THE ASSOCIATION BETWEEN DECISION TO DELIVERY INTERVAL (DDI) AND FETAL OUTCOME AMONG PATIENTS WITH PRESUMED FETAL DISTRESS IN HOSPITAL TENGKU AMPUAN AFZAN

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`Ainnun`ain binti Abdullah

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LIST OF ABBREVIATIONS

ACC OT	Ambulatory Care Centre Operation Theatre
AS	Apgar score
BMI	Body mass index
Cs	Caesarean section
CTG	Cardiotocograph
DDI	Decision-delivery interval
GA	General anaesthesia
GOT	General Operation Theatre
HIE	Hypoxic Ischaemic Encephalopathy
HRLR	High Risk Labour Room
MOT	Maternity Operation Theatre
NICE	National Institute for Health and Care Excellence
NICU	Neonatal Intensive Care Unit
NMRR	National Medical Research Register
PAC	Patient Assessment Centre
RCOG	Royal College of Obstetricians and Gynaecology
SPSS	Statistical Package for the Social Sciences
WHO	World Health Organization

ABSTRAK (BAHASA MALAYSIA)

Pengenalan dan Objektif: Dalam kes kelahiran kecemasan, janin mesti dilahirkan dalam masa yang sesingkat mungkin. Garis panduan di banyak negara telah mencadangkan mengekalkan selang membuat keputusan dan kelahiran (DDI) kepada kurang daripada 30 minit untuk kes sedemikian. Walau bagaimanapun, banyak pusat, terutamanya di negara membangun, tidak dapat mematuhi selang yang dicadangkan, sekali gus menjejaskan kesihatan janin.

Kaedah: Kajian retrospektif telah dijalankan dari Januari 2017 hingga Jun 2020 di Hospital Tengku Ampuan Afzan, Kuantan. Rekod perubatan 400 pesakit yang menjalani pembedahan caesarean kecemasan telah disemak dan dikumpul. Data dianalisa menggunakan perisian SPSS versi 26. DDI digambarkan sebagai purata dengan sisihan piawai dalam beberapa minit. Perkaitan antara DDI dan hasil janin dianalisis menggunakan ujian khi kuasa dua. Pembolehubah dengan nilai $p < 0.05$ dianggap signifikan.

Keputusan: Purata DDI kajian ini ialah 49.8 ± 12.01 minit. Walaupun terdapat peratusan lebih tinggi hasil buruk janin di kalangan kumpulan DDI> 30 minit, perbezaannya adalah tidak signifikan secara statistik ($p>0.05$). Kategori pembedahan, kaedah bius, masa pemindahan yang dan masa yang lebih lama untuk induksi dikaitkan dengan DDI yang lebih panjang secara signifikan dari segi statistik ($p=0.022$, <0.001 dan <0.001, masing-masing).

Kesimpulan: Purata DDI adalah lebih lama daripada masa yang disyorkan. Walaupun DDI tidak menjejaskan hasil janin yang buruk, ia harus sentiasa menjadi faktor penyumbang yang ketara. Oleh itu, tindakan memendekkan DDI untuk pembedahan caesarean kecemasan perlu dititikberatkan.

ABSTRACT (ENGLISH)

Background: In cases of emergency delivery, the fetus must be delivered in the shortest time possible. Guidelines in many countries have suggested keeping the decision delivery interval (DDI) to less than 30 minutes for such cases. However, many centres, especially in developing countries, cannot comply with the suggested interval, thus affecting the fetal outcome.

Aim: To determine the DDI among patients who underwent emergency caesarean section for presumed fetal distress and its associated factors with fetal outcome.

Materials and Methods: A retrospective study was conducted from January 2017 until June 2020. Medical records of 400 patients undergoing emergency caesarean section were reviewed and collated. The data was analysed using SPSS version 26 software. The DDI was described as mean with standard deviation in minutes. The association between DDI and fetal outcome was analysed using a chi-square test. Variables with a p-value of <0.05 were considered significant.

