Risk factors and outcome in clinical pancreas transplantation

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Donor risk indices in pancreas allocation in the Eurotransplant region

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Introduction: Pancreas donor selection and recognition are important to cope with increasing organ shortage. We aim to show that the PDRI is more useful than the P-PASS to predict acceptance and should thus be preferred over P-PASS.

Methods: Eurotransplant donors from 2004 until 2014 were included in this study. PDRI logistical factors were set to reference to purely reflect donor quality (PDRI donor). PDRI and P-PASS association with allocation outcome was studied using area under the receiver operating characteristic curve (AUROC). Regional differences in donor quality were also investigated.

Results: Of the 10 444 pancreata that were reported, 6090 (58.3%) were accepted and 2947 (28.2%) were transplanted. We found that P-PASS was inferior to $PDRI_{donor}$ in its ability to predict organ reporting, acceptance, and transplantation: AUC 0.63, 0.67 and 0.73 for P-PASS vs. 0.78, 0.79 and 0.84 for $PDRI_{donor}$, respectively. Furthermore, there were significant differences in donor quality among different Eurotransplant countries, both in reported donors and in transplanted organs.

Conclusions: PDRI is a powerful predictor of allocation outcome and should be preferred over P-PASS. Proper donor selection and recognition, and possibly a more liberal approach toward inferior quality donors, may increase donation and transplant rates.

INTRODUCTION

Pancreas (and combined kidney) transplantation is the definitive treatment for patients with type 1 diabetes mellitus and end-stage renal disease.[1-4] With increasing scarcity of suitable organ donors, the Eurotransplant Pancreas Advisory Committee is continuously working to improve pancreas transplantation outcomes, in part by improving the organ allocation process. Especially in pancreas transplantation, where discard rates are among the highest of all organs, proper donor recognition and selection is paramount.[5,6]

In 2008, the Eurotransplant International Foundation introduced the preprocurement pancreas allocation suitability score (P-PASS) was introduced.[7] This donor scoring system, which was one of the first quantitative donor scoring systems, consists solely of donor factors (age, body mass index (BMI), duration of intensive care unit (ICU) stay, duration of asystole, sodium, amylase, lipase and inotropic therapy). The system identifies a suitable pancreas donor, using a cut-off value of 17 (range 9–27). Its intention was to educate and inform transplant professionals, such as ICU clinicians referring potential donors, as well as transplant coordinators reporting donors to Eurotransplant. Side by side with this education, the donation rates were thought to increase, which appeared to be the case since 2009.[8]

The disadvantage of the P-PASS is that it was initially developed based on acceptance rate, without data on patient and graft survival. While the same authors went on to identify a relationship with graft survival in a later study[9], studies by other researchers could not find any correlation between P-PASS and graft survival.[10-12]

Seven years after its introduction, the original P-PASS thresholds have shifted along with increasing donor age and numbers of donation after circulatory death (DCD) pancreas transplantations.[13,14] Some factors are less relevant than previously believed or caused by other mechanisms, for example brain dead donors with high serum amylase due to mandibular trauma. This elevated amylase does not affect the outcome following pancreas transplantation.[15] Eurotransplant professionals still use the P-PASS to make decisions about the allocation process (e.g. whether to continue with whole-organ allocation, to proceed to islet allocation or to evaluate changes in guidelines), despite the above-mentioned shortcomings. Also, data on lipase and amylase might not always be available, which makes calculation of the P-PASS impossible in the current Eurotransplant algorithm. Therefore, a more recent and precise tool is needed.

In 2010, a risk index for predicting graft survival after pancreas transplantation was designed using data from the Organ Procurement and Transplantation Network (OPTN): the pancreas donor risk index (PDRI).[16] This model consists of eight donor factors (age, sex, race, height, BMI, serum creatinine, cause of death (COD), and DCD) along with two transplant/logistical factors (cold ischemia time (CIT) and type of transplant (simultaneous pancreas–kidney transplantation (SPK), pancreas after kidney transplantation (PAK) or pancreas transplant-alone (PTA) transplantation)). The advantage of this PDRI is that it was

derived from a large data set. This evidence-based approach provided an index (indicating that the standard donor has a score of 1.0), which allows for direct comparison of a potential donor with this standard donor. This risk index was recently validated as means for predicting graft survival in the UK population[17] and in The Netherlands.[12] The concept of a donor risk index allows risk estimation prior to transplantation and might aid in decision-making whether to accept the offer as well as, perhaps even more important, comparison of results post-transplantation.

