Duration of passive and active phases of the second stage of labour and risk of severe postpartum haemorrhage in low-risk nulliparous women.

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Running title: duration of active second stage of labour and postpartum haemorrhage

Key words: passive second stage; active second stage; nullipara; postpartum haemorrhage

Abstract:

Objective: To assess the risk of severe postpartum haemorrhage (PPH) according to the duration of the passive and active phases of the second stage of labour

Design: Secondary analysis of the PREMODA prospective observational study

Setting: 138 French maternity units

Population: 3330 low-risk nulliparous women with vaginal deliveries of cephalic singletons

Methods: Analysis of the prospectively recorded durations of the active phase of the first stage and the passive and active phases of the second stage of labour and their association with severe PPH, defined by estimated blood loss>1000 ml or blood transfusion. Factors associated with severe PPH were analysed by uni- and multivariable analysis with logistic regression models.

Main outcome measures : Severe postpartum haemorrhage

Results: The frequency of severe PPH was 2.1%(n=69). In the univariable analysis, severe PPH increased with the duration of the active but not the passive second stage: 1.2% for active second stage <10 min, 1.6% for 10-19 min, 2.1% for 20-29 min, 2.6% for 30-39 min, 4.5% for 40-49 min and 14.3% for ≥50 min (p<0.001). After adjustment for confounding factors, the risk of severe PPH was statistically significant when the active first stage exceeded 6 hours (adjusted OR=2.5[1.0-6.1]) and when pushing lasted longer than 40 minutes (40-49 min: adjusted OR=3.5[1.0-12.3], ≥50 min: adjusted OR=10.6[2.8-40.3], reference: <10 min). The duration of expulsive efforts was not associated with other maternal or neonatal complications.

Conclusion: A prolonged active —but not passive— second stage is associated with the risk of severe PPH in nulliparas. The optimal duration of these phases remains to be defined.

Introduction

Many authors report that a prolonged second stage is associated with maternal complications, especially postpartum haemorrhage (PPH) related to uterine atony (1-7). They studied the second stage of labour, beginning at full dilatation and finishing at birth, as an only one continuous phase. However, the second stage is divided into two phases: the passive second stage, during which the fetal head descends passively down the maternal pelvis, and the active second stage, which corresponds to the phase of pushing expulsive efforts. The physiology of the two phases differs, as demonstrated by Buhimschi et al., who found that women in labour increase their intrauterine pressure 62% by actively pushing with a contraction during the second stage (8). Studying the two phases separately might make it possible to determine which— passive or active or both — increases maternal complications, especially the risk of severe PPH. This finding could have important clinical implications, favouring the practice of either early or delayed pushing, or limiting the duration of expulsive efforts. In a recent publication from a secondary analysis of the PEOPLE trial, we found an increased maternal risk of PPH after 2 hours of active second-stage labour (9). That study did not, however, take in account the relation between PPH and duration of the passive second stage.

The objective of our study was to analyse maternal consequences, especially severe PPH, according to durations of the passive and active phases of the second stage of labour, in low-risk nulliparous women.

Methods

The PREMODA study was a prospective observational study of the delivery of term breech infants, conducted, between 1 June 2001 and 31 May 2002, in 138 French maternity units (more than one fifth of all French maternity units) (10). The study was approved by the National Data Protection Authority in Paris (on 9 May 2001). The control group included 9962 singleton pregnancies in cephalic presentation at more than 37 weeks, specifically, those in the same units over the same period who were assigned a delivery record number that was a multiple of 20. This procedure provided a random selection of 5% of all the singleton cephalic term births. This study was based on prospective data rigorously collected from a questionnaire specifically designed to assess management of labour and delivery, neonatal health status and maternal complications.

For our study, we conducted a secondary analysis of a population of low-risk nulliparas from the PREMODA study control group. This population of low-risk nulliparas was defined by the following criteria: nulliparous women with a singleton fetus in cephalic presentation at term (gestational age ≥37 weeks) (n=4218), as used in other secondary analysis of PREMODA study (11, 12). Women with caesarean delivery before (n=101) and during labour (n=460), induction of labour for maternal (n=159) or fetal (n=116) disorders, and congenital malformations (n=60) were excluded.

