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# Donor selection criteria for liver transplantation in Argentina: are current standards too rigorous?

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## Summary

Organ shortage is the major limitation for the growth of deceased donor liver transplant worldwide. One strategy to ameliorate this problem is to maximize the liver utilization rate. To assess predictors of liver utilization in Argentina. The national database was used to analyze transplant activity in 2010. Donor, recipient, and transplant variables were evaluated as predictors of graft utilization of number of rejected donor offers before grafting and with the occurrence of primary nonfunction (PNF) or early post-transplant mortality (EM). Of the 582 deceased donors, 293 (50.3%) were recovered for liver transplant. Variables associated with the nonrecovery of the liver were age ≥46 years, umbilical perimeter ≥92 cm, organ procurement outside Gran Buenos Aires, AST ≥42 U/l and ALT ≥29 U/l. The median number of rejected offers before grafting was 4, and in 71 patients (25%), there were ≥13. The only independent predictor for the occurrence of PNF (3.4%) or EM (5.2%) was the recipient's emergency status. During 2010 in Argentina, the liver was recovered in only half of donors. The low incidence of PNF and EM and the characteristics of the nonrecovered liver donors suggest that organ acceptance criteria should be less rigorous.

## Introduction

A large and increasing imbalance exists between the supply of donor organs for liver transplantation and the pool of potential recipients, being organ shortage the major limitation for transplantation worldwide [1]. Argentina is not an exception [2]. In a recently published paper by Cejas *et al.* [2], which analyzed the adoption of the MELD allocation model in Argentina, the improvement in liver organ allocation was informed, as indicated by a significant decrease in waiting list mortality. However, the waiting list size increased 70.4% during the MELD era without a parallel increase in the liver donor pool, and this resulted in a significant decrease in liver transplant accessibility; therefore, the suggested goal was to improve organ procurement and increase the number of multiorgan donors.

Despite the fact that increasing the number of available donors should be a main priority, less attention has been paid to the impact that a more efficient utilization of the available livers would have in the number of transplants performed [3–6]. Therefore, in this study, the goal was to further investigate the criteria used for deceased donor selection in Argentina. The study objectives were as follows: (i) to investigate the liver utilization rate in Argentina, (ii) to compare the characteristics of recovered liver donors and non-recovered liver donors, (iii) to describe the number of rejected offers before graft's acceptance and the variables related to this event, and (iv) to explore which

features were associated with primary non-function or early post-transplant mortality.

## Patients and methods

In this study, the Argentinian national database (SINTRA) of the National Procurement Organization (INCUCAI) was used to analyze the liver transplant activity during the year 2010. Every deceased donor that donated at least one vascularized organ registered during this period was included; that is to say only donors that were accepted for at least one viable organ other than the liver were considered as potential liver donors and included in this analysis. In Argentina, liver allocation is organized in a single national waiting list with no center or regional allocation. Liver transplant is performed only with brain-dead donors. Patients are listed under two different categories: emergency listing that includes fulminant hepatitis, post-transplant arterial hepatic thrombosis, and primary nonfunction patients; and patients listed under the MELD/PELD scoring system.

When a potential deceased donor was reported to the national procurement organization (INCUCAI) without clear causes of exclusion such as HIV infection, tumors, or family refusal, the liver was offered to the first candidate in the single national waiting list according to their status and MELD/PELD value. If rejected, it was offered to the next wait-listed patient and if the liver offer was declined before procurement, it was defined as a non-recovered liver donor [7]. When it was accepted for transplant, it was defined as a recovered liver donor, which could later be grafted or discarded after recovery. The number of rejected offers (quality refusals) before graft acceptance was calculated in each recovered liver donor. The median of quality refusals was 4 per graft; therefore, it was considered as a cutoff point <5 and ≥5 quality refusals for further analysis. Regarding split-liver transplants, each partial graft was considered as an independent deceased donor (as they had a different number of quality refusals). Seventeen deceased donor characteristics were analyzed, four recipient characteristics and two variables related to transplant surgical technique. The variables alcohol consumption, diabetes mellitus, abdominal ultrasound findings, and hemodynamic state were not included due to missing data in more than 50% of the deceased donor studied. Abdominal obesity was defined as a waist circumference ≥102 cm in men or o ≥88 cm in women [8]. Donors were considered to be pediatric when they were under 18 years old of age. [9]. The variable MELD/PELD score was stratified as below or above 20 (as patients with a score above 20 are considered an urgency and listed within 24 h of their request) [9]. Primary nonfunction was defined as the failure of an allograft within 1 week of its revascularization with no discernible cause, which leads either to retransplantation or to patient death [10].

