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New Donor Selection Criteria Result in Optimal Outcomes of Kidneys from Uncontrolled Donation After the Circulatory Determination of Death

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Background. The aim of our study is to share our experience with uncontrolled donation after the circulatory determination of death (uDCDD) kidney transplantation and to propose updated donor selection criteria for uDCDD programs. **Methods.** A prospective study comparing kidney recipients of grafts from local uDCDD donors with recipients of grafts from local standard criteria donors after the neurological determination of death (DNDD) between 2013 and 2024. Donor acceptance was determined using a combination of 3 factors: donor age, no-flow period, and warm ischemic time (WIT). Normothermic regional perfusion was the preservation method in uDCDD cases. **Results.** The study included 43 kidney recipients from uDCDD donors and 80 controls. The median no-flow period was 10 min (interquartile range, 5–13), and the median WIT was 101 min (interquartile range, 86–118). The incidence of delayed graft function was significantly higher in the uDCDD group (46.5% versus 21.3%; $P = 0.004$), although no significant difference was observed in primary nonfunction rates (2.3% versus 0%; $P = 0.35$). Long-term outcomes, including serum creatinine levels and estimated glomerular filtration rate at 5 y, were similar in both groups. Graft survival rates at 1 y (95.3% versus 100%) and 5 y (92.1% versus 95%) showed no significant differences between the uDCDD and the DNDD groups. Multivariate analysis revealed that uDCDD kidney recipients did not have a higher risk of graft loss. **Conclusions.** Kidney transplantation from uDCDD donors is a viable option, yielding outcomes comparable with those from standard DNDD donors. Strict donor selection criteria and efforts to minimize WIT are essential to achieving optimal long-term results.

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Kidney transplantation is the most effective treatment for patients with kidney failure and is associated with better survival and quality of life compared with chronic dialysis.[1] However, the persistent shortage of organs for transplantation results in prolonged waiting times, during which many patients may either die or be withdrawn from the waiting list because they become too sick to receive a transplant.[2]

Donation after the circulatory determination of death (DCDD) emerged in the 1990s as a promising alternative to address the disparity between organ supply and demand.[3] Kidney transplantation using organs from controlled DCDD

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(cDCDD) donors has since been widely adopted worldwide, achieving long-term outcomes equivalent to kidneys obtained from donors after the neurological determination of death (DNDD).[4] In contrast, uncontrolled DCDD (uDCDD) remains restricted to a small number of countries and hospitals, mainly as a result of legal and ethical obstacles, as well as the technical and logistical complexities of the procedure.[5,6]

Surprisingly, the limited implementation of uDCDD programs persists despite recommendations from the European Resuscitation Guidelines to consider uDCDD when advanced cardiopulmonary resuscitation (aCPR) is deemed unsuccessful.[7] The limited uDCDD activity is even more surprising given the estimation that 38–55 cases of out-of-hospital cardiac arrest (CA) cases per 100 000 person-years occur annually in Europe and the United States, with resuscitation attempted by Emergency Medical Services (EMS).[8] According to the Parisian Registry, implementing a uDCDD program could expand the potential donor pool by >600 donors per year.[9] In contrast, the global expansion of extracorporeal-assisted cardiopulmonary resuscitation (E-CPR) programs provides a unique opportunity to integrate uDCDD into existing frameworks, allowing for the successful coexistence of both programs.[10]

uDCDD represents a vast and underused source of kidneys for transplantation. Although the literature describing the outcomes of kidneys obtained from uDCDD donors is limited, available studies report satisfactory long-term graft survival.[11-13] However, there is still a reluctance to use uDCDD kidneys due to a higher rate of primary nonfunction (PNF) and delayed graft function (DGF).[14-16] In addition, the high kidney discard rate in most uDCDD programs jeopardizes the value of this challenging procedure.[5,17]

The inclusion criteria for uDCDD donors have remained unchanged during the past 20 y, reflecting the limited research conducted on this type of donation.[6] Advanced donor age, prolonged no-flow periods and warm ischemic time (WIT), and the in situ cooling of kidneys as the preservation strategy seem to be key risk factors for PNF and graft loss.[16,18]

Applying stricter and more refined inclusion criteria may improve short-term outcomes compared with those traditionally reported. This study aims to share our experience with uDCDD kidney transplantation based on a protocol that incorporates new and easy-to-apply criteria for donor selection, potentially addressing some of the challenges and maximizing the benefits of this underused donor pool.

