

Decision to Delivery Interval in Emergency Cesarean Section at Two Academic Hospitals in Yogyakarta and Central Java, Indonesia



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ABSTRACT

Background: The international guideline suggests that the ideal DDI is 30 minutes for grade 1 and grade 2 CS, but they are still hardly achieved. Therefore, the main purpose of this study was to determine the DDI for grade 1 and 2 CS, and its determinants in two academic hospitals.

Methods: A prospective cohort study was conducted using pregnant women who underwent grade 1 and 2 emergency CS. Data regarding demographic characteristics of the subjects were extracted from the medical record, while DDI and its components were measured by direct observation. Odds ratio was used to determine the association between DDI and its determinants.

Results: The median DDI for grade 1 and 2 CS in the main academic hospital were 112.5 minutes and 181 minutes respectively, longer than their duration in the affiliated hospital with 80 minutes for grade 1 CS and 104 minutes for grade 2 CS. The significant determinants for a 75-minute DDI in the main academic hospital were grade of CS (OR: 0.12; 95%CI: 0.01-1.05; p: 0.047), indication of CS (OR: 0.77; 95%CI: 0.6-0.89; p: 0.014), and anesthesiologist response time (OR: 9.18; 95%CI: 2.21-38.13; p: 0.001), while in the affiliated academic hospital, operating room waiting time was the only significant determinants (OR: 6.18; 95%CI: 2.07-18.48; p: 0.001).

Conclusions: DDI for emergency CS still exceeded the standard in academic hospitals with different determinants causing the delay. Strengthening interprofessional collaboration should be implemented systematically.

Keywords: Emergency cesarean section, decision to delivery interval (DDI), determinants.

Cite This Article: Prawitasari, S., Widyandana, D., Hakimi, M., Utarini, A. 2021. Decision to Delivery Interval in Emergency Cesarean Section at Two Academic Hospitals in Yogyakarta and Central Java, Indonesia. *Bali Medical Journal* 10(1): 266-272
DOI: 10.15562/bmj.v10i1.2030

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Received: 2020-10-20

Accepted: 2021-04-12

Published: 2021-04-30

INTRODUCTION

Cesarean Section (CS) has a huge potential to reduce maternal and perinatal deaths up to 72%,¹ especially in emergency cases with indications such as hemorrhage from placenta previa, placental abruption, umbilical cord prolapse, or uterine rupture.² The moment between a decision to delivery time is very crucial because it can be an imminent threat for mother, baby, or both life.^{3,4} The Decision to Delivery Interval (DDI), defined as the interval in minutes between the decision by obstetrician and time to deliver the baby, is important to measure quality of care, mainly in grade 1 and grade 2 CS where there are chances of life-threatening conditions.⁴ According to the international

guidelines from The National Institute of Clinical Excellence (NICE) UK, and The American College of Obstetrician and Gynecologist (ACOG), a 30 minute DDI should be applied for grade 1 and grade 2 CS with an extension up to 75 minutes for grade 2.^{1,5}

Previous large cohort studies in developed countries found that only two-thirds of all primary CS were delivered within 30 minutes.² Another large national cross sectional survey across UK found 63% of units had 50% of DDI within 30 minutes for grade 1 CS.¹ The reasons for delayed DDI were impaired inter-professional collaboration in preparing CS, lack of personnel, and lack of appropriate facilities.^{5,6} In conditions

where DDI within 30 minutes could not be accomplished, undesirable outcome is unavoidable if the delay continues beyond 75 minutes.⁴ Thomas et al. found that DDI >75 minutes was associated with 80% increased odds of a five minute APGAR score of < 7 (1.8, 1.3 to 2.4) and 50% increase in the odds of special care admittance for mothers.¹

In developing countries, the data from several studies showed that the average DDI are still lagging, with interval between 100-180 minutes.⁷ Indonesia as one of the developing countries in South-East Asia is also struggled to achieve the standards.⁸ This problem was evident even in hospitals with high resources, such as the academic hospitals. Despite having

better facilities and human resources compared to the non-academic hospitals,⁶ those challenges remain, especially in interprofessional collaboration. Therefore, this study was carried out to determine the DDI for grade 1 and 2 emergency CS and to measure its determinants in academic hospital settings.

