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Research Article

Risk Factors for Early Neonatal Death despite Cesarean Section

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Abstract

Objective: To identify the risk factors for early neonatal death (NND) despite cesarean section (CS).

Methods: This case-control study was carried out between 1st February and 31st May, 2019. Files of women whose newborns died within seven days following CS and those of women whose newborns were alive seven days after CS were examined. The main variables recorded included maternal age, educational level, gestational age at delivery, number of antenatal visits done, whether the woman was referred or not, intrapartum fever or hemorrhage, indication of CS, decision delivery interval, birthweight and sex of newborn. Data were analyzed using SPSS 21.0. Fisher exact test, t-test and logistic regression were used for comparison. P<0.05 was considered statistically significant.

Results: Our frequency of NND after CS was 4.8% (51/1053). Significant risk factors for NND after CS were birth weight <2000g (aOR 48.18, 95%CI 12.97-152.21), intra-partum hemorrhage (aOR 12.15, 95%CI 5.77-25.97), intra-partum fever (aOR 5.64, 95%CI 1.81-17.66), <4 antenatal visits (aOR 4.13, 95%CI 2.71-6.74), arrival >1h after referral (aOR 3.09, 95%CI 1.67-5.71) and primary school education level (aOR 2.39, 95%CI 1.16-4.92).

Conclusion: From the risk factors identified above, we can recommend that women, especially those with primary school education level, should be counselled to attend at least four antenatal visits to allow the diagnosis and treatment of some diseases. Moreover, CS should be carried out as fast as possible in the cases of intrapartum hemorrhage. Women with intrapartum fever needs particular attention. Lastly, referral should be organized so that the woman arrives earlier.

Key words: early neonatal death following emergency cesarean section; risk factors; birth weight less than 2000g; intra-partum hemorrhage; intra-partum fever

Introduction

Cesarean section (CS) consists of performing a laparotomy and hysterotomy to deliver the fetus, though other techniques such as vaginal cesarean delivery does not need a prior laparotomy. The rate of CS has risen in the last decades in almost all the continents. Nowadays, these rates range approximately between 16% and 51.9% [1,2]. High rate of 87.9% has been observed in Brazilian private health sectors [2].

This surgical procedure carries some risks, especially the emergency CS. The frequent immediate maternal complications include bladder or bowel injuries, hemorrhage and even maternal death. Short- and long-term complications include surgical site infection, thrombo-embolic diseases, urinary tract infection, uterine synechiae, morbidly adherent placenta and even uterine rupture during subsequent deliveries [3-5]. This procedure has a cost, especially in low- and middle-income countries where health insurance policies often do not exist and the family has to afford all the cost.

Although many of these emergency CSs are carried out to safe the fetus life, it frequently happens that some newborns die after the operation. Early neonatal death (NND), defined as the death of a newborn between delivery and seven days after birth, represents 73% of all postnatal deaths worldwide [5]. It is a very difficult condition for the mother or the couple to lose the baby, especially after having spent sometimes lot of money through a CS, operation they would qualify as useless.

There is scarcity of studies in the literature on neonatal death despite emergency CS. The available studies found that prematurity, low birth weight, neonatal asphyxia, late arrival after referral and neonatal infection

were the main risk factors for NND after CS [6]. Some other risk factors might exist especially in our country where for various reasons CSs are sometimes carried out late. This lateness might be associated with increased risk of NND. Identifying the risk factors might help in the prevention of some cases of NND after CS.

No study aimed at determining the risk factors for NND despite emergency CS has been carried out in our country. This study, therefore, aimed at identifying these risk factors.

Methods

This case-control study was carried out between 1st February and 31st May, 2019 in two University Teaching Hospitals. Files of women whose newborns died within seven days following a CS were recruited as cases. For each case, the files of the three women whose newborns were delivered by CS immediately after the case and who were alive and healthy seven days after CS were recruited as controls. Files of women with multiple pregnancies and intrauterine fetal demise before CS were excluded. A written informed consent was obtained from each woman or from their relatives. This study was approved by the two institutional ethics committees.

