

RESEARCH ARTICLE

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Evaluating practitioners' preferences regarding vascular emergency access in newborn infants in the delivery room: a national survey

Bianca Haase*, Laila Springer and Christian Friedrich Poets

Abstract

Background: Venous access during neonatal emergencies in the delivery room (DR) can be accomplished through an umbilical venous catheter (UVC) or an intraosseous (IO) access. Preference of one over the other is unclear. We wanted to evaluate practitioners' views.

Methods: An anonymous online questionnaire was circulated to healthcare professionals with different background and experience, all working in neonatal intensive care units in Germany. The web-based survey consisted of 13 questions and data collection was performed using an online tool.

Results: We received 502 completed questionnaires, 152 (30%) were from neonatologists, the remainder from residents, fellows and neonatal nurses. For resuscitation of term newborns in the DR 61% of neonatologists vs. 53% of non-neonatologists were in favour of UVC instead of an IO as an emergency access. UVC placement was rated (very) difficult to impossible by 60% of neonatologists and 90% of non-neonatologists ($p < 0.05$). All respondents cited lack of experience as the main reason for feeling reluctant to place an UVC or IO access, the latter only being taken into consideration in term infants.

Conclusions: UVC placement in the DR is rated more often difficult to use by non-neonatologists than by neonatologists, apparently related to lack of experience. IO access was only considered for resuscitating term infants due to lacking practice and missing approval for birth weights < 3000 g. Frequent training might improve these clinical skills.

Keywords: Delivery room, Resuscitation, UVC placement, Intraosseous access, Venous access

Background

In the crucial first postnatal minutes the establishment of a venous access is essential especially in very premature infants and term newborns with circulatory compromise. This, however, may be challenging and time consuming [1] and untreated arterial hypotension or persistent bradycardia may ensue [2]. The 2015 ERC

(European Resuscitation Council) guidelines for newborn resuscitation recommend an umbilical venous catheter for the administration of drugs (UVC) [3]. However, placing an UVC might be challenging and takes longer than an intraosseous (IO) access especially for untrained personnel [4]. Moreover, UVC placement as an invasive procedure entails additional risks, e.g. thrombosis [5] and necrotizing enterocolitis (NEC) [6]. If an intravenous vascular access is unsuccessful, the IO access seem to be a good alternative during resuscitation

* Correspondence: bianca.haase@med.uni-tuebingen.de
Department of Neonatology, University Children's Hospital Tuebingen,
Calwerstraße 7, 72076 Tuebingen, Germany



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of critically ill neonates in comparison to the more sophisticated UVC placement procedure, especially for untrained personnel [7].

Therefore, IO cannulas should be available in all neonatal units and their application should be trained [8]. It is a non-natural access pathway, however, with a complication rate of 13% [9].

In order to verify whether prevailing practice during DR management corresponds to current guidelines, we developed a national online survey for healthcare professionals with different background and experience with a focus on the most commonly used access routes in a neonatal emergency setting.

Methods

Study design and consent

An anonymous web-based online survey was created using SurveyMonkey (San Mateo, USA) and circulated between 11/2018 and 1/2019 after approval by the Ethics Committee of Tuebingen University Hospital (871/2018). Since this is an anonymous data analysis of the SurveyMonkey platform, consent was given by voluntarily participation the questionnaire.

Data collection

Data were collected using a web-based survey (SurveyMonkey, San Mateo, USA), which was distributed among healthcare professionals via e-mail. While responses were anonymous, participants were asked to use an online link to receive a unique token to complete the survey, which was announced at neonatal workshops organised by the authors' institution with the request to distribute the link among colleagues. There was no financial incentive for taking part in the survey.

