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Risk of Severe Postpartum Hemorrhage in Low-Risk Childbearing Women in New Zealand: Exploring the Effect of Place of Birth and Comparing Third Stage Management of Labor

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ABSTRACT: Background: *Primary postpartum hemorrhage is a leading cause of maternal mortality and morbidity internationally. Research comparing physiological (expectant) and active management of the third stage of labor favors active management, although studies to date have focused on childbirth within hospital settings, and the skill levels of birth attendants in facilitating physiological third stage of labor have been questioned. The aim of this study was to investigate the effect of place of birth on the risk of postpartum hemorrhage and the effect of mode of management of the third stage of labor on severe postpartum hemorrhage.* **Methods:** *Data for 16,210 low-risk women giving birth in 2006 and 2007 were extracted from the New Zealand College of Midwives research database. Modes of third stage management and volume of blood lost were compared with results adjusted for age, parity, ethnicity, smoking, length of labor, mode of birth, episiotomy, perineal trauma, and newborn birthweight greater than 4,000 g.* **Results:** *In total, 1.32 percent of this low-risk cohort experienced an estimated blood loss greater than 1,000 mL. Place of birth was not found to be associated with risk of blood loss greater than 1,000 mL. More women experienced blood loss greater than 1,000 mL in the active management of labor group for all planned birth places. In this low-risk cohort, those women receiving active management of third stage of labor had a twofold risk (RR: 2.12, 95% CI: 1.39–3.22) of losing more than 1,000 mL blood compared with those expelling their placenta physiologically.* **Conclusions:** *Planned place of birth does not influence the risk of blood loss greater than 1,000 mL. In this low-risk group active management of labor was associated with a twofold increase in blood loss greater than 1,000 mL compared with physiological management. (BIRTH 39:2 June 2012)*

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Primary postpartum *hemorrhage* is a leading cause of maternal mortality and morbidity internationally. In Africa and Asia, hemorrhage (all types) accounts for approximately one-third of all maternal deaths (1). In high-resource countries maternal death as a result of postpartum hemorrhage is rare, although severe blood loss can result in significant morbidity. Primary postpartum hemorrhage is often defined as a blood loss of over 500 mL during or within the first 24 hours of birth (2). However, average blood loss during vaginal birth has been estimated at 500 mL, and this amount of blood loss is usually well tolerated by women in high-resource countries, who enter labor and birth in good health. These women are usually not hemodynamically compromised (3) by a blood loss of 500 mL and will not require active treatment. Some authors are calling for a change from the definition of primary postpartum hemorrhage to one that incorporates measures that are more clinically significant, for example, a blood loss of 1,000 mL (3).

Visual estimation of blood loss is notoriously inaccurate (usually resulting in the underestimation of blood loss) (4,5). However, it is the primary method available to practitioners in the immediacy of the clinical situation, providing the basis for clinical management decisions. Although this study relies on the estimation of blood loss by midwives, and we acknowledge that inaccuracy is inherent in this method, midwives' estimates of blood loss are assumed to be consistent in different birth settings and when different methods of third stage management are used.

Two broad approaches to the management of the third stage of labor are used: active (using a uterotonic drug) or physiological (also known as "expectant" and omitting the use of a uterotonic drug). These approaches are described in a consensus statement by the New Zealand College of Midwives (6) and are summarized in the "Methods" section of this paper. Many variations occur within these two broad approaches, making comparisons difficult (7). A meta-analysis of active versus expectant management of the third stage of labor (7) found that active management reduced the risk of severe primary postpartum hemorrhage (>1000 mL blood loss) (RR: 0.34, 95% CI: 0.14–0.87). The review included five studies, all of which were conducted in hospital settings. Three studies used only women at low risk of bleeding and subanalysis of these data demonstrated no statistically significant difference in risk of severe primary postpartum hemorrhage (>1,000 mL) (RR: 0.31, 95% CI: 0.05–2.17). Active management of labor reduced blood loss at the time of birth but increased hypertension, pain and discomfort, and readmission to hospital for postnatal bleeding. The authors identified that midwives in the included studies were not necessarily skilled in both methods of management of third stage. They recommend that trials of third stage management be conducted in countries where midwives are skilled in both management techniques, and cite the Netherlands and New Zealand as examples (7).

