AOTEAROA NEW ZEALAND RESEARCH

Timing of cord clamping: An observational study of cord clamping practice in a maternity hospital in Aotearoa New Zealand

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ABSTRACT

Background: When the umbilical cord is left unclamped after birth, a significant proportion of the blood from the placenta flows into the newborn, increasing the baby's blood volume by approximately 30%. Routine intervention of immediate cord clamping is harmful as it deprives the newborn access to their own blood, resulting in impaired physiological transition at birth and lower iron stores in early infancy. Iron deficiency in early life, even without anaemia, is linked with impaired neurodevelopment.

Aim: The aim of this study was to accurately record birth to cord clamping interval at term vaginal births in a tertiary hospital in Aotearoa New Zealand and concurrently to examine some of the circumstances that may influence the timing of when the cord is cut.

Method: This observational study was undertaken from August 2017 to April 2018. Participants were pregnant women having a vaginal birth at ≥37 weeks gestation. Data collected included birth to cord clamping interval, mode of birth (spontaneous or instrumental), maternal position for birth and practitioners involved in the birth. Descriptive statistics were used to summarise the data.

Results: Participants were 55 women with term vaginal births. The median interval between birth and cord clamping was 3.5 minutes (IQR 2.18 - 5.68 mins). There was a longer median cord clamping time in the group who had a spontaneous birth (median 3.71; IQR 2.67 - 6.23) vs instrumental birth (2.08; IQR 0.55 - 2.30); with maternal side-lying position (6.37; IQR 4.15 - 9.48) vs lithotomy position (2.24; IQR 1.87 - 3.50); with midwife-facilitated birth (4.06; IQR 2.68 - 6.65) vs obstetric-facilitated birth (2.13; IQR 1.48 - 3.28); and when the neonatal team was not called to attend (4.73; IQR3.32 - 8.26) vs when they were called to attend (2.13; IQR 1.28 - 3.27).

Discussion: The median cord clamping time of 3.5 minutes aligns with current local, national and international guidelines, although clamping times as short as 0.23 minutes were observed. The study provides a snapshot of practice at one tertiary hospital, examining data on a range of vaginal births, from uncomplicated midwifery-led births to complicated obstetric-led births requiring neonatal team attendance. By identifying some of the circumstances where cords are clamped early, we may be able to modify the associated factors for these births, thereby improving newborn health outcomes in the future.

Keywords: birth practice, placental transfusion, term newborn, third stage, umbilical cord clamping timing

BACKGROUND

Since its introduction as one of the earliest interventions in childbirth, umbilical cord clamping has been a topic of ongoing debate and research (Downey & Bewley, 2012). There is now substantial evidence showing that immediate cord clamping is harmful. It leads to a reduction in blood volume, leading to low iron stores for infants up to 6 months of age (McDonald et al., 2013), a disruption to newborn transitional physiology (Andersson et al., 2019; Bhatt et al., 2013; Ersdal, et al., 2014; Hooper et al., 2015; Niermeyer & Velaphi, 2013), and a 30% increase in mortality for preterm babies (Fogarty et al., 2018). Whereas, leaving the cord intact for at least 3 minutes has been shown in a randomised control study to increase ferritin by 45% at 4 months (Andersson et al., 2011). Furthermore, reduced iron stores in infancy, even without anaemia, are linked with impaired neurodevelopment (Andersson et al., 2015; Carter et al., 2010; Lozoff et al., 2013; Mercer et al., 2018). Neonatal jaundice has been linked to delayed cord clamping in one meta-analysis (McDonald et al., 2013) but in other studies no correlation was found (Andersson et al., 2011; Begley et al., 2019; Hutton & Hassan, 2007).

Immediate cord clamping, alongside the administration of uterotonic medication and controlled cord traction, was widely adopted in the 1960s when active management was introduced to manage placental birth and to reduce maternal blood loss (Begley et al., 2019). In response to the evidence of harm caused by immediate clamping, a growing number of maternity clinicians report leaving the umbilical cord unclamped for extended periods of time (Boere, Smit et al., 2015; Devin & Larkin, 2018; Fulton et al., 2016; Leslie et al., 2018; Richards, 2009). Also, active management has been adapted to include deferred cord clamping with no significant increase in rates of maternal postpartum haemorrhage (PPH; McDonald et al., 2013).

