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The effect of Kristeller maneuver on maternal and neonatal outcome

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ABSTRACT

Objective: The use of fundal pressure in management of the second stage of labor is controversial. The aim of this study was both to evaluate the effectiveness of fundal pressure in shortening the second stage of labor and to examine the related neonatal and maternal outcomes.

Materials and Methods: Patients were randomly allocated to Kristeller maneuver (KM) intervention group (n = 145) and control group (n = 140). Umbilical artery blood gas analysis, creatinine kinase (CK), CK with myocardial specific isoform, aspartate amino transferase, alanine amino transferase, lactate dehydrogenase and lactic acid were assessed. Vaginal laceration, cervical laceration, length of episiotomy and vagina before and after delivery and duration of the second stage of labor in minutes were recorded. Neonatal information included: Infant birth weight, Apgar scores, babies requiring pediatric help, and admission to neonatal intensive care units (NICU) were examined.

Results: KM leads to elongation of episiotomy incision. Vaginal lacerations were similar between control and intervention groups; however the cervical laceration rate was higher in intervention group. Gestational week, Apgar scores, birth weight, NICU admission, babies requiring pediatrician help or healthy babies were not different between the two groups.

Conclusions: The possibility of lacerations to the perineum and cervix is increased by using KM. On the other hand, fundal pressure seems safe for the fetus.

Key words: *Kristeller maneuver, neonatal outcome, obstetrical outcome, perineal laceration, second stage of labor*

Introduction

Fundal pressure during the second stage of a vaginal delivery is known as the “Kristeller maneuver” (KM). This maneuver has been described as the application of manual pressure to the uppermost part of the uterus towards the birth canal in an attempt to shorten the second stage of labor [1]. In the literature, indications of this maneuver are listed as; fetal distress, failure to progress in the second stage of labor and/or maternal exhaustion or medical conditions [2].

Although the studies in the literature have not demonstrated any risk associated with the use of fundal pressure, fetal bradycardia and fetal hypoxia might be seen as a result of increased intracranial pressure associated to the use of mechanical force [3]. Additionally, there are other reports of KM complications, including perineal lacerations, uterine rupture, uterine inversion, and morbid outcomes, both maternal (abdominal bruising and pain, hypotension, respiratory distress, liver rupture, and fractured ribs) and fetal (neurologic and orthopedic, non-reassuring fetal heart tracing secondary to head compression, fetal hypoxemia and

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asphyxia, and intracranial hemorrhages), that have occurred in association with fundal pressure [4]. In fetal macrosomia cases, the risks of shoulder dystocia associated with orthopedic and neurologic injuries may be even greater following KM [5].

The use of KM may be controversial because of the absence of definitive data about safety and role of fundal pressure. Currently, it is still commonly used; however the literature has not demonstrated any benefits and KM may lead to potential complications.

The aims of this study were both to evaluate the effectiveness of fundal pressure in shortening the second stage of labor and to examine the related neonatal and maternal outcomes.

Materials and Methods

A prospective, randomized, controlled trial was conducted between 25-07-2012 and 01-03-2013 at Kayseri Education and Training Hospital of Medicine. The study protocol was approved by the Ethics Committee (No: 2012/307). All patients examined agreed to participate in the present study, and a written informed consent form (ICF) was obtained from each patient. All participants were between 37 and 40 weeks of gestation with singleton cephalic presentation and none had any medical or obstetrical problems. Neither epidural nor combined spinal epidural analgesia was used. The sample size was calculated by using the results of Api et al. [2]. In this calculation, the sample size was found to be 260 in total, being 130 women per each group using $\alpha = 0.05$ and the power (90%). PASS 11 (NCSS, LLC, Kaysville, Utah, USA) software was used for the calculation.

