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CLINICAL & BASIC RESEARCH

Decision-to-Delivery Time Intervals in Emergency Caesarean Section Cases

Repeated cross-sectional study from Oman

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الوقت ما بين اتخاذ القرار وإجراء العملية القيصرية العاجلة

دراسة متكررة لمقطع عرضي من عمان

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abstract: ***Objectives:*** In cases of fetal intolerance to labour, meeting the standard decision-to-delivery time interval (DDI) of ≤30 minutes is challenging. This study aimed to assess DDIs in emergency Caesarean section (CS) cases to identify factors causing DDI delays and the impact of a delayed DDI on perinatal outcomes. ***Methods:*** This repeated cross-sectional study included all emergency CS procedures performed due to acute fetal distress, antepartum haemorrhage or umbilical cord prolapse at the Nizwa Hospital, Nizwa, Oman. Three audit cycles of three months each were conducted between April 2011 and June 2013, including an initial retrospective cycle and two prospective cycles following the implementation of improvement strategies to address factors causing DDI delays. Poor perinatal outcomes were defined as Apgar scores of <7 at five minutes, admission to the Special Care Baby Unit (SCBU) or a stillbirth. ***Results:*** In the initial cycle, a DDI of ≤30 minutes was achieved in 23.8% of 84 cases in comparison to 44.6% of 83 cases in the second cycle. In the third cycle, 60.8% of 79 women had a DDI of ≤30 minutes (P <0.001). No significant differences in perinatal outcomes for cases with a DDI of ≤30 minutes versus 31–60 minutes were observed; however, a DDI of >60 minutes was significantly associated with poor neonatal outcomes in terms of increased SCBU admissions and low Apgar scores (P <0.001 each). Factors causing DDI delays included obtaining consent for the CS procedure, a lack of operating theatre availability and moving patients to the operating theatre. ***Conclusion:*** The identification of factors causing DDI delays may provide opportunities to improve perinatal outcomes.

Keywords: Obstetric Delivery; Medical Decision-Making; Cesarean Section; Clinical Audit; Fetal Death; Apgar Score; Oman.

الملخص: الهدف: تم قياس الوقت بين اتخاذ القرار وإجراء العملية القيصرية العاجلة خلال 30≤ دقيقة أو أقل في حالات عدم تحمل الجنين للمخاض وذلك لتقييم هذه الفترة لمعرفة الأسباب التي تؤخر العملية وما هو تأثير ذلك على حالة الجنين قبل الولادة وبعدها. **الطريقة:** شملت هذه الدراسة جميع العمليات القيصرية العاجلة التي إجريت في مستشفى نزوى بعمان في حالات الجنين الحرجة الحادة ونزف ما قبل الولادة أو نزول الحبل السري قبل الجنين. إجريت ثلاثة حلقات تدقيق مدة كل منها ثلاثة أشهر خلال الفترة بين شهر إبريل 2011 وحتى يونيو 2013. تضمنت الحلقة الأولى منها دراسة الحالات السابقة على فترة التدقيق أما الحلقتين الثانية والثالثة كانتا لعمل تدقيق مستقبلي. تم بعدهما اجراء تعديل في استراتيجيات معالجة الأسباب التي ادت إلى التأخير في إجراء العملية. تم التدليل على تدهور حالة الجنين اذا كان معدل أبجار أقل من 7 بعد خمس دقائق من الولادة أو تم ترقيد الوليد في غرفة الرعاية المركزة أو ولادته ميتا. **النتائج:** في الحلقة الأولى أظهرت النتائج إجراء العملية القيصرية في 23.8% من بين 84 حالة في أقل من 30≤ دقيقة. وفي الحلقة الثانية تم إجراء العملية في 44.6% من 83 حالة وأما في الحلقة الثالثة فقد أجريت العملية في أقل من 30≤ دقيقة في 60.8% من 79 حالة (P <0.001) تبين عدم وجود اختلاف ملحوظ في حالة الجنين ما قبل وبعد الولادة في الحالات التي أجريت فيها العملية في أقل من 30≤ دقيقة. بينما لوحظ وجود تدهور في حالات المواليد حديثي الولادة عند تأخير العملية القيصرية بين 60–31 دقيقة، بينما كان الوقت بين اتخاذ القرار و إجراء العملية لأكثر من 06 دقيقة مرتبطا بشكل كبير بتدهور حالة المريض ويتضح ذلك من وجود زيادة ملحوظة أحصائيا في عدد المواليد الذين ادخلوا للعناية المركزة مع هبوط في معدل أبجار (P <0.001 لكل حالة) وكانت أهم العوامل التي أدت الى التاخير هي التاخير في موافقة المريضة وذويها على إجراء العملية القيصريةوعدم جاهزية غرفة العمليات لأسباب عدة وأيضا التأخير في نقل المريضة إلى صالة العمليات. **الخلاصة:** أن معرفة الأسباب المؤدية لتأخير العلمية القيصرية قد تخلق فرصا تؤدي الي تحسين حالة الطفل الوليد.

