9% (4)	0.15
Induction of labor[a]	22.3% (1627)	23.9% (169)	0.37	28.6% (440)	29.4% (62)	0.88
Infant birth weight >4 kg[a]	9.2% (673)	8.3% (59)	0.46	8.8% (136)	13.7% (29)	0.03
BMI>30[a]	5.4% (397)	3.8% (27)	0.08	3.5% (54)	5.7% (12)	0.17
Age[b] (mean, SD)	28.87 (8, 22)	28.21 (7, 91)	0.04	28.75 (8, 50)	27.76 (9, 75)	0.11
Second stage of labor >2 h[a]	10.2% (746)	33.3% (236)	<0.01	56.6% (870)	58.3% (123)	0.70

Data are expressed as % (n) or mean (SD); n=number, UFP=uterine fundal pressure, SD=standard deviation.
[a]χ^2-test; women with and without the application of UFP were compared within each delivery group.
[b]Unpaired *t*-test.

Table 2: Outcomes in spontaneous deliveries with and without UFP.

		Spontaneous deliveries (n=7287)	Spontaneous deliveries with UFP (n=708)	P-value[d]	OR (95% CI)	Adjusted OR (95% CI)
Maternal	Shoulder dystocia	0.9% (66)	1.6% (11)	0.14	1.7 (0.91–3.29)	**2.44 (1.23–4.84)[a]**
	Uterine rupture	0.01 (1)	0.14% (1)	0.42	10.31 (0.64–164.94)	
	Anal sphincter tear	0.8% (57)	1.4% (10)	0.12	1.82 (0.92–3.57)	**46.25 (11.78–181.6)[b]**
	Intact perineum	52.2% (3802)	34.5% (244)	**<0.001**	0.48 (0.410–0.567)	**0.44 (0.372–0.520)[b]**
Neonatal	Umbilical arterial pH<7.2	15.1% (1097)	31.5% (223)	**<0.001**	2.62 (2.21–3.11)	**3.18 (2.64–3.82)[c]**
	Umbilical arterial pH<7.1	1.29% (94)	4.5% (32)	**<0.001**	3.66 (2.43–5.50)	**4.13 (2.68–6.46)[c]**
	5 min Apgar score<7	0.6% (46)	1.3% (9)	0.08	2.03 (0.99–4.16)	**2.19 (1.04–4.6)[c]**
	10 min Apgar score<7	0.27% (20)	0.8% (6)	**0.03**	3.14 (1.26–7.83)	**3.04 (1.17–7.9)[c]**
	Admission to neonatal care unit	2.7% (194)	2.5% (18)	0.95	0.95 (0.59–1.56)	0.97 (0.59–1.59)[c]

OR=Odds ratio, CI=confidence interval.
[a]Adjusted for infant birth weight >4 kg, BMI>30, second stage of labor >2 h, primiparity.
[b]Adjusted for shoulder dystocia, second stage of labor >2 h, infant birth weight >4 kg, primiparity.
[c]Adjusted for second stage of labor >2 h, shoulder dystocia, induction of labor.
[d]χ^2-test; women with and without the application of UFP were compared within each delivery group.
Bold values are statistically significant (p<0.05 or after adjustment).

UFP was associated with a lower chance for intact perineum in spontaneous deliveries (34.4% vs. 52.2%, P<0.01; adj. OR 0.44 CI 95% 0.37–0.52) and after multivariate analysis with a higher incidence of AST as well (1.4% vs. 0.8%, P=0.12; adj. OR 46.25 CI 95% 11.78–181.65). In assisted vaginal deliveries, UFP was associated with a higher incidence of shoulder dystocia (9.0% vs. 1.4%, P<0.01; adj. OR 6.88 CI 95% 3.50–13.53). It was also associated with fetal acidosis, defined as arterial umbilical pH<7.2 (36.0% vs. 26.8%, P<0.01; adj. OR 1.59 CI 95% 1.17–2.16) (Table 3). UFP in assisted vaginal deliveries was associated with a non-significant increase in neonatal care unit admissions (5.7% vs. 3.4%, P=0.15). There was no significant difference regarding the incidence of AST or intact perineum in assisted vaginal deliveries. In our study population, four cases of uterine rupture could be observed with 1 case of uterine rupture after the application of UFP without significant correlation.

