



CLINICAL PAPER

# Ante- and intra-partum factors that predict increased need for neonatal resuscitation<sup>☆</sup>

Khalid Aziz<sup>a,\*</sup>, Mairi Chadwick<sup>b</sup>, Mary Baker<sup>c</sup>, Wayne Andrews<sup>b,c</sup>

<sup>a</sup> Department of Pediatrics, University of Alberta, Room 5027 DTC, Royal Alexandra Hospital, 10240 Kingsway, Edmonton AB, Canada T5H 3V9

<sup>b</sup> Faculty of Medicine, Memorial University, 300 Prince Philip Drive, St. John's NL, Canada A1B 3V6

<sup>c</sup> Division of Newborn Medicine, Janeway Children's Health and Rehabilitation Centre, 300 Prince Philip Drive, St. John's NL, Canada A1B 3V6

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## KEYWORDS

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Risk factors;  
Endotracheal intubation;  
Positive pressure ventilation;  
Outcomes;  
Resuscitation team;  
Quality improvement

## Summary

**Background:** In the absence of identified risk factors, 7% of term newly borns require PPV-ETT (positive pressure ventilation and/or endotracheal intubation). Factors increasing need for resuscitation, and therefore for individuals with advanced resuscitation skills, require further evaluation.

**Objective:** To evaluate the predictive value of ante- and intra-partum risk factors for PPV-ETT in "at-risk" deliveries.

**Design/methods:** Over a 30-month period, the neonatal resuscitation team (NRT) at the tertiary perinatal centre in St. Johns, Newfoundland and Labrador, prospectively recorded reasons for attending "at-risk" deliveries, and subsequent use of PPV-ETT, rates of low 1- and 5-min Apgar scores, and admission to neonatal intensive care or death.

**Results:** Of 5691 deliveries, 3796 (66.7%) were attended by the NRT. Data were available for 3564 (94%) at-risk attendances, of which 780 (22%) required PPV-ETT. Using multivariate logistic regression analysis, significant ante-partum risk factors for PPV-ETT included multiple pregnancy <35 weeks, maternal infection, hypertension, and oligohydramnios; intra-partum factors were preterm delivery at <36 weeks, breech presentation, meconium-stained amniotic fluid (MSAF), non-reassuring fetal heart rate, emergency Caesarean section (EmCS), shoulder dystocia, and opiates in normal labour. Elective Caesarean section (ElCS) was protective. Forceps, vacuum, and regional or general anaesthesia did not increase risk. EmCS and preterm birth predicted PPV-ETT, low Apgar scores, and admission to neonatal intensive care (or death), and along with MSAF, made up the majority of "at-risk" babies.

**Conclusions:** Given the baseline risk (22%), factors that increase need for resuscitation in a tertiary centre may not alter the practice of the NRT attending all "at-risk" deliveries, with the exception of ElCS.

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\* Corresponding author. Tel.: +1 780 735 4670; fax: +1 780 735 4072.

E-mail address: [khalid.aziz@ualberta.ca](mailto:khalid.aziz@ualberta.ca) (K. Aziz).

## Introduction

For most newly born babies, transition to extrauterine life occurs without the need for resuscitation. For those who may require assistance, the 2005 American Heart Association (AHA) Guidelines state that "Anticipation, adequate preparation, accurate evaluation, and prompt initiation of support are critical for successful resuscitation".<sup>1</sup>

The AHA Guidelines also point out that "With careful consideration of risk factors, the majority of newborns who will need resuscitation can be identified". A list of ante-partum and intra-partum risk factors may be found in the Neonatal Resuscitation Program (NRP) (5th edition, 2006) text,<sup>2</sup> however, no mention is made of the relative importance of each factor.

Neonatal resuscitation, as taught in the NRP, is, to a large extent, a basic life support skill: When compromise occurs, the first responder is expected to maintain the infant's airway and ensure lung inflation. The more advanced skills of neonatal resuscitation, particularly on-going ventilation, endotracheal intubation, central venous access, and administration of medications, require the proximity of a second provider to assist the first, or to provide the additional skills. More accurate assessment of risk would ensure the immediate presence of this additional person in advance of delivery.

