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CLINICAL ARTICLE

Severe maternal morbidity and near miss due to postpartum hemorrhage in a national multicenter surveillance study

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ABSTRACT

Objective: To assess the occurrence of severe maternal complications owing to postpartum hemorrhage (PPH) and its associated factors. *Methods:* A secondary analysis of data from a multicenter cross-sectional prospective surveillance study included 9555 cases of severe maternal morbidity at 27 centers in Brazil between July 2009 and June 2010. Complications of PPH, conditions of severity management, and sociodemographic and obstetric characteristics were assessed. Factors independently associated with severe maternal outcome (SMO) were identified using multiple regression analysis. *Results:* Overall, 1192 (12.5%) of the 9555 women experienced complications owing to PPH (981 had potentially life-threatening conditions, 181 maternal near miss, and 30 had died). The SMO ratio was 2.6 per 1000 live births among women with PPH and 8.5 per 1000 live births among women with other complications. Women with PPH had a higher risk of blood transfusion and return to the operating theater than did those with complications from other causes. Maternal age, length of pregnancy, previous uterine scar, and cesarean delivery were the main factors associated with an increased risk of SMO secondary to PPH. *Conclusion:* PPH frequently leads to severe maternal morbidity. A surveillance system can identify the main causes of morbidity and could help to improve care, especially among women identified as being at high risk of PPH.

1. Introduction

Postpartum hemorrhage (PPH) is a leading cause of maternal morbidity and mortality worldwide, but is of particular concern in low- and middle-income countries [1]. In such regions, PPH is estimated to account for one-quarter to one-third of all maternal deaths [2,3]. For each reported maternal death, approximately 20 women survive but go on to experience the consequences of related morbidities [3], creating a large social and economic burden.

Most cases of PPH are caused by uterine atony [4]. Consequently, key risk factors for PPH include situations that overdistend the uterus, labor induction and augmentation, previous cesarean delivery, hypertensive disorders of pregnancy, fibroids, placenta previa, and coagulopathy [4]. In the past 15 years, an increase in the incidence of PPH—even in high-income countries—has been shown in several independent studies [5–8]. This observation probably reflects multifactorial causes, such as advanced maternal age, obesity, comorbidities, multiple pregnancy, ethnic origin, and rising rates of cesarean delivery [5–8].

The classic definition of PPH is based on the estimated volume of blood loss that occurs either during delivery or within 24 hours of delivery [9]. Nevertheless, use of this definition can be challenging in clinical practice, and diagnosis is usually made by visual estimation of blood loss, suggesting that PPH might actually be underdiagnosed [10,11]. This inaccuracy in blood-loss estimation has triggered efforts to determine the global incidence of PPH [4], and to identify clinical signs that might objectively relate to blood loss, such as the shock index [12]. Depending on the presence of pre-existing conditions (e.g. anemia), untreated PPH can lead to hypovolemic shock, multiorgan dysfunction, and maternal death [13]. Therefore, timely and accurate identification of this complication is crucial to ensure that appropriate interventions are initiated (e.g. drugs, surgery, and referral) and that adverse outcomes are avoided [14].

For many years, interest in PPH was focused on the evaluation of risk factors, prevention, and treatment [9]. Other studies have tried to understand the reasons for substandard care in PPH [8], accurate diagnosis

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[12], and identification of potentially severe cases. To date, few studies have collected consistent prospective data on severe maternal morbidity owing to PPH. The Brazilian Network for Surveillance of Severe Maternal Morbidity Study Group previously conducted a multicenter cross-sectional survey of severe maternal morbidity in Brazil [15].

The aim of the present study was to perform a secondary analysis of data from this survey, focusing on risk factors for severe maternal morbidity secondary to PPH, using WHO criteria for potentially life-threatening conditions (PLTC), maternal near miss (MNM), and maternal death [16].

2. Materials and methods

A cross-sectional prospective surveillance study was conducted between July 1, 2009, and June 30, 2010, at 27 referral obstetric units located throughout Brazil. An investigator and a coordinator were present at each center. Among all deliveries in these institutions during the 1-year period, 9555 women with severe maternal morbidity were identified; cases of PLTC, MNM, and maternal death were identified using WHO criteria [16–18]. Approval was obtained from the National Council for Ethics in Research and the institutional review boards of participating units. The need for informed consent was waived because study data were collected from medical records and the women were enrolled either after hospital discharge or death.

Sample size for the multicenter cross-sectional survey was originally estimated using a theoretical incidence of MNM of approximately 10 cases per 1000 live births [16], considering this measure was the main primary outcome of the study. Approximately 75 000 deliveries were predicted to occur at the 27 centers during the study period, so 750 cases of MNM would be expected.

The medical records of women who were admitted to participating units for delivery or any pregnancy-related issue were reviewed by local researchers immediately after hospital discharge. To obtain clinical information on women who had transferred away from one of the study units, local researchers contacted the receiving healthcare units to establish the patients' outcomes. Information was also obtained for women who had died. If required, information was also obtained from prenatal records or directly from the healthcare team.

