

Long peripheral cannula in COVID-19 patients: 769 catheter days experience from a semi-intensive respiratory COVID unit

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Emanuele Gilardi¹ , Tommaso Grandi¹, Rosangela Giannuzzi³, Fabio Valletta¹, Solange Fugger¹, Silvia Mazzaroppi¹, Martina Petrucci², Alfonso Piano² , Andrea Piccioni², Kidane WoldeSellasie², Federica Sambuco¹ and Francesco Travaglino¹ 

Abstract

Background: In the daily management of peripheral venous access, the health emergency linked to the COVID-19 pandemic led to re-examining the criteria for choosing, positioning and maintaining the different types of peripheral venous access.

Objectives: This study aimed to observe the dwell time of long peripheral cannula (LPC, also known as *mini-midline*) in patients affected by COVID 19 related pneumonia. The secondary objective is to study any complications due to mini-midline insertion.

Materials and methods: We conducted a prospective observational study on COVID19 patients who arrived at our Semi-Intensive Respiratory Unit from territorial ED between January and April 2021, to whom were positioned an LPC at the time of admission following the SIPUA protocol (Safe Insertion of Peripheral Ultrasound-guided Access). We used Vygon™ Leader-Cath® 18G in polyethylene and 8 cm long catheter.

Results: We enrolled 53 consecutive patients, reaching 769 catheter days. The procedure was performed without immediate complications in 37 patients out of 53 (69.8%). In 14 patients (26.4%), we observed a local hematoma (no one led to a failure or early removal of the device) and in two patients (3.7%) was not possible to draw blood. The average catheter dwell time was 14.5 days, from 3 to 41 days. In 42 patients (79.2%), the device was removed at the end of use. In 11 patients out of 53 (20.8%), the device was removed early due to complications: seven accidental removals, one obstruction, two vein thrombosis, and one superficial thrombophlebitis.

Conclusions: The ultrasound-guided implantation of an 18G LPC in COVID19 patients, regardless of the state of their venous heritage, would seem to be an excellent strategy for these patients, reducing the number of venipunctures and CVC implantation, as well as allowing multiple and high pressure (contrast) infusions.

Keywords

Mini-midline, long peripheral cannula, COVID19, SIPUA protocol, peripheral vascular access, ultrasound-guided vascular access, semi-intensive respiratory unit

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¹Emergency Medicine Department, Semi-Intensive Respiratory Covid Unit - Campus Covid Center, Policlinico Universitario Campus Bio-Medico di Roma, Rome, Italy

²Emergency Medicine Department, Fondazione Policlinico Universitario "A. Gemelli" - IRCCS, Rome, Italy

³Emergency Medicine Department, IRCCS Fondazione Sant'Orsola, Bologna, Italy

Corresponding author:

Emanuele Gilardi, Emergency Medicine Department, Semi-Intensive Respiratory Covid Unit - Campus Covid Center, L'Argo Gemelli 8, Rome, Lazio 00128, Italy.

Email: emanuele.gilardi@outlook.com

Table 1. SIPUA protocol (SIPUA: Safe Insertion of Peripheral Ultrasound-Guided Access).

0. Preparation for the procedure: space, time, and necessary
1. Hand washing, aseptic technique, and protective equipment
2. Ultrasound exploration of arm veins before the procedure
3. Choice of the most suitable vein
4. Ultrasound detection of median nerve and brachial artery before venipuncture
5. Ultrasound venepuncture
6. Blood samples and lock with saline of long cannula
7. Catheter fixing with suture-less device
8. Documentation and information

Source: Modified with permission of authors from "Gilardi E. et al. Mini-midline in difficult intravenous access patients in emergency department: A prospective analysis. *The Journal of Vascular Access*. 2020;21(4):449–455."

