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Audit of Neonatal Deaths According to the Three Delays Model in a Referral Hospital

Kouakou Kouamé Cyprien, Djivohessoun Augustine, Djoman Isabelle, Gro Bi André, Soro Charlène, Mansou Amoro, Niango Stella, Folquet Amorissani

Mother and Child Department, Faculty of Medicine, Felix Houphouët Boigny University, Abidjan, Cote d'Ivoire
Email: doccyprien@yahoo.fr, tinadjivo@yahoo.com, isadjoman@hotmail.fr, grobimarius2018@gmail.com, amorokomenan@yahoo.fr, charlenesorho@gmail.com, ebanguestella@yahoo.fr, amorissanifolquet@hotmail.fr

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Abstract

Introduction: Neonatal mortality is a key indicator of international development. Its reduction remains a challenge and a concern for Côte d'Ivoire, which has a high ratio of neonatal deaths (30 per 100,000 live births). The causes are known in the hospitals. We analyzed the causes of neonatal deaths and the factors contributing to them in a second level health facility. Patients and method: The audit of neonatal deaths took place between January 1 2022 to December 31 2022 in the neonatal unit of the Abobo Regional Hospital, using the three delays model. Results: The neonatal mortality rate was 14%, and the main direct causes were neonatal asphyxia (34%), neonatal infection (24%) and prematurity (14%). The three most common delays were: delay in decision-making (84.2%), delay in access to health services (20.2%) and delay in receiving appropriate care (15.7%). These three delays multiplied the risk of death by 1.94, 0.52 and 3.69 respectively. The three other delays were: delay in decision-making (84.2%), delay in access to healthcare services (20.2%) and delay in receiving appropriate care (15.7%). These three delays multiplied the risk of death by 1.94, 0.52 and 3.69 respectively. Conclusion: Neonatal asphyxia and prematurity are the main direct causes of neonatal mortality in our department. To reduce neonatal mortality, it is necessary to overcome the three contributing delays through the effective implementation and evaluation of emergency obstetric and neonatal care.

Keywords

Audit, Delays, Neonatal Mortality, Cote d'Ivoire

1. Introduction

According to the WHO, 295,000 women and 2.5 million newborns die every year during childbirth from preventable causes. In addition, 2.6 million stillbirths occur

every year. Around 98% of these deaths occur in low-resource countries [1]-[4]. In sub-Saharan Africa, including Côte d'Ivoire, various demographic and health surveys show that neonatal mortality accounts for 40% of infant deaths [5] and is higher in absolute terms than in the rest of the world. The challenge for this country is to ensure a high quality of care [6]. This involves identifying care problems and adopting good practices. The WHO recommends carrying out an audit of morbidity and neonatal deaths to identify and implement ways of improving the quality of maternal and neonatal care [7]. Through this process, hospital staff can learn from the audited cases and improve care. The Ministry of Health of Côte d'Ivoire has included in its action plan for the survival of newborns, a decentralization of the care of newborns in regional hospitals as one of the interventions to be implemented. The Ministry of Health of Côte d'Ivoire has included in its action plan for newborn survival, a decentralization of the care of newborns in regional hospitals as one of the high-impact interventions for the reduction of neonatal mortality [8].

This is how a neonatal unit has been opened in a regional hospital (CHR), which is a second-level hospital in the Ivorian health pyramid. To firmly anchor this decentralization policy, it is important to put in place a strategy for large-scale implementation. To facilitate this transition, an audit of neonatal deaths was carried out in this unit. The aim of this study was to provide teams with tools enabling them to understand the causes and factors leading to neonatal deaths.

2. Method

2.1. Population and Methods

2.1.1. Scope of the Study

This study took place at the regional hospital center (CHR) d'Abobo in Abidjan, in the neonatology unit. The healthcare system in Côte d'Ivoire is organized as a three-level pyramid, with the lower level referring to the level immediately above. The CHR is a secondary-level health center located in the middle of this pyramid (see **Figure 1**). The CHR has a maternity unit. This means that all newborn babies come either from the CHR maternity unit, or from peripheral maternity units.

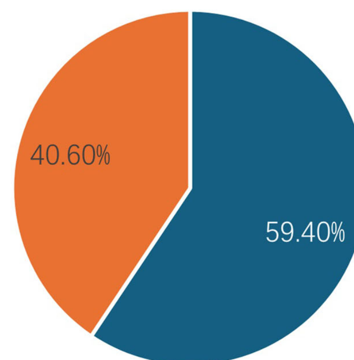

Figure 1. Lung enlargement technique used.

2.1.2. Type, Population and Duration of Study

This case-control study ran from January 1st 2022 to December 31st 2022 (12 months). All neonates hospitalized during the study period were included. Cases were neonates who died and controls were neonates who had a favorable outcome. Each case was matched with 3 controls. Neonates admitted to the neonatal unit whose condition did not require hospitalization and neonates who arrived dead were not included in the study.

