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ORIGINAL RESEARCH

Decision-to-Delivery Interval and Obstetric Outcomes of Emergency Caesarean Sections in a Nigerian Teaching Hospital

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Abstract

Background: Prolonged Decision-to-Delivery interval (DDI) is associated with adverse maternal-foetal outcomes following emergency Caesarean section (EmCS).
Objectives: To determine the DDI, predictive factors, and the foeto-maternal outcomes of patients that had EmCS in a Nigerian Teaching Hospital.
Methods: A descriptive study of all EmCS performed at the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife, Nigeria, from 1st June 2020 to 31st May 2021, was conducted. Relevant data were extracted from the documentations of doctors, nurses and anaesthetists using a designed proforma. The data obtained were analysed using the IBM SPSS Statistics for Windows, version 25.
Results: The median (IQR) DDI was 297 (175-434) minutes. Only one patient was delivered within the recommended DDI of 30 minutes. The most common cause of prolonged DDI was delay in procuring materials for CS by patients' relatives(s)/caregiver(s) (264, 85.2%). Repeat CS (AOR = 4.923, 95% CI 1.09-22.36; p = 0.039), prolonged decision-to-operating room time (AOR = 8.22, 95% CI 1.87-8.66; p<0.001), and junior cadre of surgeon (AOR = 25.183, 95% CI 2.698-35.053; p = 0.005) were significant predictors of prolonged DDI. Prolonged DDI > 150 minutes was significantly associated with maternal morbidity (p = 0.001), stillbirth (p = 0.008) and early neonatal death (p = 0.049).
Conclusion: The recommended DDI of 30 minutes for CS is challenging in the setting studied. To improve foeto-maternal outcomes, efforts to reduce the DDI should be pursued vigorously, using the recommended 30 minutes as a benchmark.

Keywords: Decision-delivery interval, Emergency Caesarean delivery, Foeto-maternal outcomes, Maternal morbidity and mortality, Perinatal morbidity and mortality.

Introduction

Category 1 or emergency Caesarean section (EmCS) is performed when there is an immediate threat to the life of the mother or/and the foetus.[1] The interval between a decision by an Obstetrician to conduct an EmCS and the delivery of the baby is the Decision-to-Delivery interval (DDI).[2] This interval is a key indicator of the quality of maternity care and a significant predictor of maternal and neonatal outcomes in EmCS.[2,3] The Royal College of Obstetricians and Gynaecologists (RCOG), the American College of Obstetricians and Gynaecologists (ACOG), and the American Academy of Paediatrics (AAP) recommend that the DDI for EmCS should be within 30 minutes.[4,5] This is due to cerebral damage risk with prolonged foetal anoxia. A DDI of more than 30 minutes constitutes a phase three delay in providing emergency obstetric care and has been linked with adverse foeto-maternal outcomes.[6]

Despite evidence demonstrating the benefits of accomplishing delivery within 30 minutes when an EmCS is indicated, obstetric units in both high- and low-income countries mostly need help to achieve the 30-minute recommendation for various reasons.[2] In a national audit of CS in the United Kingdom (UK), only 63 % of obstetric units could perform up to 50 % of their EmCS within 30 minutes.[7] The situation is worse in developing countries, where most obstetric units are not adequately funded, understaffed, over-stretched, with insufficient infrastructural support, and sub-optimally motivated maternity staff, many of whom may need better training in emergency service delivery.[6] In Nigeria, studies conducted in different parts of the country have reported mean DDIs of between 106 and 511 minutes.[8-11] Evidence from these studies has been contradictory regarding the correlation between prolonged DDI and adverse maternal and perinatal outcomes, with some reporting no significant associations.[6,10]

Being an indicator of the quality of emergency obstetric care, a measure of the overall performance of an obstetric unit, and a predictor of foeto-maternal outcomes following EmCS, regular audits of DDI should be conducted by obstetric units.[12] The last audit of DDI at the Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife, Nigeria, where this study was conducted, published in 2006 by Orji *et al.*, revealed a mean DDI of 4.48 hours, which was nine times longer than the recommended 30 minutes.[13] Since then, however, there has not been any follow-up study to ascertain if progress has been made, especially when the Sustainable Development Goal (SDG) targets are challenging all countries to eliminate all avoidable maternal and perinatal deaths. This study, therefore, sought to determine the current DDI, assess the factors influencing the DDI, and the effects of prolonged DDI on maternal and perinatal outcomes of EmCS at the OAUTHC, Ile-Ife, Nigeria.

