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ORIGINAL RESEARCH

# A Retrospective Review of Decision to Delivery Time Interval for Foetal Distress at a Central Hospital

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**Purpose:** The aim of this study was to describe the trajectory of emergency caesarean deliveries for foetal distress at Chris Hani Baragwanath Academic Hospital (CHBAH).

**Patients and Methods:** A retrospective, contextual, descriptive study, using consecutive convenience sampling was done reviewing all the records of emergency caesarean deliveries for foetal distress at CHBAH in February 2019 until a minimum sample size of 385 was reached.

**Results:** During the study period, a total of 617 caesarean deliveries were done, of which 572 (92.7%) were emergencies. Foetal distress accounted for 395 (69.1%) of the emergency caesarean deliveries. No emergency caesarean delivery for foetal distress conformed to the 30-minute DDI and the mean (SD) DDI was 411 (291) minutes. The mean (SD) 5-minute and 10-minute Apgar scores were 8.4 (1.6) and 9.6 (1.3), respectively. There was a significant difference between the type of anaesthetic (general or neuraxial), with those receiving general anaesthesia having shorter anaesthetic start to cut time (p=0.0110). However, those delivered following neuraxial anaesthesia had better 5-minute (p=0.0002) and 10-minute (p=0.0175) Apgar scores.

**Conclusion:** This study showed that a DDI of 30-minutes, was not achieved at CHBAH during the study period. Most babies diagnosed with foetal distress pre-delivery had 5-minute and 10-minute Apgar scores inconsistent with this diagnosis. This over-diagnosis of foetal distress in some cases could have led to delays in delivery of babies who had actual foetal distress and where a 30-minute DDI could have improved outcome.

**Keywords:** decision to delivery time interval, foetal distress, emergency caesarean delivery

## Introduction

Foetal distress occurs when the foetus becomes hypoxic during the antenatal or intrapartum period[1] and requires immediate intrauterine resuscitation and caesarean delivery.[2] Effective diagnosis and management of foetal distress have short and long-term implications for not only the neonate but also for the family, the health care system and the community.[3] However, the accurate diagnosis and effective management of foetal distress remain complex[4] challenging and inexact.[5]

Clinically foetal distress may be suspected by decreased foetal movement reported by the mother,[6] meconium in the amniotic fluid,[7] a non-reassuring pattern on electronic foetal monitoring[8] and biochemical signs such as foetal metabolic acidosis or elevated foetal blood lactate level.[9] The pathogenesis of foetal distress is multifactorial and can be due to processes such as uteroplacental deficiency, foetal sepsis and cord compression.[10] During the foetal distress pathogenesis, increased ischemic modified albumin levels maybe the best indicator of an underlying non – acute ischemic condition.[11] Hypoxia during intrapartum causes difficulties in nearly 1% of labours and results in mortality in almost 0.5 in 1000 pregnancies as well as cerebral palsy, a long-term neurological sequelae of intrapartum hypoxia, in a similar number of pregnancies.[12]

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For the obstetric anaesthetist, emergency caesarean deliveries for foetal distress can be challenging given the limited time, the increased threat to the foetus and the well-being of the mother. Therefore, the technique of anaesthesia chosen has clinical significance.[13] For elective caesarean delivery, neuraxial anaesthesia is recommended over general anaesthesia since there is less aspiration risk.[14] For emergency caesarean delivery, neuraxial anaesthesia should be used provided it does not delay the commencement of surgery.[15] Limited data exist regarding the best anaesthetic practice for emergency caesarean deliveries for foetal distress.[13]

The Royal College of Obstetricians and Gynaecologists (RCOG)[16] and National Institute for Clinical Excellence (NICE)[17,18] state that "where the indication to deliver is an immediate threat to the life of the mother or the foetus, delivery should occur within 30 minutes of the decision". They further state "that for emergency deliveries, where there is no immediate threat to maternal or foetal health, delivery should occur within 75 minutes". The reason for this classification is because the period of in-utero foetal hypoxia is considered as an important factor for the development of permanent foetal hypoxic-ischemic brain damage.[19] These various decisions to delivery time intervals (DDI) have been recommended by international professional organisations[17] as a target and are key for clinical governance and risk management. Nevertheless, evidence that a 30- or 75-minute DDI is a clinically significant threshold lacks both in theory and practice.[20] It has been shown that the 30-minute DDI is not always met in obstetric units.[21–24] It is, therefore, important to determine whether the stipulated DDIs are being met in different settings. The DDI of emergency caesarean delivery for foetal distress at Chris Hani Baragwanath Academic Hospital (CHBAH) is not known and the aim of this study was to describe this trajectory.

