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Pancreas transplantation: differences in activity between Europe and the United States

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Abstract

Background. Although pancreas transplantation (PT) is the treatment of choice in selected diabetic patients, the International Pancreas Transplant Registry (IPTR) has reported important differences in activity between USA and Europe. Of all cases reported, 75% are from USA and only 23% from Europe. Therefore, an analysis of PT activity in selected European countries (SEC) and USA was performed.

Materials and methods. We compared national data reports (2002–06) of deceased donors (DD) and deceased solid organ transplantation (DSOT), with special attention to PT activity from 13 SEC countries (375 million inhabitants) and USA (298 million inhabitants).

Results. The number of PT performed in USA was 2-fold higher than in SEC, with the annual rate >2.4 times higher in USA [5.08–4.64 versus 1.61–1.91 per million population (p.m.p.)]. DD and other DSOT activity rates were only slightly higher in USA. In SEC, important differences in PT activity rate were found between countries in the same year (0–6.21 p.m.p.) and in the same country between different years (6.21–2.47 p.m.p.), unrelated to DD or other DSOT activity rate. PT activity rate increased in SEC from 1.61 to 1.91 p.m.p. but decreased in six countries. The waiting list for PT at the end of 2006 was almost 2-fold higher in USA than in SEC.

Conclusions. Differences in PT activity rate between 13 SEC countries and USA were not related to DD or other DSOT activity. Different waiting list inclusion criteria or incidence of diabetes complications may be considered in more specific studies.

Keywords: deceased donors; diabetes mellitus; pancreas transplantation; solid organ transplantation; transplant activity

Introduction

Despite improvement in insulin therapy, pancreas transplantation (PT) is currently the only treatment that restores normal glucose metabolism and substantially improves the quality of life in type 1 diabetes mellitus (T1DM) patients [1,2]. Depending on donor characteristics and the clinical condition of the recipient, there are differences in both graft and patient survival [3,4]. In diabetic patients with end-stage renal disease (ESRD), simultaneous pancreas-kidney transplantation (SPKT) offers lower patient mortality than patients on the waiting list or deceased donor (DD) kidney transplant recipients [5–9]. The advantage in patient survival of pancreas after kidney (PAKT) or pancreas transplantation alone (PTA) over conventional therapy remains controversial [5,6].

According to the International Pancreas Transplant Registry (IPTR), at 31 December 2004, >23 000 pancreas transplants had been reported, with a higher proportion performed in USA (n=17 132) than in non-USA countries (n=5294) where 89% were performed in Europe [3]. Moreover, between 2000 and 2004, the annual number of PT reported in USA remained constant at ~1400, while in non-USA countries, the number of reported cases decreased from >450 to ~250 in the same period [3]. The discrepancy in PT activity between USA and Europe may be due, at least in part, to differences in the reporting registry. While the IPTR has a relation with the United Network for Organ Sharing (UNOS) of USA and transplant activity report to UNOS is mandatory, such reports from non-USA countries are voluntary [3]. However other factors, such us decease organ donation, other deceased solid organ transplant (DSOT) activity, waiting list inclusion criteria and prevalence of T1DM or ESRD secondary to T1DM, may play a role in the differences of reported PT worldwide when adjusted to population.

The primary objective of the present study was to compare the true incidence of pancreas transplant activity between USA and 13 selected European countries (SEC) and secondly, to evaluate the relationship with deceased organ donation and other DSOT activity during the period between 2002 and 2006. Obviously, this could help to optimize pancreas transplant policies around the world.

Table 1. Population, total number of pancreas transplants, pancreas waiting list and DD in USA and 13 European countries