Many national and international guidelines on intrapartum care have been updated to recommend a delay between birth and cord clamping for any baby not needing resuscitation (Table 1). An umbilical cord clamping guideline introduced at the study hospital in 2014 recommended that, unless resuscitation was required, term neonates should have the cord left unclamped for at least 3 minutes at a vaginal birth and 2 minutes at a caesarean birth (Canterbury District Health Board [CDHB], 2014).

The way in which placental birth is managed is a key driver as to the timing of cord clamping. Midwives in Aotearoa New Zealand (Aotearoa NZ) continue to facilitate physiological placental birth, without a routine uterotonic and with the cord left intact, when the chance of a PPH is low. Even in tertiary hospitals in Aotearoa NZ, where intervention is prevalent, 34.1% of normal births are followed by a physiological placental birth (Dixon et al., 2009).

For women who require active management of placental birth due to a higher risk of PPH, guidance on the timing of uterotonic administration in relation to cord clamping varies from one guideline to another (Table 1). Maternal blood loss and neonatal morbidity do not appear to be affected when synthetic oxytocin is administered before or after cord clamping (Andersson et al., 2013; Farrar et al., 2011; Soltani et al., 2010; Vain et al., 2020; Winkler et al., 2022). As with all perinatal decision making, the timing of administration of a prophylactic uterotonic requires a consideration of potential complicating factors, both maternal and newborn.

International guidelines have not clearly defined an optimal time for cord clamping (Table 1). Early/immediate cord clamping is generally conducted within 1 minute of the birth, interrupting the blood flow between the newborn and the placenta. Delayed/deferred cord clamping typically refers to clamping and cutting between 1 and 5 minutes following the birth of the baby or is sometimes described as leaving the cord intact until pulsations have ceased or until after the placenta is birthed. Post birth, umbilical blood flow accounts for approximately one-quarter to one-third of potential total blood volume in term neonates (Farrar et al., 2011; Yao et al., 1968). This flow is not necessarily related to a set timeframe and varies considerably from one birth to another, dependent on factors such as gestation (Linderkamp, 1982), mode of birth (Andersson et al., 2016), uterine contractions (Stenning et al., 2021; Yao et al., 1968) and neonatal breathing efforts (Bhatt et al., 2013; Boere, Roest et al., 2015; Ersdal et al., 2014). Further, gravity does not influence the volume of placental transfusion as much as was previously reported (Yao & Lind, 1969), with newborns found to receive as much blood when placed on the maternal abdomen as when held at the level of the vagina (Vain et al., 2014).

Blood may continue to move through the cord, both in umbilical arteries and the vein, beyond five minutes post-birth, and will continue even when pulsations have ceased (Boere, Roest et al., 2015). A "cessation of pulsations" continues to be used as an indication that the newborn has received its full quota of placental blood, even though pulsations are felt in the umbilical arteries and not the vein, representing blood moving away from and not towards the baby (Boere, Smit et al., 2015). There is a move towards terminology such as “Wait for white”, to recommend waiting until the cord is flaccid and empty of blood (Burleigh, 2021), or “physiological-based cord clamping” to recommend individualised practice according to the newborn’s response to their extra-uterine transition (Knol et al., 2019).

Observational data on cord clamping practice are limited. The largest observational studies were conducted in maternity hospitals in low-income countries (Ersdal et al., 2014; Nelin et al., 2018). Of those conducted in high-income countries, one observational

Table 1. Cord clamping guidelines. Summarised guidance for umbilical cord clamping for term newborns current at the time of data collection

Organisation (year)	For vigorous term newborn	Timing of uterotonic (active management)	For non-vigorous newborn
New Zealand College of Midwives (2013)	At least 3 minutes	After cord clamping	May be beneficial to leave cord intact for resuscitation
Royal Australian and New Zealand College of Obstetricians and Gynaecologists (2017)	No urgency ...appropriate time frame	Not specified	Not stated
World Health Organization (2014)	Not earlier than 1 minute	Not specified	Ventilation can be initiated before clamping cord
National Institute for Health and Care Excellence (2017)	Not earlier than 1 minute; before 5 minutes	Immediate, prior to cord clamping	Earlier than 1 minute only if concern about cord integrity or newborn heart rate
Royal College of Obstetricians and Gynaecologists (2015)	Defer cord clamping until 2 minutes after delivery	If given before cord clamping, unlikely to have a substantive effect on placental transfusion	Refers to WHO and NICE
American College of Obstetricians and Gynecologists (2017)	At least 30-60 seconds	If delayed until after cord is clamped, no increase in PPH	Immediate if resuscitation is needed
American College of Nurse-Midwives (2014)	5 minutes if skin to skin; 2 minutes if below level of introitus	Not stated	Early or immediate clamping; cord milking may be of benefit
Canterbury District Health Board Guideline (2014)	At least 3 minutes	Uterotonic within first 3 minutes after birth; clamp and cut between 3 and 5 minutes	If newborn needing resuscitation, clamp and cut at 1 minute