Methods

This study was a descriptive, retrospective study of the records of all patients who had EmCS conducted in the Department of Obstetrics and Gynaecology, Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Nigeria, from 1st June 2020 to 31st May 2021. Categories 1 and 2 CS were reviewed for this study, as it is our practice in the unit to consider Category 1 and Category 2 CS as EmCS, with a reference DDI of 30 minutes for both categories.

In the Obstetric Unit of the OAUTHC, booked and unbooked pregnant women with obstetric emergencies present to the Obstetric Emergency Room, where they are promptly reviewed by the Labour Ward Team, comprising Consultant, Resident Doctors and Interns. Patients who require EmCS will be identified and counselled for the procedure, and written informed consent will be obtained. Samples for urgent packed cell volume (PCV), urinalysis, and crossmatching of at least two units of blood will be processed in the laboratory. Additional investigations may be requested based on the indication for the CS. Emergency CS surgical consumable packs are sometimes available in the Labour Ward Theatre for use and to be replaced by the patient after surgery. Often, these packs are unavailable as many patients do not replace them after surgery. In such instances, surgical packs for CS are requested from and supplied by the hospital pharmacy. These packs often do not contain all the required CS materials, and in such instances, patients' relatives have to purchase the unavailable materials out-of-pocket.

Ethical consideration

This retrospective study involving only a review of completely anonymised information without any intervention in patient care was not considered to require approval by the Ethics Committee of the hospital.

Data collection

Relevant data related to the sociodemographic and obstetric characteristics of the study population, indications for EmCS, transfer, anaesthesia and operation times, DDI and associated factors in cases with delays, as well as maternal and perinatal outcomes of the EmCS, were extracted from the records of the doctors, nurses and anaesthetists using a purpose-designed proforma.

The following operational definitions were used for the study:

Category 1 or EmCS: Caesarean section is performed when there is an immediate threat to the life of the woman or/and foetus, requiring delivery within 30 minutes.[1] Examples include abruptio placentae, uterine rupture, and cord prolapse with a live foetus.

Category 2 or Urgent CS: Caesarean section performed when there is a maternal or foetal compromise that is not immediately life-threatening, requiring delivery of the foetus within 75 minutes.[1] An example is failure of labour progress due to cephalopelvic disproportion and failed induction of labour.

Decision-to-delivery interval (DDI): The time between the decision for an EmCS and the baby's delivery. A DDI of more than 30 minutes was considered prolonged. [4, 5]

Decision-to-operating room interval (Transfer time): The time from the decision for EmCS to arrival in the operation theatre (OT). A transfer time of more than 15 minutes was considered prolonged.[2]

Operating room-to-incision interval (Anaesthesia time): The time between arrival in the OT and the start of anaesthesia to skin incision.[3]

Incision-to-delivery interval (IDI): The time from skin incision to baby delivery. An IDI of more than 5 min was considered prolonged.[2,3]

Social class: The women's social class was determined using their level of education and their husbands' occupation, according to the recommendation of Olusanya *et al.* [14]. According to this scheme of classification, the husband's occupation was scored 1 to 3, while the woman's level of education was scored 0 to 2, giving a possible total score of 5. A score of 1 or 2 was classified as belonging to the high social class. A score of 3 represented the middle social class, while a woman with a score of 4 or 5 belonged to a low social class. The husband's occupation was scored 1 for a professional, top civil servant, politician or businessman; 2 if a middle-level bureaucrat, technician, skilled artisan or well-to-do trader; and 3 if an unskilled worker or any other worker with a monthly income at or below the minimum wage. The woman's level of education was scored 0 if educated up to university level; 1 for secondary or tertiary level of education below the university level, e.g. college of education,

school of nursing, etc.; and 2 for no formal education or primary level of education. For single women, their level of education and occupation were used to determine their social class.