Local area was defined as the city of Buenos Aires and its surroundings (Gran Buenos Aires) as the majority of the active transplants centers in the country (15 of 21) are located in the aforementioned area. D-MELD (donor age x recipient MELD) was calculated in recovered liver donors, with exception of emergency listed patients, where MELD was not calculated. Categories were defined as: A (<338); B (338–1628); and C (>1628), determining different levels of post-transplant survival risk [11].

### Statistical analysis

Descriptive statistics were used to summarize the demographic and clinical characteristics of the donors registered. Parametric and nonparametric test were used to compare quantitative variables as required. Pearson's chi-square statistic or Fischer's test were used to test for significant association in qualitative variables, with the level of significance set at 0.05.

A multiple logistic regression model was fit for the following outcomes (i) liver graft discard, (ii) ≥5 rejections before graft acceptance, and (iii) graft failure or early death. When a given numeric variable and its dependent variable were not linearly correlated, they were dichotomized using their median value as the cutoff point.

## Results

### Deceased liver donation

Among 583 deceased donors, there were 289 non-recovered liver donors and 294 recovered liver donors (50.4%). Twenty three (7.8%) of them were discarded after recovery and the remainder 271 were grafted into 289 recipients. The split-liver technique was used in 34 transplants. Of the 289 liver transplants performed, 53 (18%) were performed in pediatric recipients; 51 (18%) patients were registered as an emergency, and the remainder 238 (82%) were listed under the MELD/PELD score system. Ten (3.5%) were combined transplants (eight with kidney and two with small bowel).

### Reasons for nonrecovery of the liver donors

According to the SINTRA database, the reason for not recovering the liver was poor organ quality in 106 (37%), hemodynamic instability in 74 (26%), donor history in 53 (18%), family refusal in 16 (6%), and other causes in 40 (13%); including logistical issues in 16 cases, graft injury during recovery in two cases, donor age in four, nonspecified laboratory alterations in five, not available matching recipient in three, refusal from country of origin in three, infections in six cases, and one case due to tumors. It must be stressed out that of the total of 289 non-recovered liver

 

donors, 249 were accepted as kidney donors, and the remaining 40 donated another vascularized organ.

### Deceased donor characteristics

Univariate analysis of donor characteristics is displayed in Table 1. Non-recovered liver donors were 9 years older in average than recovered liver donors. Weight, body mass index (BMI), chest, xiphoid and umbilical perimeters, were significantly higher in non-recovered liver donors. There was almost a twofold increase in the recovery rate of donors for liver transplant located within the local area (18%) when compared with donor recovered from other regions (10%). Donor location outside local area and laboratory tests (AST, ALT, serum sodium, and serum creatinine) were significantly higher in the non-recovered liver donor group.

Features associated with non-recovery of the liver on multivariate analysis are shown in Table 2.

### Liver donors discarded after recovery

In 23 cases (7.8%), the liver was discarded after recovery. Almost 80% of them (18/23) were located within the local area. Among discarded donors, mean age was 48 (±19) years, mean BMI 29 (±8). Trauma was the reported cause of death in only three cases. Mean serum sodium was 146 mEq/l (±10), mean AST 50 U/l (±12), and mean ALT 41 U/l (±14).

### Quality refusals before liver grafting

In recovered livers, there was a median of 4 quality refusals (IQR of 1 to 12) before liver transplantation. Livers were transplanted after none to 1 quality refusal in 75 cases (26%), after 2–4 in 76 (26%), after 5–12 in 67 cases (23%), and after 13 or more rejected offers in 71 cases (25%).

