Available online at www.sciencedirect.com

Resuscitation Plus

journal homepage: www.journals.elsevier.com/resuscitation-plus

Pediatric intravascular access in simulated COVID-19 patients among paramedics wearing personal protective equipment

To the Editor,

We read article written by Perkins et al.[1] with great interest. In those article authors show present suggestions for how the risk of transmission by and to medical staff can be minimized and how personal protective equipment policies relate to COVID-19 pandemic context. It is worth emphasizing that, as many authors show, medical procedures in the case of patients with suspected/confirmed SARS-CoV-2 infection should be performed by medical personnel wearing full personal protective equipment (PPE) for aerosol generating procedures (AGPs).[2] However, the use of PPE-AGP may reduce the effectiveness of the procedures performed, both to extend the duration of these procedures and reducing their effectiveness. This applies too many medical procedures, including securing the airways, chest compression, or gaining intravascular access.[3] Vascular access is one of the key elements of managing a patient in a life-threatening condition. However, with hypovolemic shock or cardiac arrest, when the vascular placenta is collapsed, rapid peripheral intravenous access (PIV) is often difficult or even impossible to achieve. As showed by the studies conducted so far, relating mainly to the aspect of PIV access in adults when using PPE-AGP, the use of PPE-AGP significantly prolongs the duration of the procedure while reducing its effectiveness[4,5]

The aim of this study was to compare the effectiveness of intravascular access in a pediatric patient by medical personnel wearing PPE-AGP. The study was designed as a prospective, randomized, crossover, single-blinded simulation trial. The study protocol was approved by the Institutional Review Board of the Polish Society of Disaster Medicine (Approval no: 17.01.2020.IRB). We conducted this study between January and February 2020. 43 paramedics took part in the study. We got voluntary informed consent from each participant. None of the participants had experience with intravascular access with PPE-AGP conditions. Before starting the study, participants took part in a 30-minute training course covering the correct donning and doffing of the PPE-AGP suit, and training in the correct intraosseous access using NIO-Pediatric, EZ-IO and Jamshidi.

In order to simulate a pediatric patient requiring IO access, a 5-year-old child simulator (Pediatric HAL® S3005; Gaumard Scientific, Miami, FL, USA) was used, which was placed on a standard transport stretcher. To simulate proper actions against a SARS-CoV-2 patient, the participants additionally wore a protective mask with FFP3 filter, protective goggles and a face shield and double nitrile gloves. During the study, we tasked participants with accessing the child's IO using the NIO-Pediatric (NIO-P; PersysMedical, Huston, TX, USA), EZ-IO (EZ-IO; Teleflex, Wayne, PE, USA) and Jamshidi needle (JHN; BD, Franklin Lakes, NJ, USA). As a control method, access to the veins in the elbow flexion was performed using a standard 20G intravenous cannula. Both the order of participants and the research methods were random.

Data are presented as number (percentage) or median [interquartile range (IQR)]. The Kolmogorov-Smirnov test confirmed the occurrence of normal distribution. Categorical data are presented as raw numbers and frequencies, and continuous and ordinal data are presented as medians and interquartile ranges (IQR). The Friedman test was used for the intra-group analysis, and the Wilcoxon signed-rank test for the pair-wise comparison. A p value less than 0.05 was considered statistically significant and the significance level was adjusted using the Bonferroni correction for multiple comparisons for the post hoc analysis. A p-value of less than 0.05 was considered statistically significant.

A total of 43 paramedics (11 females, 25.6%) participated in the study. Their median age was 31 (IQR, 25−33.5) years, and mean work experience time was 4.7 (IQR, 3−7) years. The time of obtaining intravascular access using the methods tested was varied and amounted to 75 (55−96) s for PIV, 11 (10−16) s for NIO-P, 19.5 (15−27) s for EZ-IO and 22 (17−38) s for JHN. In turn, time to connect infusion line and start infusion varied and amounted to 103 (87−145) s vs. 28 (25−36.5) s vs. 33 (28−42) s vs. 33 (32−52) pp. The vascular access efficiency in NIO-P and EZ-IO was 100%. In the case of JHN, the effectiveness of the first attempt was 51.2%, and 76.7% with PIV (Table 1).

With PIV, ineffective access attempts (n=11; 25.6%) were caused by perforation of the blood vessel through the hole. In 21 JHN access cases, a bent needle was observed that prevented IO access. According to study participants, most participants would choose NIO-P as their preferred method of obtaining intravascular access (n=27; 62.8%). Detailed comparisons between individual groups are presented in Supplementary Table 1.