MATERIALS AND METHODS

Data were prospectively obtained from all kidney recipients who received a graft from a local uDCDD donor between the start of our program (December 2013) and April 2024. Follow-up continued for all recipients until May 2024. The control group comprised all kidney transplant recipients during the same period who received organs from local DNDD donors meeting standard criteria as defined by the United Network for Organ Sharing—donors younger than 50 y or donors younger than 60 y with a maximum of one of the following: history of arterial hypertension, serum creatinine >130 mmol/L, or death due to cerebrovascular events.[19] Kidney recipients undergoing simultaneous kidney-pancreas transplantation and those with donor-specific antibodies at the time of transplantation were excluded.

The study protocol received institutional review board approval, adhering to Spanish legislation.

The uDCDD Procedure

The donor selection criteria for our uDCDD program are described in Table 1. Ideal cutoff points were established for donor age (younger than 50 y), no-flow period (<10 min), and WIT (<120 min). To minimize kidney discard rates and ensure appropriate posttransplant outcomes, donors had to meet at least one of these ideal criteria to proceed with organ recovery. Donors failing to meet any of the 3 criteria were excluded from donation.

The uDCDD protocol has been detailed previously.[20] The protocol was activated only if EMS had initiated aCPR after a witnessed CA and had deemed aCPR unsuccessful. National aCPR protocols were aligned with international standards.[21,22] Once aCPR had been exhausted and considered unsuccessful on the grounds of futility by the EMS team, a preliminary phone screening was conducted between the EMS and the donor coordinator at the receiving hospital to confirm donor eligibility based on inclusion criteria (Table 1). If the criteria to activate uDCDD were not met, the EMS terminated aCPR and confirmed the patient´s death, following international resuscitation guidelines.[21,22]

If donor eligibility criteria were met, cardiac compression and mechanical ventilation would continue beyond futility to preserve donation opportunities during the transfer of the potential donor to the hospital. All potential uDCDD donors were transferred to the hospital with mechanical cardiac compression using the LUCAS 2 device.

To minimize WIT, the potential uDCDD donor was directly transferred to the intensive care unit (ICU), where death was declared and legal permission was obtained to proceed with postmortem preservation measures. The declaration of death was performed by the ICU physician on duty, who was independent of the donation and

TABLE 1.

Criteria for the selection of potential uDCDD kidney donors

Witnessed collapse
No trauma
Not eligible for E-CPR
Age <60 y (ideal <50 y)
No-flow period < 20 min (ideal <10 min)
Warm ischemic time <150 min (ideal <120 min)
Duration of A-NRP <240 min
Normal macroscopic kidney appearance
Resistance index <0.3 in pulsatile machine perfusion
One of the criteria has to be ideal (age, no-flow period or warm ischemic time)

A-NRP, abdominal normothermic regional perfusion; E-CPR, extracorporeal-assisted cardiopulmonary resuscitation; uDCDD, uncontrolled donation after the circulatory determination.

transplantation team. In Spain, the diagnosis of death based on circulatory criteria only requires a physician independent of the transplant team and the coordination team. This physician declared death after confirming that aCPR had been exhausted and that there was no indication for alternative therapeutic interventions, as well as after observing a "no-touch period" of 5 min of complete absence of cardiopulmonary activity, defined by the absence of respiratory movements and electrical activity on the electrocardiogram. Postmortem interventions entailed the cannulation of femoral vessels and the initiation of abdominal normothermic regional perfusion (A-NRP). A double-lumen cannula (ThruPort Systems, Edwards) was inserted into the femoral artery, and through it, an aortic occlusion balloon was placed, avoiding the need to cannulate the contralateral groin and minimizing WIT.

Relatives were approached to discuss donation opportunities and assess whether organ donation was consistent with the person's wishes and values. On consent and confirmation of medical eligibility, the donor was transferred to the operation theater for kidney recovery. All recovered kidneys underwent machine perfusion (LifePort; Organ Recovery System, Diegem, Belgium) for at least 2 h. Kidneys with a vascular resistance index (RI) >0.3 mm Hg/mL/min were discarded.