A retrospective cohort study (*n* = 33,752) in New Zealand (using the same database accessed for this study) (8), focusing on the third stage management of low-risk women, found that 48.1 percent of this group experienced a physiological third stage of labor. Higher proportions of women giving birth at home and in primary settings had a physiological third stage of labor compared with those giving birth in secondary and tertiary hospitals. Despite this important difference in third stage management by birth setting, significantly fewer women giving birth at home had a blood loss of between 501 and 1,000 mL or greater than 1,000 mL than women giving birth in the tertiary hospital. However, these results were not adjusted for confounders, and it seems outcomes were attributed to actual rather than planned place of birth, creating the potential for inflation of blood loss in secondary and tertiary settings, as women with complexities arising in labor are transferred to secondary and tertiary hospitals.

In New Zealand midwives are lead maternity caregivers for most women (9). Midwives can support women to give birth in a variety of settings: home, primary birth units or birth centers, and secondary- and tertiary-level hospitals. As lead maternity caregivers, midwives provide continuity of care to a caseload of women from early pregnancy through to 6 weeks postpartum, consulting with and referring to other health practitioners as the clinical situation warrants. A nationally agreed set of consultation and referral criteria provide details of the conditions for which a consultation or referral is necessary (10). All practitioners (midwives, general practitioners, and obstetricians) providing primary maternity care do so under a standard agreement with the Ministry of Health. This contract specifies the services that must

be provided by maternity caregivers nationally. Midwives are able to prescribe within the scope of normal childbirth (this includes agents for the management of third stage of labor), and request the necessary blood or radiology tests. The New Zealand College of Midwives is the professional college for midwives and supports physiological third stage of labor when labor has been physiological (6).

We wanted to focus on outcomes for the management of third stage of labor in a low-risk group and test the hypothesis that place of birth affects the risk of postpartum hemorrhage. Analysis of these data demonstrated high rates of postpartum hemorrhage with active management of labor for each birth setting (see "Results"); therefore, we proceeded to analyze severe postpartum hemorrhage (blood loss > 1,000 mL) by mode of third stage management for the entire cohort regardless of place of birth. The aims of this paper were to investigate the effect of place of birth on the risk of postpartum hemorrhage and the effect of mode of management of the third stage of labor on severe postpartum hemorrhage in the total cohort.

Methods

Data for the study were obtained from the New Zealand College of Midwives research database managed by the Midwifery Maternity Provider Organisation. The population comprised all low-risk women giving birth in 2006 and 2007. The Midwifery Maternity Provider Organisation provides midwife members with a practice management system that includes claims for service provision and collection of clinical data. Midwives can enter clinical data electronically or in hard copy. In 2006 and 2007, this database held data for approximately 32 percent of all births occurring in New Zealand (11). Data quality is enhanced by regular auditing and validation procedures. The database is comprehensive collecting data on demographics, medical history, pregnancy, labor, and birth (including third stage management), postnatal care, and planned (at labor commencement) and actual place of birth. As many of the fields are not mandatory, the denominator varies for some outcomes reported in this study. In addition, poor compliance with some data fields precluded our use of body mass index as an exclusion criterion to obtain our low-risk cohort. Issues related to confidentiality also prevented us from accessing the woman's postal code and using it to control for socioeconomic status.

Notwithstanding these limitations, the exclusion criteria are comprehensive, enabling us to identify an appropriate low-risk cohort from the database. The exclusion criteria were as follows: previous cesarean section, stillbirth, previous postpartum hemorrhage (>1,000 mL), severe pregnancy-induced hypertension, gestational diabetes, Rh sensitization, ABO incompatibility existing, essential hypertension, diabetes, thyroid disease, drug and/or alcohol abuse, heart disease, pulmonary disease/asthma, hematological disorder, neurological disorder, renal/urinary tract disorder, muscular skeletal disorder, any consultation with or transfer of care to another practitioner during the antenatal period, multiple birth, fetal death before commencement of labor, women who presented in labor before 36 completed weeks' gestation (on or before 36 + 6 days) or after 42 completed weeks' gestation (after 41 + 6 days), induced labor, breech or shoulder presentation, transverse lie, and elective cesarean section.

