WANTING THE BEST FOR NEWBORNS: UMBILICAL CORD CLAMPING PRACTICES OF MIDWIVES IN AOTEAROA/NEW ZEALAND

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DECLARATION CONCERNING THESIS PRESENTED FOR THE DEGREE OF MASTER OF MIDWIFERY

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solemnly and sincerely declare, in relation to the thesis entitled:

Umbilical Cord Clamping Practices of Midwives in Aotearoa/New Zealand

(a) That work has been done by me, personally

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ABSTRACT

Delayed clamping of the umbilical cord at birth has been demonstrated to enhance a newborn's physiological transition from intrauterine to extra-uterine life with significant benefits at birth extending into the first year of their life (Mercer, 2001). These benefits include increased blood volume for organ perfusion; increased red blood cell count providing iron; and increased haematopoietic stem cells to support on-going well-being (Hutton & Hassan, 2007).

Timing of the decision to clamp the umbilical cord is frequently the domain of the midwife and two research studies have specifically identified midwives cord clamping practices relating these to neonatal transitional physiology (Airey, Farrar, & Duley, 2008; Mercer, Nelson, & Skovgaard, 2000). Cord clamping practices of midwives in New Zealand have not been specifically identified and it is not known what influences their practice.

The aim of this research project was to identify and describe the umbilical cord clamping practices of midwives working in New Zealand including the rationale for their practice and any influences upon it.

A quantitative and non-experimental survey method was used to collect the data. Midwives were asked to identify their rationale for the timing of cord clamping in specific birthing situations. An anonymous randomised sample of 400 midwives from the New Zealand College of Midwives membership were invited to complete a postal questionnaire in 2008. A 64% return rate was achieved and the data was analysed using the Statistical Package for the Social Sciences (SPSS).

Three significant findings were identified in the results. These were related to the perspectives of safety emerging from differing birth philosophies, incomplete understanding of intra-partum foetal hypoxia and neonatal transitional physiology, and the influence of the birth environment on cord clamping when

newborn resuscitation was required. Practices varied due to a lack of consistent evidence to support practice and also an incomplete understanding of available evidence.

Recommendations from this study include the need for further education for midwives about neonatal transitional physiology, accurate information for parents and modification of the birth environment to enable resuscitation of the newborn with an intact umbilical cord.

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The old African proverb 'It takes a village to raise a child' has always seemed logical to me and I can now relate to the effectiveness of this approach as I consider my own experience of completing this research project. I have been surrounded by my community of supportive, enthusiastic and caring family, friends and colleagues who have nurtured my self confidence throughout this process and to whom I am immensely grateful.

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GLOSSARY

Aotearoa - Frequently used Māori word for New Zealand

Ecbolic - an ergot alkaloid medication. Commonly used word for uterotonic in New Zealand

Iwi - tribe

Kai Tahu ki Arai-te-Uru - the Māori tribe of the South Island who reside in the southern areas and the Otago coast line.

Kaitohutohu - Māori word for advisor

Manawhenua - the people of an identified area of land who have customary authority

Māori - the name of the indigenous or first people of New Zealand

Midwifery and Maternity Provider Organisation - practice management service for self-employed midwives in New Zealand

Midwifery Council of New Zealand - the regulatory body for midwives in New Zealand

New Zealand College of Midwives - The professional body for midwives in New Zealand

Pākehā - Māori word for white or non-Māori person.

Pēpi - Māori word for baby

Primary Maternity Facility - maternity unit staffed by midwives

Secondary Maternity Facility - maternity unit staffed by midwives with anaesthetic and caesarean section services available

Tangata whenua - the indigenous or first people of the land

Te Kōmiti Kāwanataka - Treaty of Waitangi governing committee

Te reo Māori - Māori language

Tertiary Maternity Facility - maternity unit staffed by midwives with obstetric, anaesthetic, surgical, paediatric and intensive care services, including neonatal

Te Tiriti o Waitangi/Treaty of Waitangi - the founding document of New Zealand signed in 1840 between representatives of the British Crown and various Māori chiefs. The principles of this document continue to define the relationship between Māori and Pākehā

Tikanga Māori - Māori custom or rule

Uterotonic - a medication that acts on the uterus by causing it to contract

Wahine - Māori word for woman

Whenua - Māori word for placenta and land

ABBREVIATIONS

PaO_2 - Partial pressure of oxygen in arterial blood

cc – cubic centimetre

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CHAPTER ONE: INTRODUCTION TO THE RESEARCH STUDY

Clamping of the newborn's umbilical cord is the most common intervention in childbirth and is often presented to parents as a practical procedure to separate the mother and baby at birth. Yet the timing of this procedure can greatly affect the newborn's physiological transition to extra-uterine life (Mercer & Skovgaard, 2002). If the clamping of the cord is delayed until the placenta spontaneously births, the baby will receive a further 60 to 160 millilitres of blood, including red blood cells, to support their transition, compared to clamping the cord immediately following birth (Lanzkowsky, 1960; Yao, Moinian, & Lind, 1969). Despite this, the latter has been the advised practice due to a focus on reducing post partum blood loss through active management of the third stage of labour (Prendiville, Elbourne, & Mcdonald, 2000). As a midwife I have witnessed the benefits for the mother and baby of supporting the physiological processes of birth and delaying the clamping of the cord until after their placenta/whenua has birthed. The current evidence demonstrates the benefits of delayed cord clamping and has a sound physiological foundation, affirming my experiential learning (Linderkamp, 1982; Mercer, 2001; Mercer & Skovgaard, 2002; Philip & Saigal, 2004).

EVOLUTION OF CORD CLAMPING PRACTICES

The benefits of delaying the time of cord clamping for newborns were established in the middle of last century (Gunther, 1957). This evidence was consistently ignored during the latter part of the century in response to the introduction of routine active management of the third stage, believed to reduce the incidence of

post partum haemorrhage. Clamping the cord immediately following the birth of the baby was one of the components of active management of the third stage of labour advocated by Bonham (1963). In the past ten years there has been renewed recognition of the significant benefits of delaying the time of cord clamping for newborns. Recent studies have focused on the benefits for babies who were born preterm or in resource poor countries (van Rheenan & Brabin, 2004). However these benefits have also been demonstrated in the full term baby along with recognition of the potentially detrimental effects of early cord clamping (Soltani, 2008).

Clamping of the umbilical cord prior to the birth of the placenta appears to have evolved out of practicality and convenience. The evolution of this practice has also corresponded with a reducing time interval from birth to cord clamping and definitions of early and late cord clamping now exist (McDonald, 2007). The earliest records of cord clamping did not have the understanding available today however it was recognised that when the cord was clamped soon after birth the baby was weaker than when the cord was clamped following the birth of the placenta (Simon, 2005). As time went on it became convenient to separate the baby from the mother enabling the cut cord to be pulled on to expedite the birth of the placenta (Inch, 1984). Eventually the introduction of active management of the third stage required the cord to be cut following the birth of the baby (Bonham, 1963). Any detrimental effects on the newborn of this process could be managed by the techniques of the rising sub-specialty of neonatology.

Since the development of neonatology and the description of the physiology of the neonate, the transition to extra-uterine life has focused on the establishment of respirations. This was likely to have been influenced by the focus on the prevention of post-partum haemorrhage in obstetrics and the routine adoption of early cord clamping as a component of active management of the third stage (Mercer & Skovgaard, 2002). Although the benefits of placental transfusion had

previously been identified these had been over-ridden by this obstetric focus and other neonatal concerns such as hyperbilirubinaemia and circulatory overload (Yao & Lind, 1977). Despite this, in countries where there is a maternity unit policy of active management of the third stage, and early cord clamping as one the components, the option to delay cord clamping is often precluded (Airey et al., 2008; Winter et al., 2007).

Internationally, four studies since 2000 have investigated the cord clamping practices of midwives (Airey et al., 2008; Jangsten, Hellstrom, & Berg, 2009; Mercer et al., 2000; Tan, Klein, Saxell, Shirkoohy, & Asrat, 2008). The variation in practice was wide as was the practice context, providing limited comparison between studies. The cord clamping practices of midwives in Aotearoa/New Zealand have not previously been identified.

NEONATAL TRANSITIONAL PHYSIOLOGY

The newborn traverses significant physiological changes in the initial period following birth to become self-sustaining and independent of its mother. This transitional process following a physiologic birth with a patent umbilical cord, is described here as background information for this study.

During intrauterine life the foetal cardio-vascular system is predominantly a low resistance circuit which includes the placenta. The pulmonary circulation at this stage is high resistance as the lungs are not yet inflated and necessitate minimal blood flow. The requirements of the foetus are supported entirely via the maternal circulatory system. Blood from the foetal and maternal systems remain separate with nutrient and waste exchange occurring at the placental membrane in the intervillous spaces. These nutrients and wastes are transported to and from the foetus via the umbilical cord (Blackburn, 2007).

Three temporary haemodynamic structures within the foetal circulation (ductus venosus, ductus arteriosis and foramen ovale) assist in distributing the oxygenated blood from the placenta. Foetal blood has a high content of foetal haemoglobin (180-200g/l) which has a higher affinity for oxygen than adult haemoglobin. This enables effective extraction of oxygen from the maternal system. Oxygen saturation of blood within the foetus is lower than that of the neonate with percentages varying from 35 to 70%, depending on the blend of oxygenated and deoxygenated blood as it traverses the body. The highest oxygen saturation is in the umbilical vein and flows toward the brain and heart with the lowest oxygen saturation being found in the abdominal inferior vena cava before returning to the placenta for re-oxygenation (Blackburn, 2007; Kiserud, 2005; Michaelides, 2004).

In utero, one third of the circulating blood of a full term foetus, or half of the blood of a pre-term foetus, is in the placenta for gas exchange with the maternal circulation while the other two thirds, or one half, is in the foetus (Lanzkowsky, 1960). The placenta requires 40 to 50% of the foetal cardiac output per minute, with the lungs requiring 10 to 12% and 14% to the brain. During pregnancy the lungs produce fluid that supports cell growth and also amniotic fluid (Blackburn, 2007).

Following birth, the baby must shift to a closed, high resistance circulatory system. At this stage, the lungs require 40 to 55% of the cardiac output in preparation for the role of gas exchange from the placenta. Blood continues to flow into the baby through an intact umbilical cord, increasing systemic blood volume and pressure. Constriction of the umbilical arteries occurs which reduces the return of blood to the placenta further increasing the blood volume and blood pressure in the baby. The increased pulmonary blood flow leads to reduced pulmonary resistance and increased systemic resistance.

The underlying physiology associated with changes in the lungs, at birth, was demonstrated by Jaykka in 1957. Using air, Indian ink and the excised lungs of stillborn babies and foetal lambs, he demonstrated how uniform lung expansion could be achieved. If the lungs were aerated before they were perfused, lung expansion was not uniform and capillary circulation expansion, with Indian ink following this, was difficult. If Indian ink was injected into the capillary system before lung aeration, it distended easily, creating a framework surrounding each alveoli to support the expansion. This enabled aeration of the lungs with lower pressure than when aeration was attempted before capillary perfusion. Jaykka used the term 'capillary erection' to describe the perfusion of the lungs prior to aeration and concluded that this was part of the cardiovascular adaptation to extra-uterine life (1957, p. 45).

Vascular system changes support closure of the haemodynamic structures of the foetal circulation that are no longer required. The cardiovascular and respiratory changes at birth occur simultaneously and are linked. Stimulation of respiration is also affected by changes in oxygen and carbon dioxide levels as well as environmental factors such as cold and touch (Blackburn, 2007; Mercer & Skovgaard, 2002).

Establishment of respiration is supported by the physical squeeze through the birth canal, enabling expulsion of some lung fluid and passive inspiration. Reduction of lung fluid occurs in late pregnancy with absorption commencing in early labour. This lung fluid is absorbed into the pulmonary vascular and lymphatic circulation following birth. Surfactant, a complex lipoprotein secreted by the pneumocytes, decreases surface tension within the lung, supporting lung compliance and clearance of fluid. This results in an increase in oxygen levels and rise in partial pressure of oxygen in arterial blood (PaO_2). This PaO_2 increase leads to constriction and closure of oxygen-sensitive structures such as the umbilical arteries and ductus arteriosus (Blackburn, 2007).

These physiological changes require an adequate blood volume at the time of birth. Factors influencing this include the intermittent high pressure contractions of second stage, a patent umbilical cord and the newborn positioned within 10cm of the level of the uterus (Yao & Lind, 1969, 1977). If the cord is not clamped at birth, 20 to 40 mls of blood per kilogram of body weight will transfuse from the placenta to the baby or approximately 90% of the placental blood volume, by three minutes (Yao et al., 1969). This will include haemoglobin containing red blood cells and multipotent haematopoietic stem cells (Chaparro, Neufield, Alavez, Cedillo, & Dewey, 2006; Moise, 2005). Therefore if the umbilical cord is clamped immediately at birth the blood volume circulating in the placenta (approximately one third) will remain trapped in the placental circulation meaning the newborn will have reduced blood volume, red blood cells and stem cells. As immediate cord clamping occurs frequently it appears the healthy newborn adapts, although the significance of this physiological compromise is unclear (Blackburn, 2007).

As the umbilical arteries (responsible for carrying deoxygenated blood to the placenta in-utero) constrict with the increasing oxygen levels, cord pulsations cease. This ensures circulating oxygenated blood cannot leave the baby and return to the placenta (Blackburn, 2007). Over-transfusion of the baby is prevented by reflexive closure of the ductus venosus and the continued patency of the valveless umbilical vein. The umbilical vein serves to equilibrate blood volume by moving blood back and forth until stasis occurs. The placental transfusion is completed when the placenta births following stasis of blood in the umbilical vein (Gunther, 1957; Lind, 1965; Yao & Lind, 1969).

RAISING PROFESSIONAL AWARENESS

The work of Dr. Judith Mercer, an American certified nurse-midwife and researcher, reintroduced the benefits of delayed cord clamping to the international midwifery community. This was initially achieved through the publication of an extensive literature review and the description of a new model of neonatal transitional physiology, associated with physiological birth. The foundation of the transitional physiology model is that an adequate blood volume is achieved by the redistribution of placental blood via a patent umbilical cord rather than respiratory effort alone (Mercer & Skovgaard, 2002). Mercer's model provided a clear rationale for what I observed in practice and was the inspiration for this research study.

PERSONAL INTEREST AND MOTIVATION

I have worked as a midwife for 23 years and the past 20 have been as a self-employed midwife, in a midwifery practice, offering a homebirth service. Central to working with women and their families is the development of an effective relationship which in New Zealand has been defined as the midwifery partnership (Guilliland & Pairman, 1995). This partnership embraces the principles of equality, respect, trust and shared decision making, while supporting the individual differences inherent in each relationship. The midwifery model for practice that has evolved from this relationship has been adopted by the New Zealand midwifery profession and is taught within the midwifery schools (Guilliland & Pairman, 1995).

Working with the principles of partnership created the opportunity, in my practice, for both woman-led and midwife-led care dependant on the needs or issues that arose. The practice focuses on information sharing with women and

health promotion toward achieving a physiological birth, with interventions limited to those with a clear rationale. The outcomes of this practice include a high normal birth rate, low rate of admissions to neonatal intensive care and a high breast feeding rate (Anderson, 2006).

Supporting women to birth in this way enabled me to observe newborns as they transitioned, undisturbed, to extra-uterine life and when necessary, resuscitation with the umbilical cord intact. Observing the benefits of physiological birth for the mother, baby and family has been a profound education for me as a midwife, and I wanted to share this knowledge. The nature of undisturbed birth limits the number of people who can be present, without altering the dynamics of the situation, therefore I needed to consider alternative methods to convey this learning. This led to the exploration of Mercer's work and the decision to develop a research study to identify the cord clamping practices of midwives in New Zealand, as part fulfilment of the degree of a Master of Midwifery.

In New Zealand, midwives are most frequently the lead practitioner at the birth of a baby with 78% of women registering with a midwife for maternity care in 2003 (New Zealand Health Information Service, 2006; Shannon, 2007). Therefore it is the midwife who is likely to be involved in the decision of when to clamp and cut the cord. It is anticipated that the outcomes of this study will contribute to an improved understanding of what is occurring in practice and the beliefs that inform and influence that practice. This will enable the recognition of any consistent gaps in knowledge and contribute to the development of under-graduate and post-registration education to bridge this gap.

Obstetrics has previously been identified as the medical discipline that was least likely to incorporate evidence into practice (Albers, 2001). I anticipate the flow on effect of providing midwives with knowledge about the benefits of delayed cord clamping will be three fold. Midwives increased knowledge and understanding of

neonatal transitional physiology can provide confidence for them to support neonates to have a physiological birth and transition. Sharing this knowledge with parents will enable them to make informed choices about their care. Further, this knowledge can be shared with other health professionals involved when the woman or newborn require referral for obstetric or neonatal assistance.

Midwives in New Zealand were reinstated as legally autonomous maternity practitioners in 1990. This enabled midwives to provide a full range of maternity and newborn services from conception through to 6 weeks following the birth of the baby, within public hospitals and the community (Ministry of Health, 1990; Newnham & Pearse, 2006). Because of the legally autonomous status of midwives in New Zealand, we are better positioned than many of our international colleagues to effect a change in practice. Many New Zealand midwives support physiological birth of the placenta which requires a 'hands off' approach to cord clamping (Dixon et al., 2009). Strengthening and protecting the normal physiological processes of pregnancy and childbirth is embedded in our midwifery philosophy and scope of practice (New Zealand College of Midwives, 2008). To support and guide women during this normal life event, midwives require a trust in the ability of women to birth, along with an in-depth understanding of anatomy and physiology (New Zealand College of Midwives, 2008; Thorstensen, 2000).

Over the last 50 years several authors have reviewed studies comparing early and delayed/late umbilical cord clamping. These reviews have demonstrated that delaying the time of umbilical cord clamping transfers a significant volume of blood to the newborn to support the physiological transition, providing both organ perfusion and oxygenation (Lanzkowsky, 1960; Linderkamp, 1982; Yao & Lind, 1977). In the last 10 years the evidence supporting delayed cord clamping has grown and many of the previous concerns regarding over transfusion of the newborn have not been demonstrated (Cook, 2007; Eichenbaum-Pikser & Zasloff,

2009; Hutton & Hassan, 2007; McDonald & Middleton, 2008; Mercer, 2001; Philip & Saigal, 2004; van Rheenan & Brabin, 2004). However, it is unknown if this recent evidence has influenced the umbilical cord clamping practices of midwives in New Zealand.

AIMS OF THE STUDY

I obtained permission from Dr. Judith Mercer to adapt her 2000 questionnaire used in the survey, Umbilical Cord Clamping: Beliefs and Practices of American Nurse-Midwives. The survey tool was adapted for the New Zealand midwifery context with the aim of identifying and describing the umbilical cord clamping practices of midwives, including the rationale for their practice and any influences upon it. The information obtained can assist in identifying areas for further education to support New Zealand midwives to practice from an evidence base.

The sample included both employed and self-employed midwives and related to well women with healthy full term babies. The data was collated and analysed and is presented both statistically and thematically. The randomised sampling process enables the results can be generalised to midwives practising in New Zealand.

The aims of this study were:

- To identify the **umbilical cord clamping practices** of midwives in New Zealand following a normal birth with a well woman and baby.
- To identify the **rationale** for umbilical cord clamping practices of midwives in New Zealand following a normal birth with a well woman and baby.
- To identify **influences** on the umbilical cord clamping practices of midwives in New Zealand.

- To identify **areas for further education** for New Zealand midwives regarding evidence informed practice.
- To contribute to the New Zealand and international body of knowledge regarding umbilical cord clamping practices

Quantitative survey methodology was utilised following randomisation of the sampling frame, to identify and describe the cord clamping practices of midwives in New Zealand. The questionnaire was adapted to ensure a wide range of response options and space for individual comment (Appendix C).

THE SIGNIFICANCE OF THIS STUDY

Birth is an intimate process and the details of midwifery practice are not always shared yet are frequently assumed. The questions in this survey tool have not previously been formally asked in New Zealand research and a midwifery approach to umbilical cord clamping has not been identified. Without this knowledge we cannot expect to effectively support evidence informed practice. This research will commence the process of exploring the cord clamping practices of New Zealand midwives and stimulate further discussion. This discussion will enable the current cord clamping literature to be brought to the fore and support reflection on both individual practice and institutional guidelines. The tenet of informed choice and decision-making, strongly present in New Zealand health legislation, will be reinforced by this process.

SUMMARY

Clamping of the umbilical cord is the most frequently occurring intervention in the birthing process in New Zealand and most likely to be instigated by the midwife. Benefits of delaying the time of cord clamping following the baby's birth, such as increased blood volume and red blood cell count, were recognised historically with the physiology being understood by the middle of last century. This practice was abandoned due to the requirements of active management of the third stage in the latter half of the 20th century, although it continued where physiological birth was supported. The work of Dr Judith Mercer increased the awareness of the positive effect of delaying the time of cord clamping on the newborns transitional physiology and this is described as a reference for the study. Using survey methodology, both the timing of cord clamping and the rationale for this practice are identified for midwives in New Zealand. It is recognised that without this information it is difficult to effect an evidence informed change in practice.

OVERVIEW OF CHAPTERS

Chapter One introduces the dominant practices related to cord clamping and identifies the impetus for the research study. This includes the evolutionary processes that have led to the current interventions in cord clamping practices and contrasts them with a physiological approach to birth. The neonatal transitional physiology model is provided as background information for the following chapters and the aims of the study are identified.

Chapter Two reviews the literature related to umbilical cord clamping practices and establishes a case for this research. A general respect and belief in the physiology of birth is evident in the early literature. This was followed by the introduction of various interventions thought to enhance the physiology. Studies of the newborn's extra-uterine adaptation are presented from the middle of last century along with evidence of the benefits of delayed cord clamping. This is followed by literature which reveals a shift in practice focus to the controlling of post partum bleeding. With the introduction of early cord clamping as a component of active management of the third stage, delayed cord clamping was abandoned. The newborn's physiological adaptation is highlighted again in research studies from the turn of this century, identifying the benefits of a delay in the time of cord clamping and the redistribution of the placental blood. Finally the outcomes from international studies, exploring midwives' umbilical cord clamping practices, are discussed.

Chapter Three explains the research design and methodological approach. The survey method is described including the randomised sampling process and questionnaire development. Identification of ethical considerations follow, with explanation of the approval process and acknowledgement of our Treaty of Waitangi partners. The method of data collection is described in detail and

includes the pre-testing process. This is followed by identification of the data analysis.

Chapter Four presents the results of the returned questionnaires in the research study. The responses to each question are analysed, the results described and illustrated with figures or tables. The data from each practice question is also compared with the demographic data and any significant results presented.

Chapter Five discusses the three findings identified from the results of the research study. Further literature is sourced to inform this discussion. Overall the midwives' intention to support the transition of the newborn to extra-uterine life is evident, while keeping the mother and baby safe. The implications for practice emphasize the practice of cord clamping as the midwives' domain and identify the responsibilities related to this. Four recommendations are tendered from the research study that consider effective care for the newborn within the context of midwifery and the neonatal service.

The following chapter presents an exploration of the literature concerning the time of umbilical cord clamping providing a foundation for the research study.

CHAPTER TWO: LITERATURE REVIEW

In this chapter the literature related to umbilical cord clamping practices are reviewed to establish a clear case for this research study. The review builds on the description of the transitional physiology of the neonate outlined in Chapter One. I begin with the information that has been recorded historically, from early observations of the birth process, and proceed to explore the effect of manipulating the events around the time of birth, and how this altered cord clamping practices. The impact of the introduction of evidence informed practice is considered next followed by a discussion of contemporary issues influencing cord clamping practices. I conclude with an examination of what we know of current international and national cord clamping practices.

ORIGINS OF UMBILICAL CORD CLAMPING

In mammals severance of the umbilical cord has been observed to occur at different intervals following birth and in various ways. For many animals the cord severs spontaneously with movement whereas other animal mothers chew or eat the cord following birth of the placenta (Linderkamp, 1982). Hrdy (2000), in her exploration of maternal instincts identified that female animals tend to display innate maternal behaviours such as licking their newborns and eating the placenta. New human mothers do not have a universal response to their newborn babies and no tribal society has been identified who traditionally consume the placenta and cord although ligation and cutting the umbilical cord, after the birth of the baby, is a custom that has been practised for centuries in most cultures.

In primitive tribes the cord was reported to be crushed and severed by rubbing it between stones or being chewed through by the midwife (Peltonen, 1981). In

ancient Greece Aristotle said tying the umbilical cord was the midwife's domain and must be done competently to avoid haemorrhage. Aristotle also identified that newborns could appear weak when born until the midwife squeezed the blood back into their body from the placenta (Levy & Blickstein, 2006). It is recorded that in the first century A.D. Soranus first advised using a sharp knife to cut the umbilical cord (Peltonen, 1981). The midwife was usually involved with cord ligation either as the instigator or as the supporter of the process (Dunham, 1991).

Cord clamping practices over time appear to have been motivated by supporting the well being of the mother and baby. Prior to the 'Age of Enlightenment' in the 17th century, which valued rationality and science, nature and logic guided events and natural attrition was part of life. With the increased understanding of anatomy and physiology and the ability to influence life and death health practices were altered. These practices reflected not just the knowledge and understanding of physiological processes but also the beliefs and attitudes of the particular era.

HISTORICAL CHANGES IN CORD CLAMPING PRACTICES

Prior to the 17th century the umbilical cord was generally cut after the birth of the placenta. This is likely to have negated the need to also tie the cord due to the occurrence of blood stasis in the cord. It is thought this practice originally changed to cutting the cord prior to the birth of the placenta, to enable removal of the baby, as it was getting in the way of removing the placenta. Pulling on the severed cord to remove the placenta was advised to prevent it being trapped by the closing cervix. This practice then led to an increase in postpartum haemorrhage and retained placentae (Inch, 1984).

Knotting the cord was first advised by Mauriceau in 1668 (cited in Botha, 1968). This practice was recommended to control the large amount of blood flowing out of the ends of the cord due to it having been cut before blood stasis had occurred. Clamping or knotting also avoided blood spilling on to the bedclothes and was one of the initial reasons for early ligature. The variation in practice at this time was described as broad (Botha, 1968; Inch, 1984; Wattis, 2001).

