



## ***The Vascular Access in COVID-19 Patients***

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#### **1. Introduction**

In this historical moment, National Health Systems are dealing with an unprecedented emergency: “SARS-CoV-2” virus, also known as COVID-19<sup>1</sup>, is gradually threatening their ability to look after citizens. In order to face up this emergency, all organizations in this field and Scientific Societies should contribute to facilitate assistance. This does not include only clinical aspects, but also organization, economy, management, and ethics.

Health care workers’ (HCW) knowledge of the clinical picture and evolution of COVID-19 patients and of the techniques and instruments for their best care is a central element to involve the HCW in strategic management of treatment pathways of the organization, and it is an essential factor to guarantee high standards of care.

The aim of this paper is to supply HCW with recommendations about the correct **Vascular Access Approach**, which is necessary to assure safety to both patients and HCW and provide safe care.

Aware of the evolving clinical picture of COVID-19 patients, the following hints and pieces of advice are the result of the experience of expert HCW, involved in the front line of the current health emergency.

Taking into account what already recommended by recent documents issued by SIAARTI<sup>2</sup> and GAVeCeLT<sup>3</sup>, about the correct approach of Venous Access in COVID-19 patient, it is our

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<sup>1</sup> <http://www.salute.gov.it/portale/home.html>

<sup>2</sup> SIAARTI VASCOVID: approccio vascolare al paziente COVID-19 positivo - versione 01 Pubblicato il 04.04.2020

<sup>3</sup> Considerazioni sull’utilizzo dei dispositivi per accesso vascolare nel paziente con COVID-19 (e alcune raccomandazioni pratiche) 5 aprile 2020 - GAVeCeLT



interest to promote an approach as accurate and sensible as possible, in order to minimize the complications and facilitate the patient path of care.

To all those who will take into consideration our proposal, we would like to suggest to record each decision connected to the choice of vascular device and to proceed to a systematic data collection, with the aim of validating a correct **Vascular Access Approach** of COVID-19 patient and to enrich the data collection that IVAS is implementing in order to have a better knowledge of this health dimension.

## 2. General Aspects

The patient care includes the placement of an appropriate vascular device according to the evolving clinical condition of COVID-19 Syndrome. For this reason, it is advisable to adopt a proactive approach<sup>4</sup> for the choice of the vascular device during this emergency. That means:

- Place a stable vascular device, suitable for COVID-19 patient's needs, based on several possible scenarios<sup>5</sup>
- Reduce the risk of catheter-related complications, adopting a correct technique of placement, stabilization, maintenance, and care of the device
- Constantly assess the need for the vascular device and consider the substitution with a more appropriate one
- Reduce HCW exposure to COVID-19 patients, limiting unnecessary venipunctures

The clinical pathway of COVID-19 patients usually starts in the Emergency Department and then goes on according to his clinical situation, in dedicated wards or ICU. The end of the hospitalization is in Rehabilitation ward, mainly after a long period in bed.

It is therefore advisable to start with a precise evaluation of the clinical picture of the patient and then daily reassess the need for a vascular device or its replacement with a more appropriate one.

Regardless of the possible scenarios and setting of care, based on currently available data, some aspects should be considered for the choice of the vascular access in COVID-19 patients:

- Careful evaluation at admission of the veins of the patient and prognostic index (C-reactive Protein, and D-Dimer)<sup>6</sup>

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<sup>4</sup> Kokotis K1. Cost containment and infusion services. *J Infus Nurs.* 2005 May-Jun;28(3 Suppl): S22-32; quiz S33-6.

<sup>5</sup> Vessel Health and Preservation: The Right Approach for Vascular Access Nancy L. Moureau

<sup>6</sup> Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet (London, England).* 2020.



- Mean length of stay in ICU or SubICU of 10-13 days<sup>7 8 9</sup>
- High risk of deep venous thrombosis (DVT) and pulmonary embolism (PE)<sup>10</sup>
- Prefer a device like PICC instead of Midline or long cannula (higher risk of thrombosis or endothelial inflammation)<sup>11 12</sup>
- Retroviral and pharmacological therapy with potentially vein-damaging drugs, in addition to support treatment<sup>13 14</sup>
- Prefer small-caliber devices to reduce the amount of the vessel lumen occupied by the catheter<sup>15</sup>
- Prefer power-injectable devices, in case of CT scan with contrast or high-flow infusion
- Select devices with two or three lumens if multiple incompatible drugs must be administered simultaneously
- Dedicated devices and technologies should be preferred, mainly if they guarantee an intraprocedural assessment of the correct placement. The aim is to reduce the risk of contamination and spreading of the virus.
- Frequent blood samples
- Central Venous Pressure (CVP) measurement