Univariate analysis of the features of recovered livers according to their acceptance with < or ≥5 quality refusals is shown in Table 3. Umbilical perimeter, expressed either in centimeters (85 ± 17 vs. 91 ± 18, $P = 0.003$) or as abdominal obesity (34% vs. 54%, $P = 0.002$), was the only variable found to be statistically significant between recovered livers with <5 vs. ≥5 quality refusals. Univariate analysis of transplant and recipient features in recovered livers according to their acceptance with < or ≥5 quality refusals is shown in Table 4. Matching between donors and recipients (D-MELD) is also described.

Only donor blood type O (OR 3.89, $P < 0.001$), listing in the emergency category (OR 0.15, $P < 0.001$), and a MELD/PELD score <20 at transplantation (OR 9.23, $P < 0.001$) were independently associated with ≥5 quality refusals before transplantation.

**Table 1.** Demographics, anthropometric measures, donor location, causes of death, blood type and laboratory tests among recovered and non-recovered deceased liver donors.

| | Deceased liver donors | | |
|---|---|---|---|
| | Non-recovered ($n$ = 289) | Recovered ($n$ = 293) | $P$ value |
| Age (years) | 47 (±17) | 38 (±17) | <0.001 |
| >60 years | 64 (22%) | 26 (9%) | <0.001 |
| Gender (males) | 173 (60%) | 180 (61%) | 0.6 |
| BMI | 27.9 (±6) | 26.1 (±5) | <0.001 |
| BMI ≥26 | 203 (70%) | 173 (59%) | 0.005 |
| Chest perimeter (cm) | 96 (±17) | 93 (±14) | 0.007 |
| Xiphoid perimeter (cm) | 93 (±15) | 88 (±14) | <0.001 |
| Umbilical perimeter (cm) | 97 (±20) | 89 (±18) | <0.001 |
| Abdominal obesity | 125 (43%) | 100 (34%) | 0.02 |
| Donor location | | | |
| Gran Buenos Aires | 28 (10%) | 52 (18%) | 0.005 |
| Outside Gran Buenos Aires | 261 (90%) | 241 (82%) | |
| Procurement day | | | |
| Working day | 208 (72%) | 218 (74%) | 0.5 |
| Weekend or holiday | 81 (28%) | 75 (26%) | |
| Cause of death | | | |
| CVA | 180 (62%) | 164 (56%) | 0.06 |
| Trauma | 78 (27%) | 107 (37%) | |
| Anoxia | 15 (5%) | 13 (4%) | |
| Other causes | 16 (6%) | 9 (3%) | |
| Blood type | | | |
| Type "O" | 188 (65%) | 177 (60%) | 0.04 |
| Type "A" | 80 (28%) | 91 (31%) | |
| Type "B" | 8 (3%) | 19 (7%) | |
| Type "AB" | 13 (4%) | 6 (2%) | |
| Laboratory tests | | | |
| AST (U/L) | 46 (27–86) | 38 (24–60) | <0.001 |
| ALT (U/L) | 37 (21–90) | 25 (17–38) | <0.001 |
| Serum sodium (mEq/L) | 151 (±16) | 148 (±10) | 0.018 |
| Creatinine (mg/dL) | 1.03 (0.8–1.58) | 0.9 (0.7–1.14) | <0.001 |

BMI, body mass index; CVA, cerebral vascular accident (ischemic, hemorrhagic and subarachnoid hemorrhage); AST, aspartate aminotransferase; ALT, alanine aminotransferase.
Values are expressed in numbers (%), median (interquartile ratio), or mean (±standard deviation).

### Post-transplant outcome

Primary nonfunction occurred in only ten liver transplant recipients (3.4%). Among them, eight were originally listed in the emergency category, six were adults, two were grafted with split grafts, and one was a recipient of a combined transplantation. Nine patients with primary nonfunction underwent retransplantation and were alive at 1 month of follow-up.

