



Historical perspectives on umbilical cord clamping and neonatal transition

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DECLARATIONS

Competing interests

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The timing of umbilical cord clamping is contested. Many textbooks imply that 'early' cord clamping (Table 1) is an inevitable and normal part of the third stage of labour.¹ Indeed, it is widely practised and supported.² The National Institute for Health and Clinical Excellence (NICE) recommended early clamping in their 2007 intrapartum care guideline.³ Yet, early umbilical cord clamping can be detrimental to the newborn, leading to an increased risk of anaemia and, in the premature infant, an increased risk of intraventricular haemorrhage and respiratory complications.^{4,5} Delaying clamping in preterm infants decreases the need for blood transfusion⁴ which has been associated with neonatal necrotizing enterocolitis and death.⁶ In the term infant, delayed clamping improves neonatal oxygen transport and red blood cell flow and in premature infants it is associated with fewer days on oxygen and ventilation.⁴ The mounting evidence for deferring clamping has prompted changes to recent guidelines. The World Health Organisation (WHO) has officially endorsed the practice of so-called 'delayed' cord clamping.⁵ The International Federation of Gynaecology and Obstetrics and the International Confederation of Midwives have also removed early cord clamping from active management guidelines.⁴

Despite the disadvantages, early cord clamping is still routine among maternity staff.² When evidence for clinical practice is lacking, its history may enlighten.

Early perspectives

The umbilical cord has long fascinated physicians. Hippocrates and Galen postulated its role in fetal nutrition.⁷ Trotula provided specific instructions

for cord cutting: it should be tied, a charm spoken during the cutting, and then wrapped 'with the string of an instrument that is plucked or bowed.'⁸ Nevertheless, no mention of timing is made in these texts.

Cord cutting is necessary for separation of the neonate from the placenta. Inch describes the practice of 'primitive' cultures: the cord is not cut until well after delivery of the placenta, even hours later.⁹ It is unclear when this practice changed. The first records of cutting before placental delivery hail from the 17th century. It has been suggested that changes in third stage management accompanied the emergence of male midwives; it became normal practice to deliver women in bed,⁹ thereby decreasing the likelihood of spontaneous delivery of the placenta and necessitating manual removal before the uterus 'closed.'¹⁰

Whilst cutting of the cord is a necessity, the rationale behind clamping is more controversial. In 1968, Botha examined the early literature on cord tying or clamping, from 1668 onwards.¹⁰ The neonatal tie or clamp was initially employed to avoid blood loss from the baby before physiological closure of the umbilical vessels. Two other reasons have emerged for clamping the placental side of the cord: to identify when the cord lengthened, indicating separation of the placenta; and in order to 'spare the bed linen'⁹ from being soiled by placental blood leaking from the cut end of the cord. Botha stated that the reasons given for the practice were 'not sufficient to justify... clamping'.

However, the practice quickly became routine, despite similar warnings from eminent minds of the day. In 1773, Charles White wrote that '[the] common method of tying and cutting the navel string

attention to the
historical aspects of
third stage
management

Table 1
Examples of variable definitions of 'early' and 'late' cord clamping (adapted from Ref 4)

<i>Trial</i>	<i>Definition of Early Clamping</i>	<i>Definition of Late Clamping</i>
Lanzkowsky (1960)	Within 15s	After signs of placental separation
Arcilla <i>et al.</i> (1967)	2–10s	3–5 min
Saigal <i>et al.</i> (1972)	Within 5s	1–5 min
Nelson <i>et al.</i> (1980)	Within 60s	After pulsations ceased
Geethanath <i>et al.</i> (1997)	Immediate	When placenta in vagina
Rabe <i>et al.</i> (2000)	20s	45s
Emhamed <i>et al.</i> (2004)	Within 10s	After pulsations ceased
Rabe <i>et al.</i> (2004)	Immediate	30s or more
Cernadas <i>et al.</i> (2006)	15s	3 min
Chaparro <i>et al.</i> (2006)	10s	2 min
Mercer <i>et al.</i> (2006)	5–10s	30–45s

*in the instant the child is born... has nothing to plead in its favour but custom.*¹¹ In 1801, Erasmus Darwin wrote, '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.'¹² His theory was verified by the crude but illuminating experiments of Budin who, in 1875, measured the volume of blood retained in the placenta after early clamping, concluding that 92cm³ was denied to the early-clamped neonate.¹⁰

Early 20th century ideas

Nevertheless, cord clamping grew in popularity. In 1899, Magennis described a 'midwifery surgical clamp' instead of the traditional cloth tie,¹³ claiming that instrumentation would reduce the chance of infection. He advised practitioners to

clamp the cord 'when it has ceased to pulsate'. Whilst the clamp became a universal tool in third stage management, the timing of its application is rarely noted.

One reason, perhaps, that clamping before placental delivery became the norm was the discovery in 1938 of placental and umbilical cord blood as a 'new source' of transfusion blood.¹⁴ Due to its unique immunological and haematopoietic qualities, cord blood has continued to be used ever since, for conditions spanning malaria to malignancy.

In the 1940s, work into erythroblastosis fetalis (haemolytic disease of the newborn) revealed the role of maternal isoimmunization in the pathophysiology of the disease. It was believed that early clamping of the umbilical cord would prevent 'excessive amounts of [maternal] antibody-containing blood' from entering the neonate.¹⁵ Subsequent development of Rh(D) Immune Globulin in the 1960s negated the need to clamp early, but by this time the practice was routine.