METHODS

Study setting

The study was conducted in two academic tertiary hospitals of the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, i.e. one main academic and one affiliated academic hospitals, located in the Southern part of Central Java province. The main academic hospital is equipped with 25 obstetricians, 15 anesthesiologists, 4 neonatologists, with 44 obstetrics residents placed in the emergency department during the study period. In 2019, 990 deliveries were recorded with 48.60% CS rate. Two emergency operating rooms were available for various emergency cases, including CS. In comparison, the affiliated academic hospital has only 5 obstetricians, 5 anesthesiologists, 1 neonatologist, and 33 obstetrics residents performing 1,567 deliveries with 33.70% CS rate in 2019. Only one emergency operating room was available for all types of emergencies. In both hospitals, the emergency operating rooms were located in separate buildings to the delivery room.

Study design and subjects

This study used a prospective cohort design and using pregnant women who underwent emergency CS grade 1 and 2 as the subjects. The criteria for grade 1 and 2 CS were taken from Thomas et al. and Hirani et al.^{1,9} Grade 1 CS was assigned for an immediate threat to woman or baby's life such as fetal distress, non-reassuring fetal heart, cord prolapse, severe antepartum hemorrhage, uterine rupture, placental abruption, and failed instrumental delivery. Grade 2 CS was assigned for antepartum hemorrhage and obstructed labor.^{5,9}

Data collection

Demographic characteristics of the patients such as age, gestational age,

parity, patient status, baby's birth weight were collected from the hospital medical birth registry and medical records. Other determinants of DDI such as the location of care, grade and indication of CS and time of CS, as well as the perinatal team response time, anesthesiologist response time, transport time, emergency operating room waiting time, and anesthesiologist preparation time were all collected prospectively using direct observation conducted by trained research assistants.

DDI was measured as the interval in minutes between time of the decision by the obstetrician to the delivery of the baby. In the analysis, we used continuous and dichotomous data which were grouped into less or equal to and more than 75 minutes based on the previous study by Thomas et al.¹ Perinatal team response time (minutes) was defined as the interval between patient arrival and perinatal team arrival at the emergency operating rooms, categorized into less or equal and more than 15 minutes according to existing practice in both academic hospitals. The anesthesiologist response time was the interval in minutes between the notifications to the approval of the anesthesiologist consultant for the time of surgery, and it was categorized into less or equal and more than 20 minutes. Transport time was defined as the interval in minutes between the approval of the anesthesiologist and patient arrival to the emergency operating room and was categorized into less or equal and more than 10 minutes; Meanwhile, operating room waiting time was measure in minutes between patient arrival to the emergency operating theatre to the patient arrival at the operating room and was categorized into less or equal and more than 10 minutes. Finally, anesthesiologist preparation time was defined as the interval in minutes from patient arrival at the operating room to successful anesthetic induction which was also categorized into less or equal and more than 10 minutes. All of these variables were recorded as dichotomous variables as in studies by Gupta et al. and Hirani et al.^{5,9}

Data analysis

Normality of data distribution was assessed and data analysis was carried out

using Statistical Package for Social Science (SPSS) software version 22 from IBM. Descriptive statistics were summarized using frequency and proportions for dichotomous variables. Median interquartile range was used to calculate DDI because data were not distributed normally. The odds ratio was used to determine the associations between DDI and subject demographic characteristics such as age, gestational age, parity, patient status, location of care, diagnosis for the CS, DDI based on CS urgency, indications, time of SC and baby's birth weight. The odds ratio was also calculated to evaluate the relationship between perinatal team response time, anesthesiologist response time, transport time, operating room waiting time, and anesthesiologist preparation and DDI. A *p*-value < 0.05 was considered statistically significant.