Introduction

The health emergency linked to the COVID-19 pandemic has led to a series of dramatic changes in clinical practice, requiring the revision of many decision-making processes, the reorganization of care units, and the reformulation of protocols and procedures. In this regard, in the daily management of peripheral venous access, essential for the appropriate treatment of COVID-19 patients in the light of the latest therapeutic evidence, it was necessary to re-examine the criteria for choosing, positioning, and maintaining the different types of peripheral venous access.^{1–4}

One of the main complications of SARS-CoV-2 infection is the occurrence of an alteration of the hemostatic mechanisms capable of inducing hypercoagulability, mainly related to the negative outcome of COVID-19 patients.^{6,7} Changes in hemostatic biomarkers, represented by the increase in D-dimer and fibrin/fibrinogen breakdown products, indicate that the essence of coagulopathy is massive fibrin formation, which is significantly more altered in non-COVID-19 patients non-survivors versus survivors.⁸ As a demonstration of it, especially in these patients, small venous accesses show a higher percentage of thrombotic complications. That's why, for the need for hydration and IV therapies, these patients require a long-lasting, safe and stable venous access, considering the high rate of bleeding of this new pathology not yet fully known.

Based on our recent experience with the treatment of these patients, it was necessary to follow a standardized protocol to simultaneously take into account the need to protect the operator by avoiding repeated attempts, to ensure the effectiveness of the maneuver, to reduce the risk of complications and discomfort for the patient, and not least of preventing a waste of resources and time.

In our department, since the opening of the COVID Center in April 2020, personal experience has shown us that the traditional peripheral venous accesses, in our private COVID patients case studies, were burdened by a high rate of displacement, occlusions, extravasation and therefore repeated replacements. For this reason, as the days went by and the staff's experience increased, we thought to insert

ultrasound-guided venous access to all patients admitted to the COVID Semi-Intensive Care Unit, not only to DiVA (difficult intravenous access) patients. We refer to *long peripheral cannulas (LPC)*, also known as *mini-midline*, intermediate-length peripheral cannulas between the traditional short cannulas for peripheral venous cannulation (3.5–5.2 cm) and the "standard" midline (15–25 cm). As already demonstrated,⁵ using a coded protocol such as *SIPUA* (Safe Insertion of Peripheral Ultrasound-guided Access - in Italian *ISAPE*) has proven valid in reducing the number of venipunctures increasing the comfort of patients and healthcare professionals. *LPC* was chosen rather than a midline or a central line based on *DAV-Expert*, a *GAVeCeLT* algorithm for the insertion of venous accesses.¹⁶

The study aims to observe the dwell time of the LPC positioned with the SIPUA protocol in patients affected by COVID-19 related pneumonia, in order to evaluate the effectiveness of the device.

The secondary objective is to study any complications due to LPC insertion. Immediate complications are failure of venipuncture or multiple venipunctures, difficulty in the progression of the wire or catheter, and local hematoma. Late complications are accidental removal, infections, vascular thrombosis, blood or drug extravasation, obstruction, or malfunction.

Materials and methods

Study design

We conducted a prospective observational study on COVID19 patients who arrived at our Semi-Intensive Respiratory Unit from territorial ED between January and April 2021. We positioned an LPC at the time of admission. We enrolled all consecutively admitted patients, inserting an LPC following the *SIPUA protocol* as already described elsewhere and shown below (see Table 1 for details), both in DiVA and not-DiVA patients. We based this choice on the familiarity with the protocol due to personal experience, and at the same time, the need to standardize the positioning of the device.

Table 2. Characteristics of the sample.

	Mean (\pm StDev)	Median (IQR)	Min-max
Gender (male)	37 (63.9%)		
Age	71.1 (\pm 12.5)	74 (62–81)	41–91
Duration of preparation (minutes)	5.42 (\pm 2.33)	5 (4–6)	1–11
Duration of procedure (minutes)	12.1 (\pm 3.6)	11 (9.5–15)	7–20
Length of device staying	14.5 (\pm 9.2)	13 (6–20)	3–41
Vein gage (mm)	4.5 (\pm 0.9)	4 (4–5)	2.4–7
Vein depth (mm)	10.4 (\pm 3.8)	10 (7.25–12)	5–20

Inclusion and exclusion criteria

The study *inclusion* criteria were: (a) admission diagnosis of “acute respiratory failure due to interstitial pneumonia from SARS-CoV-2 infection”; (b) age over 18; (b) patient expressed informed consent to the study.