### 3. Venous Access Selection

#### *COVID Ward/Sub-ICU*

For COVID-19 patients who are prescribed and infusion therapy it is recommended to implement an algorithm for the choice of the vascular device which include the chemical

<sup>7</sup> Guan WJ, Ni ZY, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. The New England journal of medicine. 2020,

<sup>8</sup> Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus- Infected Pneumonia in Wuhan, China. Jama. 2020,

<sup>9</sup> Wu C, Chen X, Cai Y, et al. Risk Factors Associated with Acute Respiratory Distress Syndrome and Death in Patients with Coronavirus Disease 2019 Pneumonia in Wuhan, China. JAMA Intern Med. 2020)

<sup>10</sup> Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet (London, England). 2020)

<sup>11</sup> Campagna PhD, RN, Silvia Gonella RN, MSc, PhD student, Paola Berchiolla PhD, Valerio Dimonte RN, MSc, Professor of Nursing Sciences, Carla Rigo RN, Giacomo Morano MD, Pietro Antonio Zerla RN, Raffaella Fuzzi RN, Gianvito Corona MD, Silvana Storto RN, Baudolino Mussa MD. A retrospective study of the safety of over 100,000 peripherally inserted central catheters days for parenteral supportive treatments Sara, Res Nurs Health. 2019;1–7.

<sup>12</sup> Sara Campagna, PhD, RN; Silvia Gonella, RN, MSc; Pietro Antonio Zerla, RN; Gianvito Corona, MD; Tiziana Correggia, RN, MSc; Baudolino Mussa, MD; Paola Berchiolla, PhD; Valerio Dimonte, RN. The Risk of Adverse Events Related to Extended-Dwell Peripheral Intravenous Access, MSc Infect Control Hosp Epidemiol 2018;1–3

<sup>13</sup> Gautret P, Lagier J, Parola P, Hoang V, Meddeb L, Mailhe M, et al. Hydroxychloroquine and azithromycin as a treatment of COVID-19: results of an open-label non-randomized clinical trial. International Journal of Antimicrobial Agents.

<sup>14</sup> Cao B, et al. A Trial of Lopinavir-Ritonavir in Adults Hospitalized with Severe Covid-19. N Engl J Med. 2020 Mar 18. doi: 10.1056/NEJMoa2001282. [Epub ahead of print]

<sup>15</sup> Evans, R.S., Sharp, J.H., Linford, L.H. . Reduction of peripherally inserted central catheter associated DVT. Chest. 2013; 143(3): 627–633



features of the drugs (pH, osmolarity, irritant drugs), and the expected duration of the therapy to reduce the risk of complications.

Yet, even though the therapy is compatible with the peripheral administration, the choice of the PERIPHERAL device must be carefully assessed, considering the evolving clinical picture of the patient.

All devices should be power-injectable

Ultrasound (US) or other imaging systems should be employed, not only in DIVA (Difficult IntraVenous Access) patients but for all COVID-19 patients, to reduce unsuccessful venipunctures and increase the probability of success in the best placement site<sup>16</sup>.

In case of short-term therapy prefer a short peripheral cannula, better if integrated because it assures a longer dwell-time than a straight cannula.

If the therapy is longer than 5-7 days, select a long cannula (10 cm), better if power-injectable.

If there is also need for frequent blood samples, the placement of power-injectable Midline catheters is recommended, being assured that the tip of the device is in the axillary vein in the region below the clavícula<sup>17</sup>

Except in the above cases and considering the clinical picture and treatment regimen of the patient, the placement of a Central Venous Catheter (PICC-CICC-FICC) should be considered.

As for the first choice, select a Power-Injectable PICC, with more than one lumen if contemporary drug infusions are needed.

In case of contraindications to a PICC placement, consider a CICC or FICC.

#### *COVID INTENSIVE CARE UNIT*

In ICU, where the patient could undergo orotracheal intubation (OTI) or Non Invasive Ventilation (NIV) it is fundamental to deal with clinical and treatment needs of the COVID-19 patient through a Central Venous Device (PICC-CICC-FICC)

The first choice should be a PICC power-injectable, multiple-lumen (e.g. 5Fr three lumens) open end.

Select a CICC in presence of contraindications to a PICC placement, or in shortness of staff trained for a PICC placement, or when more than three lumens are needed.

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<sup>16</sup> Nancy L. Moureau, Vessel Health and Preservation: The Right Approach for Vascular Access

<sup>17</sup> Elli S, Pittiruti M, Pigozzo V, Cannizzo L, Giannini L, Siligato A, Rondelli E, Foti G, Lucchini A. Ultrasound-guided tip location of midline catheters. J Vasc Access. 2020 Feb 28



Consider a FICC placement whenever contraindications to PICC or CICC are present (Mediastinum diseases or Superior Vena Cava thrombosis).

