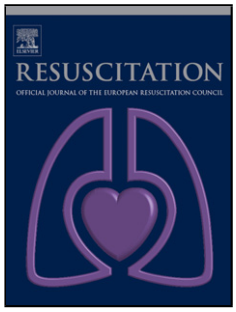
Potential organ donors after Out-of-Hospital Cardiac Arrest during a ten-year period in Stockholm, Sweden

Peder af Geijerstam, S. Forsberg, A. Claesson, T. Djärv, M. Jonsson, P. Nordberg, A. Tibell, F. Rosell Ortiz and M. Ringh

af Geijerstam, P., Forsberg, S., Claesson, A., Djärv, T., Jonsson, M., Nordberg, P., Tibell, A., Rosell Ortiz, F., Ringh, M., (2019), Potential organ donors after Out-of-Hospital Cardiac Arrest during a ten-year period in Stockholm, Sweden, *Resuscitation*, 137, 215-220.
https://doi.org/10.1016/j.resuscitation.2019.01.001



Title: Potential organ donors after Out-of-Hospital Cardiac Arrest during a ten-year period in Stockholm, Sweden

Authors: P. Geijerstam, S. Forsberg, A. Claesson, T. Djärv, M. Jonsson, P. Nordberg, A. Tibell, F. Rosell Ortiz, M. Ringh

PII: S0300-9572(18)30812-8
DOI: https://doi.org/10.1016/j.resuscitation.2019.01.001
Reference: RESUS 7847

To appear in: *Resuscitation*

Received date: 24 August 2018
Revised date: 29 November 2018
Accepted date: 2 January 2019

Please cite this article as: Geijerstam P, Forsberg S, Claesson A, Djärv T, Jonsson M, Nordberg P, Tibell A, Rosell Ortiz F, Ringh M.Potential organ donors after Out-of-Hospital Cardiac Arrest during a ten-year period in Stockholm, Sweden.*Resuscitation* (2019), https://doi.org/10.1016/j.resuscitation.2019.01.001

Potential organ donors after Out-of-Hospital Cardiac Arrest during a ten-year period in Stockholm, Sweden.

Geijerstam P[1], Forsberg S[1], Claesson A[1], Djärv T[1], Jonsson M[1], Nordberg P[1], Tibell A[2], Rosell Ortiz F[3], Ringh M[1]

[1]Karolinska Institutet, Department of Medicine, Solna, Sweden. Center for Resuscitation Science, Stockholm, Sweden

[2]Karolinska Institutet, Department of Learning, Informatics, Management and Ethics, Solna, Sweden

[3]Empresa Pública de Emergencias Sanitarias, Almería, Andalucía, Spain

[*]Corresponding author:

Mattias Ringh

Karolinska Institutet, Department of Medicine, Solna, Sweden. Center for Resuscitation Science, Department of Cardiology, Medical Intensive Care Unit, Södersjukhuset

Stockholm, Sweden

Mail: mattias.ringh@ki.se

Phone: 0046-70-7741878

Manuscript formatted for journal: Resuscitation

Word count: 2661

Abstract: 197 words

Abstract

Background: Donation after brain death (DBD) is current praxis in Sweden. Circulatory death is far more common. Donation from patients suffering Out-of-Hospital Cardiac Arrest (OHCA) may have the potential to increase the organ-donor pool. The aim of this study was to describe the potential donor pool and its characteristics if uncontrolled donation after circulatory death (uDCD) were to be implemented in the metropolitan area of Stockholm, Sweden.

Methods: A retrospective analysis was made using data from the Swedish Register for cardiopulmonary resuscitation (SRCR) between 2006 and 2015. Evaluation of potential organ donors was made using selection criteria from five previously published protocols concerning uDCD.

Results: When applying different criteria from each of the five studied protocols in a total of 9793 cases of OHCA, between 7.5% (n=732) and 1.5% (n=150) of the patients were found to be potential candidates for uDCD. The median age of the sampled uDCD candidates in each protocol was between 48 and 57 years. Male donors were found in 67–76% of all cases.

Conclusion: Although not taking important real-life limitations into account, our results indicate that implementation of a uDCD programme may substantially increase the number of potential organ donors in Stockholm.

