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ORIGINAL ARTICLE

Decision Delivery Interval in Emergency and Urgent Caesarean Sections: Need to Reconsider the Recommendations?

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Abstract

Introduction The timeline between a decision made and delivery of the baby is termed decision delivery interval (DDI). According to current recommendations, an emergency caesarean section must be performed within 30 min of the decision. The present study was conducted with an objective to assess DDI in a busy obstetric unit in India and its impact on obstetric outcome.

Material and Method A total of 480 women with indications of category I (emergency): Immediate threat to life of woman or foetus ($n = 66$), and category II (urgent): Maternal or foetal compromise but not immediately life-threatening ($n = 414$), were studied in the context of DDI and composite adverse perinatal outcomes including fresh stillbirth, 5-min Apgar score <7 and NICU admission.

Result Recommended DDI of <30 min could be achieved in 30% cases of emergency CS only. Sixty-three per cent with prolapsed cord could be delivered within 30 min. The composite neonatal outcomes were not significantly increased up to DDI of 60 min for category I (emergency) (except in prolapsed cord) and up to 90 min in category II (urgent) caesarean sections.

Conclusion Authors propose reconsideration of the present recommendations of DDI in categories I and II, while

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Crash CS (cord prolapse or catastrophic antepartum haemorrhage) should be a separate group with recommended DDI of 30 min. For the remaining cases in the present emergency CS group, the suggested DDI of 60 and, for urgent group, 90 min may be made following further studies to prevent this DDI yardstick from becoming a rod at our back.

Keywords Caesarean section · Decision–delivery interval · Foetal distress · Low-resource settings · Cord prolapse · Composite neonatal outcome

Introduction

A caesarean section is the commonest major obstetric surgery. The timeline between a decision made and delivery of the baby is referred to as decision delivery interval (DDI). Caesarean section is classified into four groups, namely emergency, urgent, scheduled and elective on the basis of the indications and recommendations of DDI. According to this, an emergency caesarean section is to be performed within 30 min of the decision. This recommendation has largely been adopted by most of the authorities worldwide [1, 2]. Failing to do so might have the potential for medico-legal complications.

This recommendation is based mostly on the observation of studies carried out in developed countries, and published data for low-resource settings including India are sparse. The practicability of this 30-min DD interval and also the proposed beneficial effect on the perinatal outcome have been doubted. Researchers have suggested that the DDI of even up to 75 min does not appear to increase the risk, whereas DDI of <30 min does not guarantee a good neonatal outcome [3]. The present study was conducted with an objective to assess the DDI in emergency and urgent caesarean sections in a busy obstetric unit in developing country, i.e., India, to determine its impact on foetomaternal outcome and the reasons for delay and whether this delay causes adverse outcomes in significant proportions.

Material and Method

The present observational study was conducted at our tertiary level government medical college teaching hospital from June 2014 to August 2015. The annual delivery rate in our institute is 8000–9000 with caesarean section rate of 30–32%. A four-step classification system [1] of caesarean section has been adopted as follows:

Category I: Immediate threat to life of woman or foetus.
Category II: Maternal or foetal compromise but not immediately life-threatening.
Category III: Needing early delivery but no foetal or maternal compromise.
Category IV: Planned for elective LSCS.

A total of 480 pregnant women with single live foetus in pregnancy between 37 and 42 weeks with category I or category II indications were included in the study. Out of these, 66 belonged to category I and 414 to category II.

The indications for category I were acute and severe foetal distress with FHR ≤80/min (not synchronous with maternal pulse) for ≥09 min with or without thick meconium, cord prolapse, failed instrumental vaginal delivery, major placental abruption and acutely bleeding placenta previa.

Category II included cases of foetal distress with FHR between 80 and 110/min with or without passage of thick fresh meconium, CS scar tenderness, obstructed labour and women with the previous caesarean in labour.

Exclusion Criteria

Women with categories III and IV, known congenital foetal anomaly and medical complications of pregnancy were excluded.

All relevant details of history and examination were noted. Total decision to delivery interval (DDI) was calculated as the sum of the following intervals:

Interval 1—between decision of caesarean section and shifting the woman from the labour room to the pre-operative area of the OT.
Interval 2—between receiving the woman by OT team and shifting her to the operation table.
Interval 3—time taken for induction of anaesthesia after shifting and pre-incision skin painting and draping.
Interval 4—between incision and delivery of the baby.