While CIT and type of transplant are unknown factors of the PDRI at the time of organ reporting, these factors could be estimated or imputed based on historical data. In this study, these factors were set to reference, so that the PDRI calculations would purely reflect donor quality ($PDRI_{donor}$) and the concept would be the same as that from the P-PASS.

The objective of this study was to compare the association of the P-PASS and $PDRI_{donor}$ with organ acceptance and pancreas transplantation and to investigate whether the PDRI is a more useful tool for donor characterization. If PDRI is more useful tool at the time of organ reporting or offering, it might replace P-PASS. Also, we reported PDRI for transplanted organs to provide insight regarding regional differences in donor quality.

MATERIALS AND METHODS

Donor selection

All donors of whom one or more abdominal organs were reported to Eurotransplant from January 2004 until December 2014 were included in the study. The data that were collected are shown in Table 1.

Data that were stored incorrectly in the Eurotransplant database (wrong unit, wrong entry) were corrected as following: for creatinine data, any 0.5% lower and 0.5% upper outliers were cross-checked and corrected when necessary. All data were converted to mg/dl. For BMI data, any values >60 and <10 were checked for feasibility and corrected when appropriate and possible. Anything below 17 was considered a low P-PASS value, whereas P-PASS equal to or above 17 was considered a high P-PASS value, as was originally defined by the P-PASS authors. Eurotransplant currently recommends considering pancreas donation in cases of a low P-PASS[18] values.

Pancreas donor risk index (PDRI)

PDRI was calculated according to Axelrod et al.[16] Race is not recorded in the Eurotransplant database and was excluded from PDRI calculations (i.e. all donors were considered as the PDRI reference Caucasian donor). For all transplanted whole pancreas, pancreas donor risk index (PDRI) was calculated. Pancreas after kidney (PAK) was coded only when solitary kidney transplantation was followed by solitary pancreas transplantation. Solitary pancreas

retransplantation after SPK was considered pancreas transplant alone (PTA). Cold ischemia time (CIT) was coded in hours and, when missing, was imputed using 20 multiple imputation rounds in SPSS. CIT was the single factor that was imputed. Donor center, donor age, donor gender, weight, height, BMI, cause of death, donor type (DBD versus DCD), liver donor (Y/N), transplant center, transplant type, and CIT were set as predictors for multiple imputation. Donor quality in different Eurotransplant countries was assessed using PDRI. Mean and standard deviations were displayed, and P-values were calculated using one-way analysis of variance methods.

Pancreas donor risk index ($PDRI_{donor}$)

$PDRI_{donor}$ was calculated for all reported pancreas donors, where CIT was set to 12 h and transplant type was set to SPK, as these were the reference values in the original equation. This $PDRI_{donor}$ enabled the use of the PDRI at time of organ reporting and was analyzed for its association with pancreas acceptance and transplantation.

Statistical methods

Statistical analyses were performed in SPSS version 22. P-value <0.05 was considered significant for all analyses. $PDRI_{donor}$ and P-PASS were evaluated as continuous variables for their ability to predict allocation outcome (reported, accepted, procured, transplanted) using area under the receiver operating curve (AUROC) analysis. Odds ratios for high and low P-PASS were calculated for allocation outcome. Also, P-PASS was evaluated for its correlation with $PDRI_{donor}$ using Spearman's rank correlation coefficients. Pancreas discard was defined as an organ being procured, but not transplanted.

Results

In the study period (January 2004–December 2014), 23 851 abdominal organ donors were reported to Eurotransplant. Of these organ donors, 10 444 (43.8%) reported pancreas; 21 063 (88.3%) reported liver; and 22 336 and 22 379 (93.6% and 93.8%) reported left and right kidney, respectively. More than half of the donors (53.8%) were reported from Germany. Other baseline demographics are shown in Table 1.

