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Determinants of Disseminated Intravascular Coagulation in Patients with Postpartum Hemorrhage: A Study from Androva University Hospital, Madagascar

[1] Randrianirina Hery Henintsoa, [2] Rosi Imelda, [3] Rakotomalala Zoly Nivoarimelina, [4] Rafanomezantsoa Toky Andriamahefa, [5] Harioly Nirina Marie Osé Judicaël, [6] Rasamimanana Naharisoa Giannie, [7] Randaoharison Pierana Gabriel

[1] Departement of Surgical Intensive Care, Faculty of Medicine, Univesity Hospital Androva, University of Mahajanga, Madagascar

[2, 6] Departement of Emergency and Intensive, Faculty of Medicine, Univesity Hospital Androva, University of Mahajanga, Madagascar

[3, 7] Departement of Obstetrics and Gynecology, Faculty of Medicine, Univesity Hospital Androva, University of Mahajanga, Madagascar

[4] Departement of Anesthesia, Faculty of Medicine, Univesity Hospital Analakininina, University of Toamasina, Madagascar

[5] Department of Anesthesia, Faculty of Medicine, Univerity Hopital Tanambao, University of Antsiranana, Madagascar

Corresponding Author: **Randrianirina Hery Henintsoa**

Abstract

Introduction: Disseminated intravascular coagulation (DIC) represents one of the most serious complications of postpartum hemorrhage (PPH) and remains an important contributor to maternal mortality. The present study sought to determine the factors associated with the occurrence of DIC among women experiencing PPH.

Materials and Methods: A retrospective analytical case-control study was carried out between January 2020 and December 2024 in the obstetrics and gynecology department and the postoperative intensive care unit of Androva University Hospital. Women with PPH complicated by DIC were included as cases, whereas those with PPH without DIC served as controls, using a 1:3 ratio. Sociodemographic, obstetric, clinical, laboratory, therapeutic, and maternal-fetal outcome variables were collected and analyzed using SPSS version 26. Statistical significance was defined as a p-value <0.05.

Results: Eighty-eight parturients were included (22 cases, 66 controls). Systolic blood pressure <90 mmHg (OR=19.11; p=0.003), was significantly associated with DIC. Uterine atony was significantly associated with DIC (OR=5.57; p=0.001). Hemoglobin <70 g/L, thrombocytopenia <150 G/L, and prothrombin time <70% were also associated with DIC. Maternal mortality was significantly higher in cases (81.82% vs 9.09%; p<0.001).

Conclusion: DIC complicating PPH is associated with severe clinical and biological abnormalities and high maternal mortality, highlighting the need for early diagnosis and prompt multidisciplinary management.

Keywords: Disseminated Intravascular Coagulation, Risk Factors, Postpartum Hemorrhage, Maternal Mortality, Obstetrics

Introduction

Disseminated intravascular coagulation (DIC) corresponds to an inappropriate systemic activation of coagulation, leading to consumption of coagulation factors and multiorgan failure [1]. In obstetrics, it is a life-threatening emergency. Severe postpartum hemorrhage (PPH) is one of its major causes and is responsible for rapid consumption coagulopathy [2]. DIC is involved in 10–20% of maternal deaths worldwide [3, 4] with a higher prevalence in sub-Saharan Africa [5]. In Madagascar, PPH accounts for 20–26% of maternal mortality [6]. The aim of this study was to identify factors associated with the occurrence of DIC among parturients presenting with PPH at Androva University Hospital, Mahajanga, Madagascar.

Materials and Methods

This was a retrospective, descriptive, and analytical case-control study conducted over a five-year period in the Departments of Obstetrics and Gynecology and Surgical Intensive Care of Androva University Hospital. Cases were parturients presenting with clinical DIC, diagnosed based on the association of one or more clinical signs (externalized hemorrhage, extensive ecchymosis, or abnormal bleeding at a venous puncture site) and/or biological abnormalities (prothrombin time <70%, activated partial thromboplastin time >40 seconds, and thrombocytopenia <150 G/L) during PPH. Controls were women with PPH without DIC, with a ratio of one case to three controls. Inclusion criteria common to both groups were parturients presenting postpartum hemorrhage (blood loss >500 mL after vaginal delivery or >1000 mL after cesarean section) of documented obstetrical origin. Medical records with complete clinical and paraclinical baseline data were also required. The specific inclusion criterion for cases was a confirmed clinical and/or biological diagnosis of DIC. The variables studied included sociodemographic, obstetrical, clinical, biological, therapeutic, and maternal-fetal outcome data. Data entry and analysis were performed using Statistical Package for Social Sciences (SPSS®) version 26 (International Business Machines™). Word® and Excel® 2013 (Microsoft Office™) were used for text processing and figure preparation. Cross-tabulations were performed between the dependent variable (DIC) and the other variables. Associations were evaluated using crude odds ratios (ORs) with 95% confidence intervals: OR >1: factor associated with an increased risk of DIC, OR =1: no association, OR <1: protective factor. No data allowing the identification of the participants were collected or disclosed, and all information gathered was treated confidentially.

