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ORIGINAL ARTICLE

Predictors of Severe Neonatal Compromise Following Caesarean Section for Clinically Diagnosed Foetal Distress

Les prophètes de Compromis Néo-natal Sévère Après la Césarienne pour la Détresse Foetale Cliniquement Diagnostiquée

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ABSTRACT

BACKGROUND: **The potential harm to a mother and baby from caesarean delivery for clinically diagnosed foetal distress may not always be justified by the degree of neonatal depression at birth.**

OBJECTIVE: **To assess the accuracy of clinical diagnosis of foetal distress indicating caesarean section and identify antepartum and intrapartum characteristics that may predict severe neonatal compromise at birth.**

METHODS: **A chart analysis of 246 singleton caesarean births primarily indicated by clinically diagnosed foetal distress over a ten-year period at a Nigerian University Hospital. Gestational and intrapartum characteristics were compared for severely compromised neonates (Apgar score 0–3) and those with Apgar score of four-seven at one minute of birth. Multivariate logistic regression analysis was applied to determine independent predictors of severe neonatal compromise.**

RESULTS: **Apgar score was < 7 in 236 neonates: 120 (48.8%) were severely compromised, 116 (47.2%) had Apgar scores of four-seven and ten (4.1%) had normal Apgar scores. Eight (3.3%) neonates were stillborn. Multivariate logistic regression analyses indicate that meconium liquor (adjusted OR, 0.24 CI: 0.12–0.46) and long admission–diagnosis interval significantly reduce while combination of abnormal FHR and meconium liquor (adjusted OR: 3.84 CI: 1.89–7.76) significantly increased the odds of severe neonatal compromise at birth.**

CONCLUSION: **Clinical diagnosis of foetal distress is valuable in identifying foetuses in need of expedited delivery in this setting. However, gestational and intrapartum characteristics have limited impact in predicting before delivery which foetus requires intensive resuscitative measures and neonatal support at birth. WAJM 2009; 28(5): 327–332.**

Keywords: **Predictors, Caesarean section, Neonatal compromise, diagnosis of foetal distress.**

RÉSUMÉ

CONTEXTE: *Le danger potentiel d'une mère et son bébé de l'accouchement par césarienne pour souffrance fœtale cliniquement diagnostiqué, en mai ne sont pas toujours justifiées par le degré de dépression néonatale à la naissance.*

OBJECTIF: *Evaluer la précision du diagnostic clinique de la détresse fœtale indiquant césarienne et identifier ante-partum et les caractéristiques qui per-partum mai prédire compromis néonatale sévère à la naissance.*

MÉTHODES: *Une analyse graphique de 246 naissances par césarienne Singleton surtout indiqué par la détresse fœtale cliniquement diagnostiqués sur une période de dix ans dans un hôpital universitaire nigérian. Caractéristiques gestationnel et intra-partum ont été comparés pour les nouveau-nés gravement compromise (score d'Apgar 0-3) et ceux avec le score d'Apgar de quatre-sept ans une minute de la naissance. L'analyse multivariée par régression logistique a été appliqué pour déterminer des facteurs prédictifs indépendants de compromis néonatale sévère.*

Résultats: score d'Apgar était <7 236 nouveau-nés: 120 (48,8%) ont été gravement compromise, 116 (47,2%) ont obtenu des scores d'Apgar de quatre-sept et dix (4,1%) avaient un indice d'Apgar normal. Huit (3,3%), les nouveau-nés sont mort-nés. Des analyses de régression logistique multivariée indiquent que l'alcool le méconium (OR ajusté, 0,24 CI: 0.12-0.46) et l'admission à long intervalle de diagnostic de réduire considérablement tandis que la combinaison de FHR anormale et de liqueur de méconium (OR ajusté: 3,84 IC: 1.89-7.76) augmenté de façon significative les chances de compromis néonatale sévère à la naissance.

CONCLUSION: *Le diagnostic clinique de la détresse fœtale est importante afin d'identifier les fœtus qui ont besoin d'une livraison accélérée dans ce cadre. Cependant, les caractéristiques et intrapartum gestationnel ont un impact limité dans la prédiction de fœtus avant la livraison qui exige des mesures intensives de réanimation néonatale et de soutien à la naissance. WAJM 2009; 28 (5): 327-332.*

Mots-clés: *prédicteurs, césarienne, le compromis néonatale, diagnostic de souffrance fœtale.*

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Abbreviations: ANC, Antenatal care; **CS,** Caesarean section; **FHR,** Fetal heart rate; **GA,** Gestational age; **OR,** Odds Ratio; **PCV,** packed cell volume.