Allocation outcome

Of the 10 444 pancreas donors, 10 092 (96.6%) pancreases were offered. Offered pancreases were accepted from 6090 (58.3%) donors. Procurement of the pancreas took place in 4731 (45.3%) procedures. In 2947 cases (28.2%), the pancreas donation procedure led to transplantation. An overview of allocation outcome is shown in Fig. 1. Pancreas was discarded in 1784 cases (56.8%).

The majority of transplants were primary simultaneous pancreas and kidney (SPK) transplants (70.5%), followed by islet transplantations (14.1%). Retransplantations were

Table 1. Demographics of reported donors (minimum 1 abdominal organ) to Eurotransplant (January 2004 – December 2014)

	n (%)
Donors	23851 (100)
Sex [a/b]	
Male	13079 (54.8)
Female	10772 (45.2)
Bloodtype	
A	10198 (42.8)
B	1317 (5.5)
AB	2687 (11.3)
O	9649 (40.5)
Cause of death [a]	
Stroke	14820 (62.1)
Trauma	5456 (22.9)
Circulatory	1264 (5.3)
Anoxia	1604 (6.7)
CNS tumor	147 (0.6)
Other	560 (2.3)
Donor type [a]	
DBD	21639 (90.7)
DCD	2212 (9.3)
Reported organs	
Liver	21063 (88.3)
Pancreas	10444 (43.8)
Left kidney	22336 (93.6)
Right kidney	22379 (93.8)
Inotropic support (Y)[b]	19139 (80.2)
Cardiac arrest [b]	
Yes	3207 (13.4)
No	9888 (41.5)
Unknown	10756 (45.1)
Donor country	
Austria	2263 (9.5)
Belgium	3319 (13.9)
Croatia	945 (4.0)
Germany	12811 (53.7)
Hungary	345 (1.4)
Luxembourg	48 (0.2)
Netherlands	3048 (12.8)
Slovenia	416 (1.7)
Outside ET	656 (2.8)

Table 1. Demographics of reported donors (minimum 1 abdominal organ) to Eurotransplant (January 2004 – December 2014) (continued)

	n	Missing (%)	Median (25^{th} – 75^{th} pct)
Age, y [a/b]	23851	0	53 (41 - 64)
Weight, kg	23849	<0.1	75 (68 - 85)
Height, cm [a]	23851	0	172 (165 - 180)
BMI, kg/m^2 [a/b]	23849	<0.1	25.2 (23.1 - 27.8)
Sodium, mmol/l [b]	23648	0.9	147 (142 - 152)
Creatinine, mg/dl [a]	23851	0	0.86 (0.64 – 1.17)
Amylase, U/l [b]	16378	31.3	73 (39 - 145)
Lipase, U/l [b]	16582	30.5	29 (17 - 68)
PPASS	19767	17.1	19 (17 - 20)

[a] PDRI factor
[b] P-PASS factor

performed in 206 patients (7.0%), and these were pancreas after SPK (5.0%) or SPK after SPK (2.0%) (Table 2).

P-PASS evaluation

P-PASS could be calculated in 19 767 cases (82.9% of all 23 851 organ donors). P-PASS could not be calculated in 4084 cases (17.1% of all 23 851 donors). This was mainly due to missing amylase and lipase values (n = 3253) or unknown ICU stay (n = 739). Median (25th–75th percentile) P-PASS was 19 (17–20). From all 10 444 pancreas donors, P-PASS could be calculated in 9795 cases (93.7%). Of these donors, 3497 (35.7% of these 9795 donors) yielded a low P-PASS value. In 2516 cases (71.9% of those 3497 cases), the responsible transplant coordinator adhered to the Eurotransplant recommendation and reported the pancreas to Eurotransplant. In 745 cases (28.1%), despite a low P-PASS value, the pancreas was not reported to Eurotransplant due to other (unspecified) medical reasons. Of the 16 270 high P-PASS-value- donors, 7279 of 16 270 (44.7%) pancreases were reported to Eurotransplant. Odds ratio of a pancreas being accepted with low versus high P-PASS was 2.21 (95% CI 2.13–2.31) (Table 2). Pancreas reported, accepted, procured and transplanted versus not reported, not accepted, not procured and not transplanted, respectively, yielded the following AUROC's (95% CI of AUROC): 0.63 (0.62–0.63), 0.67 (0.67–0.68), 0.68 (0.67–0.69) and 0.73 (0.72–0.74), respectively (Figure S1 a–d). AUROC's (95% CI of AUROC): 0.78 (0.77–0.78), 0.79 (0.78–0.80), 0.76 (0.75–0.77), and 0.84 (0.83–0.84), respectively (Figure S2 a–d).

