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Perinatal Morbidity and Mortality Associated with Maternal Diabetes in the Neonatology Department of the Issaka Gazoby Maternity Hospital, Niamey, Niger

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Abstract

Introduction: The association of diabetes and pregnancy is associated with a significantly higher risk of perinatal morbidity and mortality. The aim of this study was to investigate the perinatal morbidity and mortality associated with maternal diabetes at the Issaka Gazoby Maternity Hospital in Niamey. **Methodology**: This was a prospective case-control study conducted from April to September 2021 at the Issaka Gazoby Maternity Hospital in Niamey. "Cases" were neonates born to diabetic mothers, and "controls" were neonates born to non-diabetic mothers. The main dependent variable was the occurrence of perinatal complications. Analysis was performed using Epi info software 7.2.1. Pearson's Chi^2 test or Fisher's exact test were used ($p < 0.05$). The Odds Ratio (OR) and its 95% Confidence Interval (CI) were used to quantify risk. **Results**: Of the 2,225 admissions during the study period, 31 newborns were born to diabetic mothers (1.4%). Diabetic mothers were 2.8 times more likely to have a history of abortion (67.7% vs. 28.6%; OR = 2.82; p = 0.001). Similarly, a history of macrosomia was found in 29.0% of diabetic mothers versus 9.5% of controls (OR = 2.15; p = 0.01). Macrosomia was also more common in newborns of diabetic mothers (38.7% vs. 9.5%; OR = 2.63; $p < 0.01$). Three (3) cases of congenital malformations were only observed in newborns of diabetic

mothers (p = 0.03). Neonatal mortality was not significant (OR = 0.85; p = 0.43). **Conclusion**: The risks of ante- and perinatal complications such as abortion, fetal macrosomia and stillbirth, as well as neonatal pathological events (macrosomia and malformations) were greater in newborns of diabetic mothers.

Keywords

Maternal Diabetes, Morbidity, Mortality, Perinatal, Niger

1. Introduction

The association of diabetes and pregnancy has a significantly higher risk of perinatal morbidity and mortality. Complications may include congenital malformations, increased perinatal mortality, prematurity, macrosomia, fetal trauma, respiratory distress and metabolic disorders [1]-[4]. In all cases, the prognosis of newborns can be improved through better management based on rigorous follow-up by multidisciplinary collaboration [5]. In Niger, there are few studies on maternal diabetes, and none on the associated perinatal risk. The aim of this study was to compare associated morbidity and mortality in neonates of diabetic and non-diabetic mothers at the Issaka Gazoby Maternity Hospital in Niamey.

2. Methodology

2.1. Study Type, Period and Setting

This was a case-control study conducted over a period of six (6) months, from April to September 2021. The study took place in the neonatology department of the Issaka Gazoby Maternity Hospital in Niamey, a national reference center for obstetrics and neonatology.

2.2. Study Population

The study focused on live neonates from singleton pregnancies admitted to the neonatology department during the study period. "Case" were newborns born to diabetic mothers, and "controls" were newborns born to non-diabetic mothers. For each "case", two "controls" born on the same days were matched. Written consent from the mothers was a prerequisite for inclusion in the study.

2.3. Sampling

We calculated the minimum sample size using the formula $t = n^2pq/i^2$, with t the minimum sample size, n the confidence level set at 1.96 at the 5% significance level, p the prevalence of diabetes, which was around 2% among women according to the STEPS Niger survey in 2021 [6], q the complement of p $(q = 1 - p)$ and i the risk of error estimated at 5%. Overall, the minimum sample size was calculated at 30 cases.

2.4. Studied Variables

The main dependent variable was the occurrence of perinatal complications. Maternal history of pathological events during previous pregnancies constituted antenatal and perinatal complications (miscarriage, abortion, prematurity, fetal macrosomia or stillbirth). Variables relating to neonatal complications were the presence at birth of intrauterine growth retardation (IUGR) or macrosomia, congenital malformations, respiratory distress, neonatal infection, hypoglycemia and the occurrence of death.

2.5. Definition of Variables

Macrosomia was defined as a birth weight above the 90th percentile on the reference curves for gestational age, and IUGR if below the 10th percentile. Hypoglycemia was considered to be a blood glucose level below 0.30 g/l in premature infants and 0.45 g/l in full-term neonates beyond 24 hours. Neonatal infection was defined according to ANAES 2000 criteria [7].