1. Introduction

Organ transplantation improves quality of life and is a life-saving treatment for patients with end-stage organ failure (1, 2). The availability of organs is insufficient in Sweden, as in most parts of the world, which results in long organ-transplant waiting lists, with subsequent patient suffering. Every year, patients die while waiting for organs or remain dependent on renal replacement or other device therapy. In 2017, there were over 800 Swedish patients waiting for organ transplantation of which 40 died while waiting for organs. The number of utilized deceased donors was 188. The mismatched number of organ donors and demands has remained unchanged during the last decade in Sweden Welfare] (3).

The shortage in organ supply has prompted stakeholders to find new ways to increase the organ-donor pool. Although the will to donate among the Swedish population is amongst the highest in Europe (>80%), due to current practice, donation from dead donors originates only from donation after brain death (DBD) (4). In, 2015 a governmental investigation was launched to oversee the possibilities to increase organ donation in Sweden and a number of changes were suggested to make it possible to include organs from donors after circulatory death (5), (6).

Donation after Circulatory Death (DCD) is categorized according to modified Maastricht criteria as either controlled DCD (cDCD) or uncontrolled DCD (uDCD). The former is organ donation following planned withdrawal of life support and subsequent circulatory arrest (categories 3, 4), whereas the latter is donation that follows unexpected circulatory death (7). Several different protocols concerning uDCD have been implemented in other countries and have been shown to be effective in increasing the donor pool (8). Most donations in these settings are derived from unexpected Out-of-Hospital Cardiac Arrest (OHCA) (9).

The aim of this study was to investigate and describe the size and characteristics of the potential pool of uDCD donors in a Swedish metropolitan area (Stockholm) in relation to various previously implemented protocols for selection of uDCD patients.

2. Methods

2.1. The Swedish register for cardiopulmonary resuscitation

This observational retrospective study was based on prospectively collected data from the Swedish register for cardiopulmonary resuscitation (SRCR), which is a quality register supported by The National Board of Health and Welfare. In Sweden, approximately 5000 annual cases of OHCA are reported by the emergency medical services (EMSs). The register includes nearly 100% of all OHCA cases in Sweden where resuscitation has been attempted by the EMSs, and has been described in detail elsewhere (10). Data is reported in accordance with a structured report form, including a detailed description of the circumstances and interventional actions in each case of OHCA. Cases that are not reported by ambulance personnel, i.e. missing, are registered manually and retrospectively by use of ambulance records to reach a cover rate of nearly 100%.

2.3. Study population and settings

This study included all cases of OHCA treated by the Emergency Medical System in Stockholm County. Stockholm County is the most densely populated county in Sweden, with approximately 2.1 million inhabitants and an annual OHCA incidence of 47 per 100,000 person-years (11).

One single Emergency Dispatch Centre (EDC) dispatches EMSs. There are 52 round-the-clock and 72 day-time ambulances providing advanced life support (ALS) in cases of OHCA. In addition, there are three round-the-clock anaesthetic nurse or doctor-staffed emergency response vehicles that are dispatched in a two-tiered system in response to suspected OHCAs. There are seven emergency hospitals throughout the county that are potential recipients of OHCA cases.

2.4. Study design

All patients included in the Swedish cardiac arrest register suffering an OHCA in Stockholm County between January 1st 2006 and December 31st 2015 in whom resuscitation attempts were initiated by EMS crews but were declared dead outside hospital or at the emergency room were included in the study.

Different protocols have been proposed, using different criteria for selecting uDCD candidates (12). A search in PubMed was performed with the search term "donation after circulatory death", giving five protocols that had previously been implemented in clinical praxis (13-17). These five protocols were then used for patient selection.

Patients were excluded when the cause of cardiac arrest was not compatible with possible organ donation as stated within all the protocols (i.e. traumatic cardiac arrest). Patients were then subsequently classified as potential uDCD candidates according to each of the protocols' specific criteria such as age span and the time delay from the onset of cardiac arrest to initiation of cardiopulmonary resuscitation (CPR).

Different procedural time intervals such as initiation of CPR to start of organ preservation methods such as cannulation for extracorporeal membrane oxygenation or time to organ procurement were not taken into account.

Other relative or absolute contraindications for organ transplantation such as infectious disease or malignancies were also not taken into account.

2.5. Ethics

The local ethics committee approved this study (review number 2014/1700-32).

