



Short paper

Validation of a new proposal to avoid donor resuscitation in controlled donation after circulatory death with normothermic regional perfusion



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ABSTRACT

Aim: The use of abdominal normothermic regional perfusion (nRP) and pre-mortem interventions in controlled donation after circulatory death (cDCD) may represent a significant advance to increase the number and quality of grafts recovered in cDCD. The main limitation for the widespread acceptance of nRP in cDCD is the concerns of restoring circulation to the brain once death has been declared should the thoracic aorta not be adequately blocked.

Methods: We describe and validate a specific methodology to ensure an appropriate blocking of the thoracic aorta in a multicenter study using this technique.

Results: A total of 78 procedures with pre-mortem cannulation and abdominal nRP were performed in four different hospitals. No case of heart or brain resuscitation was observed after nRP

Conclusion: The use of pre-mortem interventions before nRP and the aortic occlusion balloon may increase the number of grafts recovered in cDCD. Our proposed methodology avoids the ethical problem of resuscitation by guaranteeing that circulation to the heart and brain is not restored after nRP

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Introduction

Controlled donation after circulatory death (cDCD) has expanded significantly over the last decade. Nevertheless, the unpredictable consequences of warm ischemic injury, which characterizes cDCD, result in a reluctance to use organs from these donors and lower patient and graft survival, particularly among liver recipients [1]. In recent years, there has been growing interest in using abdominal normothermic regional perfusion (nRP) with extracorporeal membranous oxygenation (ECMO) devices to restore blood flow to the abdominal cavity after death in cDCD [2]. This strategy may restore cellular energy substrates and as organ function can be assessed prior to transplantation, better grafts may be selected, compared to current cDCD transplantation [3]. nRP also transforms an urgent recovery procedure into an elective one, an

advance that could reduce organ damage and losses due to surgical events.

Ethical concerns about the use of abdominal nRP and pre-mortem interventions in cDCD have been aired [4], including the possibility of resuscitating the patient after death declaration.

To resolve ethical challenges in a methodological manner, the facts of the situation must be analyzed. The ethical problem of resuscitation could be avoided if an nRP procedure to guarantee the absence of cardiac or cerebral resuscitation is developed.

The legal framework regulating cDCD varies significantly among different countries. In some places, pre-mortem cannulation is forbidden, while in others it can be performed with the consent of the patient or his family.

According to the Spanish regulatory framework, specific informed consent must be obtained for any pre-mortem interventions, immediately after consent for organ donation has been obtained from the legal representatives of the potential donor (2 separate consents must be obtained, one for organ donation and the other for pre-mortem interventions).

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We describe and validate for the first time a specific methodology to ensure appropriate blocking of the thoracic aorta during nRP in four Spanish centers.

Methods

New proposal to avoid donor resuscitation

This is a multicenter retrospective review of all actual cDCD procedures performed with premortem cannulation and nRP at four Spanish centers from the start of the programmes (2014) to January 2017.

cDCD was considered in patients < 75 years, in whom the decision had been made to withdraw life-sustaining treatment (WLST) on the grounds of futility of further care. The common protocol to avoid donor resuscitation during nRP is described below.

Informed consent

Specific informed consent for premortem interventions, consisting of the administration of heparin (500–600 IU/kg) and cannulation of femoral vessels prior to the WLST, was obtained.

Cannulation of the femoral vessels

The femoral artery and femoral vein were cannulated surgically or percutaneously using the Seldinger technique, with adequate sedation and analgesia.

Aortic occlusion catheter

An aortic occlusion balloon was placed through the contralateral groin, in order to relegate preservation measures to the abdominal cavity during nRP. We used standard commercial devices as aortic occlusion balloon. Before WLST, the aortic occlusion balloon was filled for just 4 seconds, in order to confirm that pressure from the arterial femoral cannula disappeared while the left wrist line was maintained (Fig. 1A), ensuring that the thoracic aorta was

adequately blocked. The balloon was then immediately emptied. The filling volume was recorded as the minimum volume to be used to block the aorta during nRP. An X-ray or fluoroscopy view was obtained before WLST to ensure the correct positioning of the catheter.

Two arterial lines, one from the femoral arterial cannula and the other from the left radial artery, were monitored throughout the procedure.

Withdrawal of life-sustaining therapy

WLST was performed in the ICU or in the operating room. Relatives were allowed to be with the potential donor throughout the whole process.

Determination of death

The absence of circulation was defined when there was no pulsatile wave form in both arterial lines. A 5-min no-touch period after the circulatory arrest was mandatory for death to be declared. The bispectral index was monitored before and after WLST to ensure there was no cerebral activity after nRP.

Balloon filling and start of normothermic regional perfusion

After death was certified and nRP was started, arterial pressure from the left radial artery disappeared with adequate blocking of the thoracic aorta, while the pressure from the femoral arterial cannula was maintained, but pressure was continuous rather than pulsatile because it was provided by the ECMO device (see Fig. 1B). A continuous pressure > 60–65 mmHg was maintained.

Detection of catheter malfunction or incorrect positioning

If flow was detected in radial line, nRP was immediately stopped and correct positioning or filling of the catheter was checked. The nRP was then reinitiated after a no-touch period of 5 min.

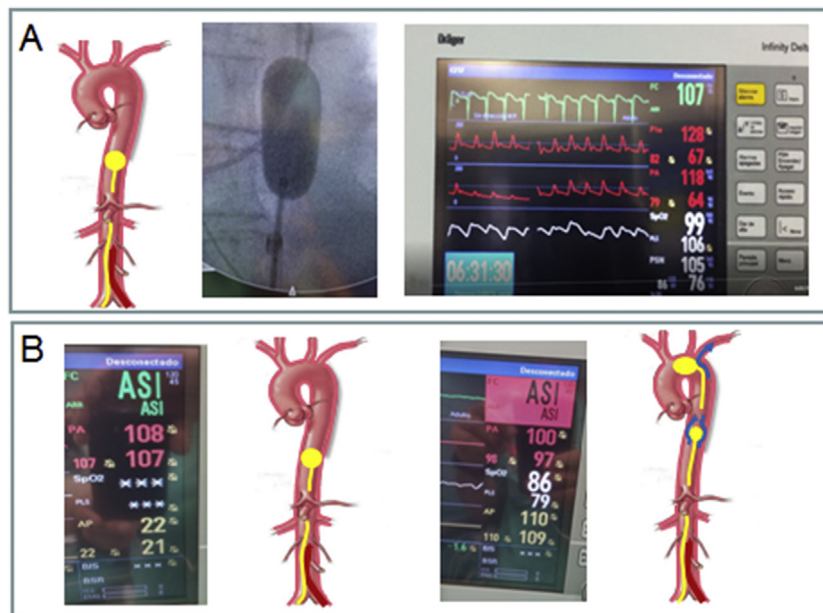


Fig. 1. **A.** Aortic occlusion catheter in the correct position with the balloon filled with radiopaque contrast. The femoral pulse taken in the ECMO cannula disappears when the balloon is filled while the radial pulse is maintained. The complete disappearance of the femoral pulse indicates the minimum filling balloon volume. **B.** If the aortic occlusion catheter is correctly positioned, the femoral cannula shows a non-pulsatile pressure while there is neither radial artery pressure nor oxygen saturation (right). If the balloon is not completely full or is too advanced, non-pulsatile pressure will be detected in both femoral and radial arteries (left).

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