Results: The mean DDI was 49.8 ± 12.01 minutes. Although there were higher percentages of adverse fetal outcomes among the DDI >30 minutes groups, the differences were statistically insignificant ($p>0.05$). Category of caesarean section, types of anaesthesia, longer transfer time and longer time for induction were significantly associated with longer DDI ($p=0.022$, 0.027, <0.001 and <0.001, respectively).

Conclusions: The average DDI in our centre was longer than the recommended time. Although the DDI did not significantly affect the adverse fetal outcome, it should always be a significant contributing factor. Therefore, actions to shorten the DDI for emergency delivery must be considered.

1.0 INTRODUCTION

Fetal well-being is one of the fundamental aspects of obstetrics care, especially when women are in labour. Labour is diagnosed in the presence of regular uterine contraction, which is associated with cervical effacement and dilatation and descending of the presenting part. The delivery of the fetus and placenta completes the labour process. The labour process varies from one woman to another, making close maternal and fetal monitoring mandatory.

Fetal distress describes a condition when a fetus is in a hypoxic state (Vannuccini et al., 2016). In fetal hypoxia, depletion of oxygen supply to the fetal tissue will be regulated by the sympathetic and parasympathetic response, which is manifested as an alteration in fetal heart rate. Thus, detecting changes in fetal heart rate is crucial in diagnosing fetal distress. A Cardiotocograph (CTG), which consists of an ultrasound transducer placed on the parturition's abdomen to provide a continuous electronic record of fetal heart rate (Grivell et al., 2015).

Interpretation of CTG is based on four components, baseline fetal heart, fetal heart variability, presence of acceleration and presence or absence of deceleration in a recognizable pattern. Normal CTG patterns reassure obstetricians that the fetus in-utero is in a safe condition. The presence of variable deceleration with concerning characteristics alarmed the obstetricians that the fetus could be in hypoxic condition if the condition persists. Thus, suspicious and pathological CTG patterns required obstetrician intention, and intrauterine fetal resuscitation could be done.

According to Mitchell and Chandrahara, meconium-stained liqour is also a clinical predictor of fetus distress due to hypoxia, which stimulates vagal response and triggers intestinal peristalsis

and sphincter relaxation. Meconium aspiration syndrome is the complication of meconium-stained liquor and occurs in up to one in ten births, associated with a neonatal mortality rate of 20%.

The presence of life-threatening conditions to both mother and fetus, such as abruptio placenta and uterine rupture, needs to be ruled out as its carries high morbidity to mother and fetus. Maternal haemorrhage due to abruptio placenta or uterine rupture is associated with a risk of disseminated intravascular coagulopathy, maternal collapse, end-organ damage and maternal death. With maternal haemorrhage, the fetus is at risk of birth hypoxia, low APGAR score, admission to the neonatal intensive unit or fresh stillbirth. Cord prolapse is another threatening condition to the fetus and warrants obstetricians' quick and efficient move to save the baby's life. In persistent pathological CTG, acute bradycardia or prolonged deceleration, one needs to expedite the delivery via emergency caesarean section if vaginal delivery is not imminent.

Caesarean section (Cs) is the most typical surgical procedure in pregnant women to deliver the fetus, and it is associated with maternal morbidity and mortality. Cs indications include fetal distress, poor progress, prolonged second stage, unstable lie and placenta praevia. The traditional classification of Cs is elective and emergency. In 2000, Lucas et al. proposed the classification of Cs into emergency, urgent, scheduled and elective. However, in 2010, the Royal College of Obstetricians and Gynaecologists (RCOG) standardized the urgency of Cs into four definitive categories based on the presence of maternal and fetal compromise.

Category 1 Cs is when there is an immediate threat to the life of the mother or fetus, such as in the event of abruptio placenta, uterine rupture, cord prolapse and acute severe bradycardia. Category 2 Cs is when there is the presence of maternal or fetal compromise, which is not immediately life-threatening, such as failed instrumentation, prolonged second stage and fetal distress. Fetal distress

is the most typical indication for category 2 Cs. While category 3 is when there is no maternal or fetal compromise but needs early delivery, for example, breech in the early phase of labour, suspected macrosomia or unstable lie in labour. Last but not least, category 4 Cs also is commonly known as elective Cs when the delivery timed to suit women or staff.