Discussion

In a multivariate logistic regression analysis of 9743 deliveries, among these 919 deliveries with UFP, the associations of UFP with shoulder dystocia in both spontaneous (adj. OR 2.4) and assisted vaginal deliveries (adj. OR 6.9) were observed. The application of UFP was associated with adverse neonatal outcome as well: in spontaneous deliveries with umbilical arterial pH<7.10 (adj. OR 4.13), pH<7.20 (adj. OR 3.18), 5 min-Apgar<7 (adj. OR 2.19), and 10 min-Apgar<7 (adj. OR 3.04), and in assisted vaginal deliveries with fetal acidosis (pH<7.20) (adj. OR 1.59). After the application of UFP in spontaneous deliveries, more AST (adj. OR 46.25) and decreased rates of intact perineum (adj. OR 0.44) were observed.

A limitation of our study is its retrospective study design. If an intervention (e.g. UFP) is observed to have

Table 3: Outcomes in assisted vaginal deliveries with and without UFP.

		Assisted vaginal deliveries (n=1537)	Assisted vaginal deliveries with UFP (n=211)	P-value[d]	OR (95% CI)	Adjusted OR (95% CI)
Maternal	Shoulder dystocia	1.4% (21)	9.0% (19)	<**0.001**	7.14 (3.77–13.53)	**6.88 (3.50–13.53)**[a]
	Uterine rupture	0.13% (2)	0	0.57	0 (0–~)	
	Anal sphincter tear	1.4% (21)	1.4% (3)	0.80	1.04 (0.31–3.52)	0.97 (0.275–3.40)[b]
	Intact perineum	34.5% (530)	28.9% (61)	0.13	0.77 (0.564–1.059)	0.76 (0.551–1.048)[b]
Neonatal	Umbilical arterial pH<7.2	26.8% (412)	36.0% (76)	**0.01**	1.54 (1.14–2.08)	**1.59 (1.17–2.16)**[c]
	Umbilical arterial pH<7.1	2.9% (45)	5.2% (11)	0.12	1.82 (0.928–3.584)	1.88 (0.95–3.73)[c]
	5 min Apgar score <7	1.4% (21)	3.3% (7)	0.07	2.48 (1.04–5.90)	2.05 (0.826–5.1)[c]
	10 min Apgar score <7	0.52% (8)	1.9% (4)	0.08	3.69 (1.10–12.37)	3.35 (0.96–11.7)[c]
	Admission to neonatal care unit	3.4% (53)	5.7% (12)	0.16	1.69 (0.89–3.21)	1.68 (0.87–3.24)[c]

OR=Odds ratio, CI=confidence interval.

[a]Adjusted for infant birth weight >4 kg, BMI>30, second stage of labor >2 h, primiparity.

[b]Adjusted for shoulder dystocia, second stage of labor >2 h, infant birth weight >4 kg, primiparity.

[c]Adjusted for second stage of labor >2 h, shoulder dystocia, induction of labor.

[d]χ^2-test; women with and without the application of UFP were compared within each delivery group.

Bold values are statistically significant (p<0.05).

an association with an adverse outcome (e.g. shoulder dystocia or fetal acidosis), it is difficult to prove whether the intervention is the cause for the adverse outcome, or if the adverse outcome is the consequence of a pathologic situation (which calls for the previously applied intervention). Furthermore, it cannot be excluded that UFP used in a spontaneous birth replaced a vacuum or forceps delivery.

In contrast to other studies, our study design provided two important steps in order to reduce these possible biases to the minimum. First, odds ratios for the occurrence of adverse outcome were adjusted for other possible risk factors as described above. Second, spontaneous and assisted vaginal deliveries were analyzed separately. In spontaneous deliveries, UFP is used only in pathologic situations. A comparison of these deliveries with physiologic situations in unproblematic deliveries without use of UFP can produce unreliable results. To our knowledge, this study design has been used in many recent studies. However, in assisted vaginal deliveries, a pathologic situation calls for an intervention; moreover, we could analyze the treatment group (assisted vaginal delivery with UFP) compared with the reference group (assisted vaginal delivery without UFP) starting from a comparable pathologic situation. To our knowledge, there is no other study that compared assisted vaginal deliveries with and without UFP. Another limitation might be that in the clinical setting, not every UFP is performed in the same way and power.

The best scientific approach to analyze the outcome of UFP is through a prospective randomized controlled trial (RCT). This was done by Api et al. [6] who analyzed 197 women (94 women with UFP). However, this number of women might be too low for the analysis of rare adverse outcomes, such as shoulder dystocia. Furthermore, the study population was not randomized in terms of parity (36% primiparity in the UFP group and 54% in the control group).