2.6. Statistical analysis

Sampling was carried out regarding the primary outcome variable, i.e. the annual number of OHCA patients that could qualify as potential organ donors. After identification, the results were

further analysed using descriptive statistics. Proportions were expressed in percentages; continuous variables were expressed as medians. P-values were two-tailed and considered significant if below 0.05. Trend tests were carried out using the Chi^2-test for trend. All statistical analyses were performed by using R for Mac OS version 3.3.3 (https://www.R-project.org).

3. Results

Between the 1st of January 2006 and the 31st of December 2015 there were 9,797 cases of OHCA that occurred in Stockholm County and were treated by the EMSs. After selection based on criteria that were common for all five previously published uDCD protocols, a total of 897 (9.2%) patients were found to be potential subjects for uDCD (Figure 1). This corresponds to an average annual number of approximately 90 potential uDCD candidates in Stockholm County. After further selection based on criteria that differed in the previously published and implemented protocols (e.g. differences in time from cardiac arrest to initiation of CPR, and age span), the proportion of potential uDCD candidates ranged from 150 (1.5%) to 732 (7.5%). This corresponded to an annual number of approximately 15 to 73 potential uDCD candidates in Stockholm County, or an annual incidence of 0.7/100 000 to 3.5/100 000 inhabitants.

The median age of the sampled uDCD candidates per protocol ranged from 48 to 57 years. Most potential donors were males and were found to constitute 66.7% to 76.1% of all cases. The proportion of OHCAs occurring at home ranged from 46.6% to 54.1% (Table 2).

The proportion of potential donors decreased significantly over time in all but one applied protocol (Figure 2). The largest decrease was seen in connection with the Maastricht protocol, where the potential donors decreased from 10.2% to 5.8%. Furthermore, the proportion of patients suffering from OHCA and surviving to hospital admission and past the emergency room increased

significantly during the same time (from 22.5% in 2006 to 30.0% in 2015; p for trend <0.001), as shown in Table 3.

4. Discussion

Organ shortage results in patient suffering and death as well as societal monetary expenses. This a common issue for healthcare stakeholders in most parts of the world and new ways are sought to increase the organ-donor pool. In Sweden, where the will amongst the general population to donate is over 80%, there are unacceptably long organ waiting lists. After a recent governmental initiative and investigation, possible changes in clinical praxis were indicated in order to make it possible to include organs from donors dying from circulatory problems. As a first step, a pilot project has been launched with the aim of implementing cDCD. In the future, the next step might be to expand to uDCD. The aim of this study was therefore to investigate the potential number of candidates that might be subjects for uncontrolled donation after circulatory death in a metropolitan area in Sweden. We also wanted to investigate how different selection criteria, already in clinical use, affect the potential number of uDCD donors.

The results show that the potential number of OHCA donors ranges between 1.5% to 7.5% of all OHCAs, depending on which criteria are used. We believe that it is important to know how different selection criteria based on previously published uDCD protocols will have a significant impact on the average annual number of potential uDCD candidates when such a programme is initiated. Dependent on the selection criteria that are applied, the number ranges between 15 to 73 individuals that would qualify as potential uDCD organ donors every year.

In a recent retrospective study based on data from a Spanish OHCA register, areas with an established uDCD programme were compared with regions without one (9) In the latter regions 7.4% of all OHCA cases were found to be potential subjects for uDCD, whereas in regions with an established programme only 4% actually became uncontrolled donors and 5% were identified as uDCD candidates. Interestingly, in regions with established uDCD programmes, as many as 9% of

all OHCA cases either became donors or were considered to be potential uDCD candidates. The proportion of potential uDCD subjects in the Spanish cohort is in line with the results found in our study. However, our data also indicate a significant decrease in the proportion of uDCD candidates during the time frame studied, as well as a concomitant increase in the proportion of OHCA patients surviving past the emergency room. The latter results are in line with those in a Swedish register for cardiopulmonary resuscitation annual report (11), showing that patients admitted to hospital alive increased from 15% to 25% between 1992 and 2013. Although more patients are surviving past the ER, such patients would not be subjects for uDCD as they could be subjects for cDCD at a later stage, especially in centres where extracorporeal membrane oxygenation-assisted CPR (E-CPR) is used. If the trend continuous and the proportion of patients admitted alive increases there might be a discussion about the effectiveness of a uDCD programme in that setting. However, such a dramatic increase in survival is seldom the case. In most EMSs, survival after OHCA has stagnated at about 10%. Therefore, we consider the results not as an indication that uDCD programmes are not worthwhile, since in Stockholm County alone there might be about 70 annual uDCD donors compared with the current number of about 180 donors in the whole of Sweden, and this in a community with relatively high survival rates.