Questionnaire

The questionnaire consisted of 13 questions (in German) and had been validated by 10 independent physicians and 10 nurses with regard to its comprehensibility, suitability of its pre-formulated answers, and simplicity. It differentiated between routine and emergency situations during DR management. Both, UVC and IO access, were evaluated for an emergency situation in the DR; the placement of an UVC was also evaluated in a non-emergency setting in non-depressed preterm infants. Non-emergency situations are routine situations in the DR with the need of a central line for administration of glucose or medications such as caffeine in extremely preterm infants. There was no evaluation for out-of-hospital use. The questionnaire contained single choice and multiple-choice responses; for 13 questions, an option to select "others" or a free-text field was also offered (Table 1). Questions could be answered with "very easy," "easy", "difficult", "very difficult" or "impossible", but

ratings were subsequently collapsed into "(very) easy" and "(very) difficult". In order to standardize terminology, we adapted the German Level I-III system for neonatal care to the American classification. Centres were divided into tertiary-level neonatal intensive care units (NICUs) Level III centres (in Germany called 'Level I centre') and non-tertiary special care nurseries (SCNs) (in Germany classified as 'Level II and Level III units'; Table 1).

Data analysis

Responses were imported from the SurveyMonkey database to SPSS version 25 (IBM, Chicago, IL). Descriptive statistics were generated for key variables including educational degrees of healthcare professionals, NICU level and annual number of deliveries. Categorical data were summarized and shown as counts and percentages. Ordinal data were analysed using Mann-Whitney U-test. A *p*-value (two-sided) of < 0.05 was considered to represent statistical significance.

Results

We received 502 completed questionnaires, including 152 (30%) from neonatologists (Table 2). 395 respondents (79%) worked in tertiary-level NICUs, the remainder in non-tertiary SCNs. Approximately one half (54%) worked in hospitals with ≥ 2000 deliveries per year. 321 respondents (64%) indicated that they had at least three years of work experience in neonatology.

50% of respondents stated they had never applied an IOC by themselves and 30% had no previous experience in establishing an UVC access.

In agreement with the above guidelines, for DR management 61% of neonatologists vs. 53% of non-neonatologists were in favour of UVC placement instead of an IO access for the resuscitation of a term newborn. In tertiary-level NICUs vs. non-tertiary SCNs, 57% vs. 50%, respectively, of respondents preferred an UVC placement in the DR.

While evaluating emergency UVC placement in the DR, almost 90% of non-neonatologists or respondents working in non-tertiary SCNs rated the procedure as (very) difficult to impossible, and even 60% of experienced neonatologists or respondents from tertiary-level NICUs considered it (very) difficult to impossible ($p < 0.05$) (Fig. 1). In all responses, lack of experience was cited as the main reason for a reluctance to place an UVC (53%).

Emergency application of an IO access (Fig. 2) in the DR was rated (very) easy by 72% of neonatologists vs. 65% of non-neonatologists, although 50% had no previous real-life experience with it, with this proportion being similar in tertiary-level NICUs versus non-tertiary SCNs. Reasons given for preference of an UVC over

Table 1 Questions of the online survey

1. PERSONAL DATA		
1.1 Professional group you belong to (SC)		
a	neonatal nurses (non-neonatologists)	b residents (non-neonatologists)
c	fellows (non-neonatologists)	d senior physicians (neonatologists)
e	head of the neonatal department (neonatologist)	
1.2 Your professional experience in years (SC)		
a	0–3 years	b 3–7 years
c	more than 7 years	d others (please specify)
1.3 Your hospital's NICU level of care (based on the German G-BA nomenclature) (SC)		
a	Level I (equivalent to tertiary unites); admitting all infants	
b	Level II; admitting infants with a birthweight of > 1250 g or > 29 wk gestation	
c	Level III (equivalent to international NICU level I); admitting infants > 1500 g or > 32 wk gestation	
1.4 Number of deliveries per year in your hospital (SC)		
a	< 1000	b 1000–2000
c	> 2000	d others (please specify)
2. CONVENTIONAL PLACEMENT OF AN UVC		
2.1 How many UVC have you placed successfully? (SC)		
a	0	b 1–5
c	more than 5	
2.2 On a scale of 1–5, how do you rate the feasibility of UVC insertion in a routine non-emergency setting in the DR? (SC)		
a	very simple	b simple
c	difficult	d very difficult
e	impossible	
2.3 On a scale of 1–5, how do you rate the feasibility of UVC insertion in an emergency setting in the delivery room? (SC)		
a	very simple	b simple
c	difficult	d very difficult
e	impossible	
2.4 What do you think are the most common problems during an UVC placement? (MC)?		
a	time delay	b catheter malposition
c	manpower (human resources)	d lack of experience
e	others (please specify)	
3. INTRAOSSEOUS CANNULA (IOC) (SC)		
3.1 How many IOC have you performed successfully?		
a	0	b 1–5
c	more than 5	
3.2 On a scale of 1–5, how would you rate the feasibility of inserting an IOC in an emergency situation in the DR? (SC)		
a	very simple	b simple
c	difficult	d very difficult
e	impossible	
3.3 What do you think is(are) the most common problem(s) during IOC insertion? (MC)		
a	causing Pain	b potential for bone injury
c	extravasate	d malposition
e	lack of experience	f others (please specify)