2.2. Data Collection and Analysis

A data collection form was used to gather information on all neonatal deaths from medical records. The variables collected concerned the characteristics of the mothers: age, profession, level of education, number of prenatal consultations, gestational age, parity, prenatal check-up, pathologies during pregnancy, delivery (place, term, route of delivery) and the characteristics of the newborns: age on admission, sex, weight, gestational age, place of delivery, Apgar score at five minutes, reason for admission, notion of resuscitation, time between onset of signs and consultation, pathologies responsible for death, length of hospital stay. Because the study is retrospective, the nutritional status of the mothers and the father's education level could not be reported. The audit of neonatal deaths was conducted according to WHO recommendations [9]. So, the first delay refers to the decision to go to a health service (insufficient prenatal consultation (ANC), incomplete prenatal check-up (BPN), consultation time for the sick newborn greater than 30 min). The WHO recommends eight contacts until delivery to detect congenital anomalies and possible pathologies which could have a negative impact on the progress of the pregnancy [10].

The second delay refers to the inaccessibility of health services once the decision to go has been made (mother's profession, birth in a peripheral maternity hospital, mother's level of education). The third delay refers to the time spent waiting for adequate management after arrival at a health facility (promptness and quality of hospital care). For each neonatal death, the auditors compared the various items with existing standards. Then, to bring statistical significance to the findings, each death was matched with three controls. The data were entered and analyzed using Excel and XLSTAT. Statistical analysis was based on univariate comparisons between deceased neonates and controls. Odds ratios (OR) with 95% confidence intervals (95% CI) were calculated for each parameter studied. Pearson's χ^2 test was used to compare proportions at the 5% p significance level. For these tests, a p-value <0.05 indicates a statistically significant difference.

3. Results

3.1. Maternal Characteristics

Of the 1495 newborns admitted during the study period, 280 newborns were included in the study, including 210 live newborns and 70 deceased newborns. The sex ratio was 1.27. The average age of the mothers was 28, and 81% were uneducated and 36% unemployed. At the time of pregnancy follow-up, 47% of mothers

had attended fewer than four prenatal consultations. Table 1 shows the characteristics of the mothers.

Table 1. Maternal socio-demographic characteristics.

	Effective (n=280)	Percentage (%)
	Maternal age (years)	
Less than 20	35	12.5
20 - 30	151	54
31 - 40	86	31
> 40	8	2.5
	Education level	
Never attended	227	81
Primary	17	6
Superior	36	13
	Professional activity	
Informal sector	97	35
Housekeeper	36	13
Pupil/Student	34	12
Civil servant	13	5
Unemployed	100	36

3.2. Characteristics of Newborns

The consultation time in the neonatal unit was less than 72 hours in 79% of cases. Premature babies represented 20% of cases and full-term newborns 80%. These children were born within the center in 68% of cases. The characteristics of the newborns are summarized in Table 2.

Table 2. Characteristics of newborns.

	Effective (n = 280)	Percentage (%)
	Gestational age (SA)	
< 28	5	2
28 - 32	12	3
33 - 36	13	5
> 37	223	80
	Weight (grams)	
< 1500	19	7
1500 - 2000	33	12
> 2000	228	81
	Place of birth	
CHR Abobo	190	68
Autres maternités	90	32
	Neonatal admission age (hours)	
< 24	175	62
24 - 72	47	17
> 72	58	21
	Pathologies encountered in neonatology	
Complications of per partum asphyxia	24	8,5
Neonatal infection	24	8,5

Continued

Complications of prematurity	30	10,7
Length of hospital stay (days)		
< 7	239	85
> 7	41	15

3.3. Frequency and Causes of Death

The mortality rate was 14%. Direct causes of death are summarized in Table 3.

Table 3. Direct causes of neonatal mortality.

Cause of death	Effective	(%)
Complications of perinatal asphyxia	30	10.7
Neonatal infection	17	6
Prematurity	13	4.6
Respiratory distress	8	3
Hemorrhagic syndrome	1	0.3

Brain damage (31.5%), prematurity (28%), respiratory distress (21%) and neonatal infection (9.5%) were the main direct causes of death.

3.4. Fatality Analysis Using the Three Delays Model

3.4.1. Impact of the First Delay on the Occurrence of Neonatal Deaths

Factors		Deceased		Living		P
		n	%	n	%	
ACN	< 4	40	57	91	43	0.048
	>4	30	43	119	57	
BPN	Uncomplete	61	87	163	78	0.109
	Complete	9	13	47	22	
Consultation time (minutes)	< 30	26	37	75	36	0.013
	> 30	44	63	135	64	
Existence of 1st delay	yes	44	63	135	64	0.013
	No	26	37	75	36	
	Total	70	100	210		

P = 0.013. OR = 1.27 (0.73 – 2.21)

There was a statistically significant link between the existence of the first delay and death. This delay multiplied the risk of death by 1.27.