	USA	Europe[a]	Austria	Belgium	Denmark	Finland	France	Germany	Italy	Netherlands	Norway	Spain	Sweden	Switzerland	UK
Population[b]															
2002	287.67	366.73	8.07	10.31	5.37	5.19	61.40	82.44	56.99	16.10	4.52	40.96	8.91	7.25	59.22
2003	290.34	368.82	8.10	10.36	5.38	5.21	61.83	82.54	57.32	16.19	4.55	41.66	8.94	7.31	59.44
2004	293.03	371.05	8.14	10.40	5.40	5.22	62.25	82.53	57.89	16.26	4.58	42.34	8.98	7.36	59.70
2005	295.73	373.34	8.21	10.45	5.41	5.24	62.64	82.50	58.46	16.30	4.61	43.04	9.01	7.41	60.06
2006	298.44	375.29	8.27	10.51	5.43	5.26	63.00	82.44	58.75	16.33	4.64	43.76	9.05	7.46	60.39
Pancreas Tx[c]															
2002	1460	591	43	64	0	0	59	161	77	17	17	69	8	13	59
2003	1373	614	37	41	0	0	70	191	77	17	17	74	17	14	59
2004	1483	657	37	24	0	0	103	187	95	22	10	74	8	11	86
2005	1444	678	33	24	0	0	92	165	87	21	11	96	7	9	133
2006	1386	718	39	26	0	0	90	141	90	23	6	94	6	10	193
Pancreas WL[d]															
2002	2835	897	38	56	0	0	189	180	245	15	11	47	20	6	90
2003	2747	877	42	56	0	0	199	145	213	14	11	75	19	5	98
2004	2388	918	36	53	0	0	178	158	216	34	13	79	14	8	132
2005	2071	920	38	34	0	0	169	169	197	40	10	87	15	16	145
2006	1984	1009	32	30	0	0	169	190	222	40	10	73	15	21	207
DD[e]															
2002	6190	6422	195	223	73	89	1198	1001	1020	202	62	1409	98	75	777
2003	6457	6598	187	248	75	85	1119	1110	1042	223	87	1443	114	95	770
2004	7150	6898	181	220	64	109	1291	1052	1203	228	90	1495	123	91	751
2005	7593	7159	200	237	63	85	1371	1185	1197	217	76	1546	128	90	764
2006	8024	7340	201	273	62	109	1442	1227	1231	200	76	1509	137	80	793

[a]All 13 countries.
[b]Million inhabitants.
[c]Tx=transplants.
[d]WL=waiting list.
[e]DD=deceased donors.

Patients and methods

For the period 2002–06, we analysed databases from different national transplant organizations (France, Italy, Spain, Switzerland and United Kingdom) [10–14], other European countries included in organ exchange organizations, such as Eurotransplant (Austria, Belgium, Germany and The Netherlands) [15], Scandiatransplant (Denmark, Finland, Norway and Sweden) [16], and the UNOS from USA [17]. In all cases, the annual report included the period between 1 January and 31 December, except for the United Kingdom which analysed the financial year (between 1 April and 31 March of the next year) [14]. For the purposes of this study, the 13 European countries previously mentioned are defined as SEC. Other European countries with >105 million inhabitants had some PT activity, such as Bulgaria, Czech Republic, Croatia, Poland, Hungary, Portugal, Ireland and Rumania [18,19], but we were unable to obtain any data from their National Transplant Organizations. In order to ensure the validity of the results from database reports, these were checked independently by the four authors (JMGP, DM, LPT and PG) and then compared with the results published every year by the Council of Europe in the Transplant Newsletter [19]. In most cases, there were no differences or they were minimal and due to the inclusion of some islet cells transplantation activity (see below); in any case, the data reports from the different transplant organizations were taken as accurate.

The number of DD, PT, deceased donor kidney transplantations (DDKT), deceased donor liver transplantations (DDLT) and heart transplantations (HT) for each year was obtained. As the pancreas is the organ most frequently transplanted together with another organ, two categories of PT were considered according to the renal function of the recipient: SPKT in patients with ESRD and solitary PT in patients without current renal disease. Islet cell transplantation was not considered. Likewise, we recorded the number of patients on the pancreas transplant waiting list at the end of each year. As PT from living donors is only exceptionally performed; any transplant activity involving living donors was not included in the analysis.

In order to take into account demographic differences between countries for comparative purposes, the total number of PT, DD and other DSOT activity was calculated, and the rates were expressed as incidence per million population (p.m.p.). The population of each European country in the different years was obtained from the Statistical Office of the European Communities (Eurostat) [20] and the USA population from the US Census Bureau [21].