The variables recorded on a pre-established questionnaire included maternal age at delivery, educational level, marital status, parity, gestational age at delivery (confirmed by an ultrasound scan performed before 20 weeks' gestation), number of antenatal visits done, number of intermittent preventive treatment (IPT) against malaria (using sulfadoxine-pyrimethamine), HIV status, fetal presentation, whether the woman was referred or not, intrapartum fever or hemorrhage, the indication of CS, the decision delivery interval (time interval between decision of CS and the delivery of the newborn), birthweight, sex of newborn, presence or not of fetal malformation, Apgar score at 1st and 5th minutes.

The necessary minimum sample size was calculated as needing at least 47 cases of NND after CS, using the following formula: $N=2\times(Z\alpha+Z\beta/P0-P1)^2\times P\times(1-P)$ [7], where $Z\alpha=1.65$ corresponds to a type I error of 5%, $Z\beta=0.84$ corresponds to a type II error of 20% or a power of 80%, P0 the assumed percentage of referred women in the group with NND (50%), P1 the assumed percentage of referred women in the group without NND (25%) and P is (P0+P1)/2. To increase the power of our study, we decided to recruit three controls for each case.

Data were analyzed using SPSS 21.0. Data of cases were compared to those of controls. Fisher's exact test was used to compare categorical variables and t-test to compare continuous variables. We used odds ratios with their 95% confidence intervals (CIs) to present the comparison between the two groups. Logistic regression was used to control for confounders. P<0.05 was considered statistically significant.

Results

During the study period, we had a total of 51 NND out of 1053 CS performed, giving a rate of 4.8%. Also, the files of 153 newborns who were alive and healthy seven days after CS were recruited as controls. Some sociodemographic and obstetrical variables are given in (Table 1).

Variables		Group (n=51) with early NND after CS N (%)	Group (n=153) without NND after CS N (%)	OR	95% CI	P-value
Maternal age (y)		28.3 ± 6.5 (18-45)	28.1 ± 7.2 (16-43)	-	-	0.860
Parity		1.9 ± 1.5 (0-6)	1.37 ± 1.4 (0-6)	-	-	0.022
Gestational age (w)		34.1 ± 9.0 (29-42)	39.0 ± 1.1 (37-42)	-	-	<0.001
Birthweight (g)		2330.1 ± 108.6 (850-5900)	3125.2 ± 461.3 (1705-4600)	-	-	<0.001
Marital status	Married	24 (47.0)	73 (47.7)	0.97	0.51-1.83	1
	Single	27 (53.0)	80 (52.3)			
Level of education	PS	16 (31.4)	21 (13.7)	2.87	1.35-6.08	0.005
	>PS	35 (68.6)	132 (86.3)			
Women referred	Yes	28 (54.9)	41 (26.8)	3.32	1.72-6.41	<0.001
	No	23 (45.1)	112 (73.2)			
Intra-partum fever	Yes	9 (17.6)	5 (3.3)	6.34	2.01-19.94	0.001
	No	42 (82.3)	148 (96.7)			
Intra-partum hemorrhage	Yes	13 (25.5)	5 (3.3)	10.12	3.40-30.15	<0.001
	No	38 (74.5)	148 (96.7)			
Birthweight (g)	<2000	25 (49)	2 (1.3)	72.59	16.21-325.09	<0.001
	≥2000	26 (51)	151 (98.7)			
Neonatal resuscitation	Yes	39 (76.5)	9 (5.9)	52.00	20.43-132.30	<0.001
	No	12 (23.5)	144 (94.1)			

NND: Neonatal death, OR: Odds ratio, CI: Confidence interval, CS: Cesarean section, PS: primary school

Table 1: *Some sociodemographic characteristics of the population under study*

The mean number of IPT against malaria was lower amongst cases (1.9 ± 1.1, range: 1-6) than amongst controls (2.8 ± 1.3, range: 1-7), P<0.0001. Also, the mean number of antenatal visits was lower amongst cases (3.0 ± 1.6, range: 1-8) than amongst controls (4.6 ± 1.6, range: 1-9), P<0.0001.