Any delay of more than 10 min in interval 1 or 3 and more than 5 min in intervals 2 and 4 were considered as delay, and cause of the delay was noted.

The primary outcome was a *composite* arithmetic *sum* of adverse perinatal outcomes including fresh stillbirth, 5-min Apgar score <7 and NICU admission. A 'born healthy' neonate was defined as a live neonate with 5-min Apgar ≥7 and no neonatal morbidity.

Secondary outcomes were the individual components of the composite outcome and included serious maternal morbidity or mortality. The women and their neonates were followed up in the post-operative period till their discharge from hospital.

Statistical analysis was done and analysed using the Statistical Package for Social Sciences (SPSS) version 20 software and presented in figures and tables. Chi-square test was used to measure the strength of associations between the DDI and reasons for delay and outcomes of the operation. Statistical significance was defined as a P value of less than or equal to 0.05.

Results

During the study period, there were 9500 deliveries in our labour unit including 3760 LSCS (39%). A total of 480 cases (66 of emergency and 414 urgent indications) fulfilling the inclusion criteria were taken into study. The mean birth weight was 2.68 kg (2 SD ± 0.58), and low-birth-weight neonates were 18.33%. These were parametric data with normal distribution in the bell-shape curve.

Recommended DDI of <30 min could be achieved in 30% cases of the emergency CS versus 14% in urgent caesarean section ($P = <0.005$). Only 11 and 13% cases remained undelivered till 2 h in emergency and urgent groups, respectively (Table 1).

Table 2 exhibits the indication-wise DDI in emergency and urgent CS cases. Significantly greater number of women, i.e. 63%, with prolapsed cord could be delivered within 30 min in comparison with women with abruption (30%, $P = <0.005$) as well as with severe degree of foetal distress (18%, $P = <0.005$). Women with cord prolapse had the mean DDI of 42 min which was the least DDI amongst all the listed indications for emergency and urgent CS groups. No woman with cord prolapse remained undelivered at the end of two hours. In case of a cord prolapse, the odds ratio of delivering within 30 min is 5.6 (with 95% confidence interval being 1.4–22.4). The mean DDI of emergency and urgent CS groups was 57.5 min versus 69.6 min, respectively, and difference was not significant statistically. The longest DDI of more than 2 h was observed in women of category II having previous uterine scar with scar tenderness, i.e. 11 (29%) cases out of 37 such cases (Table 2).

Figure 1 shows the reasons of delay which reflects in prolongation of DDI. The most common cause of delay was busy operation theatres (39%) and busy labour ward (20%). Manpower shortage accounted for 3.25% of delay in which 1.25% were because of unavailability of

Table 1 Distribution of DDI

DDI(in min)	Emergency no (%)	Urgent no (%)	Total no (%)	Mean (min)	95% CI
<30	20 (30)*	60 (14)*	80 (16)	24	23.41–25.49
31–60	24 (36)	167 (40)	190 (40)	45.5	45.39–47.89
61–90	7 (11)	89 (21)	96 (20)	77	75.12–78.70
90–120	8 (12)	44 (11)	51 (11)	105	103.32–108.17
>120*	7 (11)	55 (13)	63 (13)	163	156.14–175.80
Total	66	414	480		

* P 0.0013

Table 2 Indication-wise DDI and mean DDI

Category	Indication no (%)	<30 min no (%)	30–60 min no (%)	60–90 min no (%)	90–120 min no (%)	>120 min no (%)	Mean DDI (min)
Emergency $n = 66$	Cord prolapse 11(16)	7 (63)*#	1 (9)	1 (9)	2 (18)	0	42
	Abruption 30(45)	9 (30)*	8 (26)	5 (16)	4 (13)	4 (13)	51
	Foetal distress 22(33)	4 (18)#	13 (59)	1 (4.5)	3 (13)	1 (4.5)	57
	Placenta previa 3(4.5)	0	2 (67)	0	0	1 (33)	80
Urgent $n = 414$	Foetal distress 338(81)	50 (15)	128 (37)	71 (21)	34 (10)	55 (16)	70
	Placenta previa 12(3)	6 (50)	3 (25)	3 (25)	0	1()	59
	Obstructed labour 18(4)	3 (16)	4 (22)	5 (27)	3 (16)	3 (16)	77
	Malpresentation active labour 9 (2)	4 (44)	3 (34)	2 (22)	0	0	47
	Previous scar with impending rupture 37(9)	0 (0)	14 (38)	7 (19)	5 (13)	11 (29)	95