Results

The total number corresponding to DD, PT activity and PT active waiting list are shown in Table 1 together with demographic changes in the different countries and years. In USA, the total number of PT decreased from 1460 in 2002 to 1386 in 2006 (−5%) and the rate from 5.08 p.m.p. in 2002 to 4.64 in 2006 (−8.7%). By contrast, in SEC, the total number increased from 591 in 2002 to 718 in 2006 (21.5%) as well as the rate from 1.61 p.m.p. in 2002 to 1.91 p.m.p. in 2006 (18.6%). This increment was mainly due to increased PT activity rate in five countries (France, Italy, The Netherlands, Spain and especially United Kingdom), which outweighed the decreases recorded in six other countries (Austria, Belgium, Germany, Norway, Sweden and Switzerland). In two SEC (Denmark and Finland), there was no reported PT activity during the period analysed (Table 1 and Figure 1). Only two SEC (Austria and Belgium) showed a higher rate of PT activity than USA for any of the 5 years analysed. Surprisingly, in Belgium, this rate decreased from 6.21 p.m.p. in 2002 to 2.47 p.m.p. in 2006 (−60.2%). The PT rate was at least 2.4

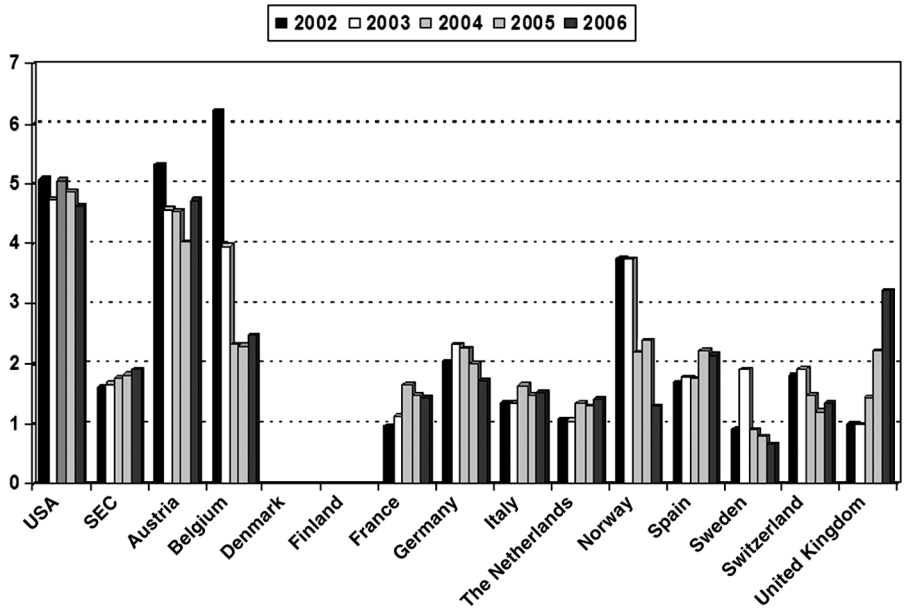

Fig. 1. Pancreas transplant activity rate (incidence per million population) in USA and 13 European countries considered together (SEC) and individually during the period 2002–06.