An RCT with an adequate statistical power is unlikely to be realized as it might be ethically disputable to randomize a large number of women to the UFP group when this maneuver would most probably not be performed during an unproblematic delivery. Based on this consideration, we think that a retrospective analysis in a large study population like ours is a valid alternative for the analysis of maternal and fetal outcomes after the application of UFP. Another drawback of any non-randomized study, which analyzes a possible association of UFP with adverse perinatal outcome, is that possible advantages of UFP (e.g. prevention of emergency cesarean section or complications associated with prolonged birth) cannot be evaluated.

Nevertheless, a strength of our study is the large number of women included in a single center study with a standardized management during delivery. Our electronic database allows solid documentation of the requested information, which is filled in prospectively. Documentation is completed for every patient before discharge and supervised by the attending consultant. Hence, the database allows a reliable retrospective analysis.

Data concerning the prevalence of UFP are scarce [7]. It is assumed that UFP may be applied more often than

it is documented after a delivery as some obstetricians might fear legal problems [6]. In our institution, the use of UFP is systematically recorded resulting in prevalence rates of 8.9% and 12.1% in spontaneous and assisted vaginal deliveries, respectively, which are lower than the prevalence rate described by Moiety and Azzam (24.4%) [5]. Our data show an association of UFP with adverse neonatal outcome. In spontaneous deliveries, UFP is significantly associated with adverse neonatal outcome, such as umbilical arterial pH<7.10, pH<7.20, 5 min-Apgar <7, and 10 min-Apgar <7. This association may be explained partly by the selection bias explained below. The application of UFP was associated with fetal acidosis (pH<7.20) in assisted vaginal deliveries as well. For other neonatal outcome parameters, a similar tendency in the assisted vaginal delivery group could be observed, but may have slightly missed the level of statistical significance. In their study population of 197 women, Api et al. [6] found no difference in the arterial umbilical pH or Apgar scores; they only observed a lower pO_2 in the UFP group. Moiety and Azzam [5] did not observe a significant difference in the 5 min-Apgar scores in an analysis of 1974 deliveries with UFP. A possible explanation for the increased occurrence of fetal acidosis after the application of UFP might be a reduced oxygenation of the placenta due to the physical pressure on the uterine fundus.

UFP was associated with an increased occurrence of shoulder dystocia in both spontaneous (adj. OR 2.4) and assisted vaginal deliveries (adj. OR 6.9) after adjusting for possible confounders, such as infant birth weight >4 kg, BMI>30 kg/m^2, duration of the second stage of labor >2 h, and multiparity. Moiety and Azzam [5] did not observe an increased rate of shoulder dystocia; however assisted vaginal deliveries were not investigated and a multivariate analysis was not performed. The association of UFP with the occurrence of shoulder dystocia might be explained by the consequences of the external pressure: the fetus is pushed down through the birth canal faster, hence, the physiological way and dynamics change such that the fetus' rotation and descent through the maternal pelvis may be influenced.

Regarding perineal injuries, our study supports the hypothesis that the occurrence of AST is more frequent after the application of UFP in spontaneous deliveries. After logistic regression analysis, we were able to detect a higher incidence of AST and a lower incidence of intact perineum in the UFP group of spontaneous deliveries (after adjustment for fetal birth weight, parity, duration of second stage of labor, and shoulder dystocia). In assisted vaginal deliveries, this association was not shown, however, a non-statistical tendency to a decreased rate of intact perineum in the UFP group was observed. Moiety and Azzam [5] showed an increased risk for severe perineal lacerations in the UFP group (10.9% vs 7.2%); however, there was no definition of "severe perineal laceration" and there were more primipara women in the UFP group (91% vs. 22%). Matsuo et al. [4] showed an increased AST rate after the application of UFP. In their study, 28% (9 out of 39) of the women who delivered with UFP suffered an AST.

Sartore et al. [8] evaluated the pelvic floor function 3 months after delivery with UFP. Dyspareunia and perineal pain were significantly more frequent in women who underwent UFP. However, in the UFP group, episiotomies were performed more often (66% in deliveries with UFP vs. 25% in deliveries without UFP) and the higher incidence of dyspareunia was not adjusted for the higher episiotomy rate.

Uterine rupture occurred in 0.04% of our study population. This agrees with the published rates of uterine rupture in western countries [9]. Thus, our study size is underpowered to fully investigate the role of UFP on the occurrence of uterine rupture.

Conclusion

The possible advantages of the application of UFP cannot be evaluated. As any obstetrical intervention, UFP should only be used with prudence and upon careful clinical evaluation.

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