In 1773, Charles White observed in "A Treatise on the Management of Pregnant and Lying-In Women", that instant tying and cutting of the 'navel string' was an error of practice supported by custom only. The differences in the foetal and neonatal circulation were described and identified as was the purpose of the placental transfusion (cited in Simon, 2005). This clarity persisted in 1801 with Erasmus Darwin stating, in "Zoonomia":

> Another thing very injurious to the child is the tying and cutting of the navel string too soon; which should always be left till the child has not only repeatedly breathed but till all pulsation in the cord ceases. As otherwise the child is much weaker than it ought to be, a portion of the blood being left in the placenta, which ought to have been in the child. (cited in Simon, 2005, p. 1)

The focus remained on waiting until cord pulsations ceased and respirations were established until late into the 1800's.

The establishment of respirations as a reference point for cord clamping was less frequently mentioned after this time. However by 1921 von Reuss suggested a time period of five to ten minutes after birth to tie and cut the cord, advising not to wait until the placenta had been expelled, although no rationale for this time frame was given (cited in Simon, 2005). Also at this time anaesthesia was being widely given to women during childbirth and Frye

(2004) identified that the introduction of early cord clamping in the 1930's was a way of reducing the transfer of anaesthetic drugs to the baby. In 1930 DeLee advised severing the cord once pulsations had weakened based on Budin's work in 1876 (cited in Simon, 2005). Budin (1876) and Schucking (1877) were the first to measure the transfer of an additional 90cc. of blood to the baby following birth through continuous weight assessment (cited in McCausland, Holmes, & Schumann, 1949).

Cord clamping practices began to change significantly in the 1950's. Eastman who authored Williams' Obstetrics, advised in 1950 to leave the cord unclamped for one to two minutes, a significantly shorter time than previously advised. He also stated that this shortened time period was often ignored with cords being clamped sooner than this (cited in Simon, 2005). A year earlier a survey of 1900 American obstetricians had identified a wide variation in the management of the cord and placental blood. The study report also advised stripping the cord to enhance the benefits of placental transfusion (McCausland et al., 1949). The midwifery texts of the 1950's continued to advise ligation of the cord after pulsations had ceased and acknowledged the benefits of placental blood volume transferred to the baby (Brown, Gilbert, & Dobbs, 1950; Mayes, 1950).

A decade later, Green (1962), acknowledged placental transfusion in his obstetric text but identified concern regarding increased neonatal jaundice from the extra blood. Green stated immediate cord clamping was now common practice. This position was also reflected in Margaret Myles' popular midwifery text, when she wrote: "There is a difference of opinion as to whether to tie the cord immediately or wait for pulsation in the cord vessels to cease…The excess cells, which were necessary during intrauterine life are no longer needed so they are destroyed" (Myles, 1964, p. 323).

The issue of newborn over-transfusion was again addressed in 1966 when Taylor identified that asphyxiated babies, or those with pathological conditions, could be detrimentally affected by the increase in blood volume (cited in Simon, 2005). Over the next 10 years a significant change in the recommended time of cord occlusion occurred. Several authors now advised clamping and cutting the cord 20-30 seconds after birth, stating this was an adequate time for placento-fetal transfusion (Chalmers, 1973; Linderkamp, 1982; Simon, 2005; Yao & Lind, 1977).

These recommendations coincided with significant changes in obstetrics and the development of the sub-specialty of neonatology (Frye, 2004; Mercer, 2001). There was also a range of childbirth interventions that significantly contributed to the changes in cord clamping practices.

INTERVENTIONS INFLUENCING PLACENTAL TRANSFUSION

Interventions, such as cord stripping, uterotonic use, altering the level of the baby after birth and caesarean sections, had been introduced over the years without any understanding of their effect on the placental transfusion to the newborn. However from the late 1940's until the 1970's a range of quantitative, physiological studies were carried out on newborns to assess the effect of these interventions. These studies conveyed a desire to understand the role of cord blood in the transition process from foetus to newborn and to assist the child who did not "have the spark"(McCausland et al., 1949, p. 190) or does not manage to adapt to extrauterine life (Lind, 1965).

Cord Stripping

Stripping the cord was a technique introduced to increase the amount and transfer rate of placental blood to the newborn and was commonly used in the mid 1900's. The wording in the following two articles suggested that the baby was expected to receive all of the placental blood.

In 1949, in Los Angeles, McClausland and associates undertook a study which focused on whether cord stripping could enhance the placental transfer of blood to the newborn. The erythrocyte counts and weights of newborns were compared following the introduction of three interventions. Three groups of newborns (*n*=36-50) were allocated to one of the following interventions, immediate cord clamping, clamping at 5 minutes, and cord and placental stripping. The literature review had identified the benefits of placental blood transfer and also some concern regarding the potential for cord stripping to over load the newborn's cardiovascular system. However it was hypothesised that gentle cord stripping should do no harm. The findings showed that delayed cord clamping transferred a variable amount of blood to the baby, whereas cord stripping created a consistent transfer of blood (100cc), significantly enhancing birth weight and erythrocyte counts at 5 days, with uterotonics assumed to "aid this process"(McCausland et al., 1949, p. 190). While a transient raised umbilical venous pressure was noted with cord stripping, particularly if done rapidly, these findings were considered to be beneficial for the baby. It was found that increased blood transfer did not cause jaundice although this was not an outcome measure of the study.

In 1960 Lanzkowsky undertook a randomised controlled trial within 1 maternity institution in South Africa comparing the haemoglobin levels of newborns. The first group was assigned early cord clamping (n=63) and the second group to cord clamping after placental separation and following cord stripping (n=70). Lanzowsky's findings identified significantly raised haemoglobin levels in the

latter group which reflected previous research. Follow up was done on all babies at three months who had not developed infections or been given iron supplements and haemoglobin levels between the two groups were by then comparable. It was noted that after this time other factors would potentially influence the haemoglobin levels, such as the feeding of iron fortified milk. Lanzkowsky also recommended rapid cord stripping during caesarean section, for the obstetrician who did not want to wait for placental separation, stating that there was no increase in jaundice in the cord stripped group.

Following Gunther's 1957 assessment of spontaneous placental transfusion by weight measurement in 50 newborns, she identified that the final blood volume was variable and there was a limit to how much the individual baby's body would spontaneously accept. Although a substantial transfer of blood was demonstrated, siphonage of blood out of the baby via the umbilical vessels was also evident. Gunther described the process as a 'picture of complicated hydrodynamics'(p. 1279). Thus siphonage of blood via the umbilical vein appeared to prevent over–transfusion.

In 1969 there was evidence that following a spontaneous placental transfusion some blood remained in the placenta. In this study Yao, Moinian and Lind, identified the amount of blood distributed between the baby and placenta following cord clamping, at different time periods. A sample of 111 healthy newborns were divided into 8 similar sized groups and their cords were clamped at intervals ranging from 5 to 180 seconds. Their findings identified that the distribution of blood between the baby and placenta was 67%/33% at birth, 80%/20% at one minute and 87%/13% at completion of transfusion. The method of measurement was placental residual blood volume and complete blood volume of the baby. All women received an uterotonic after the cord was clamped and cut. A further group of newborns, in the study, had their cords clamped between 3 and 6 minutes. No further increase was found in the volume for the 6 minute group.

This study also identified the red cell volume as a better guide to the amount of placental blood transfered, than blood volume alone, as it displayed the least variability in the first hours after birth (Yao et al., 1969).

Uteronic Use

Uterotonic use became more widely used in the 1960's due to concern over the consistently high number of deaths from post partum haemorrhage. Research by Bonham (1963) in London, compared the length of the third stage and blood loss for three combinations of uterotonics (ergometrine; ergometrine and hyaluronidase and ergometrine with oxytocin) with three different methods of extracting the placenta (controlled cord traction; fundal pressure or a combination of both). The findings identified that controlled cord traction in combination with both ergometrine and oxytocin or ergometrine and hyaluronidase was the most effective means of delivering the placenta. Immediate clamping and cutting of the umbilical cord following birth had previously been identified as part of the controlled cord traction process (Spencer, 1962) and I assume that this was to enable unencumbered access to the cord, as no rationale for this action was provided.

Controlled cord traction had been introduced because of the increasing incidence of retained placenta following the administration of intravenous ergometrine. The rapid and sustained action of the drug on the cervix could cause the placenta to become trapped in the uterus, if not removed immediately. Hence controlled cord traction was introduced to resolve the potential iatrogenic consequences of using the medication (Inch, 1984).

It had previously been identified in 1877 by Schucking (McCausland et al., 1949) that blood transfer to the baby was correlated with uterine contractions. In 1968,

Yao, Hirvensalo and Lind studied the placental transfusion rate to the newborn following birth. Immediately following birth 195 women were given the uterotonic methylergometrine, which was now ‘routine management', and the cord was left unclamped. The remaining 106 women were not given the uterotonic or given it after the cord was clamped and cut. The allocation process was not included in the report so it is not known if the groups were randomised. The group receiving the methylergometrine had an increase in the intensity and frequency of contractions and the placental transfer was complete by one minute. When no uterotonic was given the same amount of blood was spontaneously transferred over a longer period of three minutes. Any adverse effects of a rapid transfusion for the baby were not identified.

Using the components of active management of the third stage but unclamping the maternal end of the cord to let it bleed, was recommended by Botha 1968 in South Africa. Botha was inspired by observing the lack of retained placentae or post partum haemorrhage in the Bantu people in Africa who do not touch the cord or placenta until after it has been birthed. He carried out a small comparative study with 60 women following a normal birth. The births occurred consecutively but it is not identified how the women were allocated in the trial. Half of the women received an oxytocic drug and the umbilical cord was clamped and cut and the other half of the women were left to birth their placenta with no intervention. The focus of the study was not on the benefits of placental transfusion for the baby and Botha identified a shorter length of third stage and less mean blood loss when there was no intervention, thus replicating the practice of the Bantu people. He speculated that this was related to the placenta being smaller, and easier to expel, because the blood had transferred through to the baby. He described cord clamping as an obstruction of the normal mechanism but interestingly continued to give the uterotonic medication and clamp and cut the cord early in his practice. However he released the maternal end to drain the

placental blood (Botha, 1968). This clarified the focus of this study was on the control of maternal haemorrhage rather than the transfer of blood to the baby.

Level of the Baby

In Sweden in 1969, Yao and Lind identified the effect of gravity on placental transfusion. Their non randomised study involved holding babies at different predetermined levels above or below the level of the mother's introitus after birth and measuring the effect on the placental transfusion. The change in the weight of each baby was measured at birth as was the residual placental blood. They found that gravity had a significant effect on the speed and amount of blood transferred to the baby. If the baby was held within 10 cm of the mother's introitus the transfer rate was unaffected. If the baby was 40 cm below the level of the introitus the transfer rate occurred in 30 seconds and if the baby was 50-60 cm above the level of the mother's introitus the transfer rate was negligible, even if a uterine contraction was present. This finding raised concern regarding the drainage of blood out of the baby at caesarean section, if the baby was elevated before constriction of the umbilical arteries occurred. This findings also confirmed those of Gunther (1957) who had previously identified 'siphonage' of blood via the umbilical vein between the baby and placenta through weight loss and gain when the baby was elevated and lowered.

Caesarean Section

It had been established that uterine contractions assist in the transfer of blood to the newborn therefore caesarean section was identified as a process likely to reduce the transfer of blood to the baby at birth. A small non-randomised study

was conducted to identify baby blood volumes at birth when delivered by caesarean section without the influence of third stage uterine contractions or the establishment of respirations (Yao, Wist, & Lind, 1967). The cord was cut prior to extraction of the baby from the uterus. All the women were in labour at the time of the operation except for one. The caesarean section was required for maternal reasons in 13 cases and for foetal distress in 5. All women were given a general anaesthetic. The babies born by caesarean section for maternal reasons had low blood volume, which was anticipated given that there was no placental transfusion occurring following birth. In contrast, the babies born by caesarean section, due to foetal distress, had a higher blood volume and red cell count suggesting increased placental transfer of blood in-utero which occurred in response to the hypoxia. This contributed to concern regarding potential cardiovascular overload following placental transfusion for newborns experiencing hypoxia at birth (Yao et al., 1967).

A SHIFT IN PERSPECTIVE

The concern that some newborns may not benefit from placental transfusion (Yao et al., 1967) became words of caution regarding delayed cord clamping in the following decade. In 1977 the same authors published a summary of several research studies they had completed on placental transfusion and the effect on the newborn. They stated that "no deleterious effects from this placental transfusion has been observed in these normal term infants"(Yao & Lind, 1977, p. 98) yet they advised that the umbilical cord now be clamped at 30 seconds following a vaginal birth or an elective caesarean section.

Yao and Lind (1977) concluded that a large placental transfusion overloaded the baby's circulatory system and although the healthy newborn managed to adapt to this it required more effort and a longer time period, compared to a limited placental transfusion. They identified that babies with cardio-respiratory pathology were less likely to cope with a large placental transfusion but there was no acknowledgement of the small number of babies this would affect. There was also no acknowledgement of the various obstetric procedures that now influenced the previous physiological process of birth. These included the routine use of uterotonic medications, lowering the baby below the level of the mother, cord stripping practices and a focus on accelerating the birth of the placenta and membranes to reduce blood loss.

In the same year, 1977, polycythemia and hypervolaemia were also identified as a possible consequence of delayed cord clamping due to the increase in haematocrit and blood volume from a large placental transfusion (Saigal & Usher, 1977). Saigal and Usher identified 11 preterm and 3 term infants, with symptoms, that suggested a link between delayed cord clamping and polycythemia in the term infants and hypervolaemia in the preterm infants. This was a small non-randomised study and the findings have not been reproduced in later studies (Mercer, 2001) yet it reiterated concern regarding an uncontrolled transfer of blood from the placenta to the baby and appeared to influence practice.

ACTIVE MANAGEMENT OF THE THIRD STAGE

By the late 1960's preventing post partum haemorrhage had become the primary focus during the third stage of labour and the effects of placental transfusion on the neonate were often not mentioned (Beischer & Mackay, 1976; Bonham, 1963; Botha, 1968). This was likely to have been influenced by the knowledge that healthy full term babies appeared to adapt to the hypovolaemia of early cord

clamping and any adverse effects had not yet been identified (Oh, Lind, & Gessner, 1966).

The most effective care during the third stage of labour continued to be debated and the three identified practice variances were active management, physiological care and mixed management. The interdependent components of active management were considered to be administering a prophylactic oxytocic drug, early cord clamping and controlled cord traction to deliver the placenta. Whereas physiological care was a 'hands off' approach, clamping and cutting the cord after birth of the placenta and mixed management was any combination of the two previous methods (Enkin, Keirse, Renfrew, & Neilson, 1995; Gyte, 1994).

In establishing the most effective care following the birth of the baby the focus continued to be on preventing post partum haemorrhage, and in particular, the effectiveness of different prophylactic oxytocic agents on its incidence (Gyte, 1994; Inch, 1984). Five randomised controlled trials were published between 1988 and 1998 comparing active versus expectant management in the third stage of labour and all included early cord clamping (Begley, 1990; Khan, John, Wani, Doherty, & Sibai, 1997; Prendiville, Harding, & Elbourne, 1988; Rogers et al., 1998; Thilaganathan, Cutner, Latimer, & Beard, 1993). The Cochrane review of management during the third stage of labour (Prendiville et al., 2000) included these trials and concluded that active management was superior to physiological care in relation to blood loss for women in maternity hospitals. Outside of this setting the effect of active management was not clear.

The findings of these trials has stimulated debate; in particular aspects of the methodology (Brucker, 2001; Fry, 2007; Gyte, 1994; 2008; Walsh, 2007; Wattis, 2001). Several of these aspects were related to the Bristol Trial (Prendiville et al., 1988) and included issues with the physiological arm of the trial and the ≥ 500ml definition of post partum haemorrhage (Walsh, 2007). The Hinchingbrooke Trial

(Rogers et al., 1998) endeavoured to address these issues with a hospital setting where midwives were more familiar with physiological care and the inclusion of blood loss range inclusive of 500 - 999mls. A statistically higher rate of postpartum haemorrhage was again revealed but the difference was minimal at the definition of blood loss ≥ 1000mls (Rogers et al., 1998).

Although these debates continue evidence to support physiological care during the third stage remains limited therefore active management, including early cord clamping, became established as 'best practice' for many maternity practitioners.

TOWARD EVIDENCE –INFORMED PRACTICE

Although studies on newborns during the 1950's to 1970's appeared to have identified the physiological benefits of delayed cord clamping for most babies the embedding of active management of the third stage in maternity care had effectively ended this practice. During the late 1980's there was a change from practice based on tradition and authority to that informed by evidence. The establishment and utilisation of The Cochrane Pregnancy and Childbirth Database introduced objective critiques of previous and recent research studies identifying strengths and weaknesses that had not previously been considered (Enkin et al., 1995).

In 2001 Judith Mercer, an American nurse-midwife, published a comprehensive literature review of umbilical cord clamping evidence for preterm and term infants. She challenged the lack of scientific evidence related to current umbilical cord clamping practices. The review critiqued the cord clamping literature published between 1980 and 2001 with earlier studies were also reviewed alongside this information. The strength of this review was that it examined the cord clamping evidence in relation to the confounding birth related factors in the

studies. These included: the level at which the baby was held following birth; the type and method of birthing; the presence of uterine contractions and the use of uterotonic medication (Mercer, 2001).

Within this review Mercer focused on four randomised and five non-randomised controlled trials on early and late cord clamping in term infants. These studies included: comparisons of haematocrit and ferritin levels, bilirubin levels, breastfeeding rates and neonatal jaundice, polycythemia, hyperviscosity, hyperbilirubinaemia and transient tachypnea of the newborn. There was no consistent evidence presented to support delayed cord clamping as a harmful practice. The review also considered any beneficial effects of delayed cord clamping for babies and identified benefits in the haematological and cardiopulmonary systems, as well as potential positive effects on behaviour. These included: higher haematocrit levels at two months; increased blood volume and blood pressure with increased red blood cell perfusion of the organs; higher peripheral temperatures and urine output; and increased early breastfeeding rates (Mercer, 2001).

Overall, Mercer's review stated that the claims within the literature of harmful effects of delayed cord clamping were unsubstantiated and that anaemia of infancy was a potentially harmful consequence of early cord clamping (2001). This paper sparked an international re-examination of the evidence for early and delayed cord clamping and was the stimulus for further research.

The following section of this review critiques the studies related to the outcome measures in the research on cord clamping practices, with a focus on those published following Mercer's 2001 literature review. In particular, these studies address the concerns raised about transient tachypnoea, increased blood viscosity and bilirubin levels, in association with delayed cord clamping. Subsequent haemoglobin and iron levels in these babies are also discussed.

TRANSIENT TACHYPNOEA OF THE NEWBORN

One of the adaptive newborn mechanisms to manage the sudden increase in blood volume in the pulmonary vascular bed following birth involves transudation of plasma from the intravascular to extra-vascular compartment, in the lung. In the newborn who has delayed cord clamping Oh and colleagues (1966) suggested that this was the result of mild pulmonary oedema as they had previously found the respiratory rate of delayed cord clamped newborns to be faster in the first four hours following birth than early cord clamped newborns. Another study identified an increase in expiratory grunting, in delayed clamped babies compared to early clamped babies, with resolution within four hours (Yao, Lind, & Vuorenkoski, 1971). It must be noted that these babies were separated from their mothers following birth and not breast-fed until 12 hours, as was the custom of the era. Suckling has been shown to improve oxygenation in the newborn (Shiao, Chang, Lannon, & Yarandi, 1997) and is anticipated that this would support the respiratory transition.

In a randomised controlled trial, Cernadas and colleagues (2006) found a small and insignificant rise in respiratory distress, tachypnoea and grunting rates in babies following delayed cord clamping with no increase in admissions to neonatal intensive care. The Cochrane review by McDonald and Middleton (2008) also found admissions to neonatal intensive care were similar for both early and delayed cord clamped newborns. This evidence appeared to indicate that transient tachypnoea of the newborn is an adaptive mechanism that does not cause pathological sequelae.

HAEMATOCRIT AND BLOOD VISCOSITY

Prevention of polycythemia is often identified as a reason for early cord clamping (Armentrout, 2003; Gordon, 2003). Neonatal polycythemia is defined as a haematocrit greater than 65% or a haemoglobin greater than 220 g/L. Polycythemia refers to an abnormally high red cell mass with normal plasma volume whereas hyperviscosity usually occurs with a haematoctrit over 60% and a raised mean cell volume (Blackburn, 2007). Hyperviscosity can develop from polycythemia decreasing blood flow and tissue perfusion (Pappas & Delaney-Black, 2004). Polycythemia in-utero occurs as a result of increased erythropoiesis initiated by intrauterine hypoxia, endocrine disorders or chromosomal disorders when the foetus produces an excess amount of red blood cells in response to its hypoxic environment (Armentrout, 2003).

Mercer's review of the literature in 2001 did not identify the presence of symptomatic polycythemia in any of the infants in the trials between 1980 and 2000. Haematocrit levels were higher in late cord clamped infants at 4 hours following birth (due to transudation) but these had returned to birth levels by 16 hours (Nelle, Zilow, Bastert, & Linderkamp, 1995). Hutton and Hassan's (2007) systematic review identified an increased risk of polycythemia in delayed cord clamped babies, compared to early clamped babies but this was no longer statistically significant when studies of lesser quality were excluded. McDonald and Middleton's (2008) review of three randomised controlled trials (RCT) also found no difference in the incidence of polycythemia between early and delay clamped babies. Thus the earlier described concerns regarding polycythemia appear unsubstantiated with the use of more recent and robust research methodology.

BILIRUBINAEMIA

Following birth the metabolism, conjugation and excretion of bilirubin occurs in the liver. The newborn produces more than twice as much bilirubin per day compared to an adult, influenced by transitional physiological changes. While in-utero the foetal red blood cell count is higher and contains mainly foetal haemoglobin which has a higher affinity for oxygen. The change to adult haemoglobin, following birth, increases oxygen levels obtained from air breathing and foetal haemoglobin is no longer required. The newborn's increased bilirubin levels are due to the breakdown of the large number of red blood cells that are no longer required and the shorter life span of the red blood cells. The passage of meconium, enhanced by early feeding, assists in the excretion of bilirubin. The increased presence of bilirubin and decreased ability of the newborn liver to conjugate bilirubin results in 'physiologic jaundice', which develops in 50-80% of term newborns. While high levels of bilirubin can cause harm, such as kernicterus, at low levels it is known to be a potent antioxidant (Blackburn, 2007).

A meta-analysis of 8 delayed versus early cord clamping trials, in term infants in 2004, found increased haemoglobin concentrations in the delayed cord clamped infants at 2-3 months (van Rheenan & Brabin). Delayed cord clamped newborns also had a 12% increased risk of hyperbilirubinaemia compared to early clamped newborns, although phototherapy or exchange transfusion were not required. Hutton and Hassan's (2007) extensive systematic review and metanalysis on the same topic, found no difference in bilirubin levels at 24 and 72 hours between the two groups. It also showed no increased risk of jaundice at 14 days with delayed cord clamping or cases of jaundice requiring phototherapy. In contrast, the Cochrane review (McDonald & Middleton, 2008) 'Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes' found a small but significant difference in infants requiring phototherapy for jaundice following

delayed cord clamping, compared to early clamped infants. The risk for early clamped infants was 3% and delayed clamped infants 5%. Despite this finding there was not an increased risk of clinical jaundice for the delayed clamped newborn compared to the early clamped newborn.

HAEMOGLOBIN AND IRON LEVELS

Red blood cell production is stimulated by the hormone erythropoietin (Epo). Epo stimulates red cell production and is present prior to birth due to the lower arterial oxygen levels of the foetus compared with the newborn. The increase in arterial oxygen levels following birth stops the release of Epo and reduces haematopoesis for the next eight to twelve weeks. The result is physiologic anaemia of infancy. (Blackburn, 2007).

The rapid growth of the newborn, subsequent expansion of blood volume and increased destruction of red blood cells, leads to a decrease in haemoglobin in the first two to three months. The oxygen carrying capacity of the blood is balanced by the change to adult haemoglobin, which increases the release of oxygen to the tissues. The haemoglobin eventually falls around eight to twelve weeks stimulating the release of Epo and erythropoiesis resumes utilising the stored iron.

This process ensures that the healthy term baby will have adequate iron stores for a further six to twelve weeks (Blackburn, 2007). Administration of iron in the first eight to twelve weeks will not increase haemoglobin production, as the infant's haemoglobin will only rise if red blood cell production is greater than the increase in plasma relative to the infant's growth (Blackburn, 2007).

Infant anaemia occurs most commonly in developing countries, particularly where malaria is endemic. It is estimated that more than 75% of infants in these areas are anaemic before six months of age (van Rheenan & Brabin, 2006). In developing

countries the correction of anaemia could contribute to the survival of a child. Low haemoglobin and iron deficiency has been found to be significantly associated with mild to moderate mental retardation, relative to the severity of the anaemia (Hurtado, Claussen, & Scott, 1999; Soltani, Dickinson, & Symonds, 2005). Therefore early cord clamping, which contributes to hypovolaemia and reduced haemoglobin, is likely to contribute to brain injury (Simon & Morley, 2005).

Research in this area has focused on resource poor countries with several randomised controlled trials having been completed (Chaparro et al., 2006; Emhamed, van Rheenan, & Brabin, 2004; Geethanath, Ramji, Thirupuram, & Rao, 1997; Grajeda, Perez-Escamilla, & Dewey, 1997; Gupta & Ramji, 2002; van Rheenan, de Moor, Eschbach, de Grooth, & Brabin, 2007). Several reviews of these trials have been published and reach similar conclusions regarding infant anaemia.

