How Recipient Age Affects Long Term Survivability in Heart Transplantation Patients

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How Recipient Age Affects the Survivability Rate in Heart Transplant Patients 60 Months After Surgery

Introduction:

Heart transplantation is very traumatic for the human body. It involves physically taking out an organ that is vital for normal function and replacing it with an organ that is foreign to the body. However, it is sometimes thought that this is a very well known and well-researched procedure, when the reality is that the very first heart transplant took place less than 50 years ago by Dr. Christiaan Banard (Brink & Hassoulas, 2009). During the last 50 years many breakthroughs have been discovered and the procedure has been vastly helped by the rise of immunosuppressant’s and new surgical technology, but there are still many unknown variables. Along with the field of heart transplantation being relatively new, it is also growing at a very high rate. In 2014, 2,679 heart transplants were performed which is a 28.4% increase from 2003 (OPTN/SRTR 2014 Annual Data Report. HHS/HRSA, 2014). With such a large volume of cases emerging the Health and Resources and Service Administration saw the need of a national transplant registry—The Scientific Registry of Transplant Recipients (SRTR)—the emergence of this registry has greatly encouraged research into various transplants especially regarding the informatics of transplant medicine. This registry was founded in 1987 to help clinicians and researches evaluate the results of solid organ transplantation. Much care still must be taken by medical professionals to ensure that this seemingly troubling procedure can sustain and improve life quality. However, with any surgical procedure especially one that has such profound effects on the body, the variables associated with the procedure must be well studied in order to maximize success. One variable that is incredibly important to body function and especially recovery after such an invasive procedure is the age of the patient that is receiving a transplant. The age of such a patient can speak to their health, their psychological outlook on the procedure, their physiological response to a foreign object into their bodies, and whole host of other possibilities (OPTN/SRTR 2014 Annual Data Report. HHS/HRSA, 2014). There has been little research on the affect and role of age on the survivability of heart transplant patients and their long-term survivability. The annual data report that was released by the SRTR in 2014 pointed to a gap in the research as to the role age has on long-term survivability in heart transplant patients (OPTN/SRTR 2014 Annual Data Report. HHS/HRSA, 2014). The purpose of this study was to analyze the 2014 heart transplant data and gain a deeper understanding of how age of a heart transplant recipient affects the survival rate after 60 months.

Methods

The data that was used in studying the effects of survivability on heart transplant patients after 60 months was acquired from the Scientific Registry of Transplant Recipients (SRTR). The SRTR was founded in 1987, and is contracted by the United States Government through the Health and Resources and Service Administration (HRSA). Data from all types of organ transplants (kidney, heart, liver, lung, intestine, pancreas, as well as multi-organ transplants) are collected and compiled by the SRTR. The data that is compiled in this registry comes from a few different sources including the hospitals,
organ procurement organizations (OPO’s), immunology laboratories, hospitals, and the Organ Procurement and Transplantation Network (OPTN) (Leppke et al, 2013). The SRTR receives updates from the OPTN contractor (in 2012 UNOS) and updates its registry monthly until the annual data report is published. We specifically took the data that was present in the 2012 annual data report—at the time the most recent data report—(OPTN/SRTR 2012 Annual Data Report. HHS/HRSA) that was compiled for heart transplants survivability and age.

Data was collected through UNOS from the Scientific Registry of Transplant Recipients (SRTR). Using the 2014 SRTR we were able to gather Kaplan-Meier generated survival probability estimates by age group (18-34, 35-49, 50-64, 65+) for all heart transplants completed between 2007 and 2009. We were also able to gather total frequency of heart transplants by age group during this time period. With this information we could estimate the frequency of survived and deceased for each age group at 5 years post-transplant. To compare 5 year post-transplant between age groups and survival groups, four separate logistic regression analyses were performed. Survival at 5 years (yes/no) were the dependent factors while age group and race were the independent factors. SAS 9.4 and a significance level of $\alpha=0.05$ were used in all analyses. Where significant differences were found, odds ratio (OR) estimates were computed with a 95% confidence interval. Survival probabilities are calculated using Kaplan-Meier, and if multiple transplants occurred for the same patient, only the first transplant was used in generating the KM estimates. This means the proportion of survivors was calculated without repeated measures, but the frequencies applied the proportion could have multiple measures.

Results

The survivability after 60 months was what was analyzed. The year 2009 was the year that these patients underwent heart transplantation. In 2009 there were a total of 2,241 heart transplants that were done, of those 362 operations were done on children (less than 18 years old). The results of long term survivability was not recorded in the data released by the SRTR so this age group’s results were unable to be analyzed.