Table 1 Questions of the online survey (Continued)

1.	PERSONAL DATA		
4.	PREVAILING PRACTICE		
4.1	In an emergency situation in the delivery room, which access route would you consider for a newborn weighing 4000 g (with pronounced centralisation)? (SC)		
a	UVC	b	IOC
4.2	For the initial delivery room treatment of a 500 g premature baby, which access route would you prefer (after failed placement of a peripheral venous line)? (SC)		
a	UVC	b	IOC

Answers possible as MC Multiple Choice, SC Single Choice and free answering fields if named: Others (please specify)

IOC included avoidance of pain (24%), a potential for bone injury (32%), catheter malposition (40%) or lack of experience (56%).

In a non-emergency setting in the DR, UVC placement was evaluated to obtain a basic assessment of this procedure. 70% of responding neonatologists respectively 66% of respondents from tertiary centres rated the application of routine UVC placement as (very) easy, whereas only 43% of non-neonatologists ($p < 0.05$; Fig. 3), respectively 32% of non-tertiary centres, rated it as very easy (data not shown).

Discussion

To our knowledge, this is the first national survey evaluating current opinions of healthcare professionals in Germany regarding placement of an UVC or IO access in an emergency setting in the DR. In accordance with current guidelines, responders preferred an UVC over IO access during transition at birth.

Only a narrow majority of 60% was in favour of an UVC in emergency situations in the DR, which could be due to the fact that establishing an IO access was classified as (very) easy by 67% of respondents, even though only 50% had ever implemented one themselves.

Respondents to our survey rated the level of difficulty according to their own level of training and experience, which might be a reason why, contrary to current

recommendations, with less experience the affinity to IO access increased. While many extremely preterm infants born in tertiary centres need a central venous line access during their subsequent neonatal intensive care [10], the UVC is often placed either in the delivery room or shortly afterwards in the NICU [11], as it provides a painless and reliable vascular access for preterm infants avoiding the skin punctures needed for other forms of vascular access [12].

However, as long as the UVC remains the recommend access in DR management in international guidelines [3] and as long as there is a lack of a device that simplifies the inserting procedure, consistent training should be enforced [4].

An umbilical cord simulator may offer a realistic training with real human cords [13] and should be preferred to manikins with an artificial and more unrealistic umbilical cord [14].

Another reason for placing an UVC is that high plasma levels of epinephrine can be reached faster and more reliably via a centrally positioned UVC than via the endotracheal route [15] and, according to the 2015 ERC Guidelines, drugs should be applied this way [3]. It remains unclear whether the same is true for an IO access [16]. Initial studies (excluding neonatal patients) showed no significant interaction between the access route and study drug outcomes [16]. However, IO access in neonates has not yet been investigated in detail, only case series, post-mortem studies and simulation studies could be identified and showed a lack of evidence in this patient group [8].