Van Rheenan and Brabin (2004) concluded that delayed cord clamping increased haemoglobin concentrations in infants by two to three months reducing the risk of anaemia in term infants. This was especially effective when the mothers were already anaemic. The authors found the same improvement in haemoglobin status at four months of age in infants in a highly malarious area (van Rheenan et al., 2007). A randomised controlled trial in Mexico (Chaparro et al., 2006), which followed infants to six months, did not find a difference in haemoglobin levels at this time in delayed cord clamped infants but did find higher ferritin levels. This study also found the effects were greatest for infants: of anaemic mothers; whose birth weights were between 2500 and 3000 g; and who were still being breastfed and not receiving either infant formulas or iron fortified milk. This is likely to be due to the bioavailability of iron in breastmilk compared to other means of iron supplementation (Blackburn, 2007).

Hutton and Hassan's (2007) review found mean haemoglobin levels were higher for infants with delayed cord clamping at seven hours after birth but not at two to three months or six months after birth. Although when the risk of anaemia was reviewed, delayed cord clamped infants had a lower risk of anaemia at 24 to 48 hours, at two to three months and at six months of age, compared to early clamped infants.

The Cochrane review on the effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes (McDonald & Middleton, 2008) found similar results. Higher haemoglobin levels in the delayed clamped babies did not extend past four months for more than one trial, whereas, ferritin levels were found to be significantly higher in the delayed clamped infants at six months compared to the early cord clamped infants.

Collectively these studies appear to provide a strong case for delayed cord clamping, particularly for infants in developing countries. However, the benefits apply for babies in resource rich countries as well (van Rheenan & Brabin, 2006).

CONTEMPORARY ISSUES RELATED TO THE TIMING OF CORD CLAMPING

This section considers the issues in practice that have more recently impacted on cord clamping practices. These include the relationship of the timing of cord clamping in regard to transmission of rhesus antibodies, the development of new technologies to harvest stem cells, plus the case for babies who may not benefit from delayed cord clamping.

FOETO-MATERNAL TRANSFUSION

Foeto-maternal transfusion is likely to occur in all pregnancies, to varying degrees (Blackburn, 2007). It can cause significant problems when the mother is rhesus negative and the foetus is rhesus positive. Rhesus isoimmunisation occurs in relation to the incompatability between the mother and foetus of the D antigen. If the blood of a rhesus D positive baby enters the vascular system of a rhesus D negative mother, she may create anti-D antibodies against the foetal blood which then transfer back into the foetal system. This is most likely to occur, and trigger antibody production, at the time of placental separation (Blackburn, 2007).

Physiologically, if the cord is clamped and cut before the transfer of blood to the baby, it will remain in the placenta, increasing the placenta's bulk and the potential for foetal cells to be forced into the maternal vascular system. If the cord is not clamped, or the clamp is released once the cord is cut and the blood drained, the placenta will be easier to birth as it is smaller in size and the possibility of foeto-maternal transfusion will be reduced. A Cochrane review of the limited evidence available found leaving the placenta to drain after cord ligation significantly decreased the length of the third stage (Soltani et al., 2005).

Dunn (1966) previously identified that early clamping of the cord and the use of ergometrine increased the pressure within the placental blood vessels and could cause them to burst. Although it was anticipated this would lead to increased foeto-maternal transfusion, a small study by the same author did not demonstrate this (Dunn, Fraser, & Raper, 1966). Whereas, Lapido's (1972) non randomised study comparing three methods of umbilical cord management, did demonstrate an increased transfer in foetal cells with early cord clamping and the administration of a uterotonic without placental drainage. This was detected by measuring foetal cells in maternal blood using the Kleihaur test. Delaying cord

clamping or leaving the placental end of the cord to drain following cutting, significantly reduced the transfer of foetal cells into the maternal circulation.

Techniques to reduce the potential of foeto-maternal transfusion must be considered for the following two reasons: firstly, administration of rhesus D immunoglobulin (Anti-D) can keep the initial activation of isoimmunisation to a minimum but its availability may not be consistent in low resource countries due to cost and supply; and secondly, rhesus D immunoglobulin (Anti-D) is a blood product and there remains the potential of transfer of yet unknown blood borne viruses.

STEM CELL HARVESTING

Umbilical cord blood (foetal blood) is rich in multipotent stem cells and progenitor cells. Multipotent stem cells can perpetually produce any blood cell to enable restoration of the haemapoietic system whereas progenitor cells can divide a limited number of times. The recent isolation of mesenchymal cells in cord blood has increased the awareness of their role and potential use in culturing tissues and preventing the development of type 2 diabetes (Ende & Reddi, 2006; Moise, 2005; Santer-Nanan, Peek, McCullagh, & Nanan, 2005). The attraction of using umbilical stem cells rather than adult bone marrow for transplant is because of the low incidence of viral infections, graft-versus-host disease and the high proliferative capacity of the cells (Moise, 2005).

Advocates of stem cell harvesting identified the opportunity to utilise this blood that was generally referred to as a 'waste product' and had been frequently discarded with the placenta (Armitage, Sheldon, Pushpanathan, Ellis, & Contreras, 2006; Kurtzberg, Lyerly, & Sugarman, 2005). Umbilical cord blood was first used in human treatment in 1988 (Smith & Thomson, 2000).With the reconsideration of

cord clamping practices has come the recognition that stem cell rich cord blood actually belongs with the baby and is likely to have a protective and preventative role in their development (Mercer & Erickson-Owens, 2006).

Cord blood donations can be stored in a public bank for allogeneic transplantation to an unrelated donor or a private bank for autologous transplant at a later time (Sullivan, 2008). The minimum donation of cord blood that can be stored is 40 ml in a public blood bank (Armitage et al., 2006; Smith & Thomson, 2000) although smaller amounts are usually accepted by private banks (Smith & Thomson, 2000). Others identify 100 million stem cells as the minimum number for banking (Eichenbaum-Pikser & Zasloff, 2009). The success of the transplantation is thought to be influenced by the blood volume and number of stem cells present (Diaz-Rossello, 2006a) therefore small donations may have limited value.

The volume of blood collected is enhanced by early cord clamping with experienced practitioners averaging a collection of 110 ml (Kurtzberg et al., 2005). Cord clamping after 30 seconds has resulted in a significantly reduced collection averaging 30 ml (Smith & Thomson, 2000). The use of gravity has been advised to enhance the volume of harvest (Grisaru et al., 1999) thus babies born vaginally are identified to produce a greater volume than babies born by caesarean section (Smith & Thomson, 2000). However when the cord is not clamped following birth the blood remaining in the placenta does not create a large enough volume to store to use for transfusion under the current requirements (Diaz-Rossello, 2006b; Yao et al., 1969).

There is on-going debate regarding the relevance of storing autologous stem cells especially in the treatment of cancers, as often an allogeneic transfusion from a healthy donor will be more appropriate (Harris, 2008; Nietfeld, 2008; Sullivan, 2008). Currently private cord blood banks target prospective parents with emotive advertising and information to encourage autologous donations into private cord

banks (CordBank, 2010), despite a low probability of the autologous transplant being appropriate or needed. The current estimate for using an autologous transplant is between 1:400 and 1:2700, indicating only a small proportion of cord blood donations will be used by the donor in their life time (Sullivan, 2008).

Research has not been undertaken to compare the effects of the timing of cord clamping on the long term status of the child, in relation to stem cell production and function but also higher neurological function. Morley (2003) suggests that early cord clamping could lead to hypoxia and ischemia with the potential to develop hypoxic ischaemic encephalopathy (HIE) and cerebral palsy. He goes on to propose that the baby who has HIE and cerebral palsy would likely benefit from a cord blood transplant but may never have developed the condition with delayed cord clamping. A 2004 Cochrane review of early versus delayed cord clamping in preterm babies identified that delayed cord clamping reduced the relative risk of intraventricular haemorrhage in preterm babies (Rabe, Reynolds, & Diaz-Rossello, 2004), although there has been no similar neurological benefit identified in full-term neonates.

CIRCUMSTANCES WHEN BABIES MAY NOT BENEFIT FROM DELAYED CORD CLAMPING

There are some situations when a full redistribution of the blood within the placenta may not be appropriate for newborns. This relates to situations where the baby is not full term and there is underlying pathology.

Preterm Babies

Preterm babies are at a greater risk of hypervolaemia and sequelae with delayed cord clamping due to the greater placental transfusion (Philip & Saigal, 2004). As previously stated, half of the blood of a preterm baby is in the placenta for gas exchange while in utero, compared to a third for a full term baby (Lanzkowsky, 1960; Yao et al., 1969). Therefore the delayed cord clamping interval for the preterm infant is often controlled between 30 seconds and one minute (Mercer, 2001; Rabe et al., 2004).

Between 1980 and 2001, seven randomised controlled trials focused on preterm infants and compared the effects of early and late cord clamping on a variety of outcome measures. These include blood pressure, oxygen needs, haematocrit and bilirubin levels and the need for blood transfusions. A review of this evidence identified beneficial effects of delayed cord clamping, including higher haematocrit and haemoglobin levels and a reduced need for blood transfusions; increased blood pressure and a decreased need for oxygen and reduced ventilation period (Mercer, 2001). A Cochrane review of the related evidence in 2004 examined a delayed cord clamping interval of up to two minutes and identified less need for blood transfusions and less intraventricular haemorrhage in preterm infants, concluding that delayed cord clamping improved their health. Treatment for hyperbilirubinaemia was reported in only one study but was considered too small to be able to draw reliable conclusions (Rabe et al., 2004).

Underlying Pathology

Chronic intrauterine hypoxia is likely to be associated with intrauterine growth restriction and some babies of diabetic mothers. In this situation red blood cells are transferred to the foetus in-utero to increase oxygen carrying capacity with the

goal of reducing the hypoxia (Wylie & Niermeyer, 2008). Philip and Saigal's (2004) review of cord clamping literature discussed how the foetus already has an increased haematocrit prior to birth and delaying cord clamping will likely lead to polycythemia and hyperviscosity syndrome in the newborn. Potential hypovolaemia due to immediate cord clamping at birth could be treated in other ways as needed following birth.

Babies at risk of cardio-vascular overload as a result of cardiac or pulmonary pathology will also benefit from early cord clamping, including monozygotic twins (Blackburn, 2007; Philip & Saigal, 2004). However most of these babies will be identifiable prior to labour and birth where an appropriate plan of care can be put in place.

VARIATIONS IN UMBILICAL CORD CLAMPING PRACTICES

This next section will present and discuss several international studies that have identified a variation in umbilical cord clamping practices. This will be followed by an exploration of studies undertaken in New Zealand that have included cord clamping in the research.

INTERNATIONAL PRACTICES

Despite the recognition of the need for evidence informed medicine, wide variations in practices related to umbilical cord clamping and the third stage of labour occur (Brucker, 2001). The evidence from the Cochrane review, of active versus expectant management of the third stage of labour, recommends active management of the third stage for women expecting to birth vaginally in a maternity hospital because of the reduced blood loss (Prendiville et al., 2000). This

recommendation has greatly influenced the timing of cord clamping and cutting practices internationally as early cord clamping is a stated component of active management (Festin et al., 2003; Stanton et al., 2009; Winter et al., 2007).

Since publication of this review, several studies have been undertaken and each has found a wide variation in practices related to the third stage of labour. For the purpose of this literature review I have focused on cord clamping information within these studies, as presented below.

In 2003 an international survey was conducted on the use of active management of the third stage, in 15 university based obstetric centres in ten developing and developed countries. The survey found variability in the practice of active management both between and within countries, even though early cord clamping was used in 79% of the births (Festin et al., 2003).

Winter and associates (2007) also surveyed various maternity units about active management of the third stage of labour in 12 European Union (EU) countries plus Norway and Switzerland. Their definition of active management included the same components as Festin et al's (2003) survey except cord clamping included both immediate clamping and also cord clamping after the cord had stopped pulsating. Early cord clamping occurred in 66 – 90% of maternity units surveyed in nine of the EU countries compared to delayed cord clamping in 64 – 74% of maternity units surveyed in five of the EU countries. In two of the countries where delayed cord clamping was frequently practiced prophylactic uterotonic administration was also the lowest. Overall Winter et al., (2007) identified frequent use of uterotonics in active management of the third stage and a wide variation in timing and use of all the components.

A further review of third stage of labour practices in seven developing countries was undertaken by Stanton et al., in 2009. The study examined national policy documents and observed a sample of vaginal births in maternity facilities against

what was considered three correct techniques for actively managing the third stage of labour. It is difficult to draw any conclusions from this information other than the indication of a continuing wide variation in international practices.

Several authors have also examined third stage of labour practices by identifying the specific practices of practitioners. In 2000 Mercer, Nelson and Skovgaard, completed a randomised survey of American Nurse-Midwives regarding the timing and rationale for their cord clamping practices for normal births. The response rate was 56% and the responses from the midwives fell into three categories of early clamping, before one minute (26%); intermediate clamping, between one to three minutes (35%); and delayed clamping, after pulsations had ceased (33%). The most frequently chosen rationale selected by the midwives for each time period was: early clamping to facilitate the management of the neonate (46%); intermediate clamping to support gradual transition (50%) and also a belief that timing of clamping is not significant for newborns (38%); and delayed clamping to enable gradual transition to extra-uterine circulation (73%). Their practice changed however, when the baby required resuscitation and the midwives reported clamping and cutting the cord early to facilitate resuscitation in 89% of situations.

In the United Kingdom in 2006/2007 a maternity unit with a policy of active management of the third stage was surveyed to identify cord clamping practices (Airey et al., 2008). Midwives were asked to complete a questionnaire and 100 births were observed. The questionnaire (83% response rate) identified that 92% of the midwives would clamp the cord within one minute of birth and 75% identified early cord clamping as being immediately after birth. This was demonstrated when practice was observed with 85% of babies having their cord clamped within 30 seconds of birth.

A survey of maternity practitioners in British Columbia (58% response rate) sought their usual practice during the third stage of labour. The results identified significant differences between midwives, obstetricians and family physicians. Practitioners were asked to identify their usual timing of cord clamping and cutting although no definitions were supplied. This was late for the majority of midwives (61%) compared to the majority of obstetricians and family physicians whose usual timing of cord clamping was early at 78% and 70% respectively. All groups also had a significant number of practitioners who identified variable timing of cord clamping as their ususal practice (Tan et al., 2008).

Finally, a Swedish study carried out in 2006/2007, explored in focus groups, the management of the third stage of labour of 32 experienced midwives from six hospitals (Jangsten et al., 2009). Despite there being no written policy for active management of the third stage, the majority of midwives adopted the prophylactic use of an uterotonic. Immediate cord clamping and cutting was routine due to a policy of blood gas testing in all units. The cord was then unclamped for the blood to drain out.

These studies continue to identify a wide range in practices amongst midwives and a probable influence of hospital policies on midwives practice. The level of understanding of newborn transitional physiology by these practitioners is unknown, thus it is not possible to know what influenced their practice.

AOTEAROA/NEW ZEALAND PRACTICES AROUND THE TIMING OF CORD CLAMPING

Umbilical cord clamping practices in New Zealand have not been specifically researched although care during the third stage of labour has included cord clamping practices.

The first New Zealand midwifery research regarding management of the third stage of labour was undertaken in 1990. Purposeful sampling was used and 180 questionnaires were sent nationally to midwives and doctors. The return rate was 56% with 97% of respondents being midwives. It is important to note that at this time midwives in New Zealand were on the brink of regaining legal professional autonomy. At this time, all but a small number of midwives were employed and all midwives attended births with medical supervision. Over half of the respondents (54%) stated that they clamped and cut the cord after it had stopped pulsating and 6% after the birth of the placenta. Clamping and cutting the cord immediately after the birth of the baby was identified by 27% of respondents and when it was practical to do so by 6%. Only 9% of respondents identified being influenced by the parents' wishes. Overall there was a wide diversity of beliefs and practices identified (Smythe, Macauley, Kerins, Schollum, & Gunn, 1992).

The next research project on the third stage of labour was also a survey focusing on outcomes following an undisturbed physiological birth of the placenta and membranes (Prichard, O'Boyle, & Hodgen, 1995). Domiciliary midwives were recruited due to their support for physiological birth with cord clamping occurring after the birth of the placenta. The main outcomes were a mean estimated maternal blood loss of 239 ml's and a post-partum haemorrhage rate of 3.3% (blood loss >500mls). Similar outcomes were revealed by Anderson (2006) when she described the outcomes for an established home birth practice. Of the women experiencing a physiological birth, 89.5% also had a physiological third stage including delayed cord clamping. Only a small number of babies (2.6%) required admission to the neonatal intensive care unit from this group.

After ten years of autonomous midwifery practice in New Zealand a further survey was undertaken to ascertain midwives decision making and management of the third stage of labour (Barlow et al., 2002). A convenience sample of 121 midwives, 48% self-employed and 38% hospital employed, were surveyed.

Although no specific questions were asked in relation to cord clamping practices, 37% of respondents identified mostly practicing physiological care (Barlow et al., 2002). Midwives in this study by Smythe et al. (1992) identified that the 'woman's preference' was the biggest influence on their decision making regarding management of the third stage.

In 2009 the New Zealand College of Midwives (NZCOM) published aggregated data on 33,752 women, comparing the outcomes for those choosing a physiological third stage with women receiving an actively managed third stage, following a normal birth (Dixon et al., 2009). The data was sourced from the NZCOM Midwifery and Maternity Practice Organisation (MMPO) clinical database over a five year period between 2004 and 2008. Of the births identified, 48.1% of the women received physiological support and 51.9% of the women received active management. Women who birthed at home or in a primary maternity unit were more likely to receive physiological support compared to women who birthed in a secondary or tertiary hospital. The majority of women had a blood loss less than 500mls and a greater number of women who received physiological support were in this category compared to women who had an actively managed third stage.

The changes in third stage of labour practice have been considerable since the return of autonomous practice to New Zealand midwives in 1990. Although physiological support for birthing the placenta is increasing midwives cord clamping practices have not been specifically studied and it is unknown what evidence influences their practice.

SUMMARY

A review of the early literature concerning umbilical cord clamping conveyed a general respect and trust of nature although interference in the process was still

prevalent. This was followed, during the middle of last century, by a period of interventions to enhance placental transfusion. After this time, research explored the physiology of the newborn transition, with evidence of the benefits of the increased blood volume and red blood cell count, following delayed cord clamping. In the latter half of last century concern regarding post partum haemorrhage dominated care during the third stage of labour and the benefits of physiological birth of the newborn and placenta appeared to have been lost. However the advantages of the redistribution of placental blood to the newborn were acknowledged again at the turn of this century, following publication of new evidence which supported this practice.

Although cohorts of midwives have been surveyed in other countries regarding their umbilical cord clamping practices this has not yet been undertaken in New Zealand. The unique midwifery environment in New Zealand supports the practice of physiological third stage care and this study provides the opportunity to determine how, or if, this influences umbilical cord clamping practices.

The following chapter outlines the research design and method of this study.

CHAPTER THREE: RESEARCH DESIGN AND METHOD

This study has a quantitative, non-experimental approach using a survey method to statistically describe the umbilical cord clamping practices of midwives in Aotearoa/New Zealand. Described in this chapter is the methodology utilised in order to meet the aims of this research project, previously identified in Chapter One. Details and rationale are provided for the research design and method, ethical considerations, data collection and data analysis.

METHODOLOGICAL APPROACH

Quantitative methodology collects data, analyses and describes it numerically and presents it in a logical and objective manner. It presents what is generally agreed upon and seeks to explain why it has happened (Cluett & Bluff, 2000; Tolich & Davidson, 2003). The paradigm of positivism is reflected in this research methodology which supports a scientific and deductive process to predict human behaviour by discovering a natural order (Davidson & Tolich, 2003a).

As a midwife researcher it has been important to consider a research process that is inclusive of participants' experience and will present the data in a way that has the potential to empower practice (Alice, 2003). At the same time it has been important to collect as much data as possible from a geographically spread sample in a short period of time (Tolich & Davidson, 2003). Therefore survey methodology was chosen for data collection.

Internationally much has been written about the benefits of delaying umbilical cord clamping for the baby and the recommendation to reconsider the practice of early cord clamping (Cook, 2007; Hutton & Hassan, 2007; Mercer, 2001; Philip & Saigal, 2004). Umbilical cord clamping practices are not frequently observed and

the rationale behind the decision of timing is not necessarily known. The cord clamping practice of midwives has been researched in the United States of America, Canada, Sweden and the United Kingdom with widely varying results (Airey et al., 2008; Jangsten et al., 2009; Mercer et al., 2000; Tan et al., 2008). Specific umbilical cord clamping research has not been undertaken in New Zealand.

Mercer, Nelson and Skovgaard (2000) in the United states and Tan et al., (2008) in Canada used survey methodology, with a response rate of 56% and 58% respectively. The survey method is low cost and can be completed within a short period of time compared to many other research techniques (Tolich & Davidson, 2003). Survey research obtains information from people using a systematic process of asking questions and obtaining measurable outcomes (Groves et al., 2004) and to be effective requires a defined target population who can effectively answer the survey questions. Disadvantages of this research approach include dependence on the participant's motivation and their truthfulness. Data collected is predominantly descriptive although it can also show correlation, enabling variables to be compared without identifying a causal relationship (Wagstaff, 2000).

Considering the above factors survey method was identified as an appropriate method to obtain data to meet the research aims of this study. A paper questionnaire based on the format used by Mercer, Nelson and Skovgaard (2000) was decided on and it was anticipated that the recent focus in the midwifery literature on newborn transitional physiology would encourage midwives to respond (Mercer & Skovgaard, 2002, 2004).

DESIGN AND METHOD

OBTAINING THE SAMPLE FRAME

Registered midwives are a clearly defined population in New Zealand as they require a standardised qualification and registration by the Midwifery Council of New Zealand (MCNZ) in order to practise. The New Zealand College of Midwives (NZCOM) is the professional body for midwives in New Zealand and over 85% of practising midwives are members of the NZCOM (Shannon, 2007). The NZCOM membership list was therefore considered to be the most complete and accessible to use as a sampling frame for this research (Davidson & Tolich, 2003b).

Permission to utilise the NZCOM membership list was sought and granted from the NZCOM National Committee in 2008 (Appendix A). As the NZCOM also has non-midwife members a membership list of registered midwives only was requested. This was obtained co-jointly with another researcher also using survey methodology. Approval was dependent on the two researchers randomising the membership list once, to ensure midwife members potentially received only one of the two questionnaires. The purpose of this was to ensure NZCOM midwife members did not receive an excessive number of requests to participate in research.

RANDOMISED SAMPLING PROCESS

The NZCOM membership list of employed and self-employed midwives was obtained, with overseas members removed. There were 1861 midwives. Biostatistician, Dr Peter Herbison, was consulted and after review of the questionnaire advised a sample size of four hundred with the anticipation of collating information from three hundred questionnaires. This allowed for a ±5%

sampling error at a 95% confidence level in the final results and is considered acceptable by social researchers with budget constraints (de Vaus, 1995; Tolich & Davidson, 2003).

Research Assistant

A research assistant was contracted to complete the randomisation process of the sampling frame to maintain the confidentiality of the final sample (de Vaus, 1995). Therefore as the researcher I did not know which midwives were included in my sample. The midwives' names and addresses in the randomised sample were available to the research assistant who signed a confidentiality agreement stating that no information would be disclosed about the midwives (Appendix B).

Prior to commencement of the randomisation process the research assistant removed the names of the midwives involved in the questionnaire pre-test process, including myself, from the sampling frame. This will be discussed in further detail later in this chapter. Due to the quality of the sampling frame, a simple random sampling process was decided on (de Vaus, 1995) and was completed by the research assistant using the randomisation equation of the Microsoft Excel programme. The first four hundred names were allocated to one researcher and the second four hundred names to the other.

Following this process the role of the research assistant included: printing name and address labels; applying these to envelopes; posting out the prepared letters; checking off the returned questionnaires against the full randomised sample list; creating a list of participant's names to receive the first and second reminder packs and creating a final list of respondent's names and addresses. At the completion of the research project the research assistant will send out a summary of the research findings and place all information on a computer mass storage device to be

securely stored at Otago Polytechnic along with the raw data. At this stage the research assistant will delete all files associated with the research from her personal computer.

QUESTIONNAIRE DEVELOPMENT

The survey instrument was based on a questionnaire designed by Judith Mercer, Carlene Nelson and Rebecca Skovgaard. This survey had been sent to a randomised sample of American Nurse-Midwives regarding their umbilical cord clamping practices and published in 2000. Approval was sought and obtained from the authors for use of, and modifications to, the questionnaire as needed (Mercer, J., personal communication, March 18, 2008). The questionnaire format was maintained and several questions were modified to reflect the research focus and differences in the New Zealand practice environment and culture.

The self-administered paper questionnaire commenced by informing participants that return of their questionnaire implied their consent to participate in the survey. This was followed by instructions and definitions of terms on the survey form. Contained within the questionnaire were eight closed questions, related to practice, and seven demographic questions. All but one of the closed questions had multiple response options and space to provide a further option if the desired choice was not available. The participants were asked for their action and rationale regarding the timing of umbilical cord clamping in different practice situations. The other practice question was a Likert-type format and asked the participant to grade how differing variables might influence their umbilical cord clamping practice.

Demographic information was requested at the end of the questionnaire and included ethnicity, country of midwifery education, years in practice, current employment status and main work environment.

In an effort to encourage participants to respond, attention was paid to the presentation of the questionnaire which was an attractive A4 booklet of 4 pages (Appendix C).

ETHICS APPROVAL AND CONSIDERATIONS

The research proposal was approved by the Otago Polytechnic Research Ethics Committee on the 4th of November 2008 (Appendix D).

The overall aim of this research project was to uncover information from midwives that could be used to further inform midwifery practice to the benefit of everyone involved. To ensure my focus on the research project did not compromise the rights of the participants, ethical principles were considered and incorporated in the research process (de Vaus, 1995; Snook, 2003).

Informed choice and voluntary participation was supported through the inclusion of a detailed information letter which was sent out with the first posting of the questionnaire. This included information about me as a researcher, aims of the research project, survey methodology, randomized selection process, an explanation of voluntary participation, anonymity, time limit for withdrawal of information and identification of where the data is likely to be presented and published (Appendix E). Completion and return of the questionnaire indicated consent to participate and this was reiterated on the questionnaire.