Certain factors, such as preterm delivery, breech presentation, and meconium-stained amniotic fluid (MSAF), have been established as predictors of need for resuscitative interventions. de Almeida et al. recently demonstrated that late preterm babies were at substantially increased risk for neonatal resuscitation when compared to term counterparts<sup>3</sup>: they also identified twin gestation, maternal hypertension, nonvertex presentation, Cesarean delivery, and lower gestational age as significant contributors to risk. Vain et al. found that 9% of babies born through MSAF needed endotracheal suction.<sup>4</sup> Molkenboer et al. found that term, breech deliveries were 4 times more likely to need resuscitation by mask.<sup>5</sup> It has also been argued that elective Caesarean section (C-section) at term has a protective effect,<sup>6</sup> reducing the need for advanced resuscitation skills. Given the numerous factors at play and their interaction, validity of these and other factors as predictors of the need for resuscitation requires further evaluation.

An audit of Canadian institutions by Mitchell et al.<sup>7</sup> found that the need for neonatal resuscitation was not anticipated in 76% of cases. On the other hand, an audit of resuscitation team practices (Aziz et al.<sup>8</sup>) using risk stratification permitted the identification of over 80% of babies who required positive pressure ventilation (PPV): in that study, only 7% of babies with no identifiable risk factors required PPV, and all of them responded by 1 min of age (as demonstrated by normal 1-min Apgar scores). Aziz et al. prospectively categorized deliveries as low, moderate, or high risk according to a list of ante- and intra-partum factors, based on NRP recommendations (modified by expert consensus). 16% and 47% of moderate and high-risk scenarios respectively required PPV, supporting the effectiveness of risk stratification.

The purpose of this study was to evaluate the relative importance of individual ante- and intra-partum risk factors in determining the need for resuscitation of newborn babies,

using prospective data collected from a complete population of at-risk newborn babies over a defined time period in a tertiary perinatal centre. The results may be used to optimize risk stratification and the planned attendance at delivery by individuals with appropriate skill levels.

## Methods

The Janeway Children's Health and Rehabilitation Centre is the single tertiary perinatal centre for the Province of Newfoundland and Labrador, Canada. As part of an on-going audit of the Centre's Neonatal Resuscitation Team (NRT), data were collected before, and immediately following, all deliveries that were deemed "at-risk" according to a pre-determined triage process (Table 1).<sup>8</sup> As a consequence of risk stratification, approximately 65% of all deliveries were attended by the NRT. Those deliveries not attended by the NRT were cared for by delivery room (case room) staff who were trained in the basic steps of NRP (including establishing an airway, and bag-mask ventilation), and who would summon the NRT if advanced or prolonged resuscitation was required. Thus all patients requiring PPV for more than 30 s, endotracheal intubation, or admission to neonatal intensive care would have been entered into the resuscitation database.

Immediately following attendance, the NRT nurse would complete a data entry sheet which included (a) *documented parameters*, such as gestation (in completed weeks), multiple pregnancy, presentation (breech, cephalic, and other), mode of delivery (vaginal, elective C-section, or emergency C-section, instrumentation (forceps or vacuum), maternal sedation (use of opiates), regional or general anaesthesia, and the presence or absence of meconium-stained amniotic fluid; (b) *verbally reported parameters*, including failure to progress in labour and non-reassuring fetal heart rate tracing; (c) *need for advanced airway management*, including PPV, endotracheal intubation for resuscitation, or intubation for MSAF; (d) *Apgar score* at 1 and 5 min; and (e) *disposition* (death in the delivery room or transfer to normal nursery or intensive care). Low 1- and 5-min Apgar scores were defined as <4 and <7 respectively.

The nature of attendance at delivery, particularly at short notice, was such that "verbally reported" ante-partum parameters may have been inconsistently communicated and therefore suspected to be of limited reliability and accuracy, particularly in the presence of more than one risk factor – as a consequence, the NRT were asked to document the single (principal) reason for being called, and then others, if known. The use of drugs and urgent vascular access for volume expansion was uncommon,<sup>8</sup> and would rarely occur in the absence of PPV-ETT – these were therefore excluded from the analysis. It should also be noted that PPV included the increasingly common practice of using early CPAP during the resuscitation of extremely preterm babies.

The primary outcome for this analysis, PPV-ETT was collectively defined as the need for PPV or CPAP, or the insertion of an endotracheal tube (for ventilation or suctioning). The secondary outcomes were: 1 and 5-min Apgar scores less than 4 and 7 respectively; and admission to NICU or death in the delivery room.

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