



ORIGINAL ARTICLE

Characterization of severe preeclampsia in intensive care

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ABSTRACT

Introduction: severe preeclampsia represents one of the leading causes of maternal morbidity and mortality worldwide.

Objective: to characterize severe preeclampsia in the intensive care unit.

Methods: a descriptive, observational, retrospective longitudinal study was conducted in patients with severe preeclampsia admitted to the intensive care unit of Abel Santamaría Cuadrado Hospital between January 2020 and March 2024. A simple random probabilistic sample of 112 patients who met the selection criteria was chosen. Documentary review of medical records provided the information analyzed.

Results: the mean age was $27,5 \pm 6,5$ years, with white skin color predominating in 58,03 %. Severe preeclampsia was more frequent in nulliparous women (65,18 %) and during the puerperium (38,40 %). Average hospital stay was $5,8 \pm 3,6$ days, with a mortality rate of 3,57 %. The most frequent cause of admission was elevated blood pressure (44,64 %), followed by renal dysfunction (14,29 %). The hypodynamic phenotype was observed in early-onset cases, while the hyperdynamic phenotype appeared in late-onset cases and during the puerperium. The most frequent complication was eclampsia (30,36 %), followed by acute renal failure (23,21 %) and hemorrhage (17,86 %). Better blood pressure control was achieved using both oral and parenteral routes in 55,36 %.

Conclusions: characterization of severe preeclampsia in intensive care allowed optimization of multidisciplinary management, aiming to improve maternal-fetal outcomes.

Keywords: Pregnancy Complications; Pre-Eclampsia; Intensive Care Units.

INTRODUCTION

Preeclampsia is part of a spectrum of conditions known as hypertensive disorders of pregnancy. According to the World Health Organization (WHO), these disorders complicate approximately 10 % of pregnancies worldwide, with preeclampsia being the most common form. Severe preeclampsia occurs in 2–3,5 % of all pregnancies and represents 20–35 % of all hypertensive disorders of pregnancy, making it one of the leading causes of global maternal morbidity and mortality—responsible for over 70,000 maternal and 50,000 fetal deaths annually.^(1, 2)

In Latin America, maternal mortality due to hypertensive disorders reaches up to 26 %, exceeded only by Africa and some Asian countries. Caribbean nations show higher prevalence, with Costa Rica reporting the highest rate at 13,6 %, followed by El Salvador (12,8 %) and Honduras (12,2 %). Hypertensive disorders occur in 5–10 % of pregnancies, with severe preeclampsia exceeding 2 %, representing a greater disease burden and higher mortality.^(3, 4)

Cuba ended 2024 with a maternal mortality rate of 40,6 per 100,000 live births. Over the past three years, mortality from hypertensive disorders increased from 3,1 in 2022 to 8,4 in 2024. Pinar del Río recorded 4 maternal deaths due to severe preeclampsia complications between 2020 and 2024,⁽⁵⁾ identifying it as a significant public health problem.

Hypertensive disorders of pregnancy are classified as gestational hypertension, preeclampsia, eclampsia, and preeclampsia superimposed on chronic hypertension. Preeclampsia is further categorized by timing of onset: early-onset (<34 weeks), late-onset (≥34 weeks), and postpartum. It is also classified as severe (aggravated) or non-severe (non-aggravated) based on blood pressure levels or organ dysfunction. Severe preeclampsia is defined by systolic blood pressure ≥160 mmHg or diastolic ≥110 mmHg, mean arterial pressure ≥126 mmHg, or—despite lower blood pressure—proteinuria >5 g/24 h, along with one or more clinical or laboratory signs of end-organ endothelial damage.^(6, 7)

An additional classification is based on maternal hemodynamic findings via echocardiography, guiding treatment through heart rate (HR), cardiac output (CO), and systemic vascular resistance (SVR). This divides preeclampsia into two phenotypes: low CO with high SVR (hypodynamic), and high CO with low SVR (hyperdynamic).⁽⁸⁾

Intensive Care Unit 3 at “Abel Santamaría Cuadrado” Hospital in Pinar del Río is the regional referral center for critically ill pregnant women. Severe preeclampsia is among the most severe conditions requiring ICU admission. Therefore, this study aims to characterize severe preeclampsia in the ICU of “Abel Santamaría Cuadrado” Hospital from January 2020 to March 2024.

METHODS

A retrospective, descriptive, observational, longitudinal study was conducted in patients diagnosed with severe preeclampsia admitted to the ICU of “Abel Santamaría Cuadrado” Hospital from January 1, 2020, to March 31, 2024. The universe comprised 496 obstetric patients admitted to the ICU. The sample included 112 women with severe preeclampsia; patients under 18 years were excluded.

Data were obtained through retrospective review of medical records, allowing collection of the following variables: age, skin color, gestational age, parity, ICU length of stay, reason for admission (related to organ dysfunction), hemodynamic profile, disease-related complications, and need for antihypertensive therapy via enteral and parenteral routes.

Empirical research methods included data collection through observation and documentary analysis. Theoretical methods included the hypothetico-deductive and historical-trend approaches, along with analytical-synthetic and inductive-deductive scientific procedures.

