Deferred cord clamping Versus Milking of the Cord in Full Term Vaginal Delivery: A randomized Controlled Trial

Thesis

Submitted for partial fulfillment of Master Degree
in Obstetrics and Gynaecology

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Acknowledgement

First of all, all gratitude is due to **God** almighty for blessing this work, until it has reached its end, as a part of his generous help, throughout my life.

Really I can hardly find the words to express my gratitude to **Prof. Dr./ Prof. Dr. Helmy Motawe El Sayed** Professor of Obstetrics and Gynecology, faculty of medicine, Ain Shams University, for his supervision, continuous help, encouragement throughout this work and tremendous effort he has done in the meticulous revision of the whole work. It is a great honor to work under his guidance and supervision.

I would like also to express my sincere appreciation and gratitude to **Prof. Dr. Sherif Fathi EL Mekkawi** Professor of Obstetrics and Gynecology, Faculty of Medicine, Ain Shams University, for his supervision guidance throughout my thesis, and tremendous effort he has done in the meticulous revision of the whole work. It is a great honor to work under his guidance and supervision.

My deep thanks **Dr. Rasha Mahmoud Medhat Abd El Hadi,** Lecturer of Obstetrics & Gynecology, Faculty of Medicine, Ain Shams University, for her continuous directions, guidance, tremendous effort she has done in the meticulous revision and support throughout the whole work.

Last but not least, I can't forget to thank all members of my Family, specially, my **Parents** and my **Husband**, for their care and support in my life.

Samia Mohamed Ahmed

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List of Abbreviations

Abbr.	Title
AAP	: American Academy of Pediatrics
ACOG	: American College of Obstetricians and Gynecologists
BMI	: Body Mass Index
CCT	: Controlled cord traction
CI	: Confidence interval
DCC	: Deferred cord clamping
ICM	: Inner cell mass
RBC	: Red blood cell
Hb	: Haemoglobin
ICC	: Immediate cord clamping
IVH	: Intra-ventricular haemorrhage
PPH	: Post-partum haemorrhage
RR	: Relative risk
UCM	: Umbilical cord milking
WHO	: World health organization

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Introduction

Clamping is followed by cutting of the cord, which is painless due to the lack of any nerves. The cord is extremely tough, and so cutting it requires a suitably sharp instrument. Negative effects of delayed cord clamping include an increased risk of polycythemia. Still, this condition appeared to be benign in studies ***(Hutton and Hassan, 2007).***

When clamping is delayed for more than one minute it is known as “deferred cord clamping” ***(Royal College of Obstetricians and Gynaecologists, 2015).***

Deferred cord clamping (DCC) in premature neonates improve neonatal morbidity; however the impact on long-term outcomes remains limited. The optimal time to delay cord clamping and potential risks are poorly studied ***(Brocato et al., 2016)***.

DCC decreased postnatal exchange transfusion needs, an improvement in the hemoglobin level at birth and longer delay between birth and first transfusion with no severe hyperbilirubinemia ***(Garabedian et al., 2016)***.

It also allows time for a transfer of the fetal blood in the placenta to the infant at the time of birth. This placental transfusion can provide the infant with an additional 30% more blood volume and up to 60% more red blood cells ***(Airey et al., 2010)***.

The American College of Obstetricians and Gynecologists recommended a 30- to 60-second deferred cord clamping for all preterm deliveries ***(American College of Obstetricians and Gynecologists Committee on Obstetric Practice, 2012).***

Umbilical cord milking (UCM), in which the unclamped umbilical cord is milked before it is clamped, may influence Superior Vena Cava flow by improving perfusion immediately after birth. During the first 30 seconds after delivery, blood volume in the newborn increases by 12 mL/kg ***(Aladangady et al., 2006);*** this early placental transfusion does not occur if the cord is clamped immediately.

Katheria et al., demonstrate greater systemic blood flow with umbilical cord milking in preterm neonates compared with immediate cord clamping (ICC) ***(Katheria et al., 2014).***

Currently, insufficient evidence exists to support or refute the benefits from DCC for term infants who are born in settings with rich resources. Although a delay in umbilical cord clamping for up to 60 seconds may increase total body iron stores and blood volume, which may be particularly beneficial in populations in which iron deficiency is prevalent, these potential benefits must be weighed against the increased risk for neonatal phototherapy ***(American Academy of Pediatrics, 2013).***

Aim of the work

To evaluate deferred cord clamping as compared to umbilical cord milking in enhancement of placenta-fetal blood transfusion among full term vaginally delivered new born.