Early post-transplant mortality was 5.2% ($n$ = 15). No significant association was encountered between primary non-function or early post-transplant mortality and the

 

**Table 2.** Multivariate analysis of donor characteristics associated with non-recovery of liver grafts.

| Donor features | OR (CI 95%) | *P* value |
|---|---|---|
| Age ≥46 years | 2.34 (1.52–3.60) | <0.001 |
| Male gender | 1.11 (0.66–1.88) | 0.67 |
| BMI ≥26 | 0.89 (0.52–1.53) | 0.69 |
| Chest perimeter ≥96 cm | 1.08 (0.63–1.86) | 0.75 |
| Xiphoid perimeter ≥90 cm | 1.34 (0.72–2.48) | 0.35 |
| Umbilical perimeter ≥92 cm | 2.52 (1.37–4.63) | 0.003 |
| Abdominal obesity | 0.70 (0.42–1.17) | 0.18 |
| Procurement outside Gran Buenos Aires | 2.13 (1.24–3.66) | 0.006 |
| Procurement day (holiday) | 1.22 (0.80–1.84) | 0.34 |
| Cause of death (trauma) | 0.82 (0.53–1.29) | 0.41 |
| Blood type "O" | 1.37 (0.93–2.00) | 0.10 |
| AST ≥42 U/l | 1.77 (1.14–2.75) | 0.01 |
| ALT ≥29 U/l | 2.11 (1.38–3.24) | 0.001 |
| Serum sodium ≥148 mEq/l | 1.35 (0.93–1.96) | 0.10 |
| Creatinine ≥1.2 mg/dl | 1.34 (0.92–1.96) | 0.12 |

OR, odds ratio; CI 95%, 95% confidence interval; BMI, body mass index; AST, aspartate aminotransferase; ALT, alanine aminotransferase.

number of quality refusals before transplant. Donor and transplant features of patients with ($n$ = 24) or without ($n$ = 265) primary nonfunction or early post-transplant mortality are shown in Table 5. A higher donor creatinine and listing in the emergency category were the only variables significantly associated with poor outcome.

On multivariate analysis, listing in the emergency category (OR: 6.33; 95% CI: 2.03–19.7; $P$ = 0.001) was the only variable significantly associated with primary non-function or early post-transplant mortality.

## Discussion

This study showed that during 2010 in Argentina, the liver was recovered in only one-half of the available deceased donors. The liver utilization rate in Argentina is thus much lower than the 84% reported in the United States (US), 89% in Spain, and 79% by Euro Transplant (seven European countries) [12–14]. These findings are quite surprising considering recently reported data from Argentina, showing rates of waiting list drop out up to 29% in a scenario of progressive organ shortage [2]. One consequence of a more aggressive approach for organ procurement is an increase of discard rates after recovery. In this series, only 8% of the recovered livers were discarded, a considerably lower rate than that reported for the United States (19%), Spain (27%), and Euro Transplant (18%) [12–14]. Thus, we believe that increasing the recovery rate in Argentina from 50% to 80% and despite a concomitant increase in the discard rate from 8% to 20%, the current number of liver donors in Argentina could expand by one-third.

**Table 3.** Demographics, anthropometric measures, donor location, causes of death, blood type and laboratory tests in recovered liver donors according to their acceptance with < or ≥5 quality refusals.

| | Number of quality refusals | | |
|---|---|---|---|
| Donor features | <5 ($n$ = 151) | ≥5 ($n$ = 138) | *P* value |
| Age (years) | 37 (±16) | 37 (±17) | 0.88 |
| >60 years | 8 (5.3%) | 13 (9.4%) | 0.17 |
| Gender (males) | 95 (63%) | 88 (64%) | 0.88 |
| BMI | 25.3 (±4) | 26.2 (±5) | 0.10 |
| BMI ≥26 | 62 (41%) | 69 (50%) | 0.12 |
| Chest perimeter (cm) | 92 (±13) | 94 (±14) | 0.20 |
| Xiphoid perimeter (cm) | 86 (±13) | 89 (±14) | 0.21 |
| Umbilical perimeter (cm) | 85 (±17) | 91 (±18) | 0.003 |
| Abdominal obesity | 34 (23%) | 54 (39%) | 0.002 |
| Donor location | | | |
| Gran Buenos Aires | 24 (16%) | 24 (17%) | 0.73 |
| Outside Gran Buenos Aires | 127 (84%) | 114 (83%) | |
| Procurement day | | | |
| Working day | 109 (72%) | 108 (78%) | 0.23 |
| Weekend or holiday | 42 (28%) | 30 (22%) | |
| Cause of death | | | |
| CVA | 82 (54%) | 73 (53%) | 0.41 |
| Trauma | 64 (42%) | 52 (38%) | |
| Anoxia | 4 (3%) | 8 (6%) | |
| Other causes | 1 (1%) | 5 (3%) | |
| Blood type | | | |
| Type "O" | 88 (58%) | 93 (67%) | 0.31 |
| Type "A" | 49 (32%) | 38 (28%) | |
| Type "B" | 13 (9%) | 6 (4%) | |
| Type "AB" | 1 (1%) | 1 (1%) | |
| Laboratory tests | | | |
| AST (U/L) | 37 (24–57) | 38 (25–60) | 0.72 |
| ALT (U/L) | 22 (16–34) | 26 (17–37) | 0.28 |
| Serum sodium (mEq/L) | 148 (±9) | 149 (±11) | 0.36 |
| Creatinine (mg/dL) | 0.90 (0.70–1.12) | 0.85 (0.68–1.11) | 0.41 |