The duration of each stage of labour was prospectively collected, together with maternal (age and place of birth) and neonatal (gestational age and birth weight) characteristics and obstetric practices (elective induction of labour, oxytocin during labour and operative vaginal delivery). The main outcome criterion was severe PPH, defined by an estimated blood loss exceeding

1000 ml or blood transfusion in the first 24 hours after delivery. Because measurement of moderate PPH is so subjective, we did not record this outcome. Other maternal outcomes studied were third- and fourth- degree perineal tears and postpartum maternal fever > 48 hours or endometritis before discharge. Neonatal outcomes studied were: neonatal asphyxia defined by pH ≤ 7.10 or 5-minute Apgar score ≤7 and neonatal morbidity defined by any adverse neonatal outcome (arterial pH at birth≤ 7.10 or 5-minute Apgar score≤7 or neonatal trauma or NICU admission).

We analysed risk of severe PPH according to duration of each stage or phase of labour, beginning with the active phase of the first stage (excluding the early labour phase), and including the passive and active second stages. About duration of the active second stage, the French College of Obstetricians and Gynaecologists (CNGOF) recommends considering an assisted delivery after 30 minutes of expulsive efforts (13). Although these guidelines date only from 2007 and the level of evidence for this recommendation is low (grade C) (14), this has been standard practice in France for a long time (15). There is no specific recommendation about optimal duration of the passive second stage.

The duration of the active first stage, i.e., from 5 to 10 cm dilatation, was categorised in two-hour intervals. The duration of the passive second stage, i.e., duration of labour between 10 cm (full dilatation) and the beginning of expulsive efforts, was divided into three classes (less than 1 h, from 1 to 2 h and more than 2 h). The duration of the active second stage, i.e., of pushing, was categorised into six classes: 0-9 minutes (min), 10-19 min, 20-29 min, 30-39 min, 40-49 min and ≥50 min. We determined the factors associated with severe PPH, the duration of each stage of labour, neonatal and obstetric factors (gestational age, birth weight, mode of onset of labour and mode of delivery), and their associations with one another.

Statistical analysis used Stata 10.0 software. We used the Chi-square test to compare proportions, and Fisher's exact test when the population size was small ($n<5$). We used the Mann-Whitney test to compare median durations for each stage of labour. When a variable was missing more than 5% of data we created a specific class for missing data.

For the univariable analysis, we calculated the crude odds ratios and 95% confidence intervals of neonatal and obstetric factors that might be associated with severe PPH, including the duration of each stage of labour. To adjust for confounding factors in the multivariable analysis, we used an unconditional logistic regression model that included factors significant in the univariable analysis with $p<0.2$. Classes with the lowest severe PPH rate were chosen as the references.

Results

Nulliparas accounted for 42.3% (n=4218/9962) of the PREMODA study control group. Among them, 78.9% (n=3330/4218) were at low risk according to the inclusion and exclusion criteria. Table 1 describes the characteristics, obstetric practices and maternal and neonatal outcomes for this study population. In all, 69 (2.1%) of them had severe PPH, but only two were admitted to a maternal intensive care unit.

Data about duration of expulsive efforts were available in 3258 (97.8%) cases. Consistent with standard French practices and guidelines, the median duration of pushing was 15 minutes (interquartile interval: 10-25 minutes). However, 602 (18.5%) women had an active second stage longer than 30 minutes. Table 2 compares the duration of each stage of labour for the groups with and without severe PPH. The median duration of the active first stage and the passive second stage were similar in the severe PPH and control groups, respectively, 2.5 hours versus 2.7 hours (p=0.279) and 30 minutes for both groups (p=0.391). The median duration of the active second stage, however, was significantly longer in the severe PPH group compared with the control group (20 minutes versus 15 minutes, p<0.001).

The rate of assisted vaginal delivery was 24.0% (n=801) and increased with duration of expulsive efforts (<10 min: 12.4%, 10-19 min: 18.1%; 20-29 min: 26.2%, 30-39 min: 39.4%, 40-49 min: 52.2%, ≥50 min: 50%, p<0.001). The relationship between assisted vaginal delivery and severe PPH was not significant (1.9% of the spontaneous vaginal deliveries had severe PPH versus 2.8% for assisted deliveries, p=0.124). Table 3 summarises the results for the association between severe PPH and duration of the active second stage according to type of vaginal delivery. The association between severe PPH and the duration of the active second

stage then remained significant only among women with assisted vaginal deliveries (p=0.006); it was no longer significant for spontaneous deliveries (p=0.093) (Table 3).

