Original Article

Evaluation of decision-to-delivery interval in emergency cesarean section: A 1-year prospective audit in a tertiary care hospital

Sunanda Gupta, Udita Naithani[1], C. Madhanmohan[1], Ajay Singh[1], Pradeep Reddy[1], Apoorva Gupta

Department of Anesthesiology and Critical Care, Geetanjali Medical College, [1]Department of Anethesiology, Critical Care and Pain Management, R.N.T. Medical College, Udaipur, Rajasthan, India

Abstract

Background and Aims: The American College of Obstetricians and Gynecologists (ACOG) committee on professional standards and the National Institute of Clinical Excellence (NICE) guidelines suggest that decision-to-delivery interval (DDI) and emergency cesarean section (CS) should not be more than 30 min, and a delay of more than75 min in the presence of maternal or fetal compromise can lead to poor outcome. This prospective 1-year study was conducted on emergency CS in a tertiary care hospital to evaluate the DDI, factors affecting it and to analyze their effects on maternal and neonatal outcome.
Material and Methods: A structured proforma was used to analyze the data from all women undergoing emergency CS, during a 1-year period, included in Category 1 and 2 of NICE guidelines for CS.
Results: A total of 453 emergency CSs were evaluated, with a mean DDI of 36.3 ± 17.2 min for Category 1 CS and 38.1 ± 17.7 min for Category 2 CS ($P > 0.05$). Only 42.4% emergency CSs confirmed to the 30 min DDI while 57.6% had a DDI of more than 30 min. Reasons of delay were identified as a delay in shifting the patient to operation theater (22.1%), anesthesia factors (18.1%), and lack of resources or manpower (16.1%). Maternal complications occurred in 15 (3.3%) patients with 3 (0.7%) nonsurvivors having a DDI of 91.0 ± 97.0 min as compared to survivors with a DDI of 36.8 ± 15.7 min, $P = 0.001$. There was no significant association between DDI and occurrence of neonatal complications.
Conclusion: Failure to meet the current recommendations was associated with adverse maternal outcomes, but not with adverse neonatal outcome.

Key words: Decision-to-delivery interval, decision-to-delivery interval, emergency cesarean section, maternal outcome, neonatal outcome

Introduction

The American College of Obstetricians and Gynecologists committee on professional standards declared in 1989 that hospitals with obstetric services should have the capacity to begin a cesarean delivery within 30 min of the time that the decision is made to perform the procedure.[1]

Recent (National Institute of Clinical Excellence [NICE], UK) guidelines 2011[2] also suggested that to measure the overall performance of an obstetric unit, decision-to-delivery interval (DDI) should be used as 30 min for Category 1 CS (immediate threat to life of women or fetus) and both 30 and 75 min for Category 2 CS (maternal and fetal compromise that is not necessarily life-threatening). The guidelines also proposed that even if the DDI was to fall outside 30 min, it is not necessarily indicative of substandard practice. The 75 min DDI time is added as a clinically important standard since delay of more than 75 min, particularly in the presence of fetal or maternal compromise, is found to be associated with poor outcome.[3]

Address for correspondence: Dr. Sunanda Gupta,
Aahna No. 26, Navratna Complex, Bedla Road, Udaipur, Rajasthan, India.
E-mail: sunandagupta@hotmail.com

Access this article online	
Quick Response Code:	Website: www.joacp.org
	DOI: 10.4103/0970-9185.202197

How to cite this article: Gupta S, Naithani U, Madhanmohan C, Singh A, Reddy P, Gupta A. Evaluation of decision-to-delivery interval in emergency cesarean section: A 1-year prospective audit in a tertiary care hospital. J Anaesthesiol Clin Pharmacol 2017;33:64-70.

The Confidential Enquiry into Stillbirths and Deaths in Infancy in the year 2000 identified the late arrival of anesthesia personnel and delays in provision of anesthesia as the main anesthetic factors contributing to the delay in delivery of the baby.[4] Various teaching and general hospitals worldwide have carried out audits on their response time for emergency cesarean sections (CSs) to assess if the proposed standards could be met in their institutions.[5-8] However, such audits from India are reported sporadically highlighting the reasons for delay in DDI, which are different from developed countries.[9-11]

Thus, the present study was designed to audit the "decision-to-delivery interval" (DDI) for emergency CS, to determine whether the current standard of 30 min is achievable routinely and to analyze the impact of DDI on the maternal and fetal outcomes. Factors related to patient, obstetrician, anesthesiologist, staff, and resource constraints, contributing to delay in DDI were also evaluated.