4.1. Characteristics of the potential donors

Male represented between 67 and 76% of our potential uDCD candidates. This is in line with the results of other studies, where the proportion has been between 62% and 80% (13, 15, 18). Further, this can be expected, since most patients suffering from cardiac arrest are male, and since the proportion of male cardiac-arrest patients is higher in lower age groups (11).

Half of our potential uDCD candidates suffered OHCA at home (47–54%). Another uDCD study also revealed that about half of the patients (52.4%) suffered OHCA at home (15).

4.2. Results in relation to current donor numbers and the effect on organ numbers

Our results can be compared with the current annual number of potential DBD donors. The number of potential DBD donors in the whole of Sweden has been estimated to be around 270 (3), whereas actual DBD donors number about half of this. Approximately 16% of the actual DBD donors come from Stockholm County (3). Thus, the introduction of a uDCD programme, theoretically contributing to an additional 12–73 donors annually, could lead to a potential doubling of the number of donors in Stockholm County. The implementation of an uDCD programme should also be compared with the potential benefits of a cDCD programme. In Sweden, the total potential number of cDCD candidates has been estimated to be around 40 to 80 annually (19). Furthermore, an increased number of donors would increase the number of available organs and thus lead to a shortening of the organ-transplantation waiting lists. However, there are significant logistical challenges to overcome when implementing a uDCD programme. Both the pre-hospital and in-hospital care of OHCA patients must change. First, EMS response times must be short and patients (without interruptions in CPR) must be transported to hospital as soon as possible in order to meet critical time constraints. This demands a change of logistics where devices for mechanical chest compression are widely deployed among EMS operators (20). Second, there has to be a change of praxis from the current “stay-and-play” (treat at the scene) to “load-and-go” (rapid transfer with ongoing CPR to designated cardiac arrest centres) to meet critical time frames. Third, when these patients arrive at hospital, a well-practised response is needed in order to optimize resuscitation efforts, decision-making and retrieval of consent. Fourth, there must be adequate logistic arrangements for organ preservation methods and retrieval.

There are several other limitations in our study. First, the potential number of uDCD donors in our study is an ideal number and will probably be lower in reality. For example, ambulance personnel can miss potential cases and critical time frames might not be met. Second, judicial issues such as

consent to donate were not accounted for because of the retrospective nature of this study. Third, patient data that would exclude donation such as infectious disease or malignancies were not taken into account. However, assuming a similar rate of consent as for DBD in Sweden (3), the annual number of consenting potential uDCD donors would be between 9 to 29 (73% of 12 and 40 respectively). However, the results of several studies have suggested that consent rates are higher in connection with DCD versus DBD (13, 21, 22).

Implementation of DCD (controlled and uncontrolled) programmes in others countries has shown mixed impact on the total number of available organs, the increase ranging from 10 to 44% (23) (15) (24) (18). In another study it was concluded that uDCD in the United States could supply 61% of all donated organs if realized to its full potential (16).

4.3. Future studies, implications and applications

We consider our results conclusive insofar as to affirm that an uDCD programme in Stockholm County has the potential to increase the number of organ donors significantly. Our study was limited geographically to Stockholm County, which differs from Sweden as a whole in both OHCA characteristics and outcome (11). Thus, our results are not applicable to the whole country but might be generalized to other urban areas sharing similar geographical and demographic characteristics.

We acknowledge several other limitations in our study. It was a retrospective study and thus could not account for several medical criteria of potential donors, donors' consent as well as protocol criteria related to logistics. Protocol criteria related to logistics, specified as follows, could not be accounted for since our study was retrospective: initiation of preservation methods within 120 minutes, and organ extraction within another 180 minutes. However, the study took place within a metropolitan area with relatively short distances to tertiary centres. It is our assumption that the

logistic criteria could be met in the majority of cases. Although, it cannot be ruled out that a limited number of real life donors would fall outside critical time frames in case of a clinical uDCD program was implemented.