## Materials and Methods

A retrospective, contextual and descriptive research design was followed. Approval to conduct the study was obtained from the Human Research Ethics Committee (Medical) (M190615) of the University of the Witwatersrand and other relevant authorities. To ensure the anonymity of the data, the name of the patient and anaesthetist was not recorded. Every patient was allocated a study number. A list with patient study number was generated and filed separately. Confidentiality was maintained as only the authors had access to the raw data.

This study was conducted according to the principles of the Declaration of Helsinki and the South African Guidelines for Good Clinical Practise.

Ethics Committee of the University of Witwatersrand did not require patient consent since data was collected retrospectively from patient records.

The study population consisted of the records of all emergency caesarean deliveries for foetal distress at CHBAH in February 2019. The records consisted of the maternal register, labour ward booking lists, the theatre utilisation sheets and the birth register. In consultation with a biostatistician, it was determined that the minimum sample size needed to estimate the true population proportion of foetal distress at CHBAH with the required margin of error (5%) and confidence level (95%) and a power of greater than 80% was 385. A consecutive, convenience sampling method was used. Illegible records and records of women with a multiple pregnancy, known foetal anomalies and gestational age below 24 weeks were excluded from this study.

A draft data collection sheet was compiled following a literature review, thereby ensuring content validity. The draft data collection sheet was reviewed by three anaesthesiologists with an interest in obstetric anaesthesia, ensuring content and face validity. A summary of the collected data is shown in Figure 1. The total number of emergency caesarean deliveries during the study period and the total number of emergency caesarean deliveries for foetal distress were documented (Figure 2).

At CHBAH foetal distress is diagnosed using cardiotocography (CTG). However, no specific standard diagnostic criteria are used to categorise foetal distress. Therefore, in this study, a caesarean delivery booked for foetal distress was regarded as an emergency caesarean delivery. The DDI was the interval in minutes from the time of the decision to carry out the caesarean delivery to the time of delivery of the baby. The anaesthetic starting time to cut time was the time in minutes from the start of the anaesthetic to the skin incision and included the cleaning and draping time.

The data were analysed in consultation with a biostatistician using the statistical program STATA version 14.2 (StataCorp, USA). Categorical variables were described as frequencies and percentages and continuous variables as means and standard deviations if normally distributed or medians and interquartile ranges if not. The comparisons

Characteristics of the mother

Additional indications for caesarean delivery

DDI trajectory

Type of anaesthesia

Characteristics of the neonate

Neonatal outcome

**Figure 1** Summary of collected data.

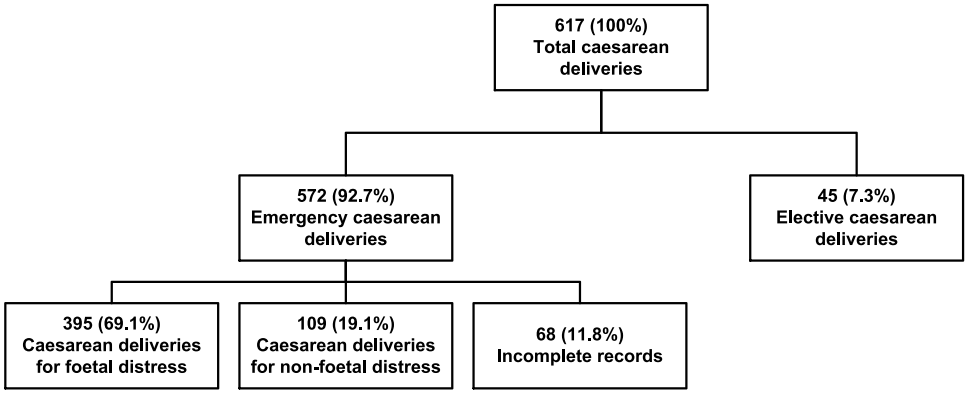


**Figure 2** Study methodology.

between the anaesthetic starting time and cut time and 5- and 10-minute Apgar scores between those receiving neuraxial anaesthesia and those receiving general anaesthesia were done using the Mann–Whitney *U*-test. A p-value of $< 0.05$ was considered statistically significant.