Material and Methods

After getting approval from the Institutional Ethics Committee, a 1-year prospective audit was conducted at a tertiary care hospital attached to a medical college. The data were collected prospectively for DDI in all consecutive women undergoing emergency CS (Category 1 and 2 of NICE guidelines) [12] for a period of 1 year, which was defined as the study population ($n = 453$) and included Category 1 ($n = 287$) and 2 ($n = 166$) CS. Category 1 CS (immediate threat to the life of the woman or fetus) included CS for acute fetal distress, cord prolapse, and uterine rupture, and Category 2 CS (maternal or fetal compromise that is not immediately life threatening) included CS for antepartum hemorrhage, obstructed labor, and failure to progress in labor with maternal and fetal compromise.

The DDI for emergency CS was defined as the interval in minutes from the time of the decision by obstetrician to the time of delivery of the baby. The total DDI was calculated as a continuum of the following four intervals:

- Interval I (A–B): Decision by obstetrician (A) and transfer of patient to operation theater (B)
- Interval II (B–C): Arrival of the patient in operation theater (B) to induction of anesthesia (C)
- Interval III (C–D): From anesthesia induction (C) to surgical incision (D)
- Interval IV (D–E): From surgical incision (D) to delivery of baby (E).

At the outset, a meeting was held between obstetricians, anesthesiologists, neonatologists, Operation Theatre (OT) staff, and the expected time intervals between various stages of communications, arrival of personnel, and execution of anesthesia and delivery were discussed. To be able to achieve a standard DDI of ≤30 min in Category 1 and 2 CS, it was decided that each unit (Steps A–E) would require adhering to a specific time frame of 10 min (Interval I–III) and 5 min (Interval IV).

The following outcome variables were documented in the structured proforma: maternal demographic profile, indication for CS, time of the day, mode of anesthesia, delivery intervals (I–IV), overall DDI, reasons for their delay, maternal and perinatal outcome, APGAR scores at 1 and 5 min, and need for admission in Neonatal Intensive Care Unit (NICU). The DDI was further divided into categories of DDI ≤30 min, >30–75 min, and >75 min.

Statistical analysis

Data were entered and analyzed using MS Excel and SPSS version 17.0 (IBM corporations, New York, USA). The data related to patient distribution according to age, weight, indication for CS, type of anesthesia, DDI, and causes of delay maternal and neonatal complications were presented as number (proportion) and compared using Pearson Chi-square test. All time intervals including DDI, age, and weight were expressed as mean ± SD and compared using Student's *t*-test or analysis of variance as appropriate. Association of maternal and neonatal outcome with the DDI categories (≤30 min, >30–75 min, and >75 min) was calculated using Chi-square test and Student's *t*-test, and $P < 0.05$ value was considered statistically significant.

Results

Demographic data

During the study period, 20,075 deliveries were conducted, of which 4077 (20.3%) were cesarean deliveries. Among the 4077 CSs, 453 (11.1%) cases were taken as emergency CS in whom mean DDI was 37.2 ± 17.4 min (range 15–203 min). DDI was ≤30 min in 42.4% ($n = 192$), >30–75 min in 55.2% ($n = 250$), and >75 min in 2.4% ($n = 11$) cases.

Among 453 emergency CSs, 287 (63.4%) were categorized as Category 1 CS and 166 (36.6%) were taken as Category 2 CS [Table 1]. Mean DDI for Category 1 CS and for Category 2 CS was comparable while there was no significant association between DDI and indication of CS ($P = 0.062$), [Table 1].

