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Target decision to delivery intervals for emergency caesarean section based on neonatal outcomes and three year follow-up

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ABSTRACT

Objective: To investigate current target decision to delivery intervals (DDIs) for 'emergency' caesarean section.
Study design: Prospective observational cohort study in a teaching hospital providing district and tertiary maternity services delivering 6000 babies per annum.
Results: 68% Category 1 deliveries were achieved within 30 min and 66% Category 2 within 75 min (26% for antepartum Category 2 deliveries). Category 1 deliveries were quicker using general rather than regional anaesthesia (21 vs. 29 min, odds ratio [OR] for delivery <30 min 4.2, 95%CI 1.3–14.2). 8% Category 1 and 4% Category 2 neonates were acidotic or asphyxiated. The risk of acidosis was not reduced by delivery within 30 min for Category 1 (OR 0.56; 0.11–2.81), or within 75 min for Category 2 (OR 2.72; 0.6–25.1). Three babies were registered with developmental impairment by three years of age; none were Category 1 deliveries.
Conclusions: Our data suggest that clinical triage is effective, with the more compromised fetus delivered more rapidly using general anaesthesia. For Category 1 deliveries a 30 min target DDI is appropriate, although those born after longer DDI did not show developmental impairment. For Category 2 caesarean sections performed for acute fetal distress or concerns, failed instrumental delivery, failure to progress or placental bleeding, a 75 min DDI may be an appropriate target but did not protect against acidosis, asphyxia or developmental impairment. Longer DDIs did not result in unfavourable outcomes for other Category 2 indications.

1. Introduction

Current audit standards for decision to delivery intervals (DDIs) at 'emergency' caesarean section have proven controversial. A recent Royal College of Obstetricians and Gynaecologists (RCOG) 'Good Practice Guideline' reiterates the 2004 National Institute for Clinical Excellence (NICE) Caesarean Section Guideline by advising target timeframes for delivery based on categories of patient risk devised by Lucas et al. (Table 1) [1–3]. This states that where the indication to deliver is an *immediate* threat to the life of mother or fetus (Grade or Category 1) delivery should occur within 30 min of the decision, and that other 'emergency' deliveries, where there is no immediate threat to fetal or maternal health (Category 2), should occur within 75 min of the clinical decision.

To be valuable as audit standards, these targets must be evidence-based and achievable. However, there are only limited data to support such targeted recommendations and little evidence from prospective studies correlating them to improved neonatal outcome. There are no reports of their effect on longer-term developmental outcome, and little information regarding delivery timescales for individual indications. Multiple studies have highlighted difficulties in achieving the proposed standards [4–8], and some authors suggest that while prompt delivery is essential for the wellbeing of compromised fetuses, others may benefit from a less aggressive approach to delivery [4,5,9,10].

The primary objective of this study was to assess the impact of DDI on neonatal condition n a large cohort of women undergoing caesarean section for emergency indications (Category 1 or 2). The secondary objective was to assess potential impact of DDI on longer term neurodevelopmental outcomes. We sought to investigate whether a shortened DDI decreases the proportion of acidotic neonates for all subgroups of indications for delivery.

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Table 1
Classification of caesarean sections.

Category 1:
Immediate threat to maternal or fetal life – antepartum
Immediate threat to maternal or fetal life – intrapartum
Category 2:
Threat to fetal health – antepartum
Threat to fetal health – intrapartum
Threat to maternal health – antepartum
Threat to maternal health – intrapartum
Category 3:
No threat to fetal or maternal health but needs early delivery
Category 4:
Delivery timed to suit mother or maternity service

The intention was to provide evidence to support or refute the currently proposed delivery time frames, provide analysis by indication for delivery, further develop audit standards, and to aid clinicians in situations where they may need to triage simultaneous cases.

2. Materials and methods

Details of all caesarean sections performed at the John Radcliffe Hospital in 2006 were collected prospectively. Apart from the authors, clinical staff were unaware of this data collection to reduce bias and altered clinical behaviour.

During the study period, there was 24-h cover on delivery suite by obstetric, anaesthetic and neonatal postgraduate medical trainees. Consultants were present on the unit from 8 am to 5 pm on 'working days', with dedicated theatre staff also present. Antenatal cardiotocograms (CTG) were performed in departments situated on floors above the Delivery Suite and operating theatres. No 'colour coding' of urgency nor 'alarm' system was used; there was no explicit policy on which indications were considered Category 1 or Category 2.