## Results

A total of 617 caesarean deliveries were done during the study period, of which 572 (92.7%) were emergencies. There were 68 incomplete patient records that were excluded resulting in a sample of 395 (69.1%). Foetal distress accounted for 395 (69.1%) of the emergency caesarean deliveries. The characteristics of these 395 mothers are shown in Table 1. In terms of Robson Ten's group classification, the high caesarean delivery rate in our institution is due to the women with previous caesarean delivery at term (Group 5) and nulliparous patients in spontaneous labour at 37 weeks (Group 1). One hundred and fifty-eight (40.0%) mothers had additional indications for caesarean delivery documented, of which 144 (91.1%) had 1 indication and 7 (4.4%) had 2 indications documented. Nine (2.3%) mothers had indications for caesarean delivery that were an immediate threat to the life of the mother or foetus, which were imminent eclampsia 5 (55.6%), eclampsia 1 (11.1%), HELLP syndrome 1 (11.1%) placental abruption 1 (11.1%) and antepartum haemorrhage 1 (11.1%).

The 7 other additional conditions included 2 (22%) failed vaginal births after previous caesarean delivery, 2 (22%) preterm rupture of membranes, 2 (22%) post-dates and 1 (10%) intrauterine growth retardation. The DDI trajectory is shown in Table 2. The DDIs in 30-minute time intervals for the 395 mothers are shown in Table 3.

Of the babies, 190 (48.1%) were males and 205 (51.9%) females. The mean (SD) weight of the babies was 2899 (674.6) g, with a minimum of 765 g and a maximum of 4450 g. Of the 392 (99.2%) babies discharged alive from theatre, 145 (37.0%) were admitted to the neonatal nursery following delivery for further observation and triage and 247 (63.0%) babies were discharged to the ward with the mother.

**Table 1** Characteristics of the Mothers

| Characteristics | Mean | SD |
|---|---|---|
| Age (years) | 28.5 | 6.9 |
| Gestational age (weeks) | 37.9 | 3.0 |
| **Parity** | **Number** | **Percentage** |
| Nulliparous | 165 | 41.8 |
| Primiparous | 116 | 29.4 |
| Multiparous | 110 | 27.8 |
| Grand-multiparous | 4 | 1.0 |
| **Additional indications** | | |
| Previous caesarean deliveries | 35 | 8.9 |
| Pre-eclampsia | 34 | 8.6 |
| Cephalopelvic disproportion | 20 | 5.1 |
| Meconium stained liquor and poor progress | 14 | 3.5 |
| Failed augmentation of labour | 13 | 3.3 |
| Prolonged latent or active phase of labour | 11 | 2.8 |
| Diabetes mellitus | 9 | 2.3 |
| Breech | 6 | 1.5 |
| Imminent eclampsia | 5 | 1.3 |
| HELLP syndrome | 1 | 0.6 |
| Eclampsia | 1 | 0.6 |
| Placental abruption | 1 | 0.6 |
| Antepartum haemorrhage | 1 | 0.6 |
| Other | 7 | 2.3 |
| **Anaesthetic technique** | | |
| Neuraxial anaesthetic | 368 | 93.2 |
| General anaesthetic | 27 | 6.8 |

**Table 2** Trajectory from Decision to Delivery Time Interval

| Time Interval | Time in Minutes | | |
|---|---|---|---|
| | Median (IQR) | Min | Max |
| **Decision to arrival in theatre** | 273 (152–547) | 5 | 1405 |
| **Decision to anaesthesia** | 293 (170–573) | 2 | 1430 |
| **Arrival in theatre to anaesthesia** | 15 (10–20) | 0 | 45 |
| **Anaesthesia start to cut time** | 15 (12–20) | 1 | 42 |
| **Decision to delivery** | 316 (188–585) | 37 | 1435 |