Due to a state of hyper-coagulability, COVID-19 patients are at high risk of DVT<sup>18</sup>.

If not contraindicated, consider the administration of LMW heparin: prophylactic dose (100 iu/kg/24h) or therapeutic dose (100 iu/kg/12h or 150 iu/kg/24h)<sup>19</sup>

In presence of contraindications to anticoagulant drugs, consider the adoption of a device with better risks-benefits ratio for the patient.

Consider an arterial device for all those patients who require hemodynamic monitoring or frequent blood tests

#### 4. Algorithm

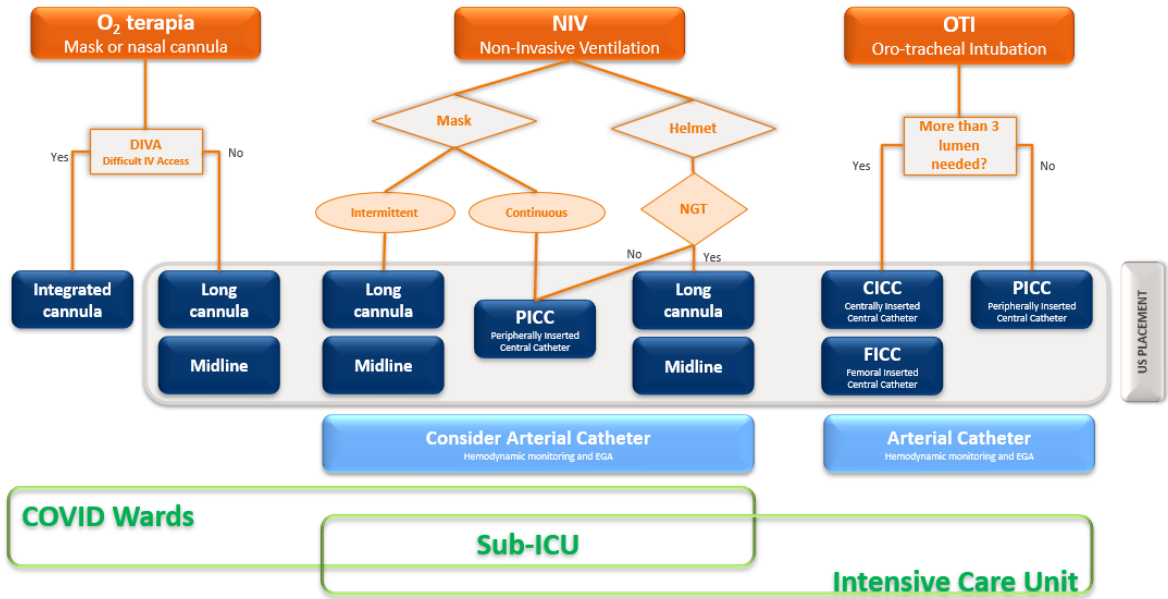


##### GENERAL RECOMMENDATIONS

- Respect the catheter-to-vein ratio
- Employ maximal barrier precautions
- Central catheters: use intraprocedural techniques of navigation/location
- Consider anticoagulant drugs
- Use US during placement
- Guarantee the follow-up of the vascular access

<sup>18</sup> Tang N, Li D, Wang X, Sun Z. Abnormal Coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost. 2020

<sup>19</sup> AIFA, Eparine a basso peso molecolare nei pazienti adulti con COVID-19, 11/04/2020





## 5. Placement procedure and technique

In all COVID-19 patients it is highly recommended to use US or other imaging technique during venipuncture, both peripheral and central.

The US should be dedicated to these patients, portable and with touch-screen technology and/or command buttons on the probe so to be easily sanitized after use.

Adopt a systematic Vascular Assessment (i.e. RACEVA<sup>20</sup> and/or RAPEVA<sup>21</sup>) to evaluate dimension, pathway, and features of the vessels, before placing a venous device.

Use a procedural Kit for placement<sup>22</sup>, which includes maximal sterile barrier precautions for the operator. Those precautions should be added to personal protective equipment (PPE) already adopted by HCW dealing with COVID-19 patients, such as FFP3 mask, protecting glasses, disposable shoe covers<sup>23</sup>.

During Central Venous Catheters placement (CICC-PICC) adopt tip location technology through intravascular ECG<sup>24</sup>, avoiding the risk of contamination of Radiology devices and other HCW (X-ray technician) and reducing the time before starting the infusion.

It is advisable to adopt dedicated and certified instruments for ECG-technique, in order to fulfil high quality standards.

In presence of properly trained staff, tip-location could be assessed through transthoracic echocardiography (TTE), using a Convex, Microconvex probe and adding the contrast-enhanced method (*Bubble Test*)<sup>25</sup>.