Recipients of uDCDD kidney grafts received induction with thymoglobulin and immunosuppressive treatment based on the delayed introduction of tacrolimus, associated with mycophenolate mofetil and steroids. Standard criteria DNDD kidney recipients received standard immunosuppression (tacrolimus, mycophenolate mofetil, and steroids). According to the treating team, induction with thymoglobulin or basiliximab was associated with patients at high risk of acute rejection or DGF.

Variables and Definitions

The no-flow period was defined as the time from CA to the start of aCPR. WIT extended from CA to the initiation of in situ preservation with A-NRP.

PNF was defined as the failure of a graft to ever function. DGF was considered by the need for dialysis during the first week after transplantation. Death-censored graft survival was calculated from the date of transplantation to the date of irreversible graft failure, defined by return to long-term dialysis or retransplantation. In the event of death with a functioning graft, the follow-up period was censored at the date of death. The glomerular filtration rate (GFR) was estimated by using the Chronic Kidney Disease Epidemiology Collaboration equation.[23]

Statistical Analysis

A descriptive analysis was performed, presenting categorical variables as absolute numbers and percentages and continuous variables as measures of central tendency and dispersion. Comparisons between uDCDD and standard criteria DNDD kidney recipients were conducted using the Student's *t* test or the Mann-Whitney *U* test for continuous variables based on distribution and normality testing (Kolmogorov-Smirnov/Shapiro-Wilk). For comparisons of categorical variables, the chi-square test or the Fisher exact test was used, as appropriate. Creatinine and GFR changes over time were assessed using a general linear model for repeated measures. Logistic regression models were used to identify risk factors associated with DGF, whereas Cox regression determined risk factors for graft loss. Survival was evaluated using the Kaplan-Meier survival analysis, considering the functional status recorded at the end of the observation period.

RESULTS

Between December 2013 and April 2024, the EMS reported 109 potential uDCDD donors to the donor coordination team. In 69 cases, the uDCDD pathway was not activated for the eligibility criteria were not met in most cases or logistical problems such as being with a cDCDD or DNDD donor at the same time (see Figure 1). In total, kidney recovery was performed in 38 uDCDD donors, with 52 kidneys recovered and 43 kidneys transplanted (37 at our hospital and 6 at other centers due to the lack of suitable local recipients). A total of 80 kidneys obtained from standard DNDD donors were transplanted at our center during the study period.

Baseline donor and recipient data, as well as posttransplant outcomes, are summarized in Table 2. The median age of uDCDD donors whose kidneys were used for transplantation was 47 y (interquartile range [IQR], 36–51). The median no-flow period was 10 min (IQR, 5–13), and the median WIT was 101 min (IQR, 86–118). The median duration of A-NRP before kidney recovery was 170 min (IQR, 139–208).

No statistically significant differences were observed in the clinical or demographic characteristics of donors and recipients between the 2 groups. However, recipients of uDCDD donors had a significantly shorter median cold ischemic time (CIT) compared with recipients of DNDD kidneys (15 h [IQR, 9–21] versus 19 h [IQR, 15.5–22]; $P = 0.032$).

The incidence of PNF was low in both groups, with no cases reported in the standard DNDD cohort and only 1 case (2.3%) in the uDCDD group ($P = 0.350$). In contrast, DGF was significantly more frequent in the uDCDD cohort (46.6% versus 21.3%; $P = 0.004$). Posttransplant kidney function outcomes are displayed in Figure 2. Serum creatinine and estimated GFR (eGFR) values at 1 and 5 y after transplantation were comparable between the 2 cohorts. Death-censored graft survival rates were 95.3% versus 100% at 1 y and 92.1% versus 95% at 5 y for the uDCDD and the standard DNDD groups, respectively (Figure 3).

Recipients of uDCDD kidneys had a significantly higher probability of developing DGF in univariate analysis (odds ratio, 3.2; 95% confidence interval [CI], 1.4-7.2; $P = 0.004$) and in multivariate analysis, adjusted for recipient age, CIT, and history of previous kidney transplant (odds ratio, 3.6; 95% CI, 1.4-8.9; $P = 0.007$). However, uDCDD kidney recipients did not exhibit a significantly higher risk of graft loss, neither in univariate analysis (hazard ratio, 2.5; 95% CI, 0.7-8.7; $P = 0.145$) nor in multivariate analysis adjusted for recipient age, CIT, DGF, and history of previous kidney transplant (hazard ratio, 0.8; 95% CI, 0.2-4.1; $P = 0.765$).