الكلمات المفتاحية: ولادة؛ قرار طبي؛ عملية قيصرية؛ تدقيق كلينيكي؛ موت الجنين؛ مقياس الأبجار؛ عمان.

Advances in Knowledge

- *The target decision-to-delivery interval (DDI) in cases of emergency Caesarean section (CS) is ≤30 minutes. In the current study, the implementation of improvement strategies—such as the introduction of a pro forma timesheet and an obstetric crash code procedure—significantly increased the rate of satisfactory DDIs in emergency CS cases.*
- *Factors affecting DDI delays in the current study included obtaining consent for emergency CS procedures from patients, transferring patients from the ward to the operating theatre and a lack of operating theatre availability.*

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Application to Patient Care

- *In the current study, it was found that a DDI of >60 minutes led to an increased risk of adverse perinatal outcomes, in terms of admissions to the Special Care Baby Unit and low Apgar scores. This finding may help raise awareness of the importance of a swift delivery in cases of acute fetal hypoxia.*
- *Healthcare institutions should implement improvement strategies to reduce DDI delays in emergency CS cases so as to improve perinatal outcomes.*

Acute intrapartum fetal hypoxia affects 1% of all women in labour and leads to fetal death in 0.5 out of 1,000 births and cerebral palsy in 1 out of 1,000 deliveries.[1] This complication necessitates immediate intervention via Caesarean section (CS) or instrumental vaginal delivery so as to prevent birth asphyxia and fetal death.[2,3] A nonreassuring fetal heart rate during labour is considered a major indicator for prompt delivery via an emergency CS procedure.[3] The decision-to-delivery time interval (DDI) indicates the period of time between the clinical decision to carry out a CS procedure and the delivery of the baby.[4] The American Academy of Pediatrics, American College of Obstetricians and Gynecologists and the Royal College of Obstetricians and Gynaecologists recommend a DDI of ≤30 minutes following a diagnosis of acute intrapartum fetal hypoxia.[5,6] Other studies have also emphasised the importance of a 30-minute interval for safe neonatal outcomes.[7,8] However, there is currently little evidence that a DDI of ≤30 minutes is the norm in emergency CS cases.[9] In particular, achieving a DDI of ≤30 minutes in cases of fetal intolerance to labour can be very challenging.

Nizwa Hospital is a 308-bed secondary care institution which serves as a regional referral centre for primary healthcare centres in the Al-Dakhylia region of Oman. There are approximately 5,500 deliveries per year, of which an estimated 21% are delivered via CS procedure.[10] The delivery suite is well equipped and fully staffed with qualified nurses, trained midwives, operating theatre (OT) staff nurses, specialist obstetricians, anaesthesiologists and neonatologists. In addition, the hospital has its own labour ward OT with 24-hour emergency staff. This study aimed to assess DDIs among emergency CS cases at Nizwa Hospital in order to identify causative factors in DDI delays, plan improvement strategies accordingly and determine the impact of a delayed DDI on perinatal outcomes.