RESULTS

Characteristics of the study participants

There were 77 and 71 pregnant women in the main hospital and the affiliated hospital who underwent CS grade 1 and grade 2 during the study period. The percentage of grade 1 CS out of all C sections performed during the study period in the main hospital was 49% and grade 2 CS was 28%. The percentage of grade 1 CS in the affiliated hospital was 51% and for grade 2 CS was 20% respectively.

The subject's demographic characteristics such as age (OR: 0.42; 95%CI: 0.11-1.51), gestational age (OR: 0.94; 95%CI: 0.27-3.28), patient status (referred or inpatient) (OR: 0.32 95%CI: 0.08-1.30), parity (OR: 2.22; 95%CI: 0.44 – 11.08) and baby's birth weight (OR: 1.14; 95%CI: 0.32-3.99) had no significant influence in achieving DDI within 75 minutes or more at the main and affiliated hospitals (Table 1).

Indications of Cesarean Section

A 30-minute standard of DDI was only achieved in 1.41% of grade 1 CS in the affiliated academic hospital, while none was achieved in the main academic hospital (data not shown).

Applying the 75 minute cut off point, 22.4% and 51% of grade 1 CS and 3.6% and 35% of grade 2 CS met the standard

Table 1. Demographic Characteristics of the Study Participants (n 148)

Variables	The Main Hospital (n=77)			The Affiliated Hospital (n=71)			OR	95% Confidence Interval	
	DDI ≤ 75 Minutes (%)	DDI > 75 Minutes (%)	p-value	DDI ≤ 75 Minutes (%)	DDI > 75 Minutes (%)	p-value		Lower	Upper
Demographic characteristics									
Age (years)									
<20 and >35	5 (25.0)	15 (75.0)	0.280	11 (37.9)	18 (62.1)	0.230	1.80	0.68	4.72
20-35	7 (12.3)	50 (87.7)		22 (52.4)	20 (47.6)				
Gestational age									
Preterm	7 (15.9)	37 (84.1)	0.928	9 (33.3)	18 (66.7)	0.082	2.40	0.88	6.49
Full-term	5 (15.2)	28 (84.8)		24 (54.5)	20 (45.5)				
Patient status									
Referred	9 (22.0)	32 (78.0)	0.100	21 (52.5)	19 (47.5)	0.248	0.57	0.22	1.48
In patient	3 (8.3)	33 (91.7)		12 (38.7)	19 (62.3)				
Parity									
Primipara	2 (9.1)	20 (90.9)	0.491	10 (52.6)	9 (47.4)	0.530	0.71	0.24	2.04
Multipara	10 (18.2)	45 (81.8)		23 (44.2)	29 (55.8)				
Baby birth weight									
<2500	7 (14.9)	40 (85.1)	1.000	11 (39.3)	17 (60.7)	0.327	1.61	0.61	4.25
>2500	5 (16.7)	25 (83.3)		22 (51.2)	21 (48.8)				

in the main and affiliated academic hospitals, respectively. The median DDI for grade 1 and grade 2 CS in the main academic hospital were 112.5 minutes and 181 minutes respectively, which were longer than their duration in the affiliated hospital (80 minutes for grade 1 CS and 104 minutes for grade 2 CS) (Table 2).

The most frequent indication for grade 1 CS was fetal distress (42.86% and 56.34% of cases in main academic and affiliated hospitals, respectively). The median DDI for fetal distress was 99 minutes (IQR: 73.25-154.00) in the main hospital and 80 minutes (IQR: 55.00-143.0) in the affiliated hospital. The second most frequent indication for grade 1 CS was severe antepartum bleeding with median DDI of 137.5 minutes (IQR: 108.5-241.75) in the main hospital and 130 minutes (IQR: 60-240) in the affiliated hospital respectively. Meanwhile, the main indication of grade 2 CS was hypertension in pregnancy, with a proportion of 25.97% in the main academic hospital and 28.17% in the affiliated academic hospital (Table 2).