study, set in a Canadian tertiary hospital in 2006 and 2007, found that over half of the newborns observed had their cord clamped within 15 seconds of birth (Hutton et al., 2013). Of the 89 practitioners observed, 76 were doctors and 13 were midwives. The majority (93%) of women giving birth in Canada, had an obstetrician or family physician (general practitioner) as their lead maternity carer (LMC) at the time of the study (Guliani, 2015). In the United Kingdom, an observational study timed cord clamping with a stopwatch at 100 births conducted by midwives in 2006 and 2007 and found that 85% of cords were clamped within 30 seconds of the birth and the remaining 15% between 30-100 seconds (Airey et al., 2008). There have not been any published observational studies on cord clamping in Aotearoa NZ where the majority (94.2%) of women have a midwife as their LMC (Ministry of Health [Manatū Hauora], 2019).

The region where this study – (Timing of Cord Clamping [TOCC]) – took place had 6,457 births in 2017, of which 81% occurred in the tertiary referral hospital, 14% occurred in midwifery-led community units and 5% at home (CDHB, 2018). The spontaneous vaginal birth rate for the region was 56.7% (including 5.4% waterbirths) and the instrumental vaginal birth rate was 12.9%. Women who have no medical or obstetric complications are encouraged to birth at the midwifery-led community units, though many choose to birth in the tertiary hospital. Of the 13 birthing rooms at the study hospital, two have birthing pools. Where birth takes place in the tertiary hospital, one of the LMC midwives from the woman's assigned group practice usually attends the birth. If the LMC midwife is unavailable or if complications ensue, birth will be facilitated by hospital-employed midwives and/or the obstetric team. The neonatal team is called to births where there is a potential or actual need for resuscitation, including all instrumental births.

In a survey conducted in Aotearoa NZ, 86% of midwives (n = 257) reported leaving the cord intact for at least 3 minutes during physiological placental birth, with 16% doing the same during an actively managed third stage (Richards, 2009). Observation and self-reported practice do not always look the same (Farrar et al., 2010) and by the researchers choosing an observational measurement of practice, further insight will be gained in this era of ongoing debate on the optimal timing of cord clamping.

AIM

The aim of this study was to accurately record cord clamping timing at term vaginal births in a tertiary hospital in Aotearoa NZ. Data on specific birth factors that may influence cord clamping timing were collected and analysed.

METHOD

Study design and participants

An observational approach was used, examining cord clamping practice at term vaginal births, both spontaneous and instrumental. The research design and population sample of the TOCC study were informed by a Canadian study where cord clamping data were collected from October 2006 to April 2007 (Hutton et al., 2013). As in the Canadian study, the context for this study was a large tertiary hospital where births were facilitated by both midwives and obstetric doctors. The intention of the TOCC study was to collect data on at least 89 births, in line with the paper by Hutton et al.

Ethical approval for the study was received from the New Zealand Health and Disability Ethics Committee (HDEC) on 19 May 2017 (Reference 17/NTB/82). Consultation with Māori health advocates identified cultural aspects to consider. Of note were the significant tikanga/customs related to the care of the pito/cord and whenua/placenta for Māori. It was identified that the results of this study were likely to be relevant for tangata whenua/people of the land. Information leaflets and consent forms, as detailed in the ethics application, were created and shared.