Methods

This repeated cross-sectional study took place between April 2011 and June 2013 at Nizwa Hospital and included all women with singleton pregnancies delivered by emergency CS procedures due to fetal distress, antepartum haemorrhage or umbilical cord prolapse. Women with multiple pregnancies or preterm deliveries were excluded from the study. As per the International Classification of Diseases, acute fetal distress was defined as an abnormal fetal heart rate pattern on cardiotocography (CTG)—such as persistent bradycardia, late decelerations, complicated tachycardia or persistent poor variability—either with or without the presence of meconium-stained amniotic fluid.[11] Category I CS cases in which there was an immediate threat to the life of the woman or her baby were defined as 'crash' emergencies, for instance due to cord prolapse, severe antepartum haemorrhage or alarming pathological CTG results.[12] Perinatal outcomes were recorded for all cases, including the incidence of stillbirths, specific Apgar scores and number of admissions to the Special Care Baby Unit (SCBU). As per hospital protocol, criteria for admission to the SCBU was defined as an Apgar score of <7 at five minutes. For the sake of analysis, DDI was categorised as either 0–30 minutes, 31–60 minutes or >60 minutes.

Three audit cycles were carried out, with each cycle lasting three months. Initially, the data collection for the first cycle was performed retrospectively. After analysis of the results for this cycle, factors causing DDI delays were identified. Inter- and intra-departmental meetings were held to discuss these issues and improvement strategies were designed and implemented accordingly. Staff were taught to transfer patients to the OT within 10 minutes of the CS decision. It was also recommended that the second OT be fully prepared at all times in case another CS procedure was required at the same time for a different patient. A *pro forma* timesheet starting from the delivery decision and ending at delivery was designed to further identify factors causing DDI delays and to encourage a sense of accountability and team work among members of the delivery team. In addition, patient counselling and staff education were provided in order to obtain rapid consent for the CS procedure. Following the implementation of these strategies, a second prospective cross-sectional audit cycle was performed. An interdepartmental meeting was subsequently held to again discuss the results of the preceding cycle and encourage interdepartmental

Table 1: Decision-to-delivery time intervals by audit cycle among emergency Caesarean section cases* performed at the Nizwa Hospital, Nizwa, Oman (N = 246)

Audit cycle	Total	DDI in minutes, n (%)			*P* value
		0–30	31–60	>60	
First	84	20 (23.8)	30 (35.7)	34 (40.5)	
Second	83	37 (44.6)	30 (36.1)	16 (19.3)	<0.001
Third	79	48 (60.8)	21 (26.6)	10 (12.7)	
Total	**246**	**105 (42.7)**	**81 (32.9)**	**60 (24.4)**	-

DDI = decision-to-delivery time interval.
**Due to acute fetal distress, antepartum haemorrhage or umbilical cord prolapse.*

Table 2: Admissions to the Special Care Baby Unit according to decision-to-delivery time interval among emergency Caesarean section cases* performed at the Nizwa Hospital, Nizwa, Oman (N = 246)

DDI in minutes	Total	SCBU admissions, n (%)		*P* value
		Admitted	Not admitted	
0–30	105	3 (2.9)	102 (97.1)	
31–60	81	8 (9.9)	73 (90.1)	<0.001
>60	60	24 (40.0)	36 (60.0)	
Total	**246**	**35 (14.2)**	**211 (85.8)**	-

DDI = decision-to-delivery time interval; SCBU = special care baby unit.
**Due to acute fetal distress, antepartum haemorrhage or umbilical cord prolapse.*

Table 3: Perinatal outcomes according to decision-to-delivery time interval among emergency Caesarean section cases* performed at the Nizwa Hospital, Nizwa, Oman (N = 246)

DDI in minutes	Total	Perinatal outcomes, n (%)			
		Apgar score at five minutes		SCBU admissions	NC
		<7	>7		
0–30	105	2 (1.9)	103 (98.1)	3 (2.9)	0 (0.0)
31–60	81	4 (4.9)	77 (95.1)	8 (9.9)	0 (0.0)
>60	60	35 (58.3)	25 (41.7)	24 (40.0)	5 (8.3)
Total	**246**	**41 (16.7)**	**205 (83.3)**	**35 (14.2)**	**5 (2.0)**

DDI = decision-to-delivery time interval; SCBU = special care baby unit; NC = neonatal convulsions.
**Due to acute fetal distress, antepartum haemorrhage or umbilical cord prolapse.*

communication. An obstetric crash code (OCC) procedure was implemented which, when activated, identified the exact location of an emergency so that relevant healthcare providers could assemble more quickly. The third and final cycle was then undertaken.