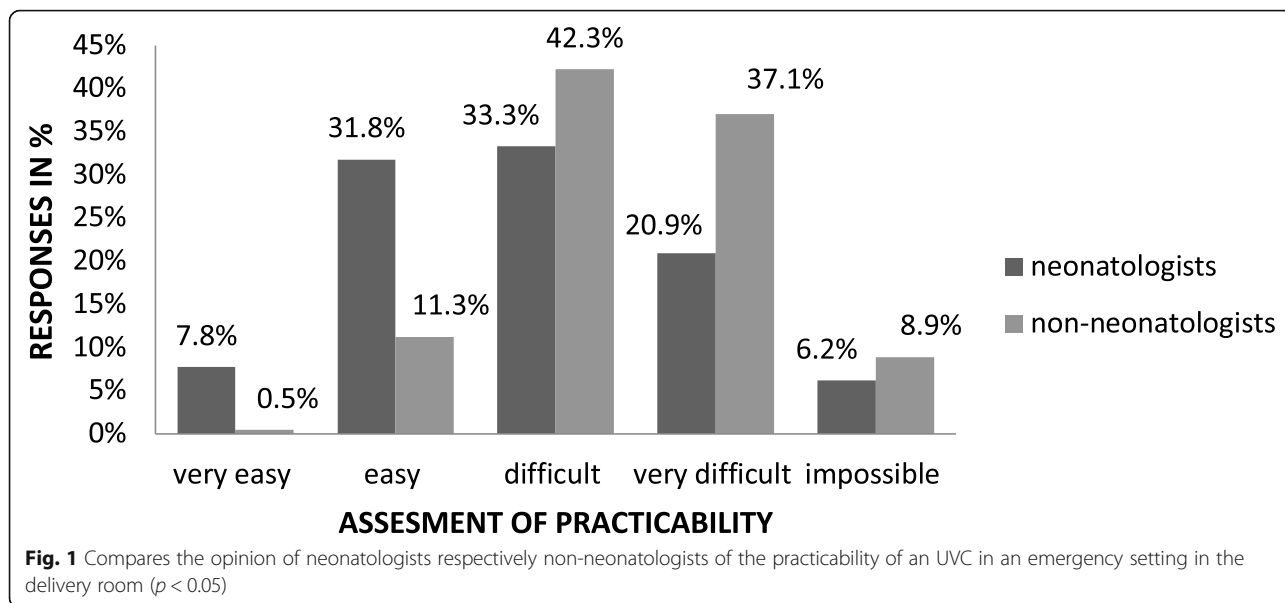
However, successful placement of an UVC took 46 s longer than application of an IO access in a simulation study [17]. In an emergency situation in the DR, this delay may be responsible for the increasing preference of an IO access during the resuscitation of term neonates, as confirmed by our survey. Therefore, such IO access should be available, trained and taken into consideration on all neonatal units if other access routes have failed [18].

Previous experience with IO access significantly reduced reluctance and increased the willingness to use an IO access as the first choice for emergency vascular access [19].

Table 2 Respondents of the online survey

Survey consisting of 13 questions; respondents 502	
Neonatologists	n = 152 (30.3%)
Non-neonatologists consisting of:	n = 350 (69.7%)
Residents	n = 145 (28.9%)
Fellows	n = 99 (19.7%)
Neonatal nurses	n = 106 (21.1%)
Respondents working in Level III centres (German called NICU level I)	n = 395 (78.8%)
Respondents working in Level II centres (German NICU level II)	n = 60 (12%)
Respondents working in Level I centres (German NICU level III)	n = 47 (9.4%)