Data collection was performed using a paper form that also collected information about adequacy of health care and any delays in receiving appropriate care. These data were then transferred by local researchers to electronic forms hosted on the Brazilian Network for Surveillance of Severe Maternal Morbidity Study Group website, located within the institutional web page of the coordinating center (University of Campinas, Campinas, Brazil). Completed electronic forms were sent to a central database using OpenClinica version 3.0 (https://www.openclinica.com/), a specialized platform designed to manage clinical studies. Further methodological details are available elsewhere [15,19,20].

An operating manual was developed and provided to all investigators and coordinators for training purposes before data collection commenced to ensure systematic quality control. Initially, each local coordinator reviewed the forms, checked for errors, and searched for any missing data. Then, the local investigator performed a second review to identify possible inconsistencies. Finally, the national coordinators checked the database, identified possible inconsistencies, and sent an error report to participating centers, which were required to respond and correct all information [19].

Constant auditing was conducted using a set of validation and cross-checking rules as part of the online data management. Participating units and researchers from the coordinating center underwent a systematic evaluation of possible delays and deficiencies in the quality of care and health-system inadequacy, with data on interhospital transfer, patient refusal in accepting treatment, and lack of equipment or medication. Overall, the delays and deficiencies identified were operationally defined as a substandard care. Hemorrhagic complications were systematically investigated and included prepartum and intrapartum hemorrhage, PPH, complicated ectopic pregnancy, abortion, or other severe hemorrhage (e.g. wound hematoma).

In the present secondary analysis, data were used for women with obstetric complications. They were initially divided by whether the complications were due to PPH or another cause. The prevalences of PLTC, MNM, and maternal death were calculated and compared between the two subgroups. Health indicators related to maternal morbidity and mortality were estimated according to WHO criteria [16]. These indicators included the MNM ratio, the severe maternal outcome (SMO) ratio (defined as the sum of MNM plus maternal death), the ratio of MNM to maternal death, the mortality index, and the maternal mortality ratio (MMR).

Data were analyzed using SPSS version 20.0 (IBM, Armonk, NY, USA) and EpiInfo version 3.5.3 (CDC, Atlanta, GA, USA). The prevalence ratio (PR) was adjusted for the cluster effect of the design. This correction was used because each participating center was considered as a cluster, and the correspondent heterogeneity in each variable among clusters was adequate [20,21]. Sociodemographic and obstetric factors potentially associated with worse outcomes among women with PPH were evaluated by comparing women with PLTC with those with SMO. Finally, multiple Poisson regression analysis was used to identify factors independently associated with SMO secondary to PPH. $P < 0.05$ was considered statistically significant.

3. Results

Among the 9555 women with severe complications in pregnancy, delivery, or the postpartum period, 8645 (90.5%) had PLTCs, 770 (8.1%) had MNM, and 140 (1.5%) died. PPH affected 1192 (12.5%) women, most of whom had PLTCs (Fig. 1, Table 1). Uterine atony was the most frequently diagnosed condition in women with PPH (Table 1). Causes other

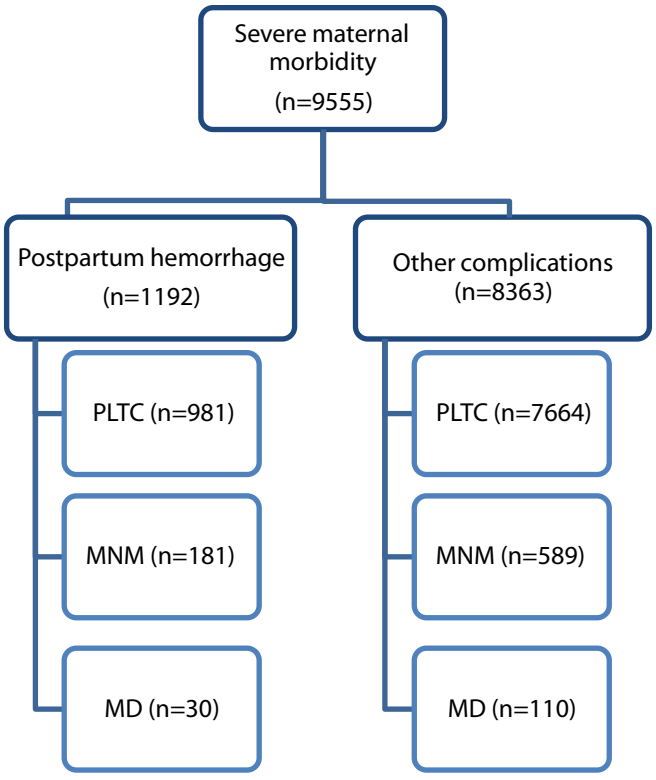

Fig. 1. Schematic of the women with severe maternal morbidity owing to postpartum hemorrhage or other causes according to the final outcome. Abbreviations: PLTC, potentially life-threatening condition; MNM, maternal near miss; MD, maternal death.

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