Data from each of the three audit cycles were subsequently analysed using the Statistical Package for the Social Sciences (SPSS), Version 20 (IBM Corp., Chicago, Illinois, USA). A Chi-squared test was used to analyse discrete variables. A *P* value of <0.050 was considered statistically significant.

Ethical permission for this study was granted by the Research & Ethics Committee of Nizwa Hospital (#3011/2011).

Results

During the study period, there were 3,940 deliveries, of which 553 (14.0%) were delivered by CS procedure. Of these, 469 (84.8%) were classified as emergency CS cases. Cord prolapse alone accounted for 44.4% of the emergency CS cases. Overall, a total of 246 women underwent emergency CS procedures due to acute fetal distress, antepartum haemorrhage or cord prolapse. The first audit cycle included 84 emergency CS cases; of these, only 23.8% achieved a DDI of ≤30 minutes. In the second cycle, after the initiation of improvement strategies, 44.6% of 83 emergency CS cases had a DDI of ≤30 minutes. In the third cycle, after the introduction of the OCC procedure, 60.8% of 79 emergency CS cases had a DDI of ≤30 minutes. The increase in the rate of cases with target DDIs between each cycle was statistically significant (*P* <0.001; χ^2 = 28.812) [Table 1]. Out of 67 CS cases defined as 'crash' emergencies, a DDI of ≤30 minutes was achieved for 54 patients (80.6%).

A total of 35 women delivered babies who were subsequently admitted to the SCBU; of these, 24 (68.5%) had a DDI of >60 minutes. There was an apparent positive and statistically significant relationship between number of admissions to the SCBU and increased DDIs (*P* <0.001) [Table 2]. Table 3 shows a comparison of perinatal outcomes in terms of Apgar scores at five minutes, SCBU admissions and neonatal convulsions according to DDI category. There was a strong and statistically significant relationship between Apgar scores of <7 and DDI (*P* <0.001). Apgar scores of >7 more frequently occurred with lower DDIs. Unfortunately, it was not possible to calculate associations between the frequency of neonatal convulsions and DDI because data for the 0–30 and 31–60 minute intervals were not available. Figure 1 shows the main reasons for delays

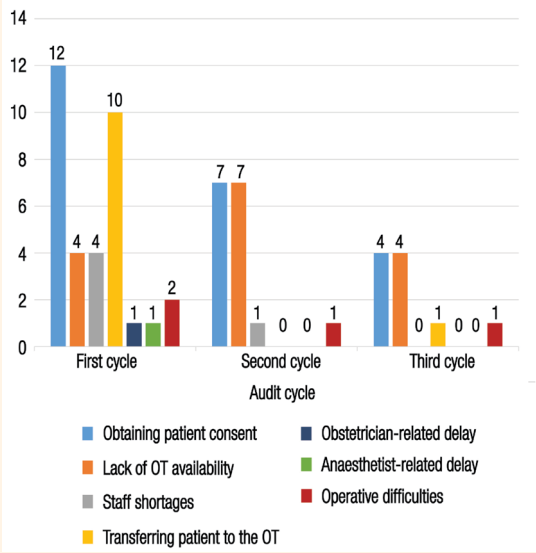

Figure 1: Reasons for decision-to-delivery time interval delays of >60 minutes among emergency Caesarean section cases* performed at the Nizwa Hospital, Nizwa, Oman (N = 60).

OT = operating theatre.

**Due to acute fetal distress, antepartum haemorrhage or umbilical cord prolapse.*

among the 60 cases with a DDI of >60 minutes; over all three cycles, the most frequent reasons for delayed deliveries were obtaining patient consent for the CS procedure (38.3%), lack of OT availability (25.0%) and moving the patients to the OT (18.3%).