Determinants for DDI

Patient location and time of surgery had no influences on DDI in both academic hospitals. In the main academic hospital, grade of CS urgency and indication of CS significantly influenced the DDI within 75 minutes or more (OR: 0.12; 95%CI: 0.01-1.05; p:0.047 and OR: 0.77; 95%CI: 0.66-0.89; p: 0.014, respectively). Similarly, another significant determinant in the main academic hospital was anesthesiologist response time (OR: 9.18; 95%CI: 2.21-38.13; p:0.001). In the affiliated academic hospital, operating room waiting time was the only significant determinant (OR:6.18; 95%CI: 2.07-18.48; p:0.001) (Table 3).

DISCUSSION

The main purpose of this study was to determine the DDI for grade 1 and grade 2 emergency CS, and the determinants in main and affiliated academic hospitals. Overall, very few grade 1 CS surgery was carried out within 30 minutes of DDI. If a longer cut off point was applied, 22.4% and 51% of grade 1 CS in two academic hospitals met the criteria within 75 minutes. The affiliated hospital had

Table 2. Indication for Grade 1 and Grade 2 Caesarean Section at the Main and Affiliated Academic Hospital

Indication	The Main Hospital (n 77)		The Affiliated Hospital (n 71)	
	n (%)	Median DDI (minutes) (IQR)	n (%)	Median DDI (minutes) (IQR)
Imminent Threat (Grade 1)	49 (63.64)	112.50 (78.25 – 159.50)	51 (71.83)	80.00 (55.00 – 143.00)
Fetal distress	33 (42.86)	99.00 (73.25 – 154.00)	40 (56.34)	80.00 (55.00 – 143.00)
Severe antepartum bleeding	10 (12.98)	137.50 (108.50 – 241.75)	7 (9.86)	130.00 (60.00 – 240.00)
Cord Prolapse	2 (2.60)	69.50 (61.00 – 69.50)	1 (1.41)	23.00
Uterine Rupture	2 (2.60)	89.00 (94.00 – 189.00)	2 (2.82)	78.00 (62.00 – 78.00)
Failed Vacuum Extraction	1 (1.30)	88.00	1 (1.41)	41.00
Maternal Respiratory failure	1 (1.30)	118.00	-	-
Non-Imminent Threat (Grade 2)	28 (36.36)	181.00 (27.25 – 220.75)	20 (28.17)	104.00 (62.00 – 254.00)
Hypertension in pregnancy	20 (25.97)	170.00 (116.50 – 220.75)	20 (28.17)	100.50 (62.75 – 250.75)
Non-Progressed second stage	3 (3.90)	144.00 (57.00 – 144.00)	-	-
Placenta accrete with a mild bleeding	2 (2.60)	181.50 (140.00 – 181.50)	-	-
Transverse Lie	2 (2.60)	195.50 (190.00 – 195.50)	-	-
Hydrocephalus baby in active phase of labor	1 (1.30)	180.00	-	-
Total	77 (100.0)	135.50 (88.25 – 200.75)	71 (100.0)	83.50 (56.50 – 161.25)

shorter DDI for grade 1 and 2 emergency CS compared to the main hospital. The significant factors for DDI in the main academic hospital was grade of CS, indication of CS, and anesthesiologist response time, while operating room waiting time became the only significant determinant in the affiliated academic hospital.

The achievement of DDI within 30-minute standard in this study was comparable to Rhadakhrisnan *et al.* study at a tertiary hospital in India where DDI within 30 minutes were only achieved in 1.8% of cases. However, the DDI for grade 1 and grade 2 in both academic hospitals in Indonesia was better than their study,¹⁰ albeit lower than in other developing countries such as in India and Tanzania.^{5,9,10} Although a 30 minute standard DDI did not significantly influence the delivery outcome, DDI of more than 75 minutes was associated with a poorer neonatal outcome and increased admission rate to special care institution for the mother.^{1,10}