During placement, use a tip-navigation technique, through electromagnetic tracking<sup>26</sup> (whenever possible) or through real-time visualization of wire and catheter while advancing into the vessel. Consider that when adopting this last technique, sterility could be broken

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<sup>20</sup> Spencer TR, Pittiruti M. Rapid Central Vein Assessment (RaCeVA): A systematic, standardized approach for ultrasound assessment before central venous catheterization. *J Vasc Access*. 2019 May;20(3):239-249.

<sup>21</sup> Lamperti M1, Biasucci DG, Disma N, Pittiruti M, Breschan C, Vailati D, Subert M, Traškaitė V, Macas A, Estebe JP, Fuzier R, Boselli E, Hopkins P. European Society of Anaesthesiology guidelines on peri-operative use of ultrasound-guided for vascular access (PERSEUS vascular access). *Eur J Anaesthesiol*. 2020 May;37(5):344-376.

<sup>22</sup> H.P. Lovedaya\*, J.A. Wilsona, R.J. Pratta, M. Golsorkhia, A. Tinglea, A. Baka, J. Brownea, J. Prietob, M. Wilcox epic3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England *Journal of Hospital Infection* 86S1 (2014) S1–S70

<sup>23</sup> Gruppo di lavoro ISS Prevenzione e controllo delle Infezioni. Indicazioni ad interim per un utilizzo razionale delle protezioni per infezione da SARS-COV-2 nelle attività sanitarie e socio-sanitarie (assistenza a soggetti affetti da covid-19) nell'attuale scenario emergenziale SARS-COV-2. Versione del 28 marzo 2020. Roma: Istituto Superiore di Sanità; 2020 (Rapporto ISS COVID-19, n.2/ 2020 Rev.)

<sup>24</sup> Pittiruti M, La Greca A, Scoppettuolo G. The electrocardiographic method for positioning the tip of central venous catheters. *J Vasc Access*. 2011;12(4):280–91

<sup>25</sup> Lamperti M, Bodenham AR, Pittiruti M et al. International evidence-based recommendations on ultrasound-guided vascular access – *Int Care Med* 2012; 38: 1105-17

<sup>26</sup> Kenneth J Tomaszewski, Nicole Ferko, Sarah S Hollmann, Simona C Eng, Howard M Richard, Lynn Rowe, and Susan Sproule Time and resources of peripherally inserted central catheter insertion procedures: a comparison between blind insertion/chest X-ray and a real time tip navigation and confirmation system *Clinicoecon Outcomes Res*. 2017; 9: 115–125



during US of neck and thorax vessels; it is therefore mandatory to lay the contaminated probe off the sterile sheet.

During CICC placement, perform sub-clavicular venipuncture (axillary vein) only if trained staff is present.

After CICC placement be sure there is no pneumothorax by checking the pleura movement with US.

## **6. Vascular Access Care and Maintenance**

International Guidelines and Recommendations on this topic, highlight the importance of a systematic approach to vascular access to maintain and protect it and to prevent complications.

Routinely assess the device, the dressing and the patency of the catheter or the occurrence of complications.

In consideration of the clinical picture of COVID-19 patient and the need for treatment, the following actions should be considered:

- Use disposable applicators of 2% Chlorhexidine in alcohol solution, for skin antisepsis
- Adopt Engineered Stabilization Device (ESD) to secure the vascular device
- Use slow-release chlorhexidine-systems for insertion site antisepsis
- Use semipermeable transparent membrane to cover the insertion site

## **7. Vascular Access Systematic Follow-up**

COVID-19 patients are at high risk of DVT and associated complications.

The presence of vascular catheters reduces the internal lumen of the vessel. The blood flow thus affected could represent a risk factor for thrombosis. A systematic US of the insertion site and the pathway of the vessel should be routinely performed to early detect the occurrence of thrombotic and occlusive complications.

## **8. Facility Organizational Aspects**





In current times, health facilities should be reorganized: some of them should have pathways exclusively designed for COVID-19 patients and others with the presence of both COVID-19 and non-COVID-19 patients. In these latter the risk of contamination is higher.

It is therefore highly recommended to split activities and staff wherever possible, so to guarantee a clear separation between the two clusters of patients<sup>27</sup>.

Vascular Access Team dedicated to COVID-19 and non-COVID-19 patients should be considered.

*The aim of this document is to reduce the risk of infection of SARS-COV-2 virus, to guarantee high quality standards of care, through the adoption of the above-mentioned recommendations about Vascular Access.*



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<sup>27</sup> Ross Soo, SPLITTING HEALTHCARE TEAMS MAY HELP TO REDUCE DISRUPTION IN PATIENT CARE, National University Cancer Institute Singapore (NCIS), Singapore 26 Mar 2020