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The Prognosis of Newborns of Hypertensive Mothers in Bukavu, Democratic Republic of the Congo

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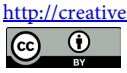

Abstract

Introduction: Pregnancy with hypertensive disorders is a serious complication that increases the risk of maternal and neonatal complications in developing countries. The aim of this study is to determine the outcome of newborns of hypertensive mothers. **Materials and Methodology:** This is a prospective descriptive study that gathered 89 neonates of hypertensive mothers in the Panzi General Reference Hospital Neonatal Department from February 20, 2021 to May 20, 2022. **Results:** The average age of mothers was 28.98 ± 7.02 years; 88.4% were housewives and 77.9% came from Ibanda commune, with a history of abortion, gravid hypertension and fetal death in utero. Prenatal consultation was attended by 98.8% of patients and started in the second trimester of pregnancy. Pre-eclampsia was responsible for 72.1%, gestational hypertension for 18.6%, pre-eclampsia being added to chronic hypertension 5.8% and chronic hypertension 3.5%. Hellp syndrome leads to pregnancy complications (17.4%), eclampsia (12.8%), and acute renal failure (5.8%). Antenatal corticosteroid therapy was administered in 26.7% of cases. Mean gestational age was 35.92 ± 2.79 SA, and delivery was by caesarean section (69.8%). The average birth weight of newborns was 2423.66 ± 794.41 grams; 90.7% had an Apgar ≥ 7 at the 5th minute; 33.7% were resuscitated at birth; and 70.9% were transferred to Neonatology. Respiratory distress was present in 39.5% and convulsions in 1.2%. Complications accounted for 38.4%, including neonatal jaundice (57.6%), neonatal infections (42.4%) and enterocolitis (9.1%), with an average hospital stay of 11.05 ± 11.40 days, and 10 cases of death (11.6%). **Conclusion:** Mortality among newborns of hypertensive mothers remains high in our setting; improved prenatal consultations and

management of the newborn will reduce this mortality.

Subject Areas

Pediatrics

Keywords

Hypertensive Disorders of Pregnancy, Prognosis, Newborns

1. Introduction

Hypertension in pregnancy is defined as systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mm Hg, measured on two separate occasions. During a normal pregnancy, blood pressure falls progressively during the first trimester due to a decrease in systemic vascular resistance. It reaches its nadir at around 22 - 24 weeks, then rises again from 28 weeks, reaching preconception levels at 36 weeks gestation. [1]

Whatever the type of hypertensive disorder, hypertension in pregnancy can lead to adverse perinatal outcomes such as low birth weight, prematurity, stillbirth and intrauterine growth restriction. [2]

Hypertensive disorders of pregnancy (HDP) are a serious complication affecting around 2.5% - 3.0% of women, increasing the risk of maternal and neonatal complications. Worldwide, hypertensive disorders remain the leading cause of pregnancy-related maternal mortality. [3]

Hypertension in pregnant women should not be underestimated. The frequency of hypertension during pregnancy is similar in most Western countries, with 9.3% in France, 10.8% in the UK, and 10 to 15% in the USA. Given the maternal-fetal complications it causes and the complexity of its management, it is the third leading cause of maternal mortality (after hemorrhage and infection) and the leading cause of perinatal mortality. [4]

HDP complicates 4 to 10% of pregnancies worldwide. They are responsible for around 15% of maternal deaths worldwide, almost all of which (>99%) occur in developing countries. Around 25% of perinatal deaths in these countries are attributable to cardiovascular disease. These disorders have been reported as one of the leading causes of maternal mortality in sub-Saharan Africa, including in most tertiary and rural hospitals in Nigeria and major tertiary health facilities in Ghana, as well as in other countries. [5]

Perinatal mortality is high following pre-eclampsia, and even higher following eclampsia. Elective prematurity, which is often necessary to protect mother and fetus, and placental insufficiency are the main causes of poor outcomes. [6]

In Benin, the perinatal morbidity rate was 49.7% (162/326). This morbidity was dominated by prematurity, immediate neonatal distress and acute fetal asphyxia. [7]

In Brazzaville, the perinatal prognosis is also poor, with an increased risk of premature delivery, fetal distress and hypotrophy, death in utero, transferring to neonatology and neonatal death. [4]

To help reduce HDP mortality, the WHO has developed a 4 pronged strategy: early detection during prenatal consultations for all pregnant women, anticonvulsant and anti-hypertensive therapy for detected cases, and uterine evacuation according to the term of pregnancy and severity of the condition. Unfortunately, many authors have described shortcomings in the implementation of this strategy in resource-limited countries. [8]

2. Methods

2.1. Study Setting

Our study was carried out in the neonatology department of Panzi GRH, located in the city of Bukavu, capital of South Kivu Province in the east of the Democratic Republic of the Congo.

