

Decision to Delivery Interval, Fetal Outcomes and Its Factors Among Emergency Caesarean Section Deliveries at South Gondar Zone Hospitals, Northwest Ethiopia: Retrospective Cross-Sectional Study, 2020

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Purpose: Although its fetal outcomes and practicality are unclear time interval between decision-to-delivery ≤ 30 minutes in emergency caesarean section (CS) is the internationally accepted standard of practice. This study aimed to determine whether a decision to delivery interval (DDI) of approximately 30 minutes was achieved in daily practice, its fetal outcomes, and associated factors among emergency caesarean section delivery at South Gondar Zone Hospitals, Northwest Ethiopia.

Patients and Methods: Retrospective cross-sectional study was carried out from August 1–30/2020 among emergency caesarean sections. Information was collected from the birth register book and individual files of standardized facility booking forms. The data was encoded and entered into Epi-Data version 4.2 and exported to SPSS version 23 for analysis. A bivariable and multivariable logistic regression analysis was conducted and a significant association was recorded at $p < 0.05$.

Results: Only 17.5% of parturients attained a decision-to-delivery interval ≤ 30 minutes. The average median of decision to delivery interval was 54 minutes with interquartile range (IQR) of 48–80 minutes. Time taken to collect material with Adjusted odds ratio (AOR=10.3, 95% CI 5.87–45.7), time of decision (AOR=0.32, 95% CI, 0.15–0.67), and time taken from decision to delivery to delivery of anesthesia (AOR=4.74, 95% CI, 1.30–17.3) were the predictors of prolonged delivery time interval. Significant fetal adverse outcomes were not observed in a decision to delivery interval higher than 30 minutes.

Conclusion: In most cases, delivery was not completed within the prescribed ≤ 30 -minutes interval, particularly in developing countries with infrastructural challenges, however, fetal outcomes were not directly correlated. Despite lack of substantial linkage between the delivery time declaration and fetal events, an unreasonable gap from the decision-making to birth of the child is not appropriate and should be discouraged.

Keywords: caesarean section, decision to delivery interval, fetal outcome, Ethiopia

Introduction

Caesarean section (CS) is an important part of global maternal health care.¹ Recent evidence indicates that the goal of the World Health Organization (WHO) for secure access and quality of care (QoC) for pregnant women and newborns in Africa has not yet been achieved.^{2,3} Depending on the severity of the fetal and/or maternal condition, a new

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classification for caesarean section was developed and this categorization of CS can help to prioritize patients. Emergency (classification I), urgent (classification II), scheduled (classification III), and elective (classification IV) were the four-category classification schemes proposed by Lucas et al.⁴

Emergency caesarean section is delivery of the fetus within 30 minutes since there is an immediate risk to the life of the mother or newborn, or both during delivery.⁴⁻⁶ The decision-to-delivery interval (DDI) is measured as the time from the date and time of notification of the procedure to the delivery of the newborn.⁷ Ethiopia has made important achievements in improving perinatal and maternal health, as per the World Health Organization report.⁸ However, Ethiopia is among the highest maternal mortality in Africa, with 412 out of 100,000 live births and neonatal death rates of 29 out of 1000 live births, according to the 2016 Ethiopian Demographic Health Survey.⁹

A crucial time interval that decides the fate of fetomaternal outcomes in obstetric emergency operational deliveries is the time elapsed from decision to birth.^{5,10} This vital period should not exceed 30 minutes, based on the American College of Obstetricians and Gynecologists Council on Professional Responsibility for Emergency CS, and similar guidelines have been provided by other foreign professional bodies.¹¹⁻¹⁴ Due to overcrowded and fragile health care systems in developing nations, the total DDI is often extended to 75 minutes without significant morbidity.¹⁵ Retrospective research performed in the United States has also shown that there is no major improvement in the proportion of intensive care enrollment in babies born within 30 minutes compared to those delivered over 75 minutes.¹⁶

However, if the DDI is pushed past 75 minutes, substantial maternal and neonatal morbidities and mortality are likely to occur.¹⁷ A recent study in Nigeria reported that 5.1% perinatal mortality and 1% fresh stillbirth is statistically significant with an increase in DDI beyond 75 minutes.¹⁷ Another retrospective research carried out in Ghana also found that increased DDI was strongly linked to hostile perinatal outcomes.¹⁰ The main objective of this research was to assess compliance of DDI with international standard of care, its influence on fetal results, and contributing variables that affect DDI in emergency cesarean section delivery ((ie, emergency) CS \leq 30 minutes) at South Gondar Zone Hospitals, Northwest Ethiopia.