The mean age was 24.6 ± 3.9 years with a mean weight of 58.3 ± 5.8 kg. A majority (92.9%, $n = 421/453$) of the cases were carried out primarily under spinal anesthesia. 26 of

Table 1: Distribution of patients according to decision to delivery interval and indications for emergency cesarean section

Indications for CS	Decision to delivery interval, *n* (%)			Total, *n* (%)	DDI (min), mean±SD
	≤30 min	>30-75 min	>75 min		
Category 1 CS	133 (29.4)	149 (32.9)	5 (1.1)	287 (63.4)	36.3±17.2
Fetal distress	118 (26.0)	133 (29.4)	5 (1.1)	256 (56.5)	38.2±18.3
Uterine rupture	2 (0.4)	2 (0.4)	0 (0.0)	4 (0.9)	36.3±17.6
Umbilical cord prolapse	13 (2.7)	14 (3.1)	0 (0.0)	27 (6.0	34.4±15.8
Category 2 CS	59 (13.0)	101 (22.3)	6 (1.3)	166 (36.6)	38.1±17.7
Obstructed labour	24 (5.3)	57 (12.6)	1 (0.2)	82 (18.1)	39.2±18.1
Antepartum hemorrhage	35 (7.7)	44 (9.7)	5 (1.1)	84 (18.5)	36.9±17.3
Unknown etiology	12 (2.6)	14 (3.1)	0 (0.0)	26 (5.7)	37.3±17.9
Abruptio placenta	12 (2.6)	14 (3.1)	2 (0.4)	28 (6.2)	39.3±18.5
Placenta previa	11 (2.4)	16 (3.5)	3 (0.7)	30 (6.6)	34.2±15.7
Total	192 (42.4)	250 (55.2)	11 (2.4)	453 (100.0)	37.2±17.4

P = 0.062. CS = Cesarean section, SD = Standard deviation, DDI = Decision-to-delivery interval

these patients (6.2%) had inadequate block, and subsequently 23 (5.5%) needed supplementation. Three (0.7%) were converted to general anesthesia with endotracheal intubation. Of 453 cases, 32 (7.1%) were carried out under general anesthesia. No significant association was found between DDI and age ($P = 0.430$), weight ($P = 0.127$), or technique of anesthesia ($P = 0.062$).

Diurnal variations

We analyzed DDI during the three time intervals according to duty shifts, and observed that 131 (28.9%) CSs were performed in the 8 a.m. to 2 p.m. shift, 144 (31.8%) in evening hours of 2 p.m. to 9 p.m., and 178 (39.3%) during the 9 p.m. to 8 a.m. shift. Mean DDI was significantly more overnight (41.3 ± 11.3 min) as compared to the two daytime frames: 33.5 ± 17.5 min (8 a.m. to 2 p.m.) and 35.7 ± 10.3 min (2 p.m. to 9 p.m.) ($P = 0.045$). The details of the delays in the four intervals are given in Table 2. Delays of >10 min occurred in 51.% (Interval I), 22.7% (Interval II) and 2.4% (Interval III). Delay of > 5 minutes occurred in 16.8% of patients for Interval IV.

Reasons for delay in decision-to-delivery interval

An analysis of various reasons contributing to delay in each of the interval (I–IV) showed that delay occurring in one interval did not necessarily translate to other intervals [Table 3]. Thus, overall delay in meeting WHO recommended that DDI (30 min) occurred in 261/453 (57.6%) patients. When reasons of delay were further analyzed, the most significant factor was system delay in shifting of patient to operation theater which took 15–20 min in 100/453 (22.1%) cases. Another important factor was lack of resources or staff in 73/453 (16.1%) cases. Anesthesia factors were responsible for delay in 82 (18.1%) cases because of procedural delay in 61 (13.5%) cases, nonavailability of senior anesthetist on-site in 10 (2.2%) cases, and time for conversion to GA in 11 (2.4%) cases. Obstetrician factors were responsible for delay in 24 (5.3%) cases, and patient factors contributed to delay in 16 (3.5%) cases [Table 4].