Decision to delivery interval (DDI) is the time interval from the decision made to perform Cs till the delivery of the fetus (Rashid et al., 2006). The latest National Institute for Health and Care Excellence (NICE) guidelines in 2020 recommended that the DDI of 30 minutes for category 1 Cs and DDI of both 30 and 75 minutes for category 2 Cs. Recommended DDI should be used as an audit standard and not judge multidisciplinary team performance for any individual Cs. (NICE, 2020). Various factors determine DDI; availability of the operation theatre, staffing, time of the event, and its dynamic multidisciplinary team, including anaesthetists, obstetricians, nurses, and supporting staff. In an evaluation of DDI, three continuums of time need to be recorded, i.e. time of transfer, anaesthesia, and operation.

In an evaluation of DDI, fetal well being and maternal well being are the primary measures that have been counted (NICE,2020). Parameters for fetal well-being include cord blood gases, Apgar scores, and respiratory distress, which requires intubation and admission to the neonatal intensive care unit (NICU). In hypoxic conditions, adaptation by the fetus will result in blood acidaemia, either due to respiratory acidosis or metabolic acidosis. The international consensus defines *metabolic acidosis* as umbilical cord pH <7.00 base excess of 12mmol/l in the umbilical arterial cord blood at birth (Yli and Kjellmer, 2016). Prolonged adaptation to hypoxic conditions intrapartum will lead to irreversible organ damage.

Apgar score, proposed in 1952, provides a rapid evaluation of newborns' clinical status at birth and response to resuscitation. Apgar score of less than 7 at 5 minutes of life has a linear relation with the prevalence of neurological disability (Ehrenstein et al., 2009). A fetus with respiratory distress might require intubation at birth and NICU admission. The criteria for adverse fetal outcomes include one or more of the following; when the Apgar score is <7 at 5 minutes of life, admissions to NICU and presence of HIE (Kitaw et al., 2021, Liyew et al., 2018))

Once the decision for Cs, whether it falls into Category 1 or Category 2 Cs, has been made, it warrants a delivery expedition. Delay in delivery of baby associated with higher morbidity and mortality either to mother or fetus, or both. Based on Allen and Brandon, prolonged hypoxia of the fetus during the intrapartum period will lead to encephalopathy, seizures, cerebral palsy and neurodevelopmental delay, which has litigation implications. (Dunn et al., 2016).

Thus, evaluating the current local practice with the recommended DDI is essential. This study determined the DDI in HTAA Kuantan, its association with fetal outcome and evaluated the factors influencing the DDI.

2.0 LITERATURE REVIEW

2.1 CAESAREAN SECTION

Caesarean section (Cs) is one of the most commonly performed surgeries among obstetric patients. While it confers immediate and long-term complications risks, it may be the safest or only way to deliver a healthy newborn for some women. Compared to vaginal delivery, Cs carry higher maternal and fetal morbidity and mortality (Geidam AD et al., 2009)(Naymi RS and Rehan N, 2000). In 1985 the World Health Organization (WHO) set the optimal rate for Cs at 10–15% of all births. However, the prevalence increases throughout the years, regardless of whether it is done in private or public hospitals. A recent analysis by Karalasingam et al. showed that the Cs rate in Malaysian public hospitals had increased 3% over the five years, from 21.8% to 25.3% (Karalasingam et al., 2020).

2.2 CLASSIFICATION OF CAESAREAN SECTION

Cs is classified into elective and emergency Cs. However, this classification is inadequate as all non-elective Cs is considered emergency, although some of them are more emergency than the other. This classification limits the comparability and usefulness of obstetric information when audits are made. According to its urgency, the Royal College of Obstetricians and Gynaecologists (RCOG) has recently further classified Cs. Based on this classification, Cs are categorised into four categories; Category 1, category 2, category 3 and category 4. This categorisation was made to ensure that delivery is conducted in a timely manner, according to maternal or fetal needs.

Category 1 Cs is when there is an immediate threat to the life of the mother or fetus, such as in the event of abruptio placenta, uterine rupture, cord prolapse and acute severe bradycardia. In this

category, fast delivery may improve the perinatal outcome. RCOG has recommended that the baby be delivered within 30 minutes after the onset of insult. Several centres have put up measures to achieve this time duration, including starting the ‘crash protocol’ for Cs in this category.

