Effect of Umbilical Cord Milking on Transition of Preterm Babies during Resuscitation

Thesis

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By

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

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Ahmed Atef Ahmed El Beltagy

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List of Abbreviations

Abb.	Full term
AUC	*Area under the variable- time curve*
bpm	*Beat per minute*
BW	*Body weight*
CI	*Confidence interval*
CMV	*Cytomegalo virus*
CPAP	*Continuous positive airway pressure*
CS	*Cesarian section*
C-UCM	*Cut- umbilical cord milking*
DCC	*Delayed cord clamping*
DM	*Diabetes Mellitus*
ECG	*Electro cardiography*
EIT	*Electrical impedance tomography*
F	*Female*
Fio2	*Initial Fraction of inspired oxygen*
GA	*Gestational age*
GDM	*Gestational Diabetes Mellitus*
HCT	*Hematocrit*
Hgb	*Hemoglobin*
HR	*Heart Rate*
HTN	*Hypertension*
ICC	*Immediate cord clamping*
I-UCM	*Intact umbilical cord milking*
IVH	*Intraventricular hemorrhage*
M	*Male*
MAP	*Mean Airway pressure*
min	*Minute*
MRI	*Magnetic resonance imaging*

List of Abbreviations cont...

Abb.	Full term
NICU	*Neonatal intensive care unit*
NVD	*Normal vaginal delivery*
PEEP	*Positive end expiratory pressure*
PIP	*Peak inspiratory pressure*
PPV	*Positive pressure ventilation*
PROM	*Premature rupture of membrane*
SD	*Standard deviation*
SE	*Standard error*
sec	*Second*
SLE	*Systematic lupus erythromatosus*
SPO2	*Peripheral capillary oxygen saturation*
UC	*Umbilical cord*
UCM	*Umbilical cord milking*
VLBW	*Very low birth weight*
WHO	*World Health Organization*

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INTRODUCTION

The goal of placental transfusion is to facilitate transfer of blood volume from the placenta to the newborn. Fetal blood circulates in the feto-placental unit throughout gestation. Owing to the relatively large size of placenta compared with the fetus at mid-term, blood is equally distributed between the fetus and placenta. By term gestation, about one-third of the blood flows through the placenta and two-thirds flows through the fetus at any point in time ***(Backes et al., 2014a).***

Although umbilical cord clamping is a quick and simple intervention, the timing of cord clamping may have a large impact on the infants' health. While it is thought that the major benefit of delayed cord clamping (DCC) is placental transfusion (blood from placenta to the infant), it is now evident that there are many benefits ***(Katheria et al., 2017).***

The effect of milking the cord at birth on blood volume was reported by ***Colozzi*** in 1954, where he stated" I have seen several infants with asphyxia pallida who were very pale and listless, with a rapid pulse and a very weak cry; with gentle, slow, methodical cord stripping, they were transformed within a few minutes to ruddy, lustily-crying infants" ***(Colozzi, 1954).***

Preterm babies managed with milking of the cord have a higher mean arterial blood pressure on admission to the NICU, increased cerebral oxygenation, and improved left ventricular diastolic function from an increase in left ventricular load due to volume expansion ***(Takami et al., 2012).***

Milking of the cord stabilizes blood pressure and heart rate at and soon after delivery. Some studies have raised a concern about the volume of blood that can be transfused with milking of the cord. The average placental blood volume is estimated to be 75-125 ml ***(Fogarty et al., 2018).***

Clamping the umbilical cord before onset of respiration resulted in an immediate decrease in heart rate from mean values above 160 bpm to mean values around 100 bpm. Pulmonary blood flow remained unchanged at the low levels present during fetal life. Flow through the ductus arteriosus remained right to left as in fetal life; and right ventricular output fell progressively during the first 90 seconds and remained low until ventilation began at 2 min. With cord clamping a sudden spike occurred in carotid artery pressure followed by equilibrium of pressure; this was paralleled by a sharp increase in carotid arterial flow followed by a large fall ***(Niermeyer & Velaphi, 2013).***

Aim of the Work

Primary outcome is to investigate the influence of active umbilical cord Milking before cord clamping compared with immediate cord clamping on cardio respiratory outcomes of preterm babies requiring resuscitation (Oxygen saturation, Heart rate and Fio_2) born between 28 and 34 completed weeks of gestation during neonatal resuscitation programme.