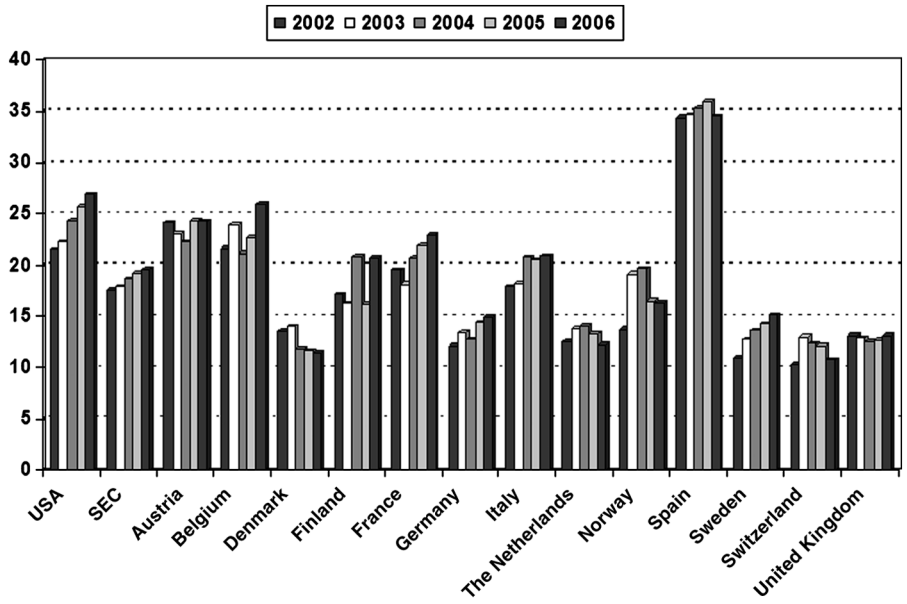

Fig. 2. DD activity rate (incidence per million population) in USA and 13 European countries considered together (SEC) and individually during the period 2002–06.

times higher in USA than in SEC for any of the 5 years analysed (Figure 1). In USA, the total number of SPKT increased from 905 in 2002 to 924 in 2006 (2%) representing 62 and 66.5%, respectively, of all PT activity. In SEC, the total number of SPKT increased from 457 in 2002 to 605 in 2006 (32.4%), representing 77 and 84.5%, respectively, of all PT activity. Only Italy showed a similar percentage of SPKT than USA, while Austria and Belgium showed a lower percentage than the SEC median (data not shown).

In USA, although the number of patients on the active waiting list for PT at the end of each year decreased from 2835 in 2002 to 1984 in 2006 (−30%) (Table 1), the number of candidates awaiting PT that remained inactive increased from 753 in 2002 to 1970 in 2006 (162%) (data not shown). The number of patients on the active waiting list in SEC increased from 897 in 2002 to 1009 in 2006 (12.5%). In five SEC countries (Austria, Belgium, France, Italy and Sweden), it decreased; in another five (Germany, The Netherlands, Spain, Switzerland and United King-

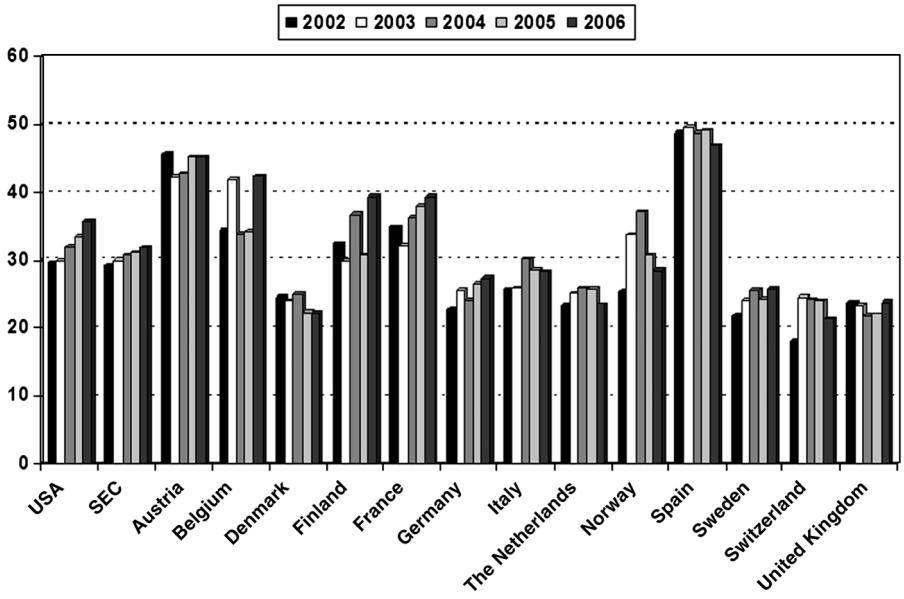

Fig. 3. Deceased kidney transplant activity rate (incidence per million population) in USA and 13 European countries considered together (SEC) and individually during the period 2002–06.