The participants could not be truly anonymous as they were identified by name at randomization but confidentiality was maintained by contracting a research

assistant. Further, participants were asked not to add their name to the questionnaire. Participant's names and their questionnaire numbers are stored on a separate computer data storage device at Otago Polytechnic.

Consequences of participation in the study were considered and it was not anticipated that this process would cause harm or distress to the participants. Participants were not coerced to respond and individual responses are not reported. Two follow-up letters, with further questionnaires, were sent to participants who had not responded within the identified time frame. No other processes were used to encourage response.

TE TIRITI O WAITANGI/TREATY OF WAITANGI

Included in my consideration of the rights of participants in this study was the recognition and acknowledgement of culture. As a researcher I recognise my culture influences my world view. I am a Pākehā woman born and raised in Ōtautahi (Christchurch) and have chosen to work with women, families and birth as a midwife for the past 23 years. I recognise Māori as tangata whenua of Aotearoa and the principles of Te Tiriti o Waitangi, partnership, protection and participation, provide a foundation for both my professional and personal relationships and I have endeavoured to honour these principles as a researcher (Durie, 2001; New Zealand College of Midwives, 2008).

As a Master of Midwifery student enrolled at Otago Polytechnic I acknowledge Kai Tahu ki Arai-te-Uru as manawhenua. The signing of a Memorandum of Understanding (MoU) in 2004 between Kai Tahu ki Arai-te-Uru and Otago Polytechnic, established them as sole Te Tiriti o Waitangi partners. The Māori Strategic Framework 2007-2011 was developed by Te Kōmiti Kāwanataka and launched in 2006 with the vision and goals for Māori across the Otago Polytechnic

campus. This framework is aligned with the MoU, Ngai Tahu 2025 Vision Document and the Polytechnic Charter (Otago Polytechnic, 2004). I acknowledge the importance of these documents and I have reflected on my research project in relation to them.

My research has focused on practices related to the umbilical cord and I am aware there is tikanga related to the care of the cord and placenta/whenua for Māori. Te reo Māori is an official language in New Zealand and I included some te reo (Ngata Dictionary, 2007) in the questionnaire. Two respondents commented that they appreciated the inclusion of their reo within the wording of the questionnaire.

Two of the closed response option questions included an option that may have honoured tikanga practices for clamping the umbilical cord, that is, 'I delay cord clamping to support cultural/spiritual practices'. A further blank option was available for midwives to identify any other practices or rationale. Ethnicity was also included in the demographic information. If cultural differences were clearly defined during the thematic analysis of the comments I had agreed to consult the Otago Polytechnic Kaitohutohu for guidance on how to manage this information respectfully. I recognised that if information was identified from this research that was specific to Māori umbilical cord clamping practices, it should be Māori who decide if and how this information is conveyed (Spoonley, 2003). Individual responses with reference to Māori birthing practices would not be reported to maintain anonymity and neither iwi nor region was requested in the questionnaire to reduce possible identification of participants.

I am aware that "being Māori" is often unrecognised in the Aotearoa/New Zealand health system (Otago District Health Board, 2006) and I wish to find a culturally safe means of acknowledging Māori without being presumptive.

DATA COLLECTION

PRE-TESTING OF THE SURVEY

The reliability and validity of this questionnaire was established through a pre-test process (de Vaus, 1995). This followed approval for commencement of the research study by the Otago Polytechnic Research Ethics Committee. The importance of pre-testing survey tools is stressed by Tolich and Davidson (2003c) advising that it can avoid problems later in the research process.

Quantitative research generally places a greater emphasis on establishing the reliability of the collected data rather than the validity in a research process (Davidson & Tolich, 2003a). The reliability of this original survey tool had previously been established through a pre-test process and a completed research study (Mercer et al., 2000). As the majority of the questions in the survey were the same as Mercer et al. their validity was given greater weight during this second pre-test process. This research study was occurring in a different country to the original and wording changes had been made to reflect both the differences in midwifery culture and the practice context. Cluett and Bluff (2000) identify the importance of establishing content validity particularly when knowledge and attitude are being measured. Therefore it was considered that the pre-test process would effectively address the content validity of the questionnaire.

Pre-testing involved purposively and conveniently seeking out local midwives who reflected the diversity of the sampling frame, other than geographical location (de Vaus, 1995; Groves et al., 2004). Twelve draft questionnaires were sent to these midwives in Christchurch with an information letter (Appendix F). The midwives were asked to complete the questionnaire providing comment on the wording and relevance of the questions to their practice situation and to identify if their choices were reflected in the options available to them. They were also asked

to comment on the ease and time it had taken to complete the questionnaire (Tolich & Davidson, 2003). As stated earlier, the names of these midwives were removed from the sampling frame prior to randomisation to ensure they did not receive a further questionnaire.

The completed questionnaires of the pre-test midwives were also not included in the data collection for various reasons including: they did not comply with the sampling process; it was not the purpose of the pre-test process; and the potential for researcher influence on the responses.

The questionnaires completed by the pre-test midwives were returned and the feedback enabled several wording changes to be made, particularly improving the content validity of the questionnaire. These questionnaires were not included in the data analysis.

RESEARCH PROCESS

The questionnaire was printed and numbered from 1 to 400. At this stage the research process was defined in writing and passed on to the research assistant to ensure confidentiality of the randomised sample was maintained.

In November 2008, 400 questionnaires were sent out to the randomised sample of midwives obtained from the NZCOM membership list resident in New Zealand. Each participant was allocated a number between 1 and 400 which correlated with the number on their questionnaire. Included with the questionnaire was the information letter and a return address envelope, to myself, at Christchurch Polytechnic Institute of Technology (CPIT).

The first response was received on the 13th of November 2008 and responses were collected by me and delivered to the research assistant every few days. The

research assistant marked off the returned questionnaires against the full sample list by identifying the number on the questionnaire.

Two weeks after the first mail out 120 (30%) questionnaires had been returned. On the 24th of November 280 first reminder letters (Appendix G) were sent out, with a second questionnaire and a return address envelope, to participants for whom a questionnaire had not been received. The numbers on the questionnaire were correlated with the original full sample list. It was recognised that there would be some time overlap due to the mail delivery system and some participants would receive a reminder pack when they had already returned the questionnaire.

A further two weeks after the second mail out 189 (47.25%) questionnaires had been returned. A second reminder letter (Appendix H) was sent on the 9th of December with a third numbered questionnaire and return address envelope to the remaining 211 participants, who had not responded.

The last completed questionnaire was received on the 20th January 2009 and the number was now 261 (65.25%). Due to the time overlap, some participants had received more than one questionnaire and three questionnaires were returned when a questionnaire had already been received for that respondent. As the responses were different to the first it was assumed it had been completed by a second person who was not part of the randomised sample. The data from these questionnaires, plus one with the number cut off, were not analysed.

The final response rate was 257 questionnaires or 64.25%, following adjustment for the return of questionnaires which were unable to be included. These return rates are similar but slightly less than those identified by de Vaus (1995) of 35%, 60% and 70% respectively following each mail out. This response rate is significantly greater than the commonly expected response for mail questionnaires of no more than 50% (Burns, 2000).

DATA ANALYSIS

The computer software Statistical Package for the Social Sciences (SPSS) version 17 was used to assist the process of coding, data entry and data analysis.

The questionnaire was coded as the data entry file was created in the SPSS programme. This required 68 variables to be identified and named. A further four variables were identified when one question was recoded to extrapolate the information. For each question response codes were developed, including missing data (Davidson & Tolich, 2003c). Some questions required a comment and this was summarised in a written form.

As the researcher I took responsibility for entering the data from the returned questionnaires once the data entry file was created. After the data from the first 100 questionnaires was entered, every tenth entry was checked to identify any coding errors (Davidson & Tolich, 2003c). As this identified a number of coding errors a change to the data entry technique was made. To further ensure the data was clean I made the decision to re-examine every entry. This process occurred at the completed entry of every 50th questionnaire. The occasional error was found and corrected indicating an effective change to the data entry technique.

The data was analysed within the SPSS programme using predominantly descriptive statistics, which simply describes the information obtained from the questionnaires. Initially univariate analysis was carried out on each option within each question and frequency tables were created. This enabled a detailed description of the responses for each question to be formulated (Davidson & Tolich, 2003c).

During the analysis a weakness was identified in the question related to identification of years practised as a midwife. In this question there were

overlapping years in 2 options therefore respondents with 10 or 20 years practise experience could have chosen different options.

Each question included an 'other' option for the description of a response that was not included within the available options. While some respondents used this option, many respondents also wrote comments to further emphasise or expand on their selected option. The written responses were grouped to identify the themes within these responses.

Following this process, bivariate analysis was undertaken comparing two variables simultaneously. Each question (dependant variable) was systematically cross tabulated with the demographic information (independent variable). The chi square test was applied to test for significance and if the probability value was less than 0.05, it was explored further (Davidson & Tolich, 2003c; de Vaus, 1995). Some inferential statistics were obtained from this analysis which can be generalised to the sample frame. Each set of variables which showed statistical significance have been represented in the results in the next chapter.

SUMMARY

This chapter has described the research design of this quantitative, non-experimental survey process. The details of the randomised sampling procedure were identified along with the development of the questionnaire adapted from Mercer et al. The processes engaged in to obtain ethical approval have also been canvassed. Following ethics approval the questionnaire was pre-tested and wording changes made to establish reliability and validity. Finally the research process has been described and the univariate and bivariate data analysis processes explained.

In the following chapter I describe and present the results of the survey of umbilical cord clamping practices of midwives in New Zealand.

CHAPTER FOUR: RESULTS

In this chapter the results and analysis are presented from the questionnaire 'Umbilical Cord Clamping Practices of Midwives in Aotearoa/New Zealand'. The analysis of each of the eight practice questions is presented followed by the demographics of the respondents. Data from each question has been compared with the demographic variables and where the result is significant ($p< 0.05$) it has been reported and presented in tables and figures.

Questionnaires were sent to a randomised sample of 400 midwives who were members of the New Zealand College of Midwives (NZCOM) in November 2008. Over the following 8 weeks 261 (65%) questionnaires were returned anonymously. Those returned with a duplicate identification number, or with the identification number removed, were not included in the analysis. This process resulted in 257 (64%) valid questionnaires to be analysed.

The majority of questions were completed in each questionnaire. Some questionnaires had missing data therefore this information was not available for analysis. The reasons for missing data include 'more than one option selected', 'no response' or 'not applicable'. 'More than one option selected' and 'no response' occurred with similar frequency except for question 8 where 'no response' was the most frequently occurring reason for missing data. The valid number of responses for analysis is identified with the results for each question.

Each question had an 'other' option where respondents could describe their own practice if this option was not provided. These responses were qualitative rather than quantitative and were grouped into themes and reported at the end of each question.

QUESTION RESPONSES

PLANNED PHYSIOLOGICAL THIRD STAGE

Question 1 asked the respondent to identify when they clamped and cut the umbilical cord with a planned physiological third stage of labour. They were provided with 7 options from 'immediately or before one minute' through to 'after the placenta/whenua is born' including 'I do not practice physiological third stage' (Appendix C). There were 251 of the 257 responses valid for analysis (*N*=251).

Over half of the respondents identified that they clamped the cord when it had stopped pulsating (59.4%, *n*=149) with a further 24.3% (*n*=61) clamping the cord after the placenta/whenua was born. Considerably fewer numbers of respondents identified clamping the cord before it had stopped pulsating (5 clamped the cord before 1 minute; 14 between 1 and 3 minutes and 8 after 3 minutes but before the cord stopped pulsating). There were 5 respondents who chose 'Other' with 4 describing practices that included delayed cord clamping and 9 who identified that they do not practice physiological third stage.

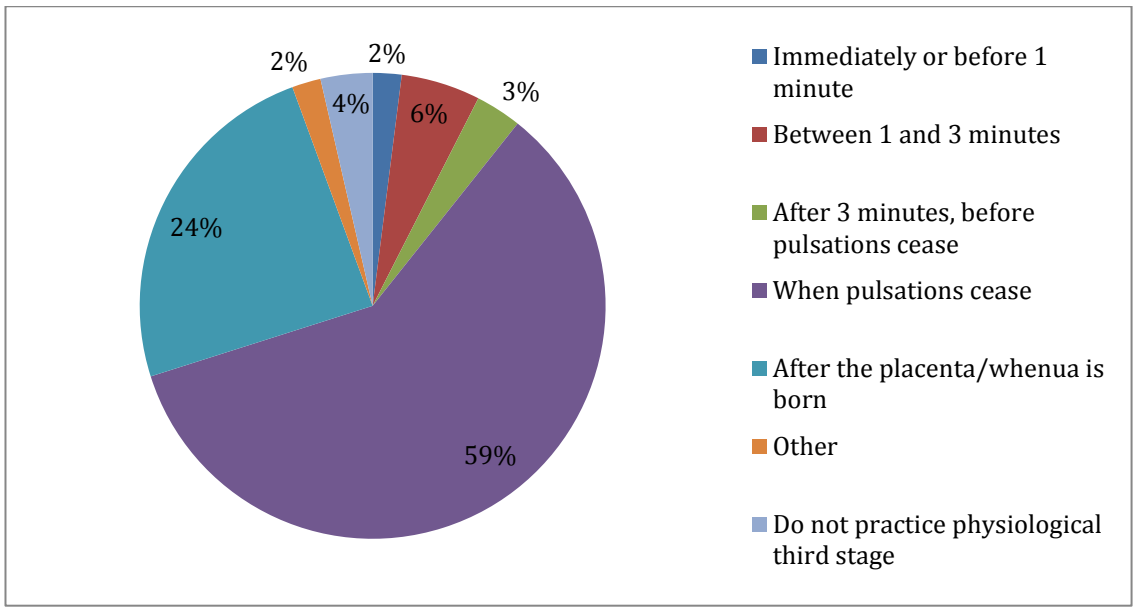


Figure 1: Planned Physiological Third Stage - Timing of Cord Clamping and Cutting (%)

Question two requested the respondents to identify the rationale for their response in question one, that is, their reasons for the timing of cord clamping. More than one rationale could be chosen. All 257 responses were valid for analysis (*N*=257).

The first four options directly related to a rationale for delayed cord clamping practices and were the most frequently selected by the midwives. Maximising the placental blood flow to the baby/pēpi was selected by 73.5% (*n*=189) of respondents; 61.5% (*n*=158) providing undisturbed time for the mother, baby/pēpi and family; 49.4% (*n*=127) believing the baby/pēpi continues to get oxygen from the mother when the cord is pulsating and 27.6% (*n*=71) to support cultural/spiritual practices. There was a total of 24 midwife respondents (9.3%) who identified they were unclear about the timing of cord clamping when no uterotonic drug was given.

Six response options directly related to early cord clamping rationale. The low response rate to these options reflected the options chosen in question one, that is,

the majority of respondents do not clamp the cord early with planned physiological third stage. Of the 6 response options 12 respondents identified clamping the cord early to facilitate management of the baby/pēpi; 8 to facilitate birth of the placenta/whenua and reduce the risk of maternal haemorrhage; 4 to hasten management of the birth process; 3 as it is the policy of the maternity facility and 3 to prevent neonatal jaundice. There were 10 respondents who identified that they clamped the cord early unless the parents requested delayed cord clamping.

The 'other' option was chosen by 33 (12.8%) respondents. These were written responses and grouped according to similarity. The more commonly occurring responses are described below. Delayed umbilical cord clamping to support the physiology of placental separation was described by 13 (5%) respondents; 4 delayed cord clamping for further benefits for the baby/pēpi and 2 delayed cord clamping as it was the way they were taught. Related to early cord clamping, 3 respondents clamped early if the cord was short or blood gases were required, and 2 clamped early to reduce isoimmunisation. There were 3 respondents who identified that cord clamping was the parents' choice. Figure 2 illustrates the frequency of the chosen rationale.

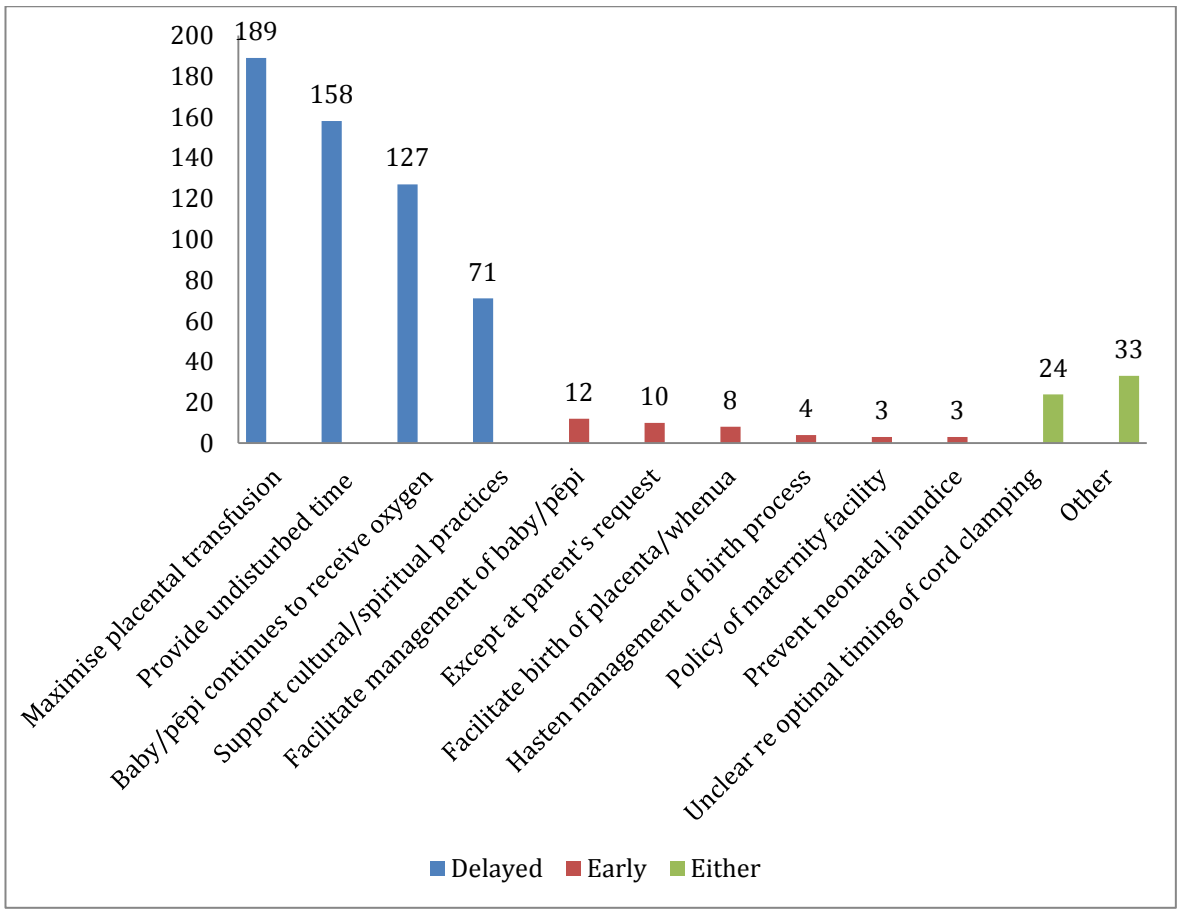


Figure 2: Rationale of Timing of Cord Clamping for Planned Physiological Third Stage (*n*)

Two options had a statistically significant association with the length of time the respondents had practised as a midwife. While the majority of respondents identified that they delayed cord clamping to maximise the placental transfusion to the baby, more midwives in the combined categories of ≤ 10 years practice experience chose this option than did midwives in the combined categories of ≥ 10 years practice experience. This was also evident for the respondents who identified that they delayed cord clamping in the belief that the baby/pēpi continues to receive oxygen. Although fewer respondents chose this option there were more midwives in the combined categories of ≤ 10 years practice experience than those with ≥ 10 years. Table 1 illustrate these statistics.

Table 1: Delayed Cord Clamping to Maximise Placental Transfusion with Belief Baby will continue to receive Oxygen Compared with Years of Practice

	Years of Practice					
	< 5yrs	5-10 yrs	10-20 yrs	20-30 yrs	>30yrs	p
	(n = no. of responses)					
Chosen Options						
Maximise placental Transfusion (n=189)	41	46	46	34	22	0.015
% within Yrs of Practice	82	85.2	74.2	61.8	61.8	
Baby continues to receive O_2 (n=127)	28	32	33	24	10	0.03
% within Yrs of Practice	56	59.3	53.2	43.6	27.8	

* Chi square test
** Overlap of years of practice categories identified

PLANNED ACTIVE MANAGEMENT OF THE THIRD STAGE

Question 3 asked respondents to identify when they clamped the umbilical cord following planned active management of the third stage after a normal birth. They were given the same time frames as for a planned physiological third stage. There were 249 of the 257 responses valid for analysis (*N*=249).

Clamping the cord immediately following birth or before 1 minute was chosen by 30.1% (*n*=75) of respondents with 45.4% (*n*=113) of respondents clamping the cord between 1 and 3 minutes. There were 6% (*n*=15) of respondents who clamped the cord after 3 minutes but before pulsations ceased and another 9.6% (*n*=24) who clamped the cord after it had stopped pulsating. Respondents who identified that they did not practice active management of the third stage after a normal or physiological birth, numbered 13 (5.2%).

The 'Other' option was chosen by 9 respondents who described their practice as follows. For 5 respondents, the timing of the administration of the uterotonic medication rather than the birth of the baby influenced the timing of the clamping of the cord. The timing of cord clamping ranged from immediately after the administration of the uterotonic, through to after the cord had stopped pulsating. One respondent clamped the cord once the baby initiated breathing. The overall percentages of these responses are illustrated in the following figure.

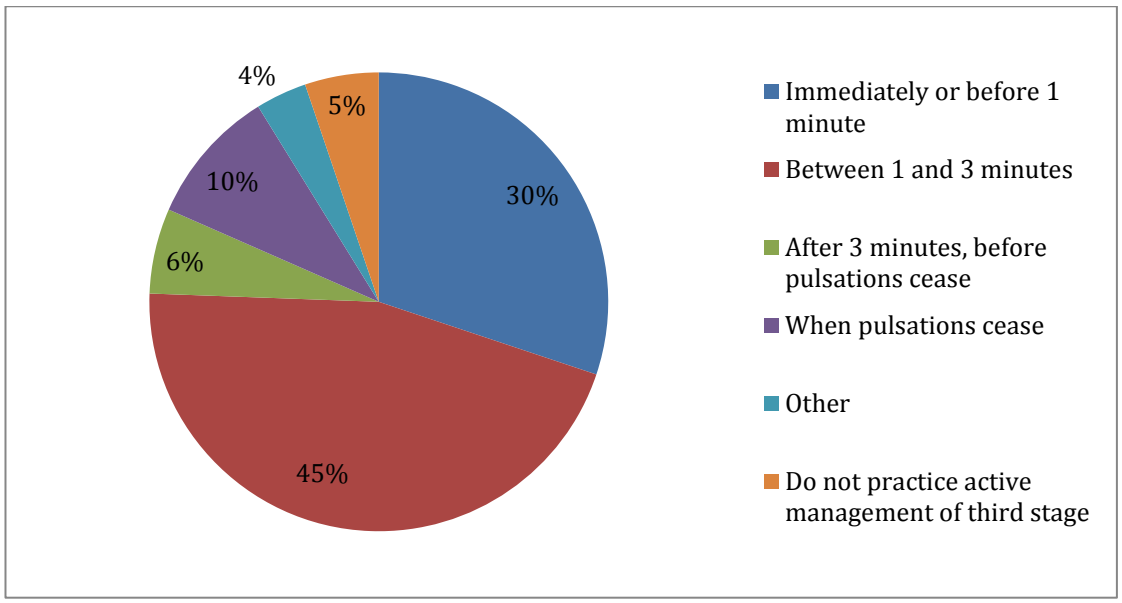


Figure 3: Planned Active Management of the Third Stage - Timing of Cord Clamping and Cutting (%)

Question 4 requested respondents to identify their rationale for their response in question three, that is, their reasons for the timing of cord clamping and cutting. More than one rationale could be chosen and valid responses to this question numbered 254 out of 257 (*N*=254).

The first seven options were related to the rationale for clamping the cord early and were selected most frequently. Clamping the cord early to facilitate the birth of the placenta/whenua and reduce the risk of maternal haemorrhage was selected by 43.2% (*n*=111) of respondents followed by 23.7% (*n*=61) of respondents who clamped early to prevent the baby/pēpi receiving the uterotonic drug. The number of respondents who clamped the cord early because they believe the baby/pēpi becomes over-transfused when the cord is left unclamped was 20.6% (*n*=53). Those who clamped early to hasten/expedite or assist management of the birth process was 17.5% (*n*=45). A small number of respondents identified clamping the cord early to facilitate management of the baby/pēpi (*n*=27), due to the policy of the maternity facility (*n*=16) and to prevent neonatal jaundice (*n*=9).

The following responses relate to the rationale for delaying cord clamping during planned active management of the third stage. Delayed cord clamping to maximise the placental transfusion to the baby/pēpi was selected by 17.5% (*n*=45) of respondents and 12.5% (*n*=32) delayed cord clamping as they believed the baby/pēpi would continue to receive oxygen from the mother while the cord was pulsating. There were 7% (*n*=18) of respondents who identified they delayed cord clamping because they believed it caused the baby/pēpi no harm after the uterotonic had been given to the woman. For 6.6% (*n*=17) of respondents cord clamping was delayed for spiritual or cultural reasons and 3.5% (*n*=9) only practiced delayed cord clamping at the parents' request.

A total of 35 respondents (13.5%) identified that they were unclear regarding the optimal time for clamping the baby's/pēpi cord following administration of the uterotonic to the woman/wahine.