2.2. Type of Study

It's about a prospective descriptive study.

2.2.1. Study Period

From February 20th 2021 to May 20th 2022, that is 15 months period.

2.2.2. Study Population

- Inclusion criteria: newborns whose mothers had a hypertensive disorder during pregnancy and who were born in the Panzi GRH.
- Exclusion criteria: newborns who were not delivered in Panzi GRH.
- Sampling: exhaustive.

2.3. Data Collection Technique and Tools

A data collection form enabled us to collect the following data:

- Mother's age in years.
- Occupation.
- Origin: urban or rural.
- Gyneco-obstetrical history.
- Pregnancy progress.
- Classification of hypertension:
  - Gestational HTA: HTA ≥ 140/90 mmHg measured on at least two occasions at an interval of at least six hours, in a patient who is usually normotensive and has passed the 20th gestational age.
  - Chronic hypertension: hypertension ≥ 140/90 mmHg, documented before pregnancy or before the 20th gestational age.
  - Preeclampsia: hypertension occurring after 20 weeks gestation, accompanied by proteinuria. In the absence of proteinuria, preeclampsia is suspected if the hypertension is accompanied by cerebral disorders, epigastric

bar, thrombocytopenia or disturbance of liver tests.

- Preeclampsia superimposed to chronic hypertension: hypertension accompanied by proteinuria starting before 20 weeks' amenorrhea.

- Maternal complications of hypertension.
- Delivery and extra uterine adaptation.
- Clinical examination of the newborn.
- Evolution.

2.4. Data Management and Analysis

Data were collected on a paper questionnaire, then entered into Microsoft Excel 2013 and analyzed using Stata SE 14.0 (Stata Corp LP, College Station, Texas, USA).

For crude analysis, descriptive statistics included means and their standard deviations (SDs), as well as medians with interquartile ranges (IQRs) for continuous variables. Categorical variables were summarized in frequencies and proportions.

For the comparison of proportions, we used Pearson's chi-square test or Fisher's exact test for proportions below 5.

Ethical considerations:

- Individual patient code to guarantee anonymity.
- Our study protocol was approved by the National Health Ethics Committee. Registration number: CNES 001/DPSK/151PP/2021.

3. Results

The mean age of the mothers was 28.98 ± 7.02 years, 88.4% were housewives and 77.9% came from the Ibanda commune. According to the mothers' antecedents, the mean parity was 3.29 ± 2.55 with a history of abortion in 27.2%, 12.8% of fetal death in utero and 23.3% had a history of gravid hypertension (**Table 1**).

During pregnancy, almost all (98.8%) mothers had undergone prenatal consultation(PNC), with 73.3% having started PNC in the second trimester. 10.5% had premature rupture of membranes, 4.7% were at risk of premature delivery and 26.7% had urogenital infections. 72.1% had pre-eclampsia, 18.6% had gestational hypertension, 5.8% had pre-eclampsia in addition to chronic hypertension and 3.5% had chronic hypertension. 12.8% of cases were complicated by eclampsia, 17.4% by Hellpsyndrom and 5.8% by acute renal failure (**Table 2**).

Antenatal corticosteroid therapy was administered in 26.7% of cases, the mean gestational age was 35.92 ± 2.79 SA and 44% of newborns were born between 33 - 36 SA and 43% between 37 - 40 SA. The majority of pregnant women had given birth by caesarean section (69.8%) (**Table 3**), the indications for which were severe pre-eclampsia (25%), iterative pre-eclampsia and eclampsia (16.7%) (**Figure 1**).

We found an even distribution of newborns by sex (50% girls versus 50% boys). The average birth weight of newborns was 2423.66 ± 794.41 grams, with

Table 1. Socio-demographic characteristics of hypertensive mothers and obstetrical history.

Characteristics	n = 86 (%)	Mean
Age (years)		28.98 ± 7.02 years
<20	7 (8.1)	
20~24	20 (23.3)	
25~29	22 (25.6)	
30~34	14 (16.3)	
≥35	23 (26.7)	
Profession		
Housewife	76 (88.4)	
Shopkeeper	6 (7.0)	
Governement employee	2 (2.3)	
Teacher	1 (1.2)	
Famer	1 (1.2)	
Residence		
Ibanda	67 (77.9)	
Kadutu	7 (8.1)	
Bagira	3 (3.5)	
Rural	9 (10.5)	
Parity		3.29 ± 2.55
Primiparous	30 (34.9)	
Pauci pare	25 (29.1)	
Multipare	15 (17.4)	
Grande multiparous	16 (18.6)	
History of abortion		
No	62 (72.1)	
Yes	24 (27.9)	
IUFD (Intra uterin fœtal death)		
No	75 (87.2)	
Yes	11 (12.8)	
Gravid hypertension		
No	66 (76.7)	
Yes	20 (23.3)	
Hypertension		
No	74 (86.0)	
Yes	12 (14.0)	

Table 2. Data related to current pregnancy, classification of pregnancy-induced hypertension and maternal complications.

