



Feasibility of pulse oximetry for assessment of infants born in community based midwifery care

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ABSTRACT

Objective: to evaluate the feasibility of using pulse oximetry (PO) for evaluating infants born in community-based midwifery care.

Design: a prospective, observational study of infants born after midwifery supervised (home) births.

Setting: 27 midwives from seven practices providing primary care in (home) births used PO at birth or the early puerperal period over a ten-month period. Data were obtained on the effect of PO on outcome, interventions and decision-making. Midwives were surveyed about applicability and usefulness of PO.

Participants: 153 infants born in primary midwifery care.

Findings: all births were uncomplicated except for one infant receiving supplemental oxygen and another was mask ventilated. In 138/153 (90%) infants PO was successfully used and 88% of midwives found PO easy to use. In 148/153 (97%) infants PO did not influence midwives' clinical judgment and referral policy. In 5/153 (3%) infants, midwives were uncertain of the infant's condition, but PO measurements were reassuring. In case of suboptimal neonatal condition or resuscitation, 100% of midwives declared they would use PO again.

Key conclusions: it is feasible to use PO in community based midwifery care, but not considered an important contribution to routine evaluation of infants. Midwives would like to have PO available during suboptimal neonatal condition or when resuscitation is required.

Implications for practice: PO can be applied in community based midwifery care; it does not lead to insecurity or extra referral. Further research on a larger group of infants must show the effect of PO on neonatal outcomes.

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Introduction

The Netherlands is one of few industrialised countries where community based midwifery-led (home) births still occur following low risk pregnancy. Almost one third of all births (32.9%) is supervised by a community-based midwife, without any obstetric

involvement (Stichting Perinatale Registratie Nederland, 2009). Only if complications occur, the obstetrician is consulted.

After birth, placental oxygenation ceases, neonatal lungs expand and blood oxygenation is primarily provided by breathing. If this transition proceeds normally, neonatal organs are oxygenated and subsequently lead to high oxygen saturation (the percentage of haemoglobin binding sites in the bloodstream occupied by oxygen).

Immediately after birth, an infant's condition is assessed by observation of breathing, heart rate, skin colour, muscle tone and reflexes (irritability), also known as the Apgar score (APGAR, 1953; van der Stouwe, 2009).

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It seems plausible that if a high Apgar score is assessed, it means that the actual oxygen saturation is also high. Studies have shown, however, that judging oxygen saturation based on the infant's colour can be very inaccurate (O'Donnell et al., 2007). Also, heart rate is often inaccurate and underestimated (lower than the actual heart rate) by auscultation or palpation (Kamlin et al., 2006).

Pulse oximetry (PO) offers objective and accurate values of oxygen saturation and heart rate and also, interventions (such as assisted ventilation) do not need to be interrupted by manual auscultation (O'Donnell et al., 2005; Kamlin et al., 2006). Therefore, PO could help to evaluate the need for, and response to resuscitation.

The actual prevalence of neonatal resuscitation in community based midwifery care in the Netherlands is unknown. However, 0.9% of all infants born in community based midwifery care have an assessed Apgar score of < 7 at 5 minutes after birth and a substantial number of these infants require some form of support and/or resuscitation (Stichting Perinatale Registratie Nederland, 2009; van der Stouwe, 2009). One can assume that in these cases, oxygen saturation was not optimal but it is unknown whether PO would have been helpful in these cases.

Both the Dutch Association of Paediatricians (NVK) and the Royal Dutch Organization of Midwives (KNOV) recommend the use of PO when resuscitation is indicated (van der Stouwe, 2009; van den Dungen et al., 2010). International guidelines recommend PO when resuscitation can be anticipated, when positive pressure is administered for more than a few breaths, when cyanosis is persistent, or when supplementary oxygen is administered (Kattwinkel et al., 2010).

In addition, recent studies recommend PO as a screening tool for congenital heart disease and the need for implementation in practice (Bradshaw and Martin, 2012; O'Connor and Morrow, 2012; Thangaratinam et al., 2012). In the Netherlands, however, this has not been implemented. Currently, midwives do not use PO as standard care, when resuscitation is necessary or for screening.