Category 2 Cs is when there is the presence of maternal or fetal compromise, which is not immediately life-threatening, such as failed instrumentation and prolonged second stage. Other indications for Cs in this category include dystocia, abruptio placenta with mild antepartum haemorrhage, severe pre-eclampsia and malpresentation in labour (e.g., brow, chin presentation). In this category, the baby is delivered within 75 minutes.

In category 3 Cs, the baby need to be born early, but there is no immediate maternal or fetal risk. Patients planned to go for an elective Cs, but in labour before the surgery, patients with an unstable lie, breech in the early phase of labour and suspected macrosomia are among the indications which fall into this category.

Category 4 Cs is also known as elective Cs. This category carries the least risks of maternal and fetal morbidity. In this category, the Cs are planned according to the time which suits the patient and services staff.

2.3 CATEGORY 1 CAESAREAN SECTION

As stated above, category 1 Cs are performed for life-threatening conditions in mothers and fetuses. Delivery within 30 minutes after the problem detection may help to reduce perinatal morbidity and mortality. Therefore, it is important to identify clinically compromised pregnant women and/or baby to provide optimal health outcomes for both.

2.4 INDICATIONS FOR CATEGORY 1 CAESAREAN SECTION

'Fetal distress' is the commonest reason recorded for Category 1 Cs. It indicates that the fetus is in a hypoxic condition. It occurs when there are fetal heart rate abnormalities or detection of acidaemia in a sample of blood collected from the fetal scalp. Although it is difficult to give a precise clinical definition, obstetricians usually use fetal distress to indicate that the fetus is becoming hypoxic (Vannuccini et al., 2016).

During fetal life, oxygen supply depends entirely on maternal respiration and circulation, placental perfusion, gas exchange across the placenta, umbilical circulation, and fetal circulation (Ayres-de-Campos et al., 2015). Disruption of oxygen to the fetus at any level, either during the antenatal or intrapartum period, will decrease oxygen concentration in arterial blood (hypoxemia) and finally in the tissue (hypoxia). Fetal asphyxia occurs when hypoxia extends to the central organs such as the heart, brain and adrenal glands (Yli and Kjellmer, 2016).

There are three subtypes of fetal hypoxia proposed by Kingdom and Kaufmann. The first subtype is pre-placental hypoxia, where both mother and fetus will be hypoxic. Examples of this condition include a mother with preexisting cardiovascular diseases such as congenital heart disease, heart failure, or staying in a high-altitude area. A mother with congenital heart disease has reduced cardiac output, which negatively impacts oxygen to the placenta. (Thompson L, 2015;5:79-89). Chronic hypoxia exposure with other maternal anaemia, acute infections, or chronic inflammation may further limit the fetus's maternal oxygen uptake and oxygen delivery. Chronic hypoxia is associated with placental insufficiency, which plays a crucial role in aetiology fetal growth restriction. (Hutter et al., 2010)

The second subtypes are uteroplacental hypoxia, where maternal oxygen is normal, but the uteroplacental circulation is impaired. Uteroplacental hypoxia is commonly seen in preeclampsia, which is related to abnormal placentation early in gestation and leads to placental vascular disease later in pregnancy. (Hutter et al., 2010)

The third subtypes are post placental hypoxia, where only the fetus is hypoxic. Postplacental hypoxia is mainly related to fetal disease either related to progressive fetal cardiac failure (fetal anomalies, complex congenital heart disease) or diminished uterine artery flow, which commonly occurs during the intrapartum event. Acute fetal hypoxia occurring during the labour process, perhaps lasting a few minutes, commonly termed acute fetal distress, occurs due to uterine contractions or compression of the umbilical cord. (Giussani, 2016)