**Table 3** Decision to Delivery Time Intervals

| DDI (Minutes) | Number | Percentage |
|---|---|---|
| ≤30 | 0 | 0.0 |
| 31–60 | 4 | 1.0 |
| 61–90 | 14 | 3.5 |
| 91–120 | 17 | 4.3 |
| 121–150 | 33 | 8.4 |
| 151–180 | 23 | 5.8 |
| 181–210 | 30 | 7.6 |
| 211–240 | 18 | 4.6 |
| ≥240 | 256 | 64.8 |

Only 6 (1.5%) babies had 1-minute Apgar scores recorded. The median (IQR) score for these babies was 5 (2.8–7.3). The mean (SD) 5-minute and 10-minute Apgar scores were 8.4 (1.6) and 9.6 (1.3) respectively. The 5-minute and 10-minute Apgar scores of the babies are shown in Table 4. Three babies were not successfully resuscitated by 10 minutes. Two of these babies had foetal distress of undocumented aetiology and one had foetal distress following placental abruption. At 5 minutes, 36 (9.1%) babies had an Apgar score of ≤6 and at 10 minutes 6 (1.5%) babies had an Apgar score of ≤6 and 3 (0.8%) were declared dead.

The comparisons between the anaesthetic start to cut time, the 5-minute and the 10-minute Apgar scores between the group receiving neuraxial anaesthesia and the group receiving general anaesthesia are shown in Table 5. All were significantly different with those receiving a general anaesthetic having a shorter anaesthetic start to cut time and those delivered following neuraxial anaesthesia having slightly better Apgar scores.

**Table 4** The 5-Minute and 10-Minute Apgar Scores

| Apgar Score | 5-Minute | | 10-Minute | |
|---|---|---|---|---|
| | Number | Percentage | Number | Percentage |
| 10 | 18 | 4.6 | 318 | 80.5 |
| 9 | 259 | 65.6 | 55 | 13.9 |
| 8 | 60 | 15.2 | 7 | 1.8 |
| 7 | 22 | 5.6 | 6 | 1.5 |
| 6 | 20 | 5.1 | 0 | 0.0 |
| 5 | 4 | 1.0 | 0 | 0.0 |
| 4 | 2 | 0.5 | 2 | 0.5 |
| 3 | 1 | 0.3 | 2 | 0.5 |
| 2 | 2 | 0.5 | 2 | 0.5 |
| 1 | 2 | 0.5 | 0 | 0.0 |
| 0 | 5 | 1.3 | 3 | 0.6 |

**Table 5** Comparisons Between Variables for Neuraxial and General Anaesthetic

| Variable | Type of Anaesthetic | | P-value |
|---|---|---|---|
| | Neuraxial | General | |
| | Median (IQR) | | |
| Anaesthetic start to cut time (min) | 15 (12–20) | 6 (2–25) | 0.0110 |
| 5-minute Apgar | 9 (8–9) | 8 (6–9) | 0.0002 |
| 10-minute Apgar | 10 (10–10) | 10 (9–10). | 0.0175 |

## Discussion

Foetal distress is one of the major indications for caesarean delivery in obstetric practice.[25] Our study showed that foetal distress was a major indication for emergency caesarean delivery (69.1%) at CHBAH. This is lower compared to Andisha and Cronje'[26] where foetal distress accounted for 81% of indications for emergency caesarean delivery at a tertiary hospital in Kwa-Zulu Natal. Our findings are similar to Guan et al[27] in Wuhan China, who found that among 991 mothers who received emergency caesarean delivery, the major direct cause was foetal distress (67.2%). However, our findings are contrary to other sub-Saharan countries where foetal distress contributed only 10% of the indications for caesarean delivery.[28] The possible explanation is that foetal distress is diagnosed using CTG at CHBAH and studies have shown that the sensitivity of CTG for foetal hypoxia is high, but the specificity is low.[29,30] Also, interobserver interpretation of foetal heart rate for diagnosis of foetal distress has been shown to be only moderate[31] and when no specific standard guideline is followed to diagnose foetal distress, studies have shown that the sensitivity and specificity of CTG were also affected.[32,33]