Babies of women who had <4 visits were more found amongst cases than amongst controls (29 or 56.9% vs 29 or 19.0%, OR 5.63, 95%CI 2.83-11.19, P<0.001). Attendance of less than 4 visits remained significantly associated with NND despite emergency CS after adjustment for confounding factors (aOR 4.13, 95%CI 2.71-6.74, P<0.001)

No woman living with HIV-AIDS was found amongst cases compared to three amongst controls (P=0.420). Women referred were more found amongst cases (Table 1).

Women who arrived more than one hour after decision of referral were more found amongst cases than amongst controls (27 or 52.9% vs 39 or 25.5%, OR 3.28, 95%CI 1.70-6.35, P<0.001). Arrival more than one hour after referral remained significantly associated with NND despite CS after adjustment for confounding factors (aOR 3.09, 95%CI 1.67-5.71, P=0.006).

Concerning gestational ages at delivery, those between 40 and 42 were less frequent amongst cases than amongst controls (5 or 9.8% vs 45 or 29.4%, OR 0.26, 95%CI 0.09-0.70, P=0.002). Prematurity (<37 weeks) was more frequent amongst cases than amongst controls (25 or 49.0% vs 6 or 3.9%, OR 23.55, 95%CI 8.80-63.00, P<0.001). Babies born before 34 weeks were more found amongst cases (17 or 33.3% vs 1 or 0.6%, OR 76, 95%CI 9.77-590.84, P<0.001).

With regards to fetal presentations, the frequencies of breech were similar amongst both groups (2 or 3.9% vs 6 or 3.9%, P=0.680). Abnormal presentations were less frequent amongst cases (1 or 2.0% vs 10 or 6.5%), but the difference was statistically insignificant (P=0.189). Cephalic presentations were commoner in both groups (48 or 94.1% vs 137 or 89.6%, P=0.250). As concerns to the type of CS, the majority of the CS in both groups were emergency CS (49/51 or 96.0% for cases, compared to 135/153 or 88.2% for controls). Emergency CS was more associated with NND, though the difference was statistically insignificant (OR 3.26, 95%CI 0.73-14.59, P=0.080). The majority of CSs in both groups were carried out by residents (40/51 or 78.4% and 106/153 or 69.3%). NND was slightly more frequent when the CS was performed by a resident (OR 1.61, 95%CI 0.76-3.41), but the difference was statistically insignificant (P= 0.140). Table 2 shows the indications for CS.

Indications	Group (n=51) with early NND after CS N (%)	Group (n=153) without NND after CS N (%)	OR	95% CI	P-value
Pre-eclampsia/eclampsia	16 (31.4)	9 (5.9)	7.31	2.98-17.92	<0.001
Acute fetal distress	10 (19.6)	20 (13.1)	1.62	0.70-3.74	0.179
Placenta abruption	7 (13.7)	2 (1.3)	12.01	2.40-59.90	0.001
Placenta praevia	5 (9.8)	3* (2.0)	5.34	1.25-23.61	0.024
CPD	4 (4.8)	91 (59.4)	0.05	0.02-0.17	<0.001
Cord prolapse	3 (5.9)	1 (0.6)	9.50	0.96-93.47	0.049
Imminent uterine rupture	3 (5.9)	6 (3.9)	1.53	0.36-6.35	0.399
Obstructed labor	1 (2.0)	6 (3.9)	0.49	0.05-4.16	0.441
Breech presentation	1* (2.0)	4* (2.6)	0.74	0.08-6.82	0.632
Transverse lie	1* (2.0)	2* (1.3)	1.51	0.13-17.01	0.580
Double scarred uterus	0 (0)	9* (5.9)	-	-	0.070

NND: Neonatal death, OR: Odds ratio, CI: Confidence interval, CS: Cesarean section, CPD: Cephalopelvic disproportion.
*Elective CSs.

