



ORIGINAL ARTICLE

Pulse oximetry versus electrocardiogram for heart rate assessment during resuscitation of the preterm infant ☆,☆☆,☆☆☆



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KEYWORDS

Newborn;
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Resuscitation;
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Electrocardiogram;
Heart rate

Abstract

Background: Heart rate (HR) assessment is essential during neonatal resuscitation, and it is usually done by auscultation or pulse oximetry (PO). The aim of the present study was to determine whether HR assessment with ECG is as fast and reliable as PO during preterm resuscitation.

Material and methods: Thirty-nine preterm (<32 weeks of gestational age and/or <1500 g of birth weight) newborn resuscitations were video-recorded. Simultaneous determinations of HR using ECG and PO were registered every 5 s for the first 10 min after birth. Time needed to place both devices and to obtain reliable readings, as well as total time of signal loss was registered. The proportion of reliable HR readings available at the beginning of different resuscitation manoeuvres was also determined.

Results: Time needed to connect the ECG was shorter compared with the PO (26.64 ± 3.01 vs. 17.10 ± 1.28 s, for PO and ECG, respectively, $P < .05$). Similarly, time to obtain reliable readings was shorter for the ECG (87.28 ± 12.11 vs. 26.38 ± 3.41 s, for PO and ECG, respectively, $P < .05$). Availability of reliable HR readings at initiation of different resuscitation manoeuvres was lower with the PO (PO vs. ECG for positive pressure ventilation: 10.52 vs. 57.89% $P < .05$; intubation: 33.33 vs. 91.66%, $P < .05$). PO displayed lower HR values during the first 6 min after birth ($P < .05$, between 150 and 300 s).

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PALABRAS CLAVE

Neonato;
 Pretérmino;
 Reanimación;
 Pulsioximetría;
 Electrocardiograma;
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Conclusions: Reliable HR is obtained later with the PO than with the ECG during preterm resuscitation. PO underestimates HR in the first minutes of resuscitation.

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Pulsioximetría frente al monitor de electrocardiograma para la determinación de la frecuencia cardíaca durante la reanimación del recién nacido pretérmino

Resumen

Introducción: La medición de frecuencia cardíaca (FC) es esencial durante la reanimación neonatal y se realiza habitualmente mediante auscultación o pulsioximetría (PO). El objetivo de este estudio es analizar si durante la reanimación del recién nacido prematuro la medición de la FC mediante ECG es tan precoz y fiable como la PO.

Material y métodos: Se realizó video-grabación de la reanimación de 39 recién nacidos prematuros (<32 semanas o <1.500 g), registrando medidas de FC simultáneamente mediante ECG y PO cada 5 s desde el nacimiento hasta los 10 min de vida. Se determinó el tiempo necesario para colocación, obtención de lectura fiable y pérdida de señal de ambos dispositivos, así como la proporción de medida fiable de FC al inicio de cada maniobra de reanimación.

Resultados: El tiempo de colocación fue menor en ECG que en PO (17,10 ± 1,28 s vs. 26,64 ± 3,01 s; p < 0,05). Igualmente, el tiempo desde el fin de la colocación hasta la obtención de una lectura fiable fue menor para ECG que para PO (26,38 ± 3,41 s vs. 87,28 ± 12,11 s; p < 0,05). La proporción de medidas fiables de la FC al inicio de la reanimación fue menor en PO (PO vs. ECG para ventilación con presión positiva: 10,52 vs. 57,89%; p < 0,05; intubación: 33,33 vs. 91,66%; p < 0,05). La PO subestimó la FC con medidas inferiores a las del ECG durante los primeros 6 min de vida (p < 0,05 entre los 150 y 300 s).

Conclusiones: En la reanimación del prematuro la obtención de la FC fiable es más tardía con la PO que con ECG; además, la PO subestima la FC en los primeros momentos de la reanimación. © 2015 Asociación Española de Pediatría. Publicado por Elsevier España, S.L.U. Todos los derechos reservados.

Introduction

International guidelines on neonatal resuscitation indicate that of all the parameters that guide both initiation of resuscitation as well as its continuation, an increase in heart rate (HR) is the quickest and most reliable indicator of resuscitation efficacy.^{1,2} Furthermore, progression to different steps during resuscitation fundamentally depends on the evolution of this parameter. Therefore, HR measurement is an essential element of neonatal resuscitation. Until recently, HR was measured exclusively by clinical assessment, either auscultation of precordial pulse or palpation of the base of the umbilical cord.¹ However, clinical assessment underestimates HR compared to measurement by electrocardiography (ECG).³ Thus, the most up-to-date recommendations for neonatal resuscitation (International Liaison Committee on Resuscitation) establish that a preductal pulse oximeter (PO) should be placed on newborns when the need of resuscitation is anticipated.¹ However, the time needed to obtain a reliable HR reading with a PO may range between 68 and 92 s,^{3,4} so that even if the PO were placed at birth, a reliable HR would not be obtained until this time interval had elapsed. Considering that based on international resuscitation guidelines severely depressed newborns could be intubated, ventilated with positive pressure and undergoing chest compressions by 90 s of life, the above suggests that

in many instances these interventions are performed when reliable HR measurements are not yet available.

Thus, a method is needed to measure HR that can provide early and reliable data to guide correct implementation of neonatal resuscitation recommendations. Electrocardiography is currently the gold standard for measuring HR.³ The mean starting time of reliable data collection described in the literature for ECG ranges approximately between 30 and 80 s.⁵⁻⁸ There is evidence that ECG provides HR data faster than pulse oximetry.⁶⁻⁸ While the literature describes an overall strong correlation between ECG and PO measurements,⁹ recent data suggest that this correlation is weak in the first minutes after birth, with significantly lower PO-derived HR values in the first 7 min of life, and the most pronounced differences occurring in the first 2 min.⁸ Most of the published studies on this subject included few very low birth weight newborns that required advanced resuscitation.³ Few data are available on the correlation between PO and ECG during resuscitation of very low birth weight newborns at birth, who are precisely the patients in whom methodical and appropriate resuscitation has the greatest impact on subsequent morbidity and mortality.^{8,9}

The aim of our study was to analyse whether HR monitoring by ECG contributes faster and more reliable data than pulse oximetry during resuscitation in neonates born at less than 32 weeks' gestation or weighing less than 1500 g.

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