Published in final edited form as:
Am J Perinatol. 2013 August ; 30(7): 595–600. doi:10.1055/s-0032-1329689.

Medical and Non-Medical Factors Influencing Utilization of Delayed Pushing in the Second Stage

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Abstract

Objective—To evaluate factors impacting selection to delayed pushing in the second stage of labor.

Study design—This case-control study was a secondary analysis of a large retrospective cohort study. Cases included women who delayed pushing for 60 minutes or more in the second stage of labor. Controls began pushing prior to 60 minutes from the time of diagnosis of complete dilation. Demographic, labor, and nonmedical factors were compared among cases and controls. Logistic regression modelling was used to identify factors independently associated with delayed pushing.

Results—We identified 471 women who delayed pushing and 4,819 controls. Nulliparity, maternal body mass index > 25, high fetal station at complete dilation, regional anesthesia use, and start of second stage during staffing shift change were independent factors associated with increased use of delayed pushing. On the other hand, black race and second stage management during night shift were associated with lower odds of employing delayed pushing. Delayed pushing was more commonly employed in nulliparous women, but 38.9% of multiparous women also delayed pushing.

Conclusion—We identified multiple factors associated with use of delayed pushing. This study helps to define current patterns of second stage labor management.

Keywords

Delayed pushing; labor management; second stage

Introduction

Delayed pushing is a technique utilized in the second stage of labor, in which fetal descent is initially allowed to occur as a result of uterine contractile forces alone. In contrast, active pushing combines maternal pushing effort with contractions to expel the fetus.[1] Critical

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appraisal of the existing evidence raises concerns regarding the true efficacy and safety of delayed pushing in modern practice.[2–9] While most studies evaluating the efficacy of delayed pushing demonstrate that delayed pushing decreases pushing time, it also results in a longer second stage of labor without evidence to support an increase in vaginal delivery rates in high-quality studies.[2–7] Longer second stage has been associated with an increase in maternal and neonatal morbidity[1,10–12] Two large studies also suggest that delayed pushing to manage the second stage at term is associated with increased risks of adverse maternal and neonatal outcomes including maternal fever[3] and fetal acidosis.[3,8]

The vast majority of efficacy trials have been limited to nulliparous women with regional analgesia, [2–4,6,7,13–17] thus limiting the generalizability of the findings. However, data from a recent retrospective study from our institution demonstrated that approximately a third of all women who engaged in delayed pushing were multiparous,[8] suggesting that the use of delayed pushing has been expanded to a broader population. The conflicting efficacy data on the use of delayed pushing highlights the importance of understanding practice patterns and patient selection to second stage labor management strategies. In this study, we explored patient characteristics, labor factors, and non-medical factors that influence whether a woman is selected to delay pushing in the second stage.

Methods

This nested case-control study was a secondary analysis of a large retrospective cohort established to examine electronic fetal heart rate patterns during labor. Approval for the study was granted by the Washington University School of Medicine Human Research Protection Office. Consecutive women admitted at term to a tertiary care center from 2004–2008 who reached the second stage of labor were identified. Exclusion criteria for the study included cesarean during the first stage of labor, multiple gestation, non-vertex presentation, known or suspected major fetal anomaly, intrauterine fetal demise, and prematurity defined as delivery prior to 37 weeks gestation. If a woman had more than one delivery during the study period, then only the first delivery was included. Cases were defined as women who delayed pushing for at least 60 minutes in the second stage of labor. The control group consisted of women who pushed within 60 minutes of complete cervical dilation. We used 60 minutes to define delayed pushing based on prior prospective studies.[2,5,13,15] At our institution, there is no protocol regarding the use of delayed pushing, thus it was employed at the discretion of the treating practitioner. Our labor and delivery unit is primarily physician-nurse managed, and a single Certified Nurse Midwife performed less than 1% of the deliveries during the study period.