Data analysis

The data were analysed using the IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, version 25 (IBM Corp., Armonk, NY, USA). Frequencies and percentages were presented in tables, and univariate and multivariate statistical analyses were conducted to determine the predictors of prolonged DDI and the association between prolonged DDI and maternal and perinatal outcomes. The significance level was set at <0.05 at 95 % Confidence Interval.

Results

Within the study period, there were 1,883 deliveries, of which 913 were Caesarean deliveries, giving a CS rate of 48.5%. Some 72.3% (660/913) of the CS were EmCS. Of this number, 313 case records were retrieved and deemed suitable for analysis, giving a retrieval rate of 47.4%.

Sociodemographic and obstetric characteristics of the women that had EmCS

The mean maternal age was 30.5±5.6 years. Most women (181, 57.8 %) had tertiary education and belonged to the middle social class (132; 42.2%). Most (195, 62.3 %) were booked, primigravid (137; 43.8%), and with singleton gestations (295; 94.2%). The mean maternal body mass index (BMI) was 27.9±5.0 kg/m^2, with a mean gestational age at admission of 38.0±3.0 weeks. These sociodemographic and obstetric characteristics are shown in Table I.

Types, indications and other characteristics of EmCS

The predominant indication for EmCS was cephalopelvic disproportion/labour dystocia in 85 (27.2%). Transverse lower segment CS was done in all cases. Spinal anaesthesia was the most common anaesthesia used (286; 91.4%). Most (278; 88.8%) of the EmCS were performed by Senior (Specialist) Registrars. The mean estimated blood loss (EBL) was 515.1±258.2ml, and 47 (15.0%) of the patients required blood transfusion. The median (IQR) duration of hospital stay was 4 (3-5) days (Table II).

Maternal and perinatal outcomes of EmCS

Ninety-three (29.7 %) women had complications. The most common maternal complications included post-operative anaemia (74; 23.6%), postpartum haemorrhage (PPH) (22; 7.0%), and puerperal/wound sepsis (18; 5.8%). One woman suffered anaemic heart failure from severe post-operative anaemia, while two had subtotal hysterectomy due to intractable PPH. One intensive care unit (ICU) admission and one maternal death put the case-fatality rate at 0.6%. The ICU admission was for severe post-operative anaemia. The patient had EmCS for antepartum haemorrhage with severe anaemia due to placenta praevia with intrauterine foetal death. The maternal death was due to intractable primary PPH secondary to uterine atony. She had suffered suspected disseminated intravascular coagulation and continued bleeding despite applying B-Lynch compression sutures.

Of the 332 babies delivered (295 singletons, 17 twins and one set of triplets), 134 (40.4%) were admitted into the neonatal intensive care unit (NICU). Birth asphyxia (67/134, 50.0%) was the most common indication for NICU admission. One-fifth (71/332, 21.4%) of all the babies suffered birth asphyxia. The mean birth weight was 2 867±738g while the mean Apgar scores at 1 minute and 5 minute were 8±2 and 9±1, respectively. There were 15 stillbirths and seven early neonatal deaths, giving a perinatal mortality rate of 66.3 per 1000 births. Table III depicts maternal and perinatal complications based on CS indication.

Transfer and anaesthesia times, IDI, DDI, and causes of prolonged DDI for EmCS

The median (IQR) transfer time and IDI were respectively 222 (120-370) minutes and 6 (4-8) minutes, while the mean anaesthesia time was 52.5±22.3 minutes. Most patients had prolonged transfer time (309; 98.7%) and IDI (187; 59.7%). The median (IQR) DDI was 297 (175-434) minutes, with modal (4, 1.3 % each) DDIs of 150 minutes and 441 minutes.