The protocols we have used have not been validated, and although standardized DCD protocols have been proposed (12), protocols of centres concerned with uDCD differ in terms of technical procedures as well as inclusion criteria (13-17). These protocol discrepancies indicate both a lack of evidence as well as international differences in culture and legislation. Therefore, prospective studies are needed in order to investigate how many of these potential donors actually donate, and the degree to which those donations would have an effect on organ transplantation waiting lists.

5. Conclusion

Although not taking important real-life limitations into account, our results indicate that implementation of a uDCD programme may substantially increase the number of potential organ donors in Stockholm. Practical implementation of such programme is needed in order to investigate if this is feasable in a real-life setting.

Conflict of interest statement

The authors declare that they have no conflicts of interest.

References

1. Maggiore U, Oberbauer R, Pascual J, Viklicky O, Dudley C, Budde K, et al. Strategies to increase the donor pool and access to kidney transplantation: an international perspective. Nephrol Dial Transplant. 2014.
2. Wolfe RA, Ashby Vb Fau - Milford EL, Milford El Fau - Ojo AO, Ojo Ao Fau - Ettenger RE, Ettenger Re Fau - Agodoa LY, Agodoa Ly Fau - Held PJ, et al. Comparison of mortality in all patients on dialysis, patients on dialysis awaiting transplantation, and recipients of a first cadaveric transplant. (0028-4793 (Print)).
3. Welfare] SNBoHa. Organdonatorer i Sverige 2013 - En rapport baserad på dödsfall inom intensivvården [Organ donators in Sweden 2013 - A report based on death cases within intensive care]: Socialstyrelsen [National Board of Health and Welfare]; 2014 [Available

from: http://www.socialstyrelsen.se/Lists/Artikelkatalog/Attachments/19477/2014-6-26.pdf.

4. Affairs] STMoHaS. Lag om kriterier för bestämmande av människans död (SFS 1987:269) [Legislation on criteria for determination of a persons death]. Stockholm: Socialdepartementet [The Ministry of Health and Social Affairs]; 1987.
5. Welfare] SNBoHa. Förutsättningar för organdonation [Conditions for organ donations]: Socialstyrelsen [National Board of Health and Welfare]; 2012 [Available from: http://www.socialstyrelsen.se/nyheter/2012november/forutsattningarfororgandonation.
6. Affairs] STMoHaS. Komittédirektiv - Utredning om donations- och transplantationsfrågor [Comittee directive – Research on donation and transplantation issues] Stockholm: Socialdepartementet [The Ministry of Health and Social Affairs]; 2013 [Available from: http://www.regeringen.se/content/1/c6/21/01/95/56efe4e2.pdf.
7. Thuong M, Ruiz A, Evrard P, Kuiper M, Boffa C, Akhtar MZ, et al. New classification of donation after circulatory death donors definitions and terminology. Transplant international : official journal of the European Society for Organ Transplantation. 2016;29(7):749-59.
8. Wind J, Faut M, van Smaalen TC, van Heurn EL. Variability in protocols on donation after circulatory death in Europe. Crit Care. 2013;17(5):R217.
9. Navalpotro-Pascual JM, Echarri-Sucunza A, Mateos-Rodriguez A, Peinado-Vallejo F, Del Valle PF, Alonso-Moreno D, et al. Uncontrolled donation programs after out-of-hospital cardiac arrest. An estimation of potential donors. Resuscitation. 2018;122:87-91.
10. Strömsöe A, Svensson L, Axelsson ÅB, Göransson K, Todorova L, Herlitz J. Validity of reported data in the Swedish Cardiac Arrest Register in selected parts in Sweden. Resuscitation. 2013;84(7):952-6.
11. Herlitz J. Svenska Hjärt- lungräddningsregistret : årsrapport 2014 [Swedish National Registry of Cardiopulmonary Resuscitation : annual report 2014]: Svenska Hjärt-lungräddningsregistret [Swedish National Registry of Cardiopulmonary Resuscitation]; 2014 [Available from: http://hlr.nu/wp-content/uploads/Svenska-HLR-registret-Arsrapport-2014.pdf.
12. Morrissey PE, Monaco AP. Donation after circulatory death: current practices, ongoing challenges, and potential improvements. Transplantation. 2014;97(3):258-64.
13. Miranda-Utrera N, Medina-Polo J, Pamplona M, de la Rosa F, Rodriguez A, Duarte JM, et al. Donation after cardiac death: results of the SUMMA 112 - Hospital 12 de Octubre Program. Clin Transplant. 2013;27(2):283-8.
14. Nunez JR, Del Rio F, Lopez E, Moreno MA, Soria A, Parra D. Non-heart-beating donors: an excellent choice to increase the donor pool. Transplantation proceedings. 2005;37(9):3651-4.
15. Fieux F, Losser MR, Bourgeois E, Bonnet F, Marie O, Gaudez F, et al. Kidney retrieval after sudden out of hospital refractory cardiac arrest: a cohort of uncontrolled non heart beating donors. Crit Care. 2009;13(4):R141.
16. Wall SP, Munjal KG, Dubler NN, Goldfrank LR, Group NuS. Uncontrolled organ donation after circulatory determination of death: US policy failures and call to action. Ann Emerg Med. 2014;63(4):392-400.