DISCUSSION

Our experience with the transplantation of highly selected uDCDD kidneys confirms the feasibility of these programs and demonstrates that posttransplant outcomes can be comparable with those achieved with standard criteria DNDD donors. Published literature on uDCDD kidney transplants has often reported suboptimal outcomes,[5,6,14,16] highlighting

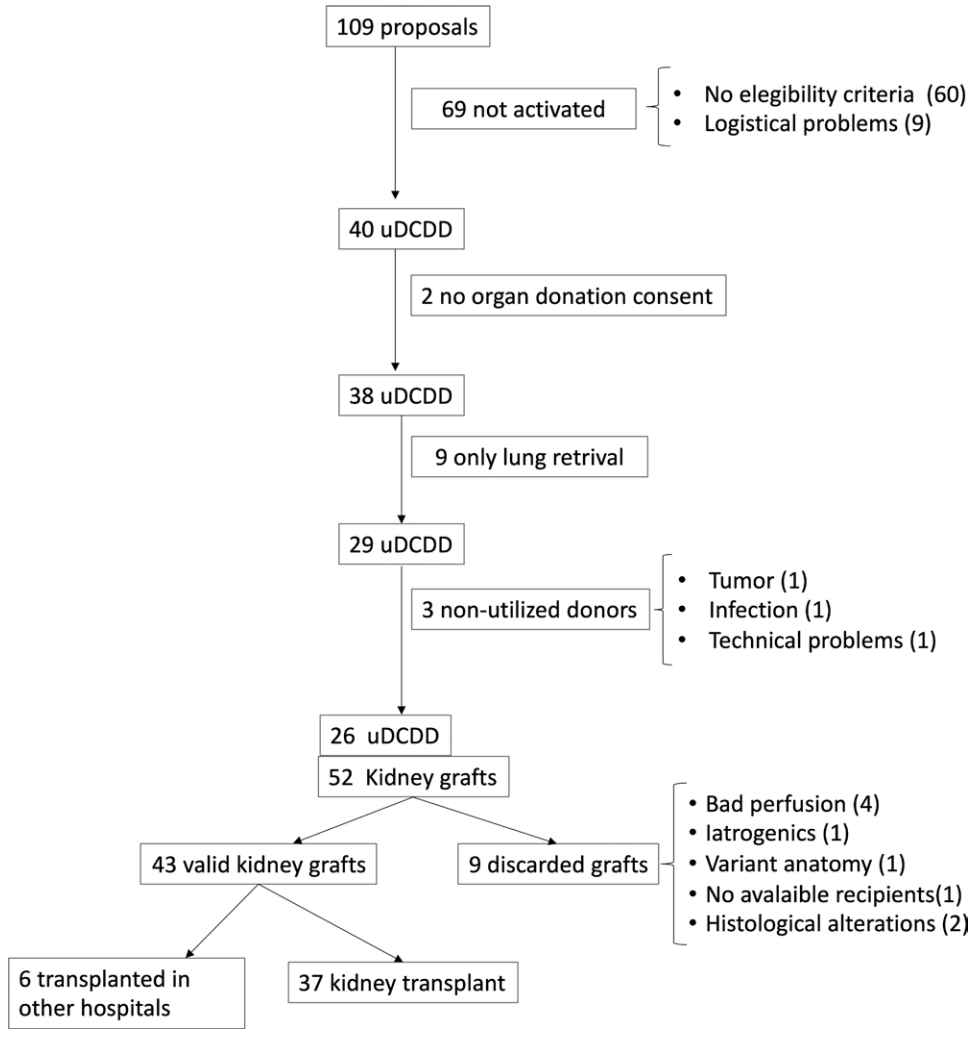


FIGURE 1. Study profile.

the challenges associated with this pathway, which also relates to a limited donor utilization and a low number of organs recovered and transplanted per donor. These factors have contributed to waning interest in establishing or maintaining uDCDD programs.[5,24]