We *excluded* from the study: (a) patients with an LPC or other valid vascular device inserted in ED; (b) patients with a long term vascular device or the need to immediately place a CVC at admission; (c) patients with hemodynamic instability.

Long peripheral cannula placement procedure

We used *Vygon*TM Leader-Cath© 18G polyethylene 8cm long catheter. Catheters are secured with Grip-Lok® and Histoacryl® glue at the exit site to fix the catheter and reduce possible contamination.⁹ For LPC placement, the staff followed the *SIPUA protocol*, a protocol born in an emergency setting and composed of nine points summarized in Table 1.

Variables in analysis

The variables analyzed in the study are age, gender, the total device dwell time, preparation time for the procedure, the execution time of the maneuver (from point 4 to point 7 of *SIPUA protocol*), vein choice, depth and diameter of the chosen vein, percentage of successful insertion, and immediate and late complications.

Ethical statement

The study was approved by the hospital’s Ethics Committee (N. 2021.70; MM-COVID19). As per all procedures, patients expressed verbal informed consent reported in medical records and, at admission, patients expressed informed consent to the study.

Results

Of 64 consecutive patients admitted with a diagnosis of *Interstitial Pneumonia Sars-CoV-2 related*, five were excluded for the previous insertion of vascular device in

Table 3. Main statistics.

Num.	%	
Preferred vein		
13	24.5	Right Basilica
11	20.8	Left Basilica
11	20.8	Left Cephalic
10	18.9	Right Cephalic
4	7.5	Left Brachial
3	5.7	Right Brachial
1	1.9	Median antibrachial vein
Immediate complications		
37	69.8	No immediate complications
14	26.4	Hematoma
2	3.7	Difficult in aspiration
Late complications		
30	56.6	Difficult in aspiration
7	13.2	Accidental Removal
5	9.4	Venous Thrombosis
1	1.9	Local Infection
2	3.8	Obstruction
Device removal		
11	20.8	Early removal for complications
42	79.2	End of use
5 of 42		Shift to CVC
1 of 42		Discharged home

ED, three for having a long term vascular device, and three for hemodynamic instability. Finally, 53 consecutive patients were enrolled, 37 (63.9%) of whom were males. The main characteristics of the sample are resumed in Table 2. Table 3 illustrates the results.

Primary end-points

A total of 769 catheter days were reached. The average device dwell time was 14.5 days, from a minimum of 3 days to a maximum of 41 days. In most cases, the device was removed at the end of use (42 patients, 79.2%); in five of them, it was necessary to shift to a CVC, and these were considered “end of use.” In three of these five patients, LPC was used to pass the guidewire through to insert a PICC, without a new venipuncture. In one of these 42

patients, the device was left on site after discharge to a retirement house; it reached the end of use without complications after a few days. In 11 patients out of 53 (20.8%), the device was removed early due to late complications.

Secondary end-points

Insertion was successful in 52 patients (98%); in only one patient of 53 was not possible to find an appropriate site to place the LPC on admission, so the patient maintained her two venous accesses for hydration and therapy for a few hours. Then it was possible to place an LPC in the brachial vein after two attempts. In 11 patients (5.8%) it took two attempts to place the catheter.

The preferred vein for cannulation has been the right basilic vein, followed by the left basilic and cephalic veins. The vein caliber in the majority of cases was 4.5 mm (from 2.4 to 7 mm), and the average depth was 10.4 mm (from 5 to 20 mm). The average duration of procedure performance (from point 4 to point 7 of the SIPUA protocol) was 12.1 min (7–20 min). In 37/53 patients (69.8%), the procedure was performed without immediate complications. The main immediate complication in 14 patients (26.4%) was a local hematoma, but no one led to the device's failure or early removal. In two patients (3.7%), we could not draw blood, maybe due to the small caliber of the vessel. However, the catheter was left in place for infusion.