Discussion

The current study sought to assess DDIs among emergency CS cases at Nizwa Hospital during three audit cycles, the results of each of which evidenced an improvement in optimal DDI rates. After the first cycle, several weak areas were identified and remedial strategies were implemented to improve DDIs before the second cycle began, including the introduction of a timesheet and staff education regarding the importance of a ≤30-minute DDI, rapid preparation of the OT room, dealing with staff shortages and ways to move patients to the OT more efficiently. Unfortunately, the second cycle indicated that the rate of cases with optimal DDIs was still substandard. At this point, poor interdepartmental communication was deemed to be the main causative factor for DDI delays and an OCC procedure was implemented. Overall, the implemented strategies resulted in a significant improvement in the frequency of cases with ≤30-minute DDIs and a decrease in the rate of poor perinatal outcomes. These results are consistent with those of a similar study of decision-to-incision time intervals among CS deliveries at a community hospital.[13] Although there is still room for improvement, the findings of the current study have indicated areas for future countermeasures to reduce DDI delays at Nizwa Hospital. Fortunately, 80.6% of deliveries in 'crash' emergencies were achieved within the 30-minute target DDI. Similarly, Dunn *et al.* reported that 100% of 'crash' emergency CS procedures in their retrospective cohort study were performed within the recommended time interval.[14]

In the present study, difficulties in obtaining patient consent for a CS procedure was identified as the main factor causing delayed DDIs of >30 minutes. In Oman, the majority of the local population have large families; however, it is a common belief that undergoing a CS procedure can limit family size.[15] It is possible that patients may be reluctant to consent to the surgical procedure for this reason. In addition, the husband and mother-in-law of an Omani female patient may have more influence in terms of healthcare decision-making than the patient herself. In the current study, obtaining patient consent for the surgery was challenging, despite counselling efforts by social workers, public relations officers, patient educators, midwives and doctors. Raising awareness of reproductive health, perhaps through nursing and midwifery programmes, may help to change attitudes and beliefs in the Omani community. Other factors resulting in delayed DDIs included delays in contacting obstetricians by the nursing staff and delays in arrival and presurgical preparation by the anaesthesiology team. Similar difficulties have been reported in a previous study.[16]

Among the 35 babies admitted to the SCBU in the current study, three showed signs of hypoxic ischaemic encephalopathy with convulsions. In one case, the fetus had severe prolonged bradycardia with meconium aspiration and the mother had had a prolonged pregnancy. In this case, the DDI was 75 minutes due to difficulties in obtaining patient consent for the procedure. In the second case, a CS procedure was indicated at 40 gestational weeks due to fetal distress; there was a 65-minute DDI due mainly to a refusal on the part of the patient to consent to the procedure. After delivery, the baby had an Apgar score of 5 at five minutes. The third baby developed hypoxic ischaemic encephalopathy as the mother had uncontrolled diabetes at 38 gestational weeks; the CS surgery was indicated due to pathological CTG findings and moderate meconium aspiration. There was a delay of 70 minutes in getting consent for the procedure and the baby had an Apgar score of 4 at five minutes. No stillbirths were reported during the study period and there was no difference between the perinatal outcomes among cases with a DDI of

≤30 minutes versus those with 31–60 minutes. These findings are consistent with those of Singh *et al*.[17]

This study is subject to certain limitations. Ideally, the most valid immediate measures to determine perinatal outcome include the five-minute Apgar score, umbilical cord acid-base balance and the presence of neonatal encephalopathy; use of five-minute Apgar scores alone is a relatively restricted measure of fetal hypoxia.[7,18] Unfortunately, in the current study, perinatal outcomes were assessed by Apgar scores and SCBU admissions, as there were no facilities available to assess cord pH. In addition, the rate of neonatal convulsions could not be compared according to DDI category as data were not available for the 0–30 minutes and 31–60 minutes groups.

Conclusion

An optimal DDI of ≤30 minutes is an important predictor of neonatal outcomes, particularly for acutely compromised fetuses. In the current study, the introduction of corrective strategies to reduce DDI delays resulted in a significant improvement in optimal DDI rate among emergency CS cases at Nizwa Hospital. Although the standard DDI target was not achieved in all cases, awareness of the factors causing DDI delays are important to help improve future patient outcomes. In particular, difficulty in obtaining patient consent for the surgery was identified as a major setback in prolonging DDIs among emergency CS cases.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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