In the multivariable analysis, the duration of the active first stage was associated with the risk of severe PPH (active first stage > 6 hours: adjusted OR=2.5 [1.0-6.1], reference: interval 2-4 h) (Table 4). We found no association between the duration of the passive second stage and the risk of PPH (for passive second stage longer than 2 hours: crude OR=1.2, 95% CI [0.5-2.9], reference: passive second stage less than 1 hour). The risk of severe PPH increased significantly with the duration of expulsive efforts. Odds ratios of severe PPH reached a significant level after 40 minutes of pushing (interval 40-49 min: adjusted OR=3.5 [1.0-12.3], ≥50 min: adjusted OR=10.6 [2.8-40.3], reference: <10 min) (Table 4). When the duration of the active second stage was treated dichotomously in two classes (up to and after 30 minutes), the risk of severe PPH was significantly higher after 30 minutes (crude OR=2.3 [1.4-3.8] and adjusted OR=2.0 [1.1-3.5]).

The risks of third or fourth degree perineal tears, of postpartum maternal fever >48 hours and of endometritis were not associated with the duration of active pushing in univariate analysis. We found no association between the duration of the active second stage and the risk of neonatal asphyxia or neonatal morbidity (data not shown).

Discussion

Our results show an association between the duration of the active phase of the second stage of labour and the risk of severe PPH in nulliparous women at low risk. On the contrary, however, severe PPH was not associated with the duration of the passive phase of the second stage.

Most authors who have studied the consequences of a prolonged second stage of labour have not differentiated between the passive and active phases of the second stage (1-7). Only a recent secondary analysis of the Canadian PEOPLE trial specifically assessed the impact of the duration of the active second stage on PPH risk: it reported that the risk of PPH increased among nulliparous women after 2 hours of pushing (9). That analysis, however, unlike this one, did not assess the impact of the duration of the passive second stage on PPH risk. Because the two phases of the second stage differ physiologically, prolongation of the duration of each could have different consequences. Thus, the passive and active phases should be analysed separately for assessing management of the second stage. Confirmation of our finding that PPH is associated with the duration of the active but not the passive second stage might allow obstetricians to adapt their management of low-risk nulliparous women, maybe to encourage delayed pushing and limit expulsive efforts.

Some randomised trials have assessed management of the passive second stage by measuring the impact of delayed pushing on the risk of PPH and found no difference between “early pushing” and “delayed pushing” groups, i.e., between women with shorter and longer periods of passive descent (16-19). In accordance with these findings, we confirmed that the duration of the passive phase of the second stage did not appear to be associated with severe PPH.

Because French management of the active second stage is particularly short in comparison with other countries, our results can not be extrapolated. However, our results about management of the active phase of the second stage of labour can be compared with those from the PEOPLE trial (9). Despite these differences between French and Canadian obstetrical practices, we also found an association between the duration of the active second stage and PPH risk under French practices. This increases the external validity of the relation observed between the duration of the active second stage and the risk of PPH.

Because the PREMODA study was not initially designed to assess PPH (10), data were not collected about management of the third stage of labour, from delivery until expulsion of the placenta. The systematic use of uterotonic agents and the use of controlled cord traction may be confounding factors for the risk of severe PPH. Similarly, blood loss was not objectively measured in each delivery. Because moderate PPH, i.e., blood loss between 500 and 1000 ml, is so subjective, this outcome was not recorded in the PREMODA study. In view of the large sample of women included and the high number of participating maternity units, the PREMODA study scientific committee considered that severe PPH was an adequate criterion for assessing maternal morbidity. An objective measurement of blood loss with the use of blood collecting bags would certainly have been more accurate.

Moreover, analgesia used during labour was unfortunately not collected in the PREMODA study. Thus, we cannot assess relationship between epidural and severe PPH in our study. We agree that epidural analgesia could be also a confounding factor limiting interpretation of our results. Indeed this practice increases duration of labour and its association with PPH remains unclear in the literature. In France, the rate of delivery with loco-regional analgesia was very high during the study period, around 85% in nulliparous women.

Caesarean section during the second stage of labour is associated with an increased risk of PPH (20, 21). The caesarean rate during the active phase of the second stage varies according to the management of this phase. The shorter the phase, the lower the risk of caesarean delivery. Delayed pushing is routine practice in France. As recommended by CNGOF to prevent expulsive efforts from exceeding 30 minutes, women do not usually begin to push until the fetal station reaches +2 or more, when fetal heart monitoring is normal. Thus, very few women had caesarean deliveries after beginning to push. Among all the PREMODA low-risk nulliparous women, only 58 (1.5%) women had a caesarean during the second stage and only 19 (0.5%) during the active phase of that stage. Only one of them had a severe PPH; she had pushed 25 minutes. The difficulty of analysing the impact of the duration of each phase of the second stage on the risk of severe PPH among women with caesarean sections during the passive or active phase led us to exclude women with caesareans during the second stage. Moreover, in view of the very few patients who had severe PPH after a caesarean during the active second stage, we do not think that this choice modifies our results.

