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## CLINICAL ARTICLE

## Errors in the treatment of hypertensive disorders of pregnancy and their impact on maternal mortality

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## ABSTRACT

**Objective:** To describe the patients' characteristics and the factors that contributed to the maternal deaths associated with hypertensive disorders of pregnancy that occurred in the department of Antioquia, Colombia, from 2004 through 2011. **Methods:** A committee of experts conducted a retrospective descriptive study to analyze the information obtained from both mandatory reports of health facilities to the Public Health Surveillance System and interviews with family members. **Results:** From 2004 through 2011, there were 720 170 births and 389 maternal deaths in the Department of Antioquia, and 70 of the deaths were due to hypertensive disorder of pregnancy. The factors that most contributed to the deaths were a lack of emergency administration of antihypertensive drugs (64.6%); the inadequate administration of antihypertensive drugs (58.8%); retaining the patient at a health facility ill equipped to treat her appropriately for her clinical state (54.7%); untimely referral or inadequate conditions for transfer (50.8%); and an error in classifying the severity of the disorder, which prevented appropriate management (49.1%). **Conclusion:** A substandard quality of care was the determining factor in the deaths of women who presented with hypertensive disorders of pregnancy.

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## 1. Introduction

The incidence of pre-eclampsia varies between 3% and 10% among pregnant women in high-income countries, and the global number of maternal deaths due to pre-eclampsia is estimated to exceed 63 000 each year [1]. Pre-eclampsia is the major cause of maternal death in Latin America and the Caribbean, with an incidence of 25.7% [2].

In Colombia, pre-eclampsia was the second-leading cause of maternal deaths in 2010, accounting for 37% of the 416 that occurred [3]. In the department of Antioquia, between 2004 and 2007, the leading cause was obstetric hemorrhage. However, by 2008, owing to a decrease in the number of deaths from hemorrhage, hypertensive disorder of pregnancy (HDP) became the leading cause, with an incidence rate of 27% [4]. Identifying risk factors that could be controlled, and enacting control, may have significantly contributed to the reduction in maternal mortality from hemorrhage in the department of Antioquia [5]. The success of the intervention later prompted the design and implementation of both an evaluation strategy and a training program for medical personnel, and resulted in the improved management of this complication [6].

Maternal death can be associated with inadequate care as well as with risks of pregnancy and childbirth [7]. The objective of the present study was to analyze the personal characteristics and the factors related to inadequate care contributing to the deaths of women with HDP in the department of Antioquia from 2004 through 2011. In an approach similar to that developed for obstetric hemorrhage, the objective was also to identify critical benchmarks in the management of women with HDP, develop management criteria for each of these benchmarks, and implement training interventions.

## 2. Materials and methods

A retrospective descriptive study was conducted by an investigating committee of the Department of Antioquia, Colombia. Although the healthcare delivery system of Antioquia comprises 184 facilities, some of the residents of the 126 municipalities can have difficulty accessing health services. In Antioquia, 98.8% of deliveries are institutional, 93.7% of the women have at least 1 prenatal visit, and 84.7% have at least 4 prenatal visits. All institutional births are attended by physicians.

All maternal deaths with HDP as the underlying cause that occurred in the department from 2004 through 2011 were analyzed. Maternal death was defined as in the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision* [8].

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The cases were collected by reviewing the Population Registry, which contains the mandatory reports from health facilities to the Public Health Surveillance System, and death certificates for all women of childbearing age. The sources of information concerning the deaths included medical records, interviews with the families, analyses performed at the health facilities and/or by the departmental epidemiologic surveillance committee, and autopsy reports (when available). Permission for publication was obtained from the Regional Health and Social Protection Secretary of Antioquia.

The 3-delays model proposed by Maine et al. [9] was used: delay 1, delay in deciding to seek care; delay 2, delay in reaching a treatment facility; and delay 3, delay in receiving adequate treatment at the facility. There is no official guideline for pre-eclampsia management in Antioquia, and each facility has its own management protocol; however, the local recommendations for the management of pre-eclampsia were consistently based on the best available scientific evidence [10–12]. The effect of the lack of adherence to the recommendations was graded by consensus.

Prenatal care was defined as receiving at least 1 complete visit. The following information was recorded during family interviews, which were the primary information source: Whether the deceased woman had received any treatments from nonmedical persons; whether any financial, administrative, or transportation difficulties delayed access to medical care; and whether the woman decided to forgo a consultation owing to a negative perception of healthcare facilities or personnel. A delay in the identification of HDP was defined as the recording of high blood pressure values or premonitory signs or symptoms of HDP in the medical chart without HDP being considered as a diagnosis.

The treatment of the patient was evaluated to determine whether, after initial stabilization, the personnel retained the care of the patient even though her clinical state required treatment at a higher-complexity medical facility. The referral process was graded with respect to timeliness and the necessity for prompt action, the means of transportation used, and the suitability of such transportation for transferring sick patients.