Extensive patient-level data was extracted by research nurses from the medical record including maternal age, maternal body mass index (kg/m^2), parity, race, insurance status and history of prior cesarean delivery. Gestational age was determined by the patient's last menstrual period and first ultrasound evaluation using established guidelines.[18] Estimated fetal weight was documented routinely at time of admission based on recent ultrasound evaluation if available and Leopold measurements. Maternal complications such as diabetes and preeclampsia were recorded. Women were classified as having diabetes if they had either gestational diabetes, defined as glucose ≥140 g/dl on a screening glucose tolerance

test followed by at least 2 abnormal values on a 3-hour glucose test using the National Diabetes Data Group definitions,[19] or pre-gestational type 1 or type 2 diabetes mellitus. Criteria used to identify women with preeclampsia included blood pressure >140 mm Hg systolic or >90 mm Hg diastolic and proteinuria (>300 mg in 24 hours).[20]

Research nurses recorded detailed information regarding labor management and progress. Date and time of admission to labor and delivery, each cervical examination, commencement of pushing, and delivery of the infant were noted as documented in the medical record and confirmed by electronic fetal monitoring. Specific labor characteristics assessed in women who pushed immediately and women who delayed pushing included station of the fetal head, length of the first stage of labor, and utilization of regional anesthesia. High fetal station was defined as fetal head at zero station or higher at the time complete dilation was diagnosed. If the fetal station was at +2 or lower, then it was coded as low station. Fetal station of +1 was used as the reference. Regional anesthesia was defined as the use of epidural, spinal, or combined spinal-epidural analgesia. Time-stamped data was also used to examine external factors present among the groups including time of the day and day of the week when second stage commenced. Definitions of night (7 p.m. to 7 a.m.) and day shifts (7 a.m. to 7 p.m.) were based on standard labor nursing schedules on our labor and delivering unit. The presence of nursing shift change at the time of second stage was determined by the diagnosis of complete dilation within one hour of a scheduled nursing shift change (6–8 a.m. or 6–8 p.m.). Among obstetric provider groups, most changes in labor and delivery coverage occurred during this time frame as well. The relationship between the delivering practitioner's proximity during labor and use of delayed pushing was also examined based on whether the practitioner took "in-house" or "home call."

Medical and non-medical factors present among the group of women who delayed pushing were compared to women who pushed immediately to determine the factors that were associated with delayed pushing. The Chi-square test was used to compare categorical variables in bivariate analysis. Normality of continuous variables was tested visually and with the Shapiro-Wilk test. Non-normally distributed variables were compared using the Mann-Whitney U test. All variables found to be significantly associated with delayed pushing ($p<0.05$) in bivariate analysis were included in the logistic regression model. Variables that remained significantly associated with delayed pushing in multivariable logistic regression were considered as independent factors associated with selection to delay pushing. All statistical analyses were performed using STATA 10.0 (special edition, Stata-Corp, College Station, TX).

Results

The total number of women admitted in labor at term during the study period who met inclusion criteria was 5,388. After excluding women for missing time-stamped data during the second stage, 5,290 women were included in the final analysis. The identified cases consisted of 471 women who delayed pushing (8.9%) while 4,819 women were controls (91.1%).

Demographic characteristics of women who delayed pushing and women who pushed immediately were compared. Factors associated with an increased likelihood of delayed pushing in bivariate analysis were maternal age less than 18, nulliparity, gestational age between $39^{0/7}$ and $40^{6/7}$ weeks, and BMI (body mass index) greater than 25. Utilization of delayed pushing was less common in women of black race. Estimated fetal weight at time of admission, history of prior cesarean, insurance status, and maternal comorbidities including diabetes and preeclampsia were not associated with delayed pushing (Table 1).