The study has certain limitations. The first limitation is to conduct the study in simulated conditions; however, only medical simulation allows for full standardization of the conditions of medical procedures performed, and this type of study allows for safe

Table 1 – Parameters of intravascular access methods.

Parameter	PIV	NIO-P	EZ-IO	JHN	P-value
Time of intravascular access	75 (55–96)	11 (10–16)	19.5 (15–27)	22 (17–38)	<0.001
Time to start fluid infusion	103 (87–145)	28 (25–36.5)	33 (28–42)	33 (32–52)	<0.001
Success of first attempt	33 (76.7%)	43 (100%)	43 (100%)	22 (51.2%)	<0.001
Preferences of reuse in clinical conditions	0 (0%)	27 (62.8%)	16 (37.2%)	0 (0%)	<0.001

conduct of the study during the SARS-CoV-2 pandemic. The second study is to limit the study to paramedics, however, reactive, often it is this group that is forced to perform life-saving procedures using PPE-AGP. After the pandemic has resolved, studies involving other health professionals are also planned.

In conclusion, in simulated COVID-19 pediatric patient scenario, the use of NIO-P and EZ-IO IOs was associated with the highest efficiency of the first intravascular access attempt, and the shortest procedure times compared to PIV and JHN. It is necessary to perform clinical tests to confirm the got results.

Conflict of interest

The authors declare that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.resplu.2020.100073.

REFERENCES

1. Perkins GD, Morley PT, Nolan JN, et al. International Liaison Committee on Resuscitation: COVID-19 consensus on science, treatment recommendations and task force insights. Resuscitation 2020;151:145–7, doi:http://dx.doi.org/10.1016/j.resuscitation.2020.04.035.
2. Szarpak L, Ruetzler K, Dabrowski M, et al. Dilemmas in resuscitation of COVID-19 patients based on current evidence. Cardiol J 2020;27(3):327–8, doi:http://dx.doi.org/10.5603/CJ.a2020.0066.
3. Malysz M, Dabrowski M, Böttiger BW, et al. Resuscitation of the patient with suspected/confirmed COVID-19 when wearing personal protective equipment: A randomized multicenter crossover simulation trial. Cardiol J 2020;27(5):497–506, doi:http://dx.doi.org/10.5603/CJ.a2020.0068.
4. Smereka J, Szarpak L, Filipiak KJ, Jaguszewski M, Ladny JR. Which intravascular access should we use in patients with suspected/confirmed COVID-19? Resuscitation 2020;151:8–9, doi:http://dx.doi.org/10.1016/j.resuscitation.2020.04.014.
5. Lamhaut L, Dagron C, Apriotesei R. Comparison of intravenous and intraosseous access by pre-hospital medical emergency personnel with and without CBRN protective equipment. Resuscitation 2010;81(1):65–8, doi:http://dx.doi.org/10.1016/j.resuscitation.2009.09.011.

Kurt Ruetzler
Departments of General Anesthesiology and Outcomes Research, Anesthesiology Institute, Cleveland Clinic, Cleveland, OH, US

Anna Drozd
Polish Society of Disaster Medicine, Warsaw, Poland

Aleksandra Gasecka
Laboratory of Experimental Clinical Chemistry, Amsterdam University Medical Center, Amsterdam, The Netherlands

Karol Bielski
Polish Society of Disaster Medicine, Warsaw, Poland

Wojciech Wieczorek[a,b]
[a]*Polish Society of Disaster Medicine, Warsaw, Poland*

[b]*Department of Emergency Medicine, Warsaw Medical University, Warsaw, Poland*

Mahdi Al-Jeabory
Polish Society of Disaster Medicine, Warsaw, Poland

Jacek Hernik
Maria Sklodowska-Curie Medical Academy in Warsaw, Warsaw, Poland

Lukasz Szarpak[a,b,*]
[a]*Polish Society of Disaster Medicine, Warsaw, Poland*

[b]*Maria Sklodowska-Curie Bialystok Oncology Center, Bialystok, Poland*

* Corresponding author at: Maria Sklodowska-Curie Bialystok Oncology Center, Ogrodowa 12 Str., 15-027 Bialystok, Poland.
E-mail address: lukasz.szarpak@gmail.com (L. Szarpak).

Received 14 December 2020

http://dx.doi.org/10.1016/j.resplu.2020.100073