Due to the increased risk of mortality in fetal distress, monitoring the fetus throughout pregnancy is essential to detect any potential problems. The most widely used fetal monitoring is electronic fetal heart monitoring or cardiotocography (CTG), which records the changes in fetal heart rate and uterine contractions. CTG interpretation comprises baseline fetal heart rate, fetal heart rate variability, and the presence or absence of acceleration or deceleration. A normal baseline heart rate ranges between 110 and 160 beats per minute, and normal beat to beat heart rate variability ranges between 5 to 25 beats per minute. The abnormal features are variable deceleration with concerning characteristics such as lasting>60 seconds, absence of shouldering, reduced fetal heart variability within the deceleration, or failure to return to baseline heart rate. The presence of an early deceleration caused by head compression during uterine contraction is not associated with hypoxia condition. Late deceleration, whereby the deceleration occurs after the contraction, is associated with fetal hypoxaemia, hypercarbia and acidosis.(Pinas and Chandraharan, 2016).

CTG is interpreted as normal, suspicious and pathological, as described by the NICE guideline. Suspicious CTG is when the presence of one non-reassuring feature and two reassuring features, while pathological CTG is when the presence of one abnormal feature and two non-reassuring features. Suspicious and pathological CTG need immediate attention from the obstetrician.

Apart from fetal distress, other indications for Category 1 Cs include cord prolapse, failed instrumentation with fetal compromise and maternal cardiac arrest. All these conditions warrant urgent delivery.

2.5 NEONATAL OUTCOME AND FACTORS AFFECTING NEONATAL OUTCOME

Fetal adaptation to the hypoxic state during the intrapartum event has closed relation with fetal reserve. Reduced fetal reserved usually associated with preplacental hypoxia or uteroplacental hypoxia, in conditions such as fetal growth restriction, prematurity, preeclampsia and pregestational diabetes mellitus. (Vintzileos and Smulian, 2016). In the presence of utero-placental insufficiency, intrapartum hypoxia been adapted by anaerobic metabolism, thus lead to accumulation of hydrogen ion and carbon dioxide which are acidic. (Pinas and Chandraharan, 2016). Risk identification of fetuses with reduced reserve is important, as they will may deteriorate and become more acidic rapidly compared to normal fetus.

Fetal exposure to chorioamnionitis or noninfective fever during labour, requires higher metabolic oxygen demand which may enhance the damaging effect of hypoxic-ishaemia in brain. Chorioamnionitis is a risk factor for neonatal encephalopathy and cerebral palsy and accounts for up to 22% of cerebral palsy cases. (Goetzl et al., 2010)

Severity and duration of insults during labour also will determine the acid base status and FHR pattern. According to Pinas and Chandraharan, in the condition of sudden drop in baseline heart rate or named as single prolonged deceleration , the fetal pH drops at rate of 0.01/minutes. While in the condition of subacute hypoxia, which characterize as deeping and widening of ongoing deceleration, the pH drops at the rate of 0.01/2-3 minutes. The longer the insult, the more acidic the cord pH will be and the fetal organ will be severely affected.

Other pattern of hypoxia classified as gradually evolving hypoxia where the hypoxic stress evolves over the time. Its allows sympathetic and parasymphatetic fetal adaptation to avoid hypoxic damage. However, prolonged hypoxic state will lead to anaerobic mechanism as well,

subsequently lead to myocardial hypoxia and acidosis. CTG will shows terminal bradycardia subsequently lead to fetal death. Prompt action prior to terminal bradycardia is mandatory to save fetal life. (Pinas and Chandraharan, 2016)

2.6 DECISION TO DELIVERY INTERVAL (DDI)

Decision-delivery interval (DDI) is the time interval from the decision made to perform Cs till the delivery of the fetus. (Rashid et al., 2006). Total DDI was calculated as a continuum from time intervals (Gupta et al., 2017) which include intervals between the decision of Cs, time called to the operation theatre, time sent to the operation theatre, the time arrived on the operation table, time induction of anaesthesia, time of skin incision and time of baby delivered.