Both academic hospitals in this study were tertiary hospitals with different volume of total deliveries annually. The main hospital had a smaller number of total deliveries but with higher CS rate compared to the affiliated hospital. The DDI in the affiliated hospital was better than the main hospital. This study was

contrary to Kolas *et al.* which found that DDI was longer in a level 3 hospital (with more than 1,500 annual deliveries) than level 2 hospital (with 400-1500 annual deliveries).¹¹ Better interprofessional collaboration in preparing the emergency CS in the affiliated hospital might become the reason.^{6,10,11,12}

Grade 1 CS significantly became the determinants for DDI within 75 minutes in the main hospital. According to the international guideline, DDI for Grade 1 CS should be accomplished within 30 minutes.¹ The median DDI for grade 1 CS in the main hospital was 112.50 minutes. Even though we had not been able to fulfill the standard yet, the awareness was already developed and would become a strength for further improvement.

Fetal distress was a significant determinant for DDI in the main hospital. The finding was similar to studies undertaken by Owalabi *et al.*, Temesgen *et al.* and Kolas *et al.*^{11,13,14} The indication of CS significantly influenced the DDI.¹¹ CS for fetal-related factors, such as fetal distress and cord prolapse, shortened the DDI in both academic hospitals. The median DDI for maternal indication such as severe antepartum bleeding as the indication for grade 1 CS were significantly longer which might be caused by stabilization required prior to CS. In Hirani *et al.* and Kolas *et al.*, hypertension

during pregnancy significantly increased the DDI.^{9,11}

Finally, anesthesiologist response time significantly influenced DDI within 75 minutes or more in the main hospital. More than 90% of prolonged anesthesiologist response time (>20 minutes) occurred in CS with DDI more than 75 minutes in the main hospital. Likewise, Rhadakhrisnan *et al.* and Gupta *et al.* discovered that interval between decision to do CS to moving the patient to operating theatre (which includes anesthesiologist response time in our study) become the most responsible factor for prolonged DDI in grade 1 and grade 2 CS.^{5,10} It was also included in decision to operating room interval in Khemworapong *et al.* study.¹² Two reasons documented in our study for delayed anesthesiologist response time were the anesthesiologist being busy with another emergency patient and waiting time required for patient stabilization. In Rhadakhrisnan *et al.* study, 15% of the delay was inevitable because of the need to do resuscitation before anesthesia induction, and 78% of them were grade 1 and 2 CS.¹⁰

In the affiliated academic hospital, none of the above factors were significant. Operating room waiting time was the only significant determinants for DDI within 75 minutes or more. The availability of only one operating room in this

Table 3. The Determinants of Delivery Decision Interval at the academic hospital and affiliated hospital

	The Main Hospital			The Affiliated Hospital			Confidence Interval (95%)		
	DDI ≤ 75 Minutes (%)	DDI > 75 Minutes (%)	p-value	OR	DDI ≤ 75 Minutes (%)	DDI > 75 Minutes (%)	p-value	Confidence Interval (95%)	
								Lower	Upper
C Section									
Grade of urgency									
Grade 1	11 (22.4)	38 (77.6)	0.047	0.12	0.01	1.05	0.225	0.17	1.51
Grade 2	1 (3.6)	27 (96.4)							
Indication									
Fetal	12 (22.6)	41 (77.4)	0.014	0.77	0.66	0.89	0.499	0.28	1.85
Maternal	0 (0.0)	24 (100.0)							
Timing of surgery									
Office hour	7 (19.4)	29 (80.6)	0.382	0.57	0.16	2.00	0.236	0.67	4.83
After office hour	5 (12.2)	36 (87.8)							
Patient location									
Delivery room	3 (13.0)	20 (87.0)	1.000	1.33	0.32	5.45	0.295	0.23	1.55
Emergency room	9 (16.7)	45 (83.3)							
Perinatal team response time (minutes)									
>15	12 (17.4)	57 (82.6)	0.344	0.82	0.74	0.92	0.124	0.73	10.04
≤15	0 (0.0)	8 (100.0)							
Anesthesiologist response time (minutes)									
>20	3 (5.8)	49 (94.2)	0.001	9.18	2.21	38.13	0.07	0.92	6.27
≤20	9 (36.0)	16 (64.0)							
Transport time (minutes)									
>10	3 (8.1)	34 (91.9)	0.082	3.29	0.81	13.26	0.192	0.71	5.27
≤10	9 (22.5)	31 (77.5)							
Operating room waiting time (minutes)									
>10	7 (13.5)	45 (86.5)	0.511	1.60	0.45	5.68	0.001	2.07	18.48
≤10	5 (20.0)	20 (80.0)							
Anesthetist preparation (minutes)									
>10	10 (14.3)	60 (85.7)	0.298	2.40	0.40	14.10	0.752	0.33	2.19
≤10	2 (28.6)	5 (71.4)							
Total	12 (15.6)	65 (84.4)							