Virginia Apgar's cord clamping legacy

The assessment of neonates is generally made *after* the transitional circulation has been interrupted by clamping, barring a few randomized controlled studies totalling 2,236 term babies.⁵ Virginia Apgar's seminal 1953 paper excluded cases of 'natural childbirth' and involved babies who had already been cord-clamped. She suggests that the initial score at 60 seconds after birth is determined after 'clamping or tying of the cord'¹⁶ (Figure 1). This sentiment is echoed in the second paper in the series, published in 1958.¹⁷ Here, Apgar qualifies her practice, implying that keeping the cord intact contaminates the 'sterile field'. Delayed clamping is deemed a part of 'slow delivery', the language suggesting that delaying is unwise or unnatural.

Research findings

First proposed in 1941, anaemia is now a recognized complication of early cord clamping.⁴ Studies have calculated that clamping after 2–3 minutes provides 40 ml/kg bodyweight more blood, which, for the average newborn, can amount to 75 mg of additional iron.⁴

Figure 1
Virginia Apgar assessing a newborn, umbilical cord already clamped¹⁸



Polycythaemia and jaundice are often cited as adverse consequences of delayed cord clamping, although the evidence is inconsistent. Saigal found significant increases in both neonatal hyperbilirubinaemia and polycythaemia in infants randomized to delayed vs early cord clamping.⁴ A subsequent systematic review and meta-analysis found a non-statistically significant increase in polycythaemia among infants in whom cord clamping was delayed, although the condition appeared benign.⁴ A recent Cochrane review⁵ concluded that although later cord clamping increases the risk of jaundice requiring phototherapy, it advantages the term infant by improving iron stores.

Delayed cord clamped infants have a higher respiratory rate, and a lower relative risk of developing infant respiratory disease.⁴ If premature, they are less likely to require resuscitation and respiratory support, and may also obtain protection against respiratory distress syndrome, intraventricular haemorrhage and sepsis.⁴

Modern obstetric practice

There are two types of management of the third stage: physiological (or expectant) and active. Expectant management excludes prophylactic drugs, the cord is neither clamped nor cut early, and the placenta is expelled by maternal effort.⁴ Active management traditionally involves routine prophylactic administration of a uterotonic agent, early cord clamping and cutting, and controlled cord traction. The administration of uterotonics reduces the risk of postpartum haemorrhage, a complication of childbirth which accounts for almost one quarter of all maternal deaths worldwide.⁴

For this reason, active management has become the convention in both developed and developing countries although within it, the early cord clamping facet has little evidence-based rationale. A recent Cochrane review has revealed that the timing of cord clamping is not associated with postpartum haemorrhage.⁵ In addition, the use of oxytocics facilitates rapid placental delivery, which may also account for maternity practitioners' eagerness to sever the cord promptly. This need not be the case: many organizations have dropped early clamping from their active management guidelines, and the neonate may be kept at the level of the introitus during placental delivery with the cord intact.

Another compelling reason to clamp early may have arisen with the growing number of surgical births. In England, 21% of births were delivered by caesarean section in 2001, compared to 3% in the 1950s.¹⁹ During surgical delivery, it may be convenient for the surgeon to clamp the cord early and remove the neonate from the operating field in order to focus on achieving haemostasis and completing the procedure. Modern obstetric practice involving potent narcotic analgesia may justify early cord cutting to remove the baby for resuscitation. Especially before the advent of widespread effective regional analgesia, the use of opiates and general anaesthesia could cause neonatal respiratory depression. Indeed, the editor of the 1950 edition of William's Obstetrics advocated delaying clamping, but cited apnoea, episiotomy and convenience as reasons to cut early.²⁰

More recently, cord blood is increasingly being collected for stem cell storage in both public and

private sectors. Future theoretical stem cell developments have prompted some parents to opt for cord blood banking, which became a for-profit business at the end of the 20th century despite persistent clinical uncertainties and ethical debate. Collecting adequately large volumes of cord blood for banking relies on early clamping and potentially distracts the practitioner from patient care. These factors have led professional bodies to take a precautionary approach.

Studies on practice

As evidence mounted against early cord clamping throughout the 20th century, it was not reflected in practice. In 1950, McCausland *et al.* surveyed 1,900 members of the American Board of Obstetrics and Gynecology, revealing that two-thirds believed that the timing of cord clamping is insignificant.⁴ In 2000, a survey of American midwives showed that 26% claimed to practise early cord clamping, believing that delay has no benefit or would cause polycythaemia or jaundice.⁴ In 2009, a survey distributed to obstetricians from 43 different units in the UK and other countries found that 53% practise delayed cord clamping only occasionally, whereas 37% have never done so.⁴ It can be difficult to implement change in practice; a survey of the level of knowledge and the common third stage practices of obstetricians, midwives and neonatologists at one London hospital showed that early cord clamping was still routine, despite having a permissive local guideline for delayed clamping.²

The reasons behind this contradiction are complex. The influence of custom is hard to overcome. Studies have identified difficulty with implementation as a reason for failure to wait before clamping. There may be gaps and errors in practitioner knowledge,² compounded by the lack of specific national guidelines and explicit definitions of 'early' and 'delayed' clamping. Indeed, definitions of these value-laden terms overlap in research papers (Table 1).

Conclusions

From 1773 onwards, maternity practitioners have articulated the benefits of physiological neonatal

transition facilitated by delayed cord clamping yet this is not matched by practice. The purported benefits of early cord clamping have changed alongside medical advances. The ostensible justifications have frequently been proven irrelevant or false with the passage of time. Nevertheless, lack of knowledge, the strong influence of tradition and the modern practice of umbilical cord blood banking keep the practice popular. Authors are again questioning whether injudicious clamping may worsen neonatal condition, leading to further resuscitation interventions. These questions may be resolved by systematic reviews, debate and education. Historical reflection may add to practitioners' reevaluation of third stage practices in order to improve outcomes for mother and baby.

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