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CLINICAL ARTICLE

Causes and avoidable factors in maternal death due to cesarean-related hemorrhage in South Africa

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ABSTRACT

Objective: To describe risk factors, clinical events, and avoidable factors in cases of maternal death due to bleeding during and after cesarean delivery. *Methods:* A retrospective study was undertaken of the clinical records of women who delivered in seven hospitals in Johannesburg, South Africa, between January 2013 and December 2014. Maternal deaths due to cesarean-related hemorrhage during or within 42 days of cesarean delivery at 24 weeks or more were selected. Case records were audited using quantitative techniques to determine the events leading up to death. *Results:* There were 123 251 deliveries and 17 maternal deaths due to bleeding during or after cesarean (3.2 deaths per 10 000 deliveries). Risk factors included previous cesarean delivery, preoperative anemia, and placental abruption. Uterine atony and surgical trauma were the main causes of bleeding. Five (29%) women died before the cause of bleeding was found. Avoidable factors included delays in the recognition and management of shock. Thirteen (76%) women died within 48 hours of the cesarean procedure. *Conclusion:* Deaths due to bleeding during and after cesarean have multifactorial causation. Maternal healthcare systems must be strengthened, with attention to the knowledge and skills of health workers. This requires increased clinical vigilance, a rapid effective response to obstetric hemorrhage and shock, and overall health system strengthening.

1. Introduction

Maternal deaths resulting from bleeding during and after cesarean have recently increased in South Africa: in the triennial report on confidential enquiries into maternal deaths in 2011–2013 [1], such bleeding accounted for more than one-third of maternal deaths due to obstetric hemorrhage [1]. The cause-specific case fatality rate for hemorrhage during cesarean delivery was 5.5 deaths per 10 000 cesareans performed [2]. More than 70% of the deaths were considered to be clearly avoidable [2].

An increasing rate of cesarean delivery is thought to be the main cause of the rising numbers of deaths due to cesarean-related hemorrhage in South Africa [2]. There is also concern about a lack of surgical skills to manage women with severe bleeding during and after cesarean [3]. A shortage of ambulances and appropriate referral systems is also a major concern [2,3]. Medical and nursing staff shortages, operating room backlogs, and emergency transport deficiencies are frequent challenges in local state-run health services in South Africa [4,5].

Nevertheless, maternal death due to bleeding during and after cesarean remains a rare outcome. To our knowledge, no case series has examined the clinical details and quality of care in this situation. The aim of the present study was therefore to describe risk factors, clinical events, and potentially avoidable factors in cases of maternal death due to bleeding during and after cesarean.

2. Materials and methods

In a retrospective study, maternal deaths due to bleeding during and after cesarean that occurred at seven hospitals in Johannesburg, South Africa, between January 1, 2013, and December 31, 2014, were audited as a case series. Ethical approval was granted by the University of the Witwatersrand's Human Research Ethics Committee, and institutional permission for the study was obtained from the Gauteng Department of Health. Informed consent was not needed because it was a retrospective study of maternal death.

Three of the study hospitals are university teaching hospitals in Johannesburg with tertiary referral functions, and four are regional (secondary-level) hospitals as part of the local referral system. Hospitals in South Africa are required to keep all clinical notes in cases of maternal death. Therefore, all maternal death records were reviewed by a certified specialist obstetrician and gynecologist (S.M.) to identify the causes. Deaths due to bleeding during and after cesarean were selected for inclusion.

The case definition of maternal death due to bleeding during and after cesarean was death during or within 42 days of surgery resulting from acute hemorrhage of at least 1000 mL (as estimated and noted in

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the file by the surgeon) during or after cesarean delivery at 24 weeks of pregnancy or more [6]. Women with medical disorders or blood clotting disorders were included, as were women with placental abruption, placenta previa, and/or placenta accreta. The exclusion criteria were uterine rupture with the fetus partially or completely extruded from the uterus, and advanced extrauterine pregnancy. Women for whom bleeding before cesarean was considered to be the primary cause of maternal death were also excluded from the audit. When there was difficulty in deciding on inclusion or exclusion of a case, two researchers (S.M. and E.B.) made a decision by consensus.

Risk factors considered in data collection included age and parity, previous cesarean delivery, prenatal anemia, HIV infection, placental disorders (abruption, previa, and accreta), breech presentation, multiple pregnancy, and prolonged labor. Obesity could not be estimated because of irregular recording of height. Anemia was defined as a hemoglobin level of less than 110 g/L [7]. Prolonged labor was defined as a latent phase of more than 8 hours in hospital or an active phase of first stage of more than 12 hours [8]. The type of hospital where the cesarean occurred and the rank of the surgeon (medical officer, resident, or specialist) were also considered. Other risk factors were time of operation (day or night), day on which the operation was performed (weekend or weekday), type of anesthesia, and birth weight.

Indications for cesarean, estimated blood loss, and interventions to arrest intraoperative hemorrhage were noted. Postoperative monitoring and management of postpartum hemorrhage (PPH) were also evaluated. The cause and site of the bleeding were determined from details in the medical notes and on the basis of the researcher's opinion. Difficult cases were discussed between the researchers. Details of the clinical and surgical management—especially blood transfusion, non-surgical methods to stop bleeding, compression sutures, hysterectomy, second-look laparotomy, and admission to the intensive care unit—were noted.