$PDRI_{donor}$ evaluation

After correction of the raw data, $PDRI_{donor}$ was calculated (Table 1 for individual factors). There was a significant correlation between P-PASS and $PDRI_{donor}$ for all donors (Spearman's

Table 2. Pancreas allocation outcome and transplant types

	N (%)	Odds ratio (95% CI) P-PASS<17 vs. P-PASS≥17
Reported to Eurotransplant	10444 (100)	1.61 (1.57 – 1.65)
Accepted by transplant center	6090 (58.3)	2.21 (2.13 – 2.31)
Pancreas procured	4731 (45.3)	2.31 (2.21 – 2.43)
Pancreas transplanted	2947 (28.2)	3.43 (3.21 – 3.66)

Pancreas transplanted	2947 (100)
Primary transplantation	
Simultaneous pancreas kidney (SPK)	2077 (70.5)
Pancreas transplant alone (PTA)	96 (3.3)
Pancreas after kidney (PAK)	29 (1)
Multi organ transplantation	62 (2.1)
Islets	417 (14.1)
Simultaneous islet kidney (SIK)	6 (0.2)
Islets after kidney (IAK)	35 (1.2)
Secondary transplantation	
Pancreas after SPK	147 (5.0)
SPK after SPK	59 (2.0)
Islets after SPK	19 (0.6)

r = 0.343, p < 0.001). Correlations were stronger for different outcomes: reported (r = 0.479), accepted (r = 0.557), procured (r = 0.569), and transplanted (r = 0.615) (p < 0.001 for all). Pancreas reported, accepted, procured and transplanted versus not reported, not accepted, not procured and not transplanted, respectively, yielded the following AUROC's (95% CI of AUROC): 0.78 (0.77–0.78), 0.79 (0.78–0.80), 0.76 (0.75–0.77), and 0.84 (0.83–0.84), respectively (Figure S2 a–d). Pooled sample $PDRI_{donor}$ was 1.27 (0.42). Dutch donor centers reported the highest $PDRI_{donor}$ values from donors, with a mean $PDRI_{donor}$ value of 2.50 (SD 1.08). Most pancreata (48.6%) were reported in German donor centers (mean $PDRI_{donor}$ 1.69, SD 0.66).

Pancreas donor risk index for transplanted organs

From 2408 transplanted pancreata, cold ischemia time was missing in 756 (31.3%) cases. Prior to imputation rounds, mean (SD) cold ischemia time was 10.7 (3.1) hours. Cold ischemia time could not be imputed in 67 cases due to missing predictors; this resulted in known cold ischemia time for 2341 transplanted grafts. Pooled sample mean CIT was 10.7 h after 20 imputation rounds. Pancreas donor risk index (PDRI) was calculated for all transplanted pancreas grafts with known cold ischemia time. The pooled sample mean

(SD) PDRI was 1.24 (0.41). PDRI was significantly lower than $PDRI_{donor}$: 0.027 (95% CI of difference 0.023–0.030, $p < 0.001$). Slovenia transplanted the highest PDRI organs, although only 8 PDRI could be calculated due to many missing values, with a pooled sample mean of 1.64 (SD 0.30). Dutch transplant centers transplanted the 2nd highest PDRI organs, with a pooled sample mean of 1.35 (SD 0.43). All other data are shown in Tables 3 and 4.