Data were processed using the digital and educational statistical package for epidemiological research (Epi Info). Chi-square test and mean $\pm$ standard deviation were used for continuous quantitative variables (with range), and percentages were used as summary measures. Frequency distributions were presented in absolute and relative frequency tables.

The study was approved by the institutional ethics committee. Patient confidentiality was strictly maintained, and data were used solely for research purposes, in compliance with the ethical principles of the Declaration of Helsinki and Cuban bioethical regulations.

RESULTS

During the study period, 496 obstetric patients were admitted to the ICU of "Abel Santamaría Cuadrado" General Teaching Hospital, of whom 115 had severe preeclampsia. Three patients under 18 years were excluded, resulting in a final sample of 112 patients. The mean age was $27,5 \pm 6,5$ years; 58,03 % were White, 65,18 % were nulliparous, and 38,40 % were in the postpartum period. Mean ICU stay was $5,8 \pm 3,6$ days, with a severe preeclampsia-related mortality rate of 3,57 % (Table 1).

Table 1. General characteristics of the study sample.

Variable		Nº	%
Age (years)*		27,5	6,5
Skin Color	White	65	58,03
	Black	35	31,25
	Mixed	12	10,71
Time of diagnosis	Nulliparous	73	65,18
	Nulliparous	39	34,82
Momento en que se diagnostica	Early-onset $\leq$ 34 weeks	39	34,82
	Late-onset $\geq$ 34 weeks	30	26,78
	Postpartum	43	38,40
ICU length of stay (days)*		5,8	3,6
Maternal mortality due to preeclampsia		4	3,57

*Notes: Mean $\pm$ standard deviation

The most frequent reason for admission to the intensive care unit was elevated blood pressure in 44,64 % of cases, followed by renal dysfunction (14,29 %) and utero-placental dysfunction (13,40 %) (Table 2).

Table 2. Reasons for ICU admission.

Reason for admission	No.	%
Severe blood pressure $\geq 160/110$ mmHg	50	44,64
Neurological dysfunction	5	4,46
Cardiovascular dysfunction	7	6,25
Renal dysfunction	16	14,29
Hepatic dysfunction	7	6,25
Utero-placental dysfunction	15	13,40
Multiple organ dysfunctions	12	10,71

Hemodynamic assessment guided by echocardiography revealed that early-onset preeclampsia was predominantly associated with a hypodynamic phenotype (high systemic vascular resistance and low cardiac output), whereas late-onset and postpartum cases showed a hyperdynamic phenotype (high cardiac output and low systemic vascular resistance), as shown in Table 3.

Table 3. Hemodynamic profile by gestational timing.

Variable	Early-onset Mean $\pm$ SD	Late-onset Mean $\pm$ SD	Postpartum Mean $\pm$ SD
Heart rate (bpm)	65 $\pm$ 2,5	108 $\pm$ 12	105 $\pm$ 15
Cardiac output (L/min)	3 $\pm$ 1,5	9 $\pm$ 1,3	11 $\pm$ 2,0
Systemic vascular resistance (dyn·s·cm ⁻⁵)	1600 $\pm$ 152	750 $\pm$ 120	720 $\pm$ 100

Notes: $M \pm DE$ = Mean $\pm$ standard deviation

The most frequent complications of severe preeclampsia were: eclampsia in 30,36 % (despite magnesium sulfate prophylaxis), followed by acute kidney injury (23,21 %) and hemorrhage—mainly due to uterine atony and polyserositis—in 17,86 % (Table 4).

Table 4. Complications associated with severe preeclampsia.

Associated complication	No.	%
Eclampsia	34	30,36
Hemorrhage	20	17,86
Acute kidney injury	26	23,21
Acute pulmonary edema	4	3,57
Cardiorespiratory arrest	5	4,46
Sepsis/septic shock	6	5,35
Mechanical ventilation	10	8,92
Disseminated intravascular coagulation	2	1,78
Multiorgan dysfunction	2	1,78
Polyserositis	20	17,86
Maternal death	4	3,57
Fetal death	6	5,35
Others	18	16,07

Table 5 evaluates blood pressure control using oral, parenteral, or combined drug administration. Better control was achieved with combined routes in 55,36 % of cases, although the correlation between variables was not statistically significant ($p > 0,05$).

Table 5. Therapeutic blood pressure control with antihypertensive drugs.

Year	Oral route		Parenteral route		Both routes	
	No.	%	No.	%	No.	%
2020	8	7,14	4	3,57	14	12,50
2021	10	8,92	5	4,46	13	11,61
2022	9	8,03	3	2,67	17	15,18
2023	5	4,46	4	3,57	15	13,39
2024	1	0,89	1	0,89	3	2,67
Total	33	29,46	17	15,17	62	55,36

DISCUSSION

Severe preeclampsia is one of the leading causes of maternal morbidity and mortality worldwide and a major reason for admission to intensive care units dedicated to critically ill pregnant women. In this study, it predominantly affected women with a mean age of 27,5 years, and 65,18 % were nulliparous—findings consistent with other studies. Real Ocaña et al.,⁽⁹⁾ reported that most pregnancies began in healthy nulliparous women, with a 7 % incidence and no family history of the disorder. Ruis Luís et al.,⁽¹⁰⁾ in Villa Clara, Cuba, also identified nulliparity as a key risk factor (93,71 %), with a mean age of 27,52 years and 72 % of cases occurring between 20–34 years.