Characteristics	n = 86 (%)	Mean ± SD
PNC (prenatal consultation)		
No	1 (1.2)	
Yes	85 (98.8)	
PNC onset		4.92 ± 1.46 (0 - 8)
Not done	1 (1.2)	
First trimester	8 (9.3)	
Second trimester	63 (73.3)	
Third trimester	14 (16.2)	
Number of PNC		3.01 ± 1.32 (0 - 6)
<4	55 (64.0)	
≥4	31 (36.0)	
PRM (premature rupture of membranes)		
No	77 (89.5)	
Yes	9 (10.5)	
TPD (threatened premature delivery)		
No	82 (95.3)	
Yes	4 (4.7)	
UGI (urogenital infection)		
No	63 (73.3)	
Yes	23 (26.7)	
Class-hypertension		
Preeclampsia	62 (72.1)	
Gestational hypertension	16 (18.6)	
Preeclampsie + chronic hypertension	5 (5.8)	
Chronic hypertension	3 (3.5)	
Complications		
Eclampsia		
No	75 (87.2)	
Yes	11 (12.8)	
HELLP syndrom		
No	71 (82.6)	
Yes	15 (17.4)	
ARF (acute renal failure)		
No	81 (94.2)	
Yes	5 (5.8)	

Table 3. Delivery data and newborn parameters.

Characteristics	n = 86 (%)	Mean ± SD
Antenatal corticosteroid therapy		
No	63 (73.3)	
Yes	23 (26.7)	
Gestational age (GA)		**35.92 ± 279** (28 - 41) GA
28 - 32	10 (11.6)	
33 - 36	38 (44.0)	
37 - 40	37 (43.0)	
≥41	1 (1.2)	
Mode of delivery		
Cesarean section	60 (69.8)	
Vaginal	26 (30.2)	
Sex		
Male	43 (50.0)	
Female	43 (50.0)	
Weight (gr)		2423.66 ± 794.41 gr
<2500	47 (54.7)	
≥2500	39 (45.3)	
Trophicity		
Eutrophic	55 (64.0)	
Dysharmonious IUGR	22 (25.6)	
Harmonious IUGR	9 (10.5)	
Apgar (5^{th} minute)		
<7	8 (9.3)	
≥7	78 (90.7)	
Resuscitation in delivery room		
No	57 (66.3)	
Yes	29 (33.7)	
Transfer to neonatology		
No	25 (29.1)	
Yes	61 (70.9)	
Reasons for hospitalization (n = 61)		
Prématurity	30 (49.2)	
RD (respiratory distress)	28 (45.9)	
MFI (materno-fœtal infection)	18 (32.8)	
IUGR (intrauterine growth restriction)	4 (6.5)	
Neonatal asphyxia	3 (4.9)	
Neonatal jaundice	2 (3.3)	

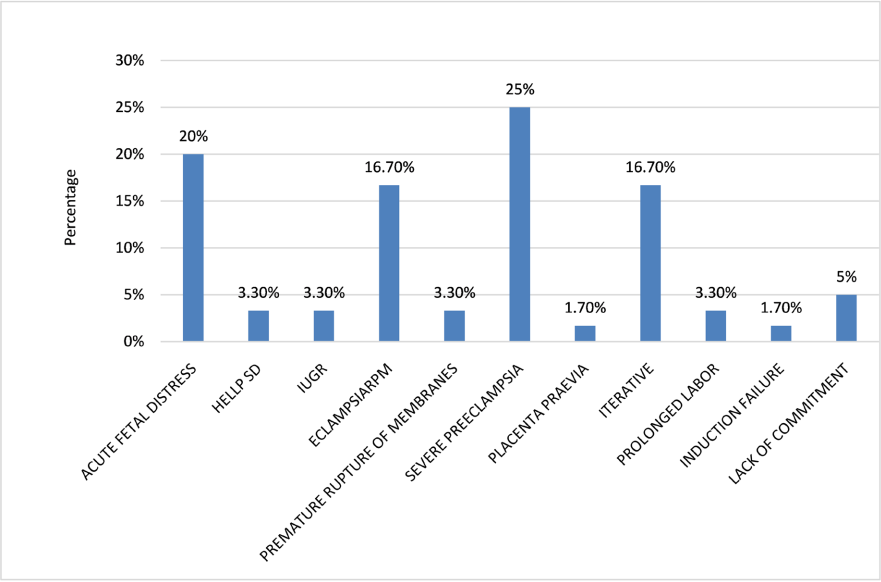

Figure 1. Cesarean section indications.