DDI is a crucial time that decides the feto-maternal fate. For category 1 Cs, this crucial period should not exceed 30 minutes per the NICE recommendation and the American College of Obstetricians and Gynecologists council. Despite this recommendation, complying with the recommended DDI is not easy. In 2002, the UK's mean DDI for 100 deliveries for fetal distress was 42.9minutes (MacKenzie and Cooke, 2002). It was reported as 60 minutes in Tanzania (Hirani et al., 2017), 65.9 minutes in India (Mishra et al., 2018) and 82 minutes in Thailand (Khemworapong et al., 2018), for emergency Cs. A study in Ethiopia and Tanzania reported that only 19.6% and 12% of cases had DDI below 30 minutes (Tesmesgen, 2022) (Hirani B.A., 2017). A study in Singapore showed mean DDI in category 1 Cs was 23.9 minutes, while for category 2 Cs was 64.5 minutes, which is parallel with the NICE recommendation. (Wong et al., 2017). Non-compliance to the recommended DDI has resulted in poorer neonatal outcomes (Grace L et al., 2015) (Degu Ayele A et al., 2020).

The difficulty in complying with the recommended DDI is because that DDI is affected by many factors, as described in section 2.6.2.

2.6.1 EFFECT OF DDI ON FETAL OUTCOME

Neonatal acidaemia and low Apgar scores are the parameters in evaluating distressed neonates. (Gandhi G, 2019). Based on NICE guideline, 2020, the primary fetal outcome of category 1 and category 2 Cs includes cord blood pH, Apgar score at 5 minutes of life, neonatal respiratory problem and unplanned admission to the NICU.

Metabolic acidosis in the fetus, as evidenced by low blood pH and immediately after birth umbilical cord pH <7.0, reflects a significant hypoxic condition. When the oxygen supply to the fetus is significantly disrupted, tissue oxygen deprivation occurs; thus anaerobic mechanism occurs, resulting in acidaemia. A Hong Kong study showed that the cord pH was significantly lower in the group with DDI within 20 minutes, with a mean of 7.19, compared to DDI more than 20 minutes, with a mean of 7.23. (Kei-Man CHOW MBChB, 2015). This result is echoed by a study by MacKenzie, in 2002; which showed greater acidaemia with shorter DDI.

Apgar score helps convey the newborn's overall status and response to resuscitation. (ACOG, 2015). The scoring consisted of five components, colour, heart rate, reflexes, muscle tone and respiration. According to Ehrenstein et al., an Apgar score of less than 7 at 5 minutes of life has a linear relation with the prevalence of neurological disability. One of the studies in Nigeria, for 224 emergency Cs, shows there was no significant correlation between DDI and low Apgar score (Onah et al., 2005). In contrast, the Tanzania study showed worse neonatal outcomes for neonates with DDI > 75 minutes. (Hirani et al., 2017). The study also reported that neonates born with DDI

> 75 minutes had higher odds of getting an Apgar score less than 7 in the first and fifth minute of life, OR: 2.29; 95% CI; 0.61-8.85, vs OR: 3.34; 95% CI; 0.39 -29.9).

2.6.2 FACTORS INFLUENCING DDI

DDI involves multilevel disciplinary and care. Factors that influence DDI start from the decision of Cs until the baby's delivery, including the availability of the operation theatre, staffing, time of the event, and its dynamic multidisciplinary team, including anaesthetists, obstetricians, nurses, and also supporting staff. Systemic review and meta-analysis by Tolcher et al. concluded that the delivery within 30 minutes was not achieved in a substantial proportion of cases.

Gupta et al. and Helmy et al. reported that the delay in shifting patients to the operation theatre, lack of staff in the operation theatre and starting the anaesthesia are the most significant factors contributing to longer DDI.

Types of anaesthesia, either general or spinal anaesthesia, might significantly influence DDI, as regional anaesthesia takes longer than general anaesthesia. Dunphy et al. (1991) stated that the regional block was associated with longer DDI. On the other hand, Lim et al. (2005) found no significant differences in DDI regardless of the type of anaesthesia used.

Optimization of maternal health conditions prior to induction (anaesthesia) also led to delay, especially for those with the pre-existing medical disease based on Kei-Man CHOW and Hirani et al.

From a study done in a tertiary hospital in Thailand, Cs done after office hours shows shorter DDI than those done during office hours (Khemworapong et al., 2018). However, previous studies by MacKenzie and Cooke, 2002; noted that time of the day did not influence DDI.

