



Redefining Second Stage of Labor: Number of Pushing Contractions

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Abstract

Introduction Despite time standards for second stage labor, “delayed pushing,” uterine contraction frequency, and alternate contraction pushing may alter the effective maternal effort. We sought to quantify the number of pushing contractions needed for a spontaneous vaginal delivery (SVD) among primipara and multipara patients.

Methods Deliveries at Harbor-UCLA Medical Center in 2017 were selected for SVD of singleton, term newborns. The first 100 primipara and 100 multipara deliveries were analyzed and monitor tracings quantified for pushing contractions.

Results Significantly more pushing contractions were required by primiparas versus multiparas (17.3 ± 1.7 vs. 5.5 ± 0.7 ; $p < 0.001$) in accord with a longer second stage (86.7 ± 7.8 vs. 27.2 ± 4.9 min; $p < 0.001$) and epidural was associated with greater number of pushing contractions among both primipara (18.5 ± 1.8 vs. 10.8 ± 0.8) and multipara women (6.1 ± 0.8 vs. 4.1 ± 0.3). Newborn weight (<3000, 3000–3500, >3500 g) demonstrated a trend for increased pushing contractions among primipara (16.9, 16.5, 19.8 pushes, respectively) though not multiparas.

Conclusion Although correlated with the absolute duration of the second stage, the number of pushing contractions eliminates ambiguities of “delayed pushing,” pushing every-other, and frequency of contractions. Examination of larger databases and patients with second stage “arrest disorders” may provide pushing contraction criteria predictive of SVD and prevention of morbidity.

Keywords

- ▶ Labor
- ▶ pushing
- ▶ second stage
- ▶ duration

The rate of cesarean section increased dramatically from 1996 to 2012, rising from approximately 21 to 32% in 20 years,¹ with the primary cesarean section rate increasing from 14 to nearly 22%. Though there has been a small decrease in the national cesarean section rate of 31.9% in 2016, total cesarean section rates in 2016 ranged from 22.3 to over 38% depending upon the state,¹ indicating significant variance in practice patterns. Among all primary cesarean sections, labor arrest accounts for approximately one-third of cases. The American College of Obstetricians and Gynecologists and The Society for

Maternal-Fetal Medicine Obstetric Care Consensus² recommended that a specific absolute maximum length of time spent in the second stage of labor beyond which all women should undergo operative delivery has not been identified. Recommendations also suggested that before diagnosing arrest of labor in the second stage, one should provide at least 2 hours of pushing in multipara women and at least 3 hours of pushing in primipara women, and longer durations may be appropriate with the use of epidural analgesia or fetal malposition.

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Significant controversy remains regarding the length of the second stage. Depending upon the study, investigators have concluded that maternal and neonatal morbidities significantly increase with second stage beyond 3 hours,³ beyond 2 hours in primipara patients,⁴ beyond 3 hours in primipara and 2 hours in multipara⁵ women or beyond 3 hours in multipara⁶ patients. In contrast, several reports have suggested that the second stage of labor does not need to be terminated for duration alone⁷ and that there is no evidence that prolonged second stage of labor has a significant impact on fetal morbidity.⁸ A large retrospective cohort study (2002–2008) demonstrated small increases in fetal and maternal morbidity among patients delivering vaginally after prolonged second stage of labor.⁹ A more recent secondary analysis of an observational cohort study (2008–2011) also demonstrated that a longer duration of pushing was associated with a small increase in neonatal morbidity, though 78% of nulliparous women delivered vaginally even after 4 hours of pushing.¹⁰ In a prospective randomized study, the extension of second stage labor for one additional hour in singleton, nulliparous women with epidural anesthesia, significantly decreased the incidence of cesarean section.¹¹

Numerous studies have examined effects of maternal parameters on the second stage of labor, including maternal hypertension,¹² body mass index,^{13,14} age,^{15,16} maternal position,^{17,18} fetal head malpresentation,^{19,20} and whether Valsalva or open pushing techniques.²¹ Although delayed pushing has been advocated for patients, particularly those with epidural analgesia, there appears to be an increase in several adverse outcomes (chorioamnionitis, postpartum hemorrhage) with this procedure.^{22,23} Consequently, controversy remains as to how to best manage the second stage of labor to optimize the rate of successful vaginal delivery and minimize maternal and infant morbidity.