Methods

Study Design

A quantitative retrospective cross-sectional design was used in selected Hospitals of South Gondar Zone, Northwest Ethiopia.

Study Setting and Period

This research was conducted in Northwest Ethiopia South Gondar Zone Hospitals. Among the eleven administrative districts of the Amhara regional state of Northwest Ethiopia, the South Gondar Zone was one of, and it comprises 15 Woredas. The zone has one comprehensive specialized and seven primary hospitals that provide emergency caesarean section deliveries. Based on the number of caesarean section deliveries and functionality of NICU ward availability, we intentionally selected four hospitals. In Debre Tabor Town (Debre Tabor Specialized Hospital), in Libokemkem woreda (Addis Zemen Primary Hospital), in Laygaint woreda (Nefas Mewucha Primary Hospital), and Estie woreda (Mechane Eyesus Primary Hospital) were selected. Using a validated checklist from 1-30 August 2020, the actual data for emergency caesarean section delivery was collected.

Study Population

Study populations comprised inpatient women who undergone emergency caesarean deliveries of two months (from 1 June to 31 July 2020).

Eligibility Criteria

Pregnant mothers who were assigned in the prenatal unit for obstetrical service and subsequently undergone emergency caesarean delivery were included in the study. Mothers having insufficient/incomplete information on the patient charts, those with hypertensive disorders, and those transferred from other health care facilities for critical obstetric service were removed. Mothers with hypertensive condition were omitted to reduce prejudice attributable to pre-established fetal impairment and slowdown from recovery and the need for more through inquires and those transferred from other institutions 'were omitted to minimize 1st and 2nd delays as possible confounding variables.

Data Source

Mothers' details were collected from the health care birth register of Debre Tabor Specialized Hospital, Addis Zemen Primary Hospital, Nefas Mewucha Primary Hospital, and Mehcane Eyesus Primary Hospital and medical records of maternal files. Chart abstraction based on the checklist detected

mothers' age, parity, gravidity, gestational age, and the indication for as well as the type of caesarean delivery along with newborn outcomes. To approximate the period from which the decision to perform delivery was made, maternal card records were used to extract detailed data, anesthesia records have been used to measure the pattern once anesthesia induction was started and the time when newborn delivery took place. Newborn indicators were reported such as 1st and 5th min APGAR scores, the need for a bag and mask resuscitation and intubation, transfer to neonatal intensive care unit (NICU), and newborn death.

Operational Definition

DDI: Time from deciding to perform cesarean delivery to fetal delivery.¹⁸

Ethical Consideration

Ethical clearance was secured from the institutional Ethics Review Committee of Debre Tabor University to do the research. Besides, permission was sought from the Medical Record Office of the selected hospitals on the use of patient files from the database. Approval was also gained to use the birth register from the labour ward. Patient informed written consent to review their chart was not required and consent was waived due to the retrospective nature of the review. The privacy and dignity of the respondents were assured by making all the information anonymous and confidential. This paper complies with the principles enunciated in the declaration of Helsinki.

Analysis and Interpretation of Data

The gathered information was encoded and loaded into Epi-Data version 4.2 then transferred to SPSS version 23 for analysis. For categorical data, descriptive statistical analysis has been presented using frequency and percentage. The DDI for each condition was estimated using the median and interquartile range. To see the relationship between the outcome and explanatory variables binary and multivariable logistic regression analysis were conducted. Variables that displayed a relationship in binary logistic regression analysis and with P-value less than 0.20 were incorporated into multivariable logistic regression analysis model by controlling the possible confounding factors. Finally, statistical significance was announced by using $p < 0.05$ at 95% CI.