Table I: Sociodemographic and obstetric characteristics of study participants

Characteristics	*Frequency, n = 313*	*Percentage (%)*
Age (Years)		
<20	5	1.6
20-29	135	43.1
≥30	173	55.3
Educational status		
No formal education	1	0.3
Primary	6	1.9
Secondary	109	34.8
Tertiary	181	57.8
Unrecorded	16	5.1
Socioeconomic status		
High	94	30.0
Middle	132	42.2
Low	84	26.8
Unspecified	3	1.0
Parity		
Primigravida	137	43.8
Multipara	172	55.0
Grand multipara	4	1.3
Number of previous CS		
0	239	76.4
1	56	17.9
≥2	18	5.8
Total	313	100

The DDIs for different CS indications are shown in Table III. Only one (0.3 %) woman was delivered within the recommended 30 minutes of deciding on an EmCS, and the indication was antepartum eclampsia complicated by abruptio placentae with a live foetus. The DDI for this patient was 28 minutes. The common causes of prolonged DDI included delay in procuring materials for CS by patients' relative(s) (264; 85.2 %), pre-operative laboratory workup (108; 34.8%), unavailability of blood/blood products in the blood bank (29; 9.4%) and lack of theatre space (28; 9.0%). Other causes are shown in Table IV.

Predictors of prolonged DDI for EmCS

Factors that were significantly associated with a prolonged DDI include repeat CS (AOR = 4.923, 95% CI 1.09-22.36; p = 0.039), prolonged decision-to-operating room (transfer) time (AOR = 8.22, 95% CI 1.87-8.66; p< 0.001), and CS done by a Registrar (Junior Resident Doctor) (AOR = 25.183, 95 %CI 2.698-35.053; p = 0.005). On further analysis, women with a previous CS were significantly more likely to have

prolonged IDI than those without prior CS (53/73, 72.6% vs. 131/237, 55.3%; p<0.001). Obese women were twice more likely than non-obese women to have prolonged DDI, but this was not statistically significant (AOR = 2.226, 95% CI 1.75-6.59; p = 0.149) (Table V). They were significantly more likely to have an IDI of >5 minutes than non-obese women (39/60; 65.0% vs. 72/121; 59.5%; p = 0.044).

Table II: Characteristics of EmCS

Characteristics	*Frequency, n= 313*	*Percentage (%)*
Indications**		
Category 1		
Severe preeclampsia/eclampsia	71	22.7
Foetal distress	44	14.1
Antepartum haemorrhage (APH)	35	11.2
Cord prolapse	3	1.0
Category 2		
CPD/labour dystocia	85	27.2
Previous CS in labour/failed TOLAC	39	12.5
Abnormal foetal lie/malpresentation in labour	34	10.9
Maternal request in labour	27	8.6
Failed IOL	4	1.3
Others	23	7.3
Type of anaesthesia		
Spinal	286	91.4
General	23	7.3
Combined spinal-epidural	3	1.0
Epidural	1	0.3
Cadre of surgeon		
Consultant	11	3.5
Senior (Specialist) Registrar	278	88.8
Registrar	24	7.7
Mean (SD) EBL (ml)	515.1 (258.2)	
Median (IQR) duration of hospital stay (days)	4 (3-5)	
Total	313	100

**In our facility, both categories 1 and 2 CS are considered and managed as EmCS, with the same reference DDI of 30 min for both categories; **Multiple CS indications in some patients, hence n>313; CPD-Cephalopelvic disproportion, TOLAC-Trial of labour after CS; IOL-Induction of labour; EBL-Estimated blood loss.*

Maternal and perinatal complications of prolonged DDI

There were no significant adverse maternal and foetal outcomes with prolonged DDI > 30 minute but ≤ 150 minute. However, prolonged DDI > 150 minute was significantly associated with maternal morbidity (p = 0.001), stillbirth (p = 0.008) and early neonatal death (p = 0.049). There was no significant association between prolonged DDI >150 minutes and birth asphyxia (p = 0.349) and neonatal intensive care unit (NICU) admission (p = 0.216) (Table VI). The DDI for the only maternal mortality was 28 minutes. She was the only woman delivered within the recommended DDI of 30 minutes in this study.