The 'Other' option was selected by 16.7% (*n*=43) of respondents who provided comments regarding individual practice in relation to this question. Just over one quarter of these responses (*n*=12) reiterated what they identified to be the process of active management of the third stage. A further twelve respondents (4.6%) identified timing of cord clamping in relation to the giving of the uterotonic medication rather than the birth of the baby and 6 of these respondents indicated they delayed giving the uterotonic medication following birth. Eight respondents chose this option to provide further rationale for their chosen responses. These comments included clamping early to: take blood gases; prevent Rh sensitization or to birth the placenta before the cervix closes. Two respondents commented on research supporting delayed cord clamping after the uterotonic medication was given.

There were 7 midwives who commented that they did not practice active management of the third stage following a normal birth, or if they did it was

considered treatment. This correlates with the 13 midwives who had identified that they did not practice active management following a normal birth in question 3, thus, 6 of these respondents had chosen to not complete question 4. Other comments were related to individual assessment and woman's choice.

The frequencies of the options chosen are shown in Figure 4.

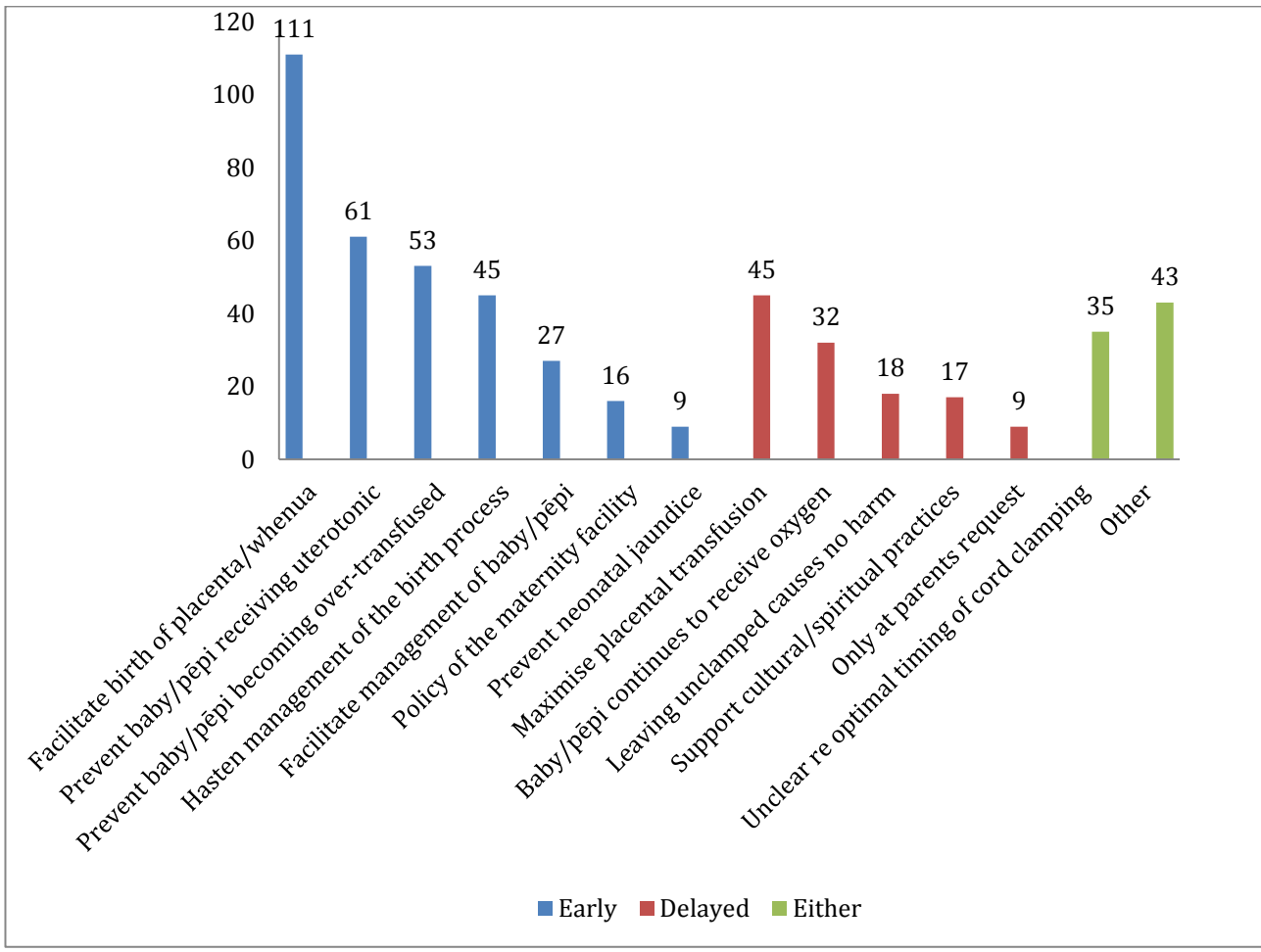


Figure 4: Rationale for Timing of Cord Clamping for Planned Active Management of the Third Stage (*n*)

One option had a significant association with the length of time the respondents had practised as a midwife, following statistical testing. This was clamping the

cord early to prevent the baby/pēpi receiving the uterotonic medication and was less likely to be chosen with increasing years of midwifery practice ($p = 0.001$). This is illustrated in Table 2.

Table 2: Cord Clamped Early to Prevent Baby receiving Uterotonic Medication Compared with Years of Practice

	Years of Practice					
	< 5yrs	5-10 yrs	10-20 yrs	20-30 yrs	>30yrs	p
	(n = no. of responses)					
Chosen Option						
Prevent Baby Receiving Uterotonic (n=61)	21	17	11	9	3	0.001
% within Yrs of Practice	42	31.5	17.7	16.4	8.3	

* Chi square test
** Overlap of years of practice categories identified

WHEN A BABY REQUIRES IMMEDIATE RESUSCITATION

Question 5 requested the respondent to identify when they clamped and cut the cord of the baby/pēpi who required immediate resuscitation following birth. The questionnaires valid for analysis were 253 out of 257 (*N*=253).

There were 201 respondents (*n*=79.4%) who identified they would clamp and cut the cord immediately or before one minute if a baby/pēpi required immediate resuscitation. A further 3.6% (*n*=9) midwives would clamp and cut the cord at one minute and 7.1% (*n*=18) between one and three minutes. The minority of respondents (*n*=11) identified they would clamp and cut the cord either after 3 minutes, when the cord had stopped pulsating or after the placenta/whenua was born.

The respondents who chose 'Other' (5.5%, *n*=14) also described their practice. Six respondents stated that they would delay cord clamping and resuscitate the baby/pēpi next to the woman/wahine if the equipment was available. Four identified that their actions would be dependent on the level of resuscitation required and two stated they would clamp the cord if the baby/pēpi needed to be transferred to the resuscitaire (Figure 5).

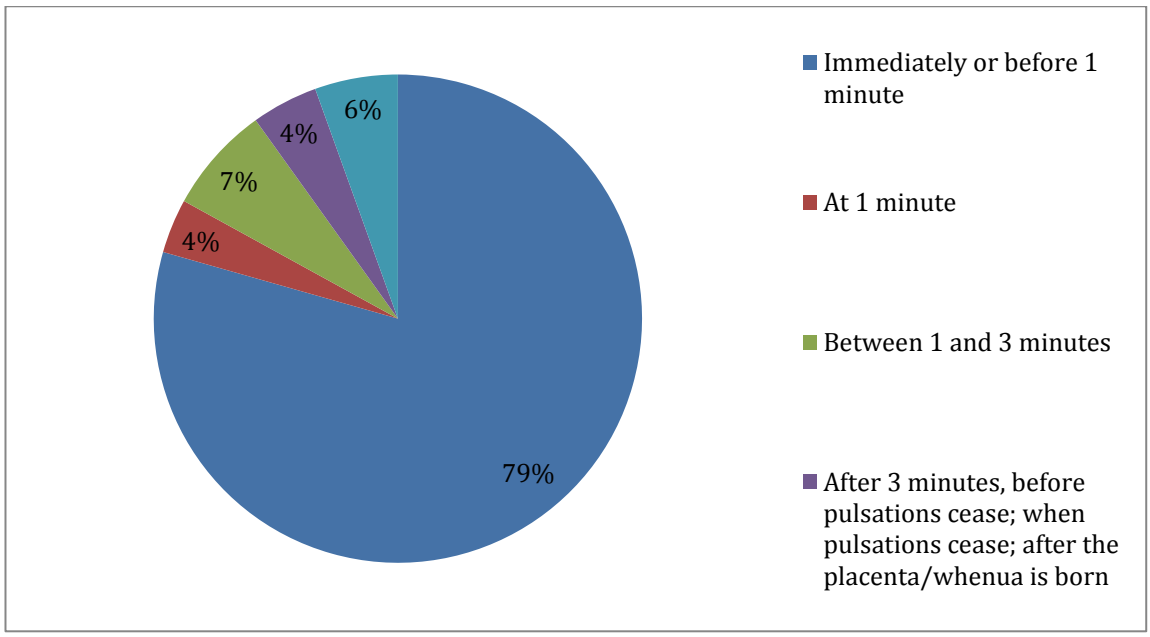


Figure 5: Timing of Cord Clamping when Baby requires Immediate Resuscitation (%)

Question 6 asked the respondents to identify their rationale for their choice in question 5. There were 252 responses valid for analysis (*N*=252).

The first 4 options in the question provided rationale for early cord clamping and two of these options were the most frequently selected. Three quarters (74.7%, *n*=192) of respondents identified that they would clamp the cord early to move the baby/pēpi to the warmer/resuscitaire and facilitate resuscitation. A further 52.9% (*n*=136) of respondents stated that they would clamp the cord early and move the baby/pēpi to the warmer/resuscitaire because it was where the resuscitation equipment was located. There were 12.1% (*n*=31) of respondents who stated that they clamped the cord early to help stimulate the baby's/pēpi respirations and 7.8% (*n*=20) who clamped early and moved the baby/pēpi to the warmer/resuscitaire because it was the policy of the maternity facility.

The rationale options for delayed cord clamping followed. There were 39 (15.2%) respondents who delayed cord clamping to dry and stimulate the baby/pēpi to

maximise the placental transfusion before moving the baby/pēpi to the warmer/resuscitaire. The same number also chose to delay clamping if the resuscitation equipment was accessible, without moving the baby/pēpi (15.2%, *n*=39). A further 10.9% (*n*= 28) of respondents identified they would resuscitate the baby/pēpi beside the woman/wahine, to maximise the placental transfusion and the same number also identified they would delay cord clamping as they believed the baby/pēpi would continue to receive oxygen while the cord was pulsating (10.9%, *n*=28). Four respondents identified that they delayed cord clamping to strip the umbilical cord toward the baby/pēpi.

Thirteen respondents chose other (5.1%) and commented on their practice. These practices included: action being dependent on the condition of the baby (*n*=5); accessibility of the resuscitation equipment (*n*=2); the dictates of the environment (*n*=1); during a water birth (*n*=1) and delayed clamping to keep mother and baby together (*n*=1). Figure 6 illustrates these results by frequency.

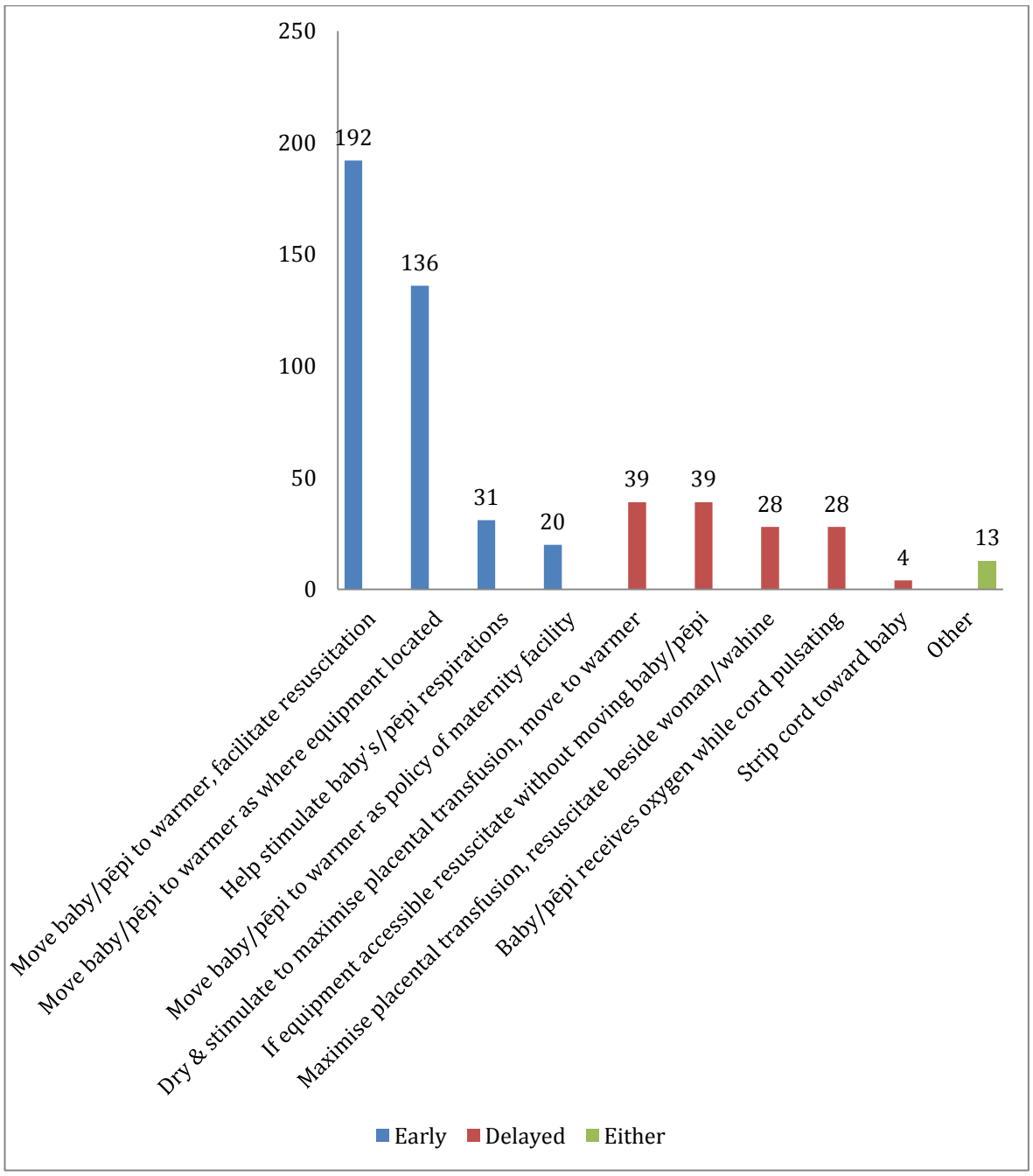


Figure 6: Rationale for Clamping and Cutting the Cord when the Baby requires Immediate Resuscitation (*n*)

One option had a significant association with how long midwives had practised. Table 3 illustrates how midwives who had been in practice for ≤ 10 years transferred the baby to access the resuscitation equipment more often than midwives with ≥ 10 years experience.

Table 3: Cord Clamped Early and Baby moved to Warmer/Resuscitaire because it is where the Equipment is Located compared with Years of Practice

	Years of Practice					
	< 5yrs	5-10 yrs	10-20 yrs	20-30 yrs	>30yrs	p
	(n = no. of responses)					
Chosen Option						
Baby moved to warmer where equipment located (n=136)	31	35	31	27	12	0.03
% within Yrs of Practice	62	64.8	50	49.1	33.3	

* Chi square test
** Overlap of years of practice categories identified

The environments in which the midwives worked influenced their responses to the previous question. Those who identified homebirth as their main work environment were less likely to move the baby/pēpi to the warmer/resuscitaire to facilitate resuscitation (52.4%, *n*=11) than respondents who worked in all other environments (76.5%, *n*=179, *p*=0.015). If home or a primary facility was the main work environment respondents were also less likely to move the baby/pēpi to the

warmer/resuscitaire because it is was where the resuscitation equipment was located (44.9%, *n*=44) than respondents who identified working in tertiary or secondary facilities or the community (58%, *n*=91, *p*=0.04). Homebirth and primary facility respondents were also more likely to delay cord clamping if the resuscitation equipment was accessible without moving the baby/pēpi (23.5%, *n*=23) compared to respondents who worked in other environments (10.2%, *n*=16, *p*=0.004).

Delaying cord clamping because the baby/pēpi continues to receive oxygen from the pulsating cord was more likely to be selected by respondents who worked mainly in homebirth or a primary care facility (16.3%, *n*=16) than respondents who worked in tertiary or secondary facilities or the community (7.6%, *n*=12, *p*=0.03). This group of respondents were also more likely to delay cord clamping to dry and stimulate the baby/pēpi to maximise placental transfusion (21.4%, *n*=21) than respondents who worked in other environments (11.5%, *n*=18, *p*=0.03).

Respondents who identified a tertiary care facility as their main work environment were less likely to resuscitate the baby/pēpi beside the woman/wahine, to maximise placental transfusion (3.6%, *n*=2), than respondents working in all other environments (13%, *n*=26, *p*=0.05). They were also less likely to delay cord clamping for the baby/pēpi to continue to receive oxygen, while the cord pulsated (3.6%, n=2), than respondents from other work environments (13%, *n*=26, *p*=0.05).

PLACEMENT OF THE BABY FOLLOWING A NORMAL BIRTH

In ***Question 7*** respondents were asked to identify where they placed the baby/pēpi immediately following a normal birth. The majority (83.1%, *n*= 212) of respondents identified that they passed the baby/pēpi into to the mother's arms, followed by

5.1% (*n*=13) of respondents who held the baby/pēpi at the level of the mother's perineum, 6 below the level of the mother's perineum and 2 above the level of the mother's perineum.

There were 22 (8.6%) respondents who chose 'Other' and described their practice in relation to placement of the baby. Of these 22 respondents, 15 identified they passed the baby onto the mother's abdomen or chest. Other comments suggested that they were influenced by the woman's position, the desire to provide skin to skin contact and supporting the mother to pick up her baby when she was ready. Figure 7 illustrates these responses.

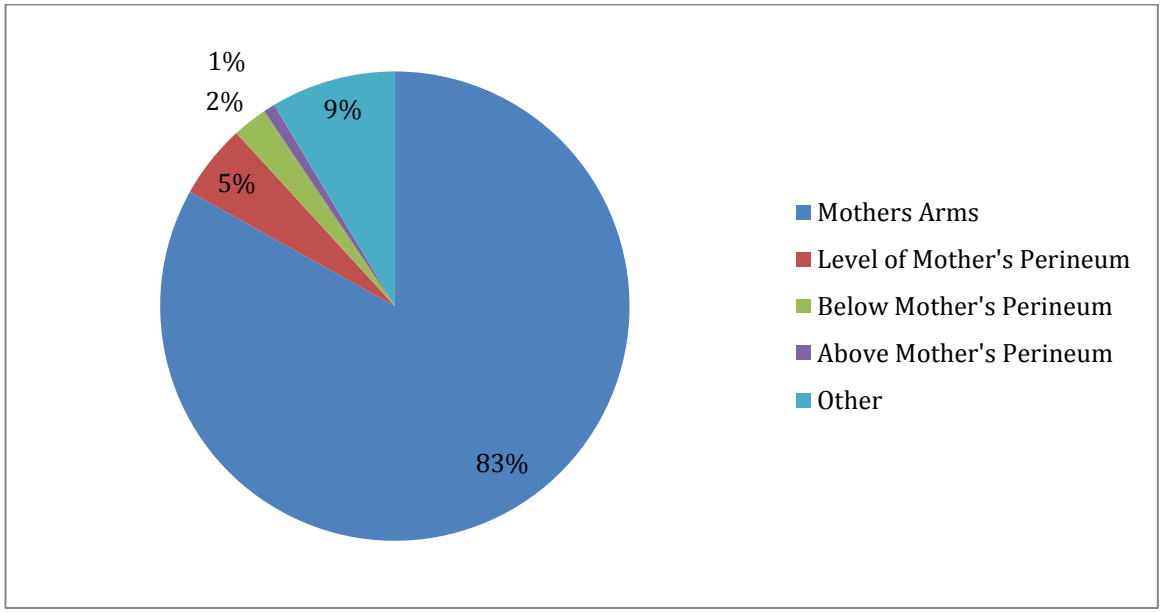


Figure 7: Placement of the Baby Immediately following a Normal Birth (%)

INFLUENCES ON THE TIMING OF CORD CLAMPING

A Likert-type scale was presented in ***Question Eight*** and respondents were asked to indicate the degree of influence the eight statements available had on their

decision of when to clamp and cut the umbilical cord. Respondents were asked to select one of the six options on the scale strongly agree; agree; undecided; disagree; strongly disagree and not applicable. The non-response rate varied for each statement in the question from 3 (*n*=254) to 20 (*n*=237) (Table 4). To enable a clear presentation the 2 affirmative options of strongly agree and agree were combined as were the 2 negative options of strongly disagree and disagree.

Table 4: Degree of Influence on Decision of Timing of Umbilical Cord Clamping

	Response to Statements			
	Agree/ Strongly Agree (n)	Undecided (n)	Disagree/ Strongly Disagree (n)	N/A
Statements				
Parent's choice	229 (90.2%)	12 (4.7%)	12 (4.7%)	1 (0.4%)
Place of Birth	84 (34.6%)	9 (3.7%)	138 (56.8%)	12 (4.9%)
Active Management	220 (88%)	11 (4.4%)	16 (6.4%)	3 (1.2%)
Birth in Water	123 (50.4%)	22 (9%)	67 (27.5%)	32 (13.1%)
Facility Policy	56 (23.1%)	32 (13.2%)	134 (55.1%)	21 (8.6%)
Time Management	26 (10.9%)	16 (6.8%)	187 (78.9%)	8 (3.4%)
Support Newborn Transition	219 (87.6%)	22 (8.8%)	7 (2.8%)	2 (0.8%)
Not Separate Mother & Baby	184 (74.2%)	29 (11.7%)	29 (11.7%)	6 (2.4%)

The first statement asked the respondents to indicate how strongly the parents' choice influenced their decision of when to clamp and cut the cord. The majority of respondents supported this statement with 50% (*n*=127) of respondents strongly agreeing and 40.2% (*n*=102) agreeing indicating this is a major influence on decision making.

Statement two asked midwives how the place of birth influenced their decision to clamp and cut the cord. These responses were more widely spread with just over half of the respondents either disagreeing 28.8% (*n*=70) or strongly disagreeing 28% (*n*=68) with this statement.

The third statement related to whether planned active management of the third stage influenced the respondents decision to clamp and cut the cord. There were 115 respondents (46%) who strongly agreed with this statement and 42% (n=105) who agreed indicating it was a strong influence on decision making.

Statement four asked respondents if their decision of when to clamp and cut the cord was influenced by the baby/pēpi being born into water. Half of the respondents either strongly agreed (19.3%, *n*=47) or agreed (31.1%, *n*=76) with this statement.

The fifth statement asked respondents if the policy of the maternity facility influenced when they clamped and cut the cord. Just over half of the respondents either disagreed (29.6%, *n*=72) or strongly disagreed with this statement (25.5%, *n*=62).

Statement six asked respondents if time management influenced their decision of when to clamp and cut the umbilical cord. The majority of respondents either disagreed with this statement (30.4%, *n*=72) or strongly disagreed with this statement (48.5%, *n*=115) indicating it was not a strong influence on decision making.

The seventh statement asked respondents if their desire to support the newborn physiological transition to extra-uterine life influenced their decision of when to clamp and cut the cord. The majority of respondents either agreed (42.4%, *n*=106) or strongly agreed (45.2%, *n*=113) with this statement indicating it was a strong influence on decision making.

The final statement asked the respondents if their desire to not separate the mother and baby/pēpi influenced their decision of when to clamp and cut the umbilical cord. A clear majority of respondents either agreed (33.1%, *n*=82) or strongly agreed (41.1%, *n*=102) with this statement indicating it was a considerable influence on decision making.

RESPONDENTS CHARACTERISTICS

ETHNICITY

Questionnaire respondents (*N*=256) identified their ethnicity from four options. These results were compared with the first ethnicity documented for registered midwives in New Zealand in 2009 (Midwifery Council of New Zealand, 2010) (Table 5). This revealed that the midwives who completed the cord clamping survey identify with similar ethnic groups to those in the wider New Zealand midwifery workforce.

Table 5: Ethnicity of Respondents

	Cord Clamping Survey (%)	Midwifery Workforce Report[a] (%)
Ethnicity		
NZ/European	87.9	88.3
Māori	3.5	4.6
Pacific	0.8	1.2
Other	7.8	5.9

[a]Midwifery Council of NZ (2010)

COUNTRY OF MIDWIFERY EDUCATION

Respondents were requested to identify the country where they completed their pre-registration midwifery education (*N*=255) (Figure 8). The majority of respondents were New Zealand/Aotearoa educated (68.2%, *n*=174) with 22.4% (*n*=57) educated in the United Kingdom, 4.3% (*n*=11) in Australia and 5.1% (*n*=13) in other countries.