3.4.2. Impact of the Second Delay on the Occurrence of Neonatal Deaths

Facteurs		Deceased		Living		P
		N	%	N	%	
Place of delivery	CHR Abobo	42	60	148	71	0.8
	Others	27	40	62.	25	
Mother's level of education	Educated	58	83	121.	58	0.04
	Unducated	12	17	89	42	

Continued

Profession of mothers	Employed	3	4	146	70	0.005
	Not employed	67	96	64	30	
Existence of the 2nd delay	Yes	27	40	153	73	0.157
	No	42	60	57	27	
	Total	70	100	210		

3.4.3. Impact of Third Delay on Neonatal Deaths

Factors		Deceased		Living		P
		N	%	N	%	
Blood sugar	Done	45	63	126	60	0.8
	Not done	26	37	84	40	
C-reactive protein	Done	33	47	121	58	0.04
	Not done	37	53	89	42	
Complete blood count	Done	52	74	146	70	0.005
	Not done	18	26	64	30	
Existence of the 3rd delay	Yes	55	79	153	73	0.157
	No	15	21	57	27	
	Total	70	100	210		

4. Discussion

This study enabled us to carry out an audit of neonatal deaths, the aim of which is to improve patient care. The audit can be carried out in several ways [11]. The three delays model designed by Thaddéus and Maine in 1994 [10] initially to audit maternal deaths has been little used in audits of neonatal deaths [12]. Its use in our study enabled us to determine the main direct causes of newborn death and to analyze the factors contributing to the three delays. The mortality rate was 14%, and the main causes of death were neonatal asphyxia (34%), neonatal infection (24%) and prematurity (14%). Our data are in line with those of several other authors, but in a different order [13]-[18] neonatal asphyxia has immediate repercussions on the morbidity and mortality of the newborn, as well as sometimes serious consequences for the child's development [19]. There is a need to reinforce guidelines aimed at transferring high-risk pregnancies in utero to specialized centers where the mother and newborn can be properly cared for, with a view to reducing maternal and infant mortality [12]. Similarly, emergency obstetric and neonatal care, and resuscitation of the newborn in the delivery room, must be taught in all centers that deliver babies. In addition, proper monitoring of labor with a partogram would prevent many cases of perinatal asphyxia [12]. Neonatal infection was the second leading cause of death. Several factors could explain infections in newborns. On the one hand, factors linked to the mother's urogenital infections, which accounted for 22.9% of untreated or poorly treated infections during pregnancy, and on the other, poor hygiene conditions during hospitalization. According to Nyenga's study, obstetrical history was a factor in neonatal infections [20]. Reinforcing the prevention of urogenital infections in mothers is necessary

[12] [21]. The audit process enabled us to note that the third delay (78.6%) was the most frequent, followed by the first delay (63%), then the second delay (40%). In the study by Mbaruku et al. in Tanzania, the third delay (72.5%) was the most frequent, followed by the second delay (21.5%) and the first delay (19%) [12].

On the other hand, for Fla Koueta et al, the second delay (77%) was the most frequent, followed by the third delay (66.9%) and finally the first delay (64.4%) [22]. The overall analysis of these results authorizes us to say that the delay in deciding to go to a health service causes the greatest number of deaths. In fact, the first delay was noted in 62.9% of deaths, and significantly increased the risk of death, with an odds ratio of 1.27. This underlines the importance of pregnancy monitoring, whose parameters and interventions are crucial to the harmonious growth of the newborn, as well as mothers' lack of awareness of danger signs [23]. Pregnancy monitoring needs to be strengthened by improving ANC for early detection of high-risk pregnancies [24]. The second delay was observed in 40% of deaths.

The contributing factors were origin from a peripheral maternity hospital and low socio-economic status, but we found no statistical link between these factors and death. For Mbaruku et al. and Hinderaker et al. in Tanzania, this delay is not only linked to the remoteness of the health center and poverty, but also and above all to the poor organization of the referral system [12] [25] [26]. Emergency obstetric and neonatal care (EmONC) should emphasize essential care at birth and emergency gestures to be performed in the event of vital distress before any transfer, which should be medicalized. The third delay (79%) was encountered in hospital. This was mainly due to a delay in the start of treatment because the paraclinical work-up had not been carried out urgently. For Kedy Koumet *et al*., the factors influencing in-hospital mortality are the socio-economic environment, access to care, patient type, technical facilities and human resources [15].

5. Conclusion

Neonatal mortality remains high and results from a delay in consultation and monitoring of pregnancy. Measures must be taken to reduce this delay.

Authors' Contributions

Kouakou Cyprien: conception, data collection, data entry, data analysis, and drafting of the manuscript

Djivohessoun Augustine: participation in study design and manuscript writing.

Djoman Isabelle, Gro Bi Andre, Mansou Komenan: participation in drafting the manuscript.

Folquet A. Designing and carrying out the work of collecting the results, Reading and revising the manuscript. All authors have read and approved the final version of the manuscript.

Conflicts of Interest

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

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