Table IIIa: DDI and foeto-maternal complications based on the indications for CS

Characteristics	*CS indication*				
	CPD/ labour dystocia n=85 (%)	*HDP n=71 (%)*	*Foetal distress n=44 (%)*	*Previous CS in labour/ failed TOLAC n=39 (%)*	*APH n=35 (%)*
DDI (minutes)	213 (150-309)	414 (246-683)	239 (159-367)	344 (240-500)	181 (112-330)
Maternal complications, *n=93*					
Postoperative anaemia*	21 (24.7)	19 (26.8)	13 (29.5)	4 (10.3)	14 (40.0)
PPH*	5 (5.9)	7 (9.9)	2 (4.5)	1 (2.6)	6 (17.1)
Hysterectomy due to intractable PPH*	0	0	1 (2.3)	0	1 (2.9)
Bladder injury intraoperative	0	0	1 (2.3)	0	0
Puerperal/wound sepsis*	8 (8.4)	3 (4.2)	2 (4.5)	0	2 (5.7)
Postop urinary retention	1 (1.2)	1 (1.4)	0	0	0
Anaemic heart failure from severe postoperative anaemia*	0	0	1 (2.3)	0	0
Paralytic ileus postoperative	1 (1.2)	0	0	0	0
Acute pulmonary oedema postoperative	0	1 (1.4)	0	0	0
Acute kidney injury postoperative	0	1 (1.4)	1 (2.3)	0	0
ICU admission	0	0	0	0	1 (2.9)
Maternal death*	0	1 (1.4)	0	0	1 (2.9)
Perinatal complications (*n*=332)					
Birth asphyxia*	16 (4.8)	16 (4.8)	9 (2.7)	3 (0.9)	13 (3.9)
NICU admission	31 (9.3)	35 (10.5)	21 (6.3)	3 (0.9)	15 (4.5)
Stillbirth*	4 (1.2)	4 (1.2)	1 (0.3)	1 (0.3)	8 (2.4)
ENND*	2 (0.6)	0	0	0	1(0.3)

**Multiple CS indications in some patients, hence n for total maternal complications, postop anaemia, PPH, hysterectomy, puerperal/wound sepsis, anaemic heart failure, maternal death, birth asphyxia, and stillbirth respectively > 93, 74, 22, 2, 18, 1, 1, 71, and 15 (Table IIIa and IIIb combined).*

n for ENND <7 (Table IIIa and IIIb combined) as the other ENNDs occurred in women who had CS for other indications; DDI expressed as median (IQR) for skewed data and mean (SD) for normally distributed data; CPD – Cephalopelvic disproportion; TOLAC – Trial of labour after CS; APH – Antepartum Haemorrhage; PPH – Postpartum Haemorrhage; ICU – Intensive Care Unit; NICU – Neonatal Intensive Care Unit; HDP - Hypertensive disorders of pregnancy; ENDD - Early neonatal death.

Discussion

The median DDI in this study was 297 minutes. The common causes of prolonged DDI included delay in procuring CS materials by patients' relative(s), pre-operative laboratory workup, and unavailability of blood/blood products in the blood bank. Repeat CS, prolonged decision-to-operating room (transfer) time, and the junior cadre of surgeons were significant predictors of prolonged DDI. Prolonged DDI > 150 minutes was significantly associated with maternal morbidity, stillbirth, and early neonatal death.

The median DDI of 297 minutes found in this study is almost ten times more than the recommended DDI of 30 minutes and is worse than the 4.4 hours and 4.48 hours reported in previous studies by Onwudiegwu *et al.* and Orji *et al.* in the same hospital, 22 and 15 years ago, respectively.[13,15] In the present study, only one (0.3 %) EmCS was done within 30 minutes, as against 6% in the previous study by Orji *et al.*[13] These findings indicate a worsening trend of phase three delay in providing emergency obstetric care in the hospital. This finding is similar to that of another hospital in the same region, where only 0.9% of EmCS were done within 30 minutes.[16]