Planned place of birth was defined as home, primary unit, secondary hospital, or tertiary hospital. New Zealand has approximately 6 tertiary, 18 secondary, and 57 primary maternity units (9).

Active management has the following characteristics as described by the New Zealand College of Midwives (6): the uterotonic drug of choice is administered as soon as possible after birth of the baby's anterior shoulder; the cord is clamped and cut as soon as possible after birth of the baby; and after signs of separation the placenta is born by maternal effort or controlled cord traction. Physiological management is described as follows: no prophylactic uterotonic drug, no controlled cord traction, and delayed clamping and cutting the cord for several minutes or until the placenta is expelled. If the cord is clamped and cut before expulsion of the placenta, the placental end is to be drained. The woman is kept warm and encouraged to put the baby to the breast if she is planning to breastfeed. When signs of placental separation are evident, the mother's position may be changed to increase the force of gravity (i.e., squatting position) and encourage maternal effort to expel the placenta. Gentle traction on the cord may be used to guide the placenta out.

The database offers the following four options for recording third stage management: active management, active management with treatment, physiological, and physiological with treatment. In this analysis active management and active management with treatment were combined under the classification "active management" and physiological and physiological management with treatment were combined under the classification "physiological third stage." Treatment refers to the administration of a uterotonic drug and in the case of active management of the third stage of labor, it refers to the administration of a further dose of a uterotonic drug.

Data Analysis

Analysis was planned with multinomial logistic regression controlling for maternal age, parity, ethnicity, smoking, augmentation of labor, length of labor, mode of birth, episiotomy, perineal trauma, and newborn birthweight greater than 4,000 g. In the analysis of place of birth, adjustments were also made for mode of third stage management. All analyses were performed using Stata V11 (12). Outcomes were attributed to the planned place of birth at the onset of labor rather than actual place of birth. The study was approved by the New Zealand Multi-Region Ethics Committee.

Results

Data were obtained for a total of 39,677 births, of which 16,453 (41.5%) met our low-risk criteria. Of this group, 11.3 percent were planning to give birth at home, 17.7 percent in a primary unit, 45.5 percent in a secondary-level hospital, and 25.4 percent in a tertiary-level hospital.

Table 1 shows the mean age, parity, length of labor, proportion of vaginal births, and active management of third stage of labor by planned place of birth. Each group differs significantly on these characteristics, with women planning to give birth at home or in primary units having a higher mean age and parity and shorter mean length of labor. The home and primary unit groups demonstrated a greater proportion of unassisted vaginal births and lower proportion of active management of third stage of labor than the secondary and tertiary hospital groups. Adjustments were made in the analysis to control for these differences and several other potential confounders.

Table 2 shows the number of cases with blood loss greater than 1,000 mL and mode of third stage management for each planned place of birth. In total, 1.3 percent (214/16,200) of this low-risk cohort experienced a blood loss greater than 1,000 mL. Although the home birth group had the lowest proportion of women receiving active management of the third stage of labor, they also had the lowest proportion experiencing a blood loss greater than 1,000 mL (1%). The tertiary hospital group had the

Table 1. Age, Parity, Length of Labor, Vaginal Birth, and Active Management of Third Stage by Planned Place of Birth

	Planned Place of Birth					
Characteristic	Home (n = 1,830)	Primary Unit (n = 2,877)	Secondary Hospital (n = 7,380)	Tertiary Hospital (n = 4,123)	Total (n = 16,210)	p
Mean age (yr) (SD)	30.4 (5.4)	27.9 (6.0)	27.7 (6.0)	29.3 (5.9)	28.5 (6.0)	<0.0005
Mean parity (SD)	1.4 (1.4)	1.1 (1.2)	0.9 (1.2)	0.7 (1.0)	1.0 (1.2)	<0.0005
Mean length of labor (hr)* (SD)	5.1 (4.8)	6.1 (4.8)	6.39 (4.6)	7.4 (5.3)	6.4 (4.9)	<0.0005
Proportion of unassisted vaginal births	95.4%	94.7%	84.5%	72.7%	84.6%	<0.0005
Proportion of emergency cesarean sections	2.6%	3.2%	8.5%	14.9%	8.5%	<0.0005
Proportion of active management	25.9%	47.1%	73.2%	77.8%	64.4%	<0.0005

*From established labor to end of second stage in hours.