Our findings show an increase in foetal distress compared to a previous study in 2015 by Adam et al[34] at CHBAH, which found that foetal distress (49.7%) was the most common indication for caesarean delivery followed by dystocia and previous caesarean delivery. These findings are consistent with a study by Mittal et al,[35] which showed that foetal distress as an indication for emergency delivery was increasing annually. This in keeping with progressive increases in the average annual caesarean delivery rate shown by multiple studies[36–39] or could be due to the practice of defensive medicine, which is driven by litigation in obstetrics and gynaecology.[40–42]

In our study, no emergency caesarean delivery for foetal distress conformed to the 30-minute DDI recommended by international professional organisations and the mean DDI was 411 minutes. Our study also found a prolonged decision to arrival in theatre time with a mean of 372 minutes and decision to anaesthesia time with a mean of 396 minutes. The prolonged decision to anaesthesia time influenced the DDI, but factors that caused the delay could not be determined as this was a retrospective study.

The prolonged decision to arrival in theatre time implies that delays occur in transferring patients to the theatre. The findings are consistent with Wong et al,[43] who found that in Singapore, caesarean delivery that exceeded the recommended timings were due to delays in transferring the patient to the theatre. According to a study by Radhakrishnan et al[44] the maximum delay occurred between the decision for caesarean delivery and transporting the patient to the theatre and was due to the non-availability of a theatre in 73.5% of cases. This could be the possible reason at CHBAH, where only two theatres are available for both emergency and elective obstetric cases and at times, are shared with gynaecological emergency cases.

Great variation regarding the percentage of babies delivered within a 30-minute DDI is reported ranging from 5%[26,45] to almost 90%.[46] In the United Kingdom, multiple studies found that most emergency caesarean deliveries for foetal distress take longer than 30 minutes to commence[47] and that it was not possible for busy obstetric units to reach this target in all emergency caesarean deliveries.[48] McKenzie and Cooke[49] found that the mean DDI for foetal distress was 42.9 minutes. Helmy et al[50] showed an improvement in DDI within 30 minutes from 36% to 70% after multiple interventions aimed at improving the DDI and found that the major sources of delay were transporting the women to

theatre and starting the anaesthetic. In Germany, Cerbinskaite et al[51] presented a shorter mean DDI of 32 minutes, with 45% of deliveries occurring in less than 30 minutes and 93% done within 75 minutes. In the United States of America, 90% of cases met the standard with a mean DDI of 25 minutes after multiple intervention such as open dialogue between nurses and physicians and the implementation of a worksheet.[46]

In African countries, much longer DDIs have been observed, for instance, Onah et al[52] reported a mean DDI of 511 minutes in a Nigerian hospital. However, a cross-sectional study in northern Tanzania found that 12.3% of the women were operated on within 30 minutes, with a median DDI of 60 minutes.[24] In South Africa, two studies have evaluated DDI. In Tygerberg Hospital, a mean DDI of 53 minutes with 20% of the women delivered within 30 minutes and 76% within one hour for Category 1 and 2 emergency caesarean delivery was found.[53] At King Edward Hospital, a median DDI of 75 minutes with 5.2% of the parturients delivered within 30 minutes for Category 1 emergency caesarean delivery was found.[26]

At CHBAH, no specific classification is used to categorise the emergency caesarean deliveries, hence all emergencies are prioritised at the discretion of the surgeon. However, Lucas et al,[54] in 2000, described a classification system for grading the urgency of caesarean delivery and defined four categories with clinical descriptions. This was later endorsed by the RCOG, NICE and Royal College of Anaesthetists and Obstetric Anaesthetists Association.

> Category one (crash caesarean delivery) is defined as a compromise that is an immediate threat to the life of the woman or foetus, for example, foetal distress, and a DDI of equal to or less than 30 minutes is recommended, but for category two (compromise but no immediate threat to the life of the woman or foetus) a DDI of up to 75 minutes is acceptable.[17]

In our study, 2.3% of the caesarean deliveries were due to an immediate threat to the life of the mother. Two mothers, one with placental abruption and the other with eclampsia, which fall under Category 1 caesarean delivery, were identified. The mother with placental abruption delivered a fresh stillbirth (DDI 75 minutes), while the eclamptic mother delivered a baby with low 5- and 10-minute Apgar scores of 0 and 4 (DDI 40 minutes), respectively. Other mothers who had an immediate threat to life were mothers with HELLP syndrome and antepartum haemorrhage. Both delivered babies with good Apgar scores of 9 and 10 even though their DDIs were prolonged at 375 minutes and 90 minutes, respectively.