BMI, body mass index; CVA, cerebral vascular accident (ischemic, hemorrhagic and subarachnoid hemorrhage); AST, aspartate aminotransferase; ALT, alanine aminotransferase.
Values are expressed in numbers (%), median (interquartile ratio), or mean (±standard deviation).

One of the goals of this study was to analyze the variables implicated in donor acceptance, as to evaluate whether the criteria used were those associated with poor outcome in current literature. When analyzing non-recovered liver donors included in the present study, age was considered the strongest predictor of liver graft quality [15,16]. This variable was significantly higher in the non-recovered liver donor than in the recovered liver donor group. However, the mean age of non-recovered liver donors in Argentina (47 years) compare favorably with liver donors in other countries such as Spain (55 years) or United States where

 

**Table 4.** Transplant and recipient features according to the acceptance of recovered liver donors with < or ≥5 quality refusals.

| | Number of quality refusals | | |
|---|---|---|---|
| | <5 ($n$ = 151) | ≥5 ($n$ = 138) | $P$ value |
| Transplant features | | | |
| Type of graft | | | |
| Whole | 130 (86%) | 121 (88%) | 0.69 |
| Split | 21 (14%) | 17 (12%) | |
| Type of transplant | | | |
| Single | 144 (95%) | 135 (98%) | 0.25 |
| Combined | 7 (5%) | 3 (2%) | |
| Recipient features | | | |
| Age | | | |
| Children | 32 (21%) | 21 (15%) | 0.19 |
| Adults | 119 (79%) | 117 (85%) | |
| Waiting list category | | | |
| Emergency | 43 (28%) | 8 (6%) | <0.001 |
| MELD/PELD | 108 (72%) | 130 (94%) | |
| MELD/PELD score at transplantation* | | | |
| <20 points | 10 (10%) | 43 (33%) | <0.001 |
| ≥20 points | 93 (90%) | 86 (67%) | |
| Center size | | | |
| <20 transplants per year | 25 (17%) | 15 (11%) | 0.16 |
| ≥20 transplants per year | 126 (83%) | 123 (89%) | |
| D-MELD | | | |
| A (<338) | 10 (10%) | 14 (11%) | 0.009 |
| B (338–1628) | 77 (77%) | 107 (86%) | |
| C (>1628) | 13 (13%) | 3 (3%) | |

MELD, model for end-stage liver disease; PELD, pediatric end-stage liver disease.

*In six recipients, MELD/PELD value at transplantation was not available.

35% of donors were older than 50 years in 2008 [12,13]. What is more, when using cutoff points established in the donor risk index, 28% of the non-recovered liver donors were younger than 40 years old. Other poor graft quality indicators have been traditionally associated with increased rates of poor initial function and primary nonfunction. Surrogate markers of liver steatosis in this study were BMI, anthropometrical measures and abdominal obesity, a parameter related with a higher risk of metabolic syndrome in the ATP III consensus report [8]. With the exception of umbilical perimeter, all of them were not found to be statistically significant. Increased aminotransferase values, a feature not associated with a higher risk of graft dysfunction [16–18], were found to be predictors for the non-recovery of the liver, both in univariate and multivariate analysis.

