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Blood Consumption in Placental Abnormalities

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Abstract

Introduction: Hemorrhage is one of the most common causes of maternal morbidity and mortality. This study was conducted to investigate how much abnormal placentation can affect blood bank capacity and to measure the burden on the blood bank caused by excessive use of blood and blood products. **Methodology**: This is a retrospective study conducted at King Saud Medical City Maternity Hospital in Riyadh, Kingdom of Saudi Arabia, from January 2019-September 2020. It includes 170 cases diagnosed with abnormal placentation (low-lying placenta or placenta previa, accreta, increta, or percreta). The primary purpose was to measure consumption of blood and blood products in cases of placental abnormalities and to investigate how much this affects blood bank capacity. A secondary aim was to report rates of admission to the ICU and maternal mortality. **Results:** This study included 170 women with placental abnormalities. Placental previa had occurred in 96 cases, followed by placenta accreta in 46 cases, placenta increta in 13 cases, placenta percreta in 8 cases, and low-lying placenta in 7 cases. Most patients (93) were treated with a Bakri balloon to prevent hemorrhage, but 38 patients had a hysterectomy. The average estimation of blood loss was 2210 ml, with no maternal mortality. An average of 3.39 units of packed red blood cells (PRBC) with a maximum of 20 units, 2.12 units of fresh frozen plasma (FFP) with a maximum of 20 units, and 0.7 units of packed platelets (PP) with maximum of 12 units consumed per patient. Eighty-seven patients (51.2%) were admitted to the ICU and 83 others (48.8%) were admitted to the high dependency unit. **Conclusion:** Blood and blood product volumes had a linear relationship with the severity of placental abnormalities and estimated blood loss. Therefore, blood bank services should be available to save mothers' life.

Keywords

Placenta Previa, Placenta Accreta Spectrum (PAS), Hemorrhage, Maternal Mortality, Hysterectomy

1. Introduction

Normal placenta is round, occasionally oval, in shape, approximately 20 - 22 cm in diameter, and 2 - 2.5 cm thick. The placenta attaches to the uterine wall and allows metabolic exchange between fetus and mother. The placenta comprises two portions, maternal and fetal, with the maternal portion developing from the decidua basalis of the uterus [1].

Placenta accreta spectrum (PAS) or abnormally adherent placenta includes (accreta, increta, and percreta) [2]. During the phase of placental development, the syncytiotrophoblast invades maternal venous sinuses quite early, invading the spiral arterioles on the 17th or 18th day after conception occurs. The lacunae—lakes established by maternal tissue fluid and blood—create the intervillous space, wherein maternal blood circulates freely throughout the rest of the pregnancy. Due to the unusual location and the invasion of placental tissue, severe maternal bleeding is likely to occur, especially in the third trimester of pregnancy and with the onset of delivery [3]. Such abnormal placentation has been observed to be associated with previous cesarean deliveries [4] or other uterine surgeries, such as myomectomy or curettage, as well as with advanced maternal age, multiparity, and smoking [5].

A woman's preference for a cesarean section (CS) may be due to health concerns. Medical and psychological factors should be addressed in antenatal counseling [6]. The number of cases of placenta previa and accrete spectrum (PAS) has increased and will continue to do so as a direct result of rising rates of CS delivery, increased maternal age, and increased usage of assisted reproductive technology. The highest rates of complication for both mother and newborn are observed when these conditions are only diagnosed at delivery [7].

Major obstetric hemorrhage can be defined as a life-threatening blood loss occurring in the antepartum or postpartum period, revealed or concealed due to poor contraction of the uterus, retained products of conception, and/or other bleeding disorders. Blood loss is considered abnormal if it is more than 500 ml post normal vaginal delivery or more than 1000 ml with a CS. Obstetric hemorrhage is a leading cause of major maternal morbidity and mortality. Deaths related to postpartum hemorrhage have unfortunately been increasing in the Kingdom of Saudi Arabia (KSA; for example, 7 between 1997 and 1999, 17 between 2000 and 2002) [8] [9] [10]. Eventually, this will lead to an increased demand for blood and blood products to save lives.

This study was conducted to investigate how much abnormal placentation and PAS may affect blood bank capacity and to measure the burden on the blood bank due to excessive use and great demand for blood and blood products.

2. Methodology

This was a retrospective study conducted at King Saud Medical City (KSMC) Maternity Hospital, Riyadh, KSA, which is a tertiary center for placenta previa

(Center of Excellency for placenta previa in Health Cluster One, Riyadh). The institutional Review Board, KSMC [H1R1-25-Aug20-02] approved the study under the exempt category with a waiver of informed consent. The primary purpose of this study was to measure consumption of blood and blood products in cases of placental abnormalities. A secondary aim was to report rates of admission to the ICU and maternal mortality.