All healthcare practitioners working at the study hospital who make decisions on timing of cord clamping (LMC midwives, hospital-employed midwives and obstetric doctors [consultants, registrars and house surgeons]) were approached to help recruit participants in the study. Any LMC (midwife or obstetrician) who consented to take part was given an explanation of the study and was supplied with information leaflets and consent forms to pass on to women in the third trimester of pregnancy. Women who consented to participate were eligible for inclusion at point of admission to the birthing suite if they were ≥37 weeks pregnant with a singleton cephalic fetus and were not booked to birth by caesarean section. If a woman was not consented at time of admission to hospital for labour care and the lead practitioner caring for her considered it appropriate (that is, she was not unduly distressed or in circumstances where the discussion about the research may have impacted on her ability to cope with labour), participation in the study was offered at this time.

Data collection and analysis

When a woman had consented and progressed to a spontaneous or instrumental vaginal birth at term, one of the health practitioners present at the birth was instructed to measure the cord clamping time by pressing a stopwatch (provided by researcher) once at the time that the entire baby was born and then again when the first clamp was applied to the cord. The stopwatch recorded this time in the format minutes:seconds:centiseconds. If the cord was clamped before the birth of the entire baby, e.g., when the cord was wrapped tightly around the baby's neck, the time was recorded as 0 minutes. Cord clamping times were recorded by the LMC midwife or hospital midwife in a designated notebook, alongside data on mode of birth, maternal position for birth and the practitioners involved. The neonatal team was recorded as being present if they arrived within 5 minutes of the birth.

The anonymised data were transferred to an Excel spreadsheet by the lead investigator. The data were then examined using descriptive statistics to report frequency distributions, medians, ranges and interquartile ranges for cord clamping times in groups with specified birth circumstances.

RESULTS

Data were collected from the births of 56 women between 14 August 2017 and 7 April 2018. One birth was excluded as gestation was <37 weeks. Thus, 55 births were included in the analysis.

The overall median cord clamping time was 3.5 minutes with a range of 0.23 min to 34 min (interquartile range [IQR] 2.18 - 5.68 min). All times were converted from minutes:seconds:centiseconds to minutes, plus the seconds as part of a minute to two decimal places (e.g., 2 minutes 11 seconds = 2.18 minutes).

The median cord clamping time was likely to be longer when the woman had a spontaneous vaginal birth rather than an instrumental birth; when she birthed in a side-lying or upright position rather than a seated position; when a midwife facilitated the birth rather than an obstetric doctor and when there was no neonatal team present at the birth (Table 2).

When cord clamping times were arranged into groups to explore the data according to frequency distribution, it was noted that

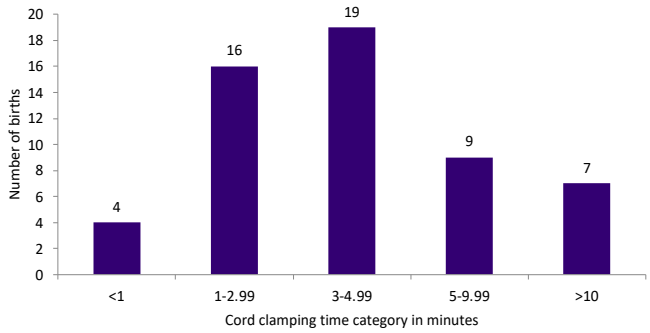
Table 2. Comparison of median and range of cord clamping times by subgroups

Births	n	%	Median	IQR*
All births	55	100	3.50	2.18 - 5.68
Mode of birth				
Spontaneous (including in water)	46	84	3.71	2.67 - 6.23
Instrumental (ventouse and forceps)	9	16	2.08	0.55 - 2.30
Birth position				
Kneeling or standing	10	18	3.93	3.27 - 9.17
Side-lying	7	13	6.37	4.15 - 9.48
Seated (upright or recumbent)	26	47	3.47	2.43 - 4.82
Lithotomy	12	22	2.24	1.87 - 3.50
Birth facilitator				
Midwife	40	73	4.06	2.68 - 6.65
Obstetric doctor	14	25	2.13	1.48 - 3.28
Student	1	2		
Neonatal team present				
No	35	63.6	4.73	3.32 - 8.26
Yes	20	36.4	2.13	1.28 - 3.27

* Interquartile range (25th to 75th centile)

64% (n = 35) of the newborns had their cords clamped between 1 and 5 minutes. Cords were clamped at less than 1 minute for four newborns and at more than 10 minutes for seven newborns (Figure 1).