17. Hoogland ERP. Kidney Transplantation Form Donors After Cardiac Death: Ways to Improve DCD Kidney Donation and Transplantation: Universitaire Pers; 2014.

18. Snoeijs MG, Winkens B, Heemskerk MB, Hoitsma AJ, Christiaans MH, Buurman WA, et al. Kidney transplantation from donors after cardiac death: a 25-year experience. Transplantation. 2010;90(10):1106-12.

19. Vävnadsrådet. Offentlig presentation - donation efter cirkulationstillstånd [Web page]. 2017 [Available from: http://vavnad.se/wp-content/uploads/2017/05/offentlig-presentation-donation-efter-cirkulationsstillestand.ppsx.

20. Rubertsson S, Lindgren E, Smekal D, Östlund O, Silfverstolpe J, Lichtveld RA, et al. Mechanical chest compressions and simultaneous defibrillation vs conventional cardiopulmonary resuscitation in out-of-hospital cardiac arrest: the LINC randomized trial. JAMA: the journal of the American Medical Association. 2014;311(1):53-61.

21. Alvarez J, del Barrio R, Arias J, Ruiz F, Iglesias J, de Elías R, et al. Non-heart-beating donors from the streets: an increasing donor pool source. Transplantation. 2000;70(2):314-7.

22. Andrés A, Morales E, Vázquez S, Cebrian MP, Nuño E, Ortuño T, et al. Lower rate of family refusal for organ donation in non-heart-beating versus brain-dead donors. Transplant Proc. 2009;41(6):2304-5.

23. Saidi RF, Bradley J, Greer D, Luskin R, O'Connor K, Delmonico F, et al. Changing pattern of organ donation at a single center: are potential brain dead donors being lost to donation after cardiac death? Am J Transplant. 2010;10(11):2536-40.

24. Saidi RF, Hejazii Kenari SK. Challenges of organ shortage for transplantation: solutions and opportunities. Int J Organ Transplant Med. 2014;5(3):87-96.

Figure Caption

Figure 1. Flowchart of potential donors, Stockholm, 2006–2015, n=9,793 OHCA cases.

