ORIGINAL ARTICLE

Analysis of potential donor losses in the emergency departments of non-transplanting hospitals in the Community of Madrid (Spain)

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Objective. In 2022, a retrospective analysis was conducted in public hospitals in the Community of Madrid (Spain) without transplant programs. The aim was to evaluate the loss of potential donors with catastrophic brain injury.

Methods. We used clinical and administrative databases (CMBD, CORE-ONT, and HORUS). Deceased patients with compatible diagnoses according to ICD-10 were included, excluding those with active tumor disease. Relevant clinical variables were analyzed, and patients were categorized into 3 groups: evaluated as donors, ineligible as donors, and potential donors not evaluated. Statistical analysis included univariate techniques and a multivariate analysis using categorical principal components analysis (CATPCA).

Results. Out of 1,429 deceased patients, 12 evaluated donors, 39 ineligible donors due to medical criteria, and 33 potential donors who were not evaluated were identified. This last group represents a significant loss in donation potential. Most effective donors were patients younger than 70 years admitted to hospitals with neurosurgery, in intensive care units, with prolonged mechanical ventilation, and without severe organ failure. In contrast, non-donors presented higher rates of comorbidities such as septic shock or renal failure. Multivariate analysis via CATPCA identified a total of 3 patient patterns and highlighted a significant group of missed potential donors.

Conclusions. These findings reinforce the need to implement strategies to improve early donor detection, such as emergency department staff training, inter-hospital collaboration, and use of technological tools. The study concludes that a structured intervention could significantly reduce donor loss in non-transplant centers.

Keywords: Donation. Emergency. Transplant.

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Análisis de las pérdidas de potenciales donantes en el servicio de urgencias de los hospitales no trasplantadores de la Comunidad de Madrid

Objetivo. Análisis retrospectivo en hospitales públicos de la Comunidad de Madrid sin programa de trasplante durante el año 2022 para evaluar la pérdida de posibles donantes con daño cerebral catastrófico.

Métodos. Se utilizaron bases de datos clínicas y administrativas (CMBD, CORE-ONT y HORUS) y se incluyeron pacientes fallecidos con diagnóstico compatible según la CIE-10, excluyendo aquellos con patología tumoral activa. Se analizaron variables clínicas relevantes y se clasificó a los pacientes en tres grupos: valorados como donantes, no posibles donantes y posibles donantes no evaluados. El análisis estadístico incluyó técnicas univariantes y un análisis multivariante mediante escalamiento óptico de datos categóricos (CATPCA), utilizando SPSS.

Resultados. De 1.429 fallecidos, se identificaron 12 donantes valorados, 39 no aptos por criterios médicos y 33 posibles donantes que no fueron evaluados. Este grupo representa una pérdida significativa del potencial de donación. La mayoría de los donantes efectivos fueron pacientes con edad inferior a 70 años, ingresados en hospitales con neurocirugía, en unidades de cuidados intensivos, con ventilación mecánica prolongada y sin fallo orgánico grave. En contraste, los no donantes presentaban mayores tasas de comorbilidades como *shock* séptico o insuficiencia renal. El análisis multivariante mediante CATPCA identificó tres patrones de pacientes y evidenció un grupo relevante de posibles donantes omitidos.

Conclusión. Estos hallazgos refuerzan la necesidad de implementar estrategias para mejorar la detección precoz de donantes, como la formación del personal de urgencias, la colaboración entre hospitales y el uso de herramientas tecnológicas. Una intervención estructurada podría reducir significativamente la pérdida de donantes en centros sin trasplante.

Palabras clave: Donación. Ugencias. Trasplante.

Introduction

The donor rate in Spain, both in brain death and circulatory death, is 48.9 donors per million population (pmp) in 2023,[1] close to the target of 50 donors pmp established by the National Transplant Organization (ONT) in its Strategic Plan.[2] However, in the Community of Madrid (Spain) this rate reached

38.1 donors pmp in 2023, despite being one of the regions with the highest transplant activity.[1] The reasons for this rate—far below the national average—are multifactorial, but increasing the detection of potential donors is one of the first necessary steps to reverse it.

