Umbilical Cord Blood—An Untapped Resource

Strategies to Decrease Early Red Blood Cell Transfusions and Improve Neonatal Outcomes

Patrick D. Carroll, MD, MPH[a,b,*]

KEYWORDS

• Delayed cord clamping • Milking • Cord blood • Transfusion
• Intraventricular hemorrhage

KEY POINTS

- Umbilical cord blood is fetal blood still remaining in the umbilical cord/placental circulation at the time of cord clamping.
- Delayed cord clamping (DCC) or milking of the umbilical cord (MUC) has been recommended as the standard of care for premature deliveries and the first step in the resuscitation process.
- In addition to resulting in higher hematocrit, fewer transfusions, and more rapid resuscitation, DCC or MUC leads to decreased intraventricular hemorrhage (IVH) and higher survival in very preterm neonates.
- In premature neonates, umbilical cord blood can be used for essential initial admission laboratory testing, thereby leading to fewer erythrocyte transfusions due to phlebotomy loss.
- Adequate volumes of umbilical cord blood can be obtained for admission laboratory testing even after DCC or MUC.

INTRODUCTION

During the past several decades, ingenious, dramatic life-saving discoveries have led to improved neonatal outcomes. Of particular note are antenatal steroid administration, exogenous surfactant, neonatal specific mechanical ventilators, and more sophisticated incubators. Together these advances have contributed to improved

Disclosures: The authors do not have any commercial or financial conflicts of interest.
[a] Women and Newborn's Program, Intermountain Healthcare, 36 South State Street, Salt Lake City, UT 84111, USA; [b] Neonatal Services, Dixie Regional Medical Center, 544 East 400 South, St George, UT 84770, USA
* NICU, Dixie Regional Medical Center, 544 East 400 South, St George, UT 84770.
E-mail address: Patrick.carroll@imail.org

Clin Perinatol 42 (2015) 541–556
http://dx.doi.org/10.1016/j.clp.2015.04.017 **perinatology.theclinics.com**
0095-5108/15/$ – see front matter

survival for neonates. The survival rate of extremely low-birth-weight (ELBW) infants weighing 500 to 750 g increased from 44% to 65% in 12 years from 1987–88 to 1999–2000.[1] Despite these advances, preterm infants, particularly ELBW neonates, remain at significant risk for the most frequent life-threatening complications of prematurity such as IVH, necrotizing enterocolitis (NEC), retinopathy of prematurity, and anemia. As the limit of viability has decreased, so too has the weight at birth and by extension, the total circulating blood volume of these infants. Indeed, the smallest infants cared for in the neonatal intensive care unit (NICU) routinely may have birth weights less than 500 g, leading to total circulating blood volumes of less than 40 mL; this leads to the current state in which transfusions have become almost universal among the smallest patients, primarily as a result of the frequent laboratory testing required by these critically ill groups. Efforts to increase the initial total circulating volume and slow its rapid rate of decline as a result of bleeding into the laboratory have been shown to decrease erythrocyte transfusions and improve other outcomes among premature infants. This article reviews the practices and outcomes associated with delayed clamping or MUC and with obtaining blood for essential initial admission laboratory testing from the umbilical cord.

DELAYED CORD CLAMPING OR MILKING OF THE UMBILICAL CORD

Transition During Gestation and from Fetal to Neonatal Circulation

Fetal oxygen delivery is accomplished by transfer of oxygen from maternal blood to fetal blood through the placental trophoblastic membrane (Fig. 1). Once placental oxygen is bound to fetal hemoglobin, it enters the fetus through the umbilical vein and is preferentially delivered to the fetal brain. To do so, most of the fetal blood flow first

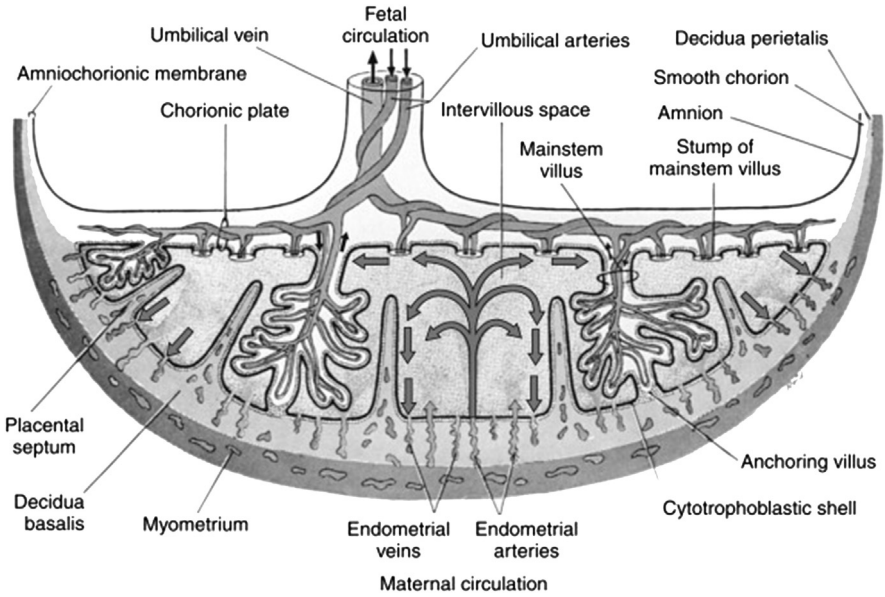

Fig. 1. Placental anatomy demonstrating components of both maternal and fetal circulation. Maternal and fetal circulation are separated by the trophoblastic membrane (cytotrophoblastic shell). (*From* Moore KL. The developing human: clinically oriented embryology. 5th edition. Philadelphia: WB Saunders; 1993. p. 117; with permission.)