Table 2: Patient distribution according to time taken for various intervals (I-IV) and their incidence

Time interval (I–IV) (min)	DDI, *n* (%)			Total, *n* (%) 453 (100%)
	≤30 min 192 (42.4%)	>30-75 min 250 (55.2%)	>75 min 11 (2.4%)	
Interval I - Decision to patient arrival in OT: 15.6±3.2 (min)				
0-10	164 (36.2)	57 (12.6)	0 (0.0)	221 (48.8)
>10-20	27 (6.0)	139 (30.7)	1 (0.2)	167 (36.9)
>20-30	0 (0.0)	38 (8.4)	0 (0.0)	38 (8.4)
>30	1 (0.2)	16 (3.6)	10 (2.2)	27 (5.96)
Delay >10 min	28 (6.2)	183 (40.4)	11 (2.4)	232 (51.2)*
Interval II - Patient arrival to induction: 10.3±2.7 (min)				
0-5	77 (17.0)	41 (9.1)	3 (0.7)	121 (26.7)
>5-10	91 (20.1)	135 (29.8)	3 (0.7)	229 (50.6)
>10-15	19 (4.2)	37 (8.2)	5 (1.1)	61 (13.5)
>15-20	5 (1.1)	23 (5.1)	0 (0.0)	28 (6.2)
>20	0 (0.0)	14 (3.1)	0 (0.0)	14 (3.1)
Delay >10 min	24 (5.3)	74 (16.3)	5 (1.1)	103 (22.7)
Interval III - Induction to incision: 6.3±1.2 (min)				
0-5	124 (27.4)	125 (27.6)	8 (1.8)	257 (56.7)
>5-10	68 (15.0)	114 (25.2)	3 (0.7)	185 (40.8)
>10	0 (0.0)	11 (2.4)	0 (0.0)	11 (2.4)
Delay >10 min	0 (0.0)	11 (2.4)	0 (0.0)	11 (2.4)
Interval IV - Incision to delivery: 4.8±1.0 (min)				
0-5	170 (37.5)	199 (43.9)	8 (1.8)	377 (83.2)
5-10	21 (4.6)	48 (10.6)	3 (0.7)	72 (15.9)
>10	1 (0.2)	3 (0.7)	0 (0.0)	4 (0.9)
Delay >5 min	22 (4.9)	51 (11.3)	3 (0.7)	76 (16.8)

**P<0.05 (incidence of delay was significantly higher in interval I as compared to Intervals II, III, IV). DDI = Decision-to-delivery interval, OT = Operation Theater*

Table 3: Patient distribution according to reasons for delay at various component intervals (I-IV) of decision to delivery interval indicating stage of delay

Interval I - Decision to patient arrival in OT >10 min is delay
>10-20 min (*n*=167, 36.9%)
Usual time taken for preparing the patient, taking consent, shifting from labor room, sending for blood group and cross matching (*n*=167, 36.9%)
>20 min (*n*=65, 14.3%)
Lack of theatre space (*n*=34, 7.5%)
Delay in giving consent by patient (*n*=12, 2.6%)
Procedural delay in preparing (*n*=5, 1.1%)
Autoclaved instrument/linen delay (*n*=2, 0.4%)
Ward assistants engaged (*n*=11, 2.4%)
Degree of clinical urgency not perceived by obstetrician (*n*=1, 0.2%)
Interval II - Patient arrival to induction >10 min is delay
>10-15 min (*n*=61, 13.5%)
Procedural delay in inducing anesthesia and technical factors (*n*=61, 13.5%)
>15 min (*n*=42, 9.3%)
Spare OT was used but delay in arrival of second anesthesia team (*n*=10, 2.2%)
Delay for senior anesthetist (*n*=10, 2.2%)
Delay for senior obstetricians (*n*=12, 2.6%)
Equipment, blood/specific drugs not available (*n*=10, 2.2%)
Interval III - Induction to incision >10 min is delay
>10 min (*n*=11, 2.4%)
Failed spinal anesthesia, conversion to GA (*n*=11, 2.4%)
Interval IV - Incision to delivery >5 min is delay
>5-10 min (*n*=72*, 15.9%)
Junior obstetrician operating (*n*=72, 15.9%)
>10 min (*n*=4, 0.9%)
Previous cesarean section with adhesion (*n*=4, 0.9%)

*Delay of >30 min in DDI occurred in only 261 cases, because delay at one stage was not necessarily followed by delay in other stages. *Out of 72 cases, only 12 cases had a significant delay of >30 min while in the rest of the cases, a delay in Interval IV did not result in a total delay of >30 min. GA = General anaesthesia, OT = Operation Theater*

Association of Maternal and neonatal outcomes with decision-to-delivery interval

Maternal complications occurred in 3.3% ($n = 15$) emergency CS, which were hemorrhagic shock requiring vasopressors and blood transfusion. The occurrence of maternal complication was not affected by DDI ($P = 0.164$). Maternal mortality occurred in 3 (0.7%) cases. These three patients underwent CS under general anesthesia for abruptio placentae, rupture uterus, and for placenta previa with DDI of 35 min, 37 min, and 203 min, respectively. Mean DDI in nonsurvivor patients (91.0 ± 97.0 min) was significantly longer compared to patients who had satisfactory outcome (36.8 ± 15.7 min), $P = 0.001$. In all the three cases, delay in DDI occurred at Stage I (shifting of patients to OT).