Data are displayed as counts and percentages. NICU Neonatal Intensive Care Unit

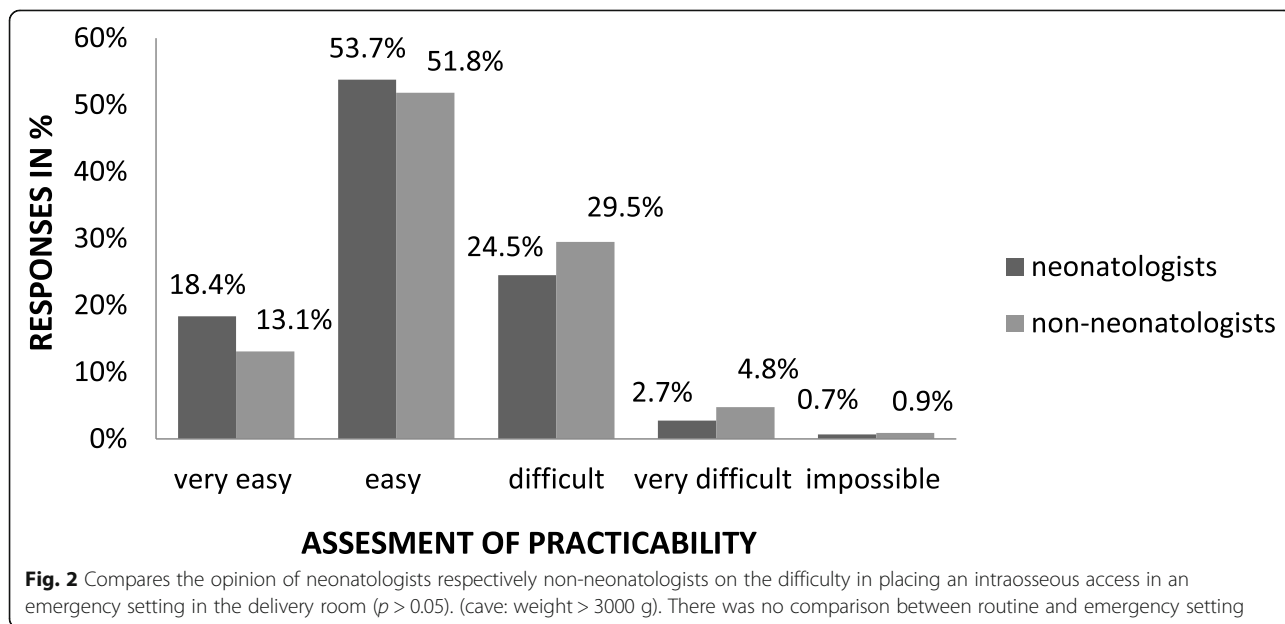


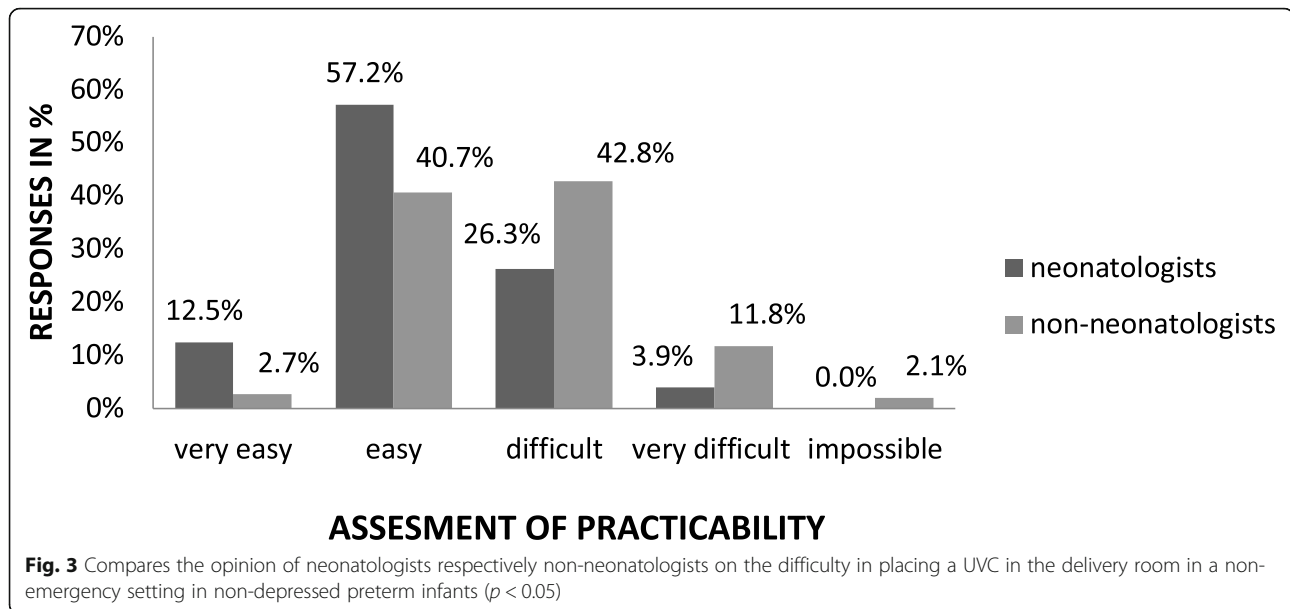
Besides that, the IO access is a non-natural access route with a complication rate of 13% [9] such as fractures, limb ischaemia and need for amputation [20, 21]. The complications are higher in smaller infants due to the small margin of error when inserting an IO device [22]. The “risk of a bone injury” and “causing pain” were the main reasons cited in our survey why respondents would not apply an IO access.