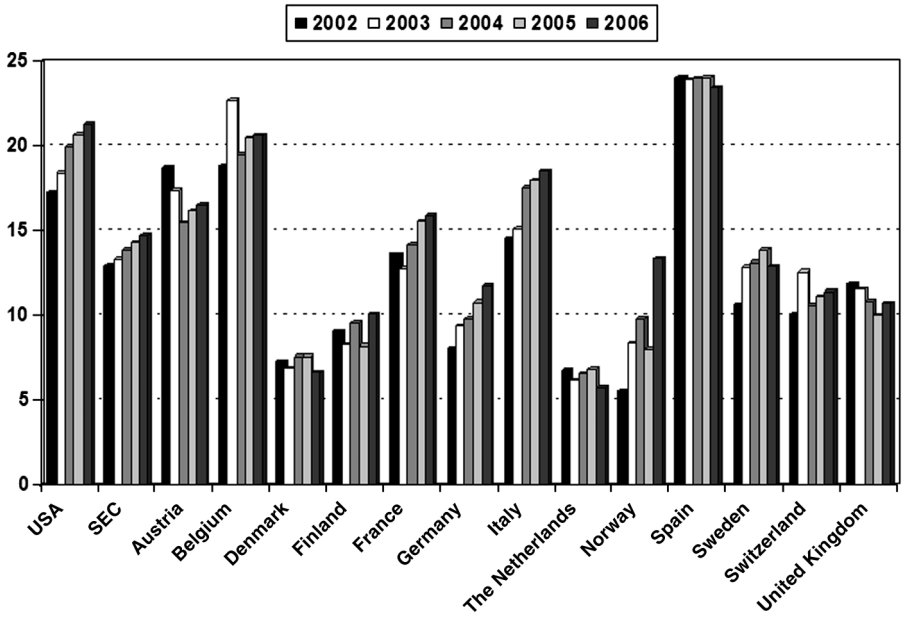

Fig. 4. Deceased liver transplant activity rate (incidence per million population) in USA and 13 European countries considered together (SEC) and individually during the period 2002–06.

dom), it increased, while in Norway this number did not change. In Denmark and Finland, there were no patients on the active waiting list during the period analysed (Table 1). We found no data about inactive candidates on the PT waiting list in SEC.

Deceased donation increased in USA from 6190 in 2002 to 8024 in 2006 (26%) and in SEC from 6422 in 2002 to 7340 in 2006 (14.3%) (Table 1). The DD rate was higher in USA (21.52 p.m.p. in 2002 and 26.89 p.m.p. in 2006) than in SEC (17.51 in 2002 and 19.56 in 2006), but the differences were not as high as in PT activity, only 1.2–1.38 times higher during the period analysed. Three SEC countries (Austria, Belgium and Spain) showed similar or higher DD activity rate than USA, while France, Finland and Italy showed a higher activity rate than the SEC median (Figure 2).

From 2002 to 2006, the total number of DDKT increased in both USA (from 8593 to 10 659; 24.8%) and SEC (from 10 736 to 11 955; 11.3%). Accordingly, DDKT activity rate was slightly higher in USA, but five SEC (Austria, Belgium, Finland, France and Spain) showed higher activity rate than USA (Figure 3).

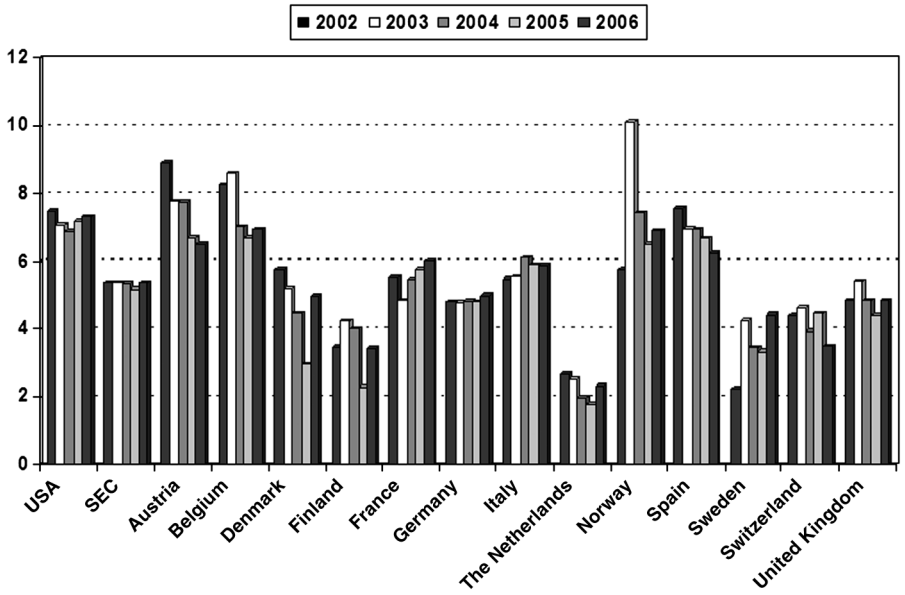

Fig. 5. Heart transplant activity rate (incidence per million population) in USA and 13 European countries considered together (SEC) and individually during the period 2002–06.