Because of expected dropouts from the study (such as caesarean section, data loss and ineligibility for inclusion), we decided to include 350 deliveries. At the end of 6 months we were able to study 386 volunteers. Out of a total of 386 deliveries, 82 were excluded before the second stage due to cesarean section (21.2%), 9 declined to participate in the study. As a result of inadequate sample collection, 4 volunteers in the control group and 2 volunteers in the intervention group were excluded from the study. Because of blood clotting, 2 volunteers in the study and 2 volunteers in the control group were excluded from study. The remaining 285 women were randomly allocated to two groups: KM intervention (study) group (n = 145) and control group (n = 140) by using a computer-generated random number chart (SPSS Version 20.0 for Windows, Inc., Chicago, USA). In all consecutive patients, numbers were written on envelopes, while the allocation data were entered on separate papers that were put into the numbered envelopes which were then sealed. When the patient was admitted to the delivery ward and met the inclusion criteria, she signed the ICF and was given her participation number. When the patient had reached the second stage, the envelope with the participation number on its cover was opened to reveal the randomization and the obstetrician was informed whether fundal pressure was to be applied or not. Pregnant women who required oxytocin augmentation, multiple gestations, pregnancy with medical problems (such as asthma, thyroid, cardiac, liver, kidney disease, preeclampsia and diabetes), pregnancy with previous caesarean and pregnancy with estimated fetal weight <2500 g or >4000 g were not included into the study (Figure 1).

Data collected from delivery records included: Patient's age, gravidity, parity, height (cm), pre-pregnancy weight (kg), pre-pregnancy body mass index (BMI, kg/m2), patient's body weight and BMI at the time of delivery, and body weight change during pregnancy, as part of the ante-partum information collection. For the intra-partum information, patient's vaginal laceration, cervical laceration, length of episiotomy, length of vagina before and after delivery and duration of the second stage of labor in minutes were recorded. Neonatal information included: Infant birth weight, Apgar scores, requirement for pediatric help, and admission to neonatal intensive care units (NICU).

To control other confounding factors that could affect second stage of labor, the study was conducted only during daylight hours by the same obstetrician and fundal pressure was applied by the same obstetric staff. The second stage was defined as the time between full cervical dilation together with the spontaneous urge to push and the expulsion of the fetus. Cervical examination frequency was increased (every 15 min) after the cervix reached 9 cm dilatation. If the woman felt a strong urge to push down, the examination was performed earlier. We tried to precisely estimate the starting point of the