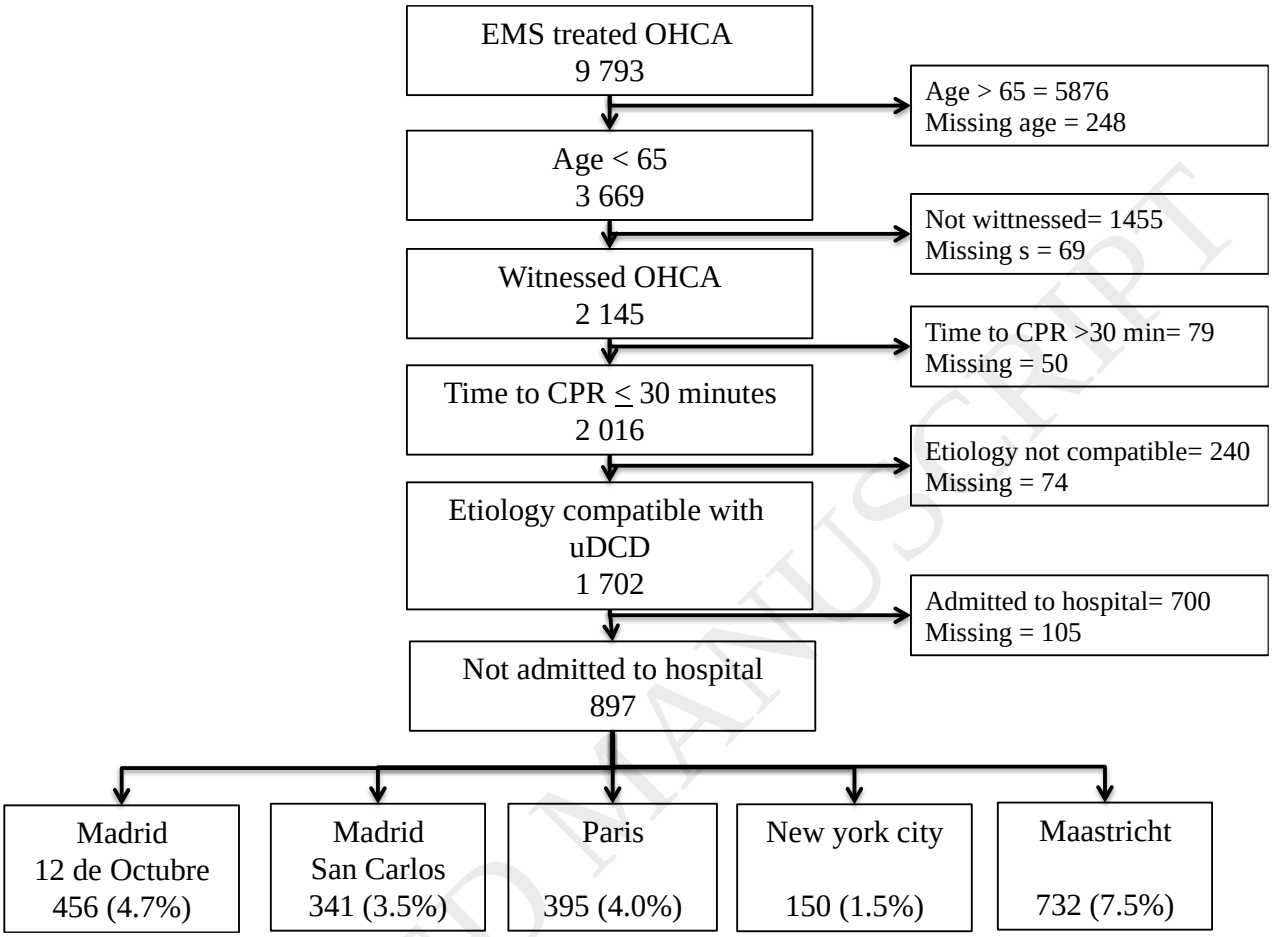


Figure 1. Flowchart of patient sampling. The first selections were made on the basis of critera that were in common in all five studied protocols, resulting in 897 potential candidates. We then selected on the basis of individual criteria of each of the five protocols, resulting in between 150 to 732 potential candidates.

Figure 2. Proportion of potential uncontrolled donation after circulatory death (uDCD) donors by year of OHCA and survival past the ER.