To justify the value of uDCDD programs, most researches have compared the outcomes of recipients of kidneys from uDCDD donors with those from DNDD donors meeting expanded criteria.[15,25] However, the inherent complexity of the uDCDD procedure, along with the significant human and financial resources it demands, can only be justified if the outcomes achieved are exceptional; uDCDD kidneys must lead to results comparable with those of kidneys from ideal DNDD donors. Recent interest in applying NRP to controlled DCDD procedures[26-29] offers potential advancements, as NRP is crucial for achieving optimal outcomes in uDCDD transplantation. A recent meta-analysis revealed higher rates of PNF and DGF in uDCDD kidneys compared with cDCDD kidneys.[6] However, it is noteworthy that NRP was associated with improved short- and long-term outcomes in uDCDD transplants.

One major limitation of uDCDD outcomes is the lack of evolution in donor acceptance criteria during the past 2 decades. Some centers in Spain continue to use unrestricted donor selection criteria established >20 y ago,[5,25,30] allowing for an upper limit WIT of 150 min, no-flow periods of up to 15–20 min, and donor age limits of 60–65 y. Notably, a significant percentage of potential uDCDD donors approach these upper limits, with an increased risk of unsuitable kidneys or PNF.

Our protocol was designed to minimize these risks by excluding donors who did not meet at least 1 of 3 ideal criteria: donor age younger than 50 y, no-flow period of <10 min, or WIT of <120 min. These criteria, informed by previous studies, aimed to optimize organ utilization and posttransplant outcomes. Viglietti et al[31] described that a no-flow period of <10 min resulted in a 1-y eGFR and interstitial fibrosis and tubular atrophy scores comparable with DNDD kidneys, whereas longer no-flow periods significantly worsened these parameters. Additionally, large Spanish studies have shown that donor age older than 50 y decreased 10-y death-censored kidney survival,[30] and that extended aCPR times predicted higher PNF rates.[15]

PNF remains the most concerning complication of uDCDD kidney transplantation, with reported incidences ranging from 1.8% to 20%.[14,15,18,20,30,32] A recent meta-analysis reported a median PNF of 12.3% across studies.[6]

Several factors such as advance donor age, prolonged WIT, extended no-flow periods, or in situ cooling as a preservation method have been found to be associated with high rates

TABLE 2.

Baseline features and outcomes of recipients of kidneys from uDCDD vs standard criteria DNDD donors

	Recipients of standard DNDD kidneys (N = 80)	Recipients of uDCDD kidneys (N = 43)	*P*
Donor data			
Age, y, median (IQR)	48 (43–52)	47 (36–51)	0.347
Recipient data			
Sex male, n (%)	53 (66.3%)	32 (74.4%)	0.350
Age, y, median (IQR)	49 (41–60)	45 (41–58)	0.508
Primary kidney disease, n (%)			0.103
Congenital	12 (15%)	10 (23.3%)	
Unknown	7 (8.8%)	2 (4.7%)	
Glomerular	24 (30%)	15 (34.9%)	
Interstitial	8 (10%)	5 (11.6%)	
Other	2 (2.5%)	5 (11.6%)	
Systemic disease	18 (22.5%)	3 (7%)	
Vascular	9 (11.3%)	3 (7%)	
Previous kidney transplant, n (%)	24 (30%)	11 (25.6%)	0.678
Status before transplant, n (%)			0.878
Predialysis	16 (20%)	10 (23.3%)	
Hemodialysis	52 (65%)	26 (60.5%)	
Peritoneal dialysis	12 (15%)	7 (16.3%)	
cPRA	20 (25%)	6 (14%)	0.152
HLA-ADR mismatches	5 (4–5)	5 (4–5)	0.145
Donation procedure			
T0-aCPR, min, median (IQR)	–	10 (5–13)	
T0-admission to the ICU, min, median (IQR)	–	61 (49–79)	
T0-A-NRP, min, median (IQR)	–	101 (86–118)	
Time from admission to ICU to A-NRP, min, median (IQR)		34 (27–40)	
A-NRP time, min, median (IQR)	–	170 (139–208)	
CIT, h, median (IQR)	19 (15.5–22)	15 (9–21)	0.032
Posttransplant outcomes			
Follow-up, median (IQR)	62.9 (35–83)	44 (14–70)	0.027
PNF, n (%)	0 (0%)	1 (2.3%)	0.350
DGF, n (%)	17 (21.3%)	20 (46.5%)	0.004
Posttransplant dialysis sessions, median (IQR)	2 (1–4)	1 (IQR 0–3)	0.032
Functioning graft, n (%)	75 (93.8%)	38 (88.4%)	0.261
Cause of graft loss, n (%)			0.115
Chronic rejection	2 (40%)	1 (20%)	
Recurrent of primary disease	3 (60%)	1 (20%)	
Vascular	0	3 (60%)	