INTRODUCTION

Foetal distress is a widely used but poorly defined term that commonly indicates concern of the obstetrician about foetal intrauterine condition and often necessitates immediate caesarean section or instrumental vaginal delivery to forestall foetal death. [1] For most part of the twentieth century, intrapartum assessment of foetal condition was based on counting of the foetal heart rate (FHR) and checking for the presence of meconium in the liquor with the assumption that an abnormal FHR pattern, especially in the presence of meconium in the liquor, signifies foetal hypoxia and acidosis. However, this assumption is sometimes misleading and has resulted in many unnecessary obstetric interventions.[2] In spite of the introduction of foetal scalp blood pH estimation and electronic foetal monitoring into labour management for over three decades, the detection of abnormal FHR or rhythm and meconium staining of liquor still represents the best available indirect evidence of poor fetal oxygenation during labour in resource constrained settings. Studies in developing countries have favourably indicated that this method is able to identify significant proportion of fetuses with early neonatal acidaemia and low Apgar score at one minute and thus attempted to validate the use of clinical diagnosis of foetal distress in selecting foetuses that requires expedited delivery and supportive therapy at birth in low resource settings.[3,4]

On the other hand, the value of a policy of operative delivery for clinical foetal distress has been questioned on the grounds that not all the babies delivered, show evidence of antecedent hypoxic insult.[3,4,5] While a few false diagnoses resulting in unnecessary caesarean delivery may be excused against the background of caesarean section safety and the medicolegally driven defensive obstetric practice in the developed countries, the same cannot be said for developing countries where aversion towards caesarean section is strong and caesarean section is still associated with significant maternal morbidity and mortality.[6,7,8] Thus, it is imperative that in developing settings, the anticipated degree of depression after the birth of a supposedly compromised foetus is weighed against the maternal risk of caesarean delivery particularly when a conservative approach is equally practicable.

It is against this background that this study was designed to first assess the accuracy of clinical diagnosis of foetal distress indicating caesarean section and secondly to identify antepartum and intrapartum characteristics that may predict severe neonatal compromise (Apgar 0–3) among neonates delivered by caesarean section for foetal distress at a University hospital in Nigeria.

SUBJECTS, MATERIALS, METHODS

This was a chart analysis of all singleton caesarean births indicated by clinically diagnosed intrapartum foetal distress over a 10-year period (January 1997–December 2006) at Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State, Nigeria. During the period, the diagnosis of foetal distress in labour was based on detection of abnormal FHR and/or rhythm (persistent tachycardia: >160 beat per minute or bradycardia: <110 beat per minute) by intermittent auscultation with the Pinard foetal stethoscope and/or presence of meconium in the amniotic fluid. There was no facility for electronic FHR monitoring, foetal blood gas or pH analysis during the period. All foetuses delivered by caesarean section were attended to by a Registrar, senior resident or Consultant from the Neonatology Unit of the hospital. The Apgar scores were assessed at one and five minutes to assess foetal intrauterine condition and response to resuscitation measures, respectively.

Information was obtained from a combination of labour ward registers, theatre records and retrieved case files of mothers. Data on maternal characteristics such as age, parity, gestational age at delivery, booking status and presence of any pre-existing medical disorders were collected. The Apgar scores at one and five minutes for the neonates were documented. Information was also obtained on antenatal and labour events that could serve as possible predictors of severe neonatal compromise at birth. These included antenatal complications, other intrapartum complications in addition to foetal distress, duration of labour (in minutes), nature of labour onset, use of oxytocin for labour augmentation, baseline FHR at diagnosis of foetal distress, meconium staining of liquor, consistency of meconium stain (thick or thin), interval between admission into labour ward and diagnosis of foetal distress, intrapartum packed cell volume of the mother, stage of labour at diagnosis and maternal oxygen administration. For the purpose of this study, 'severe neonatal compromise' was defined as one minute Apgar score of 0–3 while 'sub-optimal neonatal condition' referred to Apgar scores ≤ 7. The Scientific and Ethics Review Committee of Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria, approved the study.

The data were analysed using EPI 2002 statistical package. [9] The frequencies of neonates delivered with Apgar scores of 0–3, 4–7, and 8–10 were computed. For neonates that were delivered in sub-optimal condition, the relationship between antepartum and intrapartum events and severe neonatal compromise at one minute of birth was explored through bivariate analyses. Independent predictors of severe neonatal compromise were explored with multivariate logistic regression analyses. Predictor variables were restricted to outcome measures that were statistically significant at <0.20 in the bivariate analyses. Logistic regression results were computed as adjusted OR and 95% confidence intervals. A p-value < 0.05 or confidence limits that did not embrace unity was considered as statistically significant.