A study on urgent caesarean delivery for different causes of foetal distress showed that, when the underlying cause of foetal distress was irreversible, such as placental abruption, cord prolapse, uterine rupture and pre-eclampsia the arterial cord pH deteriorates rapidly from the onset of foetal bradycardia. In such patients, immediate delivery is essential to minimise the risk of foetal brain damage due to hypoxia.[55] Kayani et al,[56] in a case-control study of pregnancy outcomes in severe placental abruption, showed that a DDI of 20 minutes or less was associated with substantially reduced neonatal morbidity and mortality and a DDI of more than 20 minutes was associated with a poor outcome such as neonatal death or later cerebral palsy. Gabbay-Benziv et al[57] found increased short-term morbidity for both mother and foetus in cases of placental abruption with foetal distress. The mean DDI was less than 30 minutes, emphasising that the 30-minute rule does not ensure short-term neonatal well-being.

Overall, studies looking at the relationship between DDI and neonatal outcomes have shown conflicting results. A study by Dunn et al,[58] had a mean DDI of 9.4 minutes for Category 1 caesarean delivery, but showed that a shorter DDI was not associated with improved perinatal outcomes. In Germany, a DDI of 20 minutes is recommended for Category 1 caesarean delivery and Hillermanns et al[59] found that DDIs below 20 minutes for Category 1 caesarean deliveries were inversely correlated to the foetal outcome, but a longer DDI between 20–28 minutes was associated with an improved foetal outcome such as higher Apgar scores. Heller et al[60] in a German perinatal survey of DDI and emergency caesarean delivery found that shorter DDIs of less than 20 minutes were associated with improved neonatal outcome.

The findings in our study showed contrary results since 64.8% of caesarean deliveries had DDIs of more than 240 minutes, but the mean 5-minute and 10-minute Apgar scores were 8.4 and 9.6, respectively. This is consistent with the findings of Roy et al[61] who showed that there was no difference in neonatal outcome when DDI was more than 30 minutes, but higher admission to the neonatal intensive unit for suspected birth asphyxia when DDI was less than 30 minutes. Onah et al[52] found that longer DDIs, even up to three hours, were not significantly correlated with poor perinatal outcome. However, Weiner et al[62] found that shorter DDIs in caesarean delivery for foetal distress resulted in improved

neonatal outcome. In our study, 80% of the babies delivered had 10-minute Apgar scores of 10 and only 37% of the babies were admitted to the neonatal nursery for further observation. Our findings suggest that the use of CTG monitoring may result in the over-diagnosis of foetal distress.

Our study was retrospective and relied on the quality of the data recorded. Data were collected from one academic hospital, which limits the ability to generalise the results to other facilities. The neonatal outcome was evaluated using 5-minute and 10-minute Apgar scores, which is subjective and not a good indicator of long-term neurological outcome.[63] However, the Apgar score has been extensively used in numerous studies and allows comparisons to be drawn.

## Conclusion

This study showed that a DDI of 30-minutes, as recommended by international organisations, was not achieved at CHBAH during the study period. This is concerning and should be addressed at both a clinical and higher management level. The majority of babies diagnosed with foetal distress pre-delivery had 5-minute and 10-minute Apgar scores inconsistent with this diagnosis. This over-diagnosis of foetal distress in some cases could have led to delays in delivery of babies who had actual foetal distress and where a 30-minute DDI could have improved outcome. This also demonstrates the need for further research into more accurate methods to diagnose foetal distress.

## Abbreviations

DDI, decision to delivery interval; CHBAH, Chris Hani Baragwanath Academic Hospital; RCOG, Royal College of Obstetricians and Gynaecologists; NICE, National Institute for Clinical Excellence; CTG, cardiotocography.

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## Disclosure

The authors declare that we have no financial or personal relationships which may have inappropriately influenced us in writing this paper and report no conflicts of interest in relation to this work.

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