extremes ranging from 960 gr to 4050 gr. 54.7% had a birth weight <2500 gr. Regarding trophicity, the majority of newborns were eutrophic (64%). Apgar score ≥ 7 at 5 minutes 90.7%, 33.7% were resuscitated in the delivery room, 70.9% were transferred to neonatology and the main reasons for hospitalization were prematurity in 49.2%, followed by respiratory distress in 45.2%, maternal-fetal infections in 32.8% and intrauterine growth retardation in 6.5% (**Table 3**).

On clinical examination, archaic reflexes were present in 66.3%, normal tone in 77.9%, convulsions in 1.2% and respiratory distress in 39.5% of cases. Mild respiratory distress was present in 52.9% of cases and moderate respiratory distress in 47.1%, assessed by the Sylverman score. Complications accounted for 38.4% and were dominated by neonatal jaundice (57.6%), neonatal infections (42.4%) and enterocolitis (9.1%). The average duration of hospital stay was 11.05 ± 11.40 days. In this study, we recorded 10 cases of death, *i.e.* 11.6%, and the main causes of death were septic shock, disseminated intravascular coagulation and respiratory failure (**Table 4**).

4. Discussion

4.1. Sociodemographic Characteristics and Obstetrical History of Mothers

In our study, the mean age of the mothers was 28.98 ± 7.02 years, 88.4% were housewives and 77.9% came from the Ibanda commune. The average parity was 3.29 ± 2.55, primiparous women were more concerned at 34.9%, abortions were present in 27.2% of cases, 12.8% of fetal deaths in utero, 23.3% of mothers had a history of gravid hypertension and 14% of mothers had a history of hypertension.

CHAHID andal, in Morocco, found the average age of parturient to be 28.8 ±

Table 4. Newborns' clinical status, complications and outcome.

Characteristics	n = 86 (%)	
Archaic reflexes		
No	29 (33.7)	
Yes	57 (66.3)	
Normal tone		
No	19 (22.1)	
Yes	67 (77.9)	
Convulsion		
No	85 (98.8)	
Yes	1 (1.2)	
Respiratory distress		
No	52 (60.5)	
Yes	34 (39.5)	
Sylverman score (n = 34)		
1 - 3 (mild respiratory distress)	18 (52.9)	
4 - 6 (moderate respiratory distress)	16 (47.1)	
Complications		
No	53 (61.6)	
Yes	33 (38.4)	
Type of complications (n = 33)		
Icterus	19 (57.6)	
Neonatal infection	14 (42.4)	
Necrotizing enterocolitis(NEC)	3 (9.1)	
Anemia	1 (3.0)	
Respiratory distress	1 (3.0)	
Duration of hospital stay (days)		**11.05 ± 11.40 days**
<7	39 (45.3)	
7 - 14	26 (30.2)	
>14	21 (24.4)	
Outcome of hospitalization		
Alive	76 (88.4)	
Died	10 (11.6)	
Age (days) at death (n = 10)		
<7	7 (70.0)	
≥7	3 (30.0)	
Causes of death (n = 10)		
Septic shock	7 (70.0)	
Disseminated intravascular coagulation	4 (40.0)	
Respiratoiry failure	1 (10.0)	

7 years, with a slight predominance of gravid hypertensive pathology in primiparous women (52%). [9]

In a study conducted in Benin by TSHABU and al, the mean age of pregnant women was 26.4 ± 6.3 years (16 - 40 years). They were traders (35%), craftswomen (28.8%), pupils/students (17.8%) and civil servants (13.2%). They were primiparous in 65%. Pregnant women were attended by qualified personnel in 60.7% of cases, but their first prenatal consultation took place after 15 weeks' gestation in 56.4% of cases. [7]

In 2022, in Pakistan, the predominant age group was ≤24 years, and more than half the subjects (62.2%) came from urban areas. Education, occupation and economic level influence the increase in preeclampsia cases. 52.3% of patients were housewives. Family history is another important factor in increasing the risk of preeclampsia. In the present study, 36.67% of women had a family history of preeclampsia. [10]

SASS *et al*., in Morocco, found that almost all women suffering from preeclampsia were from urban areas, 86% compared with only 14% from rural areas. In terms of occupation, housewives were in the majority, accounting for 82% of cases, while civil servants and shopkeepers accounted for a very small proportion. [11]

The socio-demographic characteristics of our study match those found by other authors, in that HDP concern all women of childbearing age, housewives, and the majority come from the urban environment, where our study site, HGR Panzi, is located. The urban environment is said to expose women to high blood pressure through stress, poor dietary habits, sedentary lifestyles, etc.

