Comparisons among measurement approaches to determine blood loss with different environmental sanitary effects

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Abstract. Labour and delivery are hazardous processes for bleeding. It will have complications, and even death for maternal because of overdue recognition and identification of the early signs of bleeding. Postpartum hemorrhage is still a problem and a major cause of maternal death. The definition, bleeding threshold, and method of assessing blood loss are still being debated today. This literature review aimed to determine the methods that had been used in measuring the amount of blood loss and risk to the mother. The review used Science Direct and Pubmed electronic online databases with related keyword searches. Measurement of blood loss was categorized into several methods, including visual estimation, direct measurement, gravimetry, and photometry. These methods were explained and then compared with various similar methods. Several studies indicated that measuring the amount of blood loss still often used conventional methods, even though this method was very improper and tends to underestimate blood loss. Several accurate and objective quantification methods had been introduced, but they were still very complicated, expensive, and time-consuming. Based on the review results, various types of blood loss measurement methods were displayed, but they were still not practical, accurate, and reliable. Researchers continue to carry out improvement research in finding methods so that postpartum hemorrhage can be prevented and treated.

1. Introduction

Maternal mortality is still being debated, and a large amount of blood loss often causes the condition. It is a significant cause of maternal mortality worldwide [1]. Every year, as many as 358,000 women who give birth die in developing countries [2]. Maternal mortality in Indonesia reach 305 per 100,000 live births [3]. When compared with ASEAN countries, Indonesia is the second-highest under Laos and nine times higher than Malaysia. At the same time, the condition of maternal mortality in Aceh increased to 167 maternal deaths per 100,000 live births [4]. According to the World Health Organization [5], there will be an average of 500 mL of blood loss in maternal delivery in normal deliveries within 24 hours postpartum or after the third stage of labor and 1,000 mL in Sectio Caesaria delivery [5,6,7]. Experts
agree that the threshold bleeding is 500 mL. Most blood of loss usually occurs within the first hour after delivery, and the most common cause is caused by uterine atony [8].

In clinical practice, to assess the amount of blood loss during and after delivery, generally the delivery room staffs, especially midwives, still conventionally assess the tendency and underestimate the majority used of available basin containers, sarongs, sanitary pads used by mothers. This method is most often done so that the incidence of postpartum haemorrhage is as much as 89% [9]. This method has many limitations, is very inaccurate in measuring blood loss, questionable and should not be used for treatment [10, 11, 12, 13, 14]. In addition, many methods have been carried out but are still unclear and ineffective [10]. In chronic cases, according to the International Confederation of Midwives (ICM), The International Federation of Gynecology and Obstetrics (FIGO) recommend balloon tamponade and anti-dress clothing shock/ anti-shock, to stop bleeding but these method does not help much [15]. To prevent bleeding, the WHO recommends some guidelines for active management of the third stage of labor. The incidence of bleeding during postpartum does not decrease significantly, so managing blood loss is needed [16]. The method of calculating blood loss is very objective and more accurate, but this method is rarely used because it is complicated, expensive, and time-consuming. The objective measurements are needed to handle postpartum hemorrhage [8]. It is crucial to conduct an early assessment and detection during labor and post-delivery with effective and measured methods to quickly and appropriately address the risk of blood loss. This accuracy is highly prioritized so that bleeding can be managed quickly and appropriately [17]. The purpose of this study was to determine an accurate and objective method of measuring blood loss so that it can be developed in diagnosing blood loss.

2. Materials and method

2.1. Visual estimation

Usually, the most widely used method is visual estimation, whereas this method is just guesswork. So, further research is not recommended because of its accuracy is questioned. It is not allowed in the treatment of postpartum hemorrhage [8] because of its inaccurate. Two-thirds of post bleeding cases labor as much as 65.4% misdiagnose of blood loss. This method is not optimal and appropriate for early detection and must be replaced with an objective measures [18], highly inaccurate as to substantially under high blood loss [19], and has been proven to be very inaccurate in terms of measuring blood loss and unreliable [12, 20].

2.2. Gravimetric method

Gravimetric is one objective method of assessing postpartum hemorrhage. The material used by the mother during labor was collected and then weighed [21]. This method takes time and is challenging to be implemented in clinical practice. However, this method is very accurate when compared with visual estimation [8]. The technique for collecting the blood from clothes used by mother must be soaked then weighed and the amount calculated. The weight of the blood is assessed by subtracting the initial weight of the basin, bucket pads and other used by the mother. The total weight of the blood-soaked assuming one gram is equivalent to 1 mL [22], but this method is time-consuming and challenging to be implemented in clinical practice. However, this method is very accurate when compared with visual estimation [8]. Gravimetric methods are very accurate, easy, inexpensive to use, allowing the detection of blood loss more accurately [11], but this method also has weaknesses.

2.3. Photometric method

Measurements with photometry are most suitable and precise but are very expensive and impractical [8]. Another method with the Alkaline Hematine technique is done by looking at a photo spectrometer [23]. However, this method is also impractical because it requires a long time and costly tools [24]. Other methods to collect the blood is by monitoring vital signs (sign monitoring) which are integrated immediately after delivery. This system monitors the maternal pulse and blood pressure with blood flow rate sensors, but the information provided is too minimal.
This research was reviewed from the database of Science Direct, Pubmed, and other related reports, using different combinations of keywords, including postpartum hemorrhage, measurement, blood loss, and relevant journals. The common methods used to measure the amount of blood loss were grouped into visual estimation, gravimetry, direct measurement, photometry, and other methods. The methods were described and combined by comparing several measurements where direct measurement was very practical, photometry was the most appropriate measurement, but it was very complex and expensive. Several other methods were displayed, but none were reliable and impractical.