The Human Umbilical Cord

Embryology of the Human Umbilical Cord (funiculus umbilicalis)

The fertilization and the first 4 days of cleavage up to the early blastocyst stage takes place in the Fallopian tubes in the human. On day 5, the early blastocyst descends down into the uterus, continues its divisions, undergoes expansion to the fully expanded blastocyst stage and then implants in the uterine endometrium around day 7 to 9. The migration of cells within the expanded blastocyst results in the laying down of two distinct cell layers, a peripheral layer of trophectoderm destined to become the placenta and a cluster of approximately 30-50 cells inner cell mass (ICM) that protrude from the inner wall of the polar TE and destined to form the entire fetus ***(Pappa and Anagnou, 2009).***

The ICM later develops into the hypoblast and epiblast. The hypoblast gives rise to the yolk sac and allantois which eventually degenerates and the epiblast cells which are pluripotent give rise to the three germ layers (ectoderm, mesoderm and endo-derm) from which the various organs and extra-embryonic membranes (amnion, chorion, placenta and UC) are formed. During further development the amnion forms an outer covering for the UC and the UC carries within it three umbilical blood vessels (two arteries and a vein) to shuttle nutrients between mother and fetus. The amnion comprises of three layers: inner epithelial cell layer, an intermediate non-cellular basement membrane and outer mesenchymal layer ***(Pappa and Anagnou 2009).***

The TE forms the cytotrophoblast and syncytiotrophoblast of the placenta while the blastocoelic cavity eventually produces the exocoelom. The part of the UC closest to the fetus may therefore contain remnants of the yolk sac and allantois.

The umbilical cord function, composition and development:

The exterior surface of the cord is dull white in colour and moist, and normally comprises two umbilical arteries and one umbilical vein which are continuous with the blood vessels in the chorionic villi of the placenta. These vessels are encased in a protective, gelatinous substance known as Wharton's jelly (a form of connective tissue), which is covered by amnion ***(Motaz, 2013).***

The umbilical cord is attached to the placenta which transfers oxygen, nutrients and waste products, such as carbon dioxide to and from the maternal blood circulatory system without any direct contact between fetal and maternal blood. The blood vessels in the umbilical cord operate differently from what would normally be expected, with the umbilical vein providing the fetus with a supply of oxygenated blood and nutrients (which it carries to the fetal heart), and the umbilical arteries carrying away the deoxygenated and nutrient-depleted blood. The only other example of this within human physiology occurs with the pulmonary veins and arteries which connect the lungs to the heart ***(Kluckow and Hooper, 2015).***

It is around 50-60 cm in length, with a diameter of approximately 1-2 centimeters in the full-term healthy neonate the cord has a spiral twist and is normally (although this diameter reduces significantly once the cord inserts itself into the fetal surface of the placenta). The length of the umbilical cord enables the baby to pass down the birth canal and deliver vaginally without any traction being applied to the placenta. Where the umbilical cord is of an above average length, although not of clinical significance, there is an increased risk that it could become wrapped around the fetal body/neck, prolapse, or become knotted (known as a true knot). A 'true knot' results from active fetal movements, where the fetus moves through a loop of its cord, so that it literally forms a knot, which can be clearly seen on examination of the cord at birth. The obstetric concern where the cord becomes knotted or is compressed, relates to the potential for the blood vessels to become blocked and deprive the fetus of sufficient oxygen in utero, especially during labour and birth ***(Vance, 2009).***

By contrast, a ‘false knot’ is caused by varicosities of the umbilical vessels and/or insignificant lumps of Wharton’s jelly that cause additional twists and protrusions on the surface of the cord. The false knots of the umbilical cord are more common than true knots. False knot occurs due to increased length of the umbilical vein in comparison to arteries, and has no known clinical significance ***(Elghazaly et al., 2016).***

Where this is the case, it can be associated with fetal growth restriction, congenital malformations, early separation of the placenta from the uterine wall, fetal distress and in the worst case, fetal death ***(Raymond and Redline, 2015).***

The umbilical cord and fetal circulation

The umbilical cord enters the developing fetus through the lower abdominal wall, at the level which, following cord separation, becomes the umbilicus or navel. Once inside the fetus, the umbilical vein continues towards the transverse fissure on the visceral surface of the liver (i.e where the portal vein and hepatic artery enter and the hepatic ducts leave). At this point it separates into two branches; the first joins with the hepatic portal vein, connecting to its left branch. The other, which is known as the ductus venosus, allows the majority of the incoming blood (around 80% of blood volume) to bypass the liver and flow via the left hepatic vein into the inferior vena cava, which carries blood