Figure 1. Frequency distribution of cord clamping times



If the cord is clamped before the full birth of the baby's body the time interval would be recorded as 0 minutes; there were no cases of 0-minute cord clamping in our results.

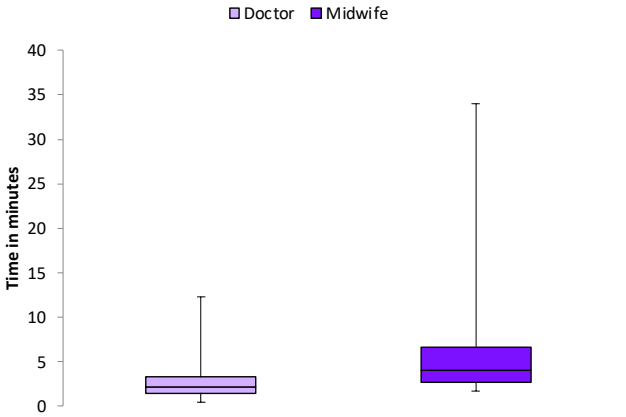
Of the births where the time interval was measured, 84% (n = 46) were spontaneous (one of which was a waterbirth) and 16% (n = 9) were instrumental (either ventouse or forceps). The maximum time that a cord was left intact at an instrumental birth was 4.15 minutes, whereas the maximum time for a spontaneous birth was 34 minutes. Cord clamping times for most spontaneous births (63%) were between 1 and 5 minutes, while the cord clamping times for most instrumental births (78%) were between 0 and 3 minutes. A cord clamping time of over 5 minutes was observed in 35% of spontaneous births but in none of the instrumental births.

The seated (upright or semi-recumbent, not including lithotomy) positions accounted for almost half (47%, n = 26) of all births in the study. There was a similar median cord clamping time for women who birthed in seated positions (median: 3.47 min. IQR: 2.43 - 4.82) and kneeling/standing positions (3.93 min. IQR: 3.27 - 9.17). The birth position with the highest median cord clamping time was side lying (6.37 min. IQR: 4.15- 9.48) and the position with the lowest was lithotomy (2.24 min. IQR: 1.87 - 3.50). Of the four newborns who had their cords clamped before 1 minute, three of the women were in the seated or lithotomy groups and one was in the side-lying group. In all the birth positions, including lithotomy, there was at least one birth where the cord was left intact for over 10 minutes.

The majority of births (73%, n = 40) in the study were facilitated by a midwife. Obstetric doctors facilitated 14 births (25%, n = 14) and one birth was facilitated by a student under the supervision of a registered midwife or obstetric doctor (not specified). The midwives had a median cord clamping time of 4.06 minutes (IQR: 2.68 - 6.65) and the obstetric doctors had a median cord clamping time of 2.13 minutes (IQR: 1.48 - 3.28). Three of the births facilitated by an obstetric doctor, and one by a midwife, had cord clamping times of under 1 minute. One of the births facilitated by an obstetric doctor and six by a midwife had a cord clamping time of over 10 minutes. Midwives commonly (35%) clamped the cord between 3 and 5 minutes, whereas obstetric doctors were most likely (43%) to clamp the cord between 1 and 3 minutes.

A box and whisker plot (Figure 2) highlights inter-professional and intra-professional variation in the timing of cord clamping and shows that the midwives clamped cords later, and with more variation, than the obstetric doctors. Both practitioner groups had similar minimum values for cord clamping timing but the 75th centile was much greater for midwives than for obstetric doctors.

Figure 2. Box and whisker plot of cord clamping times according to practitioner who facilitated the birth



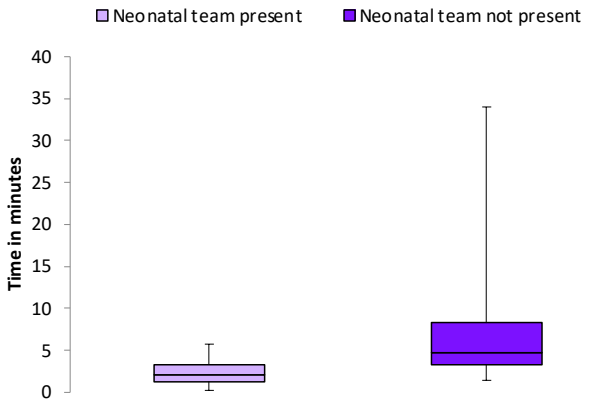
Note: One birth facilitated by a student is not included, as data collection did not specify whether student supervision was by obstetric doctor or midwife.