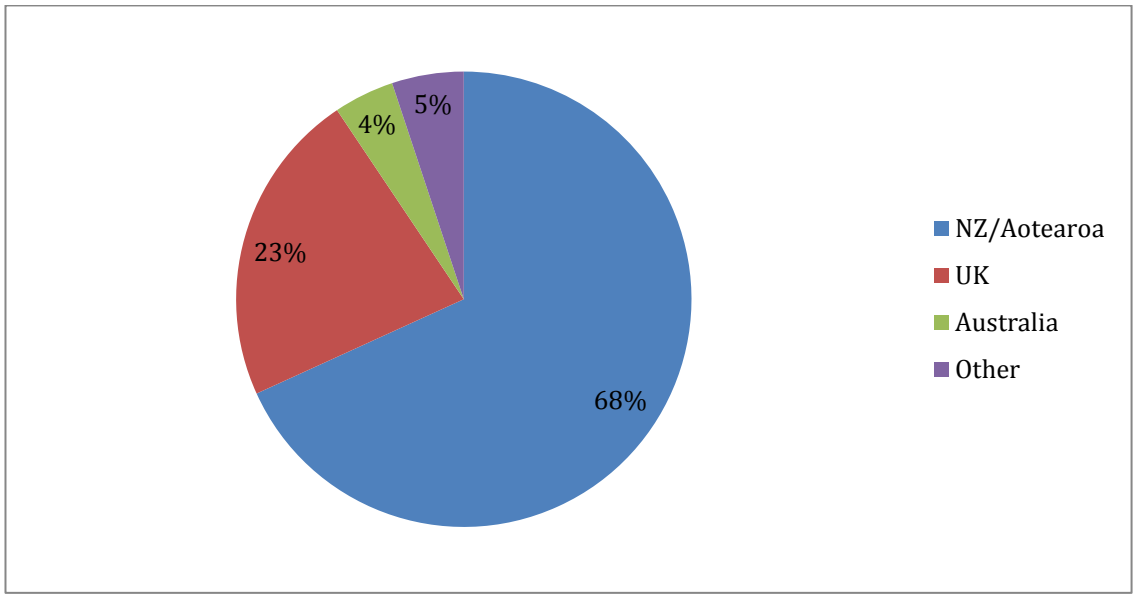
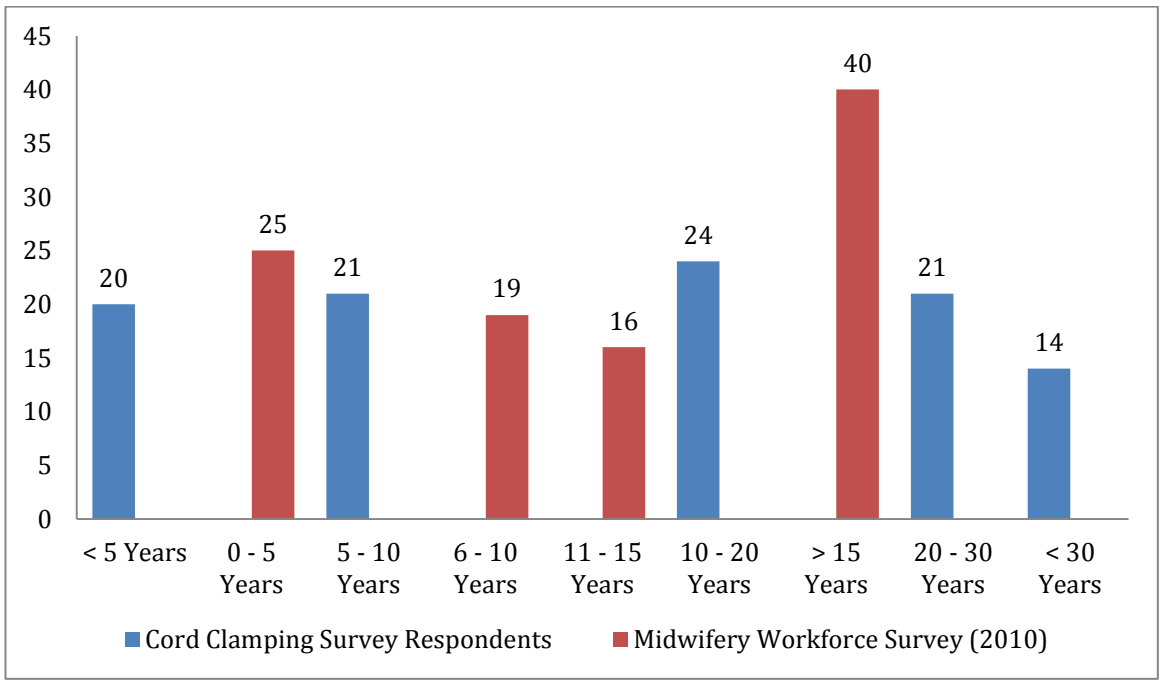


Figure 8: Country of Pre-registration Midwifery Education (%)

MIDWIFERY PRACTICE

Respondents were asked to identify the number of years they had practised as a midwife (*N*=255). Five options were given from: less than 5 years (*n*=50); 5-10 years (*n*=54); 10-20 years (*n*=62); 20-30 years (*n*=55) to more than 30 years (*n*=36). As identified previously (Chapter 3) an oversight in the questionnaire design resulted in overlapping years of practise ranges for 10 and 20 years. However, the proportional size of each category is similar when contrasted with the Midwifery Workforce Survey (2010).



***Overlap of years of practice categories in cord clamping survey identified**

Figure 9: Years of Midwifery Practice - Cord Clamping Survey Respondents and Midwifery Workforce Survey (2010) (%)

Respondents were asked to identify their main type of work as an employed and/or self-employed midwife (*N*=257). This is illustrated in Figure 10 by frequency. There were 66.9% of respondents who identified as being employed and 53.7% who identified as self employed. This revealed an overlap of 20.6% (*n*=53) of survey respondents as being both employed and self-employed. When this information was compared to the 2009 Midwifery Workforce Survey, 30.4% of midwives nationally identified self employment as their main work situation and overall 24.4% of respondents identified a second work situation, which was mainly in midwifery (Midwifery Council of New Zealand, 2010).

In addition the midwife respondents were asked to identify their main work environment from six options provided (*N*=255) (Figure 11).

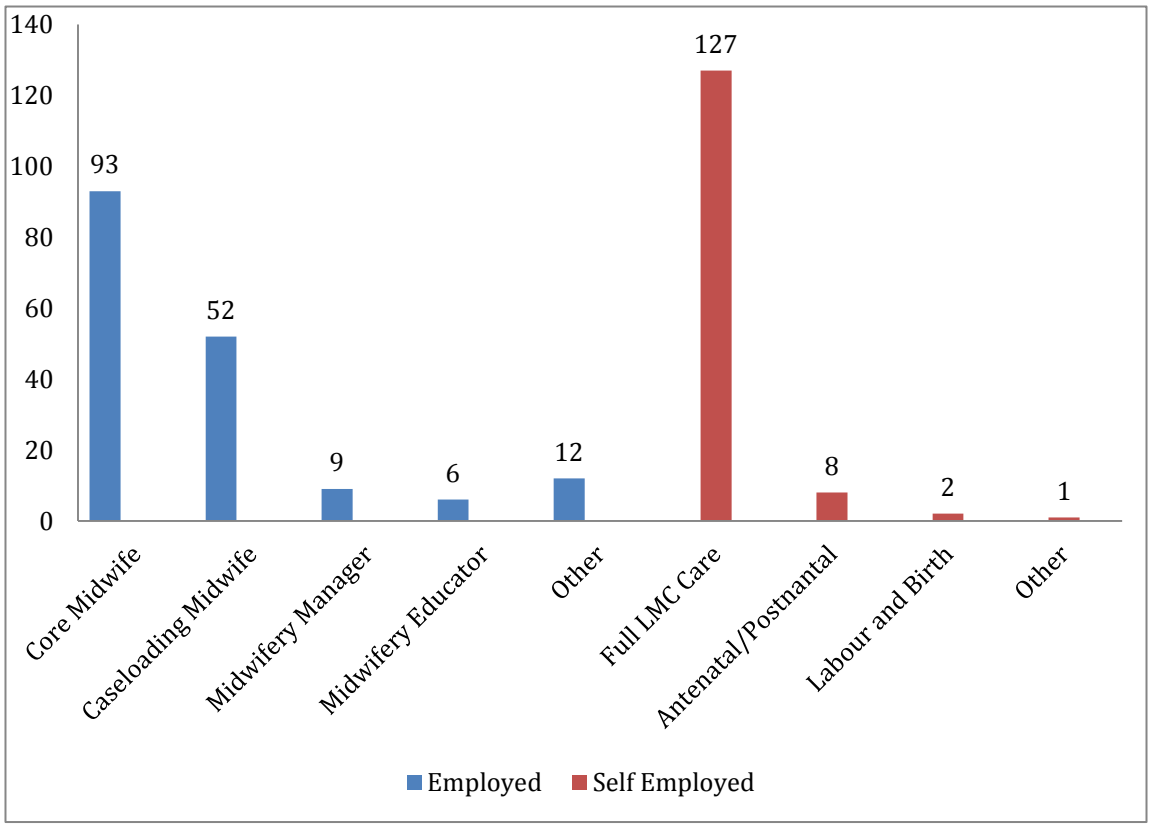


Figure 10: Main Type of Midwifery Work - Employed and Self-employed (*n*)

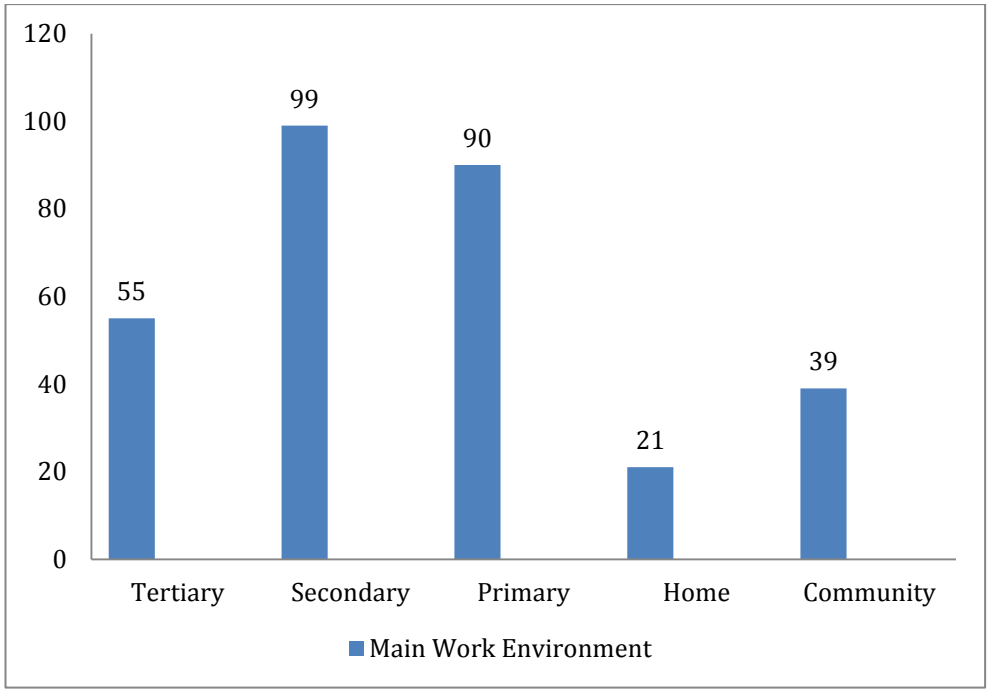


Figure 11: Main Work Environment (*n*)

SUMMARY

Of the 400 questionnaires sent to a random sample of the NZCOM midwifery membership, 257 returned questionnaires were valid for analysis. The demographics of the respondents were similar to the respondents of the Midwifery Council of NZ Workforce Report 2009 (2010) in relation to ethnicity and midwifery experience.

When supporting women with a planned physiological third stage the majority of respondents delayed clamping the umbilical cord until the cord had either stopped pulsating or the placenta/whenua was born. The most commonly chosen reasons for delayed timing of cord clamping were: to maximise the placental transfusion to the baby/pēpi; to provide undisturbed time for the mother, baby/pēpi and family; and because the baby/pēpi continues to receive oxygen while the cord is pulsating.

For women having an actively managed third stage, almost three quarters of respondents clamped the cord either immediately or before three minutes. The most frequently chosen rationale for the timing of cord clamping with active management, were to: facilitate the birth of the placenta/whenua to reduce the risk of haemorrhage; prevent the baby/pēpi receiving the uterotonic drug; and prevent the baby/pēpi becoming over transfused.

Following a normal birth when the baby/pēpi required immediate resuscitation the majority of respondents clamped the cord immediately or before one minute. When a baby/pēpi required immediate resuscitation the rationale most frequently chosen was the need to: move the baby/pēpi to the warmer/resuscitaire and facilitate resuscitation and move the baby/pēpi to the warmer/resuscitaire because it is where the resuscitation is located. Immediately following a normal birth most respondents identified that they passed the baby/pēpi into the mother's arms.

Respondents identified three statements as having the greatest influence on their decision to clamp and cut the cord. These were: parents' choice, planned active management of the third stage and supporting the newborn's physiological transition.

The results in this chapter have described the responses to the questionnaire 'Umbilical Cord Clamping Practices of Midwives in Aotearoa/New Zealand'. In the following chapter several aspects of these results in relation to midwifery practice will be discussed. The chapter is concluded with recommendations for current midwifery practice and areas of interest for future research.

CHAPTER FIVE: DISCUSSION – WANTING THE BEST FOR NEWBORNS

Emerging evidence identifying the effects of cord clamping practices on the newborn's transition to extra-uterine life stimulated the need to understand what is happening in the Aotearoa/New Zealand context. My personal experience of observing the newborn's spontaneous and effective transition following physiological birth, with an intact umbilical cord, left me questioning the implications for midwifery practice.

The research and reviews of Dr. Judith Mercer provided the inspiration for this study. Using a survey tool developed by Dr. Mercer, modified for the New Zealand context, questionnaires were sent to a randomised sample of midwives practising in New Zealand, resulting in a response rate of 64%. The study aim was to describe when midwives clamped the newborn's umbilical cord including the rationale for their decision in three different birthing situations.

This study sought to describe the timing of cord clamping practices of a representative sample of New Zealand midwives and three key findings were identified. The first finding related to the perspective of safety emerging from differing birth philosophies. Safety of the mother and baby was believed to be maintained by either supporting the physiological birth process or by intervening. The second finding related to the timing of cord clamping during resuscitation. The results suggested that there was a limited understanding of the physiology of intra-partum foetal hypoxia and the processes of neonatal transition. The final finding was the influence of aspects of the birth environment, on the timing of cord clamping, when newborn resuscitation was required. These findings are discussed further in this chapter.

In this chapter the main findings are discussed as well as themes collated from the comments written on the questionnaire. These comments relate to modification of the components of active management of the third stage; the goal appearing to be supporting the newborn's extra-uterine transition. A comparison is also made with the results of the American Nurse-Midwives survey of cord clamping practices undertaken by Judith Mercer et al., in 2000.

The chapter concludes with reflection on the study as a whole, consideration of the implications for practice, future research and recommendations based on the study findings.

DIFFERING PERSPECTIVES OF SAFETY

Evident in the results was an intention by most respondents to support the newborn's transition to extra-uterine life. The focus of how this was achieved divided the responses into two different perspectives on safety. One perspective was keeping the mother and baby safe by supporting the physiological process of birth and delaying cord clamping. While, the second perspective focused on maintaining the safety of the mother and baby by giving a uterotonic and clamping the cord early to protect the baby from the effects of the uterotonic medication.

MAINTAINING SAFETY THROUGH DELAYED CORD CLAMPING

When a woman chooses a physiological labour and birth process including the birth of her placenta/whenua, she makes a clear statement regarding her belief in her potential to give birth and the birth process. The midwife maintains her vigilance monitoring the wellbeing of the woman and her baby but there is no

expectation of intervention to maintain the safety of a process that is already trusted.

The study results for the usual time of cord clamping and cutting during a physiological third stage were compared with a frequently used definition for physiological care. This definition has been identified in several sources and describes physiological care as a process where no interventions are used before, during or after the spontaneous birth of the placenta, other than breastfeeding and position changes (Edwards, 1999; Gyte, 1994; Prendiville et al., 2000). According to this definition cord clamping and cutting would not occur until after the placenta was born.

A quarter of respondents identified clamping and cutting the cord after the placenta was born which fits with the definition of physiological third stage above, whereas over half of the midwives identified clamping and cutting the cord after cord pulsations had ceased. From the perspective of the newborn, the latter enables a full placental transfusion to occur but does not enable the potential for blood to flow away from the baby for the equilibration process (Gunther, 1957).

The small number of midwives who identified clamping and cutting the cord between one and three minutes after birth, or before pulsations had ceased, did not replicate recommendations for physiological third stage rather the recommendations of the paediatric papers on this topic (Cernadas et al., 2006; Chaparro et al., 2006; Pappas & Delaney-Black, 2004; Philip & Saigal, 2004). Cernadas et al., (2006) identified a rise in neonatal venous haematocrit within a physiologic range with delayed cord clamping at 3 minutes compared to 15 seconds and 1 minute. This study also identified improved iron and haematological status in full term infants following delayed cord clamping of 2 minutes compared to 10 seconds. Therefore recommendations have been made for cord clamping at these intervals.

The following rationale chosen for the timing of cord clamping following a physiological birth reflects varying levels of understanding of newborn transitional physiology and this is addressed next.

Delayed Cord Clamping to Maximise Placental Transfusion

Almost three quarters of respondents delayed clamping the cord to maximise the placental transfusion yet only half of the respondents identified oxygen being transferred to the baby while the cord continued to pulsate. The blood transferred to the baby during a placental transfusion continues to be oxygenated by the maternal circulation until the placenta separates. Cord pulsations diminish or cease with the rise in PaO_2 in the newborn and the corresponding constriction of the umbilical arteries. This will often correspond with the separation of the placenta (Mercer & Skovgaard, 2002).

This variation in understanding of neonatal transitional physiology was also evident when the respondents' years working as a midwife were compared with their selected rationale. Respondents with ten years or less experience were more likely to select the options of 'maximising placental transfusion' and 'the baby continues to receive oxygen from the mother' compared to midwives with ten years or greater experience. This is likely to reflect the growing understanding of newborn physiology in the midwifery profession and in the midwifery education programmes (Midwifery Council of New Zealand, 2007). Further, this knowledge is critical if midwives are to practice autonomously and work with women to make informed decisions about their care (New Zealand College of Midwives, 2008; Pairman, 2001).

Delayed Cord Clamping to Provide Undisturbed Time for Mother and Baby

Delaying cord clamping to provide undisturbed time for the mother and baby was an option selected by over half the midwife respondents. Similarly the desire to avoid separating the mother and baby was also identified as an influence on the timing of cord clamping by three quarters of the respondents. The intact umbilical cord provides a natural obstacle to the separation of the mother and her baby following birth and would reduce any spontaneous opportunities to pass the baby to someone else to hold during this time. Although clamping and cutting the cord does not necessarily lead to the removal of the baby from his/her mother, historically this was one of the identified reasons for early cord cutting (Inch, 1984).

Early skin to skin contact between a mother and her baby has been demonstrated to have a statistically significant positive effect on breastfeeding and maternal attachment as well as keeping the baby warm (Moore, Anderson, & Bergman, 2007). Nissen, Lulja, Widstrom and Uvnas-Moberg (1995) identified that oxytocin levels remained elevated for the first hour after birth with early skin to skin contact maintained for up to 2 hours. High oxytocin levels following birth stimulate the uterus to contract to expel the placenta and control bleeding. Oxytocin also stimulates the myoepithelial cells of the breast to release milk (Blackburn, 2007) and enhances bonding between the mother and her baby (Buckley, 2009; Odent, 2002).

This information would suggest that in general the midwife respondents had a strong desire to support the newborn's transition to extra-uterine life; although only half appeared to have a clear understanding of the physiological processes involved.

MAINTAINING SAFETY THROUGH EARLY CORD CLAMPING

The use of active management of the third stage following a normal birth indicates that there is doubt about the ability of the woman's body to complete the last stage of the labour safely. This practice has been reinforced by the evidence available on active versus expectant management of the third stage over the last 20 years (Prendiville et al., 2000).

Internationally third stage management practices vary (Winter et al., 2007). Therefore a definition commonly accepted in New Zealand was used to compare the study results for the usual time of cord clamping and cutting during active management of the third stage. This was identified as before 1 minute and defined in the introduction of the questionnaire sent to the respondents (New Zealand College of Midwives, 2006; Prendiville et al., 2000; Thorpe & Anderson, 2006).

In this study just under one third of respondents identified that they clamped the cord, during active management, before one minute. This indicated they were practising in accordance with the commonly defined norm. However almost half of the respondents identified clamping the cord between one and three minutes and this will be addressed later in this chapter.

The most frequently chosen rationale for the timing of cord clamping with active management of the third stage, is discussed next. These rationale reflect varying levels of understanding of the consequences, for the newborn, of uterotonic medication use and early cord clamping. It also highlights significant gaps in the evidence to support understanding, information sharing and decision making by practitioners.

Cord Clamping to Birth the Placenta and Reduce the Risk of Maternal Haemorrhage

The most frequently selected rationale for early cord clamping was to facilitate the birth of the placenta to reduce the risk of maternal haemorrhage, although this was selected by less than half the respondent midwives. This rationale is supported by the most recent Cochrane review comparing active versus expectant management in the third stage of labour (Prendiville et al., 2000) and informs many of the international obstetric guidelines (National Collaborating Centre for Women's and Children's Health, 2007; Royal College of Obstetrics and Gynaecologists, 2008; The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2007). However, this Cochrane Review has been withdrawn pending the review of more recent studies related to third stage management.

The findings of the third stage Cochrane review are commonly used to support the practice of active management, including early cord clamping. Yet the many weaknesses in the studies bring the conclusions into question. These include the sole use of the hospital environment for the studies, the lack of experience and confidence of the practitioners with physiological birth of the placenta, the inclusion of women who were not experiencing a physiological birth and the ≥ 500ml definition of post partum haemorrhage (Dixon, 2008; Fry, 2007; Gyte, 1994; Soltani, 2008; Walsh, 2007). The recently published outcomes of the New Zealand College of Midwives (NZCOM) midwifery database, with a sample size of 33,752, demonstrated reduced blood loss with physiological third stage compared to active management when a physiological labour and birth had occurred (Dixon et al., 2009). Although this was not a randomised controlled trial the sample size of this study was significantly greater than any of the samples of the five trials included in the Cochrane review. The largest sample within the Cochrane review

was 4709 women. This evidence will be welcomed by those midwives with an understanding of physiological birth and transitional neonatal physiology.

Cord clamping to Prevent the Baby Receiving the Uterotonic Medication

Clamping the cord early to prevent the baby receiving the uterotonic medication was the second most frequently selected rationale by just under a quarter of respondents. This was also reflected in several of the comments made by respondents in this and the previous question, stating that they delayed clamping of the cord because they had delayed the administration of the uterotonic medication. Therefore, the timing of cord clamping was decided in relation to the administration of the uterotonic and not the period of time since birth.

Naturally occurring oxytocin is produced and metabolised by both the mother and the foetus during labour and birth (Blackburn, 2007). Synthetic oxytocin administered to the mother is distributed throughout the extracellular fluid and small amounts are known to reach the foetus (New Zealand Medicines and Medical Devices Safety Authority, 2009), with small quantities also found in the breastmilk. Synthetic oxytocin creates a uterine contraction after two and a half minutes, when given intramuscularly, and has a half life of three to twenty minutes. It is eliminated from the body by the liver and kidneys with less than 1% being found in the urine (New Zealand Medicines and Medical Devices Safety Authority, 2009).

There is very little information available regarding any effect on the newborn of an intramuscular injection of uterotonic medication to the mother after birth and before separation of the placenta. Oxytocin has a similar structure to the Anti diuretic hormone (ADH), therefore it can act as an agonist on the ADH receptors leading to water retention and hyponatraemia; (Bryant, Knights, & Salerno, 2007) this metabolic condition having been found in the newborn following prolonged intravenous infusion of synthetic oxytocin to the mother to induce labour (New

Zealand Medicines and Medical Devices Safety Authority, 2009). Induction of labour with synthetic oxytocin is also known to increase the incidence of neonatal hyperbilirubinaemia (Enkin et al., 1995).

Accidental administration of an adult dose of Syntometrine (synthetic oxytocin and ergometrine) to newborns has occurred on several occasions with short term morbidity but no apparent long term sequelae (Dargaville, 1998; Whitfield & Salfield, 1980). Syntometrine drug information advises accidental administration to the newborn could be fatal although I was unable to source any evidence in relation to this outcome (New Zealand Medicines and Medical Devices Safety Authority, 2009).

Less information is available on ergometrine but it is believed to be rapidly and completely absorbed following intramuscular injection with a uterine response by seven minutes and an elimination half-life of up to 3 hours after intravenous administration (The European Agency for the Evaluation of Medicinal Products, 1999). It is thought to be eliminated by metabolism in the liver and excreted in the bile although this may be prolonged in neonates. Ergometrine is secreted in breast milk and may lower prolactin levels following multiple doses postpartum (New Zealand Medicines and Medical Devices Safety Authority, 2008).

Physiologically, the placenta begins to separate from the uterine wall with the contractions following birth and is aided by the diminishing placental size as the blood is transferred to the newborn through a patent umbilical cord (Edwards, 1999). Yao, Hirvensalo and Lind (1968) identified these contractions commenced soon after birth with the placental transfusion completed by three minutes in most situations or by 1 minute, following the administration of intravenous methylergometrine.

Considering the physiology of placental separation, it appears unlikely that the uterotonic medication will reach the newborn's vascular system in any significant

amounts if the cord is not clamped following intramuscular administration and the placenta separates with the contractions soon after birth. This is conjecture based on the study of Yao, Hirvensalo & Lind (1968) as discussed above.

The information available on synthetic oxytocin and ergometrine maleate would suggest synthetic oxytocin alone is a safer medication to use for the neonate during active management of the third stage of labour, compared to a combination of the two drugs. This is particularly relevant if the cord is not clamped following administration (New Zealand Medicines and Medical Devices Safety Authority, 2008, 2009), given that there is a lack of information on the effects of ergometrine on the newborn. Theoretically if the placenta did not separate following uterotonic use, and the newborn retained a circulatory connection to the mother, it could be assumed that the medication could reach the newborn.

Consequently there appears to be a lack of evidence to support best practice with regard to the timing of uterotonic administration and cord clamping which warrants further study. In theory the baby should equilibrate any over-transfusion via the umbilical vein, following the administration of a uterotonic, as long as the cord is not clamped (Gunther, 1957).

Cord Clamping to Prevent the Baby Becoming Over-transfused

Preventing the baby from becoming over-transfused following the administration of an uterotonic medication was a concern of 1 in 5 respondents. Over-transfusion refers to an increased blood volume resulting in polycythemia and may also be associated with hyperbilirubinaemia, as there is an increased number of red blood cells to be haemolysed. The study by Yao, Hirvensalo and Lind (1968), identified that the amount of blood transferred during placental transfusion, following the use of intravenous methylergometrine, did not alter but the period of time for the

blood to transfer shortened. Despite this research early cord clamping became a component of active management of the third stage without evidence to indicate it was necessary (Inch, 1984; Weeks, 2007).