This study was conducted from January 2019 until the end of September 2020. Both hard and soft copies of all medical records were reviewed to collect the data. Collection tools were built to collect the variables. Inclusion criteria included pregnant patients with abnormal placentation and PAS. Including low-lying placenta (placental edge is <2 cm from the internal os) confirmed by transvaginal ultrasound at 36 weeks, placenta previa, accreta, increta, or percreta diagnosed from 24 weeks onward and delivered at KSMC within the above mentioned period. Diagnoses were determined mainly by transvaginal ultrasound and magnetic resonance imaging during pregnancy and confirmed during delivery by senior obstetrician and by histopathology reports. Exclusion criteria included pregnancy with normal placentation, delivery at a hospital other than KSMC, and diagnoses that were not confirmed during delivery.

The main parameters that were collected included age, gravidity, number of deliveries, gestational age (weeks), type of placenta abnormality (low-lying placenta, or placenta previa, accreta, increta, or percreta), number of CS, type of CS (elective or emergency), blood loss (milliliters, estimated by anesthetists and circulating nurses by observing blood-stained pads, swabs, and contents of the suction bottle), use of Bakri balloon, need for hysterectomy, number of packed red blood cell units and/or fresh frozen plasma units and/or platelet units required, and admission to the ICU.

Intraoperatively all cases are managed by a senior obstetrician anesthetist and senior intensivist in ICU. In the case of young mothers with low parity who have placenta accrete, we used large wet gauze with normal saline to peel the placenta, then immediately inserted a Bakri balloon with the use of uterotonic medications to control the bleeding. However, in the case of placenta increta or percreta hysterectomy performed regardless of parity. Data were collected, cleaned, and verified in an excel sheet, after which they were coded and analyzed using SPSS (version 26). The chi-square and ANOVA tests were used to compare variables to each other.

3. Results

This study identified 200 cases of pregnant women diagnosed with abnormal placentation and PAS, but only 170 patients met all inclusion criteria for analysis. Among these 170 women, the average age was 33.68 ± 5.6 years. Placenta previa occurred in 96 pregnant women (66%), a significant majority ($p < 0.0001$), followed by placenta accreta in 46 cases (27%; $p < 0.05$), placenta increta in 13 cases (8%), placenta percreta in eight cases (5%), and low-lying placenta in seven cases (4%; **Figure 1**).

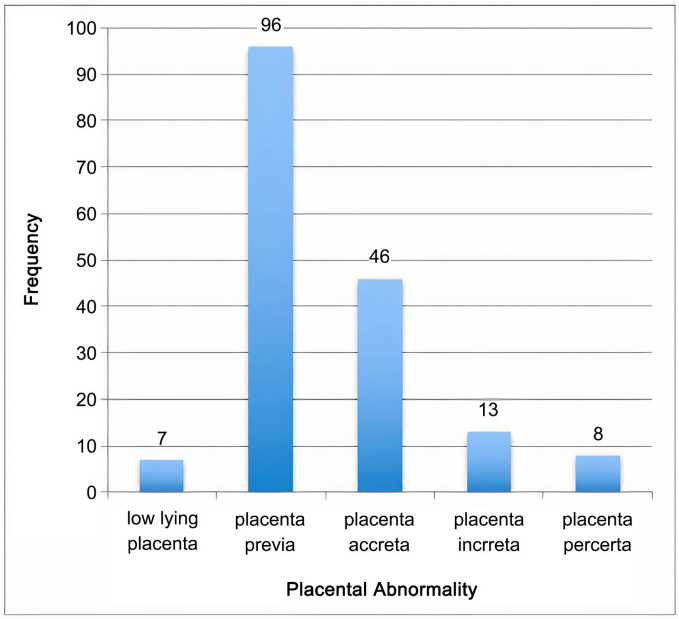

Figure 1. A diagram illustrated the occurrences and frequencies for severities of placental abnormalities and its distribution for 170 women with low lying placenta, placenta previa, placenta accrete, placenta inccreta and placenta percreta.

The majority of placental abnormalities were treated with BAKRI balloon to prevent hemorrhage (93 patients, 54.7%), and only 38 patients (22.4%) had hysterectomy. Additionally, only 48 patients (28.2%) had no history of CS; the remaining women had undergone one to eight CS procedures before the delivery reported in this study.