aCPR, advanced cardiopulmonary resuscitation; A-NRP, abdominal normothermic regional perfusion; CIT, cold ischemic time; cPRA, calculated panel-reactive antibody; DGF, delayed graft function; DNDD, donation after the neurological determination of death; ICU, intensive care unit; IQR, interquartile range; PNF, primary nonfunction; T0, time of cardiac arrest; uDCDD, uncontrolled donation after the circulatory determination of death.

of PNF in uDCDD.[15,16,18] The primary reasons for the results achieved in our series, with a reduced rate of PNF, are most likely the strict donor selection criteria applied, avoiding the accumulation of risk factors. The combination of keeping donor selection criteria (advanced age, prolonged no-flow period, and WIT) in the upper limit of acceptance is, in our opinion, the main reason for the high rate of PNF in this type of donation. This issue was clearly observed in the Spanish experience, where WIT >130 min, donor age 60 y and older, and the use of in situ cooling as a preservation method were associated with significantly higher rates of PNF in multivariate analysis.[16] We would like to emphasize the importance of decreasing the duration of WIT. The Spanish Registry showed that 46% of kidneys transplanted from uDCDD donors exhibited WIT >130 min, and the percentile 75 was 141 min, very close to the upper limit,[16] similar to the French experience, which recorded 135 min of WIT.[18] This high WIT combined with other extended criteria might be the reason for the high rates of PNF described in these studies.

Despite a higher DGF rate in our uDCDD group (46%) compared with the DNDD group, this was lower than what was previously documented.[13-16,18,32] Although DGF does not impact long-term survival, it prolongs the length of hospital stay and increases the cost of the transplant procedure, so more efforts are required to reduce the occurrence of this posttransplant event.

Our 5-y graft survival rate of 92% surpasses previously reported rates[13-16,18,32] (Vijayan et al[6] reported 70% in their meta-analysis) and demonstrates the success of our optimized protocol. Moreover, the long-term kidney survival rate was similar in both groups and they were far better than what had been recorded in most publications.[13-16,18] In fact, uDCDD