Perinatal neonatal complications included intrauterine deaths (IUDs) in 24 (5.3%), and admissions to NICU in 51 (11.3%) due to birth asphyxia in 29 (6.4%), meconium aspiration in 17 (3.8%), respiratory distress in 3 (0.7%), anorectal malformation, and low birth weight in one each (0.2%). Among 51 NICU admissions, 23 (5.1%) had a negative outcome with 28 (6.2%) survivors, thus increasing the total neonatal mortality to 47 (10.4%) with IUD in 24 (5.3%) and NICU deaths in 23 (5.1%). There was no statistically significant association between DDI and occurrence of neonatal complication ($P = 0.084$), neonatal mortality ($P = 0.136$), IUD ($P = 0.145$), and APGAR <7 at 1 min ($P = 0.242$) and 5 min ($P = 0.451$).

Discussion

Attempts to enforce an ideal time limit to minimize morbidity related to CS, have been a subject of intense research by obstetricians as well as anesthesiologists.[3,6,13,14] To conform to the recent NICE 2011 guidelines, it is mandatory that obstetric units should conduct regular audits of their DDI.[8-10]

In our audit, we observed that only 42.4% of emergency CS conformed to the 30 min DDI recommended by WHO while 57.6% cases had a >30 min DDI, the mean DDI being 37.2 ± 17.4 min. Two Indian studies[10,11] have shown a mean DDI of 38.2 ± 12.5 min[11] and 42.6 ± 19.4 min[10] while some of the Western counterparts[15,16] showed a mean DDI of 32 ± 13 min[15] with 45% deliveries occurring in <30 min and 93% deliveries occurring in <75 min. Kolås *et al.*[16] found an 11.8 min DDI for emergency CS while Helmy *et al.*[13] found the recommended DDI exceeded in 64% of cases of CS.

In contrast, much longer DDI has been observed in reports from some of the African countries, for example, Onah *et al.* reported a DDI of 511 min from Enugu and 201 min from Abiya,[17] while Yakasi found a mean DDI of 137 min at a tertiary center from Northern Nigeria.[18] In our study, there was only one case with a DDI of 203 min who had a negative fetomaternal outcome (other two nonsurvivors had a DDI of 35 min and 37 min, respectively).

The maximum delay occurred at Interval I due to delay in shifting of patient to OT ($P < 0.05$). Failure to achieve the desired DDI resulted from delay in obtaining consent, sending blood for grouping, cross matching, delay in shifting to OT, nonavailability of OT degree of clinical urgency not being perceived by the obstetric team, and procedural delay during induction of anesthesia.

The main sources of delay were in transferring women to operating theater and in starting the anesthetic as was also observed by Helmy *et al.*[13] The other reasons cited by various authors[6,10,11,13] for delay were nearly similar, such as delay in

Table 4: Reasons for delay in 261 cases in with decision to delivery interval >30 min

Reasons for delay	Frequency (%)	Intervals affected
Patient factors	16/453 (3.5)	
Patient delay in consenting	12 (2.6)	I
Previous surgery with adhesions	4 (0.9)	IV
Obstetrician factors	24/453 (5.3)	
Nonavailability of senior obstetrician on-site	12/453 (2.6)	I
Junior obstetrician operating	12/453 (2.6)	IV
Anesthesia factors	82/453 (18.1)	
Procedural delay	61 (13.5)	II
Nonavailability of senior anesthetist on-site	10 (2.2)	I
Conversion to GA	11 (2.4)	III
Lack of resources/staff	73/453 (16.1)	
Lack of operation theatre space	34 (7.5)	I
Delay in arrival of second anesthesia team	10 (2.2)	II
Delay due to nonavailability of instruments/linen	2 (0.4)	I
Nonavailability of helpers	12 (2.6)	I
Equipment/drugs/blood not available	10 (2.2)	II
Delay in patient preparation	5 (1.1)	I
Others (system delay)		
Shifting of patient to OT took 15-20 min due to system delay	100/453 (22.1)	I
Total reasons	295*/453	