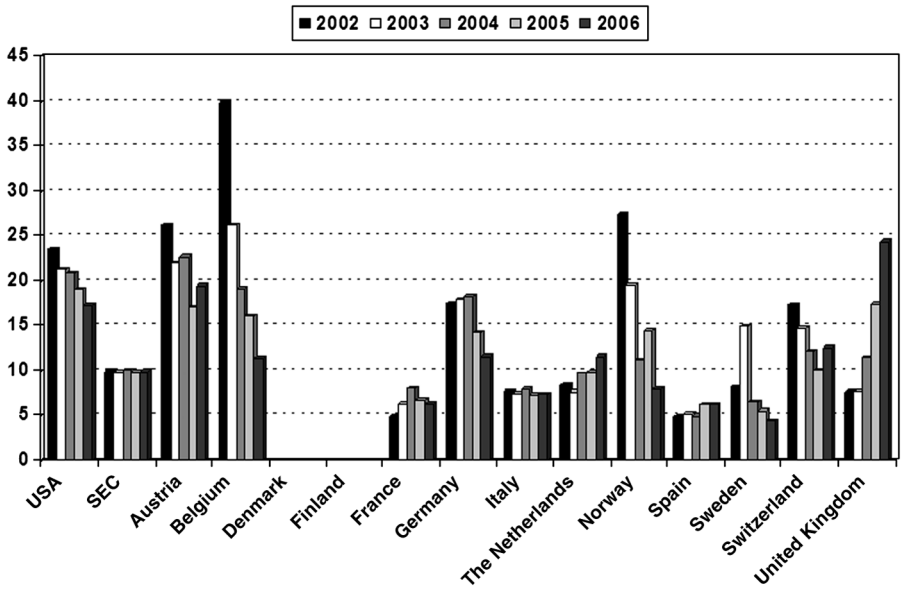

Fig. 6. Number of pancreata recovered and transplanted from every 100 DD in USA and 13 European countries considered together (SEC) and individually during the period 2002–06.

The total number of DDLT increased in USA from 4969 in 2002 to 6362 in 2006 (28%), whereas a lower increase was observed in SEC (from 4757 in 2002 to 5536 in 2006; 16.4%). DDLT activity rate was higher in USA (17.27–21.32 p.m.p.) than in SEC (12.97–14.75 p.m.p.) between 2002 and 2006, but the differences were not as high as in PT (only 1.3–1.44 times higher). Only two SEC countries (Belgium and Spain) showed a higher DDLT activity rate than USA (Figure 4).

The total number of HT was similar between 2002 and 2006 in USA (2155–2192; 1.7%) and SEC (1970–2011; 2.1%), with a higher activity rate in USA. Nevertheless, four SEC (Austria, Belgium, Norway and Spain) showed a similar or higher HT activity rate than USA (Figure 5).

The percentage of pancreata recovered and transplanted from DD was higher in USA (23.6% in 2002 and 17.3% in 2006) than in SEC (9.2% in 2002 and 9.9% in 2006), but overall, this percentage decreased in USA with respect to SEC. However, five SEC (Austria, Belgium, Germany, Norway and Switzerland) showed an important decrease in this percentage, while in four (France, The Netherlands, Spain and specially United Kingdom), it increased (Figure 6).

Discussion

Several observations on this analysis may be made. Firstly, a large number of PT performed in non-USA countries are not reported to the IPTR. Secondly, in USA, the rate of PT was much higher than in SEC. Thirdly, there was great variability between SEC countries in PT activity not related to the number of DD or other organ transplant activity. Finally, despite the increase in the number of patients on the PT waiting list in some countries, a high percentage of pancreata are not recovered from DD.