Although PE is a pathology of the primiparous woman, the literature affirms that multiparous patients with a history of PE, Intra Uterin Fetal Death (IUFD) or other complications of PE represent a population at high risk of developing a second episode of the disease, especially in its severe forms which can be identified early in pregnancy. Thus, a history of PE has emerged as a significant risk factor in numerous studies, with recurrence rates varying between 20% and 55% depending on the publication. [12]

For BISMA *et al*, seven women (7.8%) had a history of abortion, while 13 women (14.5%) had a history of kidney disease, which is a risk factor for preeclampsia. [10]

In addition, almost one in five (17.9%) hypertensive women delivered a stillbirth or neonatal death in a study conducted in sub-Saharan Africa (SSA), India and Haiti. [13]

From a pathophysiological point of view, there is a genetic predisposition to pre-eclampsia, which means that women with a history of HDP will develop hypertension in subsequent pregnancies, or remain hypertensive. Abortions and IUGR would be due to a lack of follow-up and/or late consultation.

4.2. Data Relating to Current Pregnancy

Almost all (98.8%) women had undergone PNC during pregnancy, and 73.3%

had started PNC in the second trimester of pregnancy. We observed 10.5% cases of premature rupture of membranes, 4.7% cases of threatened premature delivery and 26.7% cases of urogenital infections.

Pregnancy was less frequently monitored in cases of gestational hypertensive (GH) (50%). The GH was diagnosed in 60% of cases on admission to the maternity hospital. The remaining cases diagnosed at the antenatal consultation were sent to the maternity ward for management. [9]

BOIRO also found that the pregnancy was monitored, with less than 4 PNC, in 92 cases (65.4%) and a premature rupture of membrane in 10.2%. [14]

Our results are close to those of other studies; the majority of women followed PNC but late, which is not a good follow-up for pregnancy. HDP is more common in developing countries, where access to care is poor and hygiene precarious; this would explain the high frequency of urogenital infections, which are responsible for threatened premature delivery and premature rupture of membranes.

4.3. Classification of Gestational Hypertension and Maternal Complications

The majority (72.1%) of women had pre-eclampsia; 18.6% had gestational hypertension; 5.8% had pre-eclampsia in addition to chronic hypertension and 3.5% had chronic hypertension. We noted 12.8% of cases complicated by eclampsia, 17.4% by Hellp syndrome and 5.8% by acute renal failure.

A study conducted by CRENTSIL revealed the following percentages of hypertensive disorders of pregnancy: chronic hypertension (1.2%), gestational hypertension (22.1%), pre-eclampsia (54.6%) and eclampsia (22.1%). [5]

In a study in Ethiopia, maternal complications were observed in 31.7% of cases. These included progression to severe pre-eclampsia (18.2%), placental abruption (5%), HELLP syndrome (2.4%) and Disseminated Intravascular Coagulation (DIC) (1.22%). [15]

Women with pre-eclampsia and eclampsia are 3 to 25 times more likely to suffer serious complications such as placental abruption, Hellp syndrome, disseminated intravascular coagulation, pulmonary oedema and aspiration pneumonia. [16]

If all causes of hypertension are considered in pregnancy, preeclampsia accounts for 80%, essential hypertension 18%, renal disease 1.9% and eclampsia 0.1%. [17]

Pre-eclampsia and eclampsia are the main causes of high maternal and fetal morbidity and mortality, particularly in developing countries. Placental abruption and postpartum hemorrhage were the most frequent maternal complications in pregnant women with pre-eclampsia and eclampsia. Other complications included disseminated intravascular coagulation, acute renal failure, acute RDS, reversible posterior encephalopathy syndrome and pulmonary edema. [18]

Maternal morbidity is dominated by eclampsia. In Madagascar, RASOLONJATOVO also noted the predominance of eclampsia, with rates of

32.6%. These rates remain high, compared with those observed in the West, at 4% for ZAREIAN. [14]

Other authors assert that preeclampsia is the most frequent form of HDP. Lack of pregnancy follow-up and genetic background seem to increase the prevalence of preeclampsia. Because of its complex pathophysiology, preeclampsia is responsible for maternal and perinatal complications.