Table IIIb: DDI and foeto-maternal complications based on the indications for CS

Characteristics	*CS indication*			
	Foetal mal-presentation in labour n=34 (%)	*Maternal request in labour n=27 (%)*	*Failed IOL n=4 (%)*	*Cord pro-lapse n=3 (%)*
DDI (minutes)	353 (193-488)	296 (137)	317 (168-554)	111 (31)
Maternal complications, *n=93*				
Postoperative anaemia*	10 (29.4)	2 (7.4)	1 (25.0)	2 (66.7)
PPH*	6 (17.6)	1 (3.7)	0	0
Hysterectomy due to intractable PPH*	1 (2.9)	0	0	0
Bladder injury intraoperative	0	0	0	0
Puerperal/wound sepsis*	3 (8.8)	3 (11.1)	0	0
Postop urinary retention	0	0	0	0
Anaemic heart failure from severe postop anaemia*	1 (2.9)	0	0	0
Paralytic ileus postoperative	0	0	0	0
Acute pulmonary oedema postop	0	0	0	0
Acute kidney injury postoperative	0	0	0	0
ICU admission	0	0	0	0
Maternal death*	0	0	0	0
Perinatal complications (*n*=332)				
Birth asphyxia*	10 (3.0)	7 (2.1)	2 (0.6)	1 (0.3)
NICU admission	16 (4.8)	10 (3.0)	2 (0.6)	1 (0.3)
Stillbirth*	2 (0.6)	0	0	2 (0.6)
ENND*	1 (0.3)	0	0	1 (0.3)

**Multiple CS indications in some patients, hence n for total maternal complications, postop anaemia, PPH, hysterectomy, puerperal/wound sepsis, anaemic heart failure, maternal death, birth asphyxia, and stillbirth respectively > 93, 74, 22, 2, 18, 1, 1, 71, and 15 (Table IIIa and IIIb combined).*

n for ENND <7 (Table IIIa and IIIb combined) as the other ENNDs occurred in women who had CS for other indications; DDI expressed as median (IQR) for skewed data and mean (SD) for normally distributed data; IOL – Induction of labour; APH – Antepartum Haemorrhage; PPH – Postpartum Haemorrhage; ICU – Intensive Care Unit; NICU – Neonatal Intensive Care Unit; HDP - Hypertensive disorders of pregnancy; ENDD - Early neonatal death.

The most common reason for prolonged DDI in our study was delay in procuring materials for CS by patients' relative(s). The problem of sourcing CS materials and consumables as a cause of prolonged DDI is not peculiar to our facility, as this has similarly been reported by other authors in Nigeria and, indeed, Africa.[6,10,17] Less than 3% of Nigeria's population is enrolled in the National Health Insurance Scheme (NHIS).[18] Consequently, out-of-pocket (OOP) spending is the predominant payment method for healthcare services.[19] More so, owing to suboptimal government funding of public healthcare in Nigeria, medical and surgical supplies, consumables, and medications often need more supply in many public health facilities.[19] Patients, including those scheduled for EmCS, therefore, often have to buy medical countermeasures, including gloves, surgical gowns, caps, drapes, and face masks, as well as anaesthetic medications OOP, because these are not routinely stocked on the wards, emergency or operating rooms, and are often out of stock in the hospital pharmacies.[19] Notably, the previous studies on DDI for EmCS in our facility did not indicate a delay in sourcing CS materials as a cause of prolonged DDI. This observation suggests a deteriorating state of public healthcare financing in our setting.

Prolonged transfer time was also significantly associated with prolonged DDI in this study. Wong *et al.* noted that transfer time was a significant determinant of prolonged DDI, [20] which has been previously corroborated.[3] Midwives play critical roles in preparing women for EmCS, including, witnessing/participating in the informed consent process, shaving, pre-operative urethral catheterisation, removal of jewellery, dentures, makeup and artificial nails, and appropriate gowning.

Table IV: Transfer and anaesthesia times, IDI, DDI and causes of prolonged DDI for EmCS

Characteristics	*Frequency*	*Percentage (%)*
Intervals (min)*		
Decision-to-operating room (Transfer time) (n=309)		
≤15	4	1.3
>15	305	98.7
Operating room-to-incision (Anaesthesia time) (n=307)		
≤10	4	1.3
>10	303	98.7
Incision-to-delivery (n=310)		
≤5	126	40.6
>5	184	59.4
Decision-to-delivery (n=310)		
≤30	1	0.3
>30	309	99.7
Causes of prolonged DD1**		
Delay in patients' relative(s)/caregiver(s) procuring materials for CS	264	85.2
Pre-op laboratory workup	108	34.8
No blood/blood products in the bank	29	9.4
Lack of theatre space	28	9.0
Anaesthetist/PON taking another case	16	5.2
Delay in patient consenting for surgery	13	4.2
No power supply	9	2.9
Lack of neonatal backup/unavailability of neonatologist	4	1.3
No oxygen in the theatre	4	1.3
Unavailability of sterile theatre CS pack	2	0.6
Others	16	5.2