**295 reasons were identified in 261 cases having DDI >30 min. This discrepancy is attributed to more than one reason contributing to delay in some cases. DDI = Decision-to-delivery interval, GA = General anaesthesia, OT = Operation Theater*

obtaining consent, delay in shifting women to OT, multiple attempts at spinal anesthesia, delay in the availability of staff because of another CS, and because the degree of clinical urgency was not perceived in the same way by all members of the healthcare team. Operating suite bottlenecks and transfer time to the OT emphasize the importance of equipping labor wards for emergency surgery.[19]

The major cause of delay observed by Yakasai *et al.*[18] from Nigeria anesthetic delay in nearly 40%. However, attempts to shorten the anesthetic time by altering established anesthetic techniques can, at the most, provide a modest time saving. A time pressured environment can lead to a significant threat to patient safety. Seniority of the surgeon was a significant predictor in achieving the recommended 30 min rule[16] as was also seen in our study as one of the multiple factors leading to delay in 12 patients (2.6%). At tertiary care centers attached to teaching medical colleges, it should be ensured that emergency CS 1 and 2 categories should be conducted under supervision of consultants with an eye on recommended time spans.

Cerbinskaite *et al.*[15] reported that for emergency cesareans, delivery is most likely to be achieved within 30 min if the complement of qualified midwives on a delivery suite is sufficient to allow one-to-one care to be provided to women in active labor. More specifically, failure to provide this level of care hinders the woman's transfer to the operation theater; however, once the woman has arrived in theater, the laboring woman to midwife ratio has no further bearing on the delivery time of the baby.

In resource-constrained hospitals like ours, the condition is further worsened by the fact that these midwives/ward-helpers have additional duties such as arranging for basic resources. Therefore, adequate recruitment of ancillary staff, better technologically advanced communication equipment, and protocol with regular "fire drills" can all reduce the delay in DDI.

Rashid and Nalliah[20] reported that the recommended "30 min rule" DDI cannot be achieved in routine practice. Its practicality and implications on negative neonatal outcome were questioned because there was no strong evidence to support a 30 min DDI in all cases. Factors causing delay in initiating emergency cesarean delivery were described as delay in transferring the patient to the theater, induction of anesthesia, inadequate coordination between the anesthesia and neonatology teams, and lack of essential drugs and blood transfusion service. They suggested that it is obligatory for hospitals offering labor and delivery services to have coordinated teamwork and in-house obstetricians, anesthetist and theater staff, and neonatology support to manage unpredictable acute emergencies that mandate immediate operative deliveries.

In contrast, Amankwah *et al.*[21] accept that a DDI of 30 min is a realistic goal. In their study, the median DDI was 16 min, 98% deliveries during the study period being achieved within 30 min. DDI more than 30 min in two cases was found, and both cases were later classified as less urgent. In both of these cases, delay occurred due to unavailability of surgeon who was attending to concurrent emergency in one case and another obstetrician on call had to be called. No delays were related either to transporting the patient to the operation room or to the mode of anesthesia used. The patient was often ready for surgery within 8 min (one-half of total DDI).

Yakasai *et al.*[18] found a delay of >30 min DDI in 307/350 (87%) cases. Anesthetist delay occurred in 126 (41%) cases, lack of theater space in 41 (13%) cases, shift/change over period for labor ward and theater staff accounted for 29 (9.5%) cases, lack of available blood in 25 (8%) cases, and delay in obtaining consent for surgery in 22 (7%) cases. Other researchers have also observed anesthetic delay,[6,13,17,22] lack of theater space,[23,24] and delay from obtaining consent.[25]

