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ORIGINAL ARTICLE

Advanced age is a risk factor for higher grade perineal lacerations during delivery in nulliparous women

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Abstract
Purpose To identify risk factors for the development of severe perineal lacerations and to give recommendations for their prevention in nulliparous women.
Methods A retrospective case–control analysis of deliveries at our University Hospital was performed. Multiparae, Caesarean sections, twin pregnancies, fetal breech position and preterm deliveries were excluded. Univariate and multivariate step forward regression analyses were performed; correlations between contributors were further analyzed by Spearman Rank Correlation. Differences between the degree of lacerations and maternal age were further analyzed with Friedman ANOVA followed by Dunn's Multiple Comparison Test.
Results A total of 2,967 deliveries fitted our inclusion criteria, 50 (1.7%) mothers had higher-grade lacerations. Mediolateral and median episiotomy, advanced maternal age, vaginal operative delivery, higher fetal birth weight and abnormal cephalic presentation were associated with severe lacerations.
Conclusions Advanced maternal age plays an important role in the development of anal sphincter tears in nulliparous women. Episiotomy and operative vaginal deliveries should be restrictively performed when possible. To identify further preventive approaches in patients with accumulated risk factors prospective randomized studies are needed.

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Introduction

Severe lacerations of the perineum with involvement of the anal sphincter or even the rectal mucosa occur in up to 8% of vaginal deliveries [1–3]. These forms of birth-related trauma to the perineum have been associated with long-term maternal morbidity, such as the development of dyspareunia, reduced sexual activity, chronic flatal and fecal incontinence, anorectal abscess and rectovaginal fistula [4, 5].

Several risk factors have been established for the development of severe—type 3 and 4—perineal injuries, such as midline episiotomy, fundal pressure, upright delivery postures, prolonged second stage of labor, vaginal operative procedures and fetal macrosomia [6]. However, nulliparity has been identified as the main risk factor.

In recent years, the parturient's age at first delivery has significantly increased, whereas the number of children per woman has decreased in developed countries [7] with a dramatic increase of the rate of Caesarean sections [8, 9]. Furthermore, the percentage of pregnancies affected by gestational diabetes rises steadily, with an increasing proportion of large for gestational age babies born. The latter is also explained by a reduction of maternal smoking [10] and a concurrent increase in maternal body mass index, which is regarded as an independent risk factor for large for gestational age babies [11]. Thus, the average birth weight has significantly increased over the years [12, 13], which itself is regarded as an increased health risk for neonates and mothers at delivery [10].

The aim of the study was to identify maternal and newborn characteristics having an impact on the rate of higher grade perineal lacerations in nulliparous women.

Materials and methods

Our University Hospital serves as a reference centre for an area of about 4 million inhabitants in Northern Germany with a predominant Caucasian population. For this retrospective case–control analysis all data of deliveries between January 1st, 2000 and October 14th, 2008 were evaluated. All data were extracted from our commercial birth documentation program (PIA Fetal Database, GE, USA).

Prior to the analysis multiparae, patients with Caesarean sections, twin pregnancies, fetal breech positions and preterm deliveries (<37 weeks of gestation) were excluded. In addition, two cases with incomplete data were excluded (Fig. 1).

For the remaining 2,967 deliveries, aspects potentially associated with incomplete and complete anal sphincter injuries during vaginal delivery were analyzed.

With respect to the impact on maternal health, lacerations were grouped for the analysis into three categories [none, mild (I°–II°), severe (III°–IV°)].

Statistics

All variables were checked for normal distribution in the Kolmogorov–Smirnov one-sample test for goodness-of-fit.