Several publications describe that the areas where donor detection can be improved include intensive care units and hospital emergency departments, which receive patients with catastrophic brain injury who are ineligible for any medical or surgical procedure. Indeed, a collaborative article by the Spanish Society of Emergency Medicine (SEMES) and the ONT has highlighted the importance of the role played by emergency department professionals in the donation process.[3] More recently, this role of emergency physicians has also been emphasized in other countries such as the United Kingdom and the United States.[4,5]

The Expanded Quality Assurance Program (PGCa) in the donation process is a quality management tool of the ONT designed to register all patients who died from catastrophic brain damage and to track their evolution until donation or death, with or without donation, defining catastrophic brain injury according to a list of ICD-10 diagnostic codes.[6] Although the main objective is monitoring within critical care units, the program also facilitates follow-up outside these areas by transplant coordinators, representing an essential analysis to identify potential donors and the capacity for donation-focused intensive care in each center.

The Specialized Care Activity Registry (RAE-CMBD) was implemented in 2016 in the Spanish National Health System as a new data model for the Minimum Basic Data Set (CMBD) of hospital discharges, integrating both administrative and clinical information. This clinical information includes principal discharge diagnoses based on ICD-10 diagnostic and procedure codes.

In the Community of Madrid (Spain), patients treated in emergency departments—with or without hospital admission—who present with catastrophic brain injury and are ineligibles for any medical or surgical procedure remain mainly in hospitals that do not have a transplant program, regardless of whether they have neurosurgery services. Several publications have highlighted the importance of detecting these potential donors in areas outside the intensive care unit, particularly in emergency departments.[3] Detecting potential donors in emergency departments may lead to an increase in effective donors. The first step in donation is detection, for which all professionals—and particularly those working in emergency departments—should be trained.[7] The present study conducts a retrospective analysis aimed at quantifying patients with catastrophic brain injury, identified through ICD-10 codes in the RAE-CMBD, treated during 2022 in hospitals without transplant programs in the Community of Madrid, and examining, through clinical record review, both contraindications for donation and the non-identification of potential donors.

Method

We conducted a retrospective observational study on a cohort of patients who died with a diagnosis of catastrophic brain injury in 11 public hospitals without transplant programs in the Community of Madrid between January 1st and December 31st, 2022. The selection of non-transplant hospitals was based on strategic limitations regarding record review and aligned with the ongoing actions of the regional transplant coordination office. These hospitals have a transplant coordinator and, in some cases, supporting nursing staff. Coordinators are intensivist physicians with limited time to perform coordination duties.

Data sources

Data were obtained from the hospital CMBD of the Community of Madrid, provided by the Directorate General of Digital Health; CORE-ONT (the national digital registry for all donation and transplant activity); and HORUS (the regional electronic medical record repository).

Inclusion and exclusion criteria

We included patients with a diagnosis of death at hospital discharge and ICD-10 diagnostic codes for catastrophic brain injury according to ONT criteria[8] (Table 1). Patients with active malignant disease[9] were excluded.

Explanatory variables

Variables analyzed included: age, sex, ICD-10 diagnosis, date of admission to the ED and to the hospital ward, discharge date, admitting and discharging department, presence of a neurosurgery service at the hospital, mechanical ventilation (MV) initiated within the first 24 hours, presence of septic shock, use of norepinephrine (> 2 mcg/kg/min), acute kidney injury (Cr > 2 mg/dL), and hepatic dysfunction (parenchymal enzymes twice the upper normal limit).

Outcome variable: donor evaluation

Donor evaluation was performed through independent review of the clinical record by two evaluators from the Regional Transplant Office (ORCT) of the Community of Madrid, classifying patients as: "Evaluated as donor" during hospital admission (with subcategories "real donor" and "family refusal") "not a possible donor" (absolute contraindications: disseminated infection or multiorgan failure), and "potential donor" (no donor evaluation performed and no contraindications identified).

