

A new hybrid technique for extracorporeal cardiopulmonary resuscitation for use by nonsurgeons

Una técnica híbrida nueva para el acceso vascular en la reanimación cardiopulmonar extracorpórea por médicos que no sean cirujanos

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Extracorporeal cardiopulmonary resuscitation (ECPR) is a second-line treatment in refractory cardiac arrest. ECPR can be performed anywhere and early and rapid initiation should be ensured¹. To this end, we have developed a hybrid technique for vascular access in ECPR that can be performed by non-surgical physicians. The aim of this study is to describe this new technique and evaluate the results obtained with its use.

In 2011, the Paris Emergency Medical Services (SAMU) initiated a protocol for prehospital initiation of CPR². The CPR team - consisting of an emergency physician or intensivist, a nurse and a paramedic - was to be called in when a refractory cardiac arrest was diagnosed by the usual resuscitation team³. To obtain femoral vascular access, the ECPR team used a hybrid technique described below (Figure 1).

Before starting the procedure, the ECPR team dressed in sterile gowns, disinfected the patient's right groin region and created a sterile surgical field. The first step consists of making a horizontal cut 5 cm and 2 cm below the groin. In the second step, a blunt dissection is made with the fingers to expose the femoral vessels in Scarpa's triangle. The third step is to identify the femoral vein and artery - the artery is thicker and white with vasa vasorum on its outer wall, the vein is darker and thinner. In the fourth step the cannulae are inserted through the skin using a tunnel technique - the hollow needle pierces the skin and then the vessel, the guide wire is then passed through the needle-. The fifth step consists of dilating, removing the needle, and passing the cannula through the guide-wire. First the venous cannula is passed (21/23 Fr) and then the arterial cannula (15/17/19 Fr). In the sixth step, the cannula is connected to the primed circuit, the pump is activated and the flow is

gradually increased. Automatic chest compressions are then interrupted. In addition, to avoid limb ischemia, distal perfusion (1 lumen catheter, 14 G) is initiated. Finally, the cannula is fixed to the skin, the cut is sutured and a compressive bandage is applied to the groin. The cannula, insertion kits and the CardioHelpR ECPR device were supplied by Getinger (Rastatt, Germany).

To evaluate the results obtained, we performed a single-center retrospective study between January 2014 and December 2017. We collected the following times: overall time (from incision to pump activation), insertion time (from incision to cannula insertion) and connection time (from cannula insertion to pump connection). ECPR was initiated in both in-hospital and out-of-hospital settings². The different times and the frequency of failure to perform the technique in the 2 settings were compared. Quantitative variables were expressed as mean and standard deviation (SD), and