Secondary outcome is to follow up occurrence of intraventricular hemorrhage in preterm babies.

Chapter 1

PLACENTAL TRANSFUSION

One essential goal of neonatal critical care is to deliver adequate oxygen to meet tissue demand. Increasing fetal hemoglobin by placental transfusion is an extremely effective method of enhancing arterial oxygen content, increasing cardiac output and improving oxygen delivery. Placental transfusion is the transfer of residual placental blood to the baby during the first few minutes of age, and can be accomplished by three different methods ***(Katheria et al., 2017):***

- Delayed cord clamping (DCC)
- Intact umbilical cord milking (I-UCM)
- Cut-umbilical cord milking (C-UCM).

Immediate cord clamping (ICC) results in ~ 30% of fetoplacental blood volume remaining in the placenta, whereas DCC reduces residual placental blood to 20% of the feto-placental blood volume by 60 sec and to 13% by ~ 3–5 min ***(Katheria et al., 2017).***

Factors determining placental transfusion

Several factors including cord clamping time, uterine contractions, umbilical blood flow, respirations and gravity have an important role in determining placental transfusion volumes ***(Katheria et al., 2017).***

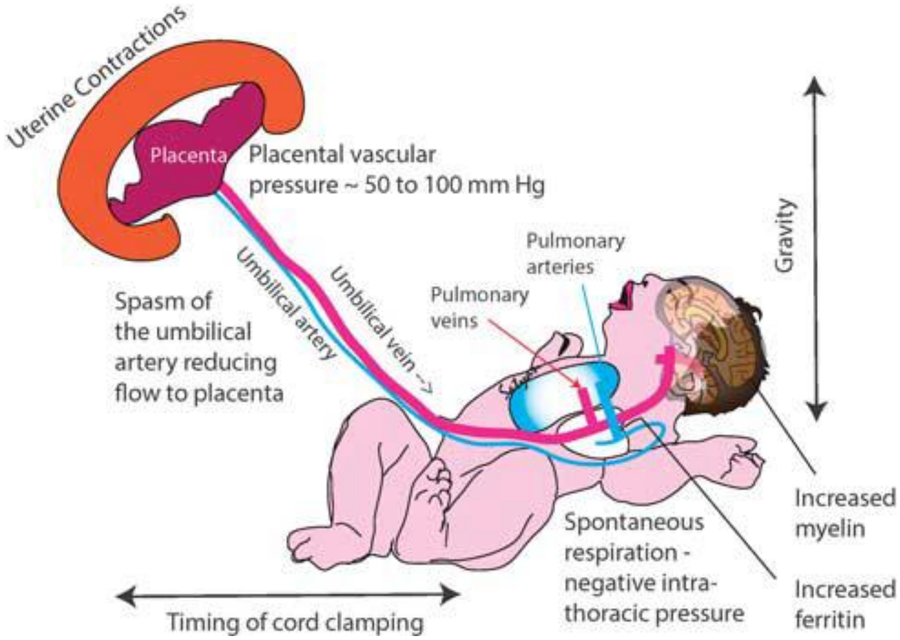

Figure (1): Factors influencing placental transfusion with delayed cord clamping (DCC). Timing of cord clamping, uterine contractions, reduced neonate-to-placental flow due to umbilical arterial spasm, spontaneous respirations and gravity influence the magnitude of transfusion. Reported long-term benefits are shown ***(Katheria et al., 2017).***

