OBSTETRICS

# Cohort study of the decision to delivery interval and neonatal outcome for emergency operative vaginal delivery

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**OBJECTIVE:** The purpose of this study was to assess whether a target decision to delivery interval (DDI) is appropriate for 'emergency' operative vaginal delivery and whether this would reduce adverse neonatal outcomes.

**STUDY DESIGN:** We performed a retrospective cohort study of 1021 singleton term babies who experienced operative delivery for 'fetal distress' in the second stage of labor between 1998 and 2003 in Dundee, Scotland.

**RESULTS:** The mean DDI in a labor room was 14.5 minutes (SD 9.5) compared to 30.0 minutes (SD 14.6) in an operating room. Shorter DDIs were associated with use of local rather than regional or general anesthesia. There were no significant differences in rates of low Apgar score (< 7 at 5 min) OR 0.99 (95% CI 0.27, 3.71), fetal acidosis (pH < 7.10) OR 1.24 (0.78, 1.99), neonatal resuscitation OR 1.00 (95% CI 0.65, 1.53), or admission to NICU OR 0.53 (95% CI 0.27, 1.03) for babies delivered within 15 minutes compared to greater than 15 minutes. The outcomes were similar for a 30-minute threshold. The DDIs for forceps and vacuum deliveries were similar as were neonatal outcomes.

**CONCLUSION:** A DDI of 15 minutes is an achievable target for operative vaginal delivery in a labor room with 30 minutes for delivery in an operating room; however, setting arbitrary limits is unlikely in itself to prevent adverse neonatal outcomes.

**Key words:** cohort study, decision delivery interval, neonatal outcome, operative vaginal delivery

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It has become an established standard of obstetric care in the developed world that delivery by 'emergency' cesarean section, usually for 'fetal distress,' should be achieved within 30 minutes of making the decision.[1-5] Several authors have questioned whether this target is feasible or indeed justified on clinical grounds.[6-13] Clinical standards are not yet in place for 'emergency' operative vaginal delivery but it is likely that a similar approach will be taken. The rationale for encouraging speed of delivery in cases of suspected fetal compromise is to avoid prolonged fetal hypoxia with the associated risks of neonatal encephalopathy, cerebral palsy, and perinatal death.[14-16] However, it is by no means certain that delivery within 30 minutes will prevent adverse neurologic sequelae. This difficulty has its origins in the wide range of pathophysiologic mechanisms underlying apparent 'fetal distress' and the unpredictable susceptibility to cerebral impairment of an individual fetus.[14] Nonetheless, the standard for cesarean section has been adopted by the Clinical Negligence Scheme for Trusts (CNST) in the United Kingdom and has been incorporated into the process of determining medical indemnity costs for individual trusts.[17] Over and above medicolegal concerns, it is clearly desirable to avoid unnecessary delay in all emergency situations and setting a timescale may encourage improved coordination of care even if this cannot prevent all adverse outcomes.

In a previous study, we reported that emergency cesarean section in the second stage of labor was associated with an increased risk of neonatal admission to the neonatal intensive care unit (NICU) compared with operative vaginal delivery in theater.[18] This association was independent of the presence of 'fetal distress' and suggested that the interval from decision to delivery may be an important contributory factor. It has also been reported that if speed of delivery is important, use of forceps may result in a quicker birth than use of vacuum.[19] The aim of this study was to evaluate the decision to delivery interval (DDI) for emergency operative deliveries in the second stage of labor in relation to venue and mode of delivery and to assess the implications for the infants' condition at birth. The emphasis was on establishing whether an arbitrary timescale could be set for 'emergency' operative vaginal deliveries and whether this would influence neonatal outcomes.

## Materials and Methods

All women booked for care at Ninewells Hospital, Dundee, who required an operative delivery for 'fetal distress' in the second stage of labor between January 1998 and January 2003 were included. Ninewells Hospital is a Scottish university teaching hospital with approxi-

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mately 3000 deliveries a year and with a complement of obstetricians at different levels of experience. In addition, there were occasional women transferred for delivery from local midwife-led units. The study center covers an entire geographic area with a stable population. There is a labor ward protocol that provides guidelines on operative vaginal delivery (based on the Guidelines of the Royal College of Obstetricians and Gynaecologists),[20] but the venue for delivery and choice of instrument is at the discretion of the individual obstetrician or supervising obstetrician according to experience. A consultant or experienced registrar (specialist registrar year 4-5) should be present for all rotational deliveries and all transfers to the operating room in the second stage of labor. The study was limited to women at term (≥ 37 weeks gestation) with live singleton pregnancies and a cephalic vertex presentation.