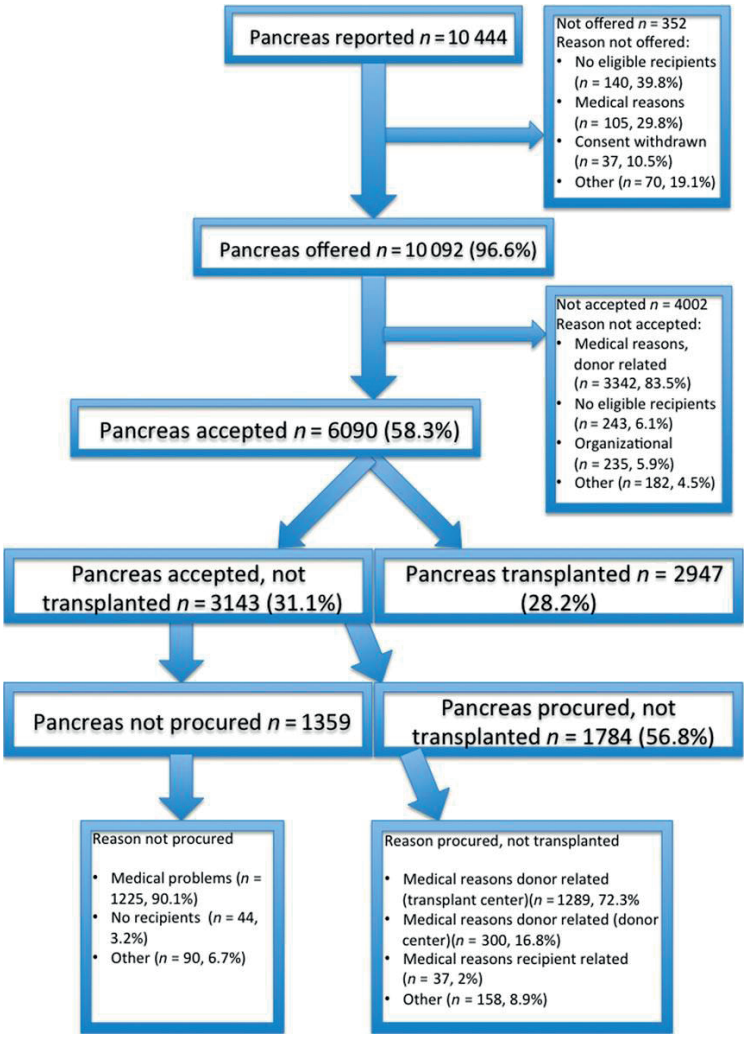

Figure 1. Allocation outcome

Table 3. Donor risk index per Eurotransplant country by allocation outcome for whole organ

	Pancreas reported [a]		Accepted		Transplanted whole organ		Transplanted whole organ	
		$PDRI_{donor}$		$PDRI_{donor}$		$PDRI_{donor}$		PDRI
	N	Mean (SD)	**N**	Mean (SD)	**N**	Mean (SD)	**N**	Mean (SD [c])
Austria	634	1.44 (0.57)	421	1.24 (0.42)	303	1.23 (0.42)	298	1.19 (0.40)
Belgium	2090	2.07 (1.03)	258	1.21 (0.38)	197	1.18 (0.36)	181	1.14 (0.36)
Croatia	261	1.48 (0.59)	85	1.05 (0.29)	68	1.04 (0.30)	68	1.00 (0.28)
Germany	5027	1.69 (0.66)	2766	1.39 (0.48)	1626	1.28 (0.42)	1588	1.24 (0.41)
Hungary	59	1.43 (0.47)	43	1.33 (0.39)	23	1.16 (0.34)	23	1.12 (0.33)
Luxembourg	29	1.67 (0.91)	0		0		0	
Netherlands	2028	2.50 (1.08)	345	1.43 (0.49)	245	1.39 (0.45)	242	1.35 (0.43)
Slovenia	211	1.67 (0.63)	23	1.45 (0.43)	8	1.64 (0.42)	8	1.64 (0.30)
Total	10339	1.90 (0.90)	3941	1.36 (0.47)	2470	1.27 (0.42)	2408	1.24 (0.41)
p [b]		p<0.001		p<0.001		p<0.001		p<0.001

[a] By donorcountry, all others displayed by accepting/transplant country
[b] One way analysis of variance (ANOVA)
[c] Pseudo-SD for imputed data

Table 4. Donor risk index per Eurotransplant country by allocation outcome for islets