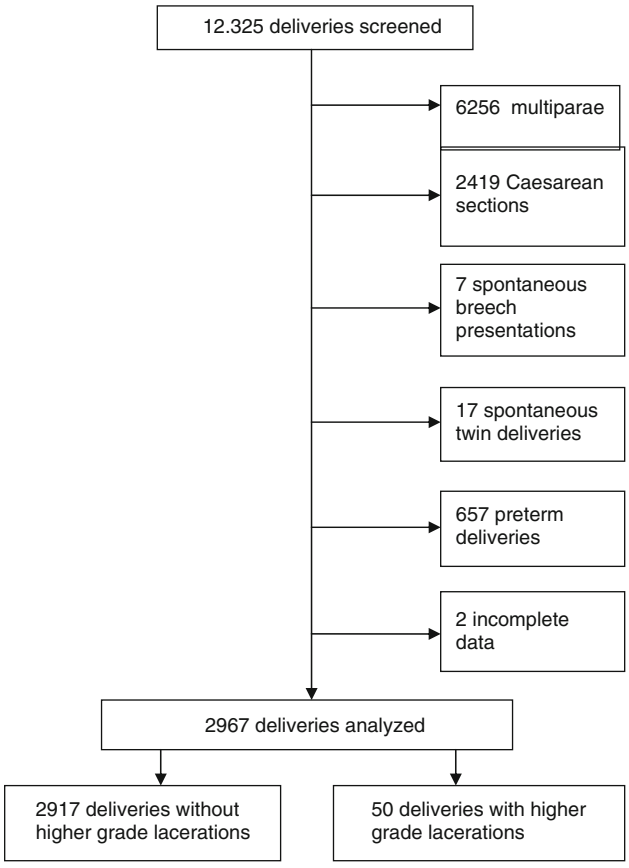

Fig. 1 Screening results

A multivariate step forward regression analysis was performed for identification of significant risk factors. The following factors at delivery were put into the equation: maternal height (cm), maternal weight (kg), maternal body mass index (kg/m^2), maternal age (years), fetal length (cm), fetal weight (g), fetal head circumference (cm), fetal sex (male, female), fetal pH after delivery, induction of labor (yes/no), cervical ripening by prostaglandins (yes/no), episiotomy (no, median, mediolateral), mode of delivery (spontaneous, forceps, vacuum extraction) and fetal presentation (regular cephalic presentation, irregular cephalic presentation). Correlations between identified significant contributors in the regression analysis were further analyzed by Spearman Rank Correlation as most of the factors were not Gaussian distributed. Differences between the degree of lacerations and female age and fetal birth weight were further analyzed with Friedman ANOVA for repeated measurements followed by Dunn's Multiple Comparison Test Regression analysis. Chi-square test, correlations and ANOVA were done by SigmaStat (SPSS Incorporated, Version 2.03). Relative risks were calculated by Review Manager (The Cochrane Collaboration, Version 5.0.17, 2008). A univariate analysis of crude data identified as significant contributors involved in the degree of lacerations by multiple step forward regression analysis was additionally performed. Dichotomous data were evaluated by Chi-square for overall significance. Relative risks were calculated for comparisons of dichotomous parameters in relation to proportions of patients without any laceration.

Results

Of the 12,325 deliveries documented in our birth documentation program, 2,967 (24.1%) fulfilled the inclusion criteria (Fig. 1). Of these 2,967 deliveries, 50 (1.7%) mothers had higher-grade lacerations (III°–IV°), 5 of whom had 4th degree injuries. Of the remaining 2,917 deliveries 237 had II° and 257 had I° lacerations. In 1,835 patients an episiotomy was performed.

Univariate analysis of crude data identified episiotomy, maternal age, fetal presentation and mode of delivery as significant contributors in the onset of perineal lacerations (Table 1). However, fetal birth weight and the number of previous pregnancies were additionally identified as significant contributors in a multivariate analysis and therefore presented as well in Table 1.