The average estimated blood loss was 2210 ml per patient, with a maximum loss of about 9000 ml. Eighty-seven patients (51.2%) were admitted to the ICU, and 83 others (48.8%) were admitted to the high dependency unit or observation ward with no maternal mortality. An average of 3.39 units of packed red blood cells (PRBC) with a maximum of 20 units, 2.12 units of fresh frozen plasma (FFP) with a maximum of 20 units, and 0.7 units of packed platelets (PP) with a maximum of 12 units consumed per patient (Table 1).

The severity of the placental abnormality in terms of PAS was positively correlated with estimated blood loss, meaning that as the severity of the abnormality increased, more blood loss occurred. This positive correlation to the severity of placental abnormalities also applied to the amount of other blood products used, including PRBC, FFP, and PP (Figure 2). Patients with placenta percreta consumed large amounts of blood products, whereas those with low-lying placenta required zero to minimal amounts of PRBC, FFP, and PP. Similarly, results showed that severity of placental abnormality mainly PAS as positively correlated with admission to the ICU. Overall, there was zero mortality.

Placental abnormalities were not related to age, number of pregnancies (parity), number of deliveries, gestational age, or type of CS (elective vs. emergency). Consequently, the amount of blood products required, including PRBC, FFP, and PP, was also not related to those variables.

Table 1. A table illustrated severity of placental abnormalities and the estimated blood loss & other blood products.

Placenta abnormalities	low lying placenta (n = 7; 4%)		placenta previa (n = 96; 66%)		placenta accreta (n = 46; 27%)		placenta incrreta (n = 13; 8%)		placenta percerta (n = 8; 5%)	
	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev	Mean	St Dev
Estimated Blood Loss (ml)	800	469	1455	1334	3010	2746	4354	2707	4400	800
Bakri Balloon	0.14	0.378	0.65	0.481	0.46	0.504	0.62	0.506	0.13	0.14
Cesarean Hysterectomy	0	0	0.07	0.261	0.41	0.498	0.38	0.506	0.88	0
Packed Red Blood Cells	0.71	1.254	2.1	2.739	5.11	4.701	6.23	4.833	6.75	0.71
Packed Platelets	0	0	0.29	1.035	1.22	2.28	1.69	2.213	2.5	0
Fresh Frozen Plasma	0.43	0.787	1.02	2.005	3.67	4.321	4.62	4.908	3.88	0.43

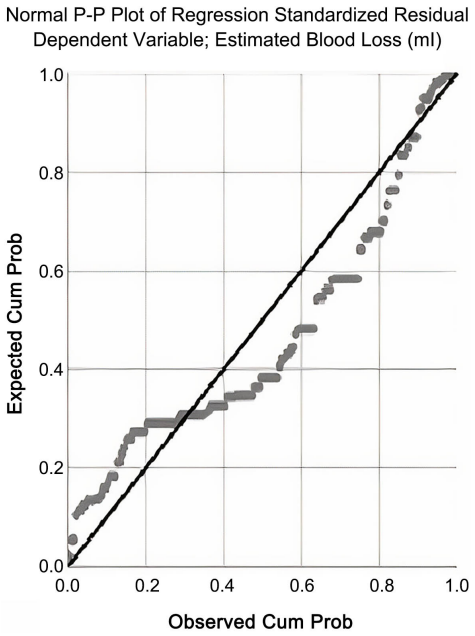

Figure 2. A model represented a significant linear relationship with ($p < 0.001$), showing that each one unit increase in estimated blood loss (dependent variable) confronted with 0.470 scale unit increased for placental abnormalities (independent variable).

4. Discussion

During the above-mentioned period about 10,000 deliveries occurred at KSMC, the maternity hospital at KSMC is considered a Center of Excellency for placenta previa in Riyadh's Health Cluster One (center with multidisciplinary teams with high level of skills, that comes with experience in treating the condition and blood services). The blood bank in KSMC is a regional blood bank with 24 hours services supporting all the hospitals in Riyadh region. The results of this study show that placenta previa deliveries at KSMC represent approximately 2.2% of the total number of deliveries. In contrast, one previous study reported that placenta previa was present in approximately 4.1 in 1000 live births at King Abdu-

laziz University Hospital in Jeddah, Saudi Arabia [11], with other observational studies showing a prevalence ranging from 3.5 to 4.6 per 1000 births [12]. This study found that the most predominant placental abnormality is placenta previa, with 96 out of 170 cases of placental abnormalities being placenta previa (66%) and a rate of 1 in 1000 cases among the total number of deliveries ($p < 0.0001$). Placenta accreta was the next most frequent abnormality, found in 46 cases (27%) and accounting for nearly 0.5 in 1000 cases among the total number of deliveries. Finally, placenta increta occurred in 13 cases (8%), placenta percreta occurred in eight cases (5%), and low-lying placenta occurred in seven cases (4%).