Results

Table 1: Sociodemographic variables and occurrence of DIC

	Cases n=22 (%)	Controls n=66 (%)	OR (95% CI)	p-value
Sociodemographic profile				
Mean age (years)	29.6	27.1		0.77
Extreme maternal age				
<18 and >35 years	4 (18.18)	12 (18.18)	1.00 (0.28–3.49)	0.61
18 to 35 years	18 (81.82)	54 (81.82)		
Place of residence				
Outside Mahajanga-I	5 (22.73)	5 (7.58)	3.58 (0.92–13.85)	0.06
Mahajanga-I	17 (77.27)	61 (92.42)		

Table 2: Clinical, biological, and therapeutic variables associated with DIC

	Cases n=22 (%)	Controls n=66 (%)	OR (95% CI)	p-value
Perioperative variables				
Systolic blood pressure <90 mmHg	5 (22.73)	1 (1.52)	19.11 (2.09–174.7)	0.003
Obstetrical factors and delay in management				
Uterine atony	17 (77.27)	25 (37.88)	5.57 (1.82–16.99)	0.001
Cervical laceration	2 (9.09)	21 (31.82)	0.21 (0.04–1.00)	0.028
Vaginal laceration	0 (0.00)	15 (22.73)	Not estimable	0.008
Retained placenta	3 (13.64)	11 (16.67)	0.78 (0.19–3.13)	0.51
Delay in management* ≥1 h	18 (81.82)	36 (54.55)	3.75 (1.14–12.28)	0.019
Biological parameters				
Hemoglobin <70 g/L	6 (27.27)	3 (4.55)	7.87 (1.77–34.96)	0.006
Thrombocytopenia (<150 G/L)	14 (63.64)	14 (21.21)	6.50 (2.27–18.57)	<0.001
Prothrombin time <70%	14 (63.64)	16 (24.24)	5.46 (1.94–15.39)	0.001
Activated partial thromboplastin time >40 s	16 (72.73)	20 (30.30)	6.13 (2.09–17.97)	<0.001
Therapeutic management				
Tranexamic acid (preoperative)	9 (40.91)	17 (25.76)	0.50 (0.18–1.38)	0.14
Blood transfusion	20 (90.91)	62 (93.94)	1.55 (0.26–9.10)	0.46
Hemostatic hysterectomy	20 (9.91)	12 (18.18)	45.00 (9.24–219)	<0.001

*Delay between onset of bleeding and initiation of management.

Table 3: Maternal-fetal outcomes and prognosis

	Cases n=22 (%)	Controls n=66 (%)	OR (95% CI)	p-value
ICU readmission	15 (68.18)	6 (9.09)	21.42 (6.27–73.2)	<0.001
Maternal death	18 (81.82)	6 (9.09)	45.0 (11.4–177.1)	<0.001
Fetal/neonatal death	7 (31.82)	3 (4.55)	9.80 (2.26–42.41)	0.001
Length of hospital stay >3 days	14 (63.64)	41 (62.12)	0.93 (0.34–2.54)	0.55