Liver donors located in the same geographic area as transplant centers seem to be "more attractive" for recovery due to lower costs and fewer logistic complications. Multivariate analysis showed that donor location outside Gran Buenos Aires was associated with a twofold increase of being rejected as a liver donor. This likely reflects a higher interest in evaluating less than ideal local donors, probably due to cost, logistic issues [19], and a perception of higher risk associated with larger distances. However, in a recently published revision [20], the geographic factor was discussed, stating that livers shared across large geographic areas, despite the chance of longer ischemia time, are not associated with poorer outcome.

When a deceased donor is reported to the procurement organism of Argentina and many other countries, the liver graft can be accepted on the first offer or after a number of quality refusals. A high number of quality refusals should reflect the poor quality of the donor (extended criteria) and result in a higher risk of primary non-function. When management of donor offers becomes inefficient, liver distribution order is altered resulting in increased waiting list mortality and decreased total population lifetime gain [21–23]. The median number of quality refusals found in this study was 4, and up to a third of recovered livers had 10 or more offers prior to their acceptance. Multivariate analysis showed that the only independent predictors of the number of quality refusals were recipient features such as being listed in the emergency category and a MELD/PELD score <20 at transplantation, in addition to donor blood type O. Not even the D-MELD score, a useful outcome predictor based on donor–recipient match, was significant in the multivariate analysis, proving once more only recipient features were determinant of quality refusals.

In a study by Lai *et al.* [24] that also analyzed the number of offers to candidates awaiting liver transplantation in the United States, the median of offer was 5, very similar to our results. Interestingly, in this study, they construct a definition of a "high-quality organ", when they came from donors between the ages of 18 and 50 years old, ≥170 cm in height, of nonblack race, suffered brain death secondary to trauma, HCV-antibody negative, not CDC high risk, and locally or regionally located. In the present analysis, 20% of transplanted livers were high-quality organs by these parameters, and in 13.6% ($n$ = 40), they were offered ≥1 time previous to acceptance; what is more, potential liver donors that were not recovered for liver transplant where "high-quality organs" in 7.6% ($n$ = 22).

The use of extended criteria donors can be associated with higher rates of primary non-function. This complication occurs in 5.8–9% in the largest series reported [18,23,25–27]. In this analysis, the prevalence of primary non-function was quite low, 3.4%, as well as early post-transplant mortality (5.2%) probably related to the preferential selection of good or even ideal donors. Multivariate analysis showed that in Argentina, the only independent predictor of primary non-function and early post-transplant mortality was the severity of the recipient illness. This suggests that the excellent early outcome after liver transplantation was probably due, at least in part, to the quality of the recovered livers [15,23,27].

 

**Table 5.** Donor and transplant variables associated with the development of primary nonfunction or early post-transplant mortality.