In accordance with national guidelines, most French obstetricians performed operative vaginal deliveries after 30 minutes of pushing, even when the fetal heart rate (FHR) monitoring was reassuring. This probably explains at least in part the higher rate of such deliveries in France (11.1% in 2003) compared with the US (6.6% in 2006) (22, 23). Previous studies have reported an association between PPH and operative vaginal delivery (24). We did not observe such an association, perhaps due to a lack of power. Cervical and vaginal lacerations due to instrumental extractions are a potential cause of PPH. Because the rate of operative vaginal delivery increased with the duration of expulsive efforts and this type of delivery may be a confounding factor, we secondly decided to stratify for it. After stratification, the risk of severe PPH among women with operative vaginal deliveries still increased with the duration

of the active second stage. The increase in operative vaginal deliveries with duration of pushing therefore does not explain the association between severe PPH and the duration of expulsive efforts.

Nonetheless, our results do not allow us to conclude that severe PPH is reduced by the current French recommendations to limit pushing to 30 minutes. A policy of operative vaginal delivery after 30 minutes of pushing may indeed decrease severe PPH related to uterine atony. However, this policy may also increase the risk of PPH related to cervical and vaginal lacerations, secondary to instrumental extractions.

Conclusion

Prolongation of the active but not the passive phase of the second stage of labour could be associated with an increased risk of severe PPH. These results may have important implications for second-stage management and may lead obstetricians to encourage delay in pushing and to limit the duration of expulsive efforts. The optimal duration of these phases remains to be defined, however.

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None

Disclosure of interest

There are no conflicts of interest

Contribution to authorship

CLR conducted the analyses.

FG coordinated and supervised the study.

CLR, WF and FG wrote the paper.

All authors have seen and approved the final version of the manuscript.

Details of ethics approval :

Procedures of the study received ethics approval from the National Data Protection Authority in Paris (on 9 May 2001).

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Table 1: Characteristics, obstetric practices, and maternal and neonatal outcomes for the study population

Characteristics	Total population (N=3330)
Maternal age in years (mean+/-SD)	27.3 +/-4.7
- < 25 years (n, %)	994 (30.1)
- 25-35 years	2107 (63.9)
- 35 years	197 (6.0)
Maternal birth place (n, %)	
- France	2577 (82.9)
- Abroad	531 (17.1)
Gestational age in weeks (mean+/-SD)	39.5 +/-1.2
- 37- 38weeks (n, %)	660 (19.8)
- 39-40 weeks	1996 (59.0)
- ≥41weeks	702 (21.1)
Onset of labour (n, %)	
- spontaneous	2815 (84.5)
- induction	515 (15.5)
Oxytocin during labour (n, %)	
- yes	2074 (62.3)
- no	635 (19.1)
- missing	621 (18.6)
Mode of delivery (n, %)	
- spontaneous vaginal delivery	2529 (76.0)
- assisted vaginal delivery	801 (24.0)
Severe postpartum haemorrhage (n, %)	69 (2.1)
Postpartum maternal fever>48 h or endometritis (n, %)	22 (0.7)
3rd–4th degree perineal tear (n, %)	52 (1.6)
Birth weight in grams (mean+/-SD)	3289 +/-406
- < 3000 g (n, %)	761 (22.9)
- 3000-3499 g	1567 (47.2)
- 3500-3999 g	834 (25.1)
- ≥ 4000 g	159 (4.8)

Arterial pH≤7.10 * (n, %)	46 (1.4%)
5-minute Apgar score ≤7 (n, %)	33 (1%)
Neonatal trauma (n, %)	50 (1.5%)
Admission to NICU (n, %)	23 (0.7%)

SD: standard deviation

* Only 1088 available data

Table 2: Association between the duration of different phases and stages of labour and severe PPH