	Pancreas reported [a]		Accepted		Transplanted islets	
	N	$PDRI_{donor}$	**N**	$PDRI_{donor}$	**N**	$PDRI_{donor}$
Austria	634	1.44 (0.57)	37	2.07 (0.53)	5	1.94 (0.37)
Belgium	2090	2.07 (1.03)	1509	2.25 (0.93)	392	2.27 (0.87)
Croatia	261	1.48 (0.59)	0		0	
Germany	5027	1.69 (0.66)	134	2.19 (0.61)	25	2.22 (0.56)
Hungary	59	1.43 (0.47)	0		0	
Luxembourg	29	1.67 (0.91)	0		0	
Netherlands	2028	2.50 (1.08)	469	2.55 (0.91)	55	2.24 (0.81)
Slovenia	211	1.67 (0.63)	0		0	
Total	10339	1.90 (0.90)	2149	2.31 (0.91)	477	2.26 (0.85)
p [b]		p<0.001		p<0.001		p=0.846

[a] By donorcountry, all others displayed by accepting/transplant country
[b] Mean (SD). One-way ANOVA

DISCUSSION

This study is an overview of the pancreas quality of donors in the Eurotransplant area. Currently available donor risk indices, both Preprocurement Pancreas Allocation Suitability Score (P-PASS) and the Pancreas Donor Risk Index (PDRI), were evaluated for their ability to predict allocation outcome in the study cohort. It has become clear from this study that

many potential donors are not being utilized and discard rates are high. This study also shows that in pancreas transplantation there is not so much an absolute shortage of organs, but merely a shortage of organs that are presumed suitable. Therefore, proper donor selection within a broad cohort of potential pancreas donors is important. We therefore selected the widest possible range of donors, without limiting age or BMI. Currently, guidelines in The Netherlands consider whole-organ DBD pancreas donation up to 60 years appropriate, and up to 50 years for DCD donation. In the UK, the upper age limit is even higher.[19] Despite this wide range, 75% of the donor population in our study was below 64 years and might therefore possibly be considered for pancreas transplantation.

The P-PASS is a scoring tool that was developed at Eurotransplant in 2008. It is well known that increasing organ shortage has pushed transplant professionals to accepting more extended criteria donor organs. Therefore, we aimed to analyze whether the P-PASS in its current form still has any value in the allocation process, whether it is still of aid to transplant professionals, and whether it can and should be used in the future. Compared to the data provided by the original authors, who analyzed a cohort from 2002 until 2005[7], the median potential donor quality, as measured by P-PASS, has declined to a median of 19. This finding questions the applicability of the P-PASS in current allocation practices, considering the recommendation that is given by Eurotransplant that any donor with a P-PASS below 17 should be considered as a potential donor. It is remarkable that the P-PASS could not be calculated in 17% of the cases. The fact that 28% of the potential donors were not reported due to medical reasons, despite a low P-PASS, questions the value of the current cut-off. Furthermore, some P-PASS factors have become more common today, so the question is whether the P-PASS scoring system is still up to date. Especially in countries with relatively high numbers of DCD donors, such as The Netherlands and, to a lesser extent, Belgium, P-PASS does not fully apply, as the factor DCD is not taken into account (although it is a known risk factor[16]). Also, in our cohort, median donor age was 53 years, which does not compare to the earlier reported median age of 34 years, for accepted donor grafts, nor to the median age of 40 years, for grafts that were not accepted. The odds ratio of pancreas acceptance with low versus high P-PASS was lower than reported by the original authors, which also indicates its decreased predictive value.[7]

The Pancreas Donor Risk Index, which was developed using OPTN data in 2010, was recently validated in a European setting to predict graft survival.[12,17] Again, as the $PDRI_{donor}$ only contains donor factors, similar to the P-PASS, it would be applicable at the time of organ allocation. We deliberately chose not to modify the intrinsic regression coefficients of the model, but decided to use the model with the logistical factors set to their reference values. In this model, cold ischemia time was set to 12h, race set to Caucasian, and transplant type set to SPK. With this approach, we were able to establish excellent discriminatory properties of the model. The additional value of the full PDRI is that it has already been proven to be associated with graft survival.