Table 2: *Indications for cesarean sections in the study population*

NNDs were a little bit more found amongst cases than amongst controls when the decision delivery interval was more than 60 minutes (42/51 or 82.3% vs 114/153 or 74.5%, OR 1.59, 95%CI 0.71-3.57), but the difference was statistically insignificant (P=0.170).

The distribution of birthweights in the population under study are illustrated in Table 3. No fetal malformations were observed amongst cases as against two amongst controls (P=0.561).

Birthweight (g)	Group (n=51) with early NND after CS N (%)	Group (n=153) without NND after CS N (%)	OR	95% CI	P-value
<1500	11 (21.6)	0 (0)	-	-	<0.001
1500-1999	14 (27.4)	2 (1.3)	28.56	6.21-131.22	<0.001
2000-2499	2 (3.9)	3 (1.9)	2.04	0.33-12.57	0.367
2500-2999	4 (7.8)	63 (41.1)	0.12	0.04-0.35	<0.001
3000-3499	14 (27.5)	51 (33.3)	0.75	0.37-1.52	0.274
3500-3999	5 (9.8)	24 (15.7)	0.58	0.21-1.62	0.211
≥4000	1 (2)	10 (6.5)	0.28	0.03-2.29	0.189
Total	51 (100)	153 (100)			

NND: Neonatal death, OR: Odds ratio, CI: Confidence interval, CS: Cesarean section.

Table 3: *Distribution of birth weights*

With regard to fetal sexes, male sex proportions were similar amongst both groups (25 or 49.0% vs 78 or 51.0%, OR 0.92, 95%CI 0.49-1.74, P=0.467).

First minute Apgar score was poorer (<7) amongst cases (41/51 or 80.4%) than amongst controls (10/153 or 6.5%), OR 58.63, 95%CI 22.83-150.51, P<0.001. Furthermore, fifth minute Apgar score was poorer (<7) amongst cases (27 or 53.0%) than amongst controls (2 or 1.3%), OR 84.93, 95%CI 18.96-380.48, P<0.001.

After regression analysis, the risk factors for NND after CS were birthweight <2000g, intra-partum hemorrhage, intra-partum fever, <4 antenatal visits, arrival >1h after referral and primary school education level (Table 4).

Risk factors	OR	95%CI	P-value	aOR	95%CI	P-value
Birthweight <2000g	72.59	16.21-325.09	<0.001	48.18	12.97-152.21	<0.001
Intra-partum hemorrhage	10.12	3.40-30.15	<0.001	12.15	5.77-25.97	<0.001
Intra-partum fever	6.34	2.01-19.94	0.001	5.64	1.81-17.66	0.003
<4 antenatal visits	5.63	2.83-11.19	<0.001	4.13	2.71-6.74	<0.001
Arrival >1h after referral	3.28	1.70-6.35	<0.001	3.09	1.67-5.71	0.006
Primary school education level	2.87	1.35-6.08	0.005	2.39	1.16-4.92	0.018

OR: Odds ratio, CI: Confidence interval, aOR: adjusted odds ratio, CS: Cesarean section.

Table 4: *Independent risk factors for early neonatal death following CS*

The protective factors were cephalopelvic disproportion, birthweight between 2500 and 2999g and gestational age between 40 and 42 weeks.

Discussion

Our rate of NND after CS (4.8%) is lower than those of 7.3% and 9.0% observed in Nepal and Rwanda respectively [8,9]. The high rates in those studies might be attributed to the fact that they dealt only with emergency CS. Moreover, the commonest indication was fetal distress in those studies.

We found no association between maternal age, parity, marital status, HIV status, fetal presentation, qualification of the surgeon (obstetrician vs resident) and NND. This might be attributed to our small sample size. The absence of association between fetal presentation and NND is in accordance with other studies which found no association between NND and the fetal presentation (whether breech presentation or cephalic presentation) in cases of cesarean deliveries [10]. In breech, deaths occur frequently during vaginal delivery due to higher risk of birth asphyxia.