The latest report of the IPTR, published in 2005, estimated that <10% of non-USA PT activity was not captured by the Registry, with <250 cases reported in 2004 [3]. However in that year, our analysis showed that, in the 13 SEC analysed, the total number of PT performed were 657 cases. Moreover, according to other sources [18,19], in 2004, >200 PT cases were performed in Australia, New Zealand, Canada, Turkey, Argentina, Uruguay, Republic of Korea, Japan, Saudi Arabia and other European countries (Czech Republic, Poland, Bulgaria, Hungary, Portugal, Ireland and Romania). Additionally, in Brazil, with no data for 2004, a total of 173 cases were reported in 2006 to the Global Observatory on Donation and Transplantation [18]. According to these data, recent PT activity from non-USA countries may be higher than 1000 cases per year, with no >30% being reported to the IPTR. Mandatory reporting of all PT activity from national registries to the IPTR is needed to allow worldwide comparisons.

We found important differences between countries in PT activity rate not related to DD or other DSOT activity. This conclusion is sustained for different reasons. Although in USA, the DD and other DSOT activity rates were higher than in SEC, the differences were much higher in PT. Moreover, while DD and other DSOT activity rate increased in most countries, PT activity showed important variability regardless of the evolution in DD or other transplant activity. Furthermore, the differences observed between countries in the same year and in the same country in different years did not show a similar evolution in DD and other DSOT activity rate. Another important difference between USA and SEC is the higher percentage of SPKT in SEC due to a lower proportion of solitary PT performed in most SEC. It is plausible that in USA, with a higher living donor kidney transplantation rate than SEC [19], the high percentage of PAKT in which the kidney came from a living donor (>60%) [3] may help to explain this difference.

Another aspect highlighted by this analysis is the evolution of the PT waiting list. It decreased in USA and increased in SEC despite the inverse evolution in PT activity. The waiting list increase in SEC was mainly due to the increment of candidates for PT in The Netherlands, Spain and especially United Kingdom; however, these countries together with France and Italy are the ones that contribute to the overall increase in PT activity in SEC. Paradoxically, the number of candidates on the active waiting list at the end of 2006 was almost 2-fold higher in USA with a lower population than in SEC. However, this may be due to different criteria for registration on the waiting list (older candidates) and different allocation policies as has been observed in USA [22,23]. In addition, the gap between the demand (number of candidates on the active waiting list) and the number of PT performed is higher in USA and again, important differences were found between countries. It increased in Belgium, Germany, The Netherlands, Norway and Switzerland but dropped in USA, Austria, France, Italy, Sweden and United Kingdom. This gap has been 'negative' (the number of PT performed per year was higher than the number of waiting list candidates at the end of the year), only occasionally in Austria, Belgium, Germany, The Netherlands and more frequently in Norway, Spain and Switzerland. In general, a very large gap may indicate the need for greater PT activity.

Pancreas underutilization is another important challenge and has been considered an important issue in USA [22,24]. When comparing practises in SEC, we found variable proportions of DD from whom pancreata were recovered and transplanted. This proportion shows important changes between countries and years, varying from <5 to >25%. This may reflect the increased number of older donors, although the lack of experience in some recovery teams has been also considered [22,25]. PT activity actually decreased during the period analysed in most countries and only increased in France, The Netherlands, Spain and especially in the United Kingdom. It may also be speculated that the option of maintaining the patient with insulin therapy plays a role in pancreas underutilization and most transplant teams only accept ideal organs [25]. In this respect, studies from USA showed that the non-recovery rate and the discard rate among recovered pancreata increased in recent years [24,25]. Taking into account these data, important efforts must be made to improve the underutilization of pancreata from DD, especially in those countries with a long waiting list.