Even though the correlation between P-PASS and $PDRI_{donor}$ was statistically significant, the correlation coefficient indicates that the actual correlation was not perfect. Both indices share risk factors and have different factors, which explains this partial correlation. For example, age and BMI are included in both indices. Both factors influence the final P-PASS score, as well as the PDRI and have also been identified as risk factors in other studies.[20,21] One of the strongest risk factors of the PDRI, DCD donation, is not included in the P-PASS. DCD pancreas transplantation has become a more accepted option in recent years.[14,22,23] With traumatic brain injuries, elevated amylase, as one of the P-PASS factors, does not have to be related to pancreas injury, but increases the P-PASS score.[15] Duration of ICU stay and vasopressor use, P-PASS but not PDRI factors, are associated with pancreas being declined for transplantation.[6,24] Because these donors are declined for transplantation, there is little evidence to support that finding. A small trial found no association with donor vasopressor use and short-term outcome.[25] Electrolytes, such as the P-PASS factor sodium and the PDRI factor creatinine, do not necessarily influence pancreas graft survival, but they do provide insight in donor kidney function and general donor condition. Especially creatinine, the main indicator of kidney function, may reflect kidney damage (but also other organ damage) in an early stage. When taking those factors into account, it is obvious that the role of P-PASS in organ allocation should be reconsidered. Furthermore, from this study it becomes clear that the $PDRI_{donor}$ is a more powerful tool to predict allocation outcome. All supplemental AUROC curves show that the PDRI is superior over the P-PASS. This implies that the $PDRI_{donor}$ and PDRI are more valuable tools in donor selection and donor population comparison and should be used instead of the P-PASS for aforementioned applications.

The difference in pancreas donor quality in different Eurotransplant countries is a remarkable finding. Donation after cardiac death is believed to play a major role in the high $PDRI_{donor}$ values in The Netherlands and Belgium. Even with these high-risk donors, good outcomes can be achieved, so organs and potential donors should never be turned down solely based on high PDRI; a high PDRI value should not be used as a single argument to turn down an organ offer. PDRI is merely a valid tool to estimate outcome. The authors think that this assessment is useful for physician-to-patient communication as well as retrospective reporting purposes. Other factors, such as recipient selection and center experience, should also be taken into account. Furthermore, countries with a lower mean $PDRI_{donor}$ that also have increasing waiting lists and increased waiting time until transplantation[26,27] might utilize a more aggressive approach by accepting higher risk donors. Therefore, to answer the question on the usefulness of these donor risk indices raised by Berney and Kandaswamy in a recent commentary in Transplant International, a donor risk index, such as the PDRI, can be helpful in proper donor selection, but also in describing a certain donor population to compare center or country specific outcome.[28]

The most important limitation of our study is that our data do not contain any outcome after transplantation. Eurotransplant depends on the willingness of its related transplant

centers for data entry and data on survival is not complete. The authors therefore chose to select allocation outcome as a surrogate marker for donor quality. The authors presume that once an organ is transplanted, outcome among centers is comparable, taking the differences in donor and recipient populations into account. Multiple studies from large Eurotransplant centers have shown excellent results in terms of graft and patient survival.[1, 4, 29, 30] Ideally, we would have validated the PDRI for graft survival in the Eurotransplant region in this study. Unfortunately, due to above-mentioned reasons, this was not possible and requires further study.

CONCLUSION

As the pancreas donor risk index (PDRI) has been shown to be associated with outcome in other studies and this study shows that the $PDRI_{donor}$ has a stronger association with allocation outcome, the pancreas donor risk index (in both forms) should be used instead of the P-PASS in organ allocation practices, as well as to describe overall pancreas donor quality in a population. Adequate donor recognition in different Eurotransplant regions might lead to increased numbers of successful pancreas donation procedures. The authors believe that better tools to identify donors will eventually increase donation rates. The PDRI is such a tool.

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SUPPLEMENTAL DATA

Supplemental figure 1. P-PASS AUROC for reported pancreas grafts (a), accepted pancreas grafts (b), procured pancreas grafts (c) and transplanted pancreas grafts (d).

Fig. 1a

Fig. 1b

Fig. 1c

Fig. 1d

Supplemental figure 2. $PDRI_{donor}$ AUROC for reported pancreas grafts (a), accepted pancreas grafts (b), procured pancreas grafts (c) and transplanted pancreas grafts (d).

Fig. 2a

Fig. 2b

Fig. 2c

Fig. 2d

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