Multivariate, non linear step forward regression analysis thus identified six significant factors which where involved in the degree of lacerations (Table 2). Episiotomy was identified as the most significant risk factor. A total of 212 median episiotomies (7.1%) and 1,623 mediolateral episiotomies (54.7%) were performed while the remaining

Table 1 Univariate analysis of crude data identified as significant contributors involved in the degree of lacerations by multiple step forward regression analysis

Variable	No lacerations (n = 2,423)	I–II° lacerations (n = 494)	III–IV° lacerations (n = 50)	Overall P
Episiotomy	None 29.0%	None 85.2 %	None 10.0%	<0.001
	Mediolateral[a] 63.3%	Mediolateral[a] 10.2% RR = 0.08 (0.06–0.11)	Mediolateral[a] 86.0% RR = 3.86 (1.54–9.7)	
	Median[a] 7.7%	Median[a] 4.6% RR = 0.29 (0.20–0.43)	Median[a] 4.0% RR = 5.65 (1.12–23.38)	
Maternal age	27.2 (17.9–36.9)	28.2 (19.1–36.6)	29.3 (19.3–36.9)	<0.001a,b
Fetal birth weight	3,385 (2,650–4,128)	3,401 (2,748–4,092)	3,528 (2,678–4282)	0.068
Fetal presentation	Regular 98.4%	Regular 98.6%	Regular 92.0%	0.002
	Irregular 1.6%	Irregular 1.4% RR = 0.90 (0.45–1.78)	Irregular 8.0% RR = 4.91 (1.85–13.04)	
Gravidity	I Gravidity 83%	I Gravidity 83%	I Gravidity 90%	0.324
	II Gravidity 15%	II Gravidity 14% RR = 0.91 (0.71–1.15)	II Gravidity 10% RR = 0.61 (0.24–1.53)	
	>II Gravidity 2%	>II Gravidity 3% RR = 1.32 (0.85–2.05)	>II Gravidity 0% RR = 0.40 (0.03–6.42)	
Mode of delivery	Spontaneous 91.4%	Spontaneous 95.8%	Spontaneous 76.0%	<0.001
	Forceps 4.0%	Forceps 2.0% RR = 0.53 (0.29–0.96)	Forceps 14.0% RR = 3.99 (1.83–8.72)	
	Vacuum extraction 4.6%	Vacuum extraction 2.0% RR = 0.47 (0.26–0.85)	Vacuum extraction 10.0% RR = 2.56 (1.03–6.37)	

Continuous data are given as mean and 95% confidence intervals. Letters indicate significant differences ($P < 0.05$) between the groups (a indicates group I vs. group II, b indicates group I vs. group III). Dichotomous data were evaluated by Chi-square for overall significance. Relative risks (RR) were calculated for comparisons of dichotomous parameters in relation to proportions of group I. Parametric values are given as mean and range. Relative risks are presented with 95% confidence intervals

[a] Episiotomy and additional laceration

patients received no episiotomy, as episiotomies are not routinely performed in our hospital. An episiotomy is usually considered as a second degree laceration. Therefore, patients were categorized into group 1 if they did not suffer from additional or aggravated perineal lacerations apart from episiotomy.

Higher grade lacerations were observed in 2 of 212 women (0.9%) with median episiotomies and in 43 of 1,623 women (2.6%) with mediolateral episiotomies, while only five severe lacerations were observed in the 1,130 (0.4%) women without any episiotomy.

After episiotomy maternal age was identified as the second most important risk factor for severe perineal lacerations and automatically added at the second step (Table 2).

Table 2 Significant contributors involved in the degree of lacerations identified by multiple step forward regression analysis

Step no.	Variable	R	R^2	P
Step 1	Episiotomy	0.315	0.100	<0.001
Step 2	Maternal age	0.329	0.108	<0.001
Step 3	Fetal birth weight	0.334	0.111	<0.001
Step 4	Fetal presentation	0.338	0.114	0.003
Step 5	Gravidity	0.341	0.116	0.014
Step 6	Mode of delivery	0.343	0.118	0.037

R correlation coefficient, R^2 square of the correlation coefficient, P P-value

Maternal age was significantly higher in patients with higher degree laceration ($29.29y \pm 4.59y$) compared to women with mild laceration ($28.20y \pm 5.30y$) or women without a laceration ($27.23y \pm 5.77y$) ($P < 0.05$) (Fig. 2).