* P 0.0252, #P 0.0132 * OR 5.6 (95% CI 1.4–22.4)

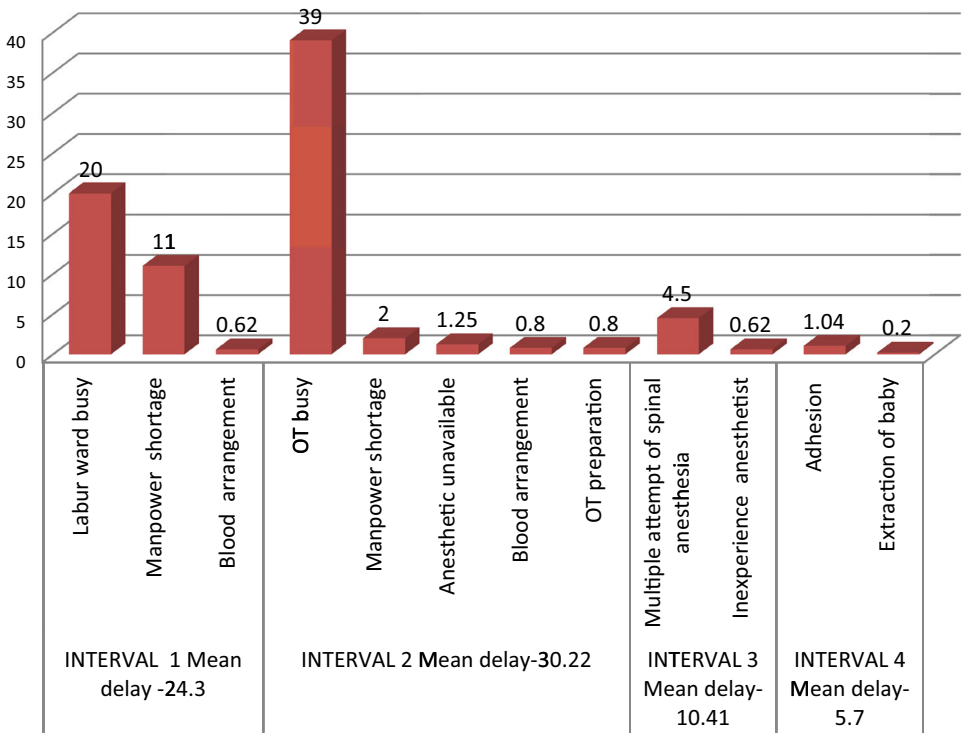

Fig. 1 Cause of delay and mean delay at different levels

anaesthetist [anaesthetists busy in other operation]. Irrespective of experience of the anaesthetist, multiple attempts of spinal anaesthesia caused delay in 4.5% cases, due to obesity (3.5%) and non-cooperation by the woman (1%). There was only one case of difficulty in the delivery of baby in an obstructed labour causing delay.

Composite adverse neonatal outcomes (still birth and NICU admission) were compared between DDI of <30 min with DDI up to 90 min. There was no statistically significant difference ($P > 0.005$). This was in sharp contrast with the groups having DDI above 90 min where the composite adverse neonatal outcome increased. The difference became significant when any group having DDI below 90 min was compared with the group of DDI of 90–120 min ($P = <005$) and became highly significant when compared with those having DDI of >120 min (Table 3).

On comparing the composite adverse neonatal outcome between emergency and urgent cases with DDI of <30 min, it was not significant statistically, but as the DDI increased in both the groups, it increased proportionately and the difference between two groups achieved significant difference. The emergency group had comparatively worse outcome as the DDI increased although without statistically significant difference up to DDI of 60 min. In the urgent group, the composite neonatal outcome remained same up to DDI of 90 min and only when DDI prolonged to >120 min, it increased to 33.6% which was again in contrast to 100% in the emergency group when the DDI crossed 120 min mark ($P = <0.05$) (Table 4).

Discussion

Caesarean delivery is a complex multidisciplinary procedure. DDI is supposed to play a significant role in maternal and neonatal outcome. In the current study, the rate of emergency caesarean delivery was 2.7% which is almost similar to other studies [4]. Caesarean section cannot easily be categorized as emergency based solely upon indications. Multiple indications like haemorrhage from placenta previa, acute and severe foetal distress and abruptio placentae also have a broad range of acuity and severity.