Statistical analysis

Qualitative variables are expressed as counts and percentages; quantitative variables as mean ± SD or

Table 1. Characteristics of the Study Groups

	Assessed as donors N = 12 n (%)	Assessed as not a possible donor N = 39 n (%)	Possible donor (not assessed) N = 33 n (%)
ICD-10 Etiology			
Skull fracture	1 (8.3)	0 (0)	1 (3)
Non-traumatic ICH	5 (41.7)	11 (28.2)	9 (27.3)
Non-traumatic SAH	2 (16.7)	7 (17.9)	4 (12.1)
Non-traumatic SDH	2 (16.7)	7 (17.9)	5 (15.2)
Cerebral infarction	2 (16.7)	10 (25.6)	12 (36.4)
Bacterial meningitis	0 (0)	1 (2.6)	1 (3)
Benign brain neoplasm	0 (0)	0 (0)	1 (3)
Malignant brain neoplasm	0 (0)	3 (7.7)	0 (0)
Sex			
Male	6 (50)	18 (46.2)	17 (51.5)
Age groups			
< 65 years	6 (50)	2 (5.1)	13 (39.4)
66–70 years	4 (33.3)	5 (12.8)	1 (3)
71–75 years	0 (0)	6 (15.4)	4 (12.1)
76–80 years	0 (0)	8 (20.5)	5 (15.2)
> 81 years	2 (16.7)	18 (46.2)	10 (30.3)
Age (years) [mean (SD)]	66 (10)	80 (9)	70 (17)
Mechanical ventilation	11 (91.7)	13 (33.3)	15 (45.5)
Mechanical ventilation time, hours [median (IQR)]	78 (36.127)	0 (0.105)	0 (0.75)
Septic shock	1 (8.3)	8 (20.5)	0 (0)
Acute kidney failure	1 (8.3)	12 (30.8)	1 (3)
Norepinephrine > 2 mcg/kg/min	3 (25)	4 (10.3)	0 (0)
Liver failure	1 (8.3)	9 (23.1)	3 (9.1)
Length of stay, days [median (IQR)]	4 [3. 8]	1 [0.7]	2 [1.5]
Hospital with neurosurgery	12 (100)	26 (66.7)	23 (69.7)
Admission to intensive medicine	11 (91.7)	16 (41)	17 (51.5)

ICH: intracranial hemorrhage; SAH: subarachnoid hemorrhage; SDH: subdural hemorrhage.

median and interquartile range (IQR) according to the Kolmogorov–Smirnov test. Comparisons between "not a possible donor" and "possible donor" groups were performed using chi-square tests for qualitative variables and t-tests or Kruskal–Wallis tests for quantitative variables. We conducted a multivariate descriptive analysis using optimal scaling for categorical principal components (CATPCA). CATPCA is a descriptive, multivariate technique used to explore and explain relationships between variables: it does not define dependent variables or hypotheses, does not produce statistical inferences, and does not require sample size calculation, although 5–10 cases per variable are typically recommended—which was met in this study.

Results

Throughout the 1-year study period, a total of 1,429 patients who died in hospitals without a renal transplant program in the Community of Madrid presented catastrophic brain injury as the principal diagnosis. Of these, 314 met exclusion criteria due to oncologic disease. Among the remaining 1,115 patients, 120 were admitted to centers without a transplant program; after excluding 20 cases transferred to long-stay facilities, the clinical records of 100 patients were reviewed.

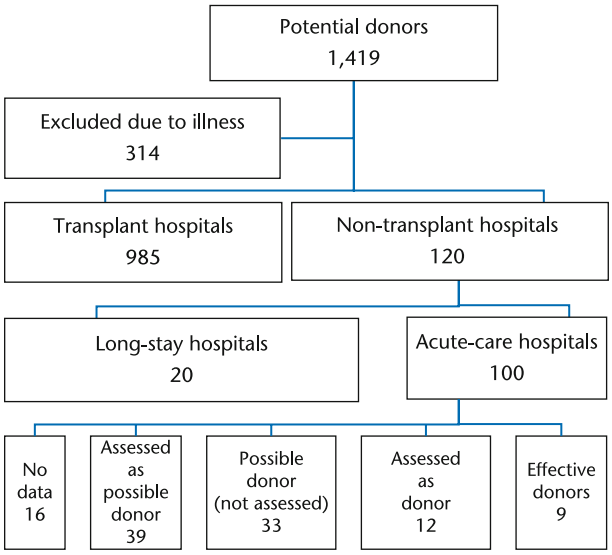

Figure 1. Population inclusion diagram.