| | PNF or EM ($n$ = 24) | Controls ($n$ = 265) | $P$ value |
|---|---|---|---|
| Donor features | | | |
| Age (years) | 35 (±15) | 38 (±16) | 0.49 |
| >60 years | 1 (4%) | 20 (8%) | 0.54 |
| Gender (males) | 18 (75%) | 165 (62%) | 0.21 |
| BMI | 25.8 (±4) | 25.8 (±4) | 0.77 |
| BMI ≥26 | 9 (38%) | 122 (46%) | 0.42 |
| Chest perimeter (cm) | 94 (±9) | 93 (±14) | 0.93 |
| Xiphoid perimeter (cm) | 90 (±12) | 87 (±14) | 0.28 |
| Umbilical perimeter (cm) | 90 (±16) | 88 (±18) | 0.48 |
| Abdominal obesity | 7 (29%) | 81 (31%) | 0.88 |
| Donor location | | | |
| GBA | 3 (13%) | 45 (17%) | 0.57 |
| Outside GBA | 21 (87%) | 220 (83%) | |
| Procurement day | | | |
| Working day | 15 (63%) | 202 (76%) | 0.13 |
| Weekend or holidays | 9 (37%) | 63 (24%) | |
| Cause of death | | | |
| CVA | 12 (50%) | 143 (54%) | 0.84* |
| Trauma | 11 (46%) | 105 (40%) | |
| Anoxia | 1 (4%) | 11 (4%) | |
| Other causes | 0 (0%) | 6 (2%) | |
| Blood type | | | |
| Type "O" | 19 (79%) | 162 (61%) | 0.37* |
| Type "A" | 4 (17%) | 83 (31%) | |
| Type "B" | 1 (4%) | 18 (7%) | |
| Type "AB" | 0 (0%) | 2 (1%) | |
| Laboratory tests | | | |
| AST (U/L) | 32 (24–38) | 39 (25–60) | 0.17 |
| ALT (U/L) | 27 (17–31) | 23 (17–36) | 0.68 |
| Serum sodium (mEq/L) | 151 (±11) | 148 (±10) | 0.21 |
| Creatinine (mg/dL) | 1.12 (0.94–1.30) | 0.87 (0.69–1.10) | 0.004 |
| Transplant features | | | |
| Type of graft | | | |
| Whole | 21 (88%) | 230 (87%) | 0.92 |
| Split | 3 (12%) | 35 (13%) | |
| Type of transplant | | | |
| Single | 23 (96%) | 256 (97%) | 0.84 |
| Combined | 1 (4%) | 9 (3%) | |
| Recipient features | | | |
| Age | | | |
| Children | 6 (25%) | 47 (18%) | 0.37 |
| Adults | 18 (75%) | 218 (82%) | |
| Waiting list category | | | |
| Emergency | 11 (46%) | 40 (15%) | <0.001 |
| MELD/PELD | 13 (54%) | 225 (85%) | |
| MELD/PELD score at transplantation* | | | |
| <20 points | 2 (15%) | 51 (23%) | 0.51 |
| ≥20 points | 11 (85%) | 168 (77%) | |
| Center size | | | |
| <20 transplants/year | 2 (8%) | 38 (14%) | 0.41 |
| ≥20 transplants/year | 22 (92%) | 227 (86%) | |

BMI, body mass index; GBA, Gran Buenos Aires; CVA, cerebral vascular accident (ischemic, hemorrhagic and subarachnoid hemorrhage); AST, aspartate aminotransferase; ALT, alanine aminotransferase.
Values are expressed in numbers (%), median (interquartile ratio), or media (±standard deviation).
*MELD/PELD scores were not available in six recipients.

A number of limitations arose, although somehow expected when working with large databases. Data regarding the hemodynamic state of liver donors (inotropic use, median arterial pressure) was not available. Secondly, information concerning abdominal ultrasound findings was available in only 44% of registered donors, prior medical history such as diabetes in 6% and alcohol consumption in 11%. Regarding cold and warm ischemia time, there was no information available about these variables. Finally, despite the fact that the data included in this analysis may be considered somewhat "old", when comparing with the SINTRA database report of the year 2013 [28], both the number of available liver donors and liver transplants performed remained stable, and the liver utilization rate showed only an increase of 6%, thus showing that the inefficient utilization of donors is still a current topic.

In summary, during 2010 in Argentina, the liver was recovered in only one-half of potential liver donors. The low discard rate after recovery and the low incidence of primary non-function suggests that the proportion of extended criteria donors that were used for liver transplantation was also low, probably reflecting that the variables considered associated with poor prognosis are too broad and not sustained by currently available evidence. Analysis of age, BMI, and cause of death of nonrecovered liver donors also suggest that a substantial number of these organs should have been at least considered for transplant before being rejected. Among recovered liver donors, the number of quality refusals was high and related only to the severity of recipient illness. The excellent outcome demonstrated in this analysis probably shows that organ acceptance criteria were too restrictive in Argentina, at least in the study period.

The current challenge for the transplant community is to develop strategies to close the gap between the number of patients in need of a transplant and the number of available organs. Even though strategies aiming to increase the number of available donors are required, a more efficient use of the available donors is an excellent approach. Based on these results, we believe that a change in donor selection policies, based on reliable objective criteria rather than nonvalidated parameters or tradition could increase

significantly the number of liver transplants, without a deleterious effect on liver transplantation outcomes.

## Authorship

MD and AER: designed study, performed study, analyzed data and wrote paper. SWB.: wrote paper. LB: contributed with data analysis. D.H.K.: contributed with data analysis. FGV: wrote paper.

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