A total of 88 parturients were included, comprising 22 cases and 66 controls. The mean age was slightly higher among cases than controls (29.6 vs 27.1 years). However, extreme maternal age was not associated with DIC occurrence. Residence outside Mahajanga-I district appeared to be associated with an increased risk of DIC in women with PPH (OR=3.58; 95% CI [0.92–13.85]), without reaching statistical significance (p=0.06) (Table 1). No significant association was found between medical history, antenatal follow-up, and DIC occurrence. Among obstetrical causes, uterine atony was significantly more frequent in the DIC group (OR=5.57; 95% CI [1.82–16.99]; p=0.001). Conversely, cervical laceration was less frequent among cases (OR=0.21; 95% CI [0.04–1.00]; p=0.028). Regarding biological parameters, patients with DIC more frequently had hemoglobin <70 g/L (OR=7.87; 95% CI [1.77–34.96]; p=0.006), thrombocytopenia (OR=6.50; 95% CI [2.27–18.57]; p<0.001), prothrombin time <70% (OR=5.46; 95% CI [1.94–15.39]; p=0.001), and activated partial thromboplastin time >40 seconds (OR=6.13; 95% CI [2.09–17.97]; p<0.001). A delay in management ≥1 hour after bleeding onset was significantly more frequent among women with DIC complicating PPH (OR=3.75; 95% CI [1.14–12.28]; p=0.019) (Table 2). Lack of tranexamic acid administration and blood transfusion were not associated with DIC occurrence. In contrast, intraoperative systolic blood pressure <90 mmHg was significantly more frequent among cases (OR=19.11; 95% CI [2.09–174.70]; p=0.003). Similarly, hemostatic hysterectomy was strongly associated with DIC (OR=45; 95% CI [9.24–219]; p<0.001) (Table 2). Moreover, the risk of ICU readmission was multiplied by 21 among patients with DIC. Maternal mortality risk was multiplied by 45. Neonatal prognosis was also unfavorable, with an increased risk of fetal death. Mean hospital stay was comparable between groups, around 5 days, without statistically significant difference (Table 3).

Discussion

The mean age observed in our study was similar to that reported by Ouattara (2024) in Burkina Faso [7]. As in the Chinese study by Zhao *et al*., we found no significant association between maternal age and DIC [8].

Patients originating from outside Mahajanga-I had a higher risk of DIC, likely related to difficulties in accessing healthcare, although the difference did not reach statistical significance. Similar findings were reported by Sah *et al.* (2022) in Nepal, where most cases originated from rural areas [9]. Severe hypotension was strongly associated with DIC. This finding is consistent with the literature, where shock is frequently reported in patients with DIC [9-11]. In our series, hypotension observed at admission could be explained by delayed referral to a tertiary center, particularly because prehospital care and medical transportation remain difficult to access, resulting in severe hemodynamic impairment. Several authors have highlighted the importance of massive hemorrhage in the occurrence of DIC, as observed in our study [6, 12-14]. Delayed management was also associated with an increased risk of DIC. Similar findings were reported by Krishna *et al*., (2011) in India, with a median delay of 6 hours [15]. Among the etiologies of PPH, uterine atony was significantly associated with DIC. This predominance has also been reported in several studies [7, 16]. Abnormal complete blood count and coagulation parameters were significantly associated with DIC. Gillissen *et al*. and Goksever Celik *et al,* reported similar findings [17, 18]. Major perioperative blood loss worsens hypovolemia, tissue hypoperfusion, and coagulation activation. According to Yamasaki *et al*. in Japan, excessive coagulation factor consumption is further aggravated by acidosis, hypothermia, and hemodilution, creating a vicious cycle [19]. Hemostatic hysterectomy was very frequent among patients with DIC, probably reflecting the severity of hemorrhage. Furthermore, conservative therapies such as embolization or coagulation factor replacement are not available in our University Hospital. Similar findings were reported in China [8]. ICU readmission was also associated with DIC in studies conducted in the United States, with risks multiplied by 2.8 and 1.6 [20, 21]. Maternal mortality rates vary across countries, reflecting differences in resources, management protocols, and blood product availability [22]. As in our study, maternal death was strongly associated with DIC, with a twofold increased risk according to Paul *et al* [23]. Neonatal mortality ranged from 0.4% to 15% in Asian studies and was associated with DIC in our study [22, 23]. Overall, several factors associated with DIC occurrence were identified. However, this study has some limitations. Its retrospective design exposes it to information bias related to medical record review. The relatively small sample size and single-center nature also limit the generalizability of the findings. Furthermore, some variables associated with DIC may reflect markers of severity rather than true independent factors.

Conclusion

DIC is a severe complication of PPH associated with high maternal and neonatal morbidity and mortality, particularly in low-resource settings. The main associated factors were hypotension, massive hemorrhage, severe anemia, uterine atony, and delayed management. These findings support strengthening standardized protocols and obstetrical care pathways, as well as promoting prospective multicenter studies. In the context of PPH, DIC should be considered a major prognostic marker.

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