RESULTS

During the reviewed period, 246 caesarean sections primarily indicated by foetal distress with or without other indication were performed for singleton pregnancies. A total of 1077 caesarean sections were performed out of the 4335 deliveries conducted during the same period. Thus caesarean section for clinical foetal distress among singleton births accounted for 22.8% of all caesarean sections and 5.7% of all

Table 1: Frequencies of antenatal and intrapartum complications among the women studied

Complication	FrequencyN(%)
Antepartum	
None	152(61.8)
PROM*	20(8.1)
Pre-eclampsia/eclampsia	40(16.3)
Prolonged pregnancy	14(5.7)
Urinary tract infection	2(0.8)
IUGR†	4(1.6)
Carpal tunnel syndrome	2(0.8)
Anaemia	6(2.4)
Malaria	2(0.8)
Antepartum haemorrhage	4(1.6)
Intrapartum	
None	66(26.8)
Poor progress in labour	84(34.1)
Pre-eclampsia/eclampsia	22(8.9)
Cord prolapse	4(1.6)
Prolonged/obstructed labour	40(16.3)
Antepartum haemorrhage	4(1.6)
Prolonged rupture of membranes	8(3.3)
Mal-presentation	8(3.3)
Previous CS§ scar	6(2.4)

**Intrauterine growth restriction*, †*Pre-labour rupture of membranes*, §*Caesarean section*

deliveries. The age of the women who had caesarean section for foetal distress ranged between 17 and 42 years with a mean of 28.6 years (SD 5.8). One hundred and fourteen (46.3%) women were nulliparous. Majority (84.6%) of the babies were born at term while 30 (12.8%) and six (2.6%) were born preterm and post-term respectively. One hundred and twenty eight (52.0%) of the women were booked for antenatal care and delivery at the hospital. Only 14 (5.2%) of the mothers had pre-existing medical condition before the index pregnancy.

Table 1 shows the frequencies of antenatal and intrapartum complications recorded among the women. A total of 96 (39.0%) women had records of antenatal complications while 162 (65.9%) had associated intrapartum complications. Pre-eclampsia/eclampsia (16.3%) was the most frequent antenatal complication while poor progress in labour (34.1%) was the most frequent intrapartum complication recorded among the women.

The mean duration of labour was 1268.1 (907.8%) minutes. The mean time between decision to perform caesarean section and delivery of the baby was 249.4 (181.6%) minutes ranging from 26 minutes to 960 minutes. Only two (0.8%) women had caesarean section within 30 minutes and 22 (8.9%) within one hour of decision to perform surgery. At one minute of delivery, 236 of the neonates had Apgar score ≤ 7. One hundred and twenty (48.8%) of the neonates were severely compromised, 116 (47.2%) had Apgar scores between four and seven while ten of the fetuses were delivered with normal Apgar scores. Eight (3.3%) neonates were stillborn.

Table 2 shows the comparison of gestational and intrapartum characteristics for severely compromised neonates and those born with Apgar scores of four-seven at one minute of delivery. At the bivariate level, the presence of meconium in liquor and intrapartum complications were significantly more frequent for foetuses delivered with Apgar score of four-seven compared to those with zero-three. However, among all neonates with

Table 2: Comparison of Gestational and Intrapartum Characteristics for Neonates Delivered with severe Neonatal Compromise and Suboptimal Neonatal Condition