Table 2. Percentage of Total Cohort with Blood Loss Greater than 1,000 mL for Each Mode of Third Stage Management and Place of Birth

	Planned Place of Birth				
Mode of Third Stage Management	Home (n = 1,830)	Primary Unit (n = 2,904)	Secondary Hospital (n = 7,359)	Tertiary Hospital (n = 4,107)	Total (n = 16,200)
Active	13	23	86	58	180
Physiological	6	9	10	9	34
Total* (%)	19 (1.0)	32 (1.1)	96 (1.3)	67 (1.6)	214 (1.3)

*Percentage of total cohort giving birth at home/primary unit/secondary and tertiary hospitals experiencing blood loss greater than 1,000 mL.

Table 3. Risk of Various Factors on Blood Loss Greater than 1,000

Variable	Crude RR (95% CI)	p	Adjusted RR* (95% CI)	p
Planned place of birth				
Home	0.93 (0.53–1.65)	0.81	0.93 (0.49–1.74)	0.97
Primary unit	(reference group)			
Secondary hospital	1.20 (0.80–1.79)	0.38	1.07 (0.68–1.69)	0.45
Tertiary hospital	1.47 (0.96–2.24)	0.08	1.10 (0.67–1.79)	0.23
Smoking (yes vs no)	0.79 (0.54–1.16)	0.23	0.80 (0.49–1.30)	0.37
Maternal age (yr) (>35 vs <35)	1.37 (0.99–1.88)	0.06	1.31 (0.89–1.93)	0.18
Parity (nulliparous vs multiparous)	**0.73 (0.56–0.95)**	**0.02**	1.11 (0.75–1.66)	0.60
Ethnicity				
NZ European	(reference group)			
Maori	0.94 (0.67–1.34)	0.75	1.18 (0.76–1.82)	0.46
Pacific Islander	1.30 (0.76–2.25)	0.34	1.61(0.90–2.88)	0.11
Asian	1.34 (0.80–2.24)	0.26	1.20 (0.69–2.09)	0.51
Other	0.88 (0.39–1.98)	0.76	0.96 (0.42–2.10)	0.93
Augmentation of labor (yes vs no)	**1.34 (1.02–1.75)**	**0.03**	0.85 (0.61–1.17)	0.32
Mode of birth				
Vaginal	(reference group)			
Assisted vaginal	**1.75 (1.10–2.78)**	**0.02**	0.89 (0.45–1.72)	0.72
Emergency cesarean section	**3.99 (2.94–5.41)**	**<0.001**	**2.98 (1.73–5.11)**	**<0.001**
Episiotomy (yes vs no)	1.29 (0.84–1.99)	0.24	0.98 (0.53–1.82)	0.96
Perineal trauma (yes vs no)	0.92 (0.69–1.21)	0.54	1.30 (0.88–1.92)	0.19
Macrosomia (>4 kg vs <4 kg)	**1.53 (1.12–2.09)**	**0.01**	1.40 (0.99–1.99)	0.06
Mode of third stage (active vs physiological)	**2.94 (2.04–4.24)**	**<0.001**	**2.12 (1.39–3.22)**	**<0.001**

*Relative risks (RR) were adjusted for smoking, maternal age, parity, ethnicity, augmentation, length of labor, mode of birth, episiotomy, perineal trauma, newborn birthweight > 4,000 g, and mode of third stage management.
Statistically significant results are presented in bold.

highest proportion of women receiving active management of the third stage of labor and the highest proportion of women experiencing a blood loss greater than 1,000 mL (1.6%).

A greater number of women with blood loss more than 1,000 mL were in the active management groups for all planned birth places. Twice as many women in the physiological third stage group went on to have further (uterotonic) treatment compared with those in the active management group (14.0% vs 7.3%).