About the late complications of the devices we implanted, we have recorded five episodes of vascular thrombosis, three of which led to the need to remove the device for occlusion of the vessel, seven accidental removals and one obstruction. One of the three venous thromboses was associated with exit-site pain and erythema, so the catheter was removed for the suspicion of superficial thrombophlebitis (a cephalic vein in all three cases reported). Three of the seven accidental removals occurred during dressing changes, and the other four occurred accidentally by the patient.

Discussion

The positioning of an ultrasound-guided peripheral venous access is now a proven valid aid in DiVA patients in emergency conditions.¹⁰ However, even in ordinary wards and departments where prolonged hospitalization with repeated infusions is expected, stable, and long-lasting peripheral access could be the right choice. This is even more valid in situations where contact with the patient is limited and complicated by safety procedures and the use of non-ordinary personal protective equipment. The longer dwell time than traditional venous access reduces the number of peripheral venous insertions required (thus saving resources and reducing risks for the operator), as indicated by the GAVeCeLT Working Group for Vascular Access in COVID-19.¹¹ Since, in our case series, a semi-intensive

care hospitalization lasts about 10–15 days, some patients have taken advantage of the positioning of a single LPC during the entire hospitalization for its versatility.

Unfortunately, an adverse finding was the impossibility of carrying out prolonged blood samples for the entire duration of the LPC. Since not all patients underwent blood tests drawing every day and, in some cases, these samples were taken from the arterial cannula, it was not possible to correctly determine how long after the catheter insertion it was no longer able to “supply” blood while being able to infuse therapies and fluids, also allowing high flow infusions. In our experience, this “phenomenon” occurred about a week after positioning, and we found a slightly longer duration (in any case never more than 10 days) in patients on anticoagulant therapy at therapeutic dosage (generally LMWH 100 mg/kg × 2 or fondaparinux 7.5 or 10 mg once daily). However, it seems necessary to emphasize that, if repeated and daily blood tests are required, an LPC is not the most suitable device of choice, and it is essential to resort to other and more specific devices (e.g. Midlines).

The results show that in 26.4% of patients (14 out of 53), a local hematoma occurred as an immediate complication, which never affected the catheter's life in place. Being true that the implanter's experience is fundamental for reducing complications, it must be said that all patients were treated with anticoagulant therapy according to the latest guidelines on COVID19 therapy.¹² However, 13 of the 14 patients and 9 of the other 39 patients were under anticoagulant therapy at a therapeutic dose (with DOACs or LMWH) with or without antiplatelet therapy. Obviously, given that the procedure was carried out not in urgency and even less frequently in an emergency setting, an excellent way to proceed could be to “schedule” the positioning of an LPC before administering the anticoagulant drug or, possibly, skipping an administration in case of complicated procedure.

On the other hand, it must be said that five out of 53 patients presented a local thrombosis despite an uncomplicated procedure and the anticoagulation (of these, two patients were on therapy with LMWH at therapeutic dosage while the others three with prophylactic-dosed LMWH). We referred this more to the critical thrombophilia of the COVID19 rather than to an incorrect procedure, as none of these patients infused drugs unsuitable for a peripheral catheter, and no immediate complications were reported during these procedures. However, it must be borne in mind that a not negligible venous traumatism occurs whenever a syringe or an infusion or withdrawal system is connected directly to the LPC; this is due to the small and repeated stresses from natural movements made on the extremity of the LPC a few millimeters away from the exit-site. In these cases, maybe, the regular use of an extension tube connected to the LPC could reduce venous traumatism as the “maneuvers” are performed far from the

exit-site, and the terminal end of the catheter is more stable. It should also be noted that, of the remaining 48 patients, 11 were subjected to infusion of drugs such as amiodarone, azithromycin, ceftriaxone or meropenem, for 3–5 days, without developing damage to the venous axis. In three of these patients, given the prolongation of therapy with drugs not suitable for peripheral venous access, the same LPC was used as a “guide” for positioning a PICC without proceeding with further venipuncture, saving the patient and the operator from the procedure.