A study by Chiroque et al.,⁽¹¹⁾ from the Peruvian University of Applied Sciences found that nulliparous mothers had a significantly higher proportion of preeclampsia than multiparous women (79,63 % vs. 15,17 %; $p < 0,01$), with nulliparity increasing the risk of preeclampsia more than threefold (aPR: 3,87; 95 % CI: 2,98–5,04).

A plausible explanation lies in immunological theory: suboptimal maternal adaptation to fetal or paternal alloantigens may lead to impaired uteroplacental perfusion, underlying preeclampsia pathogenesis. Nulliparous women also exhibit angiogenic imbalance, with higher circulating levels of soluble fms-like tyrosine kinase-1 (sFlt-1) and an elevated sFlt-1/PlGF (placental growth factor) ratio, contributing to preeclampsia development.⁽¹²⁾

Notably, severe preeclampsia was most frequent in the postpartum period (38,40 %), differing from most literature. However, this is physiopathologically justified: after placental delivery, vasodilatory hormones secreted by the placenta decline, leading to increased systemic vascular resistance (SVR) and blood pressure, with a systolic peak between days 5–7 postpartum. Rapid fluid shifts and interstitial fluid mobilization further contribute to postpartum hypertension.⁽¹³⁾ ICU length of stay ($5,8 \pm 3,6$ days) aligns with findings by Durán Rodríguez et al.⁽¹⁴⁾

Maternal mortality due to severe preeclampsia in ICU was 3,57 %, with three deaths (2,67 %) occurring before 34 weeks—likely due to more severe placental dysfunction causing profound systemic maternal involvement and multiorgan damage.⁽¹⁵⁾

Elevated blood pressure in severe preeclampsia acts as a stress trigger that can precipitate failure in the most vulnerable organs. Preeclampsia is a syndrome of generalized endothelial dysfunction, damaging the inner lining of all maternal blood vessels; hypertension is the most visible manifestation of this systemic disorder.

Mohamud et al.,⁽¹⁶⁾ studied 71 patients admitted to ICU for preeclampsia complications and found seizures (46,5 %) as the leading admission cause, followed by severe hypertension (28,2 %), confirming that high blood pressure directly correlates with neurological and other organ dysfunctions. Leal et al.,⁽¹⁷⁾ reported a marked increase in acute kidney injury among women with hypertensive disorders (adjusted RR: 1,7; 95 % CI: 2,.6–7,7), consistent with our findings.

Echocardiographic hemodynamic studies in women with severe preeclampsia have demonstrated significant cardiac dysfunction before and at clinical onset. In our study, early-onset cases showed a hypodynamic phenotype, while late-onset and postpartum cases exhibited a hyperdynamic phenotype—results highly significant ($\chi^2 = 97$, $p < 0,001$). This hemodynamic distinction is crucial for therapeutic decision-making, as management differs entirely by profile. Thus, bedside echocardiography is a valuable tool for evaluation and monitoring.^(8,15,18)

Eclampsia—a convulsive manifestation and the most severe form of preeclampsia—is primarily driven by uteroplacental ischemia. Studies show that over one-third of eclampsia cases occur suddenly without prior preeclampsia signs, although up to 83 % present prodromal symptoms (e.g., neurological dysfunction) before seizures.⁽¹⁹⁾ Acute kidney injury occurred in 23,21 % of cases—consistent with "glomerular endotheliosis" leading to acute tubular necrosis, bilateral cortical necrosis, and maternal death. Pérez et al.,⁽²⁰⁾ found that 69,9 % of severe preeclamptic patients had stage 1 renal injury on admission, progressing to stage 2 in 3,33–13,33 %, aligning with our results.

Severe preeclampsia (BP $\geq 160/110$ mmHg) is a medical emergency requiring prompt blood pressure control within 150–180 minutes to prevent cerebrovascular and cardiac complications while maintaining uteroplacental perfusion. The European Society of Cardiology recommends dual-drug therapy—parenteral labetalol as first-line, combined with oral nifedipine or methyldopa based on organ dysfunction.⁽²¹⁾ In our study, combined routes achieved better control, consistent with Pasquo et al.,⁽²²⁾ in a multicenter prospective study that tailored treatment to hemodynamic profiles.

CONCLUSIONS

Severe preeclampsia in the ICU represents one of the most complex obstetric emergencies, frequently involving multiorgan dysfunction that threatens both maternal and fetal life. This scenario demands a proactive, multidisciplinary approach involving intensivists, obstetricians, anesthesiologists, and internal medicine specialists to ensure close monitoring and timely interventions. Implementing and optimizing standardized protocols not only reduces immediate complications but also improves long-term maternal–fetal health outcomes.

Conflict of interest

The authors declare no conflict of interest.

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Author contributions

DBC: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

ACAP: Conceptualization, Data curation, Writing – original draft, Writing – review & editing.

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