No significant association was found between decision delivery interval >60 min and NND. This might be attributed to the fact that cephalopelvic disproportion (CPD) (one of the protective factors for NND after CS) was the most frequent indication amongst the total population (82/204 or 42.0%). Moreover, the majority of CS with NND were carried out amongst women referred from less equipped health structures (28 cases or 54.9%), with 27 of them arriving more than one hour after decision of referral. Late arrival after referral might be associated with fetal hypoxia or acidosis, therefore, with brain injury. Henceforth, the promptitude or not of performing CS might have little effect on the neonatal outcome.

No association between acute fetal distress (AFD) and NND was observed in our series. It might be explained by the fact that the realization of CS was speedy when AFD was diagnosed.

CS should be carried out as fast as possible (within 30 min as recommended by the American College of Obstetricians and Gynecologists and other societies [11], especially in cases of placenta previa, placenta abruptio, cord prolapse, preeclampsia/eclampsia and AFD, since they were significantly associated with NND in our series. Some authors observed that for some other indications (with maternal or fetal compromise but not immediately life-threatening), the CS could still be practiced after 60 or even 90 minutes without increasing the risk of early NND [12].

Arrival >1h after referral was a risk factor for NND in our study. Late arrival has also been associated with NND in other studies with an OR of 2.11 [13]. More precisely, arrival more than 60 min after referral has been associated with NND with an OR of 5.82 [9]. This lateness in our series might be due to transport difficulties, traffic jam or reluctance of the woman to leave the health structure. Studies should be carried out to elucidate this.

CPD was protective for NND after CS. When there is CPD, the fetal head does not engage easily. Therefore, no hypoxia resulting from a cord compression or traction or from maternal hemorrhage is present. It is only in cases of prolonged second stage of labor that the fetal head and therefore the fetal brain can be seriously traumatized by the maternal bony pelvis, leading to AFD with subsequent neonatal asphyxia and death [14].

The newborns whose birthweight was <2000 g were at risk of NND. This shows that pregnancies should be well followed up to avoid as much as possible intrauterine growth restriction and premature deliveries. Moreover, our neonatal intensive care unit should be well equipped in order to take care of these babies, especially those <1500g.

Women should attend more visits (at least four), this would enable prevention if possible, early diagnosis and treatment of some diseases or unusual conditions such as preeclampsia, placenta previa or malaria. Some cases of intrapartum fever might be due to malaria given that the mean number of IPT was lower amongst cases. Emphasis should be carried out amongst women with primary school education level, who might not understand the importance of frequent visits.

Newborns with 5th min Apgar score <7 had an OR of 58.63 of dying within the seven days following CS. Some authors found an OR of more than 102 of dying when the 5th min Apgar score was <7 [15].

Our limitations are firstly our small sample size. Secondly, we could not appreciate the impact of the decision delivery interval on the neonatal outcome because the majority of referred cases arrived more than one hour after decision of referral.

Conclusion

NND after CS is more observed in women who had <4 visits, in women with pre-eclampsia/eclampsia, placenta abruption, placenta praevia, cord prolapse, birth weight <2000g, primary school education level and intrapartum fever. Therefore, women should be counselled to attend at least four antenatal visits to allow the diagnosis and treatment of eventual diseases. Moreover, CS should be carried out as fast as possible in the cases of intrapartum hemorrhage. Referral should be organized so that the woman arrives earlier. Women with intrapartum fever needs particular attention.

Declaration of interest:

The authors report no declaration of interest.

List of abbreviations:

AFD: acute fetal distress, AIDS: acquired immunodeficiency syndrome, CI: Confidence interval, CPD: cephalopelvic disproportion, CS: Cesarean section, HIV: human immunodeficiency virus, IPT: intermittent preventive treatment, NND: neonatal death, OR: odds ratio, SPSS: statistical package for social sciences.

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