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Editorial

Point-of-Care Haemoglobin Measurement during Caesarean Section: Where do we Stand Now?

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Received: November 13, 2018; **Published:** February 01, 2019

Keywords: *Cesarean Section; Point-of-Care; Hemoglobin; Blood Loss; Hemocue™*

Abbreviations

aOR: Adjusted Odds Ratio; BIS: Bispectral Index score; CI: Confidence Interval; ED_{50}: Concentration Causing 50% Inhibition of the Contractile Amplitude; IV: Intravenous; MAC: Minimal Alveolar Concentration; MEOWS: Modified Obstetric Early Warning Scoring System

Pregnancy significantly alter maternal physiology and response to anaesthetic drugs. Of note, blood volume, plasma volume and red blood cell volume increase on average by 35, 45 and 20% respectively [1]. As the parturient nears term, the blood volume expansion is approximatively 1,000 to 1,500 mL compared with non-pregnant status [1]. Because haemoglobin increases less than plasma volume, pregnancy is accompanied by a "relative anaemia" with haemoglobin and haematocrit usually staying above 110 G/L and 33%, respectively [1,2]. Postpartum haemorrhage is defined as ≥ 500 mL for vaginal delivery and ≥ 750 mL for a caesarean delivery [3]. Risk factors for blood loss ≥ 1500 mL during elective caesarean delivery are: general anaesthesia (adjusted odds ratio [aOR] = 22.3; 95% confidence interval [CI], 4.9 - 99.9; reference group = spinal anaesthesia), multiple pregnancies (aOR = 8.0; 95% CI, 4.2 - 15.0; reference group = singleton pregnancy), and placenta previa (aOR = 6.3; 95% CI, 3.4 - 11.8). Risk factors for blood loss ≥ 1500 mL during intrapartum caesarean delivery are: general anaesthesia (aOR = 5.4; 95% CI, 1.7 - 17.1), multiple pregnancies (aOR = 3.2; 95% CI, 1.7 - 6.3), and a predelivery haemoglobin ≤ 99 G/L (aOR = 3.0; 95% CI, 1.3 - 6.9; reference group = predelivery haemoglobin ≥ 110 G/L) [4].

Although general anaesthesia is usually recognized as a factor for increased blood loss compared with spinal anaesthesia, its influence on blood transfusion requirement is not as clear [5,6]. Unplanned conversion from spinal anaesthesia to general anaesthesia at elective caesarean section may also be associated with increased blood loss [7]. Volatile anaesthetic agents (often added to ensure maternal unconsciousness) inhibit uterine contractility in a dose-dependent manner, and therefore potentially increase blood loss. Concentrations causing 50% inhibition of the contractile amplitude of human full-term pregnant uterine muscles (ED_{50}) are: 1.72 (sevoflurane), 1.44 (desflurane), 2.35 (isoflurane), and 1.66 minimal alveolar concentration (MAC) (halothane) [8]. While both sevoflurane and desflurane will decrease oxytocin-induced contractions, at 1.0 MAC desflurane inhibits the amplitude less than sevoflurane [9]. This suggest that sevoflurane 0.5 MAC or desflurane 1.0 MAC should be the highest concentrations used during caesarean section to reduce the risk of increased blood loss during caesarean section [9]. The incidence of awareness (defined as spontaneous recall of an event occurring during general anaesthesia) occurs in approximately 26 per 10,000 parturients undergoing caesarean section [10]. A target of 0.7 MAC, which has been shown to consistently achieve a Bispectral Index score (BIS) < 60 has been advocated to reduce the risk of maternal aware-

ness during caesarean section [10]. Women proceeding to caesarean delivery after prior labour may require slightly less volatile agents to achieve similar BIS values [11]. Adding nitrous oxide will reduce volatile anaesthetic requirements to achieve a similar BIS, but may increase neonatal depression unless the delivery can be done within a very short time after induction of general anaesthesia. The ratio of umbilical vein to maternal artery nitrous oxide concentrations correlates with the duration of nitrous oxide anaesthesia, resulting in ratios of 0.37, 0.61 and 0.70 for induction to delivery intervals of 2 to 9 minutes, 9.1 to 14 minutes and 14.1 to 50 minutes, respectively. Infant Apgar scores at 1 minute correlate inversely with the duration of anaesthesia as well as the umbilical vein nitrous oxide concentrations [12].