Mean DDI was significantly more in 9 p.m. to 8 a.m. shift compared to evening (35.7 ± 10.3 min) and morning shifts. This was attributed to increased presence of senior staff of obstetrics and anesthesia "on floor" in the morning hours. In a recent study[10] from India, the mean DDI during the day was 30.3 ± 19.7 min versus 49.9 ± 20.8 min at night. However, Mackenzie and Cooke[5] and Cerbinskaite *et al*.[15] found no significant association between DDI and time of delivery by CS. Cerbinskaite *et al*.[15] from the UK reported that in most of the obstetric units in the UK, the pattern of medical staffing during the day time differed from that seen overnight on the study site. The consultant obstetrician and anesthesiologist provided "on call" services rather than "on-site services" in the night time, but they found no significant association between DDI and time of delivery. Though we found increased DDI during the night shift, it was not associated with adverse perinatal outcome, as in other literature.[17,18,23,26,27]

In our study, the occurrence of maternal complications was not affected by DDI. Yakasai *et al*.[18] found 83.4% had good outcomes and only 16.6% had at least one bad outcome.

Recently Korda and Zimmermann,[8] analyzed a 5 years impact of a new departmental protocol on emergency CS target time, with respect to DDI (crash call to birth); pathology-to-decision interval (PDI) pathology to crash call, the 5-year learning curve, and perinatal outcomes in mother and neonate. The PDI was timed from the beginning of pathology to crash call (for e.g., beginning was timed manually from the electronic CTG; while vaginal bleeding was timed from midwife's call to the obstetrician). In contrast some audits have concluded that inability to meet this target has a positive rather than a negative impact on neonatal outcome[6,26] Korda and Zimmermann explain that neonates who were expected to have a poor outcome were delivered faster, leading to a biased observation that a DDI >30 min would improve neonatal outcome.

Recently,[28] the effect of a simulation-based multidisciplinary team training proved that the proportion of emergency CS achieved within a 30 min time frame was higher after team training.[8]

A limitation of this study is that we assessed the neonatal outcome only by APGAR scores and NICU admissions as these are claimed to be restricted measures of fetal hypoxia. We suggest that future audit should involve introduction of time sheets, after proper sensitization of the emergency care personnel involved in care of the parturient for emergency CS.

Conclusion

Identifying obstacles responsible for delay at different stages and improving coordination between members of the surgical team are essential components to improve the quality of services in obstetric units. Since these data are generated from a busy, tertiary care center, we find that there are huge gaps in areas of clinical practice which needs to be addressed and needs more critical appraisal to bring about improvements.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1. American College of Obstetricians and Gynaecologist. Standards of Obstetric-Gynaecologic Services. 7th ed. Washington, DC: ACOG; 1989. p. 39.
2. National Institute for Health and Clinical Excellence. CG132 Cesarean Section. Clinical Guidelines for Emergency CS. Available from: http://www.guidance.nice.org.uk/CG132. [Last accessed on 2016 Jul 23].
3. Thomas J, Paranjothy S, James D. National cross sectional survey to determine whether the decision to delivery interval is critical in emergency caesarean section. BMJ 2004;328:665.
4. CESDI. Obstetric Anesthesia Delays and Complications. In: Confidential Enquiry into Stillbirth and Deaths in Infancy 7th Annual Report. London: Maternal and Child Health Research Consortium; 2000. p. 41-52.
5. MacKenzie IZ, Cooke I. What is a reasonable time from decision-to-delivery by caesarean section? Evidence from 415 deliveries. BJOG 2002;109:498-504.
6. Tuffnell DJ, Wilkinson K, Beresford N. Interval between decision and delivery by caesarean section-are current standards achievable? Observational case series. BMJ 2001;322:1330-3.
7. Tan WC, Tan LK, Tan HK, Tan AS. Audit of 'crash' emergency caesarean sections due to cord prolapse in terms of response time and perinatal outcome. Ann Acad Med Singapore 2003;32:638-41.
8. Korda V, Zimmermann R. Five-year impact of a new departmental protocol on emergency cesarean target times. Open J Obstet Gynecol 2013;3:148-53.
9. Roy KK, Baruah J, Kumar S, Deorari AK, Sharma JB, Karmakar D. Cesarean section for suspected fetal distress, continuous fetal heart monitoring and decision to delivery time. Indian J Pediatr 2008;75:1249-52.
10. Singh R, Deo S, Pradeep Y. The decision-to-delivery interval in emergency Caesarean sections and its correlation with perinatal outcome: Evidence from 204 deliveries in a developing country. Trop Doct 2012;42:67-9.
11. Radhakrishnan G, Yadav G, Vaid NB, Ali H. Factors affecting