Duration	Severe PPH N=69	Control N=3261	p
Between 5 and 10 cm, in hours (median [IQ])	2.5 [1.5-3.9]	2.7 [1.4-4.7]	0.279†
- Less than 2 h (n,%)	19 (31.7)	876 (29.6)	
- Interval 2-4 h	19 (31.7)	1345 (45.5)	
- Interval 4-6 h	15 (25.0)	563 (19.0)	
- More than 6 h	7 (11.7)	175 (5.9)	0.076‡
Passive second stage, in minutes (median [IQ])	30 [10-60]	30 [10-60]	0.391†
- Less than 60 min(n,%)	44 (66.7)	2234 (71.3)	
- Interval 60-120 min	16 (24.2)	647 (20.7)	
- More than 120 min	6 (9.1)	252 (8.0)	0.710‡
Active second stage, in minutes (median [IQ])	20 [15-31]	15 [10-25]	<0.001†
- Less than 10 min(n,%)	6 (8.8)	477 (15.0)	
- Interval 10-19 min	23 (33.8)	1378 (43.2)	
- Interval 20-29 min	16 (23.5)	756 (23.7)	
- Interval 30-39 min	11 (16.2)	415 (13.0)	
- Interval 40-49 min	6 (8.8)	128 (4.0)	
- More than 50 min	6 (8.8)	36 (1.1)	<0.001‡

IQ: interquartile

† Mann-Whitney test

‡ Chi2 test

Table 3 : Rates of severe PPH according to mode of delivery and duration of the active second stage

	Spontaneous Vaginal Delivery		Operative Vaginal Delivery	
	Total (n)	PPH (n, %)	Total (n)	PPH (n, %)
Active second stage				
- Less than 10 min	423	6 (1.4)	60	0
- Interval 10-19 min	1147	17 (1.5)	254	6 (2.4)
- Interval 20-29 min	570	12 (2.1)	202	4 (2.0)
- Interval 30-39 min	258	7 (2.7)	168	4 (2.4)
- Interval 40-49 min	64	2 (3.1)	70	4 (5.7)
- More than 50 min	21	2 (9.5)	21	4 (19.1)
p		0.093		0.006

Table 4: Factors associated with severe PPH – univariable and multivariable analysis

	Severe PPH N=69 n (%))	Crude OR [95%CI]	Adjusted OR [95%CI]
Gestational age			
- 37-38 weeks (n=660)	8 (1.2)	1	1
- 39-40 weeks (n=1966)	38 (1.9)	1.6 [0.7-3.5]	1.6 [0.7-3.7]
- 41-24 weeks (n=704)	23 (3.3)	2.8 [1.2-6.2]	1.9 [0.7-4.8]
Birth weight			
- <3000 g (n=761)	9 (1.2)	1	1
- 3000-3499 g (n=1567)	30 (1.9)	1.6 [0.8-3.5]	1.0 [0.5-2.3]
- 3500- 3999 g (n=834)	26 (3.1)	2.7 [1.3-5.8]	1.6 [0.7-3.6]
- ≥ 4000 g (n=159)	4 (2.5)	2.2 [0.7-7.1]	0.6 [0.1-3.0]
Onset of labour			
- Spontaneous (n=2815)	51 (1.8)	1	1
- Induced (n=515)	18 (3.5)	2.0 [1.1-3.4]	1.5 [0.8-3.0]
Mode of delivery			
- Spontaneous (n=2529)	47 (1.9)	1	1
- Assisted (n=801)	22 (2.8)	1.5 [0.9-2.5]	1.2 [0.7-2.1]
Duration from 5 to 10 cm			
- Less than 2 h (n=895)	19 (2.1)	1.5 [0.8-2.9]	1.8 [0.95-3.5]
- Interval 2-4 h (n=1364)	19 (1.4)	1	1
- Interval 4-6 h (n=578)	15 (2.6)	1.9 [1.0-3.7]	1.7 [0.9-3.4]
- More than 6 h (n=182)	7 (3.9)	2.8 [1.2-6.8]	**2.5 [1.0-6.1]**
Duration from 10 cm to beginning of expulsive efforts			
- Less than 1 h (n=2278)	44 (1.9)	1	
- Interval 1-2 h (n=663)	16 (2.4)	1.3 [0.7-2.2]	
- More than 2 h (n=258)	6 (2.3)	1.2 [0.5-2.9]	
Duration of expulsive efforts			
- Less than 10 min (n=483)	6 (1.2)	1	1
- Interval 10-19 min (n=1401)	23 (1.6)	1.3 [0.5-3.3]	1.3 [0.5-3.5]
- Interval 20-29 min (n=772)	16 (2.1)	1.7 [0.7-4.3]	1.7 [0.6-4.8]
- Interval 30-39 min (n=426)	11 (2.6)	2.1 [0.8-5.7]	1.9 [0.6-5.7]
- Interval 40-49 min (n=134)	6 (4.5)	3.7 [1.2-11.7]	**3.5 [1.0-12.3]**
- More than 50 min (n=42)	6 (14.3)	13.2 [4.1-43.2]	**10.6 [2.8-40.3]**

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