3. Results and Discussion

Bleeding more than 500 mL occurs after the baby was born with vaginal delivery or more than 1000 mL after an Abdominal / Sectio Caesaria delivery [6]. In this case, bleeding consisted of two, namely, primary bleeding, that was bleeding occurs within the first 24 hours of labor, while secondary bleeding was excessive bleeding, that occurs more than 24 hours until up to 12 weeks postpartum. The caused of bleeding that often occur was uterine Atonia, retention of the placenta, tearing of the birth canal, and a history of postpartum bleeding [25]. The delivery room staff must be faster and more careful in identifying the source and cause of postpartum hemorrhage.

To overcome the blood loss, the researchers tried to modify the conventional measurement of visual estimation by increasing simulation and training and designing special visual aids to be used for postpartum bleeding. This method was the easiest, fastest, and most commonly used to measure blood loss. However, the research had repeatedly identified the weaknesses and inaccuracies in measuring blood loss [11, 12, 13, 14]. The inaccurate estimation caused blood loss to be 20% greater than measured blood loss. Then by guessing and ignoring blood loss would cause blood loss of about 30% [19]. Such methods were questionable and should not be used for treatment [8]. This method was only devoted to determining blood loss in normal cases, identifying interventions for excessive blood loss, and intervention strategies to correct blood loss so that treatment was optimal. Stafford et al. [26] conducted a seven-station simulation, with normal maternal and post-caesarean maternal blood waste using pads, sponges, curtains placed under the mother's buttocks from various labor clinics, then comparing visual pre and post-simulation estimates. The study then incorporated a mathematical formula and found that blood counts that were too high at lower levels, even underestimated blood loss at higher levels at five stations.

Providing education through training could improve the ability of midwives refer to various studies. At present, the visual estimation was still one method that often used even though repeated studies had showed inaccuracies in estimating blood counts in simulated clinical scenarios. Nevertheless, this method was still inaccurate, especially with large numbers. According to Buckland & Homer [27], in determining the accuracy of blood loss estimation, the simulation was done using clinical samples. With practice, it could help midwives improve their visual estimation of blood loss with accurate estimates that could be handled quickly and properly. Based on various studies, visual estimation was one of the most frequently used methods even though repeated research had shown its inaccuracies. Prasertcharoensuk et al. [9] compared the visual estimation method with direct measurement of blood loss during postpartum, underestimating postpartum hemorrhage incidence to be 89%.

Direct measurement method was used to determine the loss of blood count, by collecting blood, the material used by the mother, with a curtain directly in a bucket that was drained through the hole in the bed with the bottom curtain method. Prasertcharoensuk et al. [9] and Lilley et al. [28] evaluated the accuracy of visual estimates that asked midwives to estimate blood loss with simulations, showing that this measurement method was inaccurate tends to underestimate small numbers and overestimate the large numbers. Lertbunnaphong et al. [18] compared visual estimates to using curtains. Visual estimation was very inaccurate, which was substantially under the high blood loss [19]. This method was inaccurate, where two-thirds of postpartum hemorrhage cases were 65.4% misdiagnose of blood loss, this method was not very optimal and appropriate for early detection of postpartum bleeding and must be replaced with an objective measure [18].

An accurate and objective method of measuring the amount of blood loss using precise calculations was considered. The method used curtains placed under the mother's buttocks, gravimetry, and laboratory analysis. Wilcox et al. [29] compared visual estimates of blood loss with actual blood loss
calculated based on the mat under pad. The amount of blood loss was calculated by multiplying the number of blood saturated squares or partial squares by 50 mL; the accuracy of this method was 69% to 97%. Zuckerwise et al. [30] designed a pocket card containing a picture of blood, which was used as a visual aid to estimate blood loss.

The study was carried out practically at six stations with artificial blood material. The results show that visual estimates were inaccurate and tend to overestimate small numbers and underestimate large numbers. However, by using visual aids, measurements became more effective at increasing the accuracy of estimated blood counts estimated at 34.9%. Some researchers [11, 14, 20, 28, 31] observed in the pre and post-training simulation sessions. The participants were asked to estimate blood loss. In the pre-test, the assessment was inaccurate, tended to overestimate where large numbers and underestimated small numbers, but after training, the accuracy could be significantly increased. Furthermore, according to Toledo et al. [14], training simulations could increase the accuracy of visual estimates by 34%, and the benefits were enormous, so this training must be routinely carried out.

4. Conclusions
Maternal death is still a significant problem. This condition is caused by blood loss, which is the most common cause of maternal death worldwide due to uterine atony. There are several methods to measure the amount of blood loss, but they are expensive, complicated, and impractical. However, in clinical practice, the method of visual estimation is most commonly used, even though it is inaccurate. If it is modified with visual aids, it is possible that each delivery room can apply the visual method properly. Furthermore, to improve skills and accuracy, medical staff must be regularly trained to implement the WHO-recommended bleeding prevention protocol. One of them is active management in the third stage of labor, so postpartum hemorrhage has decreased significantly.

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