Early cord clamping was not questioned again until recently when the benefits of delayed cord clamping became apparent. In 1996 McDonald presented the findings of a randomised controlled trial to establish if there was a relationship between the timing of cord clamping and intramuscular oxytocic administration, on the risk of post partum haemorrhage. The trial had 4 arms: early cord clamping and early uterotonic administration; late cord clamping and early uterotonic administration; late cord clamping and late uterotonic administration; and early cord clamping and late uterotonic administration (McDonald, 2007; McDonald & Middleton, 2008). When the early and late cord clamping groups were compared, the only neonatal outcome with statistical significance was for jaundice requiring phototherapy. This appears to be the only study to compare the timing of intramuscular oxytocin administration and variable cord clamping intervals. Therefore it is unclear if the outcome of jaundice requiring phototherapy is directly related to the administration of the uterotonic prior to cord clamping.

The Cochrane review (McDonald & Middleton, 2008) comparing the effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes did not identify an increased incidence of polycythaemia in late clamped newborns. Because the timing of the uterotonic was not stated in all of the studies it was not possible to relate its administration to the incidence of over-transfusion.

The rationale provided by the midwives in this study in relation to cord clamping reflects a desire to keep the mother and baby safe by providing appropriate care. However, it appeared that the physiological effects of the uterotonic medication were not well understood by some midwives. This is not surprising considering

the lack of evidence available regarding best practice. One in seven respondents indicated they were not clear about their rationale for the timing of cord clamping during active management of the third stage; a greater number than when an uterotonic medication was not given during physiological care. The majority of midwives indicated that active management of the third stage did influence their decision of when to clamp and cut the cord.

In this study, two perspectives of safety related to the timing of cord clamping were identified. The viewpoint of maintaining safety through delayed cord clamping was identified by respondents predominantly selecting the survey options of maximising placental transfusion and to provide undisturbed time for the mother and baby. The other perspective, of maintaining safety through early cord clamping, was identified through respondents' selections of birthing the placenta to reduce the risk of maternal haemorrhage, preventing the baby receiving the uterotonic and hence preventing over-transfusion.

TIMING OF CORD CLAMPING DURING RESUSCITATION: FIRST DO NO HARM

The second finding in this research study was the incomplete understanding of intra-partum foetal hypoxia by the majority of respondents. When a baby required immediate resuscitation following birth, most midwives clamped and cut the cord immediately or before one minute, prior to commencing neonatal resuscitation. This practice indicated a limited understanding of the effect of intra-partum foetal hypoxia on the neonatal transition to extra-uterine life. Describing a resuscitation event that elicits a universal understanding can be difficult, because it is a variable and dynamic situation, and some respondents identified their actions would be dependent on the level of resuscitation required.

The results of this study are very similar to those found by Mercer et al. in her survey of American Nurse-Midwives. In that study 89% of midwives clamped the cord before 1 minute when neonatal resuscitation was required (Mercer et al., 2000).

INTRAPARTUM FOETAL HYPOXIA AND EARLY CORD CLAMPING

Following birth, asphyxiated infants require resuscitation due to an inadequate oxygen supply to meet their needs. This reduction in oxygen supply can be the result of either intra-partum or intrauterine hypoxia. The physiological response of the foetus is different dependant on the cause of the hypoxia and therefore a different cord clamping interval following birth is advised (Linderkamp et al., 1978; Philip & Saigal, 2004).

Physiology of Intrapartum Hypoxia

The baby born with intrapartum asphyxia is most often hypoxic due to cord blood flow obstruction related to compression, tension or uterine hypercontractability, although it may be caused by bleeding complications such as placental abruption (Wylie & Niermeyer, 2008). Intrapartum asphyxia is an acute rather than chronic cause of hypoxia and the obstruction will have reduced the available blood volume at the time of birth (Linderkamp et al., 1978; Philip et al., 1969; Yao et al., 1967).

Complete cord occlusion leads to an increase in foetal blood pressure, stimulating the baroreceptor reflex followed by bradycardia. Occlusion of only the umbilical vein, which is thin walled and returns oxygenated blood to the foetus, does not cause bradycardia unless chemoreceptors are stimulated due to a decrease in PaO_2

(Blackburn, 2007). Mercer and Skovgaard (2004) suggest that the umbilical arteries are more resistant to compression and therefore continue to pump blood from the foetus to the placenta for re-oxygenation. This process may continue to reduce foetal blood volume when cord occlusion is present.

If the cord was clamped and cut immediately following birth, in order to initiate resuscitation, the loss of blood volume to the baby would be significantly greater than if the cord obstruction had not occurred. This outcome was demonstrated in a study by Linderkamp et al., (1978) where newborns were divided into 4 groups dependent on their mode of birth and presence of foetal distress. All cords were clamped between 5 and 15 seconds after birth and plasma volume and haematocrit were measured with blood cell volume and red cell mass calculated from this result. Babies born with a tight nuchal cord or born vaginally with apgars ≤ 5 had the lowest measures of blood volume and red cell mass compared to newborns that were born vaginally with apgars ≥ 6, by caesarean section or had intrauterine hypoxia.

Newborns affected by intra-partum hypoxia often have an erectile or pulsing cord and several paediatric and midwifery authors have identified that if resuscitation is required it should be commenced with the umbilical cord intact to recover the blood trapped by the obstruction (Diaz-Rossello, 2006a; Hutchon, 2006; Mercer & Skovgaard, 2004; van Rheenan & Brabin, 2006; Weeks, 2007; Wylie & Niermeyer, 2008). Wylie and Niermeyer (2008) identify this alone may reduce the need for administration of volume expanders and stimulating drugs.

Mercer and Skovgaard (2004) acknowledge that it may be difficult to differentiate between the baby who is slow to start breathing and the baby who requires full resuscitation. The condition of the umbilical cord continues to be a guide to the appropriate action at this time. Diaz-Rossello (2006a, p.560) describes the umbilical cord as "a live show of the haemodynamics of neonatal adaptation." In the

situation that the baby's apgars are low yet the cord is still pulsating some authors advised lowering the baby below the level of the mother and stripping the cord toward the baby to reverse the hypovolaemia and stimulate respirations. Although, if the cord is flaccid and bloodless as in extreme foetal distress, placental transfusion is unlikely to occur and the cord should be cut if it aids the resuscitation process (Mercer & Skovgaard, 2004; Morley, 1998).

Intrauterine Hypoxia: Situations When Delayed Cord Clamping is not Advised

The newborn that has experienced chronic intrauterine hypoxia will have made adaptations to the low oxygen uterine environment and will therefore may not benefit from delayed umbilical cord clamping. The conditions that contribute to this often result in intrauterine growth restriction and include infants with cyanotic heart disease; those born at high altitude; mothers who have pre-eclampsia, hypertension or smoke and some women with poor diabetic control (Blackburn, 2007).

When intrauterine hypoxia occurs erythropoietin (Epo) is produced to increase the red blood cell production to enable an increase in tissue oxygenation (Blackburn, 2007). Blood is also redistributed from the placenta to the foetus while in utero. This was demonstrated in studies by Yao, Wist and Lind (1967), replicated by Philip et al., (1969) and further explored by Yao and Lind in 1972. In all of the studies infants born following significant foetal distress and asphyxia at birth were compared with infants without foetal distress. All of the babies in the study by Yao, Wist and Lind were born by caesarean section and their cords were clamped immediately. Red blood cell and blood volume were measured and both were higher in the newborns with intrauterine hypoxia (n= 5) compared to the newborns without (n=13).

To support this Philip et al. (1969) found the placental residual volume was lower in the newborns with intrauterine hypoxia (*n*= 10) compared to the newborns without foetal distress (*n*= 20), indicating a greater transfer of placental blood when the foetus was distressed. In this study the cords were clamped by 60 seconds.

A later study by Yao and Lind (1972) compared the mean blood, plasma and red cell volumes of 6 groups of newborns; asphyxiated spontaneous birth (*n*=12), asphyxiated caesarean section (*n*=5), non-asphyxiated caesarean section (n=13), non-asphyxiated cord round neck spontaneous birth (*n*=6), non-asphyxiated spontaneous birth with cord clamped at 5 seconds (*n*=5), and non-asphyxiated spontaneous birth with cord clamped after 3 minutes (*n*=22). The cord was clamped by 18 seconds in the first 4 groups. The blood, plasma and red cell volumes were the highest and comparable in the first 2 groups of asphyxiated newborns and the last group with cord clamping after 3 minutes. The group with the lowest volumes was the non-asphyxiated newborns with the cord round the neck. This detailed analysis supported the previous findings.

Therefore the foetus with intrauterine hypoxia already has an increased red cell mass and total blood volume prior to birth and it is suggested that delayed cord clamping may lead to polycythemia and hyperviscosity syndrome in the newborn (Philip & Saigal, 2004; Wylie & Niermeyer, 2008). Despite this, van Rheenan and Brabin (2006) advise delayed cord clamping for newborns in low resource countries, even when intrauterine growth restriction is present, given that the risk of polycythemia is low due to foetal anaemia.

There are also rare practice situations when early cord clamping may be the best option. These include: the severely asphyxiated baby described above who may be more effectively cared for with the cord cut and the baby with a nuchal cord that

cannot be born with the somersault manoeuvre because of restriction by the cord (Mercer & Skovgaard, 2004; Morley, 1998).

Cord Clamping to Obtain Cord Blood Gases

Cord clamping to obtain blood gases is a common procedure when a baby is born asphyxiated and this was specifically identified as a rationale for early cord clamping by some of the study respondents. Information from cord blood gas measurements assists in correlating the foetal intra-partum information with the neonatal outcome. Although this information is valuable it is not necessary before commencing treatment on the newborn as the clinical signs provide the information for decision making (Diaz-Rossello, 2006a). Cord clamping also does not need to occur for cord blood gases to be obtained, although the measured values are sensitive to a delay in sampling. Wiberg, Kallen and Olofsson (2008) effectively obtained cord blood gases using a 0.9mm needle and minimal manipulation of the cord without clamping and cutting the umbilical cord. This provides further opportunities for resuscitation to occur with the umbilical cord intact.

Working With Parents when Resuscitation is Required

In this study the vast majority of respondents identified that the parents' choice influenced their decision of when to clamp and cut the cord. Therefore it is essential that parents are given accurate and appropriate information to base their decision making on.

When a baby is born requiring resuscitation midwives are aware of the expectation of responding both immediately and in the best interests of the baby

to support life. It is also a time when midwives often assume the parents will comply with their judgements and actions. This was evident in a Swedish study of midwives experiences of the third stage of labour. Women were encouraged to identify their individual desires and needs while experiencing a normal birth but once the baby was born the midwives saw this period as their domain and "took command over the process" (Jangsten et al., 2009, p. 5). Smythe (1998) also identified that despite the commitment of New Zealand midwives to informed choice and decision making it did not extend to areas that the midwife perceived they had expertise.

The process of informed decision making is difficult to achieve when resuscitation is required (Mason & Allmark, 2000) therefore it would be more appropriate for the situation to be raised and discussed in the antenatal period. Parents placed a high value on their participation in the informed consent process for the care of their baby, according to Mason and Allmark (2000), who investigated if the informed consent obtained from parents to clinical trials on neonates leads to valid consent.

Consequently, where midwives and other health professionals have a limited understanding of intra-partum foetal hypoxia they are less likely to be able to assess the most appropriate time for cord clamping when babies need resuscitating following birth. The differing physiology of foetal intra-partum and intrauterine hypoxia needs to be understood so that appropriate actions can be taken, and clear information provided to parents, to assist them to make informed choices about the care of their infant.

ENVIRONMENT AS AN INFLUENCE ON THE TIMING OF CORD CLAMPING DURING RESUSCITATION

The third finding of this study identified how the birth environment influenced cord clamping practices when newborn resuscitation was required. In the hospital environment the warmer or resuscitaire has become established as the place where the equipment is located and where resuscitation occurs. Hence, for the majority of the respondents cord clamping and cutting became necessary in order to access the resuscitation equipment, effectively integrating cord clamping and cutting into the resuscitation procedure.

CORD CLAMPING TO FACILITATE RESUSCITATION

More than three quarters of the respondents clamped and cut the cord early to move the baby to the warmer/resuscitaire to facilitate resuscitation and this was likely to be done within one minute of birth. According to Tzong-Jin and Waldemar (2001) most resuscitation techniques are successful but they are based on few physiologic studies. Diaz-Rossello (2006a) identified that the timing of cord clamping has been missed from the clinical algorithms for neonatal resuscitation and that this was evident in the International Guidelines for Neonatal Resuscitation (2000).The United Kingdom newborn life support guidelines advise that in most situations, when a baby requires resuscitation, aeration of the newborn lungs by opening the airway is often the only intervention required. This should be followed by giving five inflation breaths if the baby has not established respirations by 90 seconds (Richmond, 2005). This is also supported by maternity and neonatal practitioners who recognise that at least 60 seconds are required to make the initial assessment of the baby before deciding on the ideal moment to clamp the cord (Diaz-Rossello, 2006a; Philip & Saigal, 2004; Wylie & Niermeyer,

2008). This would enable some redistribution of blood volume back to the baby, before clamping and cutting the cord, if resuscitation could not occur with the cord intact.

CORD CLAMPING TO ACCESS RESUSCITATION EQUIPMENT

The location of resuscitation equipment clearly influenced the study respondent's timing of umbilical cord clamping and cutting when a baby required immediate resuscitation. Over half of the respondents identified clamping and cutting the cord early to access the resuscitation equipment and this increased by a further 10% if they had less than ten years experience.

For less experienced respondents this may reflect a greater anxiety with newborn resuscitation because of inexperience or feeling they will be judged by others if they did not transfer the baby immediately. It may also reflect a lack of understanding about the physiology of intra-partum hypoxia. However this supposition is at odds with the finding that respondents with less than ten years experience appeared to have a greater understanding of newborn transitional physiology than do their colleagues who had practised for more than ten years.

WHERE BIRTH OCCURS

The study respondents' main work environment also influenced their cord clamping practices when managing a baby requiring resuscitation. The chosen rationale for timing of cord clamping appeared to fit with the individual midwife's work environment and the location of the resuscitation equipment within it. For example, respondents in the homebirth setting were less likely to transfer a baby to a warmer/resuscitaire to facilitate resuscitation, compared to respondents in all

other work environments, presumably because there was no warmer/resuscitaire in the home environment. Respondents in the primary and homebirth settings were more likely to delay cord clamping, if the resuscitation equipment was accessible without moving the baby, than their colleagues in other settings. Equipment in primary and home environments is likely to be more portable providing the option to resuscitate the newborn with the cord intact.

Respondents who worked in the tertiary setting were less likely to delay cord clamping for any reason, when a baby required resuscitation, compared to respondents in home or primary unit environments. In tertiary settings the resuscitation equipment is not portable and neonatal staff, who are frequently present when resuscitation is needed, require that the baby be moved to the warmer/resuscitaire, therefore necessitating early cord clamping. A quarter of respondents agreed that the maternity facility policy influenced their decision of when to clamp and cut the cord.

The importance of maintaining the placental circulation was previously brought to the attention of maternity and neonatal practitioners when adverse outcomes occurred for babies following cutting of the nuchal cord prior to the identification of shoulder dystocia (Iffy, Varadi, & Papp, 2001). There is also an increasing volume of literature from midwifery, obstetric and neonatal disciplines suggesting ways of managing neonatal resuscitation with an intact umbilical cord.

To resuscitate the newborn close to the mother following birth would require the collaboration of all practitioners involved. Information would need to be shared and modifications made to the physical environment prior to birth for this to be successful (Diaz-Rossello, 2006a; Wylie & Niermeyer, 2008). During resuscitation close to the woman's introitus, care would need to be exercised to protect her personal needs and dignity and that of her family, during this intimate process.

In summary, this third and final finding in the study identified the birth environment as an influence on cord clamping practices when newborn resuscitation was required. The placement of resuscitation equipment in secondary and tertiary settings, such as a warmer/resuscitaire, influenced the early clamping and cutting of the cord. Whereas, in home and primary settings portable resuscitation equipment could be brought close to the woman. Resuscitation of the newborn with the umbilical cord intact in all birth settings would require changes to the placement of resuscitation equipment and discussion and agreement between midwifery, obstetric and neonatal practitioners.

MODIFICATION OF THE COMPONENTS OF ACTIVE MANAGEMENT OF THE THIRD STAGE OF LABOUR

Each question of the survey tool included space for respondents to write a comment if the response option provided did not describe their practice. Although this section was not considered a finding of the study this data provided some insights into how the respondents modified the components of active management of the third stage.

In the questionnaire, sent to the sample group of midwives, physiological third stage and active management of the third stage, were not defined. This was intentional due to the wide variation in practices that have previously been identified internationally as physiological or expectant management and active management (Brucker, 2001; Winter et al., 2007). Smythe et al (1992) previously surveyed New Zealand midwives to identify their practices and beliefs related to the third stage of labour and concluded that these were diverse.

REDEFINING EARLY CORD CLAMPING

Early cord clamping was defined in the questionnaire as any time before 1 minute, as it reflected the definition in much of the international literature (Mercer, 2001). It became clear the respondents did not agree with this as they generally selected early cord clamping options, as rationale for cord clamping times, of both 'before 1 minute' and 'between 1 and 3 minutes'.

The main goal of active management of the third stage is to reduce the incidence of postpartum haemorrhage, with early cord clamping one of the three components (McDonald, 2007). In New Zealand maternity practitioners are advised to manage an active delivery of the placenta in the following order: administration of an uterotonic medication with the birth of the baby's anterior shoulder or immediately after the birth of the baby; early cord clamping (before one minute) and controlled cord traction to deliver the placenta (New Zealand College of Midwives, 2006; Prendiville et al., 2000; The Royal Australian and New Zealand College of Obstetricians and Gynaecologists, 2007; Thorpe & Anderson, 2006).

The reason for clamping the umbilical cord by 1 minute is not clear in the literature but historically it appears to be related to removing the baby to effectively perform controlled cord traction (Bonham, 1963). Therefore the question has been asked as to which components of active management lead to the goal of reducing postpartum haemorrhage and is immediate cord clamping necessary (McDonald & Middleton, 2008)?

In 1996, in a randomised controlled trial, McDonald endeavoured to address this question. Maternal and neonatal outcomes were compared following oxytocic administration, either with the baby's anterior shoulder, or soon after the birth. The timing of cord clamping was either immediately or after cord pulsations ceased (or by 5 minutes after birth) (McDonald, 2007). Delayed cord clamping was

found not to increase the incidence of postpartum haemorrhage (> 500 mls) as long as the uterotonic was administered as a prophylactic rather than as treatment and before placental delivery. This appeared to be the only study which has addressed this subject and McDonald identified that compliance was an issue in the late cord clamping arm of the study.

PLACENTAL TRANSFUSION AND ACTIVE MANAGEMENT

In this study the most frequently identified time for clamping the cord after birth, with active management of the third stage, was between 1 and 3 minutes. The time of uterotonic administration was not requested in the study but written comments identified that uterotonic administration was delayed by several respondents in comparison to the usual definition. The spontaneous comments made by the respondents included:'Delay clamping and uterotonic'; 'Delay active management until cord has stopped pulsing'; 'Delay clamping to 1-3 minutes and have never run into problems'; 'Cord stops pulsing, clamp cord, give ecbolic'; 'Straight after ecbolic given at 1-2 minutes'; 'Give ecbolic at 3-5 minutes and clamp 1 minute after'; 'Clamp a few minutes after ecbolic given'. A possible reason for delaying the administration of the uterotonic after the birth could be that the midwives were attempting to address both the needs of the mother and the needs of the newborn during this time. The delay would enable some placental transfusion to the baby but clamping the cord once the uterotonic was administered would prevent the newborn receiving any perceived adverse effects from the medication.

In 2003 the International Confederation of Midwives (ICM) along with the International Federation of Gynaecology and Obstetrics (FIGO) released a position statement on active management of the third stage. This body recommended the administration of the uterotonic medication within 1 minute of birth but advised not to clamp and cut the cord until after the cord pulsations had ceased

(International Confederation of Midwives & International Federation of Gynaecology and Obstetrics, 2003). This represented a change from their previous active management policy of clamping and cutting the cord immediately after the birth of the baby, instigated before further research to establish the benefits of this practice (van Rheenan & Brabin, 2006). The focus for this change in policy by ICM/FIGO was to continue to recommend active management to prevent post partum haemorrhage in low resource settings, while obtaining the benefits for the baby of delayed cord clamping (Miller, Lester, & Hensleigh, 2004).

For some practitioners it may appear the ideal solution for both the mother and the baby is to administer an uterotonic medication and delay cord clamping. Unfortunately the evidence to support delayed cord clamping following uterotonic administration is lacking. McDonald's 1996 randomised controlled trial discussed in the previous section appears the only one to explore this issue.

The need for further research into the use of uterotonic medication with delayed cord clamping has been identified by Mercer and Erickson-Owens (2006) as essential. While there is no clear evidence to guide best practice, publication of differing opinions will continue and contribute to both confusion and practice variation (Abalos, 2009; Cook, 2007). The benefits of delayed cord clamping to the newborn have been consistently identified and it is important that a lack of new evidence regarding uterotonic administration does not delay its establishment in practice.

COMPARISON OF THE FINDINGS WITH THE ORIGINAL SURVEY

The questionnaire used in this study was adapted from that used by Dr. Judith Mercer and colleagues in 1998 to survey American certified nurse-midwives (ACNM) the results of which were published in 2000 (Mercer et al.). Permission

was obtained from Dr Mercer to use and modify the survey tool for this study. Although several wording changes were made to address the difference in the midwifery context, some comparisons can be made from the findings in each survey.

Mercer et al.'s (2000) response rate was 56% compared to the response rate of 65% for this study. The ACNM respondents had slightly more practice experience with 88% having greater than 5 years experience compared to 80% in this study. Mercer et al.'s survey asked questions related to cord clamping following a normal birth and following a birth where the baby was distressed whereas this survey also included questions related to the type of management used for the third stage of labour.

Following a normal birth in Mercer et al.'s (2000) survey, clamping the cord after 3 minutes, or following the cessation of pulsations, was chosen by 73% of respondents to allow a gradual transition to extra-uterine life, and by 63% of respondents as the baby continues to receive oxygen via the cord. In comparison to this cord clamping survey, following a normal birth and planned physiological care of the placenta, 86% of respondents clamped the cord either after 3 minutes, when pulsations ceased or after the birth of the placenta. Rationale for this choice was predominantly to maximise placental transfusion (74%), provide undisturbed time for the mother and baby (62%) and because the baby continues to receive oxygen (49%).

When a distressed baby was born, 89% of the ACNM respondents clamped the cord before 1 minute compared to 79% in this cord clamping survey. The most commonly chosen rationale by the ACNM respondents was to move the baby to the warmer to commence resuscitation (80%). This was similar to this New Zealand survey where 75% of respondents moved the baby to the

warmer/resuscitaire to facilitate resuscitation. In Mercer et al. (2000) 4.5% of midwives chose to clamp the cord after 3 minutes, the same as for this study.

Placement of the baby following birth was similar in both surveys with 87% of the ACNM respondents placing the baby on the mother's abdomen compared to 83% in this survey who passed the baby into the mother's arms. In both survey's 2% of respondents held the baby below the perineum.

These two surveys were completed 10 years apart in countries with differing legislation governing midwifery practice but there are similar responses in many areas, with the New Zealand survey suggesting an increased awareness of neonatal transitional physiology.

SUMMARY

This survey has provided a unique insight into New Zealand midwives' umbilical cord clamping practices. As midwives we frequently work in isolation during the intimate process of birth therefore, we do not often discuss the detailed rationale of our actions unless the outcome is adverse. The responses from the midwives in this study, showed an overall desire to support the transition of the newborn to extra-uterine life and keep the mother and baby safe.

Three significant findings are highlighted from this study. The first was the differing philosophical perspectives of safety leading to the practice of either delayed cord clamping or early cord clamping by the midwife. Over time gaps in information have lead to the establishment of a variety of poorly informed practices. This has obscured some of the new evidence related to neonatal transitional physiology and for some practitioners this has made it difficult to understand and assimilate into practice. Hence the second finding has identified the limited understanding by many practitioners of the physiology of foetal

hypoxia and the effect of early cord clamping practices on newborn adaptation following birth. The third finding of the study addresses the influence of the birth environment on cord clamping practices when newborn resuscitation was required. In secondary and tertiary birth environments, the warmer/resuscitaire has become the place where the equipment for newborn resuscitation is located, necessitating early clamping and cutting of the cord in order to facilitate resuscitation of the neonate.

From the spontaneous comments written on the survey forms, a pattern of modified components of active management of the third stage emerge. Again, these responses appeared to indicate a desire to meet the physiological needs of the baby during their extra-uterine transition, though there was minimal evidence to support these variations of practice. To conclude comparisons were made between the results of the original survey by Judith Mercer et al., and this New Zealand study. Because some changes were made to the original survey all aspects could not be compared. Nevertheless, cord clamping practice and the rationale for these were similar in several areas of the respective surveys. One notable difference in the New Zealand survey was the apparent increased awareness of neonatal transitional physiology.

REFLECTIONS AND CONCLUSIONS

Clamping and cutting of the umbilical cord is both a practical and symbolic event. During normal birth, midwives in New Zealand, in consultation with women and their families, take responsibility for the timing for this event.

The aims of this study focused on identifying the time of umbilical cord clamping practices of midwives in Aotearoa/New Zealand, including the rationale for their practices. This is the first study in New Zealand to directly address this aspect of practice and the findings provide a valuable resource and impetus for future research and discussion.

In this final section, I begin by reflecting on the research process for this study, outline areas of future research around the topic of umbilical cord clamping, suggest four recommendations for consideration in midwifery education and practice settings, and summarise the study as a whole.