Our indications for category I were similar to other studies [5] and differed from those who have taken all the non-elective cases as the emergency caesarean section [6, 7].

As per guidelines, the recommended DDI category I cases should be <30 min. In the present study, only 30% of women in the emergency group could be delivered within the 30-min period which is contrary to a study where this could be achieved in 66.3% of cases in a high resource setting [8]. Observation from developing nations like Nigeria show a mean DDI of 106 min [6]. There are limited studies in the Indian context. This reflects the huge

Table 3 Adverse neonatal outcome according to DDI with comparison between <30 min DDI with others

$N = 480$	Born healthy no. (%)	SB no. (%)	NICU no (%)	Apgar <7 @5 min no (%)	Neonatal death no (%)	Discharge no. (%)	Composite adverse neonatal outcome
<30 min ($n = 80$)	70 (87.5)	0	10 (12.5)	10 (12.5)	5 (6.25)	5 (6.25)	10 (12.5)*,#,$,**
30–60 min ($n = 190$)	166 (87.8)	1 (0.5)	23 (12)	23 (12)	9 (4.7)	14 (7.3)	24 (12.6)*
60–90 min ($n = 96$)	83 (86)	0	13 (13.5)	13 (13.5)	7 (7.2)	6 (6.25)	13 (13.5)#
90–120 min ($n = 52$)	35 (67)	1 (1.9)	16 (30.7)	16 (30.7)	6 (11.5)	10 (19.2)	17 (32.6)$
>120 min ($n = 62$)	36 (59)	2 (3.2)	24 (38.7)	23 (37)	14 (22.5)	10 (16)	26 (41.9)**
Total	390	4	86	85	41	45	90

* $P = 0.11$(NS), # $P = 0.83$(NS), $ $P = 0.011$(S), ** $P = < 0.001$(HS)

Table 4 Comparision of composite adverse neonatal outcomes

DDI in min	Emergency number (%)	Urgent number (%)	P value	OR (95% CI)
<30 min	4 (20)*	6 (10)	0.25 (NS)	2.25 (0.56–8.9)
30–60 min	8 (31)*	16 (9.5)	0.002 (S)	4.6 (1.7–12.6)
60–90 min	5 (71)	8 (8.9)	0.004 (S)	25.3 (4.2–15.2)
90–120 min	7 (87.5)	10 (22)	0.005	23.8 (2.6–21.7)
>120 min	7 (100)	19 (33.6)	0.024 (S)	28.1 (1.5–15.2)

* $P = 0.3227$ (>0.05 NS)

difference in DDI between developed and developing nations.

The mean DDI of 65.87 min in emergency caesarean section in the present study reflects the difference in infrastructure, like number of human resources including doctor, nurse and paramedical staff as well as limited capacity of labour wards, operation theatre and overwhelming work load. Improvement in above parameters can help in achieving recommended DDI.

Neonatal outcome is the comprehensive expression of a multitude of variables including intrauterine foetal health status, gestational age, maternal medical/obstetric complications and available healthcare resources; however, **c**ord prolapse is a dire emergency with an increased risk of neonatal hypoxic brain injury and perinatal death, so immediate delivery is the rule. In our study, nearly 63% of women with cord prolapse could be delivered within 30 min and had good Apgar score. Perinatal mortality was 18% when DDI exceeded 60 min. We were able to achieve better foetomaternal outcome in this group in comparison with other developing countries with perinatal mortality of 45.2% [9].

In our study, acute and severe foetal distress (FHS—<80/minute for 9 min) had a mean DDI of 57 min. Four out of 22 women who delivered within 30 min had good neonatal outcome, whereas all 5/22 (22.7%) women with DDI of >60 min had their neonates admitted to NICU and later on died. The results of our study are comparable to others [10, 11].

The cases of placenta previa with profuse bleeding are always counted as emergency, but in our setting, arranging blood was difficult and hence none of the cases could be delivered within 30 min. All the babies were admitted in NICU, one out of three died. There was no change in maternal outcome. In women with abruptio placentae with major degree of haemorrhage, the mean DDI was 51 min. Only 5/30 (16.6%) women delivered within 30 min and total 11/30 (36.6%) women had perinatal mortality; out of these 11 women, 8 women had DDI of >60 min.