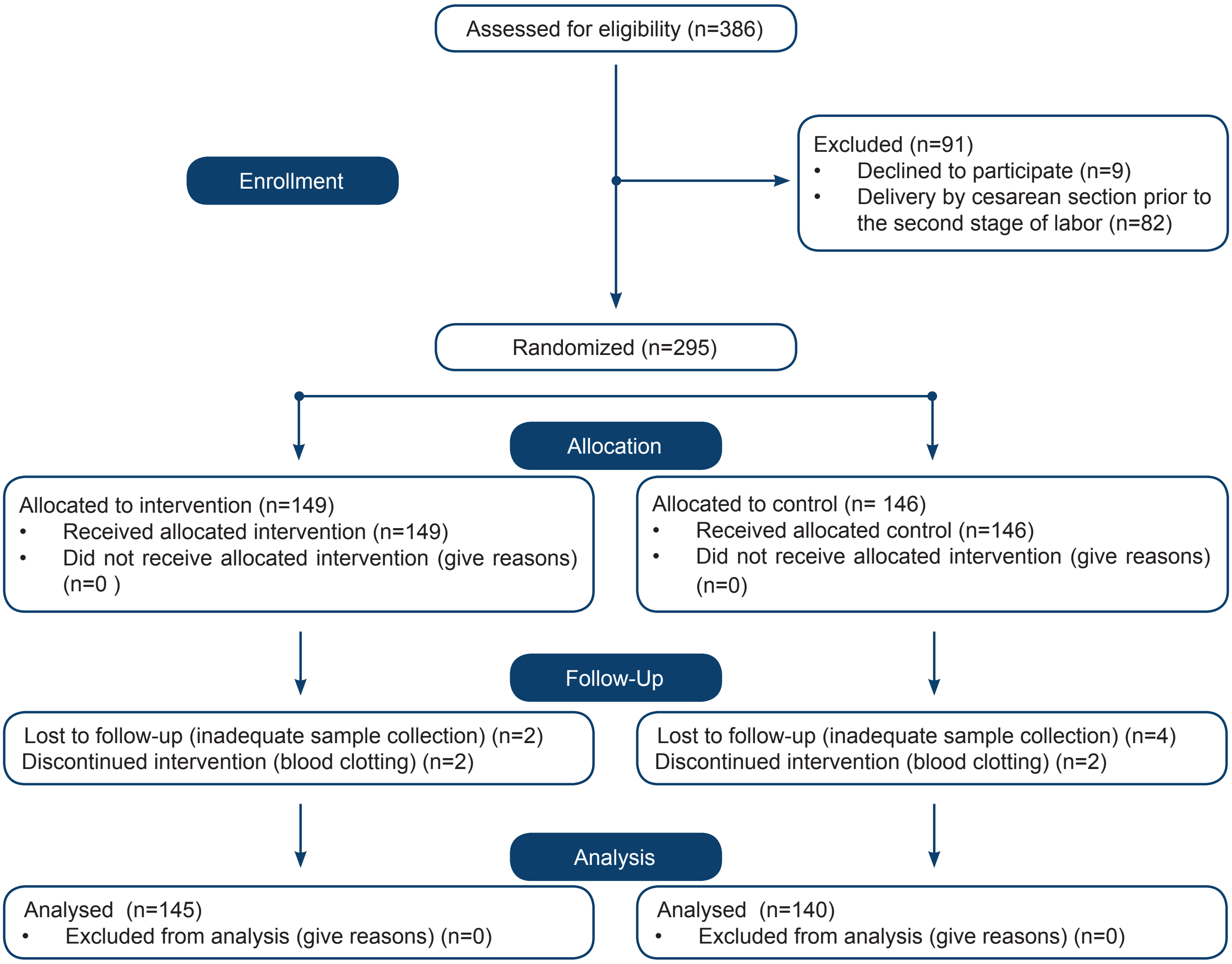

Figure 1. CONSORT 2010 flow diagram

second stage by frequent examination.

In our clinic, mediolateral episiotomy is preferred and applied commonly if necessary. The incision is initiated at the fourchette and the scar angle should be 45° from the midline to minimize the occurrence of sphincter injury. Length of episiotomy and length of vagina were measured at 45° from the midline, before and after delivery, by using a hysterometer (Vagina: Distance between caruncle hymenalis and posterior fornix. Episiotomy: Distance between caruncle hymenalis and apex of the vaginal laceration). Vaginal and cervical lacerations were recorded and elongation of episiotomy was calculated.

Umbilical artery blood gas was sampled immediately following delivery. After double-clamping the umbilical cord (15-20 cm), umbilical artery blood gas was obtained using a pre-heparinized syringe Radiometer Pico 50 (Radiometer Medical APS, Bronshoj, Denmark) to assess the newborn's acid-base status. Measurements were analyzed immediately using the Radiometer ABL basic 800 blood gas analyzer (Radiometer Medical APS, Bronshoj, Denmark). Umbilical artery pH, HCO3, base excess, PO2, PCO2 values, glucose and calcium (Ca) were measured.

The umbilical artery levels of creatinine kinase (CK), CK with myocardial specific isoform (CK-MB), aspartate amino transferase (AST), alanine amino transferase (ALT), lactate dehydrogenase (LDH) and lactic acid (LA) were measured and served to rule out perinatal stress, confirming the diagnoses of perinatal asphyxia, muscular damage, fetal acidosis and myocardial damage.