The physical examinations, interviews, and laboratory tests were evaluated to determine whether their omission or misinterpretation delayed decision making or elicited inappropriate treatment.

The non-administration of an antihypertensive agent was recorded if an emergency medication was not ordered or administered when a patient's blood pressure reached or exceeded 160/110 mm Hg. An inadequate use of an antihypertensive agent was recorded if labetalol, nifedipine, hydralazine, or sodium nitroprusside was not used at the proper time or dosage. An absence of magnesium sulfate prophylaxis was recorded if an initial intravenous bolus of 4 to 6 g magnesium sulfate was not ordered for patients with symptoms of cortical irritation before the presumptive or confirmed diagnosis of severe pre-eclampsia was reached, or if a maintenance dose of 1 to 2 g per hour of magnesium sulfate was not ordered for these patients after they received the initial bolus. An absence of prophylaxis in the postpartum was recorded if the administration of the chosen hypertensive agent was not continued for at least 24 hours postpartum. The non-administration of an additional intravenous bolus of magnesium sulfate in patients with eclampsia was also recorded, as was the lack of strict monitoring for signs of toxicity in these patients. The administration, and frequency of administration, of medications such as  $\alpha$ -methyl dopa, captopril, and diazepam, which are not recommended for use in the management of pre-eclampsia, hypertensive crises, or eclampsia, were also recorded. Finally, the unavailability of a required treatment at a healthcare facility with the appropriate self-declared level of complexity was recorded as a lack of resources.

A database was created using Microsoft Access 2007 (Microsoft, Redmond, WA, USA) and the data were analyzed using SPSS version 19 (IBM, Armonk, NY, USA). Maternal age and gestational age are presented as mean and standard deviation; discrete quantitative

variables are presented as median and interquartile percentiles; and qualitative variables are presented as number and percentage. Denominators indicate the number of patients known as having had the relevant characteristic.

Research information is at the basis of the epidemiologic surveillance system of the department, which is supported and financed by the Regional Health and Social Protection Office. Family members provided informed consent before being interviewed, and the health facilities provided consent prior to the review of clinical records.

### 3. Results

According to the national vital statistics system, 707 018 live births occurred in Antioquia from January 1, 2004, through December 31, 2011 (official data for 2004–2010 and preliminary data for 2011) [4]. Of the 389 maternal deaths that occurred in the same period, 70 (18.0%) were due to HDP, making HDP the second-leading cause of maternal death after obstetric hemorrhage. The overall maternal mortality ratio in Antioquia was 55.01 per 100 000 live births, and the ratio for deaths caused by HDP was 9.9 per 100 000 live births. Two patients were excluded from analysis because of insufficient information. Among the 68 remaining patients, the main complications associated with HDP were eclampsia ( $n = 45$  [66.1%]); hemolysis, elevated liver enzyme levels, and low platelet count (HELLP) syndrome ( $n = 39$  [57.3%]); cerebrovascular disease ( $n = 34$  [50%]); acute kidney failure ( $n = 21$  [30.9%]); acute pulmonary edema ( $n = 19$  [28.0%]); hemorrhagic complication ( $n = 13$  [19.1%]); and placental abruption ( $n = 8$  [11.8%]). Table 1 presents the characteristics of the study population.

Women sought care for the following: premonitory symptoms ( $n = 27$  [39.7%]); eclampsia ( $n = 19$  [27.9%]); labor ( $n = 9$  [13.2%]); and other ( $n = 11$  [16.2%]). Two more women (2.9%) were dead on arrival. Eleven of the 63 women (17.5%) for whom information was available were hospitalized for hypertension during their pregnancy and then discharged. The mean  $\pm$  SD gestational age at the onset of symptoms was  $34 \pm 4.5$  weeks, and the median time between the onset of symptoms and consultation with a physician was 23.5 hours (interquartile range, 4.8–48.0 hours). The family interviews revealed that the pregnancy was not intended in 53.7% of cases (the information was missing for 27 women).

Table 2 describes the factors that contributed to the deaths according to the type of delay. Only those the investigating committee considered to have contributed directly to the deaths were taken into account.

The supplies, materials, or resources that were not available at the facilities where the patients were treated, and whose lack of availability contributed to the deaths, included antihypertensive (19.1%) and hemoderivative (4.4%) agents, an intensive care unit or other place to perform close monitoring (2.9%), computed tomographic imaging (2.9%), and magnesium sulfate (1.5%).

### 4. Discussion

In Antioquia, deficiencies in quality of care are strong determining factors for the death of women who present with HDP. In the present study, two-thirds of the patients who died from HDP presented to healthcare facilities in a timely manner, but the correct measures were not applied soon enough to prevent the progression of the condition. Some patients who arrived with an advanced stage of HDP did not receive the care required to stabilize their condition. One study quantified the reduction in mortality due to hypertensive complications of pregnancy after evidence-based practices were implemented, and reported that the in-hospital mortality of women with severe pre-eclampsia or eclampsia could be reduced by more than 84%, even when there was a delay in seeking medical attention [13].

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