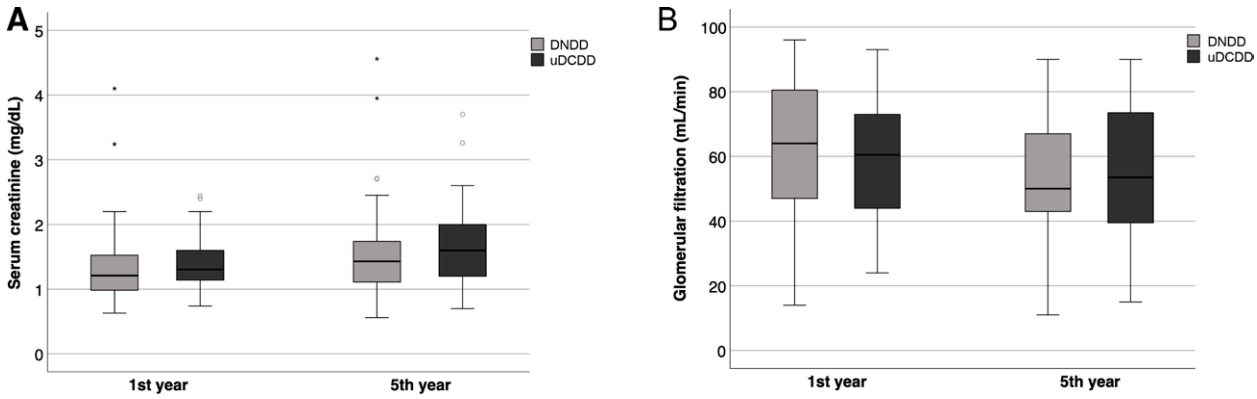
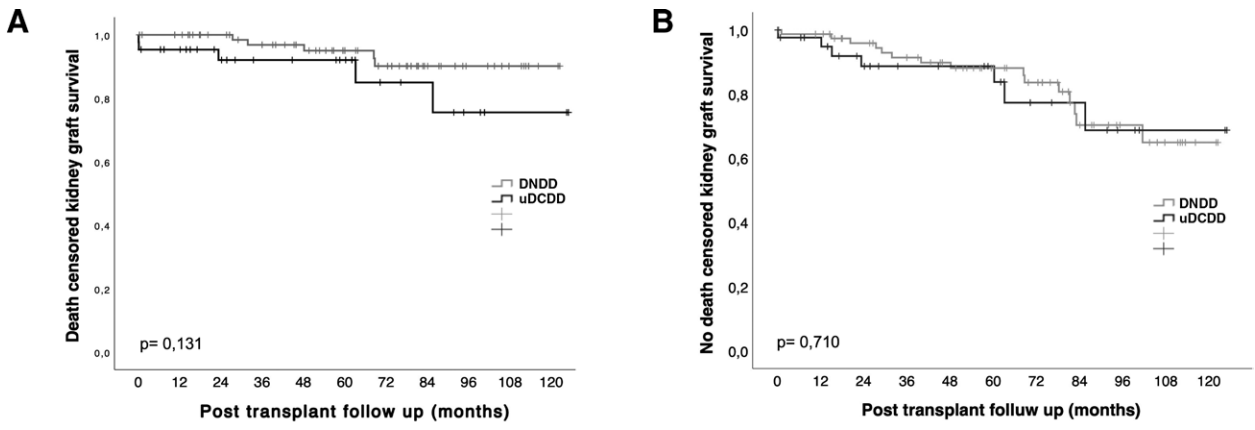


FIGURE 2. Sequential serum creatinine levels (A) and glomerular filtration rate (B) in kidney recipients from both groups (in black uDCDD; in gray DNDD). The bar represents the median and the error bars the interquartile range for each time point. A general linear model for a repeated measures test was used. At all-time points $P > 0.05$. DNDD, donation after the neurological determination of death; uDCDD, uncontrolled donation after the circulatory determination of death.



Number at risk	Time (months)										
	0	12	24	36	48	60	72	84	96	108	120
uDCD	43	35	28	22	20	18	10	9	6	3	3
DBD	80	75	66	59	53	44	35	20	13	9	1

Number at risk	Time (months)										
	0	12	24	36	48	60	72	84	96	108	120
uDCD	43	35	28	22	20	18	10	9	6	3	3
DBD	80	75	66	59	53	41	35	20	13	8	2

FIGURE 3. Kaplan-Meier graphs. A, Death-censored kidney graft survival. B, No death-censored kidney graft survival. DNDD, donation after the neurological determination of death; uDCDD, uncontrolled donation after the circulatory determination of death.

in itself was not a risk factor for graft loss in multivariate analysis.

We also analyzed data on kidney function in the long term, which were again appropriate in recipients of kidneys from uDCDD donors, with no differences in serum creatinine or eGFR values at 1 and 5 y compared with recipients of ideal DNDD kidneys. The description of analytical parameters in our series is of great importance since most studies published on uDCDD kidney transplantation have only reported survival data, with no information on graft function.[6]

One of the main discouraging issues in uDCDD is the high kidney discard rate, >30% in large Spanish studies.[15,30] Vijayan et al[6] described a median nonutilization rate of kidneys of 36.9%, 2-fold higher than what was observed in our study (17.3%). There is not a unique factor to explain our low rate of discarded kidneys, but likely the combination of an optimal donor selection, the use of mechanical compressors (LUCAS 2) during the transport to the hospital, and the use of A-NRP with extracorporeal membranous oxygenation devices as the in situ preservation method might explain this result.