4.4. Data on Childbirth

Antenatal corticosteroid therapy was administered in 26.7% of cases, the mean gestational age was 35.92 ± 2.79 SA and 44% of newborns were born between 33 - 36 SA and 43% between 37 - 40 SA.

The majority of women had given birth by caesarean section (69.8%) versus 30.2% by vaginal delivery. The indications for caesarean section were 25% severe pre-eclampsia, 16.7% iterative eclampsia and eclampsia.

Acceleration of fetal lung maturation was necessary in 20.2% of cases. [7]

Pre-eclampsia was considered significantly associated with the occurrence of prematurity ($p < 0.001$; OR 17.023 [5.009 - 57.847]), and fetal hypotrophy ($p < 0.001$; OR 9.164 [2.631 - 31.916]). [19]

There was a significant difference in terms of preterm delivery in women with and without preeclampsia (8.94% (n = 424) vs. 20.16% (n = 50), p = 0.001), and the probability of preterm delivery in women with preeclampsia was 2.57 times greater than the probability of preterm delivery in women without preeclampsia (CI95%: 1.85 - 2.56). [20]

In our study, the prevalence of caesarean section was 37%. A statistically significant association between the amount of proteinuria and caesarean section was noted. [21]

Caesarean section was the route of delivery for 93 patients in the "Case" group, with indications dominated by severe pre-eclampsia (61.53%), retroplacental hematoma (20.87%) and acute fetal distress (12.08% of cases). [19]

HDP is one of the causes of induced prematurity. Caesarean section is indicated in emergency cases of complicated preeclampsia to save the mother and fetus, depending on the term of pregnancy, after fetal pulmonary maturation with corticosteroid therapy.

4.5. Extra Uterine Adaptation and Clinical Examination

We noted an equal distribution of newborns by sex (50% girls versus 50% boys). The average birth weight of newborns was 2423.66 ± 794.41 grams, with extremes ranging from 960 gr to 4050 gr, and 54.7% had a birth weight <2500 gr. The majority of newborns were eutrophic (64%). We noted that 90.7% of newborns had an Apgar ≥ 7 at 5 minutes, 33.7% were resuscitated in the delivery room, 70.9% of newborns were transferred to neonatology and the main reasons for hospitalization were prematurity in 49.2%, followed by respiratory distress in 45.2%, maternal-fetal infections in 32.8% and intra-uterine growth retardation in 6.5%.

The majority of newborns had archaic reflexes (66.3%), normal tone (77.9%), respiratory distress (39.5%) and convulsion (1.2%). We also noted mild respiratory distress in 52.9% of cases, and moderate respiratory distress in 47.1%, assessed by the Sylverman score.

In a study in India, the percentage of IUGR in babies born to mothers with HDP was 18.96%, compared with 5% of babies with IUGR in the control group, which is statistically significant. [22]

Of a total of 90 births, 46 (51.1%) had a normal birth weight, ranging from 2.5 kg to 4 kg. Of the 80 babies who survived, 32 (35.6%) had respiratory problems, eight (8.89%) were stunted and 12 (13.3%) had mental abnormalities. [10]

In Iran in 2019, 266 cases (5.46%) had low birth weight, and the prevalence of low birth weight in women with and without preeclampsia was 15.32% (n = 38) and 4.93% (n = 228) respectively (OR: 3.48, 95%CI: 2.40 - 5.05, P = 0.001). [20]

The percentage of IUGR in our study is high, and may be due to late diagnosis of HDP, as pregnant women did not start PNC until the second trimester of pregnancy.

At the end of the 5th minute, the Apgar score ranged from 3 to 10 in the case group and from 5 to 10 in the control group, the means being 8.2 ± 1.7 and 9.3 ± 0.8 respectively. There was a significant difference between the two averages ($p < 0.0001$). High blood pressure appears to play a role in the incidence of neonatal depression at 5 minutes ($p = 0.0287$), with a 4.6-fold increase in the risk of a depressed Apgar score in hypertensive mother's newborns (OR = 4.60 [1.07 - 37.71]). [2]

A study of pregnant women diagnosed with hypertensive syndromes had an elevated risk of having a newborn with an APGAR score of less than seven at the first (RR = 2.33, $p < 0.001$) and fifth minute (RR = 2.96, $p = 0.003$), which is characterized by fetal hypoxia; in addition to a higher relative risk of prematurity (RR =2.06, $p = 0.017$), low birth weight (RR = 2.33, $p = 0.009$), fetal death (RR = 2.36, $p = 0.03$) and Caesarean delivery with adverse outcome (RR = 4.41, $p < 0.001$). [23]