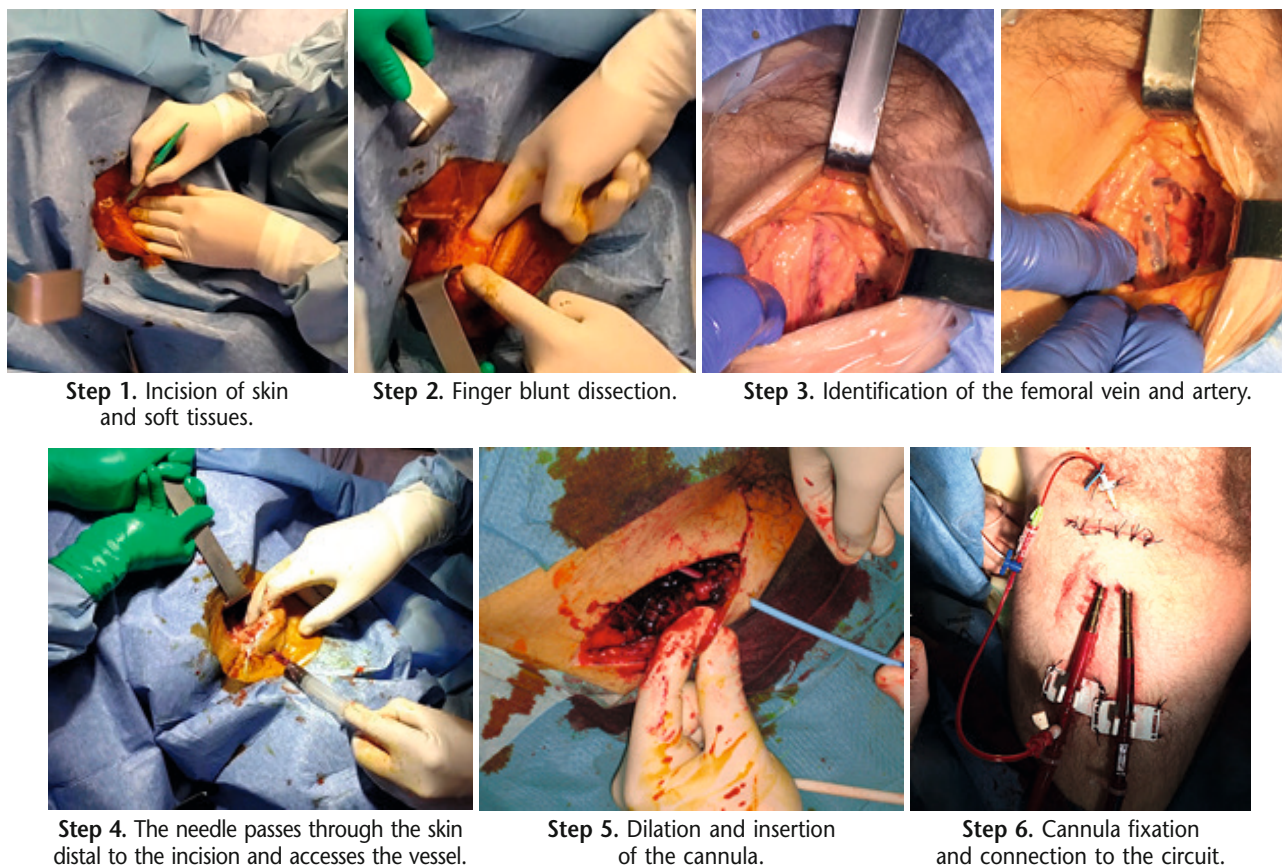


Figure 1. Hybrid technique for vascular access in extracorporeal cardiopulmonary resuscitation.

Table 1. Patient characteristics, vascular access times and vascular access failure

	Global N = 187 n (%)	Pre-hospital ECPR N = 124 n (%)	In-hospital ECPR N = 63 n (%)	P
Age [mean (SD)]	50 (13)	50 (13)	52 (14)	0.5
Sex (male)	152 (82.8)	104 (83.8)	51 (80.9)	0.6
Overall time* [mean (SD)]	21 (9)	22.5 (9.9)	20.8 (13.4)	0.37
Insertion time** [mean (SD)]	15.1 (7)	15.7 (8)	14.2 (5.5)	0.36
Connection time*** [mean (SD)]	6.1 (4.7)	7.3 (5.5)	4.4 (2.7)	0.004
Vascular access failure	14 (7.4)	9 (7.4)	5 (8.7)	0.8

ECPR: extracorporeal cardiopulmonary resuscitation.

*Overall time: from incision to pump activation.

**Insertion time: from incision to insertion of the cannula.

***Connection time: from the insertion of the cannula to the connection of the pump.

qualitative variables as frequency and percentage. Comparisons of quantitative variables were performed with Student's t test and qualitative variables with the chi-square test. A p value < 0.05 was considered statistically significant. Statistical analysis was performed using XLSTAT (Addinsoft). The protocol was approved by the local Institutional Review Board (CPPII de France II: A0082934).

During the study period, 187 ECPR patients were included. Table 1 shows patient characteristics, vascular access times and number of vascular access failures. The mean overall ECPR implementation time was 21 (9) minutes, cannula insertion times were 15 (7) minutes and connection time was 6 (4.7). The overall failure rate was 7.6%. There were no differences according to where the procedure was performed except for connection time, which was lower in the hospital setting (p = 0.004).

This study describes a new technique for the implementation of ECPR by non-surgical physicians. This technique has been shown to be rapid and efficient in the hospital and prehospital setting. Implementation of ECPR, anywhere and by non-surgical physicians, could increase access to ECPR and decrease hypoperfusion time in patients far from centers performing ECPR^{1,3-6}. Non-surgical physicians

routinely perform vascular access guided by ultrasound or fluoroscopy^{4,5,7}. However, failure rates can be high. During cardiac arrest, reduced flow within the vessels, anatomical variations and cardiopulmonary resuscitation-induced movements make cannulation difficult. Our technique can be performed anywhere without the need for imaging technique. Compared to the surgical technique^{8,9}, the incision is made in the lower part of the Scarpa triangle, thus cardiopulmonary resuscitation movements have less influence and dissection is safer. This technique has the advantage of directly visualizing the vessels. These factors explain the low failure rate. The connection time was longer for the prehospital implementation. This result can be explained by the time required for priming the device during cannulation and could be reduced by using a pre-impregnated device -in the in-hospital ECPR, the device is primed in the ICU while waiting for the patient-.

The main limitation of this study was that vascular access by hybrid technique was the only method used, so it cannot be compared with other techniques.

In conclusion, vascular access for ECPR using a hybrid technique and performed by nonsurgical physicians

is an efficient and safe procedure. The use of this technique could make a contribution to increasing access to ECPR.

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Conflicting interest: The authors declare no conflicts of interest in relation to this study.

Contribution of the authors, financing and ethical responsibilities: All authors have confirmed their authorship, the absence of external financing and the maintenance of confidentiality and respect for patients' rights in the author's responsibilities document, publication agreement and assignment of rights to EMERGENCIAS. The protocol was approved by the local Institutional Review Board (CPPII de France II: A0082934).

Article not commissioned by the Editorial Board and with external peer review.

Editor in charge: Aitor Alquézar Arbé.

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