Results

Socio-Demographic Characteristics

A total of 510 mother charts were reviewed for this study. Among these more than half of the participants, 287 (56.3%) were found in the age group of 25–34 years old with the mean age of 27.10 SD (± 4.75) years. Regarding educational background around half 250 (49%) of respondents had completed college and above by their education. About 194 (38%) of respondents were housewife. Majority of the participants 313 (65.1%) have no history of previous caesarean section delivery. Around three forth 372 (72.9) of the emergency CS were done at a gestational age of between 37 and 40 weeks with the mean GA of 38.50 \pm SD 1.80 weeks (Table 1).

Table 1 Socio-Demographic and Reproductive Characteristics Study Participants, South Gondar Zone Hospitals, Northwest Ethiopia (N=510)

Characteristics	Frequency	Percent (%)
Age in years		
15–24	163	32.0
25–34	287	56.3
≥ 35	60	11.7
Ethnicity		
Amhara	500	98.0
Others*	10	2.0
Religion		
Orthodox	462	90.6
Muslim	41	8.0
Others**	7	1.4
Educational status		
No formal education	76	14.9
Primary	98	19.2
Secondary	86	16.9
College and above	250	49.0
Occupational status		
House wife	194	38.0
Government employed	150	29.5
Private business	166	32.5
History of previous CS		
No previous CS	313	61.4
One previous CS	162	31.7
Two or more previous CS	35	6.9
Gestational age in week		
≤ 36	54	10.6
37–40	372	72.9
≥ 41	84	15.5

Notes: *Oromo, Tigray, Gurage; **Protestant, catholic.

Table 2 Indication of Emergency Caesarean Section, South Gondar Zone Hospitals, Northwest Ethiopia (N=510)

Indication	Frequency	Percent	DDI in Minute
			Median (IQR)
NRFHRP	123	24.1	48 (29–54)
CPD	80	15.7	55 (54–72)
Failed induction	78	15.3	76 (54–95)
Malpresentation	40	7.7	65.5 (54–83.5)
Placenta previa	37	7.3	53 (49–54)
Abruptio placenta	34	6.7	54 (53–55)
≥2 previous scars in labour	29	5.7	55 (53–78)
Prolonged labour	22	4.3	78.5 (78–85)
Impeding uterine rupture	7	1.4	54 (49–51)
Failure of trial of scar	6	1.2	53.5 (52–60)

Abbreviations: CPD, cephalopelvic disproportion; DDI, decision to delivery interval; IQR, interquartile range; NRFHRP, non-reassuring fetal heart rate pattern.

Indication of Emergency Caesarean Delivery

The principal indications for emergency C/S were non-reassuring fetal heart rate patterns (NRFHRP) 123 (24.1%) and Cephalopelvic disproportionate (CPD) 80 (15.7%) followed by failed induction 78 (15.3%) and prolapsed umbilical cord. More than three fourth of the participants 421 (82.5%) has a DDI of longer than 30 minutes but, only 89 (17.5%) of deliveries were accomplished within the suggested DDI 30 minutes. The overall media of DDI was 54 minutes (IQR 48–80 minutes) and the median time from DDI to transfer of patients to Operation Theater was 25 minutes (IQR16–39 minutes). The median of time required from decision of CS to delivery of anesthesia was 23 minutes (IQR 16–32 minutes) and from anesthesia to birth of the fetus was 9 minutes (IQR 8–12) (Table 2).

Factors Associated with DDI

In binary logistic regression availability of materials, time of decision, type of anesthesia, the decision to anesthesia time, experience of surgeons, and experience of anesthetists had a statistically significant influence on DDI.

In multivariable logistic regression analysis after modifying certain confounders by using backward likelihood stepwise method; time taken to collect instrument, time of the decision, and time needed from the decision to delivery

of anesthesia were related with prolonged DDI longer than 30 minutes.

Compared with easily available surgical material, the odds of having longer DDI more than 30 minutes were 10.3 (AOR=10.3, 95% CI 5.87–45.7) times higher in materials that took time to collect. About 68.8% of mothers who undergone emergency caesarean deliveries during night time (AOR=0.32, 95% CI, 0.15–0.67) had shorter DDI below 30 minutes as compared to CS deliveries performed at day time. DDI to anesthesia time longer than 30 minutes has nearly 5 times (AOR=4.74, 95% CI, 1.30–17.3) more likely to has longer DDI more than 30 min as compared to DDI to anesthesia less than 30 minutes (Table 3).