Sixteen of these 100 patients could not be analyzed due to insufficient data. Twelve patients were evaluated as donors, 9 of whom became effective donors, while 39 patients were considered ineligible donorss. A total of 33 patients were categorized by the evaluators—based on the review of clinical records—as potential donors who did not eventually become donors, and whose health records did not contain any reference to donor evaluation by the transplant coordination team.

Among the principal causes of death, non-traumatic intracerebral hemorrhage was predominant across all groups and was the most common cause among evaluated donors (41.7%), followed by ischemic stroke, which predominated among potential donors (36.4%). Regarding sex, men represented the majority in all 3 groups.

Regarding age, patients evaluated as donors had a mean age of 66 years, while non-possible donors were older, with a mean of 80 years. Potential donors who were not evaluated had an intermediate mean age of 70 years, and in this latter group, patients aged ≤ 65 years were predominant (39.4%). Mechanical ventilation (MV) was more frequent among donors (91.7%) and less common among non-possible donors (33.3%), with longer ventilation times among donors (median, 78 hours).

Complications such as septic shock and acute kidney injury were more frequent among non-possible donors (20.5% and 30.8%, respectively). Similarly, hepatic dysfunction affected this group more frequently (23.1%), whereas it was less common among evaluated donors (8.3%). The length of stay was shorter for non-possible donors (median 1 day) vs evaluated donors (median 4 days).

Finally, all patients evaluated as donors were treated in hospitals with neurosurgery services, as were most

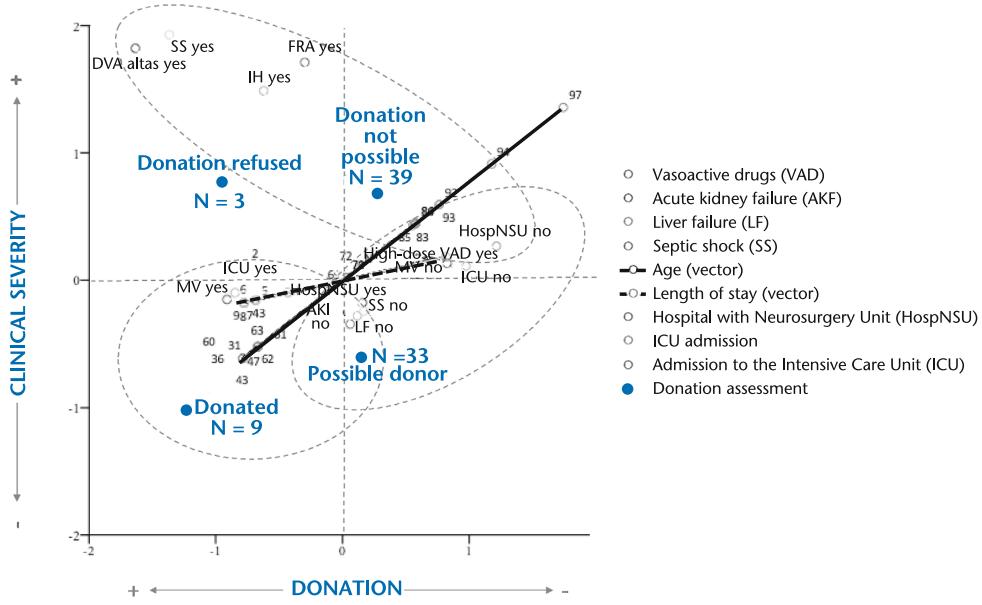

Figure 2. Categorical component analysis of the variables collected in the descriptive analysis.

unevaluated potential donors (69.7%). Admission to intensive care units was more frequent among evaluated donors (91.7%) and among unevaluated potential donors (51.5%).

Figure 2 illustrates the results of applying CATPCA to the original set of variables. The purpose of CATPCA is to reduce the dataset into a smaller number of dimensions (components or factors) that eliminate redundant information while preserving most of the variability. Dimensionality reduction facilitates interpretation and graphical representation, making it possible to identify patterns and relationships among variables that may not be evident in conventional descriptive analysis. The graphical output identifies 2 dimensions (with the X-axis representing donation outcome and the Y-axis representing clinical severity). Three patterns emerge: the 12 evaluated donors (9 real donors and 3 with family refusal) cluster in the lower-left quadrant, associated with hospitals with neurosurgery, intensive care admission (and corresponding life-support measures), absence of organ failure, age < 70 years, and short lengths of stay. In contrast, non-possible donors cluster in the opposite quadrant (upper-right), characterized by organ failure, absence of mechanical ventilation, advanced age, and short lengths of stay. CATPCA recognizes a third, independent cluster (lower-right quadrant) of potential donors who were never evaluated, despite lacking significant clinical severity—highlighting a critical area of missed opportunities.