Statistical Analysis

Shapiro–Wilk's test was used; histograms and q-q plots were also assessed to test data normality. For comparisons, either two-sided independent sample t-test or

Mann–Whitney U-test was used for continuous variables and Chi-square analysis were used for categorical variables. Values were expressed n (%), mean ± standard deviation (SD) or median (25-75th percentiles). All analysis were performed using IBM SPSS Statistics 20.0 (SPSS IBM, Inc. Chicago, IL, USA), considering a $P < 0.05$ statistically significant.

Results

Table 1 summarizes age, parity, gestational week, BMI, Apgar scores, birth weight and neonatal status of the groups. BMI (before pregnancy), gestational week, Apgar scores, birth weight, NICU admission, babies requiring pediatrician help or healthy babies were not different between the two groups. The study group was 2.02 years younger than the control group. High BMI was detected in the control group during admission for delivery. 56.6% of the study group and 30% of control group were nulliparous.

In Table 2, blood gas analysis, LA, CK, CK-MB, AST, ALT, and LDH levels of the groups were com-

Table 1. Comparison of age, parity, gestational week, BMI, Apgar scores, birth weight and neonatal status between intervention and control groups.

Variables	Groups		*P*
	Control (*n*=140)	Study (*n*=145)	
Age (years)	26.10±5.20	24.08±5.54	0.002
Parity (nulliparous/multiparaus)	42 (30.0)/98 (70.0)	82 (56.6)/63 (43.4)	<0.001
Gestational weeks	39.00 (38.00-40.00)	39.00 (38.00-40.00)	0.300
BMI in 37-40th weeks of pregnancy (kg/m²)	28.37±4.28	27.48±3.89	0.068
BMI before pregnancy (kg/m²)	28.33±4.26	27.38±3.85	0.049
Birth weight (kg)	3.25±0.36	3.26±0.36	0.805
Apgar score (1 min)	8.00 (8.00-8.00)	8.00 (8.00-8.00)	0.989
Apgar score (5 min)	10.00 (10.00-10.00)	10.00 (10.00-10.00)	0.145
NICU admission (yes/no)	3 (2.1)/137 (97.9)	5 (3.4)/140 (96.6)	0.723
Babies requiring pediatrician help (yes/no)	11 (7.9)/129 (92.1)	8 (5.5)/137 (94.5)	0.429
Healthy babies (yes/no)	126 (90.0)/14 (10.0)	132 (91.0)/13 (9.0)	0.766

Values are expressed as *n* (%), mean±SD or median (25-75th percentiles). BMI: Body mass index, NICU: Neonatal intensive care units, SD: Standard deviation

Table 2. Comparison of blood gas analyses, LA, CK, CK-MB, AST, ALT, and LDH levels between two groups.

Variables	Groups		*P*
	Control (*n*=140)	Study (*n*=145)	
pH	7.37±0.06	7.34±0.08	0.002
PCO_2	39.34±7.62	41.42±9.55	0.044
PO_2	23.14±5.52	21.88±5.87	0.064
Ca (mg/dL)	1.31 (1.28-1.32)	1.31 (1.29-1.34)	0.021
Glucose (mg/dL)	93.00 (78.50-108.00)	99.00 (88.00-115.00)	0.002
Lactic acid	2.89±1.03	3.43±1.28	<0.001
HCO_3	21.08±1.85	20.38±3.26	0.026
Base excess	−1.67±2.85	−3.06±4.04	0.001
AST (U/L)	28.00 (24.00-35.50)	29.00 (25.00-35.00)	0.377
ALT (U/L)	11.00 (9.00-15.00)	12.00 (8.00-15.00)	0.678
Total CK (ng/mL)	193.50 (130.50-258.00)	206.00 (153.00-322.00)	0.059
CK-MB (ng/mL)	26.00 (19.00-33.00)	24.00 (17.00-34.00)	0.117
LDH (U/L)	330.00 (280.50-389.50)	324.00 (288.00-386.00)	0.774

Values are expressed mean±SD or median (25-75th percentiles). LA: Lactic acid, CK: Creatinine kinase, CK-MB: Creatinine kinase with myocardial specific isoform, AST: Aspartate amino transferase, ALT: Alanine amino transferase, LDH: Lactate dehydrogenase, SD: Standard deviation pared. LA, Ca, glucose, PCO2 levels were higher and HCO3, PO2, pH and base excess were lower in study group. There was no significant difference in CK, CK-MB, AST, ALT, and LDH levels between control and study groups.