**n is different for the various intervals owing to missing data from some patients' case records; **Multiple causes in many patients, hence n>310; PON-perioperative nurse*

All these facilitate the timely transfer of the patient to the OT. A transfer time of < 15 minutes and a DDI of 30 minutes is likely to be achieved if the labouring woman-to-midwife ratio in delivery suites is 1:1. [12] This is, however, not usually the case owing to poor staffing in maternity units. In Nigeria, healthcare professionals are in short supply, with a nurse-to-patient ratio of 1.5:1,000. [21,22] Maternity units across the country, therefore, expectedly suffer staffing shortages with an overwhelming workload. In the hospital where this research was conducted, which serves over 34 million Nigerians, not more than two to three midwives cover the labour ward per shift.

This contributes significantly to prolonging the transfer time for EmCS.

Pre-operative laboratory workup and unavailability of blood/blood products were also implicated as causes of prolonged DDI in nearly 45 % of the patients in this study. To ensure blood availability for immediate transfusion in the event of life-threatening CS-related haemorrhage, it is the practice in our Obstetric Unit, as in many such units in Nigeria, [23,24] to crossmatch and reserve at least two units of blood for all patients undergoing an EmCS, before the surgery starts.

Table V: Predictors of prolonged DDI for EmCS

Characteristics	*DDI (minutes)**		*AOR [95% CI]*	*p-value*
	≤150 (%)	*>150 (%)*		
Repeat CS (n = 310)				
No	44 (18.6)	193 (81.4)	Ref	
Yes	5 (6.8)	68 (93.2)	4.923 [1.09-22.36]	0.039
Maternal BMI (n = 180)				
<30 kg/m^2	26 (21.7)	94 (78.3)	Ref	
≥30 kg/m^2	6 (10.0)	54 (90.0)	2.226 [1.75-6.59]	0.149
Transfer time (n = 308)				
≤ 15 minutes	4 (100.0)	0 (0)	Ref	
>15 minutes	45 (14.8)	259 (85.2)	8.22 [1.87-8.66]	<0.001
Cadre of surgeon (n = 310)				
Consultant	7 (70.0)	3 (30.0)	Ref	
Senior Registrar	4 (16.7)	20 (83.3)	12.627 [1.978-62.950]	0.052
Registrar	38 (13.8)	238 (86.2)	25.183 [2.698-35.053]	0.005
Type of anaesthesia (n = 310)				
Regional	40 (13.9)	247 (86.1)	Ref	
General	9 (39.1)	14 (60.9)	1 (empty)	

**150 minutes was the modal DDI*

Table VI: Association between prolonged DDI and obstetric outcomes of EmCS

Outcomes	*DDI (minutes)**		*p-value*
	≤150 (%)	*>150 (%)*	
Maternal morbidity (n = 310)			
Yes	25 (26.6)	69 (73.4)	0.001
No	24 (11.1)	192 (88.9)	
Apgar score <7 at 1 minute (n = 308)			
<7	8 (11.4)	62 (88.6)	0.349
≥7	38 (16.0)	200 (84.0)	
NICU admission (n = 302)			
Yes	19 (14.3)	114 (85.7)	0.216
No	27 (16.0)	142 (84.0)	
Stillbirth (n = 310)			
Yes	6 (40.0)	9 (60.0)	0.008
No	43 (14.6)	252 (85.4)	
Early neonatal death (n = 310)			
Yes	2 (28.6)	5 (71.4)	0.049
No	47 (15.5)	256 (84.5)	

**150 minutes was the modal DDI*

Most blood donations to blood banks in sub-Saharan Africa (SSA), including Nigeria, are by replacement donors, usually patients' family members or friends, rather than by volunteers, -only 25 % of blood donors in Nigeria are volunteers-. [25] Thus, even in emergencies, blood/blood products may not be available for a patient whose relatives have not donated any. The situation worsens in our facility, where only 6.7% of blood donations are voluntary. [26] Often, relatives and caregivers who serve as blood donors for patients scheduled for surgery either need funds for the crossmatch test, have incompatible blood groups, or are ineligible to donate blood. [6] Therefore, the unavailability of blood/blood products in the bank remains a significant cause of prolonged DDI in our setting, as seen in this study.