Factors	Severely Compromised (Apgar ≤3) n=120	Suboptimal Condition (Apgar 4–7) n=116	Odds Ratio (OR) (95% CI)	P-value
Mean maternal age (years)		28.4	28.8	0.5509
Nulliparity	50(41.7)	60(51.7)	0.67 (0.39–1.15)	0.1210
Mean GA* at delivery (days)	276.2	274.7	0.5048	
Booked for ANC†	58 (48.3)	64 (55.2)	0.76 (0.45–1.27)	0.2932
Antepartum complication(s) present	52 (43.3)	38 (34.9)	1.56 (0.92–2.66)	0.0945
Intrapartum complication(s) present	70 (58.3)	84 (72.4)	0.53 (0.31–0.92)	0.0231
Mean duration of labour (mins)	1248.3	1294.4	0.0569	
Oxytocin augmentation	38 (31.7)	46 (39.7)	0.70 (0.41–1.20)	0.2000
Induced labour	14 (11.7)	14 (12.1)	0.96 (0.43–2.11)	0.9238
Meconium liquor	42 (35.0)	62 (53.4)	0.47 (0.27–0.79)	0.0043
Admission diagnosis interval (mins)	270.1	436.6	0.0139	
Intrapartum PCV‡	32.4	32.7	0.6161	
No maternal oxygen administration	30 (25.0)	26 (22.4)	1.15 (0.61–2.20)	0.6405
Decision-delivery interval	293.3	309.0	0.6353	
Abnormal FHR§ at diagnosis	74 (61.7)	73 (62.9)	0.94 (0.56–1.60)	0.8412
Abnormal FHR§ + Meconium liquor	46 (38.3)	26 (22.4)	2.15 (1.21–3.81)	0.0079

**Gestational age*, †*Antenatal care*, ‡*Packed cell volume*, §*Foetal heart rate*

Table 3: Multivariate logistic regression analysis showing independent predictors of severe neonatal compromise

Term	Odds Ratio	95%	C.I.	Coeffi-cient	S. E.	Z-Statistic	P-Value
Admission-diagnosis interval (mins)	0.9992	0.9984	0.9999	–0.0008	0.0004	–2.1053	0.0353*
Antenatal complication (Yes/No)	1.5084	0.8242	2.7608	0.4111	0.3084	1.3329	0.1826
Duration of labour (mins)	1.0001	0.9998	1.0005	0.0001	0.0002	0.8138	0.4158
Abnormal FHR + meconium liquor (Yes/No)	3.8412	1.8992	7.7689	1.3458	0.3594	3.7448	0.0002*
Intrapartum complication (Yes/No)	0.5588	0.2990	1.0441	–0.5820	0.3190	–1.8246	0.0681
Meconium liquor (Yes/No)	0.2407	0.1249	0.4639	–1.4241	0.3347	–4.2545	0.0000*
Oxytocin augmentation (Yes/No)	0.9452	0.5077	1.7598	–0.0563	0.3171	–0.1777	0.8590
Parity (nullipara/multipara)	0.8361	0.4658	1.5007	–0.1790	0.2984	–0.5999	0.5486
CONSTANT	*	*	*	0.6796	0.4007	1.6960	0.0899

* $P < 0.05$

meconium stained liquor, thick meconium was significantly more likely to be associated with severe neonatal compromise compared to thin meconium (OR 2.61 CI: 1.08-6.36) (not shown in table). The admission-diagnosis interval was significantly much shorter and abnormal FHR in combination with meconium staining of liquor more frequent for severely compromised neonates compared to those with Apgar score of four-seven. Multivariate logistic regression analyses indicate that meconium liquor (adjusted OR 0.24 CI: 0.12-0.46) and long admission-diagnosis interval significantly reduce the odds while combination of abnormal FHR and meconium liquor (adjusted OR: 3.84 CI: 1.89-7.76) significantly increases the odds of severe neonatal compromise at birth (Table 3).

DISCUSSION

This investigation was motivated by the need to address the dilemma often faced by obstetricians practising in low resource settings when confronted with clinical evidence of intrauterine hypoxia that cannot be confirmed by more objective methods. The results indicate that majority of neonates delivered by caesarean section due to clinically diagnosed foetal distress in this institution had suboptimal Apgar scores with approximately half of them being severely depressed at birth. It also suggests that antepartum and intrapartum characteristics have limited impact in predicting before delivery which foetus may require intensive resuscitative measures and neonatal support and whose caesarean section should be performed without hesitation. Of all the potential predictors assessed, only short admission-diagnosis interval and detection of abnormal FHR in addition to meconium liquor are significantly associated with severely compromised foetus. We believe that these findings have important implications for the providers of maternity care in developing settings and among underserved populations in developed settings.