A number of factors have been identified as increasing the risk of fetal acute distress. They include not attending school, hypertension during pregnancy, intrauterine growth retardation and fetal macrosomia. These factors are compounded by a lack of prenatal follow-up and spontaneous rupture of the membranes over 24 hours. [19]

In a study of acute fetal distress, the incidence of arterial hypertension was 4.20% in cases versus 1.15% in controls. The difference was significant, with a p-value of 0.003. [24]

In Morocco, the hospitalization rate was 26.3%, and the reasons for hospitalization were dominated by prematurity, respiratory distress and perinatal asphyxia. [9]

Some 22% of babies were stillborn, and 54.5% of live babies were admitted to the NICU. The vast majority of babies admitted (81.5%) were admitted due to a combination of prematurity, low birth weight and respiratory distress syndrome

(RDS), and 18.5% due to a low Apgar score. Of the total number (127) of babies born, 35 (27.6%) were early neonatal deaths. [25]

In a study in India, 34.25% of babies born in the HDP group required neonatal unit care, compared with 16.16% in the control group. Most babies required special nursing care in the neonatal unit, either because of prematurity or low birth weight. Other comorbidities such as transient tachypnea, hyaline membrane disease, meconium inhalation, birth asphyxia and neonatal sepsis were also responsible for admissions to the neonatal intensive care unit. [26]

Among 51 neonates with complications, 14 were diagnosed with meconium inhalation syndrome, 12 were premature, 10 had low birth weight (LBW), 10 had intrauterine growth retardation (IUGR) and five were diagnosed with respiratory distress syndrome (RDS). No complications were observed in the babies of mothers with chronic hypertension and chronic superimposed hypertension. [18]

In another study in Ethiopia, 66.4% of newborns had at least one complication; the majority of complications were low birth weight, respiratory distress syndrome, premature birth and stillbirth. The rate of neonatal complications was significantly higher in women with pre-eclampsia/eclampsia. [16]

IUGR, intrauterine fetal death(IUFD), fetal distress and prematurity were the adverse neonatal outcomes observed in a study carried out in India, among whom three newborns presented with IUGR, IUFD, four with premature delivery and two with fetal distress. The number of adverse fetal outcomes was also significantly higher in women suffering from HDP than in normal pregnant women. [27]

Among babies born to mothers with HDP, 5.12% suffered from transient tachypnea of the newborn (TTNN), while 2.0% of babies suffered in the control group. [22]

Studies show that newborns of pre-eclamptic mothers are more likely to develop severe respiratory distress and bronchopulmonary dysplasia. Other studies show that pre-eclampsia increases the risk of hyaline membrane disease in premature infants. [28]

Eighteen percent of hospitalized premature infants developed hyaline membrane disease (HMD). We have already seen that in pre-eclamptic women, there is an increase in the level of soluble sFlt1 receptors, which bind and neutralize VEGF, thus preventing its physiological action. Thus, the pulmonary alveoli cannot function in the absence of VEGF action, which would be likely to lead to more HMD. [29]

We have observed the same findings as other authors: HDP is the cause of several complications in newborns due to the placental exchange disorders they cause. This would explain the frequent consultation of neonatologists.

4.6. Complications and Evolution of Newborns

We found 38.4% of cases of complications in newborns, including neonatal

jaundice (57.6%), neonatal infections (42.4%), enterocolitis (9.1%), respiratory distress and anemia (3%). The average hospital stay was 11.05 ± 11.40 days.

We recorded 10 cases of death (11.6%), 70% of which occurred within the first 7 days. The main causes of death were septic shock, DIC and respiratory failure.

The association between kernicterus and acidosis has also been noted in previous studies, the explanation given being the increase in free fatty acids in asphyxia, which compete with albumin for binding sites, and the increase in free bilirubin and tissue toxicity. [30]

In our context, in addition to prematurity, jaundice may be secondary to polycythemia in newborns with perinatal asphyxia. This in turn increases the risk of NEC.