"decision to delivery interval" in emergency cesarean sections in a tertiary care hospital: A cross sectional observational study. Int J Reprod Contracept Obstet Gynecol 2013;2:651-6.
12. Wee MY, Brown H, Reynolds F. The National Institute of Clinical Excellence (NICE) guidelines for caesarean sections: Implications for the anaesthetist. Int J Obstet Anesth 2005;14:147-58.
13. Helmy WH, Jolaoso AS, Ifaturoti OO, Afify SA, Jones MH. The decision-to-delivery interval for emergency caesarean section: Is 30 minutes a realistic target? BJOG 2002;109:505-8.
14. Weiner E, Bar J, Fainstein N, Ben-Haroush A, Sadan O, Golan A, *et al.* The effect of a program to shorten the decision-to-delivery interval for emergent cesarean section on maternal and neonatal outcome. Am J Obstet Gynecol 2014;210:224.e1-6.
15. Cerbinskaite A, Malone S, McDermott J, Loughney AD. Emergency caesarean section: Influences on the decision-to-delivery interval. J Pregnancy 2011;2011:640379.
16. Kolås T, Hofoss D, Oian P. Predictions for the decision-to-delivery interval for emergency cesarean sections in Norway. Acta Obstet Gynecol Scand 2006;85:561-6.
17. Onah HE, Ibeziako N, Umezulike AC, Effetie ER, Ogbuokiri CM. Decision-delivery interval and perinatal outcome in emergency caesarean sections. J Obstet Gynaecol 2005;25:342-6.
18. Yakasai IA, Ahmed ZD, Okonofua FE. Decision delivery interval in emergency cesarean section in tertiary centre in Northern Nigeria. Orient J Sci Res 2012;1:16-23.
19. Hillemanns P, Hasbargen U, Strauss A, Schulze A, Genzel-Boroviczeny O, Hepp H. Maternal and neonatal morbidity of emergency caesarean sections with a decision-to-delivery interval under 30 minutes: Evidence from 10 years. Arch Gynecol Obstet 2003;268:136-41.
20. Rashid N, Nalliah S. Understanding the decision-delivery interval in cesarean births. Int EJ Sci Med Educ 2007;1:61-8.
21. Amankwah Y, Caughey S, Walker M. A prospective study of the efficiency of the "code 333" process at the Ottawa hospital. J Obstet Gynaecol Can 2011;33:244-51.
22. Spencer MK, MacLennan AH. How long does it take to deliver a baby by emergency Caesarean section? Aust N Z J Obstet Gynaecol 2001;41:7-11.
23. Onwudiegwu U, Makinde ON, Ezechi OC, Adeyemi A. Decision-caesarean delivery interval in a Nigerian university hospital: Implications for maternal morbidity and mortality. J Obstet Gynaecol 1999;19:30-3.
24. Orji EO, Ojefeitimi EO. Time-motion study of obstetric emergencies in a Nigerian teaching hospital. J Turk Ger Gynecol Assoc 2007;8:172-6.
25. Samia H, Misbah KJ, Sadia T. Emergency cesarean section: Comparative analysis of problems encountered between patients of elective cesarean section and patients from whom elective cesarean section was planned but ended up in emergency. Prof Med J 2008;15:211-2.
26. Bloom SL, Leveno KJ, Spong CY, Gilbert S, Hauth JC, Landon MB, *et al.* Decision-to-incision times and maternal and infant outcomes. Obstet Gynecol 2006;108:6-11.
27. Huissoud C, Dupont C, Canoui-Poitrine F, Touzet S, Dubernard G, Rudigoz RC. Decision-to-delivery interval for emergency caesareans in the Aurore perinatal network. Eur J Obstet Gynecol Reprod Biol 2010;149:159-64.
28. Fuhrmann L, Pedersen TH, Atke A, Møller AM, Østergaard D. Multidisciplinary team training reduces the decision-to-delivery interval for emergency caesarean section. Acta Anaesthesiol Scand 2015;59:1287-95.