Bivariate analysis of intrapartum factors and likelihood of delayed pushing showed that high fetal station (zero station or higher) was associated with increased use of delayed pushing, while the practice was less common among women with low fetal station at time of complete dilation (+2 station or lower). The length of the first stage of labor was longer in women who delayed pushing (573 minutes compared to 473 minutes, $p<0.01$). Regional anesthesia was more common in women who delayed pushing (Table 2). Complete dilation at time of shift change increased the chance of delayed pushing during second stage. In contrast, delivering at night was associated with a lower likelihood of delayed pushing. The day of the week that the delivery occurred did not affect the use of delayed pushing (Table 3).

Multivariable logistic regression was used to control for confounding. All factors associated with delayed pushing in bivariate analysis were included in the model. In adjusted analysis, nulliparity, maternal BMI > 25, regional anesthesia use, high fetal station, and second stage during shift change were associated with an increased odds of delayed pushing. In contrast, factors with lower odds of selection to delayed pushing were black race, low fetal station, and start of second stage at night.

As this study is a secondary analysis with a fixed sample size, *a priori* sample size calculation was not performed. However, a *post hoc* analysis revealed that we had 94% power to identify factors associated with a two-fold odds for selection to delayed pushing given the fixed sample size and assuming an α of 0.05 and a baseline risk of diabetes, the least frequent factor, of 4% in our population.

Comment

In this study, we identified several factors that influence utilization of delayed pushing for management of the second stage of labor. Patient characteristics and labor factors which increase the odds of delayed pushing were nulliparity, regional anesthesia, higher maternal BMI, and high fetal station at complete dilation. Black race and low fetal station were associated with lower odds of delayed pushing. In addition, we found that non-medical factors also influenced use of this management technique. Shift change at time of complete dilation and commencement of second stage during daytime hours increased the odds of delaying pushing.

Most published randomized controlled trials examining the effects of delayed pushing in the second stage of labor have been conducted among nulliparous women with regional anesthesia.[2–4,6,7,13–17] Nevertheless, 38.9% of multiparous women also engaged in delayed pushing. Delayed pushing in multiparous women has not been adequately studied.[5,8,21] In

our study, fetal station at the time complete dilation was also associated with the utilization of delayed pushing. Considering the goal of delayed pushing is to allow passive descent of the fetal head in order to minimize active maternal pushing efforts, it is not surprising that the practice is employed more frequently in cases of high fetal station at the commencement of second stage of labor. While prior prospective clinical trials have presented baseline data regarding fetal station in women randomized to delay pushing and those who pushed immediately[3–5,14,16], none of those studies evaluated the effect of fetal station on the efficacy of delayed pushing. In a prior retrospective study, we found delayed pushing did not affect mode of delivery in women with high fetal station thus challenging the concept that this technique is particularly useful in women who begin second stage labor at high station.[8] Maternal BMI also influenced selection to delayed pushing, yetthere is no published evidence that delayed pushing is an effective strategy in women who are overweight or obese. Interestingly, there was also a non-significant trend towards higher rates of delayed pushing among women with preeclampsia, and while our study did not evaluate the impact of delayed pushing on adverse events, others have demonstrated that delayed pushing lengthens total duration of second stage.[2–7] The efficacy and safety of this technique among women with medical complications should be evaluated in future studies.

It is noteworthy that non-medical factors also affected second stage management patterns. Women of black race were less likely to delay pushing. This may reflect different patient preferences, variations in second stage labor progress among women of different ethnic backgrounds, or other unmeasured factors. The increased use of delayed pushing during shift change demonstrates that the practice may be employed at our institution for reasons other than perceived maternal benefit, such as convenience. Similarly, the association of time of day and use of delayed pushing may reflect external factors such as staffing differences between night and day shifts or variation in delivering practitioner availability.

A limitation of this study is the retrospective design. Although logistic regression was used to control for confounding, it is possible that unmeasured variables contribute to the decision to delay pushing in the second stage of labor. In addition, intention to delay pushing was not recorded as part of the study. By defining delayed pushing by the time between complete dilation and initiation of pushing rather than intent, it is possible that delayed pushing was employed for a time shorter than 60 minutes in women included in the control group. In contrast, 60 minutes is a considerable amount of time thus is it unlikely that women who intended to push immediately were misclassified.