Comparisons of episiotomy length, vaginal length, duration of the second stage of labor between control and intervention groups before and after delivery are shown in Table 3. Duration of the second stage of labor, length of vagina before delivery and the length of episiotomy before delivery were not different between two groups; however, episiotomy length was elongated in the intervention group after delivery. Although vaginal lacerations were similar between control and intervention group, the cervical laceration rate was high in intervention group.

Duration of the second stage of labor, length of vagina and episiotomy before delivery, length of vagina and episiotomy after delivery, rate of vaginal and cervical laceration were not significantly different between nulliparous and multiparous (Table 4).

Discussion

The purpose of this article was to give an overview of the perinatal effects of KM to determine if the use of fundal pressure has a role in the contemporary management of the second stage of labor. We performed this study with a view to giving our fetal and maternal outcomes. This study is the first to evaluate the effects of fundal pressure by comparing nulliparous and multiparous patients. The rates of episiotomy were higher in the nulliparous group, as was the laceration diameter. Moreover, a systematic review revealed that the

Table 3. Comparison of episiotomy length, vaginal length, duration of second stage of labor between control and intervention group before and after delivery.

Variables	Groups		*P*
	Control (*n*=140)	Study (*n*=145)	
Duration of second stage of labor	10.00 (5.00-21.00)	10.00 (6.00-15.00)	0.373
Length of vagina before delivery	7.00 (6.00-8.00)	7.00 (6.00-8.00)	0.106
Length of vagina after delivery	8.00 (8.00-9.00)	8.00 (8.00-9.00)	0.290
Difference between the two measurements	1.00 (1.00-2.00)	1.00 (1.00-2.00)	0.760
Length of episiotomy before delivery	3.00 (2.00-4.00)	3.00 (3.00-4.00)	0.116
Length of episiotomy after delivery	4.00 (3.00-4.63)	5.00 (3.00-6.00)	0.002
Difference between the two measurements	0.00 (0.00-1.00)	1.00 (0.00-2.00)	0.001
Cervical laceration (yes/no)	2 (1.4)/138 (98.6)	10 (6.9)/135 (93.1)	0.022
Vaginal laceration (yes/no)	23 (16.4)/117 (83.6)	29 (20.0)/116 (80.0)	0.435
Episiotomy (yes/no)	75 (53.6)/65 (46.4)	107 (73.8)/38 (26.2)	<0.001

Values are expressed *n* (%), mean±SD or median (25-75th percentiles). SD: Standard deviation

Table 4. Comparison between nulliparous and multiparous volunteers for length of episiotomy, length of vagina, duration of second stage of labor, in study group.

Variables	Parity		*P*
	Nulliparaus (*n*=82)	Multiparaus (*n*=63)	
Duration of second stage of labor	14.50 (6.00-20.00)	10.00 (5.30-15.00)	0.051
Length of vagina before delivery	7.00 (6.00-8.00)	7.00 (7.00-8.00)	0.306
Length of vagina after delivery	8.00 (8.00-9.00)	8.00 (8.00-9.00)	0.704
Difference between the two measurements	2.00 (1.00-2.00)	1.00 (1.00-1.00)	0.048
Length of episiotomy before delivery	3.00 (3.00-4.00)	3.00 (2.81-4.00)	0.252
Length of episiotomy after delivery	5.00 (3.00-6.00)	3.25 (3.00-5.00)	0.070
Difference between the two measurements	1.00 (0.00-2.00)	0.00 (0.00-1.75)	0.051
Cervical laceration (yes/no)	8 (9.8)/74 (90.2)	2 (3.2)/61 (96.8)	0.187
Vaginal laceration (yes/no)	18 (22.0)/64 (78.0)	11 (17.5)/52 (82.5)	0.503
Episiotomy (yes/no)	81 (98.8)/1 (1.2)	26 (41.3)/37 (58.7)	<0.001