The Donabedian model was used to assess the quality of health care in each maternal death, looking for avoidable factors. The model supposes that the clinical outcome of a patient is influenced by health service structure (facility and resources where the outcome took place) and process (diagnosis and treatment by the healthcare workers) [9]. Avoidable factors were subdivided into process and structure. If there was a factor or factors that directly resulted in the death of a patient, then the death was deemed avoidable. Expected structure factors included blood transfusion delays, emergency transport failures, and operating room delays. Process factors included patient-related issues, such as nonattendance at prenatal clinics and refusing hospital treatment, and healthcare worker-related factors, such as failure to recognize, diagnose, and respond to intraoperative or postoperative bleeding, including deficits in routine monitoring, inadequate volume resuscitation, and failure to undertake actions to arrest hemorrhage or treat hypovolemic shock.

The study used quantitative techniques. Data were analyzed by Stata version 11 (StataCorp, College Station, TX, USA). Values were reported as mean ± SD for normally distributed continuous data, median (range) for non-normally distributed continuous data, and number (percentage) for categorical data.

3. Results

During the study period, there were 17 maternal deaths due to bleeding during and after cesarean in the seven hospitals. In total, there were 123 251 deliveries at the hospitals, 43 137 (35%) of which were by cesarean. In 14 of the 17 included deaths, the woman underwent the cesarean delivery at one of the seven study hospitals, giving a case fatality rate of 3.2 deaths per 10 000 cesarean deliveries (14/43 137) at the seven hospitals. The other three women were transferred postoperatively from district hospitals because of bleeding complications.

The mean age of the 17 women was 28.6 ± 6.7 years; two women were younger than 19 years, and three were older than 35 years (range 17–42). The median parity was two (range 0–6); there were three primigravidas and two women with a parity of six before delivery. Four (24%) women had a previous cesarean delivery. Seven (41%) had a record of prenatal anemia. Fourteen (82%) women attended prenatal care. Four (24%) women were infected with HIV. Three (18%) cesarean procedures were done preterm (<37 weeks). Three (18%) women had labor induced, and 1 (6%) had labor augmented with oxytocin. Three (18%) women underwent the cesarean before onset of labor, and 3 (18%) had the cesarean in the second stage of labor. There was 1 (6%) multiple pregnancy and 1 (6%) singleton breech presentation. Five (29%) women had placental abruption, and 1 (6%) had placenta accreta (Table 1). There were no cases of placenta previa.

All operations were performed by non-specialists, and two were done by residents in training. All 17 deaths were associated with potentially avoidable factors. Patient-related process factors included two women who did not attend prenatal care, and a woman with severe pre-eclampsia who refused hospital admission and cesarean delivery. This woman returned 5 days later with eclampsia, placental abruption, and a resistant atonic uterus with coagulopathy. Fourteen (82%) procedures were performed from Monday to Friday, and 3 (18%) were performed during a weekend. Fifteen (88%) cesareans were booked as emergencies, and 2 (12%) as elective. Seven (41%) procedures were done during the day, and 10 (59%) at night. Thirteen (76%) women had regional anesthesia. Stillbirth occurred in 7 (41%) cases. The mean birth weight was 2518 ± 882 g (range 1270–3820).

Ten (59%) procedures were recorded as "difficult" by the operating surgeons. The median estimated blood loss was 750 mL (range 300–8000; unrecorded in two cases). Two (12%) women died during the operation. Seven women (41%) had blood transfusions during the cesarean procedure. Atonic uterus was the main cause of bleeding in 7 (41%) cases, including five women with placental abruption, followed by surgical trauma in 5 (29%) cases. The cause of bleeding remained unknown for 5 (29%) women, three of whom died in the postoperative wards before any life-saving intervention could be started.

Surgical interventions included hysterectomy during the cesarean procedure for 3 (18%) women, and B-Lynch compression suture for 1 (6%) woman. Nine (53%) women subsequently had second-look laparotomies, during which 4 (44%) women underwent a hysterectomy, and 1 (11%) woman had B-Lynch compression suture (Table 2). Balloon tamponade was not attempted in any case, nor was tranexamic acid injection used. Postoperative artificial ventilation was provided to 14 (82%) women and inotropic drugs to 15 (88%) women. Nine (53%) women were admitted to the intensive care unit. Thirteen (76%) women died within 48 hours of surgery.

Recurrent avoidable factors related to the health system included shortages of emergency blood and emergency transport, and operating room delays. Health-worker-related factors included cesarean procedures with no clinical indication (e.g. grand multiparity, and breech presentation with fetal death), failure to detect hypovolemic shock, failure to control bleeding and/or treat shock, prolonged labor with delayed intervention, and delay in performing second-look surgery (Table 3).

4. Discussion

The present study found a case fatality rate of 3.2 maternal deaths due to bleeding during and after cesarean per 10 000 cesarean procedures. This is lower than the national case fatality rate for hemorrhage during cesarean delivery (5.5 per 10 000 cesareans [2]), possibly because of the better skills and resources available in Johannesburg with its academic hospitals and socioeconomic advantages relative to the rest of South Africa. Recurring risk factors for maternal death in the present audit were prenatal anemia, placental abruption, previous cesarean delivery, and second stage of labor. Factors contributing to the deaths of these women included the perioperative management of hemorrhage by the healthcare worker and the healthcare facility. Pre-operative factors—e.g. delays in performing cesarean or non-indicated cesarean procedures—might also have had a causative role. Deaths

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