This is one of the first studies to examine the “real world” application of delayed pushing in a tertiary care center. Because there is no protocol directing the management of second stage labor at our institution, we were able to explore the factors that impact second stage management. Understanding current trends in the use of this technique in clinical practice is a key step in evaluating its effectiveness and safety. Although there is extremely limited data on the use of delayed pushing in multiparous women, the use of the practice in a significant proportion of our multiparous study population highlights a need to perform additional research. Furthermore, it is likely that differences in the baseline characteristics of the populations evaluated in previously published studies accounts for at least some of the variation in outcome results such as mode of delivery and maternal and neonatal

complications. In the largest prospective randomized controlled trial, delayed pushing reduced the risk of difficult delivery, defined as second stage cesarean, midpelvic operative vaginal delivery, or manual or instrument-assisted rotation of the fetal head by >45° prior to any operative vaginal delivery.[3] In a subsequent study, in which the investigators randomly selected a subgroup of women from the initial cohort to develop a risk model to predict difficult delivery, delayed pushing was not associated with a significant reduction in difficult deliveries.[22] These contradicting conclusions illustrate that the efficacy of delayed pushing depends on the population in which it is employed.

The size of the cohort evaluated in this study is the largest to date. The quantity and quality of the data available for analysis is another major strength as only 2.1% of the data was missing. Detailed information collected about each woman's demographics, past medical and surgical history, and labor management correlated with time-stamped data allowed us to evaluate multiple factors which could influence utilization of delayed pushing.

In conclusion, delayed pushing is a commonly employed practice in the second stage of labor. To enhance the understanding of the current clinical paradigm in which this practice is used, we examined medical and non-medical factors associated with its use. The differences identified in women selected to delay pushing should be further explored in prospective studies to determine how this management strategy can be best incorporated into modern obstetric practice.

Acknowledgments

Financial support: Dr. Cahill is a Robert Wood Johnson Foundation Physician Faculty Scholar, which partially supports this work.

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Am J Perinatol. Author manuscript; available in PMC 2014 May 09.

Table 1

Comparison of characteristics of women who delayed pushing and women who pushed immediately

Characteristic	Delayed Pushing* (n=471)	Immediate Pushing* (n=4918)	Odds ratio (95% CI)	p	Adjusted Odds Ratio (97% CI)	p
Age						
18–34 years	374 (79.4)	4051 (84.1)	ref			
< 18 years	66 (14.0)	427 (8.9)	**1.67 (1.25–2.23)**	**<0.01**	0.99 (0.72–1.36)	0.93
>34 years	31 (6.6)	341 (7.1)	0.98 (0.65–1.45)	0.94		
Body mass index						
BMI ≤ 25.0	49 (10.7)	717 (15.4)	ref			
BMI 25.1–29.9	156 (33.9)	1443 (31.0)	**1.58 (1.12–2.26)**	**0.01**	**1.55 (1.09–2.19)**	**0.01**
BMI >30.0	255 (55.4)	2490 (53.6)	**1.50 (1.09–2.10)**	**0.01**	**1.48 (1.06–2.09)**	**0.02**
Parity						
Multiparous	183 (38.9)	3135 (65.0)	ref			
Nulliparous	288 (61.1)	1684 (35.0)	**2.93 (2.40–3.58)**	**<0.01**	**2.85 (2.29–3.56)**	**<0.01**
Gestational age						
37–38 6/7 wks	135 (28.8)	1677 (35.0)	ref			
39–40 6/7 wks	287 (61.2)	2692 (56.2)	**1.32 (1.07–1.65)**	**0.01**	1.10 (0.90–1.35)	0.36
≥41 wks	47 (10.0)	424 (8.8)	1.38 (0.95–1.97)	0.07		
Estimated fetal weight						
Median (gm) (Interquartile range)	3340 (3200–3600)	3400 (3195–3600)	NA	0.09		
≤4000 gm	377 (80.0)	3722 977.2)	ref			
>4000 gm	94 (20.0)	1097 (22.8)	0.85 (0.66–1.07)	0.16		
Prior cesarean						
No	445 (94.5)	4506 (93.5)	ref			
Yes	26 (5.5)	313 (6.5)	0.84 (0.53–1.27)	0.41		
Insurance status						
Non-Private	406 (86.2)	4214 (87.5)	ref			
Private	65 (13.8)	605 (12.5)	1.12 (0.83–1.47)	0.44		
Race						