Newborn Results of Emergency Caesarean Delivery

The newborn finding that was identified in our research were 1st and 5th minute Apgar score, bag and mask resuscitation, intubation, shift to neonatal intensive care unit, early neonatal sepsis, early neonatal deaths, and stillbirths. Among 510 caesarean section deliveries, Apgar scores of less than 7 was documented in 75 (14.7%) newborns at the 1st minute and in 43 (8.4%) at the 5th minute. Bag and mask resuscitation was performed in 85 (16.7%) babies, 14 (2.7%) newborns were intubated and 45 (8.8%) were shift to the neonatal intensive care unit, 26 (5.1%) newborns were developed neonatal sepsis, and 12 (2.4%) newborns died. Among 421 babies who were born after 30 minutes, 56 (13.3%) had APGAR score less than seven at the 1st minute, 28 (6.7%) had APGAR score less than seven at the 5th minute, 79 (18.8%) provided resuscitation through bag-mask ventilation, 12 (2.9%) had intubation, and 39 (9.3%) were admitted at NICU ward (Table 4).

Discussion

Our study found that only 89 (17.5%) of emergency CS deliveries were achieved a proposed DDI of ≤30 minutes. The median DDI was 54 minutes, with an interquartile range of 48–80 minutes. This outcome was in parallel with a study done at University of Gondar specialized hospital which concluded that 19.6% of clients who undergoes emergency CS were born with the recommended DDI of 30 minutes.¹⁹ But the result was lower than a study conducted in Oman showing that in 23.8% of emergency CS deliveries, a DDI less than 30 minutes was achieved.²⁰

Table 3 Bivariate and Multivariate Logistic Regression Analyses on Predictors of DDI in Emergency Caesarean Section, at South Gondar Zone Hospitals, Northwest Ethiopia (N = 510)

Variables	DDI		COR	AOR	P-value
	≤ 30 Min	> 30 Min			
	N (%)	N (%)			
Availability of materials					
Easily available	88 (29.2)	213 (70.8)			
Took time to collect	10 (4.8)	199 (95.2)	11.8 (6.22–52.2)	10.3 (5.87–45.7)	0.000*
Time of decision					
Day	7 (2.8)	245 (97.2)			
Night	82 (31.8)	176 (68.2)	12.9 (7.35–36.13)	0.32 (0.15–0.67)	0.000*
Previous CS					
≥two previous CS	15 (42.8)	20 (57.1)			
One previous CS	68 (41.9)	94 (58.1)	1.03 (0.954–2.144)	0.73 (0.13–2.15)	0.321
No previous CS	52 (16.6)	261 (83.4)	3.76 (0.98–5.42)	1.42 (0.67–6.86)	0.976
Type of anesthesia					
General	48 (34.3)	92 (65.7)			
Regional	41 (11.1)	329 (88.9)	4.18 (2.59–6.74)	1.51 (0.47–4.90)	0.074
Decision of CS to anesthesia					
≤15 minutes	7 (2.1)	327 (97.9)			
>15 minutes	82 (46.6)	94 (53.4)	9.56 (3.41–23.28)	4.74 (1.30–17.3)	0.018*
Experience of surgeons					
Obstetricians	73 (29.1)	178 (70.9)			
Emergency surgeons	16 (6.2)	243 (93.8)	2.22 (3.50–11.06)	0.89 (0.07–7.54)	0.071
Experience of anesthetists					
MSc holders	58 (24.2)	181 (75.8)			
BSc holder	41 (17.0)	199 (83)	6.79 (3.54–18.94)	6.1 (0.99–21.2)	0.059
BSc student	9 (20.0)	22 (80)	1.13 (0.71–1.79)	1.08 (0.29–4.01)	0.900
Anesthesia to delivery of baby					
≤10minutes	57 (17.2)	275 (82.8)			
>10minutes	32 (18)	146 (82)	0.94 (0.58–1.52)	1.27 (0.44–3.66)	0.640

Note: *P-value ≤ 0.05 considered as statistically significant.

Abbreviations: COR, crude odds ratio; AOR, adjusted odds ratio.

On the contrary, our result is higher than research conducted in Tanzania which found that only 12.3% of emergency CS was achieved by a DDI of less than 30 minutes and the median of DDI was 60 minutes (IQR 40–120 minutes).²¹ Our findings are also higher than those of 5.7% in Nigeria⁷ and 5.2% in South Africa.²² The variation may be explained due to the time gap between studies and socio-demographic differences.