All women who had experienced an operative delivery in the second stage of labor were identified from the "MaterniTay" database. This is a validated system with a high rate of accuracy when compared to handwritten records. Ascertainment was cross-referenced with the labor ward records, operating theater admission books, and the handwritten medical records where necessary. Inconsistency in recorded items occurred in less than 5% of the records accessed for this study. There is a similar neonatal database for admissions to the neonatal intensive care unit (NICU). In addition, a Scottish morbidity record (SMR) is completed for each individual woman and infant for national recording purposes (Scottish Information and Statistics Division [ISD]). The MaterniTay data were cross-referenced with the relevant ISD data sources (SMR 2 and SMR 11).

## Exposure

The indications for emergency operative delivery were classified within the database according to standard criteria. We limited the study to emergency cases with 'fetal distress,' as these are urgent on fetal grounds and are more reliably ascertained than emergency cases for other indications. 'Fetal distress' is a nonspecific term used to describe situations where there is suspected fetal compromise. The widely accepted definition for 'fetal distress' is based on the presence of abnormal features on a cardiotocograph (CTG) (persistent bradycardia, late decelerations, complicated tachycardia, persistent poor variability)[21] with or without the presence of meconium stained liquor. This classification was used by obstetricians and midwives entering data on MaterniTay. Fetal blood sampling was available within the unit and recommended in the context of CTG abnormalities unless delivery was imminent. Operative delivery was by forceps, vacuum, or cesarean section (either immediate or after a failed attempt at operative vaginal delivery). Rotational deliveries included Kiellands forceps, manual rotation followed by direct traction forceps, or rotational vacuum. The venue for delivery was in a labor room, or in an operating room located on the labor ward with dedicated anesthetic and theater staff. Transfer to the operating room was indicated for spinal or general anesthesia, complex rotational instrumental deliveries, attempted operative vaginal delivery considered a trial with potential recourse to cesarean section, and for cases where immediate delivery by cesarean section was planned.

## Outcomes

The operator reported the time of making the decision to deliver and the actual time of birth on the computer record. Similar information was entered by the midwife and in the operating room records, allowing validation of decision delivery intervals (DDIs). The handwritten medical records were reviewed where there were missing data or a discrepancy in timings. Shoulder dystocia and brachial plexus injury were defined clinically according to the attending clinicians. Third-degree tear was recorded where tearing involved the anal sphincter muscle and fourth-degree tear if the anal mucosa was involved. Apgar scores were recorded at 1 and 5 minutes and scores of $< 4$ at 1 minute and $< 7$ at 5 minutes are reported, due to the known association with encephalopathy and later cerebral palsy.[22] Similarly, cord blood was taken from the umbilical artery and vein and a pH below 7.10 and base excess below $-12.0$ have been taken as relevant markers of adverse neurodevelopmental outcome.[16] Neonatal resuscitation included bag and mask ventilation, intubation with intermittent positive pressure ventilation, and full cardiac arrest procedures. A neonatologist or specialist neonatal nurse practitioner was requested for all deliveries. Neonatal trauma included bruising, cephalhematoma, lacerations, intra- or extracranial hemorrhage, facial nerve palsy, brachial plexus injury, or fractures. Due to small numbers of individual adverse outcomes these were reported as a composite "neonatal trauma" outcome. Forceps marks were not considered traumatic, nor was a chignon unless there was additional bruising or lacerations. Infants were considered to have suspected neonatal sepsis where the infant or liquor was offensive smelling or where there was a neonatal fever. Neonatal outcomes were available up until the time of first hospital discharge. The data were downloaded into the statistical package SPSS (version 11.0, Chicago, IL) for analysis. The local research ethics committee granted ethical approval.

## Statistical analysis

Decision delivery intervals (DDIs) were calculated as means and standard deviations and also as medians and interquartile ranges to take account of outlying results. Differences between groups were evaluated using the Student *t* test. Univariable comparisons were made for the maternal, infant, and delivery factors according to the DDI comparing the odds of having a particular factor in relation to a 15 or 30 minute DDI compared to an interval of greater than 15 or 30 minutes. Maternal and neonatal outcomes were compared in a similar way with separate analyses for all attempted operative vaginal deliveries and for operative vaginal deliveries in the labor room. Multivariable analyses were not appropriate for these comparisons as the clinical factors identified in the initial comparisons were