1. Time of cord clamping

The mean amount of placental transfusion was 81 ml (range, 50–163 ml) or 25 ml/ kg (range, 16–45 ml/ kg). The authors estimated that placental transfusion contributed to about 20% of the infant's blood volume at birth ***(Farrar et al., 2011).***

In term and preterm births, DCC results in more blood being transferred to the infant and is proportional to the time delayed ***(Boere et al., 2015).***

2. Uterine contractions

Uterine contractions are the primary determinant of placental transfusion in spontaneous deliveries with DCC. The initial uterine contraction that expels the fetus contributes to 25–30% of placental transfusion. The intrauterine umbilical venous pressure is high (~40–50 mm Hg in between contractions and increasing to 100 mm Hg during contractions) and provides a gradient for blood flow from the placenta to the neonatal right atrium may facilitate 50% of placental transfusion ***(Katheria et al., 2017).***

3. Umbilical blood flow

During fetal life ~ 29% of the combined ventricular output (equivalent to 130 ml/kg fetal body weight) flows through the umbilical arteries to the placenta and returns to the fetus via the umbilical vein. After birth, during the third stage of labor, the umbilical arteries constrict, often within 45 sec, minimizing blood flow from the neonate to the placenta, whereas the umbilical vein remains patent facilitating placental transfusion ***(Boere et al., 2015).***

4. Spontaneous breathing and respirations

Spontaneous breathing and crying creates negative intrathoracic pressure and increases the gradient between placental vasculature and fetal right atrium facilitating placental transfusion ***(Katheria et al., 2017).***

Intermittent flow every 1.5 sec in the umbilical vein by Doppler of the umbilical cord possibly reflecting a respiratory rate of 40 per min. However, in the presence of strong uterine contractions (with pressure gradients of ~ 100 mm Hg), respiration does not appear to further enhance placental transfusion ***(Kluckow and Hooper, 2015).***

Following cesarean section with absent uterine contractions, spontaneous respiration might have a more important role in facilitating placental transfusion. Residual placental blood volume and change in hematocrit were measured. Increasing duration of respiration resulted in increasing amounts of placental transfusion. Positive pressure ventilation (PPV) increases intrathoracic pressure. PPV increases pulmonary blood flow and reduces pulmonary vascular resistance, but its effect on placental transfusion is not clear ***(Katheria et al., 2017).***

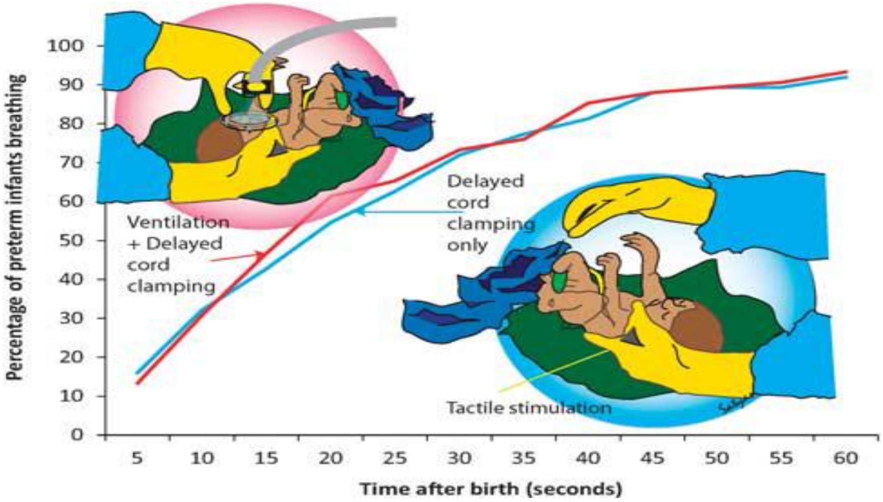

Figure (2): Onset of spontaneous breaths in preterm infants following DCC with stimulation (blue line) and positive pressure ventilation (PPV) with DCC (red line) ***(Katheria et al., 2017).***