We would like to emphasize that the favorable results obtained in our center with the transplantation of uDCDD kidneys were not related to a restrictive selection of kidney recipients. In fact, there were no differences between both recipient groups in donor age, recipient age, rate of sensitized patients, or the percentage of second recipient transplant.

The keystone of successful uDCDD programs is optimizing all logistical requirements with the clear goal of reducing warm ischemic injury. Although we cannot interfere with donor age or in the duration of no-flow periods that all EMS try to reduce as much as possible to increase the probability of return of spontaneous circulation and save lives, we are able to reduce the duration of intrahospital procedures to minimize the period until A-NRP. In this regard, the obvious feature that distinguishes our uDCDD program from others is that both the diagnosis of death and the start of A-NRP were performed in the ICU. The centralization of both phases of the

process in the same unit helped us to avoid in-hospital transfers that turned out to be difficult in multimonitored patients subject to mechanical cardiac compression and mechanical ventilation. This approach reduces WIT and largely contributes to improving graft quality.[20,33] The use of a double cannula to place the aortic occlusion balloon, instead of cannulating the contralateral groin, also reduced WIT by several minutes. Therefore, WIT can be reduced by shortening the duration of in-hospital logistics, through a good management of human and material resources.

In our study, all kidneys were perfused on pulsatile hypothermic machine perfusion (HMP). Pulsatile HMP has shown to be effective in reducing the incidence of DGF, both in DNDD and DCDD, but has not been associated with a decreased risk of PNF.[5,16,34] However, it seems helpful to evaluate the potential viability of kidney grafts in uDCDD,[13] being a common practice nowadays to discard those kidneys with RI >0.30 mm Hg/mg/min. Notably, not a single kidney was discarded because of a high RI in our experience. We can speculate that this was due to the low residual endothelial damage suffered by our grafts because of the strict donor selection criteria applied. The use of A-NRP might also have contributed to achieving lower RI during HMP.

There has been a debate concerning the coexistence of E-CPR and uDCDD programs. In our hospital, E-CPR is available, and to activate the uDCDD procedure, it is mandatory to check that there is no indication to activate the E-CPR pathway. The inclusion criteria for both programs are different.[10] Our criteria for activating E-CPR are a witnessed CA with a no-flow period <5 min, ventricular fibrillation as the initial rhythm, and the possibility of being in the hospital within 45 min after the CA. Notably, aCPR must be maintained as long as defibrillating rhythms are identified, which are those that could potentially benefit from E-CPR.[35] Should patients fulfill the selection criteria, the corresponding process should be activated; uDCDD should only be considered when aCPR is deemed unsuccessful and E-CPR is not indicated.[36]

We are aware of the ethical-legal barriers to setting up DCDD programs,[37,38] such as conflicts related to the termination of aCPR and the determination of death. In Spain, the diagnosis of death always occurs in the in-hospital and is conducted by a physician independent from the donation team and from the team originally responsible for aCPR. This independent physician confirms that further interventions are not indicated and observes the absence of spontaneous circulation during a 5-min period. Some scholars have suggested that the observation period to diagnose death should be >5 min in the uDCDD setting.[39,40] This observation is based on anecdotal cases of return of spontaneous circulation associated with a short duration of aCPR, a rhythm different from asystole, or the inadvertent maintenance of the norepinephrine infusion. In our protocol, aCPR must be exhausted (including the possibility of E-CPR) and the initial rhythm must be asystole for uDCDD to be activated. Indeed, death was declared at around 90 min after the CA in our series, during which aCPR measures have been maintained. So, we do consider that 5 min as an observation period is enough to confirm death.

Our study has several limitations. Our kidney survival data have included our learning curve in uDCDD, and the study period is >10 y, although the number of cases with a prolonged follow-up is still extremely low. We are also aware of the small sample size and that our study was not randomized. Finally, although we used a control group with similar characteristics, recipients were selected to receive a DNDD or a uDCDD graft based on an assessment of donor-recipient compatibility and other data by the treating team, so we cannot exclude a certain selection bias.

In summary, our results support that obtaining renal grafts from uDCDD donors is not only feasible but also provides results that are as good as those obtained from standard DNDD donors. Strict donor selection criteria, improved in-hospital logistics to reduce WIT, and the systematic use of A-NRP are key factors for success in terms of kidney utilization and posttransplant outcomes.

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