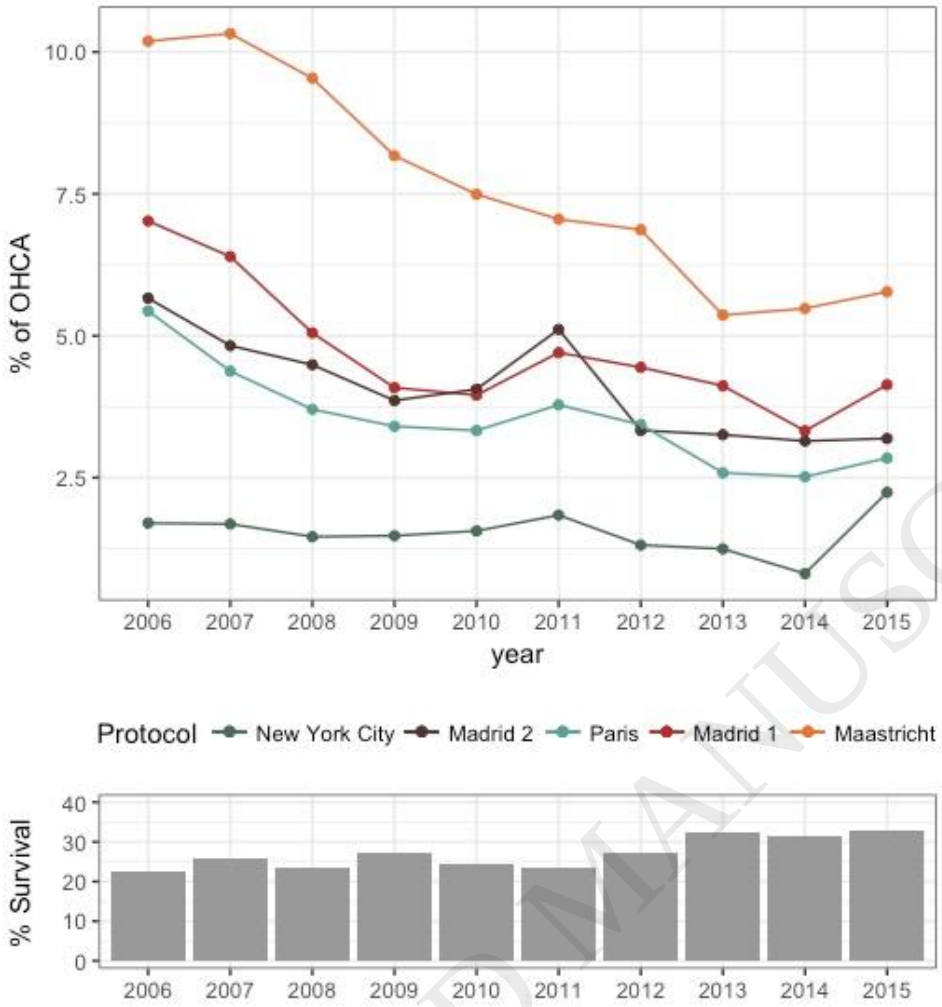


Table 1. Criteria on patient characteristics for uncontrolled donation after circulatory death (uDCD).

Based on previously published uDCD protocols.

Protocol/ Criteria	**Madrid, Spain (13)**	**Madrid, Spain(14)**	**Paris, France (15)**	**New York, USA (16)**	**Maastricht, Nether-lands (17)**
Age	18–60	7–55	18–55	< 60	< 65
CA to CPR (minutes)	< 10	< 15	< 30	0	< 10
Witnessed CA	Yes		Yes	Yes	Yes
Medical characteristics	Cause of death known or easily diagnosed, no evidence of bleeding lesions in thorax or abdomen or HIV risk factors		No evidence of hypertension, diabetes, cancer, sepsis, HIV, HBV, HCV, renal disease or abdominal trauma	No evidence of renal failure, liver disease, IVDA, suicide, homicide, major trauma, vascular disease or brain stem activity	No systemic signs of infection or evidence of sepsis

Abbreviations: CA = cardiac arrest; CPR = cardiopulmonary resuscitation; HBV = hepatitis B virus; HCV = hepatitis C virus; IVDA = intravenous drug abuse.

Table 2. Protocol inclusion criteria for uncontrolled donation after circulatory death (uDCD), the number of potential cases and base-line characteristics of uDCD in Stockholm for each protocol criterion.

Protocol/ Criteria[1]	Madrid, Spain (13)	Madrid, Spain (14)	Paris, France (15)	New York, USA (16)	Maastricht, Netherlands (17)
Age	18–60	7–55	18–55	< 60	< 65
CA to CPR, minutes	< 10	< 15	< 30	0	< 10
Results					
Potential uDCD candidates, n	465	341	395	150	732
Age in years, median (q1, q3)	53 (46-57)	48 (41-52)	48 (42-52)	53 (45-57)	57 (50-62)
Sex, male, n (%)	347 (76.1)	258 (75.7)	295 (74.7)	100 (66.7)	548 (74.9)
OHCA location, home, n (%)	232 (51.1)	173 (50.7)	206 (52.7)	70 (46.6)	395 (54.1)

1. Protocol criteria that varied between protocols. Criteria concerning logistical requirements (transfer time to hospital, stand-off period, time to initiation of preservation methods and time to organ extraction) are not listed, as they could not be studied retrospectively.

Abbreviations: CA = cardiac arrest; CPR = cardiopulmonary resuscitation; uDCD = uncontrolled donation after circulatory death; ER = emergency room.