According to our finding, the time elapsed to receive operational supplies is directly linked to longer DDI in emergency CS (AOR= 10.3, 95 CI, 5.87–45.70). The result is consistent with the study of the specialized hospital at the University of Gondar.¹⁹ A study conducted by

Tak Yeung Leung and Lao; concluded that if operational supplies were readily available, a DDI below 30 minutes was achievable.²³ Similar study results have suggested that the key explanation for longer DDI time was the unavailability of surgical equipment.²⁴

Based on our finding, 68.8% of emergency CS deliveries made at night time were found to have shorter DDI below 30 minutes (AOR= 0.32, 95 CI, 0.15–0.67) compared to day time. A Thailand study concluded that when the CS decision was made after working hours, DDI was considerably shorter than during working hours.²⁵ Our conclusion was also consistent with the study conducted in Uganda which stated that DDI was extended by CS

Table 4 Bivariate Logistic Regression Analyses on Neonatal Outcomes in Emergency Caesarean Section, at South Gondar Zone Hospitals, Northwest Ethiopia (N = 510)

DDI in Min	Fetal Outcomes		COR	P-value
≤30 minutes >30 minutes	APGAR score at 1st minute		1 1.76 (0.99–3.15)	0.44
	<7, n (%) 19 (21.3)	≥7, n (%) 70 (78.7)		
≤30 minutes >30 minutes	APGAR score at 5th minute		1 2.84 (0.44–5.58)	0.23
	<7, n (%) 15 (16.9)	≥7, n (%) 74 (83.1)		
≤30 minutes >30 minutes	Bag and mask resuscitation		1 0.31 (0.13–3.74)	0.08
	Yes, n (%) 6 (6.7)	No, n (%) 83 (93.3)		
≤30 minutes >30 minutes	Intubation		1 0.78 (0.17–3.56)	0.75
	Yes, n (%) 2 (2.2)	No, n (%) 87 (97.8)		
≤30 minutes >30 minutes	NICU admission		1 0.70 (0.29–1.72)	0.12
	Yes, n (%) 6 (6.7)	No, n (%) 83 (93.3)		
≤30 minutes >30 minutes	Neonatal sepsis		1 0.60 (0.17–2.05)	0.41
	Yes, n (%) 3 (3.4)	No, n (%) 86 (96.6)		
≤30 minutes >30 minutes	Neonatal death		1 1.59 (0.42–6.02)	0.48
	Yes, n (%) 3 (3.4)	No, n (%) 86 (96.6)		

performed at day time than those performed overnight.²⁶ This may be explained by the operating table that could have invaded elective customers in the daytime. This showed that the patient handling procedure can be simple during the night time, and there is also accessibility at night time to the operating theater since almost all elective procedures are conducted during the day time.

In this study decision of CS to anesthesia time longer than 15 minutes has a statistically significant relationship with prolonged DDI (AOR=4.74, 95% CI, 1.30–17.3). The finding was in line with studies from Uganda,²⁶ Tanzania,²¹ Nigeria⁷, and Kenya²⁷ which revealed that gaps in the formulation and induction of anesthesia were

statistically linked with prolongation of DDI. This might be explained by most of the time anesthetists were not available at the ward and were more active somewhere in the hospital when needed for operation.

The findings of our study showed that as opposed to spinal anesthesia, emergency CS performed by general anesthesia usually had lower DDI, which was 48 (34.3%) vs 41 (11.1%). As we do not have adequate evidence, it is rather difficult to ascribe cause and effect, but we presume that cases labeled as very high risk were moved to the theatre more rapidly and were, therefore, more likely to receive GA, ie, a faster transfer rather than a shorter DDI contributed to the GA. Different studies showed that general anesthesia was positively correlated with lower DDI than spinal anesthesia for emergency operational deliveries.^{22,28,29}

None-reassuring fetal heart rate patterns (NRFHRP) were the commonest indications for emergency CS. This was supported by a study from Thailand that showed that NRFHRP was the leading indication of emergency CS deliveries and 3/4th of mothers with an indication of NRFHRP were delivered within the recommended DDI of 30 minutes.²⁵ The result was also consistent with a study done by Abdissa et al³⁰. Mothers with possible hazards such as cord prolapse had a lower DDI with a 30-minute median DDI (IQR 29–48 min) and achieve a 30-minute DDI. This was in line with previous research carried out in Ghana.¹⁰ This might be explained by the fact that, in such a case, immediate action was taken without any hesitation, since these clients were at greater risk of adverse fetomaternal outcomes.