The neonatal team attended 36% of the births (n = 20) and the median cord clamping time for these births was 2.13 minutes (IQR: 1.28 - 3.27) compared to births where they were not present (median: 4.73 min. IQR: 3.32 - 8.26).

The neonatal team was present for all births where the cord was clamped before 1 minute (n = 4) but not present for any births where the cord was clamped more than 10 minutes after the birth (n = 0). Similarly, they were not present for 70% of the births when the cord was clamped at over 3 minutes. Figure 3

shows there was more variation in cord clamping times for births where the neonatal team was not present compared to when they were present.

Figure 3. Box and whisker plot of cord clamping times according to neonatal team presence



DISCUSSION

The aim of this study was to accurately record birth to cord clamping interval for a sample of term vaginal births in a tertiary hospital in Aotearoa NZ. Time intervals were measured between birth and cord clamping for the 55 babies born vaginally with gestations of ≥ 37 weeks, and specific circumstances related to these births were recorded. The median interval between birth and cord clamping for this sample was 3.5 minutes (IQR 2.18 - 5.68). There was a longer median cord clamping time in groups with spontaneous birth (3.71; IQR 2.67 - 6.23) vs instrumental birth (2.08; IQR 0.55 - 2.30); with maternal side-lying position (6.37; IQR 4.15 - 9.48) vs lithotomy position (2.24; IQR 1.87 - 3.50); with midwife-facilitated birth (4.06; IQR 2.68 - 6.65) vs obstetric-facilitated birth (2.13; IQR 1.48 - 3.28); and when the neonatal team was not called to attend (4.73; IQR 3.32 - 8.26) vs when they were called to attend (2.13; IQR 1.28 - 3.27).

In a similar Canadian study conducted 11 years prior to the TOCC study, the median cord clamping time interval at 89 births was 12 seconds (Hutton et al., 2013). The major difference between this study and the earlier Canadian study is likely due to an awareness of new evidence of the benefits of delayed cord clamping and may also be related to different models of care between the two countries. For example, in Aotearoa NZ most women (94.2%) choose a midwife as their LMC (Ministry of Health [Manatū Hauora], 2019), whereas, in Canada obstetric-led care is more common (Guliani, 2015).

A tertiary location was chosen as the setting for this study to provide a comparison to the previous observational study (Hutton et al., 2013) and to reveal some of the factors known to influence the timing of cord clamping when a mix of health professional groups is involved. For a complex birth at a tertiary hospital, the obstetric, midwifery and neonatal teams are expected to make fast collaborative decisions on cord clamping, often in high-stress situations. Therefore, healthcare practitioners require clear definitions of timings, management and exclusion criteria, to assist in the successful implementation of placental transfusion at births (Anton et al., 2018). Further, the health practitioner groups involved in this study would likely have been influenced by the guidance provided by their own professional organisations (Table 1). However, of note, a local guideline can bring together recommendations from different health professions and provide a general interdisciplinary consensus. Our results aligned with the local health board guideline which recommended a cord clamping time interval of a minimum of 3 minutes where the newborn does not require resuscitation, and a cord clamping time of 1 minute where the newborn does require resuscitation (CDHB, 2014). Of the 55 term vaginal births in this study, only 7% of newborns had their cords clamped at less than 1 minute, demonstrating a shift in practice away from immediate cord clamping.

Whether the birth of the placenta was active or physiological was not documented as part of this study. It is possible that when the extended cord clamping times were documented (29% with median cord clamping time over 5 minutes) a physiological placental birth had occurred. In a survey of midwives in Aotearoa NZ, 73% of respondents (n = 257) reported that, for physiological placental birth, they would leave the cord intact until after pulsations ceased or until the after the placenta had birthed (Richards, 2009).

In this study 81% of all vaginal births were spontaneous and 19% instrumental. A similar distribution of spontaneous to instrumental births was reported in the Canadian study (Hutton et al., 2013), and the finding of a shorter median cord clamping time at instrumental compared to spontaneous births was common to both studies. Neonates who require ventouse or forceps delivery are more likely to require resuscitation (Australian and New Zealand Committee on Resuscitation, 2021) with associated early cord clamping, as indicated by the fact that the neonatal team were present at all nine instrumental births.