At KSMC, CS deliveries represented approximately 39% of all deliveries in 2019, likely because most of the cases are un-booked, as per KSMC data. CS deliveries accounted for only 20.4% of all of deliveries in 2010, but that proportion increased to 27% of all deliveries in 2016 [13]. In this study, the increased incidence of placenta previa cases is expected, paralleling the progressive increase in CS rates and the number of referred cases from other hospitals. It has been observed that 60.6% of patients deliver by emergency CS. In other literature, placenta previa without complications would be delivered by elective CS between 36 and 37 weeks, or earlier in cases of increta and percreta [14].

In this study, most of the patients were above 30 years of age, which could be explained due to repeated CSs by this age due to previous deliveries. Massive bleeding can occur during surgery while trying to deliver the placenta, so proceeding to hysterectomy is considered the treatment of choice, although conservative management has recently been proposed [15]. Most KSMC patients delivered at a gestational age of 34 weeks as emergencies due to either bleeding or uterine contractions.

Bakri balloons were utilized to prevent postpartum hemorrhage (PPH) in 93 patients (54.7%), and the rate of successful control of massive PPH after Bakri balloon placement was 82.5% [16]. Data showed that 22.4% of patients had a hysterectomy to control bleeding—a higher percentage than the 6.5% reported in a different study [11]. Another retrospective study found that emergency peripartum hysterectomy was necessary in 17.6% of morbidly adherent placenta cases [17]. This high percentage could be explained due to emergency presentation of the patient and the need for urgent CS without enough preparation. Many studies have shown improved clinical outcomes if placenta accreta is managed with a planned cesarean hysterectomy rather than an emergency surgery at the time of an unscheduled delivery [18] [19] [20]. The incidence of an emergency hysterectomy varies between 0.2 [21] [22] and 2.70 in 1000 deliveries [23]. Incidence varies among countries, ranging from 1.2 - 2.7 (USA), to 0.63 (Saudi Arabia), to 0.3 (Ireland), to 0.2 (Norway) per 1000 deliveries [24] [25].

Although blood loss and blood transfusion morbidity was observed, the average blood loss in this study was 2210 ml, which is comparable to another study's finding of a blood loss of >2000 ml ($p = 0.042$) [11]. Furthermore, the severity of

placental abnormalities in term of PAS was positively correlated with estimated blood loss in this study, as well as being positively correlated with the amount of blood products required. In other words, patients with placenta percreta consumed large amounts of blood products, whereas patients with low-lying placenta required zero to minimal amounts. Patients who underwent an emergency CS required the largest volumes from the blood bank. In contrast, a different study found that 88.7% of patients with PPH did not receive any blood transfusion, and only 26 patients (11.3%) received at least six units of PRBCs [11]. Another study of patients with PPH observed a blood transfusion rate of 0.53% [26]. These differences could be because most of our study patients were un-booked or came near to delivery.

Eighty-seven patients (51.2%) were admitted to the ICU due to complications with placental abnormalities, but no maternal deaths or blood reactions were recorded in our cases. Another similar study found that 11.3% of such cases experienced hypovolemic shock with massive blood transfusion and admission to the ICU [11]. No maternal deaths were reported. No blood complications like blood reaction, pulmonary edema, or Transfusion-related acute lung injury (TRALI) were recorded among the 170 cases analyzed.

When the Canadian Consensus Conference defined TRALI in 2004 and subsequently increased, recognition of this syndrome, cardiac surgery, septic, and critically ill patients were significantly recognized as being at risk for the onset of TRALI. Consequently, TRALI has become the leading cause of transfusion-related morbidity and mortality [27] [28] [29].

The strength of this study is that it was conducted in a tertiary referral center in the Riyadh region that covered all placental abnormalities as a Center of Excellency. This study's limitation is that it is a retrospective study, which inevitably leads to missing data and an inability to collect all required information. In conclusion, Blood loss was positively correlated with the severity of the placental abnormality. Consequently, blood and blood product volumes also had a linear relationship with the severity of placental abnormalities and estimated blood loss. Available services of blood banks are a mainstay in decreasing morbidity and mortality in such cases. Abnormal placentation, particularly placenta previa, is a major cause of maternal morbidity and mortality.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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