In our study, the perinatal mortality was slightly higher in emergency group having DDI of <30 min compared with those having DDI of 30–60 min (15 vs. 12.5%). The probable reason may be an already compromised foetus. A somewhat similar interesting observation was made by others with poor foetal outcome in DDI within 30 min [12]. This paradoxical observation may be due to the pre-existing poor foetal condition rather than DDI.

The composite adverse neonatal outcomes (still birth and NICU admission) significantly increased as DDI increased to >60 min and were worst with DDI > 120 - min. In the urgent group, 355/414 (85%) neonates were born with good neonatal outcome with no change in composite adverse neonatal outcome up to DDI of 90 min. These findings are in accordance with others [7]. Blooms et al. found that there was no evidence to indicate that decision delivery interval up to 120 min was detrimental to the neonate unless delivery was crash caesarean section [13], while others recommended that 30 min of decision

delivery interval for category I and 75 min of decision delivery interval for category II caesarean section are justified [14].

The existing recommendations of decision delivery interval can raise many medico-legal issues and impose great pressure on the health facility to deliver a baby in less than 30 min in all emergency caesarean sections. Our study highlights the need of clear categorization of the indications of caesarean section as emergency or urgent. Composite perinatal outcome in our study emphasized the fact that even if the baby was delivered in less than 30 min in emergency group, the outcome was not significantly better. It also revealed that adverse composite perinatal outcome was not affected much till 60 min in emergency and 90 min in urgent caesarean section cases. This observation highlights the fact that for a compromised foetus, DDI is not the sole factor responsible for poor outcome. Notwithstanding this observation, the decision delivery interval should be achieved in 30 min and must be mandatory in cases of crash caesarean section like cord prolapse and/or catastrophic antepartum haemorrhage. Although our study observed that DDI up to 60 min for other indications of emergency and up to 90 min in urgent caesarean section was not associated with a significant difference in composite adverse outcome, it will be prudent to have more studies with larger sample size before a definite recommendation for extending the DDI in these two categories may be suggested. Meanwhile, the existing guidelines for DDI remain although it may not always be achievable in very busy obstetric referral units; cases need to be individualized, and infrastructure must be improved by all means.

Some investigators have attempted to elucidate the reasons for delays in performing emergency caesarean sections, and majority were due to anaesthesia. [7] In our study, over 98% of cases were done using spinal anaesthesia, which is safe and is the technique of choice. There was no evidence to suggest that adverse perinatal outcome resulted from delays occasioned by spinal anaesthesia as these occurred only in a few cases of multiple needle attempts. Only 2% of the caesarean sections were done under general anaesthesia for potential bleeding cases (APH), acute foetal conditions or when spinal anaesthesia failed. Seniority of the surgeon was not a significant predictor in our study and is similar to the observations made by some researchers [15], but contrary to others [16].

In our study, major cause of delay was a long waiting list of emergency caesarean section in operation theatre. Second most common cause was excessive work load in labour room leading to delay in preparing the women for operation, counselling, taking consent and shifting the women in pre-operative area. We highlight the excessive work load in government tertiary care hospital. For reduction in decision delivery interval, the infrastructure facilities must be improved, particularly manpower and operation theatres.

Conclusion

A decision delivery interval should always be considered as one of the important contributing factors but not as the sole factor in determining composite neonatal outcome even in emergency and urgent caesarean cases; moreover, a decision delivery interval of 30 min for emergency LSCS is not pragmatic in low-resource setting and may not be applicable to all emergency CS and needs to be reconsidered. The composite neonatal outcomes comprising admission to the NICU and perinatal mortality were not significantly increased up to DDI of 60 min for category I (emergency) caesarean section and up to 90 min in category II (urgent) caesarean sections. This dictum does not apply to indications of crash caesarean section like cord prolapse or catastrophic antepartum haemorrhage where expedited delivery is warranted and any purposeful delay is unjustified.

Authors propose to make crash CS (including cases of cord prolapse or catastrophic antepartum haemorrhage) a separate group with recommendation of DDI of 30 min. For the remaining cases in the present emergency CS group, the suggestion to extend the recommendation of DDI to 60 min and for some if not all cases of urgent group to 90 min may be made following further studies which are the need of hour so that this DDI *yardstick does not become a rod at our backs* in the medico-legal context.

Compliance with Ethical Standards

Conflict of interest Authors declare that there is no conflict of interest.

Ethical approval All procedures followed were in accordance with ethical standard of the responsible committee on human experiments (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008(5). This article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

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