Median cord clamping times for different birth positions were on a continuum from lithotomy (2.24 min) to seated (3.47 min) to kneeling/standing (3.93 min) to side-lying (6.37 min). As lithotomy position is most often used for complex births, including instrumental births, this could explain the shorter median clamping time to facilitate newborn resuscitation. When observing maternal positions for birth it was not possible to determine whether the position itself affected the timing of cord clamping or whether certain positions such as lithotomy and supine may have led to an increase in fetal heart abnormalities (Gupta et al., 2017; Huang et al., 2019) and/or lower Apgar scores (Dahlen et al., 2013) and, consequently, a higher likelihood of early cord clamping to facilitate newborn resuscitation.

In this study, the position associated with the longest interval between birth and cord clamping was side-lying, adopted by women at 13% (n = 7) of the births. Births in the side-lying positions may be followed by an initial period of the newborn lying alongside the woman, on a flat surface and in skin-to-skin contact. This flat surface allows the birth practitioner to position the newborn with an effective open airway and thus to encourage spontaneous breathing with an intact cord without having to disturb the maternal or newborn position. In contrast, with seated/lithotomy positions, the newborn will lie on the maternal abdomen to remain skin-to-skin, which is less likely to be an effective flat surface for airway opening. The link between maternal birth position and effective newborn stabilisation with intact umbilical cord has not yet been studied and is a focus of future cord clamping research that may lead to improved neonatal outcomes.

Observations of practitioner involvement in the births found that the median cord clamping times for births facilitated by midwives (4.06 min) was longer than for those by obstetric doctors (2.13 min). This variation in cord clamping practice between health practitioner groups was consistent with findings from the similar Canadian study (Hutton et al., 2013), where the median time for obstetricians was 12 seconds (39/89 births), for family physicians 19 seconds (37/89 births) and for midwives 81 seconds (13/89

births). In Aotearoa NZ, midwives are more likely than obstetric doctors to attend spontaneous uncomplicated births, which are less likely to warrant immediate separation of mother and newborn for preventative or resuscitative measures. In contrast, at complicated births, midwifery, obstetric and neonatal teams are required to share decision-making around when to clamp and cut the cord, taking into consideration the wishes of the woman and her support people. When a new practice is implemented, such as prolonging the interval between birth and cord clamping, interprofessional collaboration is a key strategy for success (Anton et al., 2018).

The neonatal team attended 36% (n = 20) of the births, indicating that there was known fetal compromise or potential newborn compromise. Where the neonatal team was in attendance, the obstetric doctors and midwives were more likely to clamp the cord within 3 minutes of the birth and the neonatal team was present for all four babies whose cords were clamped under 1 minute.

The birthing rooms in the study hospital have resuscitation equipment attached to the wall which is not easy to position at the mother's side at the time of birth. More mobile equipment would enable intact cord resuscitation and compromised babies could benefit from a longer period of placental transfusion, which is known to facilitate cardiopulmonary transition (Bhatt et al., 2013; Ersdal et al., 2014; Hooper et al., 2015; Mercer & Skovgaard, 2002; Niermeyer & Velaphi, 2013). Studies on intact cord resuscitation have demonstrated this practice to be safe and acceptable to parents and clinicians (Katheria et al., 2018; Thomas et al., 2014). In a recent randomised controlled trial, term non-breathing newborns who were resuscitated with an intact cord had higher oxygen saturations than those who had early cord clamping (Andersson et al., 2019). Research into intact cord resuscitation and the implications for birthing practice is currently ongoing across multiple centres worldwide (Katheria, 2019).

STRENGTHS AND LIMITATIONS

This paper reports on the birth to cord clamping interval in Aotearoa NZ and provides valuable information to inform birth practice. A major strength of the study is the robust methodology, whereby participants were consented prior to labour onset and where the interval between birth and cord clamping was timed accurately with a stopwatch.

Because the study avoided the use of an additional person at births to record data, there was less likelihood of the birth being disturbed by a researcher's presence, thereby keeping stress stimuli for women and their newborn to a minimum (Hastie & Fahy, 2009). While we acknowledge that observation will influence practice, the median cord clamping time of 3.5 minutes represents a considerable change in practice compared to previous international observational studies (Airey et al., 2008; Ersdal et al., 2014; Hutton et al., 2013; Nelin et al., 2018), more, we suggest, than would be attributable to the observation factor alone.