In nearly all studies, the second stage is quantified by time. Yet the frequency of uterine contractions may vary by at least twofold, from one contraction every 2 minutes to one every 4 minutes or more. Pushing may be limited to every other contraction to prevent fetal acidosis in the presence of heart rate decelerations and pushing effort may vary with the use of epidural. As the primary factor for descent and ultimate vaginal delivery is maternal pushing, the number of pushing contractions may represent a better quantification of the second stage for predicting the likelihood of successful vaginal delivery or fetal/maternal morbidity. To examine the potential for quantifying the number of pushing contractions, we performed a feasibility study to assess the number of pushing contractions needed for a spontaneous vaginal delivery (SVD) among primipara and multipara patients.

Methods

The study was designed to determine the number of pushing contractions among primipara versus multipara patients who underwent successful vaginal delivery. This study was approved by the Institutional Review Board at Los Angeles Biomedical Research Institute at Harbor-UCLA Medical Center. Deliveries at Harbor-UCLA Medical Center were analyzed sequentially

beginning January 1, 2017. Patients were selected for having a successful SVD of a singleton, term (≥ 37 weeks) newborn, and included both spontaneous and induced labor. Data for the first 100 primipara and 100 multipara SVD were analyzed. PowerChart (Cerner, North Kansas City, MO) maternal records were accessed for maternal demographic data, obstetrical details, and newborn outcome. Ethnicity was not recorded, though the labor population at Harbor-UCLA Medical Center approximates 80% Hispanic ethnicity. Subsequently, FetaLink (Cerner) monitor tracings were examined to quantify the number of maternal pushing contractions, by recognition of uterine tocodynamometer or intrauterine pressure catheter (IUPC) waveforms, in combination with physician and nursing chart notes regarding pushing activity. Two investigators (S.M.B., G.E.P.C.) were trained to discriminate pushing from nonpushing contractions and subsequently quantified each of the second stage labors. Random patient recordings were counted and confirmed by the senior investigator (M.G.R.) for quality control.

The beginning of the second stage was defined as the point at which patients were observed to be completely dilated. “Delayed pushing” time was included in the duration (minutes) of second stage, for the purpose of this study. Pushing efforts were quantified as pushing contractions, though the patients typically were instructed for three (approximately 10 second) pushing efforts during each second stage contraction. Only patients with external or IUPC tracings were utilized in which nonpushing and pushing contraction efforts were readily discernable.

Although there was no prior data available for sample size calculation, we assumed a mean of 20 versus 15 pushing contractions for primipara and multipara patients, with a standard deviation of 10, α error of 0.5, and power of 80%. This resulted in a sample size requirement of 63 patients in each group to compare primipara and multipara pushing efforts. Due to the lack of prior data for sample size calculation, a sample size of 100 patients in each group was selected.

Primipara and multipara patients were compared for second stage duration and number of pushing contractions. Statistical analysis was performed for using unpaired *t*-test, Chi-square, and analysis of variance, as appropriate. Data are presented as mean \pm SD for demographic data and mean \pm standard error of mean (SEM) for quantification of pushing contractions.

Results

A total of 108 primipara and 137 multipara women with SVDs were screened to obtain 100 patients with qualifying uterine activity tracings in each group. Monitor tracings were inadequate for assessment of uterine activity in 8 primipara and 37 multipara patients.

Primipara patients were significantly younger than multipara patients (25.02 ± 0.62 vs. 29.11 ± 0.64 years; $p < 0.01$) though weights were equivalent among the groups (81.9 ± 21.3 vs. 80.2 ± 16.3 kg). Among the multipara patients, parity averaged 1.99 ± 1.07 . Gestational age was longer in primipara as compared with multipara patients (272.4 ± 5.8 vs. 269.9 ± 5.1 d; $p < 0.01$), though there was no

difference in the use of labor induction (45 vs. 32%). Primiparas were more likely to receive labor epidurals than multiparas (83 vs. 67%; $p < 0.01$). The proportion of patients receiving oxytocin in the first stage of labor was greater in primiparas (69 vs. 51%; $p < 0.01$), though there was no difference in the use of oxytocin in the second stage (38 vs. 26%). Primiparas more frequently utilized IUPC monitoring during labor (38 vs. 18%; $p < 0.01$).

Newborn APGAR scores were similar among primipara and multipara patients at 1 (8.3 ± 1.4 vs. 8.4 ± 1.3) and 5 minutes (8.9 ± 0.6 vs. 8.8 ± 1.2). Gender distribution was 55% male in primiparas and 51% male in multiparas. Delayed pushing was used commonly for brief periods of time, as 91% of primiparas had delayed pushing for 29.4 ± 63.0 minutes and 59% of multiparas had delayed pushing for 9.6 ± 21.9 minutes.