Data relating to category of delivery and indication was abstracted from clinical documentation – either in the main body of the maternity notes or from the operating note; all surgeons used a standard operation sheet proforma. If the clinician listed more than one indication, investigators decided, for the purpose of this study, which to enter as primary indication for delivery. In practice, this happened infrequently, and when it did related mainly to situations where surgeon had ticked "failure to progress" and "suspicious CTG pattern" on the operation sheet proforma: in such cases, investigators recorded the primary indication as "fetal distress".

For the purposes of analysis Categories 1 and 2 were combined as 'emergency' deliveries. A diagnosis of acidosis was made if the cord arterial pH was $\leq$7.10 and the base excess <-12.0 mmol/l [11]. A diagnosis of asphyxia was defined as a 5 min Apgar score $<$7 [12,13].

In January 2010 details of all the live births in this audit population were linked to *4Child* – Four Counties Database of Cerebral Palsy, Vision Loss and Hearing Loss in Children [14], to identify those children subsequently diagnosed with a motor and/or sensory impairment and notified to the *4Child* register.

The variables selected for analysis were those previously found in a report from our unit to have a significant relationship to DDI. [5] Statistical analysis was performed in StatsDirect (StatsDirect Ltd., Cheshire, UK). Descriptive statistics are provided as numbers and percentages for categorical variables and as mean $\pm$ standard deviation for normally distributed continuous variables and median and interquartile range for non-normally distributed continuous variables. Comparative tests for proportions included chi-squared or Fisher's exact tests where appropriate for categorical and binary variables. Students *t*-tests were used to compare continuous normal data and the Mann–Whitney *U* tests was used for continuous non-normal data including all DDI time period comparisons for which 95% confidence intervals of differences were also estimated. Comparative statistics are presented using odds ratio (OR) together with their 95% confidence intervals. Figures and regression curves were generated using GraphPad Prism version 3.0 (GraphPad Prism Software Incorporated, San Diego, CA).

3. Results

During the study 5998 women delivered in the unit; 1402 (23.5%) by caesarean section. Of these 59 (4%) were Category 1, 532 (38%) Category 2, 187 (13%) Category 3 and 624 (45%) Category 4.

3.1. Decision to delivery intervals

DDI was recorded for all Category 1 and 487 (91%) Category 2 deliveries. Category 1 deliveries were achieved within a significantly shorter DDI than intrapartum Category 2 deliveries (Mann–Whitney *U*-test $p < 0.0001$, 95%CI 24–38) (Tables 2 and 3); delivery within 30 min of decision was achieved in 40 of 59 (68%). For 487 Category 2 caesarean sections, delivery was achieved within 75 min in 319 (66%) and 180 min in 93%. Category 2 deliveries were more likely to be within the 75 min target if the primary indication for delivery was suspected fetal distress during labour (Table 4); only 5 of 19 (26%) Category 2 antepartum caesarean sections performed for maternal reasons were within the 75 min target (Fig. 1).

General anaesthesia (GA) was used as the primary technique for 34 (58%) Category 1 procedures with the method being required to support a regional block for one further case during surgery. The DDI (IQR) for these deliveries (21 min, 18–28) was significantly shorter than those under regional anaesthesia (29 min, 20–41) (Mann–Whitney *U*-test $p = 0.02$, 95%CI 0–14) and a significantly higher proportion of GA deliveries were within the 30 min target time (OR 4.2; 95%CI 1.3–14.2; Yates-corrected χ^2 $p = 0.03$). All Category 2 procedures commenced under regional anaesthesia; 41 (8.4%) required conversion to GA during surgery. The median (IQR) DDI for these 41 women was 61 (27–93) min compared to 60 (41–87) min for those delivered under regional block; the proportion

Table 2
Decision-delivery-intervals (DDIs) and neonatal condition at birth for Categories 1 and 2 caesarean sections, analysed by indication.

	Category 1	Category 2		
		Intrapartum	Antepartum	Intrapartum and antepartum
Total caesarean sections with known DDI	59[a]	434	53	487
Median DDI [IQR] (min)	23 [19–37]	58 [36–82]	97 [65–226]	60 [39–88]
1-min Apgar $\leq$3 *n*	9 (15%)	25 (6%)	6 (11%)	32 (6%)
5-min Apgar score $\leq$7 *n*	8 (13%)	21 (5%)	6 (11%)	29 (5%)
Cord arterial pH Mean $\pm$ SD	7.17±0.145	7.24 ± 0.09	7.24 ± 0.09	7.24 ± 0.09
Cord arterial base excess Mean $\pm$ SD (mmol/l)	−6.64 ± 4.672	−7.47 ± 3.81	−3.77 ± 3.12	−4.66 ± 3.705
Acidotic neonates *n*	7 (11.8%)	16 (3.7%)	2 (3.8%)	18 (3.7%)

[a] 58 intrapartum and one antepartum.