Discussion

The continued increase in transplant indications—and consequently the need to maintain adequate donation rates—requires a sustained effort to detect potential donors. Within the framework of the PGCa and donation-oriented intensive care, this obligation extends beyond traditional critical-care areas. Active participation of emergency departments, continuous training of healthcare personnel, and close collaboration with transplant coordination teams are essential to improving organ and tissue donation rates.[10]

The present retrospective analysis reveals a significant opportunity to improve the identification of potential donors who die in hospitals without a transplant program. Over 1 year, a total of 1,429 patients with catastrophic brain injury were detected; after exclusions, 100 representative cases were evaluated. Among these, 33% (n = 33) were identified as potential donors but were never evaluated, despite lacking absolute contraindications. This figure is consistent with published literature, where 25%–40% of potential donors are lost due to failures in detection or timely referral.[11,12]

One of the most salient findings is the pattern revealed by the CATPCA analysis, showing 3 clear patient clusters: actual donors, non-possible donors, and overlooked potential donors. This last category represents a critical gap in the donation process. The concept of "missed donors" is well documented, particularly in hospitals without active transplant structures. For example, the multicenter study by Vincent[13] demonstrated that up to 35% of potential donors in European hospitals without transplant units were never considered due to lack of detection protocols or absence of a resident transplant coordinator.

Factors associated with a higher likelihood of donor evaluation in this study coincide with those previously published: age < 70 years, length of stay > 48 hours, prolonged MV, ICU admission, and treatment in a hospital with neurosurgery.[14] The strong correlation between advanced life support and donor evaluation un-

derscores the importance of early stabilization of critically ill patients, a point emphasized in ONT and Council of Europe clinical practice guidelines.[15]

Of note, non-possible donors presented greater acute comorbidity (septic shock, hepatic failure, acute kidney injury), which is consistent with current exclusion criteria. However, the finding that a substantial number of viable potential donors were not evaluated suggests organizational limitations, insufficient clinical awareness, or absence of structured detection protocols in these centers.

Another significant variable was the presence of neurosurgery. All actual donors came from hospitals with neurosurgery, suggesting that such services not only improve diagnosis and management of catastrophic neurological injury but also enhance awareness and visibility of the donation process. This observation aligns with findings from Matesanz *et al.*[16], showing that hospitals with neurosurgery report a 40% higher detection rate of potential donors vs those without such services.

Finally, the actual donor's mean age (66 years) was lower than that of non-possible donors (80 years), yet relatively high vs historical standards, reflecting the trend toward expanding donor criteria—consistent with recent studies from Spain and other European countries.[17]

A major limitation of this study is the number of health records reviewed. The gap between hospital deaths and actual donors is large, as only a subset of deaths meet the stringent conditions required for donation.[2] Another key limitation is the limited human resources available for donor detection in these centers. Having only 1 transplant coordinator significantly restricts coordination activities, which in more complex hospitals are carried out by teams of 3–4 professionals. Nevertheless, the essential task of staff sensitization is similar in both settings.

This study reveals a significant loss of potential donors in hospitals without transplant programs, where one-third of clinically viable patients were never evaluated. The lack of neurosurgery and intensive care units, along with the absence of active detection protocols, hinders the identification and stabilization of potential donors. Factors such as MV and length of stay were positively associated with donor viability, emphasizing the need to avoid premature withdrawal of life support. CATPCA analysis further identified clinical profiles predictive of undervalued donor potential.

Based on these findings—and in line with the regional strategy to increase donor detection—interventions are being planned to improve detection in all centers, particularly non-transplant hospitals. A similar study in transplant hospitals is clearly needed. Sensitization of emergency and other healthcare professionals is essential. Structured measures such as radiologic alert systems triggered by detection of catastrophic brain injury, automated detection of end-of-life situations for donor assessment, and other strategies are being introduced in several centers.

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