As expected, fetal birth weight was significantly involved in the risk of perineal lacerations according to our multivariate regression analysis. Fetal birth weight in patients with higher grade lacerations was 3528.10 ± 439.87 g compared to 3401.55 ± 418.86 g in the women with mild laceration whereas women without perineal

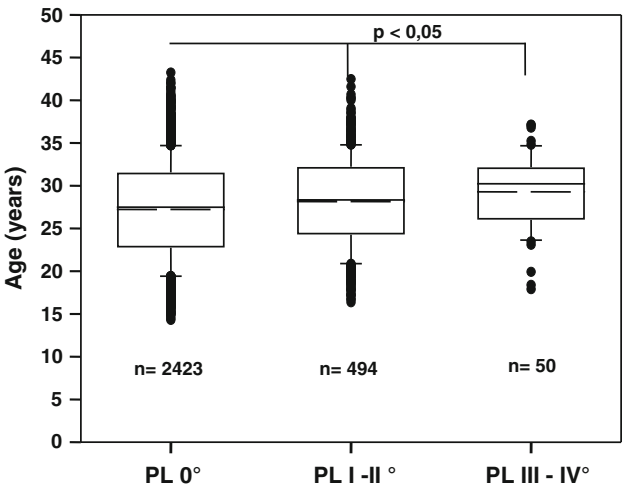

Fig. 2 Association of perineal lacerations (*PL*) with maternal age

Table 3 Analysis of cross correlations between the significant contributors involved in the degree of lacerations as identified by former regression analysis

	Maternal age	Fetal birth weight (g)	Fetal presentation	Gravidity	Mode of delivery
Episiotomy	$R = 0.068$	$R = 0.103$	$R = 0.065$	$R = -0.041$	$R = 0.210$
	$P < 0.001$	$P < 0.001$	$P < 0.001$	$P < 0.027$	$P < 0.001$
Maternal Age		$R = 0.061$	$R = -0.006$	$R = 0.085$	$R = 0.064$
		$P < 0.001$	$P = 0.763$	$P < 0.001$	$P = 0.001$
Fetal birth weight (g)			$R = -0.025$	$R = 0.005$	$R = 0.025$
			$P = 0.182$	$P = 0.798$	$P = 0.175$
Fetal presentation				$R = -0.016$	$R = 0.066$
				$P = 0.388$	$P < 0.001$
Gravidity					$R = -0.034$
					$P = 0.062$

R correlation coefficient, *P* *P*-value

laceration had an average fetal birth weight of 3385.68 ± 452.89 g (Table 1).

The distribution of fetal presentation was as follows: in patients with higher grade lacerations an abnormal cephalic presentation (occipito-posterior position) was seen in 4 of 50 (8.0%) patients. In patients with mild lacerations, the occipito-posterior position was detected in 7 of 494 patients (1.4%) whereas it was seen in 39 of 2,423 (1.6%) patients in women without perineal lacerations.

Patients with higher grade lacerations had a mean number of 1.1 ± 0.30 pregnancies. Patients with mild lacerations were 1.21 ± 0.49 times pregnant and the mean number of all gestations of patients without lacerations was 1.21 ± 0.51.

Vaginal operative deliveries were identified as a significant risk factor. A total of 37 children of the 50 (74.0%) patients with higher grade lacerations were delivered spontaneously, 7 (14.0%) by forceps and in 5 (10.0%) cases a vacuum extraction was performed. In patients with mild lacerations, spontaneous deliveries were seen in 474 of 494 (96.0%) patients, forceps in 10 (2.0%) and vacuum extractions in 10 (2.0%) cases. Patients without a laceration were delivered spontaneously in 2,215 of 2,423 (91.4%) cases, 97 (4.0%) by forceps and in 111 (4.6%) cases by vacuum extraction.

Significant contributors involved in the degree of lacerations were closely related to each other in an additional correlation analysis (Table 3). All factors involved in the regression analysis were also significantly cross-correlated with "episiotomy." As it can be seen "maternal age" was significantly cross-correlated with "episiotomy", "fetal birth weight", "gravidity" and "mode of delivery". "Fetal birth weight" was significantly cross-correlated with "episiotomy", "maternal age" etc. (Table 3).