Table 3 shows the relative risk of blood loss greater than 1,000 mL by planned place of birth. The relative risk of a blood loss greater than 1,000 mL was 0.93 (95% CI: 0.49–1.74) for the home birth group, 1.07 (95%CI: 0.68–1.69) for the secondary hospital group, and 1.10 (95% CI: 0.67–1.79) for the tertiary hospital group, although the differences were not statistically significant. Place of birth in this study was not associated with risk of blood loss greater than 1,000 mL. Table 3 also shows the relative risk of blood loss greater than 1,000 mL for several variables, including mode of third stage management. In this

low-risk cohort of women, those women receiving active management of third stage of labor had a twofold risk of a blood loss greater than 1,000 mL compared with those undergoing physiological management of third stage of labor (RR: 2.14, 95% CI: 1.42–3.22). In addition, women experiencing an emergency cesarean section had an almost threefold risk of blood loss greater than 1,000 mL than women who had an unassisted vaginal birth.

Discussion

The proportion of women experiencing severe postpartum hemorrhage (>1,000 mL) in this study was 1.3 percent, which is lower than that reported in other low-risk populations. For example Fahy (13) reported that 2.6 percent of women in their cohort study had a blood loss greater than 1,000 mL, and Rogers et al (14) identified in their randomized controlled trial that 2 percent (90/3,436) of women had a blood loss greater than 1,000 mL. The reporting of postpartum

hemorrhage nationally in New Zealand uses a definition of greater than 500 mL, and does not distinguish between women of high and low risks of hemorrhage. The report by Thompson et al (15) demonstrated that 2.3 percent of women giving birth vaginally had a blood loss of 1,000 mL or more but less than 1,500 mL and 1.6 percent had a blood loss of 1,500 mL or more. However, these data included women who had risk factors for postpartum hemorrhage. The low rate of severe postpartum hemorrhage found in our study may reflect the rigorous low-risk criteria used (which excluded women undergoing induction of labor among other factors), or underestimation of blood loss and under-reporting of postpartum hemorrhage. Another relevant factor is the model of continuity of care provided to all women in this study. One-to-one care may afford greater vigilance in the third stage than other models of care.

In this study of low-risk women (during the period 2006–2007), 35.6 percent had a physiological third stage of labor. Using the same database (for the period 2004–2008), Dixon et al reported that 48.1 percent of their low-risk cohort experienced a physiological third stage (8). This disparity may arise because of the different study samples. Dixon et al included only those women experiencing a normal vaginal birth, whereas our study included all women deemed low risk at the point of labor commencement regardless of the subsequent mode of birth. It is difficult to compare the rate of physiological third stage identified in this study with those found in other high resource settings because of the dearth of published data on the prevalence of this practice. Active management of the third stage of labor is a policy in most obstetrics hospitals (in high-resource countries), and we suggest that the rate of physiological third stage of labor in New Zealand is high compared with similar countries. It is not surprising that significantly more women experienced a physiological third stage of labor who were planning to give birth at home or in primary birth settings compared with those planning to give birth in secondary or tertiary hospitals. This finding could result because the former would be more motivated toward physiological birth in general and also would have been more likely to have had a physiological labor and birth (16). It is not surprising that twice the proportion of women in the physiological group compared with the active management group were administered a uterotonic as treatment, because it would be one of the first courses of action for midwives concerned about blood loss because of uterine atony in the third stage of labor.

Fahy (13) expounded a theory of holistic physiological third stage of labor—a psychophysiological approach. These authors critique expectant management of the third stage for merely representing the absence of active management techniques, as they maintain that optimal third stage management is much more complex. Their approach recognizes the importance of the context and birth environment in facilitating an optimal hormonal response to labor and birth, which includes minimizing the release of stress hormones (catecholamines) and facilitating the release of endorphins (oxytocin and prolactin) (17,18).

Oxytocin is important to the third stage of labor as it stimulates uterine contractions, thereby promoting hemostasis. After birth in a physiological labor, the woman's contact with her baby (the smell and touch), especially during breastfeeding, results in a flood of oxytocin. Environmental factors that cause disruption to this process can therefore affect the physiology of the third stage of labor. Hastie and Fahy (18) suggest that the birth environment is critically important to the physiology of labor and birth, including the third stage, although our study did not identify any association between birth setting and postpartum blood loss greater than 1,000 mL.