affiliated hospital dedicated for all types of emergency surgeries might explain the reason. Dunn *et al.* in a study evaluating the use of a public announcement system to alarm the multidisciplinary team and a special operating theatre just 50 meters from the obstetric ward for emergency CS found that these strategies improved DDI within 30 minutes significantly.¹⁵ Dedicating one operating room especially for emergency CS would be the solution to minimize the operating room waiting delay.

Tertiary academic hospitals such as in this study placed residents as the front liners in patient care under supervision of the consultants on duty. Hierarchical communication between residents and interprofessional collaboration with other healthcare provider such as nurses and midwives across departments might become challenging and influenced the DDI.^{6,16} Sutcliffe *et al.* further found that conflicting roles and role ambiguity, interpersonal power and conflict might also interfere the communication between residents and other health professionals.¹⁶ Previous study suggested that the ability of the obstetrician to communicate the urgency of the CS and remind the passage of time to the anesthesiologists and the rest of the team was essential to improve DDI.⁶ Another study by Le Mitouard *et al.* used the color code protocol to improve the DDI for grade 1 and grade 2 CS in an academic hospital in Lyon, France. With this protocol, effective communication between the interprofessional team was improved and the DDI was significantly shorter.¹⁷ Several interventions such as automated call-outs, implementing standard operating procedures, and staff training using crew resource management techniques might be used to prevent delays in care of acutely ill patients.¹⁸ Standard operating procedure for grade 1 and grade 2 CS preparation with interprofessional collaboration approach should be implemented strictly in the main and affiliated hospital.

There were several limitations in this study such as limited data on the reasons behind delays in each interval processes that contributed to DDI of grade 1 and grade 2 CS in both hospitals. There was

also no recorded data about the ratio of pregnant women and midwives during the CS preparation which may contribute to the delayed DDI as well. Detailed recording on barriers for every process interval (anesthesiologist response time, perinatal team response time, transport time, operating room waiting time, and anesthesiologist preparation) and the availability of human resources during CS preparation would give valuable insights on how to evaluate the implementation of existing standard operating procedure for emergency CS grade 1 and grade 2. Nonetheless the existing data was valuable enough for better understanding of the delayed DDI in this study

CONCLUSION

The Decision to Delivery Interval (DDI) in both academic hospitals were still below the international standard in most of the CSs. The critical factor in the main academic hospital was the anesthesiologist response time delay, while the affiliated academic hospital should overcome delay due to availability of the operating room. Quality improvement studies are needed to find the most effective approaches to reduce the DDI in emergency CS in the academic hospital setting.

AUTHOR CONTRIBUTION

All authors have contributed to all processes in this research, including preparation, data gathering, and analysis, drafting, and approval for publication of this manuscript.

ACKNOWLEDGMENT

The authors would like to thank nurses, residents and staff of Obstetrics and Gynecology Department, Anesthesiology and Reanimation Department, and Maternal Perinatal Installation of the main Academic Hospital and the affiliated Academic Hospital for their valuable help and participation in this study.

CONFLICT OF INTEREST

Authors have no conflict of interest related to this work.

ETHICAL CLEARANCE

Ethical clearance was obtained from the Medical and Health Research Ethics Committee, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada (KE/FK/0015/EC/2019). A written informed consent was taken from all study subjects.

FUNDING

No funding or grant support was obtained.

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