Other reasons could account for the differences observed in PT activity rate between countries. A higher prevalence of T1DM in USA than in Europe is one possibility. However, according to the International Diabetes Federation and the Diabetes Mondiale Project Group, the incidence of T1DM in children (0–14 age range) is higher in Europe than in North-America, with a very high incidence (>20/100 000 per year) observed in Finland, Norway, Sweden and United Kingdom [26,27]. More important than the incidence of T1DM in children is, in this case, the incidence of ESRD, at any age, secondary to T1DM. However, we found a very limited number of studies analysing this issue in recent scientific literature [28–31]. This incidence varies in Europe in 1999–2000, between 16.3 cases p.m.p. in Denmark, ~13 cases p.m.p. in Finland, Sweden and United Kingdom (Scotland), 8.3 cases p.m.p. in Austria, ~6 cases p.m.p. in Spain (Catalonia), Norway and The Netherlands and 3.8 cases p.m.p. in Belgium (French-speaking) [28–30]. Although this incidence has increased in most countries with respect to the period 1991–92, it decreased in Austria and especially in Belgium [28], and in more recent years, it stabilized in Denmark [29] and decreased in The Netherlands [30]. This may be a reason for the decrease in PT activity in some countries. On the other hand, according to reports of the United States Renal Data System, it can be calculated that the incidence of ESRD secondary to T1DM decreased in USA from ~16 cases

p.m.p. in the period 1997–2001 to 13 cases p.m.p. in the period 2002–06 [32,33]. The higher incidence of ESRD secondary to T1DM in USA compared with SEC with a lower incidence of T1DM may be due to an increased risk of this complication among ethnic minorities (blacks and Hispanics) in USA [34,35], although the role of disparities in access to health care (universal in Europe and mostly private in USA), especially for chronic disease such as T1DM, requiring prolonged and regular treatment, should also be considered [35].

Other potential explanations for the observed discrepancies in PT may include different insurance reimbursement policies and attitudes regarding the indication for PT, as reflected by the different statements issued by scientific societies [36–39]. However, these factors may play a minor role because PT is covered by the different national health systems or private insurance in most SEC or by Medicare in USA (except for PTA in USA which has only been covered since April 2006) [22]. Moreover, similar specific recommendations for PT in diabetic patients have been published by the American Diabetes Association, the National Kidney Foundation and the American Society of Transplantation [36–38] as well as the European Renal Association and the European Society for Transplantation [39].

Finally, it is plausible that the clinical criteria for inclusion on a PT waiting list vary between countries and even between different teams in the same country, as previously reported for SPKT in The Netherlands [7]. As an example, SPKT is not indicated for ESRD diabetic patients in countries with a high incidence of this complication (Denmark and Finland), where kidney transplant alone (KTA) with more intensive treatment is the therapeutic option used with improved results in patient survival in recent years [16,40]. In addition, in USA, ~7% of all SPKT are performed in type 2 diabetic patients [3], while there are no comparable data from SEC. Although in a single-centre study from Spain, this percentage was similar (5.2%) [41], specific studies in the different SEC are needed in order to determine whether there are differences in this attitude. The development of PT has been historically limited by the lack of randomized, controlled trials and relatively poor survival but currently, surgical and immunosuppressive advances have improved the results [42]. Although KTA is clearly associated with a significant increase in life expectancy when compared with diabetic patients remaining on the waiting list [43], there is controversy as to whether adding a pancreas contributes independently to patient survival. While large population multi-centre and single-centre studies comparing SPKT versus KTA have found longer patient survival for SPKT recipients [7], registry-based analysis showed contradictory results [9,44–46], probably limited to the information available in the database from registries. In addition, the clear and significantly lower mortality risk, after the 3 months post-transplantation period, in SPKT as compared with patients who remained on the waiting list [5,6,9], is less evident for PAKT and PTA [5,6]. These discrepancies may be a reason for the differences in prevailing attitudes in the medical community worldwide. A future survey of practitioners in Europe and perhaps in USA will better delineate the current position regarding the utility of PT. Although a decade ago, SPKT was considered as optimal and the treatment of choice for juvenile diabetic patients with ESRD for an increasing number of centres in Europe [47], currently this approach remains uncommon and even inexistent in some European countries. Due to the high mortality, while on dialysis, of this population [9,43], a debate is needed about the reasons of disparities in PT activity in Europe.

In conclusion, PT activity rate and active waiting list candidates were higher in USA than in SEC countries. The differences were not related to deceased donation or other deceased transplant activity and are likely to be multifactorial. Future analyses are needed to determine whether these results are due to differences in clinical indication for PT, higher incidence of diabetic nephropathy secondary to T1DM or other unknown reasons.

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Conflict of interest statement. None declared.

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