By Mishra et al., the seniority of the surgeon was not a significant predictor value in causing the delay in DDI. Emergency Cs in a patient with previous scars and adhesion cause delay before extracting the baby (Hirani et al., 2017), thus increasing the time duration of anaesthesia to delivery of the baby.

2.7 STUDY JUSTIFICATION

The Cs rate in Hospital Tengku Ampuan Afzan, Kuantan (HTAA) was slightly higher compare to Malaysia Cs rate, which was 25.27% based on National Obstetrics Registry 4th Report 2013- 2015. The Cs rate has been in increasing trend since 2017, being 29.57% in 2017, 30.98% in 2018 and 33.47% in 2019.

More than 50% of the Cs were emergency Cs with fetal distress as its main indication. However, an audit on the urgency of Cs and the outcome of the newborn has never been done. Therefore, the aim of the study is to determine the DDI among patients with presumed fetal distress undergoing emergency Cs and to study the association between DDI and fetal outcome. This study also aimed to identify factors that influences the DDI in HTAA setting, thus able to facilitate in improvement of services.

3.0 OBJECTIVES

3.1 RESEARCH QUESTIONS

1. What is the DDI among patients with presumed fetal distress undergoing emergency caesarean section in HTAA?
2. What is the association of DDI and fetal outcome among patients with presumed fetal distress undergoing emergency Cs?
3. What are the factors influencing DDI Cs caesarean section?

3.2 OBJECTIVES OF THE STUDY

3.2.1 General objective

To study the association between DDI and fetal outcome among patients with presumed fetal distress undergoing emergency Cs in HTAA.

3.2.2 Specific objectives

1. To determine the DDI among patients with presumed fetal distress undergoing emergency Cs in HTAA.
2. To determine the association of DDI and fetal outcome among patients with presumed fetal distress undergoing emergency Cs.
3. To identify the factors influencing the DDI among patients with presumed fetal distress undergoing emergency Cs.

4.0 METHODOLOGY

4.1 RESEARCH DESIGN

The study was a retrospective study, hospital-based study.

4.2 STUDY AREA

The study was conducted at Hospital Tengku Ampuan Afzan, which is located in Jalan Tanah Putih, Kuantan Pahang. It is a government tertiary care in Pahang State.

The hospital has two different buildings for obstetrics unit. One known as Low Risk Center, comprises of Patient Admission Centre (PAC) and obstetrics ward with labour suite. Only patient categorized as low risk pregnancy are admitted and delivered at the Low Risk Center. The other one which is the main hospital building consist of High Risk Labour Room (HRLR), antenatal ward and postnatal ward in the first floor.

There are three operation theatres available; the General Operation Theatre (GOT) on the third floor of main building, the Maternity Operation Theatre (MOT) on the first floor of main building, just next to the HRLR and the other operation theatre is the Ambulatory Care Centre Operation Theatre (ACC OT) which is located on the third floor of Ambulatory Care Centre building.

Ambulance facility is needed to transport patient from Low Risk Center to the main hospital building.

4.3 STUDY POPULATION

Patients who underwent emergency Cs for presumed fetal distress in HTAA from January 2017 until June 2020 and met the subject criteria were enrolled in the study.

4.4 SAMPLE SIZE ESTIMATION

A total of 400 pregnant women were recruited using the simple random sampling method.

4.4.1 Sample size calculation for specific objective (1)

Sample size was calculated using the single proportion formula, based on OpenEpi version 3, open source calculator--SSPropor.

Based on 4th National Obstetrics Registry 2013 - 2015, the Cs rate in Malaysia in 2015 was 25%.

According to local data in HTAA; the average rate of Cs for the last 3 years was 31.34%. The annual Cs rate is as shown in Table 4.1.