2.6. Data Collection and Statistical Analysis

Data were collected from the records of newborns and their mothers, using a pre-established data extraction form. Analysis was performed using Epi info software version 7.2.1. The relationship between variables was estimated using Pearson's Chi^2 test or Fisher's exact test. The test was significant if the p-value was less than 0.05. Risk quantification was calculated by estimating the Odds Ratio (OR) and its 95% Confidence Interval (CI).

3. Results

Of the 2,225 admissions during the study period, 31 newborns from diabetic mothers were found, representing a frequency of 1.4%. The study involved all newborns of diabetic mothers, and 63 newborns of non-diabetic mothers chosen as controls.

3.1. Perinatal Complications

The risks of perinatal complications are shown in Table 1. Diabetic mothers were 2.8 times more likely to have a history of abortion, with 67.7% of cases compared with 28.6% of control mothers (OR = 2.82; p = 0.001). Similarly, a history of macrosomia was found in 29.0% of diabetic mothers versus 9.5% of controls, with a statistically significant risk (OR = 2.15; p = 0.01). Diabetic mothers reported a 24.8% history of stillbirth, compared with 14.3% in non-diabetic mothers (OR = 2.08; p = 0.09).

Table 1. Perinatal associated risk factors.

	Status				
	Case N (%)	Controls N (%)	OR	CI	p
	History of abortion				
Yes	21 (67.74)	19 (28.57)			
No	10 (32.26)	45 (71.43)	2.88	[1.53 - 5.44]	0.001

Continued

History of fetal macrosomia					
Yes	9 (29.03)	6 (9.52)			
No	22 (70.77)	57 (90.48)	2.15	[1.24 - 3.71]	0.01
History of stillbirth					
Yes	8 (24.80)	9 (14.30)			
No	23 (74.20)	54 (85.70)	2.08	[0.71 - 6.08]	0.09

3.2. Associated Neonatal Morbidity and Mortality

Respiratory distress was found in 64.0% of neonates born to diabetic mothers, compared with 25.4% of controls (OR = 1.17; p = 0.37) (Table 2). Macrosomia was also more common in newborns of diabetic mothers (38.7% vs. 9.5% in controls), with a statistically significant risk (OR = 2.63; p < 0.01). On the other hand, IUGR and hypoglycemia were observed in approximately the same proportions in cases as in controls, with no statistically significant relationship with the presence or absence of maternal diabetes (OR = 0.92; p = 0.45 and OR = 1.14; p = 0.41). Three (3) cases of congenital malformations were only observed in newborns of diabetic mothers (p = 0.03). These were one case of cyst of the right thigh, one case of anorectal malformation such as anal imperforation and one case of bilateral varus equinus clubfoot. Neonatal mortality was 9.7% in newborns of diabetic mothers versus 11.1% in controls, with no statistically significant association (OR = 0.85; p = 0.43).

Table 2. Neonatal associated morbidity and mortality.

	Status				
	Case N (%)	**Controls N (%)**	**OR**	**CI**	**p**
Neonatal infection					
Yes	17 (54.80)	35 (55.60)			
No	14(45.20)	28 (44.40)	0.97	[0.40 - 2.30]	0.47
Respiratory distress					
Yes	9 (29.03)	16 (25.39)			
No	22(70.77)	47 (74.86)	1.17	[0.44 - 3.07]	0.37
Stillbirths					
Yes	8 (24.80)	9 (14.30)			
No	23 (74.20)	54 (85.70)	2.08	[0.71 - 6.08]	0.09
Macrosomia					
Yes	12(38.70)	6 (9.52)			
No	19(61.30)	57 (90.48)	2.63	[1.58 - 4.37]	<0.01
Intrauterine growth retardation					
Yes	6 (19.36)	13 (20.64)			
No	25 (80.64)	50 (79.36)	0.92	[0.31 - 2.73]	0.45
Glycemia					
≤0.45	10(33.33)	7 (30.43)			
>0.45	20(66.67)	16 (69.57)	1.14	[0.35 - 3.67]	0.41
Death					
Yes	3 (9.67)	7 (11.12)			
No	28(90.33)	56 (88.88)	0.85	[0.20 - 3.56]	0.43

4. Discussion

This study found that perinatal complications were more common in newborns of diabetic mothers, confirming the literature's findings regarding the role of maternal diabetes in their occurrence. The study was limited by the small sample size, although representative of the population of diabetic mothers in our context. In addition, the monocentric nature of the study meant that the results could not be extrapolated to the entire population of newborns born to diabetic mothers.