Although these emergency cesarean sections are with the indicated indications, they may also occur due to uterine rupture and life-threatening bleeding. In such cases, poor results such as hysterectomy, hypogastric artery ligation, and relaparotomy have been reported.^{31–34}

In our finding, almost half of the operation (50.8%) was conducted by emergency surgeons and 49.2% by senior obstetricians. DDI attainment less than 30 minutes was 6.2% vs 29.1%, respectively. But, the background of surgeons was not an important predictor for DDI. This is equivalent to a prospective study conducted by Mackenzie and Cooke et al which declared that the physicians' years of experience did not affect DDI.²⁸ However, this finding needs more additional research.

As per finding, anesthetic service was given by BSc holder anesthetists in most of the clients (47.1%), and the rest 46.8, and 6.1% by MSc holders, and BSc undergraduate students, respectively. In contrast to this finding

prospective cohort study done by Temesgen et al showed that majority of the cases (44.6%), 32.5% and 11.7% of anesthetic service is delivered by BSc holders, MSc students, and MSc holders, respectively.¹⁹ According to the finding of this study practice of the anesthetists had no significance with DDI. However, a study has shown that the lack of expertise of obstetrician, anesthetists, and pregnant women unwillingness to sign may be obstacles to attain faster DDI.²⁴

Our finding revealed that DDI lower than 30 minutes did not improve or degrade the neonatal effects. This result was supported by different kinds of literature which indicated that no significant interaction was discovered among DDI and fetal consequences through emergency operational deliveries.^{25,26,35} Neonatal outcomes do not change for the decision to delivery duration of 75 minutes, but variations from childbirth of more than 75 minutes are associated with worse neonatal results; this effect is enhanced when maternal or fetal compromise is expected. The outcome was comparable with research conducted by Jane Thomas et al, which found that DDI greater than 75 min was positively associated with adverse effects on newborns.¹⁵

Even though DDI has not shown a statistically significant impact on fetal outcomes, it takes more than 30 minutes for most babies with negative events. The results have been supported by previous research indicating that higher DDI has not been statistically relevant concerning bad fetal events.^{19,29,36} Based on the current finding from babies who were born with DDI greater than 30 minutes; 13.3% and 6.7% has APGAR score less than 7 at the 1st minute and 5th minute, respectively, 18.8% got resuscitation through bag-mask and 9.3% had NICU admission.

One drawn back of this research was that due to the retrospective nature of the study, accurate details on the women's intrapartum service may not be determined. Moreover, late neonatal events were not measured; even the initial newborn results were determined simply by using the APGAR score.

Conclusion

In most cases, delivery was not completed within the prescribed ≤ 30 -minute time interval, particularly in developing countries with infrastructural challenges, however, fetal outcomes were not directly correlated. Despite lack of substantial linkage between the delivery time declaration and fetal events, an unreasonable gap from the decision-making to the birth of the child is not appropriate and

should be discouraged. Time taken to gather supplies, time of decision, and time taken from DDI to delivery of anesthesia were significantly related to prolonged DDI.

We highly suggest that supplies that are essential for emergency operational delivery must be easily accessible in the nearby stock room and obstetric dispensary. The authors also recommended that a more realistic time of 30–75 minutes may be reasonable for most cases under comparable setup. Simultaneously, for each emergency obstetric unit, it is important to efficiently dispatch clients and to improve the capacity to begin those cases as quickly as possible.

Abbreviations

AOR, Adjusted Odds Ratio; APGAR, Appearance Pulse Grimace Activity Respiration; CPD, Cephalopelvic Disproportion; CS, Caesarean section; DDI, Decision Delivery Interval; IQR, Interquartile Range; NICU, Neonatal Intensive Care Unit; NRFHRP, Non-Reassuring Fetal Heart Rate Pattern.

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