A recent trial in 16 stillborns showed success rates in newborns between 40% and 60%, depending on the needle used [22]. However, checking the correct position of an IO access with a CT-scan is difficult to accomplish during neonatal resuscitation.

Moreover, a major problem of UVC placement is malposition, which is associated with a higher risk of thrombosis [5] and NEC [6]. In our survey, a risk of malposition was mentioned 72 times in the free-text option when respondents were asked to mention most common problems during UVC insertion.

This leads to the first limitation of our study: only few multiple-choice responses were used, thus “malposition” was not offered as a response. Furthermore, we did not compare blunt hollow cannulas with umbilical venous catheters, this might have been interesting especially in the context of resuscitation in the DR.





Additionally, we included fewer open questions to minimize the risk of having a low participation rate.

Another limitation is that distribution of the questionnaire was random and therefore not all neonatal centres might have been reached. This was due to the fact that there is no general email list for specified healthcare professionals in neonatology, which may have introduced a selection bias. In addition to that, GDPR (General Data Protection Regulation) rules dictated anonymity of the e-mail responses received, prohibiting us from gathering data on the number of participants and refusals to participation.

Nevertheless, a strength of our study is a high number of respondents during the 3-month period so that we can still present a broad picture of opinions.

Conclusions

UVC placement in an emergency setting in the DR was rated more difficult by non-neonatologists compared to neonatologists in this German online survey, mainly due to the perceived difficulties in performing an UVC placement and lack of experience; both of which can only be improved by frequent training until there is a device that simplifies the sophisticated and challenging process of placing a UVC.

For this reason, inserting an IO access, which is much easier to accomplish, may continue to be justified during resuscitation of term neonates and should be trained and available in all neonatal units.

Abbreviations

CT-scan: Computer Tomography Scan; DR: Delivery room; ERC: European Resuscitation Council; GDPR: General Data Protection Regulation; ILCOR: International Liaison Committee on Resuscitation;

IO: Intraosseous; NEC: Necrotizing enterocolitis; NICU: Neonatal intensive care unit; SCN: Special Care Nursery; UVC: Umbilical venous catheter

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Not applicable.

Authors' contributions

BH conceived the study idea, created the online survey, collected and analysed the data and wrote the first draft of the manuscript. CFP and LS revised the manuscript for important intellectual input. All authors participated in critical revision of the manuscript for important intellectual content. All authors approved the final manuscript as submitted and agree to be accountable for all aspects to the work.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The research was conducted ethically in accordance with the World Medical Association Declaration of Helsinki. Since this is an anonymous data analysis of the SurveyMonkey platform, consent was given by voluntarily participation the questionnaire. The study was approved by the institutional Ethics Committee of the University of Tübingen (approval number: 871/2018).

Consent for publication

Not applicable.

Competing interests

BH is founder of Neotools (neotools GmbH, Erkelenz, Germany). The other authors have no conflicts to declare.

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