Moreover, concerns have recently arisen regarding the possibility of axillary vein thrombosis in patients receiving non-invasive ventilation using Helmet straps attached to the armpits.¹³ This event did not occur in our series since our Helmets are fixed with a pneumatic “donut” at the neck without straps.

The last remark concerns the duration of the procedure. The use of “bulky” personal protective equipment (PPE) imposed by the pandemic could have been, from the unique experience of the operators, the cause of a slightly longer procedure time than usual, as well as the cause of the difficulty of the dressing change that led to some accidental removals.

Some colleagues highlighted how, given the clinical profile of these patients and based on more recently published recommendations,¹⁴ a midline-type venous catheter could be a more appropriate choice than an LPC. However, assuming that there is no such thing as “perfect venous access” and that each patient may need different devices during their hospital stay, some considerations are appropriate. First of all, the clinical profile of these patients was not known in the early stages of the pandemic, as paucisymptomatic patients could remain stable for days or become critically ill during hospitalization; in these situations, a versatile and easily implantable venous access is for us the first choice as in all emergency situations, both clinical and logistical. Moreover, an average “expected” stay of no more than 2 weeks makes it excellent at the beginning to use an LPC rather than a midline, and this is due not only to the mere economic cost but also to the simplicity of insertion by those who wear heavy PPE, the speed with which it is possible to acquire the appropriate skills as well as the availability that each structure has of various devices. For example, in our system, while an LPC is freely available in the ward, there is a need for a specific motivated request for a midline, which makes it usually not immediately available. In addition, the midlines available to us are not power-injectable, and this is an important limitation given that all patients suffering from COVID-19 pneumonia undergo CT scans with iodinate contrast, even several times during their stay. As a final consideration, nothing prevents the same patient from being implanted with an LPC on arrival, and subsequently, due to the prolongation of the stay or the need for multiple infusions/withdrawals, a midline or PICC may be placed if needed.

Limitations

As the first limitation, the study is a single-center study based on only 53 patients.

The second significant limitation, as already reported, was the impossibility to test the LPC daily, both in aspiration and in infusion. Correct device management, particularly regarding the proper dressing procedure and the flush with SF for the “lock” of the LPC, could extend the catheter duration and the possibility of aspiration for more than 7–10 days.

Conclusions

The emergency situation that we experienced during the first waves of the COVID19 pandemic has often led us to compare official indications and guidelines with everyday clinical practice. The high number of intravenous therapies in patients with COVID19 interstitial pneumonia, as well as the need for repeated blood sampling, makes it necessary to place a stable and reliable peripheral venous access, also to be used for infusions of high pressure iodinate contrast, without forgetting that the need to wear bulky PPE for many hours can also make simple procedures, like placing a standard peripheral venous access, complicated.

In our practice, the ultrasound-guided implantation of an 18G LPC patients hospitalized for SARS-CoV-2 pneumonia, already at the time of admission to the ward and regardless of the state of their venous heritage, proved to be an excellent strategy for our patients. LPC demonstrates high versatility in all emergency conditions, clinical and logistical, able to guarantee for a long time stable and safe venous access, reducing the number of venipunctures than standard venous cannulas with savings of resources and exposure of health personnel to contagion, and sometimes avoiding CVC implantation,¹⁵ or being able to act as a safe guide for the insertion of a PICC, as well as allowing multiple and high pressure (iodinate contrast) infusions.

As far as we know, this is the first study in which the prompt positioning of a long peripheral cannula is proposed not only for DIVA patients but based on its clinical employment (e.g. duration of therapy foreseen, mean duration of hospitalization, possibility to use iodinated contrast, etc. . .). Certainly, larger studies are needed to validate their use in this and other clinical settings.

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ORCID iDs

Gilardi E  <https://orcid.org/0000-0003-0689-540X>

Piccioni A  <https://orcid.org/0000-0001-5703-8737>

Travaglino F  <https://orcid.org/0000-0001-9935-0665>

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