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Donor Height in Combination With Islet Donor Score Improves Pancreas Donor Selection for Pancreatic Islet Isolation and Transplantation

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Abstract

To maximize the islet isolation yield for successful islet transplantation, the key task has been to identify an ideal pancreas donor. Since implementation of the islet donor score in donor selection, we have consistently obtained higher islet yields and transplantation rates. In this study, we tested whether assessing donor height as an independent variable in combination with the donor score could improve the pancreas donor selection. Donor and islet isolation information (n = 22) were collected and studied between 2011 and 2012. Pearson correlation analysis was used in statistical analysis. Donor height as an independent variable was significantly correlated to the weight of the pancreas, pre-Islet Equivalents (pre-IEQ), post-IEQ, and IDS (P <.05). When donor with height of 179 cm ± 3 was selected in combination with IDS > 80, the clinical islet transplantation rate reached 80%.

Over the last 5 years, outcomes of pancreatic islet transplantation have improved substantially. Islet transplantation has become an effective alternative to whole pancreas transplantation in selected patients with “brittle” type 1 diabetes mellitus. At experienced centers, 40% to 50% of patients remain insulin free 5 years after the transplantation [1]. Despite the progress in clinical results, islet cell processing remains a challenging procedure as well as an expensive and time-consuming. To obtain a high islet yield necessary for successful islet transplantation, the correlation between donor factors and islet yield has been investigated for more than 2 decades [2–9]. Efforts were made to identify useful donor information allowing for prediction of islet yield and islet quality. Islet donor score (IDS) was first reported in 2005 by O’Gorman and colleagues [1] and has been used successfully for optimal pancreas/donor selection for islet isolation. The IDS is based on multivariable analysis, for which the most important donor factors were identified and weighted accordingly. Donor factors in IDS include: donor age, body mass index (BMI), cold

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ischemia time, blood test results, medical history, days of hospital stay, vasopressor use, cause of death, and procurement team. Addition of points for a specific donor gives the score, which correlates to the potential success or failure of the islet isolation [10]. Use of IDS also helps evaluating complex donor information in a more objective way and allows making a decision about organ acceptance or rejection depending on center donor selection strategy and financial support. In this study, we assessed the value of donor height as an independent variable in prediction of the islet isolation yield in addition to IDS.

METHODS

Twenty-two cases of research and clinical pancreatic islet isolation were performed in the current Good Manufacture Practice (cGMP) facility of the University of Chicago between 2011 and 2012. The islet isolation protocol was approved by the Institutional Review Board of University of Chicago and the United States Food and Drug Administration. Donor information was collected from the United Network for Organ Sharing websites (https://portal.unos.org). An IDS excel template spread sheet with minor modifications from the original publication was kindly provided by Mr. O'Gorman from the Islet Team at the University of Alberta, Edmonton, Canada. The donor information was entered into the IDS excel template to calculate individual IDSs for each donor. Information regarding donor height, islet yield in islet equivanlent (IEQ) transplantation status, and final pancreatic weight were analyzed together with IDS. Pearson correlation analysis was used in statistical analysis.

RESULTS

Table 1 shows the overall information regarding IDS, IEQ, and transplantation frequency. When the IDS was greater than 80 and donor height was selected (average height, 179 ± 3 cm), the success rate of the islet isolation allowing for clinical transplantation was 80%. In contrast, when the IDS was less than or equal 80, the rate of success was as low as 17% (3/17). Interestingly, for those three cases in which we were able to obtain an IEQ > 300,000 despite a lower IDS, the height of the donor was high (175 to 177 cm; Table 2). All together, successful isolation was found only if the donor mean height was >175 cm. Table 3 shows that the height as an independent variable was statistically significantly correlated to final pancreatic weight, both pre- and post-purification IEQ, as well as IDS.

DISCUSSION

Overall, the success of islet isolation is correlated with both a high islet mass and a high quality of the donor pancreas. In general, a large pancreas more likely contains a higher islet mass. Kin et al examined 354 cases and showed that pre-and post-purification islet yield is directly proportional to the donor pancreas weight [6]. However, we cannot estimate islet mass in a pancreas; we can only base it on the organ weight. Donors who have a high BMI may have more fatty texture of the pancreas, hypertrophy of the islets, and to some extent, also a higher islet mass. In addition to islet mass in the pancreas, the yield of islet isolation depends strongly on the quality of the pancreas and islets inside. Poor quality may be related to organ injury before or after donor death. Regardless of pancreas size and islet mass, islet

yield will be most likely low after islet isolation from a poor quality donor. IDS as a scoring system was developed in Edmonton and validated in other centers [7]. It has been an important tool for donor selection and prediction of the islet isolation outcome in many centers. It combines all factors affecting islet yield. Of a maximum 100 points, IDS assigns 85 points for donor/organ quality and only 15 points for BMI, which is correlated with islet mass in the donor pancreas. Because pancreas/donor quality depends on so many factors, it is important that the IDS reflect all of them, especially because a high islet yield is less likely obtained from a pancreas with poor quality, regardless of how high the BMI is. However, at the same time, islet isolation from a donor with a high IDS score (85) but a low BMI may result in poor islet yield due to low islet mass in the pancreas before isolation. Therefore, to improve prediction of the islet mass in the pancreas, we included donor height as an independent predictor of the pancreas weight and islet mass in the organ. In O'Gorman's study [10], when the IDS was more than 80, the islet transplantation rate was reported to be as high as 50%. When considering IDS alone our clinical islet transplantation rate is comparable (approximately 50%); however, on incorporating donor height as an independent variable, our success rate has significantly increased. In the current study, we confirmed that donor height as an independent variable was significantly correlated with the pancreatic weight and islet isolation yield expressed as pre-IEQ and post-IEQ. Moreover, if consider IDS and donor height (179 cm ± 3) together, our clinical islet transplantation rate is as high as 80%.

CONCLUSION

Our results indicate that as a supplement to IDS, the donor height as an additional parameter can be used to facilitate the optimal pancreas selection for clinical islet isolation.

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Table 1

IDS, IEQ, and Transplant Frequency (2011–2012)

IDS	Number of Donors	Number of IEQ >300,000*	Frequency (%) of IEQ > 300,000	Number of Transplantations	Frequency (%) of Transplantation
0–60	7	1	14	0	0
61–80	10	2	20	0	0
>80	5	4	80	4	80

Abbreviations: IDS, islet donor score; IEQ, islet equivalent.

*Post-purification IEQ.

Table 2

Information of Donor When Post IEQ > 300 k

Donor	IDS	BMI	Height (cm)	Pre-IEQ	Post-IEQ	Final Pancreas Weight (g)
IDS > 80						
Transplants	86 ± 1	28 ± 3	179 ± 3	446,087 ± 59,402	401,757 ± 52,097	87 ± 6
Mean ± SD						
n = 4						
Nontransplantation n = 1	81	22	157	193,765	169,225	44
IDS ≤80 and post IEQ > 300 k						
n = 3	71	34	175	879,801	397,372	108
	67	33	175	388,604	323,060	89
	57	29	177	250,628	431,128	106

Abbreviations: IEQ, islet equivalent; IDS, islet donor score; BMI, body mass index.

Table 3

Correlation Analysis of Height and Related Factors (n = 22)

Height	Pre-IEQ	Post-IEQ	IDS	Final Pancreas Weight
r	0.5486	0.5534	0.5919	0.4882
P	.0082	.0093	.0037	.0212

Abbreviations: IEQ, islet equivalent; IDS, islet donor score.