REFLECTIONS ON THE STUDY

One of the strengths of this study evolves from the quality of the sample frame. Obtaining the annually updated New Zealand College of Midwives membership list enabled access to over 85% of the midwives registered in Aotearoa/New Zealand, with an equal weighting of employed and self-employed status. This was reflected in the results with over half the respondents selecting self-employed status and almost three quarters employed. The 20% overlap was due to midwives identifying as both self-employed and employed. A simple randomisation of the sample frame was completed through a computerised process which reduced the potential for human error. A research assistant was also contracted to ensure confidentiality of participants.

The demographics of the respondents are very similar to those of midwives registered with the Midwifery Council of New Zealand in 2009 indicating that the sample closely reflected the midwifery population at the time.

The quality of the sample may have been mitigated by the response rate of the questionnaire. A return rate of 80% was required to obtain a 95% level of confidence in the results. Two reminder letters and questionnaires were sent to participants following the initial mail out. A satisfactory return rate of 64% was achieved, therefore, the sampling error of this study was closer to 8% (de Vaus, 1995). The 36% non-response rate also creates potential bias in the results as very little information is known about the non-responders.

An oversight in the development of the questionnaire was the overlap of years since midwifery registration in the demographics section of the questionnaire. This may have slightly affected the number of midwives in 2 of the groups.

OPPORTUNITIES FOR FUTURE RESEARCH

The main aim of this study was to identify when midwives clamped the umbilical cord and their rationale for this decision. As anticipated this process has uncovered more questions to be asked to further clarify the original question. I have considered these and provide the following suggestions.

1. The current study.

   A qualitative approach to this question would expand the results from the current study and provide insight into midwives' rationale for the timing of cord clamping. Focus groups would enable midwives to discuss their decision making process and assist in further understanding their actions.

2. The timing of administration of the uterotonic medication.

   In this study an assumption had been made that midwives practised active management of the third stage according to a commonly used definition. Analysis of the results of this study identified that many midwives manipulated the components of active management in various ways and did not follow the accepted protocol. Further, review of the international literature related to the timing of uterotonic administration following the birth of the baby identified a significant lack of information and a lack of guidance for practice.

3. The administration of uterotonic medication with delayed cord clamping.

   Review of the international literature on umbilical cord clamping has revealed minimal information on the combination of these practices. Therefore, further research is required on the effect of various uterotonic medications, in combination with delayed cord clamping, on neonatal outcomes. As this practice is already being recommended research in this area is a matter of urgency.

4. The effect of the birth environment on newborn outcomes following resuscitation at birth.

   The literature suggests that in most instances it is beneficial to the newborn for the umbilical cord to remain patent when commencing neonatal resuscitation following intra-partum hypoxia. This study identified that the birth environment influenced cord clamping practices, when resuscitation of the newborn was required, and resuscitation with the umbilical cord attached was more likely to occur at home or in a primary birthing facility. Therefore further research focused on the effect of the birth environment on neonatal outcomes following resuscitation is warranted.

IMPLICATIONS FOR PRACTICE

Care of the umbilical cord following birth is in the midwives domain of practice unless the birth is operatively assisted. The timing may be influenced by parents' choice and other practitioners' requests but the procedure is usually instigated and facilitated by the midwife. It is the midwife who discusses the procedure of cord clamping and cutting, offering options during a woman's pregnancy and creating a plan for the time following birth. Because of the long term association of cord clamping with third stage of labour management, the options of timing of cord clamping have often been related to this aspect of birth care, rather than the effect on the physiological adaptation of the newborn.

This study has suggested that midwives have a partial understanding of the physiology of neonatal adaptation, as described in the literature. A significant number of respondents identified they were unclear of the optimal time to clamp the cord indicating that they recognised their knowledge deficit. Knowledge of neonatal physiology and anatomy continues to grow and it is incumbent on practitioners to maintain currency in these important scientific areas. The quality and depth of practitioner knowledge is critical when working with women and their families when making informed choices during pregnancy and birth. Informed choice is one of the tenets of the health profession in New Zealand (Ministry of Health New Zealand, 1994). Childbearing is recognised as a normal life event and women are provided with information to make decisions related to their well-being and that of their baby. The degree of participation and self responsibility in decision making is dependent on the quality of the information shared. In relation to decisions about the timing of cord clamping it is important that women and their families are aware that early cord clamping, although standard practice for many years, is now recognised to reduce the newborn blood

volume by a quarter. Concern regarding the continuation of this practice is increasing amongst researchers and some clinicians (Soltani, 2008).

Prior to professional independence in New Zealand, midwives frequently felt powerless to effect changes in practice not condoned by the medical profession. This was true even in the presence of robust evidence (Walsh, 2007). Now, as an autonomous midwifery profession we are guided by our scope of practice, professional standards and legal status, with the expectation of basing our practice and advice to women, on the best evidence available. Part of autonomous practice is our collaborative relationships with our obstetric and neonatal colleagues. Therefore as midwives we need to share new knowledge and support our colleagues as they also navigate the systems to integrate new evidence into practice.

In New Zealand, one of the major benefits for midwives of the partnership relationship with women is that, we do not act alone in creating change. The premise of informed choice and decision making is enshrined in legislation and is an expectation of health care provision (Ministry of Health New Zealand, 2003). If women are provided with appropriate and accurate information it will create the opportunity for them to make choices relevant to their individual situation.

RECOMMENDATIONS

The following recommendations have been formulated from the primary findings of this study.

One

Education is provided to under-graduate student midwives and post registration midwives regarding the physiological transition of the newborn from intrauterine to extra-uterine life. Aspects to address are: the potential effect of uterotonic

medications on maternal and neonatal physiology; the physiology of intrauterine and intrapartum foetal hypoxia and strategies to introduce new knowledge into practice.

Two

Information is shared with the women/parents in the antenatal period regarding neonatal transitional physiology and the current evidence on umbilical cord clamping. The parents' wishes need to be respected in regard to the timing of clamping and cutting the cord including if necessary, facilitating neonatal resuscitation with the cord intact. This will involve ensuring that the woman's privacy is respected during this process.

Three

Discussions are commenced with the District Health Boards, as the provider of hospital based obstetric and neonatal services, regarding the current evidence in relation to umbilical cord clamping practices for babies at full-term. This would enable effective collaboration when a multi-disciplinary approach to care is required. Representatives of groups directly affected by any changes to current practices should be included such as maternity unit managers; representatives of maternity and neonatal practitioners involved at birth; childbirth educators; Māori representatives; and consumer group representatives. These meetings should be on-going to obtain feedback on any change in practice.

Four

Following on from recommendation three, consideration is given to the arrangement of the birthing environment in all settings to enable the newborn to be resuscitated with the umbilical cord intact.

CONCLUSION

The aims of this study focused on identifying the time of umbilical cord clamping practices of midwives in Aotearoa/NewZealand including the rationale for and the influences on these practices. The information described in the results met the study aims within the limitations of the information requested in the questionnaire.

When compared with international research on this subject within midwifery both similarities and differences were identified. This reflects the larger body of research completed on practices related to the third stage of labour, which includes umbilical cord clamping. In these papers wide variation in practices were consistently found both within countries and between countries (Festin et al., 2003; Stanton et al., 2009; Winter et al., 2007).

Study results identified that the majority of respondents delayed clamping of the umbilical cord during a physiological birth of the placenta, for reasons related to supporting the newborns transition to extra-uterine life. Practices during active management of the third stage were less clearly defined although the majority of midwives defined their cord clamping practices as 'early'. However, compared to the current international definition for active management of the third stage this timing was considered late (McDonald & Middleton, 2008). The rationale given for this situation was generally related to facilitating the birth of the placenta and preventing adverse effects of the uterotonic medication on the baby.

As with physiological care the cord clamping practices for a newborn requiring immediate resuscitation were very clearly defined with the majority of respondents clamping the cord early to move the baby to the warmer/resucitaire for resuscitation.

The clearest influences on cord clamping practices were: parent's choice; active management of the placenta; supporting the newborns transition to extra-uterine life; and not separating the mother and baby.

One aim of this study was to collate and present the current evidence related to the effects on the newborn of the timing of umbilical cord clamping. Responses from this study, describing cord clamping practices and reasoning, offer an opportunity for midwives to reflect on their practice individually and as a profession. In the wake of international research into this area of practice, it is anticipated that changes in practice will occur for midwives and the other practitioners involved at the time of birth.

This research study compliments the previous study by Judith Mercer, Carlene Nelson and Rebecca Skovgaard who identified the umbilical cord clamping beliefs and practices of American nurse-midwives in 2000. The questionnaire of this current study was based on that used in the above with several changes made to accommodate differences in the New Zealand midwifery context. These two surveys were completed 10 years apart in countries with differing legislation governing midwifery practice. Similarities were identified between some responses with the current cord clamping survey suggesting some increased awareness of neonatal transitional physiology.

Cord clamping practices are currently under review and the findings in this thesis will contribute to this discussion, both nationally and internationally. Umbilical cord clamping is a consistent intervention in birth and the timing of cord clamping has lacked scientific review since the introduction of cord clamping as a component of active management of the third stage of labour. Universal early clamping of the umbilical cord has therefore been recommended practice since the 1960's, without support from a considerable body of evidence based on the physiology and science of newborn transition processes. Consequently this will

have been to the detriment of the majority of newborn babies involved. If midwives are to support parents to make informed choices on behalf of their newborn baby it is vital the profession provides them with the available evidence to be able to do this effectively. In Judith Mercer's words:

> The use of evidence-based research guidelines will allow clinicians to look beyond unsystematic clinical experiences, the pathologic emphasis on neonatal transition, and institutional routines and assist them to interpret the evidence obtained from clinical research (Mercer, 2001, p. 402).

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APPENDIX A

Permission from New Zealand College of Midwives to access Membership List

NEW ZEALAND COLLEGE OF MIDWIVES (INC)

10 September 2008

Julie Richards
210 Huntsbury Avenue
Cashmere
Christchurch 8022

Elaine Gray
15 Panckhurst Drive
Woodend 7610

Dear Julie and Elaine

QUANTITATIVE RESEARCH PROPOSALS FOR NZ MIDWIFERY PRACTICE

Thank you for your letter dated 1 September 2008.

As discussed at the 30 April 2008 National Committee meeting, National Committee have approved your access to the New Zealand of Midwives membership database list for your two quantitative research project surveys.

Approval is given on the basis that you will randomly select names from the employed and self employed members in the database. One questionnaire for both pieces of research will be sent out to these members.

Yours sincerely

Karen Guilliland
CEO

376 Manchester Street PO Box 21106 Edgeware Christchurch Telephone 03 377 2732
Facsimile 03 377 5662 Email Address: nzcom@nzcom.org.nz

APPENDIX B

Research Assistant Consent Form

I _____

agree to maintain the confidentiality of the participants and potential participants in the research conducted by Julie Richards.

I agree to:

- Maintain the names of the randomised sample and their allocated questionnaire number in a password protected computer file.
- Not discuss the list of names with anyone including the researcher.
- Delete the file of names and associated questionnaire numbers at a time that the researcher defines at the completion of the research.

(research assistant signature)

(researcher's signature)

(date)

APPENDIX C

Survey Questionnaire

Umbilical Cord Clamping Practices of Midwives in New Zealand/Aotearoa

Thank you for considering completing this questionnaire. Return of this questionnaire implies your consent to participation in this survey.

The following questions relate to when you clamp the umbilical cord following birth and the reasons why you decide to do it at this time. Please circle or write in your responses as indicated. Your responses are relevant and important even if you are not currently supporting women during labour and birth.

Each question asks you about midwifery practice in relation to a well woman/wahine and well baby/pēpi at full term unless otherwise stated.

A 'normal birth' is defined as a physiological birth that has required no obstetric intervention.

'Early cord clamping' is defined as any time before one minute.

1. After a normal birth with planned physiological third stage, I usually clamp and cut the umbilical cord

(Please circle one answer)

a. immediately or before 1 minute
b. between 1 and 3 minutes
c. after 3 minutes but before the cord stops pulsating
d. when the cord stops pulsating
e. after the placenta/whenua is born/delivered
f. other (please specify)_____
g. I do not practice physiological third stage

2. The following choice(s) describe my rationale for the preceding answer

(Please circle all that apply)

a. I delay cord clamping in order to maximise placental transfusion to the baby/pēpi
b. I delay cord clamping to support cultural/spiritual practices
c. I delay cord clamping because I believe the baby/pēpi continues to receive oxygen from the mother when the cord is pulsating
d. I delay cord clamping to provide undisturbed time for the mother, baby/pēpi and family.
e. I am unclear about the optimal timing of cord clamping when no uterotonic drug (Syntocinon/Syntometrine) is given
f. I clamp the cord early in order to facilitate management of the baby/pēpi
g. I clamp the cord early because it is the policy of the maternity facility
h. I clamp the cord early except at the parent's request
i. I clamp the cord early to prevent neonatal jaundice
j. I clamp the cord early to facilitate the birth of the placenta/whenua to reduce the risk of maternal haemorrhage
k. I clamp the cord early to hasten management of the birth process
l. Other (please specify)_____

Otago Polytechnic Research Ethics Committee Approval: 4th November 2008

3. **After a normal birth and a planned active management of the third stage, I <u>usually</u> clamp and cut the umbilical cord**

(Please circle <u>one</u> answer)

a. immediately or before 1 minute
b. between 1 and 3 minutes
c. after 3 minutes but before the cord stops pulsating
d. when the cord stops pulsating
e. after the placenta/whenua is born/delivered
f. other (please specify) .....
g. I do not practice active management of the third stage

4. **The following choice(s) describe my rationale for the preceding answer**

(Please circle <u>all</u> that apply)

a. I clamp the cord early in order to facilitate management of the baby/pēpi
b. I clamp the cord early because it is the protocol of the maternity facility
c. I clamp the cord early to prevent neonatal jaundice
d. I clamp the cord early to facilitate the birth of the placenta/whenua to reduce the risk of maternal haemorrhage
e. I clamp the cord early to hasten/expedite/assist management of the birth process
f. I clamp the cord early to prevent the baby/pēpi receiving the uterotonic drug Syntocinon/Syntometrine)
g. I clamp the cord early because I believe leaving the cord unclamped after giving a uterotonic drug to the woman can cause the baby/pēpi to become over-transfused
h. I delay cord clamping in order to maximise the placental/whenua transfusion
i. I delay cord clamping to support cultural/spiritual practices
j. I delay cord clamping only at the parent's request
k. I delay cord clamping because I believe the baby/pēpi continues to receive oxygen from the mother when the cord is pulsating
l. I delay cord clamping because I believe leaving the cord unclamped after giving a uterotonic drug to the woman causes the baby/pēpi no harm
m. I am unclear about the optimal timing of cord clamping following giving a uterotonic drug
n. Other (please specify) .....

5. When a baby/pēpi is born requiring immediate resuscitation, I usually clamp and cut the cord

(Please circle one answer)

a. immediately or by 1 minute
b. at 1 minute
c. between 1 and 3 minutes
d. after 3 minutes but before the cord stops pulsating
e. when the cord stops pulsating
f. after the placenta/whenua is born/delivered.
g. Other (please specify) .....

6. The following choice(s) describe my rationale for the preceding answer

(Please circle all that apply)

a. I clamp the cord early to move the baby/pēpi to the warmer and facilitate resuscitation
b. I clamp the cord early and move the baby/pēpi to the warmer because it is the policy of the maternity facility
c. I clamp the cord early to help stimulate the baby's/pēpi respirations
d. I clamp the cord early and move the baby/pēpi to the warmer because that is where the resuscitation equipment is located
e. I delay cord clamping in order to maximise the placental transfusion and resuscitate the baby/pēpi beside the woman/wahine
f. I delay cord clamping because the baby/pēpi continues to receive oxygen from the mother while the cord is pulsating
g. I delay cord clamping to milk/strip the umbilical cord toward the baby/pēpi
h. I delay cord clamping while I dry and stimulate the baby/pēpi to maximise the placental transfusion before clamping the cord and moving to the warmer for resuscitation
i. I delay cord clamping if the resuscitation equipment is accessible without moving the baby/pēpi
j. Other (please specify) .....

7. Immediately following a normal birth, I usually

(Please circle one answer)

a. Pass the baby/pēpi into the mother's arms
b. Hold the baby/pēpi at the level of the mother's perineum
c. Hold the baby/pēpi below the level of the mother's perineum
d. Hold the baby/pēpi above the level of the mother's perineum
e. Other (please specify).....

In the next question tick the box that indicates your response to the following statements. Please respond to each statement.

8. Following a normal birth, my decision of when to clamp and cut the cord is influenced by:

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	N/A
The parent's choice	☐	☐	☐	☐	☐	☐
The place of birth, Eg. Home, 1°, 2°, 3° birthing facilities	☐	☐	☐	☐	☐	☐
Planned active management of the third stage	☐	☐	☐	☐	☐	☐
The baby/pēpi born into water	☐	☐	☐	☐	☐	☐
The policy of the maternity facility	☐	☐	☐	☐	☐	☐
Time management	☐	☐	☐	☐	☐	☐
My desire to support the newborn's physiological transition to extra-uterine life	☐	☐	☐	☐	☐	☐
My desire not to separate the mother and baby/pēpi	☐	☐	☐	☐	☐	☐

Please fill in the following information so that I know more about the context of your midwifery practice

Ethnicity: Please tick <u>one</u> ethnicity you most strongly identify with

☐ NZ/European/Pakeha ☐ Māori ☐ Pacific ☐ Other

Country of pre-registration Midwifery Education:

☐ New Zealand/Aotearoa ☐ Australia ☐ United Kingdom ☐ Other

How long have you practised as a midwife?

☐ Less than 5 years ☐ 5-10 Years ☐ 10-20 years
☐ 20-30 years ☐ More than 30 years

Do you currently work as a midwife?

☐ Yes ☐ No

If you are an <u>employed midwife</u>, what is your <u>main</u> employment type?

☐ Core Midwife ☐ Caseloading (LMC) Midwife ☐ Midwifery Educator
☐ Midwifery Manager ☐ Professional Advice/Policy ☐ Other

If you are a <u>self-employed midwife</u>, what is your <u>main</u> work activity?

☐ Full LMC Care ☐ Labour & Birth Only ☐ Antenatal Only
☐ Postnatal Only ☐ Antenatal & Postnatal Only ☐ Other

What is the <u>main</u> environment that you work in as a midwife?

☐ Tertiary Care Facility ☐ Secondary Care Facility ☐ Primary Care Facility
☐ Community ☐ Homebirth ☐ Other

Thank you for taking the time to complete this questionnaire.
Please return it in the self addressed envelope as soon as you are able.
Return Address: Julie Richards, CPIT, Faculty of Health, Humanities and Science PO Box 540, Christchurch 8140

APPENDIX D

Otago Polytechnic Research Ethics Committee Approval

04 November 2008

Julie Richards
20 Huntsbury Ave.
St. Martins,
Christchurch 8022

Dear Julie,

ETHICS 422 An exploration of the umbilical cord clamping practices, at birth, of Midwives in Aotearoa/New Zealand

Thank you for the amendments and additional information for your application. The Otago Polytechnic Research Ethics Committee grants you approval to commence your project.

I would remind you that at the conclusion of your research you should send a brief report with findings/conclusions to the Research Ethics Committee.

We wish you every success with this particular research project.

Yours sincerely,

Alex Morales
Administrator
Research Ethics Committee

cc Jean Patterson
Sally Baddock

Research Ethics Committee | Private Bag 1910 Dunedin 9054 | Freephone 0800 762 786 Phone +64 3 477 3014 Fax +64 3 471 6861 | info@tekotago.ac.nz www.otagopolytechnic.ac.nz

APPENDIX E

Information letter to Participants

School of Midwifery

Otago Polytechnic

Private Bag 1910

Dunedin

25th November 2008

Dear Midwife

RE: QUESTIONNAIRE ON THE UMBILICAL CORD CLAMPING PRACTICES AT BIRTH OF MIDWIVES IN AOTEAROA/NEW ZEALAND

You are invited to participate in this survey of midwife practices around the timing of umbilical cord clamping. As a midwife member of the New Zealand College of Midwives (NZCOM) your name was selected during an independent, confidential randomisation process of the NZCOM membership list. I am currently undertaking a research project to identify when midwives in New Zealand clamp the newborn's umbilical cord and their rationale for this timing. I am Julie Richards and I am undertaking this research project as a component of my Master of Midwifery, which I am completing at Otago Polytechnic.

I do not know who has received questionnaires and the list of participants will remain confidential once the research is complete. The Otago Polytechnic Ethics Committee has approved this research project. *Participation in the survey is voluntary and you may omit any questions or withdraw at any time up until the data is analysed.* Your return of the questionnaire indicates your consent to participate in this research project. *Please do not put your name on the questionnaire.*

The questionnaire will take about 10-15 minutes to complete. A stamped addressed envelope is included to return the questionnaire. If your questionnaire is not returned a reminder and a further questionnaire will be sent by a research assistant at 2 and 4 weeks. Participation in this survey is completely voluntary. Sending the reminders is to make it as easy as possible for you to respond, if you wish to.

Your responses will remain confidential and no information that might identify you will be released or used in any publications that may result. At the completion of the research process you will be provided with a summary of the findings. The entire research project will be written up as my Masters thesis and I will share the findings with the midwifery community in the form of journal articles and conference presentations.

If you have any questions about the questionnaire please contact me at richardsj@cpit.ac.nz or Ph: 03 940 8298.

I am hoping you will be interested in sharing what you do in your practice. If you choose to participate in this survey *please return the questionnaire by the 15th of December 2008.*

Thank you very much for your time,

Julie Richards RN, ADN, RM, PG Dip., Cand. MA

Midwife

Otago Polytechnic

Dunedin

Ph: 03 940 8298

Email: richardsj@cpit.ac.nz

Jean Patterson RN, RM, MA, Cand. PhD

Research Supervisor

Otago Polytechnic

Dunedin

Ph: 0800 800 583

Email: jeanpat@tekotago.ac.nz

APPENDIX F

Information Letter to Midwives participating in Pre-test

4th November 2008

Dear

RE: Umbilical Cord Clamping Practices of Midwives in Aotearoa/New Zealand

Thank-you for agreeing to be one of a group of midwives to provide feedback on this questionnaire. The questionnaire will provide information toward the completion of my Master of Midwifery at Otago Polytechnic. I will distribute the questionnaire to a randomised sample of the NZ College of Midwives membership following any wording changes from this feedback process. If you are a member of the NZCOM your name will be removed from the list of midwives names prior to the randomisation process to ensure you do not receive a further questionnaire. Your response to this questionnaire will not be included in the survey results.

I have contacted midwives from a range of practice settings anticipating this group will reflect the sample of midwives who eventually receive the questionnaire. I want feedback from you on whether your choices were reflected in the options provided and how easy the questionnaire is to complete. I will not be focusing on your responses rather whether the questionnaire worked for you or not. Please do not be concerned if it has been some time since you clamped or cut an umbilical cord. This is a fundamental midwifery skill and your past experience is very relevant.

The questionnaire is in a closed option format meaning you are asked to choose one or several of the options provided or if necessary fill out the 'other' option. I have endeavoured to include all of the most likely choices but I am aware of the limitations of my own perspective and would appreciate further points of view. Could you please fill out the questionnaire and consider if I have missed any choice options, either from what you would have chosen or what you know others might have chosen. Please write these other options below the question and comments on how easy or difficult it was to complete the questionnaire on the back of the form.

Thank-you, I am really grateful for you taking the time to provide me with feedback. I have enclosed a return address envelope and if possible I would appreciate your response within 7 days.

Warm regards

Julie Richards

APPENDIX G

First reminder Letter to Participants

School of Midwifery

Otago Polytechnic

Private Bag 1910

Dunedin

25 November 2008

Dear Midwife

RE: QUESTIONNAIRE ON THE UMBILICAL CORD CLAMPING PRACTICES AT BIRTH OF MIDWIVES IN AOTEAROA/NEW ZEALAND

This is a friendly reminder letter regarding my research project on the cord clamping practices of New Zealand midwives.

I would really like to encourage you to complete and return the questionnaire, as it will convey a more accurate picture of the cord clamping practices of midwives in New Zealand. The questionnaire has 8 questions related to when and why you clamp the newborn's umbilical cord and some demographic information. It takes about 15 minutes to complete.

Please find enclosed a further questionnaire and postage paid envelope to return your questionnaire in. These have been sent to you by a research assistant to maintain your confidentiality.

You may contact me if you have any questions regarding the questionnaire or your participation at richardsj@cpit.ac.nz or Ph: 03 940 8298.

Thank you very much for your time,

Julie Richards RN, ADN, RM, PG Dip., Cand. MA

Midwife

Otago Polytechnic

Dunedin

Ph: 03 940 8298

Email: richardsj@cpit.ac.nz

Jean Patterson RN, RM, MA, Cand. PhD

Research Supervisor

Otago Polytechnic

Dunedin

Ph: 0800 800 583

Email: jeanpat@tekotago.ac.nz

APPENDIX H

Second Reminder Letter to Participants

School of Midwifery

Otago Polytechnic

Private Bag 1910

Dunedin

December 9 2008

Dear Midwife

RE: QUESTIONNAIRE ON THE UMBILICAL CORD CLAMPING PRACTICES AT BIRTH OF MIDWIVES IN AOTEAROA/NEW ZEALAND

This is a friendly reminder letter regarding my research project on the cord clamping practices of New Zealand midwives.

I would really like to encourage you to complete and return the questionnaire, as it will convey a more accurate picture of the cord clamping practices of midwives in New Zealand. The questionnaire has 8 questions related to when and why you clamp the newborn's umbilical cord and some demographic information. It takes about 10-15 minutes to complete.

Please find enclosed a further questionnaire and postage paid envelope to return your questionnaire in. These have been sent to you by a research assistant to maintain your confidentiality.

Please return the questionnaire by the 20th of December 2008. You may contact me if you have any questions regarding the questionnaire or your participation at richardsj@cpit.ac.nz or Ph: 03 940 8298.

Thank you very much for your time

Julie Richards RN, ADN, RM, PG Dip., Cand. MA

Midwife

Otago Polytechnic

Dunedin

Ph: 03 940 8298

Email: richardsj@cpit.ac.nz

Jean Patterson RN, RM, MA, Cand. PhD

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