To our knowledge, this is the first study that attempted to identify the determinants of the extent of neonatal depression following caesarean birth for clinical foetal distress in addition to determining its accuracy. The potential predictors of immediate neonatal outcome were selected on the grounds that foetal response to processes that are often responsible for intrapartum hypoxia (such as uteroplacental vascular disease, reduced uterine perfusion and reduced foetal reserves) can be modified by gestational and intrapartum factors. [10]

Similar to what was reported in previous studies,[3,4] the proportion of neonates with suboptimal Apgar score at one minute of birth appears to put some value on clinical diagnosis of foetal distress in this setting, as it is far in excess of the 64.6% reported for newborns who showed no evidence of intrapartum distress in the same institution.[11] However, the proportion of those with mildly depressed and normal Apgar scores at birth also justifies a reconsideration of the mode of delivery in an environment where the potential harm of caesarean birth to both mother and baby may outweigh its benefits. Our study reiterates the benefits of combining abnormal FHR with meconium staining of liquor as against singly employing either of the two for intrapartum diagnosis of foetal distress. The relationship between abnormal FHR (as a single entity) and the immediate neonatal outcome in this study was not surprising as the use of intermittent auscultation with the Pinard stethoscope for full assessment of the characteristics of FHR has many limitations.[12] These include its inability to assess baseline FHR variability and poorness in detecting decelerations that occur during uterine contractions. Besides, foetal tachycardia may be a reflection of other influences (such as maternal pyrexia and anxiety) that are not directly related to foetal acidaemia, and in theory may be a sign of good central nervous system response to hypoxia.[13] This is supported by the finding of Gilstrap *et al*[14] who found that umbilical cord blood acidaemia was present in 40% of neonates with foetal bradycardia and only 18% of those with tachycardia.

Conversely, the use of meconium staining of liquor alone as an evidence of non-reassuring foetal condition that warrants urgent delivery is more controversial. While some workers demonstrated that foetuses with meconium stained liquor are at significant risk of neonatal morbidity and mortality,[15,16] others have shown that it correlates poorly with infant condition.[17,18] Fenton and Steer[19] who attempted to separate meconium passage from other markers of foetal compromise indicated from their study that the passage of meconium does not have any hypoxic consequences on the foetus if the FHR is greater than 110 beats per minute. Besides this explanation, the

relationship between meconium staining of liquor (as a single entity) and extent of neonatal depression in our study may be attributable to the lack of discrimination in the consistency of meconium used for diagnosis since the evidence linking thick meconium staining of liquor to severe birth asphyxia is not in dispute.[15] This is supported by the reversal of the relationship between meconium liquor and severe neonatal compromise when the consistency of meconium was separately considered.

Short interval between admission and diagnosis of foetal distress as a determinant of severe neonatal compromise at birth may reflect the profound nature of the hypoxic insult that left obstetrician with little doubt about the severity of ongoing or imminent intrapartum foetal acidosis. This therefore implies that the earlier the diagnosis of foetal distress, the more demanding the resuscitative measures required for the expected neonate.

Of serious concern is the mean decision for caesarean delivery interval that is far in excess of the recommended standard of 30 minutes for foetal distress. This interval is, however, similar to the mean decision-delivery interval for all emergency caesarean sections in another tertiary centre in southwest Nigeria[20] suggesting that foetal distress does not to receive special treatment with respect to swiftness of labour attendants in this environment. Although the decision-caesarean delivery interval in Nigeria is generally long, the reported implications for perinatal morbidity and mortality should be expected to have far more reaching consequences where it concerns foetal distress. While the progression of hypoxic insults tends to be slow and delivery within 30–60 minutes is unlikely to result in serious harm,[21] the proportion of neonates in this study that were delivered after one hour of decision to intervene may have contributed to the recorded neonatal outcome. Nevertheless, the lack of an association between decision-delivery interval and severe neonatal compromise in our study supports the reports of MacKenzie[21] and Dunphy *et al*[22] which showed no relationship between this interval and important neonatal outcome measures.

A recognised limitation of this study is the use of Apgar score for assessment of neonatal condition. Apgar score may not correlate perfectly with neonatal acidaemia and is not universally accepted as evidence of or consequence of asphyxia. Although a low score may be evidence of hypoxia, the scores may also be influenced by other non-asphyxial factors that affect infant's responsiveness, tone and respiration.[23] While this calls for caution in the application of our study findings to settings where neonatal outcome is assessed differently, it should be realised that low Apgar score at one minute nevertheless suffices as an excellent indicator of infants in need of resuscitation in a setting where no other method of assessment is available. In addition, it remains relevant in our environment where Apgar score is the primary tool used for determination of resuscitation needs of babies and selection of those requiring intensive care.

In conclusion, a significant proportion of neonates delivered abdominally following clinical diagnosis of foetal distress in this institution were severely compromised at birth suggesting that this method is still valuable in identifying foetuses in need of expedited delivery in this setting. The identified predictors of very low Apgar score at birth may serve as potential targets for interventions to prevent intrapartum foetal death and severe neonatal morbidity and mortality especially in situations where the option of conservative management also exists.

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