Data collection stopped at 55 births for pragmatic reasons (approximately two-thirds of the number we had aimed for) and this was a limitation. The differences in the median birth to cord clamping intervals between groups may not be significant because of the small study sample and therefore should be interpreted with caution. However, the data provide ideas and motivation for future research topics.

The maternity system in Aotearoa NZ experiences multiple structural and systemic factors that have led to workforce shortages (Dawson et al., 2019). Thus, workforce pressures present during the study may have contributed to the delay in reaching greater recruitment numbers. For instance, it was an additional commitment to ask the midwifery and obstetric teams to take part in the study alongside demanding workloads. Due to the small numbers in this study, these results cannot be generalisable to a wider population.

Further, while the presence of a dedicated researcher in the birthing room may have improved consistency of data collection, the decision was made to utilise existing team members to avoid any additional disturbance to the birth setting. However, this meant that these practitioners had to remember to use the stopwatch and record the data.

In addition, the intention was to record a wide range of circumstances which may have influenced cord clamping (such as the intention for active management of third stage, timing of administration of the uterotonic and type of resuscitation) but, as a condition of the locality ethics agreement, the author was asked to limit the volume of data collection to ease workforce pressures. Discussion with midwifery leaders assisted the author to identify which data collection method and which details were most appropriate for the existing work environment and still likely to yield the most useful data.

RECOMMENDATIONS FOR FURTHER RESEARCH **The following areas may provide valuable evidence that could add to the findings of this study:**
A study with a similar methodology but with a larger number of births. There may be some statistically significant differences between births that could be demonstrated with a larger data set.
An observational study of midwifery-led births in a community setting. It is likely that midwives practise differently when working in primary care settings. Birth to cord clamping interval may be longer where physiological births are the norm.
Further study into which circumstances may impact the timing of cord clamping. Data collection may be expanded to include: intention of third stage management, timing of uterotonic administration (before or after cord clamping), location of the woman at time of birth (e.g. bed, floor, couch, chair, toilet), positioning of baby before cord clamping (e.g. on woman's abdomen/chest/legs, on birth "surface", held by birth practitioner), length of cord, complications around the time of the birth, Apgar scores, details of newborn resuscitation, and details of cord blood sampling.
A before and after study to support the implementation of an evidence-based multidisciplinary cord clamping guideline.

CONCLUSION

The TOCC study provides a snapshot of practice at one tertiary hospital, examining cord clamping practice at a range of vaginal births, from uncomplicated midwifery-led births to complicated obstetric-led births requiring the neonatal team in attendance.

The median cord clamping time of 3.5 minutes is a positive finding as evidence suggests that, although the optimal time for placental transfusion varies from one birth to another, most newborns need at least 3 minutes of intact cord time post-birth to benefit from increased iron stores and a stable physiological transition.

By identifying some of the circumstances for the 36% (n = 20) of infants in this study that had their cords clamped within 3 minutes of their birth, we may be able to modify these factors for births in the future and thereby provide newborns better access to the full potential of their placental blood.

It is likely that the main reason for early cord clamping is the need to separate the mother and her newborn to facilitate neonatal

resuscitation. This was seen in this study where all four of the newborns who had their cords clamped in less than 1 minute had the neonatal team present at the birth. One strategy to increase placental transfusion time for these newborns is to introduce "bedside" resuscitation tables to support complex resuscitation with an intact cord.

Ongoing work to ensure effective placental transfusion for newborns will involve more education, ongoing research and a re-framing of early cord clamping as an intervention that must only be used when there is clear evidence that it will add benefit and avoid harm.

Key points

- While there is considerable evidence that immediate cord clamping can cause harm, there is little research in Aotearoa New Zealand identifying current practice.
- This study, set in a tertiary maternity hospital in Aotearoa NZ, reveals that, for the births observed, most cords were left intact for over 3 minutes.
- By identifying some of the circumstances where cords are clamped early, we may be able to modify factors for these births, thereby improving newborn health outcomes in the future.

CONFLICT OF INTEREST DISCLOSURE

The authors declare that there are no conflicts of interest.

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