Out of 10,000 live births, as many as 17 women suffer from severe postpartum haemorrhage and 0.7 may die from it [13]. Adequate maintenance of circulating blood volume and effective coagulation is critical for resuscitation of the haemorrhagic parturient.

In a joint task force, the American Society of Anesthesiologists and the Society for Obstetric Anesthesia and Perinatology recommended that: 1. A routine platelet count is not necessary in the healthy parturient. Ordering a platelet count should be individualized and based on a patient's history (e.g. preeclampsia with severe features), physical examination, and clinical signs; 2. A routine blood cross-match is not necessary for healthy and uncomplicated parturients for vaginal or operative delivery. The decision whether to order or require a blood type and screen or cross-match should be based on maternal history, anticipated haemorrhagic complications (e.g. placenta accreta in a patient with placenta praevia and previous uterine surgery), and local institutional policies; 3. The following resources for obstetric haemorrhagic emergencies should be immediately available: large-bore IV catheters; fluid warmer; forced-air body warmer; availability of blood bank resources; massive transfusion protocol; equipment for infusing IV fluids and blood products rapidly (examples include, but are not limited to, hand-squeezed fluid chambers, hand-inflated pressure bags, and automatic infusion devices); 4. In an emergency, type-specific or O-negative blood is acceptable. In cases of haemorrhage, when banked blood is not available or the patient refuses banked blood, consider intraoperative cell salvage if available [14].

A complete review of the recommendations from the practice guidelines for perioperative blood management from the American Society of Anesthesiologists is beyond the scope of this editorial but just as a reminder: 1. "The determination of whether haemoglobin concentrations between 60 and 100 G/L justify or require red blood cell transfusion should be based on potential or actual ongoing bleeding (rate and magnitude), intravascular volume status, signs of organ ischemia, and adequacy of cardiopulmonary reserve"; 2. "Blood loss monitoring consists of visual assessment of the surgical field, including the extent of blood present, presence of microvascular bleeding, surgical sponges, clot size and shape, and volume in suction canister" [2]. However, when trying to evaluate surgical blood loss during a caesarean section, dilution by amniotic fluid may add to the difficulty. Estimations by paramedics, surgeons, obstetricians and midwifes are often inaccurate and vary widely [15,16]. Furthermore, in the postpartum period, blood loss may not be visible. For this reason, assessments scores have been developed [17]. For instance, the Modified Obstetric Early Warning Scoring System-MOEWS), allows easy assessment of trends in hemodynamic assessments and impending shock [17].

Since the 1990s, several point-of-care devices have been developed and, in many centres, they have gradually replaced estimation of haematocrit from a centrifuged blood filled glass capillary tube which was used whenever results from the central laboratory (gold standard) could not be obtained quickly enough. Non-invasive continuous monitors using multi-wavelength pulse co-oximetry (such as HCueART™) have a precision of 14 G/L (95% CI 12 to 15) [18]. The precision of haemoglobinometers (such as HemoCue™) may vary depending on the sample technique: 4 G/L (95% CI 3 to 4) for an arterial sample and 12 G/L (95% CI 10 to 15) for a capillary sample [18]. Although these devices may differ slightly in their accuracy, they are usually considered adequate to determine red blood cell transfusion requirements in the operating theatre when recommendations of the American Society of Anesthesiologists are followed [19]. For pregnant women undergoing caesarean section under neuraxial block, sampling at the thumb or at the great toe gives equally adequate

accuracy for determination of haemoglobin concentration performed with a haemoglobinometer [20]. We are not aware of any trial evaluating a potential mortality reduction with the use of point-of-care hemoglobinometers compared with other techniques of estimating blood loss during caesarean section.

Acknowledgements

The authors wish to thank University of Sherbrooke, University of Quebec in Abitibi-Temiscamigue and Laval University who granted access to databases and major medical journals.

Conflict of Interest

Both the authors declare no conflict of interest.

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Volume 5 Issue 2 February 2019