4.1. Antenatal and Perinatal Morbidities

History of abortion, stillbirth and fetal macrosomia were significantly higher in diabetic mothers in this study. In a series from Benin, Alassani and *al.* found a higher risk of fetal macrosomia in women with gestational diabetes (15.8% vs. 3%), with a statistically significant association ($p < 0.05$) [8]. Mimouni and *al.* reported a similar result, with a higher frequency among diabetics (32.7%) compared with the control population (7%) in Algeria [9]. In Mali, Sylla and *al.* reported a frequency of macrosomia in half the pregnant women followed for delivery [10]. Indeed, fetal macrosomia, like other ante- and perinatal complications, has been reported in many studies to expose newborns of diabetic mothers to a significantly higher risk of morbidity and mortality in the neonatal period [1]-[5] [11] [12]. Macrosomia is classically attributed to fetal hyperinsulinism in response to maternal hyperglycemia, due to the anabolic effect of insulin [13]. Other complications are thought to be secondary to glycemic imbalance, raising the issue of proper monitoring of pregnant women.

4.2. Morbidity in Newborns

In this study, neonatal infections were represented in approximately the same proportions. In the work of Opara and al. in Nigeria and Guerbelmous and *al.* in Morocco, a higher incidence of maternal-fetal infection was found in newborns of diabetic mothers [14] [15]. Indeed, diabetics are more exposed to the risk of infection due to the high frequency of carriage of Group B Streptococcus and Escherichia coli, the germs most frequently found in diabetic urinary tract infections [16].

Respiratory distress was more common in newborns of diabetic mothers, but there was no statistically significant relationship. A similar result was reported by Boiro and *al.* in Senegal [12], who recorded more cases of respiratory distress in newborns of diabetic mothers. Similar results have also been found in the literature [1]-[5] [8] [9]. Newborns of diabetic mothers are usually at greater risk of developing neonatal respiratory distress for three possible reasons. These include the greater risk of premature birth, which exposes them to hyaline membrane disease, and caesarean section births, which increase the risk of respiratory distress through delayed resorption of pulmonary fluid. Finally, the neonatal infection mentioned above [17] [18] may also be involved.

Macrosomia was one of the most frequent neonatal complications, with a high

frequency of 45%. This finding has been corroborated by other studies [14]-[16] [19] [20]. Macrosomia would largely explain the risk of severe obstetric trauma in the population of newborns born to diabetic mothers. The absence of obstetric trauma in this series is attributable to the high rate of caesarean delivery. In fact, these obstetrical traumas are attributable to attempted vaginal delivery, exposing the infant to shoulder dystocia, limb fractures and brachial plexus elongation [13].

Hypoglycemia, more common in neonates of diabetic mothers in this series, was not significantly associated with maternal diabetes. On the other hand, Boiro and *al.* in Senegal and Muche and al. in Ethiopia reported a statistically significant risk of hypoglycemia in newborns of diabetic mothers [12] [21]. In general, maternal diabetes is recognized as a risk factor for neonatal hypoglycemia. This is most often secondary to residual fetal hyperinsulinism and poor peripartum control of maternal glycemia [13] [22].

In this study, all cases of malformation were found in newborns of diabetic mothers. The risk of congenital malformations is significantly higher in the population of newborns born to diabetic mothers than in the literature. These mainly affect the heart, nervous and musculoskeletal systems [13] [23]. Hyperglycemia early in the period of organogenesis is thought to play a decisive role in the occurrence of these anomalies [24].

Mortality was not higher in newborns of non-diabetic mothers in this series, as reported by Opara and *al.* in 2010 in Nigeria [14]. On the other hand, other studies have highlighted an increase in mortality in newborns of diabetic mothers. This would be due to the neonatal complications described above, which are frequently associated with diabetes [1]-[5] [22] [23].

5. Conclusion

The newborn of a diabetic mother remains a child at risk. Morbidity and stillbirths were statistically higher in newborns of diabetic mothers than in newborns of non-diabetic mothers. These were risks of ante- and perinatal complications (abortion, fetal macrosomia and stillbirths) and neonatal complications (macrosomia and malformations). Improving fetal and neonatal prognosis will require the involvement of a multidisciplinary team during prenatal follow-up and after delivery.

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Conflicts of Interest

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

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