Pushing contractions were easily recognized by a typical pattern of three peaks during a contraction and were consistent with physician and nursing chart comments. Primipara women required significantly more pushing contractions than did multiparas (mean \pm SEM) (17.3 ± 1.7 vs. 5.5 ± 0.7 pushing contractions; $p < 0.001$) in accord with a longer second stage (86.7 ± 7.8 vs. 27.2 ± 4.9 min; $p < 0.001$). The 95th percentile for pushing contractions was markedly greater among primiparas than multiparas (53.7 vs. 14.9 pushes; $p < 0.05$). Among the multipara patients, compared with para 2, para 3 patients required a reduced number of pushing contractions (7.5 vs. 4.1 pushes), though there was no further decrease with increasing parity. The use of epidural was associated with greater pushing contractions among both primiparas (18.5 ± 1.8 vs. 10.8 ± 0.8 ; $p < 0.01$) and multiparas (6.1 ± 0.8 vs. 4.1 ± 0.3 ; $p < 0.01$). Increasing newborn weight (<3,000, 3,000–3,500, >3,500 g) demonstrated a trend for increased pushing contractions among primiparas (16.9, 16.5, 19.8 pushes; $p < 0.01$ respectively) though not multiparas (3.8, 6.5, 5.0 pushes), respectively. Female infants required fewer pushing contractions than did male infants among both primipara (16.6 ± 2.6 vs. 17.8 ± 2.3 ; $p < 0.001$) and multipara patients (4.8 ± 0.5 vs. 6.1 ± 1.3 ; $p < 0.001$).

Discussion

The results of the present study demonstrate the feasibility of quantifying the number of pushing contractions rather than solely time duration of the second stage. Primipara women required significantly more pushing contractions than multiparas in accord with a longer duration second stage, and the 95th percentile for pushing contractions was markedly greater for primiparas than that for multiparas. Compared with a para 2, para 3 patients required a reduced number of pushing contractions though there was no further decrease with increasing parity. In both primipara and multipara patients, use of epidural was associated with a greater number of pushing contractions, and newborn weight showed a trend for increased pushing contractions among primipara, though not multipara patients.

The time duration of second stage that we observed is similar to that noted in prior studies of primarily Hispanic or

mixed ethnicity patient populations.^{24–26} As reported by Jones and Larson,²⁴ the mean duration of the second stage of labor among Hispanic nulliparous and multiparous women was 54.2 and 22.2 minutes, respectively. Of note, much of the literature has focused upon the 95th percentile duration of the second stage. However, in counseling women preparing for labor, a mean or median value may be more useful. Furthermore, knowledge of the number of pushing contractions required, adjusted for individual findings (e.g., epidural, fetal position) potentially may have a motivational value.

We did not specifically explore the effects of delayed pushing. Although reports indicate that delayed pushing results in a decrease in the time pushing,^{22,23} it remains to be determined if it reduces the number of pushing contractions required. We did not assess the adequacy or strength (i.e., Montevideo units) of uterine contractions in the second stage as intrauterine pressure transducer measurements are elevated in response to maternal pushing efforts. As previously demonstrated, the use of epidural was associated with a longer duration of the second stage and an increased number of pushing contractions. This likely represents the reduced maternal exertion and intrabdominal pressure associated with epidural analgesia.

As the aim of the study was to confirm the feasibility of quantifying second stage labor by number of pushing contractions, we included only patients who had successful SVD. Furthermore, we did not examine rates of neonatal or maternal morbidity associated with these deliveries. These results do not include potential patients with prolonged second stages requiring cesarean section or operative vaginal delivery. Future studies which define thresholds for the number of pushing contractions associated with SVD versus operative vaginal delivery or second stage cesarean section may provide valuable predictive information. Further studies also may quantify the number of pushing contractions associated with maternal (e.g., age, type of pushing, position) and fetal characteristics (e.g., head position) and assess the association of number of pushing contractions with maternal and neonatal morbidity.

In summary, the present findings demonstrate the feasibility of quantifying the length of second stage as the number of maternal pushing contractions. In view of the variation in the frequency of uterine contractions and the use of delayed pushing, the number of pushing contractions may ultimately be a useful measure for physicians and nurses and a motivational guide for patients as to what is necessary to achieve a vaginal delivery.

Conflict of Interest

None.

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