This prompted us to perform a pilot study in the use of PO in midwifery supervised (home) birth. We aimed to assess the feasibility of a PO for midwives to assess neonatal condition after birth. We were interested in the applicability and usefulness of the device and if using a PO changed referral behaviour of the midwife in charge. Also, we aimed to explore whether midwives would like to incorporate PO routinely in their daily practice.

Methods

Twenty-seven midwives in Leiden region agreed to participate in the study. The study was conducted from April 2011 to February 2012. We requested midwives to use PO in all births they supervised in primary care. Midwives were asked to use the PO for evaluating all infants after birth, and were encouraged to use the device when in doubt of the infant's clinical condition (directly after birth or in the early puerperal period) or when support of transition or resuscitation was needed. As this study aimed to assess the feasibility of PO in daily midwifery practice, no exclusion criteria were applied.

The midwives received an update in neonatal resuscitation and were trained in using PO and interpreting its measurements and how to proceed in case of alarm messages displayed on the device. Using previously published percentiles for heart rate and oxygen saturation by Dawson et al., we defined 10th percentile values as pre-lower limit (Fig. 1) (Dawson et al., 2010a, 2010b).

There were a limited number of Masimo hand held pulse oximeters (Masimo Corporation, Irvine, California) available and it was not possible to equip every midwife with a device.

Minutes after birth	1 minute	2 minutes	5 minutes	7 minutes	>10 minutes
Spo2 (%)	35	40	75	85	90
Heart Rate (bpm)	30	80	120	120	120

Fig. 1. Based on previously published percentiles by Dawson et al. (2010a, 2010b); defined 10th percentiles for oxygen saturation and heart rate used as reference by midwives in preductal measurements in infants.

Therefore, we allocated one PO to each midwifery practice. The community based midwife 'on call' had a device at her disposal as often as possible. Initially, a Masimo Rad-5 was used but replaced by Rad-8, because of technical problems and frequent false alarms with the Rad-5. Both devices contained identical software (Signal Extraction Technology, SET, V.7.8.0.1.) and were set to read measurements with 2-second averaging intervals and maximal sensitivity (Dawson et al., 2010b).

When PO was used directly after birth, the midwives were instructed not to let the device interfere with normal procedures, such as skin-to-skin contact or immediate breast feeding. The umbilical cord was clamped in adherence to the normal procedures. In the Netherlands, late-cord clamping is generally applied; this involves clamping the umbilical cord at least one minute after birth or when cord pulsation has ceased (McDonald and Middleton, 2008).

In adherence to other studies conducted on PO in term infants, midwives were instructed to place a disposable sensor (Masimo Low Noise Cable Sensor (LNCS[®]) Newborn Sensor) around the infant's right wrist (Altuncu et al., 2008; Dawson et al., 2010b). PO was switched on after applying the sensor to the infant; this offers the quickest display of data (O'Donnell et al., 2005; Altuncu et al., 2008; Dawson et al., 2010b). A preductal oxygen saturation and heart rate were obtained for a minimum of ten consecutive minutes. Preductal oxygen is the highest oxygenated blood in the infants' circulation due to the preferential flow through the foramen ovale to the left atrium (Nijland et al., 1994).

Apgar scores were assigned by the community based midwife in charge. Interpretation and action based on the obtained data was also at the discretion of the midwife in charge.

After use of PO, participants were requested to fill in a case report form (CRF), containing characteristics of mother and infant, place of birth, interventions after birth and, if applicable, referral to the paediatrician. Subsequently, midwives were surveyed concerning usefulness, applicability and decision-making when using PO. Also, in case PO was *not* used, we requested the community based midwife to report the reason(s) on a separate form.

After the ten-month study period, an evaluation questionnaire was sent to all participants. Specific questions on practical use of PO and possible implementations in practice were asked. Furthermore, data on all deliveries and neonatal referral during the study period of all practices were obtained in order to compare groups.

Approval for this study was obtained by the Leiden Medical Ethics Committee in February 2011. In all midwifery practices, clients were informed about the study through wall posters in waiting rooms and flyers were distributed antenatally. Midwives informed and subsequently asked clients and their partners to participate in the study. Verbal parental consent was obtained by the community based midwife, prior to the onset of birth. Also, all paediatricians in Leiden region were informed via e-mail regarding this study and possible referrals based on PO results.

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