Table 4.1: Annual Caesarean section rate in HTAA

Year	No. of Deliveries	Caesarean section rate
2017	10519	29.5%
2018	10049	30.98%
2019	9543	33.47%
Average	10037	31.34%

Sample Size for % Frequency in a Population (Random Sample)		
Population size	10100	If large, leave as one million
Anticipated % frequency(p)	31.34	Between 0 & 99.99. If unknown, use 50%
Confidence limits as +/- percent of 100	5	Absolute precision %
Design effect (for complex sample surveys--DEFF)	1	1.0 for random sample

Sample Size for Frequency in a Population

Population size(for finite population correction factor or fpc)(*N*):	10100
Hypothesized % frequency of outcome factor in the population (*p*):	31.34%+/-5
Confidence limits as % of 100(absolute +/- %)(*d*):	5%
Design effect (for cluster surveys-*DEFF*):	1

Sample Size(*n*) for Various Confidence Levels

ConfidenceLevel(%)	Sample Size
95%	321
80%	140
90%	228
97%	390
99%	541
99.9%	854
99.99%	1155

Equation

Sample size $n = [DEFF*Np(1-p)]/ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)]$

Results from OpenEpi, Version 3, open source calculator--SSPropor

4.4.2 Sample size calculation for specific objective (2)

The fetal outcomes which were evaluated include cord blood pH, Apgar score at 5 minutes of life, requirement of intubation and unanticipated admission to neonatal care unit.

The comparison of 2-proportion formula was used to calculate the sample size (using Power & Sample Size Calculator, Dupont and Plummer, 1997)

n - sample size

α - Level of statistical significant

ß - power of the study

P0 - proportion from literature review

P1- expected difference

m- ratio between two group

n- sample size

Table 4.2: Sample size calculation for Specific Objective 2

Neonatal outcome	**α**	**1-ß**	**Ratio**	**P0**	**P1**	**Calculated sample size**	**Total sample size**	**Drop out**	**Sample size**
Apgar at 1 min < 7 (Khemworapong et al., 2018)	0.05	0.8	1	0.186	0.08	160	320	20%	**384**
Apgar at 5 min < 7 (Khemworapong et al., 2018)	0.05	0.8	1	0.127	0.02	92	184	20%	221
Admission to NICU (Khemworapong et al., 2018)	0.05	0.8	1	0.397	0.25	158	316	20%	380

4.4.3 Sample size calculation for specific objective (3)

Factors that influence DDI include the availability of the operation theatre, staffing, time of the event and its dynamic multidisciplinary team, including anaesthetists, obstetricians, nurses, and supporting staff. The comparison of 2-proportion formula was used for the calculation (using Power & Sample Size Calculator, Dupont and Plummer, 1997).n - sample size

α - Level of statistical significant

1-ß - power of the study

P0 - proportion from literature review

P1- expected difference

m- ratio between two group

n- sample size

Table 4.3: Sample size calculation for specific objective (3)

Factor	α	1-ß	Ratio	P0	P1	Calculated sample size	Total sample size	Drop out	Sample size
Technique of anaesthesia (Gupta et al., 2017)	0.05	0.8	1	0.062	0.16	160	320	20%	**384**
Previous scar (Hirani et al., 2017)	0.05	0.8	1	0.201	0.35	138	276	20%	331
Time of decision (office hour or after office hour) (Khemworapong et al., 2018)	0.05	0.8	1	0.001	0.1	76	152	20%	182
Experience of surgeon (Kei-Man CHOW MBChB, 2015)	0.05	0.8	1	0.85	0.7	120	240	20%	288

Based on the above calculation, the largest calculated sample size was 384. Therefore, this number was taken as the minimum sample for this study.

4.5 ETHICAL CLEARANCE

The conduct of this study was approved by the Medical Research and Ethic Committee (MREC) of Ministry of Health Malaysia via the National Medical Research Registry (NMRR) (Appendix 1), and the Universiti Sains Malaysia Human Research Ethics Committee (Appendix 2).

4.6 SUBJECT CRITERIA

4.6.1 Inclusion criteria

1. Patient who underwent emergency lower segment Cs for fetal distress, and the decision for Cs been made in HTAA.
2. Availability of CTG tracing during diagnosis of fetal distress
3. Pregnancy between 37-42 weeks
4. Singleton pregnancy
5. Documented cord blood gases

4.6.2 Exclusion criteria

1. Patient with antenatal problems which excludes intrauterine growth restriction, oligohydramnios, congenital abnormalities, abnormal presentation and placenta praevia.
2. Patient with chorioamnionitis.
3. Intrauterine death before caesarean section.
4. Patient with epidural anaesthesia before caesarean section
5. Patient whose data not available.