Other aspects of delivery (umbilical pH, APGAR values, etc) were not found to contribute significantly to severe perineal lacerations in our setting.

Discussion

Vaginal births can be accompanied by trauma to the genital tract due to spontaneous obstetric lacerations, episiotomy or a combination of both. The incidence of anal incontinence is described to be increased in cases with lacerations of the anal sphincter [14]. As mentioned before, factors such as episiotomy, higher fetal birth-weight, abnormal cephalic fetal presentation or vaginal operative delivery are independent risks for severe perineal lacerations [15, 16]. Our results support these findings.

In our institution, a median episiotomy is only considered under specific circumstances such as sufficient perineal length, and, e.g., performed when indicated in patients suffering from preexisting dyspareunia. As thus a selection bias cannot be completely excluded we decided to group both types of episiotomy together instead of differentiating between the two forms.

According to our inclusion criteria none of the patients had given birth before. In our analysis a smaller number of previous, unsuccessful pregnancies are identified as a risk factor for higher grade injuries of the perineum.

According to our multiple step forward regression analysis, maternal age is a stronger risk factor for high grade perineal lacerations than the number of unsuccessful previous pregnancies. As there is usually a positive correlation between the mother's age and her number of previous pregnancies the identification of a smaller number of previous pregnancies as a risk factor for higher grade laceration is not obvious. Further studies are necessary to find possible reasons for this apparent paradox.

Our results suggest furthermore that factors that can be directly influenced by the obstetrician, such as episiotomy and vaginal operative deliveries, are significantly related to higher grade lacerations. Although they cannot always be avoided, they—especially episiotomy—should only be

performed restrictively in nulliparous women according to our results.

Our study has some limitations: In addition to its retrospective approach, we were not able to define multiple *major* risk factors in our sample with a low rate of severe perineal injuries. The described effects were in its majority rather small and reached statistical significance mainly due to the fact that a large number of pregnancies had been analyzed. We were therefore not able to define clear cut-offs for risks factors such as maternal age and fetal weight.

Special attention in the management patterns of spontaneous deliveries has to be laid on factors that can usually not be influenced directly, e.g., maternal age. According to our retrospective data both increased maternal age and fetal birth weight are independent risk factors for the development of higher grade lacerations. It remains speculative to assume that a hypothetically decreased elasticity of the perineum might be the reason for the significantly higher rate of anal sphincter injuries in older nulliparous patients. Nulliparity itself in women with advanced age is associated with a higher rate of antepartal, intrapartal and neonatal complications [17]. Furthermore, nulliparous women with advanced age (>35 years) tend to have a higher level of concern about their infants' vulnerability during labor [17]. However, to the best of our knowledge, no publications exist about possible differences in the compliance during delivery of nulliparous patients comparing women with advanced age and younger women. Other authors [18] even defined maternal age >32 years as risk factor for obstetric complications in nulliparous women.

The establishment of advanced maternal age as risk factor for severe perineal injuries is one of the major results of our study in a large cohort of nulliparous women.

In any case, with an increasing maternal age at first delivery, the decreased number of children per female [7] and the significant increase of fetal birth weight [5] several risk factors for severe perineal lacerations are accumulated in Western societies. Therefore, the prevention of high-grade perineal injuries in older nulliparous women should receive special attention in the future. One way might be the realization of prospective randomized studies to elucidate whether an earlier induction of labor, e.g., after 38 completed weeks of gestation, is associated with a decrease of high-grade lacerations due to a lower fetal birth weight in patients with an increased risk for severe perineal injuries. Such studies will have to respect maternal factors predicting a favorable outcome of induction [19], and monitor especially side-effects, e.g., possible influences on the rate of Caesarean sections [20]. Such data might allow us to counsel patients better in the future, concerning long-time consequences of vaginal deliveries. In any case, counseling of patients with accumulated risk factors for perineal lacerations has to be prudent, without increasing the patient's worries about their infants' vulnerability.

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