Characteristic	Delayed Pushing* (n=471)	Immediate Pushing* (n=4918)	Odds ratio (95% CI)	p	Adjusted Odds Ratio (97% CI)	p
Non-Black	156 (33.1)	1281 (26.6)	ref			
Black	315 (66.9)	3538 (73.4)	**0.73 (0.59–0.90)**	**<0.01**	**0.75 (0.60–0.93)**	**0.01**
Diabetes						
No	452 (96.0)	4644 (96.4)	ref			
Yes	19 (4.0)	175 (3.6)	1.12 (0.65–1.82)	0.66		
Preeclampsia						
No	432 (91.7)	4514 (93.7)	ref			
Yes	39 (8.3)	305 (6.3)	1.34 (0.92–1.90)	0.06		

OR, odds ratio; *CI*, confidence interval;

* n (%)

Table 2

Comparison of intrapartum factors in women who delayed pushing and women who pushed immediately

Characteristic	Delayed Pushing* (n=471)	Immediate Pushing* (n=4918)	Odds Ratio (95% CI)	p	Adjusted Odds Ratio (97% CI)	p
Station when complete						
+1 station	193 (41.5)	1258 (26.5)	ref			
0 station or higher	119 (25.6)	542 (11.5)	**1.43 (1.10–1.85)**	**<0.01**	**1.67 (1.28–2.18)**	**<0.01**
+2 station or lower	153 (32.9)	2940 (62.0)	**0.34 (0.27–0.43)**	**<0.01**	**0.36 (0.29–0.45)**	**<0.01**
Length of 1st stage						
Median minutes (interquartile range)	573 (333–969)	473 (221–805)	NA	**<0.01**		
Length <90th percentile	411 (87.3)	4349 (90.3)	ref			
Length 90th percentile	60 (12.7)	470 (9.7)	**1.35 (1.00–1.81)**	**0.04**	0.86 (0.63–1.17)	0.34
Regional anesthesia						
No	7 (1.5)	846 (17.6)	ref			
Yes	464 (98.5)	3973 (82.4)	**14.1 (6.76–35.4)**	**<0.01**	**10.02 (4.70–21.24)**	**<0.01**

OR, odds ratio; *CI*, confidence interval;

* n (%)

Table 3

Comparisons of non-medical factors in the delayed pushing and immediate pushing groups

Variable	Delayed Pushing* (n=471)	Immediate Pushing* (n=4918)	Odds Ratio (95% CI)	p	Adjusted Odds Ratio (97% CI)	p
Night shift						
No	259 (55.0)	2294 (47.6)				
Yes	212 (45.0)	2525 (52.4)	**0.74 (0.61–0.90)**	**<0.01**	**0.72 (0.59–0.88)**	**<0.01**
Shift change when complete						
No	367 (77.9)	3969 (82.4)	ref			
Yes	104 (22.1)	850 (17.6)	**1.32 (1.04–1.67)**	**0.02**	**1.34 (1.04–1.72)**	**0.02**
Day of week						
Weekday	374 (79.4)	3761 (78.0)	ref			
Weekend	97 (20.6)	1058 (22.0)	0.92 (0.72–1.17)	0.50		
Delivery practitioner availability						
In-hospital call	353 (74.9)	3771 (78.2)	ref			
Home call	118 (25.1)	1048 (21.8)	1.20 (0.96–1.50)			

OR, odds ratio; *CI*, confidence interval;

* n (%)