Repeat CS was also significantly associated with prolonged operation time and DDI in this study. Repeat CS is technically more difficult to perform owing to adhesions, which must be tackled before delivering the baby and are thus associated with longer operation time and prolonged DDI. As also seen in the present study, EmCS done by a Consultant or Senior/Specialist Registrar was significantly associated with shorter DDI than that performed by a Registrar/Junior Resident because the former is more experienced than the latter.[12]

Even though the DDI for all but one of the EmCS in this study was longer than the recommended 30 minutes, significant adverse maternal and perinatal outcomes were only recorded when the DDI exceeded 150 minutes. This finding should, however, be interpreted with caution, because even though DDI is a significant predictor of maternal and perinatal outcomes, other factors aside DDI also contribute to these outcomes. Other authors have similarly reported that foetal-maternal outcomes were not significantly negatively affected with a DDI of up to 75 minutes. They recommended that 75 minutes may be an acceptable DDI for EmCS in settings like ours, where the standard DDI of 30 minutes is not feasible owing to several already highlighted challenges. [27-29]

This present study, being retrospective in design, has limitations. With a case note retrieval rate of 47.4 % and some missing information in the retrieved case notes, the study findings may not accurately represent the study population. In addition, the adverse maternal and perinatal outcomes reported may not solely be attributable to prolonged DDI, as other factors, which we did not explore in this study, may also contribute to foeto-maternal outcomes. Further, DDI remains a significant predictor of maternal and neonatal outcomes in EmCS and a key indicator of the quality of maternity care. Routine audits of DDI, as this, therefore, serve to assess progress and provide important data upon which interventions can be planned to reduce the DDI to improve foeto-maternal outcomes. This is important, especially at this time, when the SDG targets are challenging all countries to eliminate all avoidable maternal and perinatal deaths.

Conclusion

The DDI for EmCS at the OAUTHC, Ile-Ife, is prolonged and worsening, with the finding of significant adverse maternal and perinatal outcomes when longer than 150 minutes. A DDI of 30 minutes is very difficult to achieve in this setting. The fact that this and other studies have shown that adverse foeto-maternal outcomes become significant when the DDI is longer than 75-150 minutes may demonstrate that a DDI of 30 minutes may not critically influence foeto-maternal outcomes in this setting. In settings where a DDI of 30 minutes is difficult to achieve, cut-offs based on institutional data and local experience may be acceptable. However, complacency must be guarded against, and clinical judgement of the degree of emergency and appropriate triaging are necessary to reduce maternal and perinatal morbidity and mortality. Efforts to reduce the

DDI for EmCS should be pursued vigorously, using the recommended 30 minutes as a benchmark. Upscaling enrolment in the NHIS, encouragement of health-related savings for non-NHIS enrolees, improvement in government funding of public healthcare, private-public partnerships in public hospitals, voluntary blood donations, free maternity services, and better maternity unit staffing would significantly improve the DDI in hospitals across SSA. Finally, a highly powered, multi-centre, national study, with prospective design, may provide robust and representative data upon which these interventions can be better planned and implemented.

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Erratum

In the article titled **"A Seven-Year Review of Emergency Obstetric Hysterectomy in a Nigerian Tertiary Institution"** published in the Annals of Health Research 2019; 5(1): 65-72, the authors were listed as Jagun OE, Nathaniel GV and Akinseku AK. Our attention has been drawn to the error in one of the names and we wish to correct the names of the authors listed on the article as "Jagun OE, Nathaniel GV and **Akiseku AK**".

-Editor-in-Chief