Values are expressed *n* (%), mean±SD or median (25-75th percentiles). SD: Standard deviation evidence does not support maternal benefits traditionally ascribed to routine episiotomy [6]. Indeed, in that review, routine episiotomy increased the severity of perineal lacerations, produced more perineal pain, and caused more discomfort with intercourse in the period after pregnancy. Unfortunately, there are no studies comparing fundal pressure with episiotomy lengths and rates. The nulliparous patients were higher in the study group. Therefore episiotomy rates were higher in that group.

In the literature, the authors concluded that the use of uterine fundal pressure during the second stage of labor increased the risk of severe perineal laceration, defined as a third- or fourth-degree perineal tear [7].

Matsuo et al. described that the risk of severe perineal laceration was 28.1% in the group that received fundal pressure versus 3.7% in the non-fundal pressure group (odds ratio 7.81 [95% confidence interval 3.33-18.3] and $P \leq 0.001$). Our results are in agreement with the literature. Elongation of episiotomy and increased cervical laceration rate were significantly higher in the KM intervention group. However, the vaginal laceration rate was not different between the two groups [7].

When we compared the baseline characteristics of control and study groups, there was no statistically significant difference between the groups. Infant birth weight, Apgar scores, babies requiring pediatric help, and admission to NICU were similar, so neonatal outcomes were not different. Although KM has vagal stimulus effects, this finding of increased intrauterine pressure was not correlated with delivery outcome or adverse neonatal outcomes. These findings were similar to the short-term neonatal outcomes in the literature [3,8].

Api et al. [2] firstly evaluated the cord blood pH, HCO3, and the base excess values in patients to whom KM was applied and these parameters were found to be similar when compared with controls. But, according to our results, a lower mean cord blood pH, a lower mean PO2 and higher mean PCO2 were found in the study group as compared to the control group. However the values were within the normal range. Lower mean PO2 and higher mean PCO2 might be caused by umbilical cord compression or functional alterations in the placental intervillous space, increasing risk of fetal hypoxemia and asphyxia [9]. Additionally, our study is the first to evaluate the relationship between fundal pressure and cardiac parameters of the fetus. Cardiac parameters were similar and within normal values between the groups.

There were additional factors that affected lacerations such as primiparity, length of labor, episiotomy and vacuum extraction. In our study, the study group had an increased ratio of episiotomy usage. One way to interpret the present findings is to conclude that episiotomy may have protective effects on vaginal laceration, but this protective effect cannot be shown for cervical lacerations. Also this was the first and the only study in the literature to evaluate the laceration diameters, and it was higher in KM group as compared to control.

This study has some limitations, as it is difficult to estimate accurately the start of the second stage. To avoid making a mistake, we examined the women frequently after 9 cm dilatation. The commencement of spontaneous pushing is not easy to define. There are such maternal and fetal complications of KM as uterine rupture, fetal neurologic and orthopedic morbid outcomes. Although there are conflicting data about complications of KM, we did not detect any complication in this study. In certain circumstances such as in fetal macrosomia, the risks associated with fundal pressure may be even greater. In these conditions, we did not choose the labor, and these patients underwent a cesarean section.

Conclusion

In conclusion, the role of fundal pressure is understudied and remains controversial in management of the second stage of labor. Our study showed that the laceration possibility to the perineum and cervix is increased by using KM. On the other hand fundal pressure seems safe for fetus.

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Conflict of interest statement

The authors have no conflicts of interest to declare.

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