In this study of low-risk women, those having active management of the third stage of labor had twice the risk of severe postpartum hemorrhage than those having a physiological third stage of labor. This finding runs counter to some of the findings from randomized controlled trials (7,14) but is congruent with the experiences of midwives in New Zealand reported anecdotally. Meta-analysis of the data in randomized controlled trials by Begley (7) and Rogers et al (14) (who focused on a low-risk group) demonstrated no significant difference between active management and physiological groups for blood loss greater than 1,000 mL although the trend favors active management (RR: 0.31, 95% CI: 0.05–2.17). However, other indicators of severe postpartum hemorrhage such as blood transfusion (RR: 0.30, 95% CI: 0.10–0.88) and iron therapy in the puerperium (RR: 0.59, 95% CI: 0.48–0.72), are statistically significant and favor active management.

These studies (7,14) have been criticized for including women with some risk factors for postpartum hemorrhage, including induction and augmentation of labor. It is also clear in these studies that physiological third stage was not common practice at the time and that midwives were less confident with this option. A more recent Swedish trial (19) of low-risk women (although also potentially including women experiencing induction or augmentation of labor) comparing a physiological third stage with active management, reported a high rate of severe postpartum hemorrhage— 13.5 percent overall. The physiological group were significantly more likely to experience blood loss greater than 1,000 mL, but no more likely to have a blood transfusion than the active management group. Although

mean postpartum hemoglobin was lower in the physiological group, it was not clinically meaningful (Hb: 118 g/dL vs 115 g/dL). Physiological third stage in the Swedish study included immediate cord clamping; therefore, this method would more appropriately be classified as a mixed method.

Drawing on the same data set as our study, Dixon et al (8) found that compared with the active management group, significantly fewer women in the physiological group had a blood loss greater than 1,000 mL (0.5% vs 1.5%). In Australia a retrospective cohort study by Fahy et al (13) comparing physiological third stage (in a birth center, $n = 361$) and active management of the third stage of labor (in a tertiary hospital, $n = 3075$) in low-risk women found that active management of labor was associated with an increase in the risk of postpartum hemorrhage (OR: 4.4, 95% CI: 2.3–8.4). It is not clear whether the outcomes for third stage were attributed to planned place of birth or actual place of birth.

Retrospective cohort studies are vulnerable to selection bias and other weaknesses, and these results should be treated with caution. We were unable to identify (and exclude) women with a high body mass index, and these women are known to have a greater risk of postpartum hemorrhage than those of a normal body mass index. The higher rate of severe postpartum hemorrhage in the active management group found in our study could be explained by selection bias, underestimation, or under-reporting of postpartum hemorrhage in the physiological third stage group. It could also reflect complacency in the third stage of labor when it is managed actively. Midwives may not be as vigilant as they should be in monitoring uterine contractility and blood loss when active management is used. It is clear, however, that we do not have good evidence that informs our decision making for women at low risk of hemorrhage (who have experienced a physiological labor), in high-resource settings and with caregivers who are confident and competent in active management and physiological third stage of labor. The results of this study suggest that women at low risk of hemorrhage with caregivers who are confident in the physiological management of third stage of labor may have less risk of severe postpartum hemorrhage than their counterparts experiencing active management of the third stage of labor. Further prospective research is needed to substantiate these results and provide stronger evidence to inform decision making.

Conclusions

Our results showed that blood loss greater than 1,000 mL was experienced by 1.32 percent of this low-risk cohort of women. Place of birth was not associated with risk of blood loss greater than 1,000 mL but women receiving active management of the third stage of labor experienced a twofold increase in risk of blood loss greater than 1,000 mL compared with those having a physiological third stage of labor. This finding is in contrast to those from randomized controlled trials on this clinical issue. Significant blood loss in labor or the postpartum period exposes women and their babies to additional risks and also comes at a financial cost to the health service. It is important, therefore, that interventions are driven by clinical need, used judiciously, and demonstrate benefit to the mother and/or her baby. It is also important that health professionals explore factors that may assist them to better support women and encourage physiological birth where appropriate. This study suggests that management of third stage of labor in low-risk women is a factor worthy of further investigation.

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