The incidence of NEC in newborns of pre-eclamptic mothers (13.7%) was significantly higher than in those born to normotensive mothers (5.5%) ($p = 0.02$). Although the pathophysiology of NEC is multifactorial, prematurity, intestinal immaturity, hypoxia, formula feeding, colonization by pathogenic bacteria and low perfusion states are the main risk factors. [31]

Maternal hypertension and prematurity can lead to fetal gastrointestinal tract immaturity, poor vascular supply and altered intestinal microbiota, which in turn can be associated with a cascade of events, culminating in the development of NEC. A significant association was observed between HDP and neonatal NEC OR of 3.8 (95% CI 1.7 - 8.6). [3]

The relationship between alterations in intestinal perfusion and oxygenation after fetal hypoxia and the development of feeding intolerance and NEC has been examined in several studies. It is known that the fetus responds to hypoxia by redistributing blood flow to essential vascular beds, a process known as cerebral sparing. Reduced blood flow to the stomach, small intestine and large intestine after hypoxia has been demonstrated in piglets and newborn lambs. [32]

Pregnancy-induced hypertension (PIH) reduces placental perfusion, which can lead to fetoplacental hypoxia. Fetal hypoxia can lead to a hypoxic-ischemic state in the gut or its mucosa during the antenatal period, resulting in neonatal NEC. In addition, uteroplacental ischemia induced by PIH can induce the production of inflammatory cytokines. Multiple factors, including hypoxia and inflammatory mediators, have been considered important causes of NEC. [33]

As for perinatal mortality, MABAGA found that it was 13.2% in newborns from hypertensive mothers versus 2.4% in those from non-hypertensive mothers. The Fischer exact test showed that there was a statistically significant influence of hypertension on perinatal lethality ($p = 0.0115$), meaning a 6.33-fold increase in the risk of perinatal lethality in hypertensive mother's newborns (OR = 6.33 [1.24 - 62.35]). [2]

Fetal/neonatal complications include stillbirth, iatrogenic prematurity and its complications, and very low/low birth weight. Around 22% of babies were stillborn, demonstrating the serious damage these hypertensive disorders can inflict on fetal health. More than half (54.5%) of live babies were admitted to the neo-

natal intensive care unit, showing that neonatal health is always under strain. Early neonatal deaths were caused by severe prematurity, very low/low birth weight and respiratory distress syndrome. [25]

MERSHA found that the prevalence of perinatal mortality among women with HDP in Ethiopia was 25%. This is in line with another study in Pakistan, which found a perinatal mortality of 17.5%. By contrast, a Norwegian study of pregnant women revealed a perinatal mortality rate of just 9.2%. This disparity may be explained by differences in the quality of care a pregnant woman receives. [34]

In Ethiopia in 2020, perinatal mortality was 42.6 per 1000, while the overall rate of perinatal complications was around 40.9%. Preterm birth was the most frequent perinatal complication observed, accounting for 18.2% of cases, intrauterine growth retardation occurred in 12% of cases, stillbirth occurred in around 1.7% of cases and 2.27% of newborns died in the early neonatal period. [15]

Prematurity is the leading cause of neonatal morbidity and mortality worldwide. It is associated with higher rates of neonatal respiratory distress syndrome, intraventricular hemorrhage, sepsis, bronchopulmonary dysplasia and neurodevelopmental disorders in childhood. [35]

According to KONE, in cases of pre-eclampsia, the frequency of IUGR or hypotrophy is 22 to 67%, with an increased risk of infection, necrotizing enterocolitis, respiratory distress, fetal distress, thrombocytopenia and renal failure. [19]

In Benin, in 2017, the perinatal morbidity rate was 49.7% (162/326). This morbidity was dominated by prematurity (39.8%), immediate neonatal distress (28.2%) and acute fetal asphyxia (13.3%). [7]

OUATTARA found a perinatal mortality rate of 31.5% (64 deaths) and an early neonatal mortality rate of 16.9% (28 deaths). [8]

In Morocco, 1.47% of newborns died within the first 3 hours of life, and 16.56% were hospitalized. 26.8% of hospitalized newborns died, 46.66% from pulmonary hemorrhage, 26.66% from septic shock, 13.36% from hemodynamic failure and 6.66% from congenital heart disease. The overall neonatal death rate in this series was 5.6 %. [29]

Currently, preterm birth (between 20 and 37 weeks' gestation) is the leading cause of death in children under five worldwide, and a major cause of disability and ill-health later in life. Sub-Saharan Africa and South Asia account for over 60% of premature births worldwide. [36]

Mortality in our study was not as high as in other studies carried out in developed countries, due to a gradual improvement in neonatal care at the Panzi GRH. The early onset of the disease is linked to poor pregnancy monitoring, with a high frequency of infections during pregnancy, and inadequate technical facilities for respiratory support of newborns.

5. Conclusion

Mortality in newborns of hypertensive mothers is high in our setting, and is

secondary to septic shock, disseminated intravascular coagulation and respiratory failure. The main reasons for hospitalization in neonatology were prematurity followed by respiratory distress. Improved monitoring of pregnancies and management of the newborn, especially in the first week of life, could improve neonatal prognosis in general.

Conflicts of Interest

The authors declare no conflicts of interest.

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