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Total N</th>
<th>Estimated Survival Probability</th>
<th># Survived</th>
<th># Deceased</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-34 years</td>
<td>673</td>
<td>0.6738</td>
<td>453</td>
<td>220</td>
</tr>
<tr>
<td>35-49 years</td>
<td>1288</td>
<td>0.7779</td>
<td>1002</td>
<td>286</td>
</tr>
<tr>
<td>50-64 years</td>
<td>2860</td>
<td>0.774</td>
<td>2214</td>
<td>646</td>
</tr>
<tr>
<td>65+ years</td>
<td>786</td>
<td>0.7448</td>
<td>585</td>
<td>201</td>
</tr>
</tbody>
</table>

Table 1: Observed Frequencies, Survival at 5 year, Age Group
The frequencies and estimated survival rates can be seen in Table 2. Using the logistic regression model, there was statistically significant evidence that the probability of survival differed by age group. (p<.0001) Pairwise comparisons indicated there was statistically significant evidence that the 18-34 year group was significantly less likely to survive at 5 years post-transplant than the 35-49 group (p<.0001), the 50-64 group (p<.0001), and the 65+ group (p=.0028). The odds of survival at 5 years post-transplant for the 18-34 group are estimated to be 0.59 (95% CI: 0.48, 0.72) times the odds of survival at 5 years for the 35-49 group. The odds of survival at 5 years post-transplant for the 18-34 group are estimated to be 0.60 (95% CI: 0.50, 0.72) times the odds of survival at 5 years for the 50-64 group. The odds of survival at 5 years post-transplant for the 18-34 group are estimated to be 0.71 (95% CI: 0.56, 0.89) times the odds of survival at 5 years for the 65+ group. No other significant differences were observed among age groups.

Discussion

The main finding from the analysis of the data from 2014 regarding age and long-term survivability after the heart transplantation is that the age group of 18-34 years has a statistically significant less likely probability of survival at 5 years than all other age groups that were analyzed (35-49 years, 50-64 years, and 65+ years). An analysis of the literature brought two primary hypotheses that should be considered. Firstly that due to various psychosocial pressures that are present at the age group of 18-34yrs could have an adverse effect on survivability and overall health. A study that was done by Brigitta Bunzel and Kurt Laederach-Hofmann showed that emotional well-being in patients post-transplant significantly decrease from year 1 post-transplant to year 5 post-transplant. They go on to suggest that an emphasis should be placed upon the emotional status of the patient (Bunzel & Laederach-Hofmann, 1999). The 18-34-year has very different social pressures than the older age groups, and it is possible that these unique social pressures
play a large role in contributing to a patient’s emotional health, which is intrinsically linked to a patient’s physical health. The second hypothesis that was generated was that this difference in survivability is due to rejection that is unique to this younger age group. Rejection is a very significant part of any organ transplant and very special must be paid to ensure the best outcomes for the patient. Chronic rejection of the donor heart is termed Cardiac Allograft Vasculopathy (CAV), which is the narrowing of the transplanted coronary circulation. CAV is a slow process and little gross function is lost in the first 12 months post-transplant. The only way CAV can be detected that early is by an ultrasound (Costello et. al., 2013). However, it has been shown that the most common cause of late mortality in youth is CAV while the most common cause of late mortality in the elderly is infection—which is likely due to an age associated decline in immune function. The literature points to the fact that as a recipient increases in age their likelihood of rejection decreases (Everett et. al., 1996). One of the explanations then for this decreased survivability in 18-34 year olds compared to the three other age groups (35-49yrs, 50-64yrs, and 65+yrs) is that 18-34 year olds have an increased likelihood of rejecting the donor heart.

Conclusion

We propose that psychosocial pressures and rejection that is unique to 18-34 year olds are two hypotheses that may account for the statistical difference in survivability at 60 months compared to 35-49yrs, 50-64yrs, and 65+yrs. These results show that within the first 5 years focused care should administered to heart transplant recipients between the age of 18-34 and that their psychological state of mind and propensity to CAV would be monitored closely. Further research should be done to better understand the varying social pressures that may impact an individual from this age group, how these pressures have a role on the physiology of the patient, and what can be done to relieve some of the emotional pressures a patient might face. Further research should also be done as to why CAV is more prevalent among the youth and how this rejection can be combated medically. The last large question that must be answered is what accounts for the early term vs. short term vs. long term survivability. We see that at the end of year 1 the oldest group has the lowest survivability, at the end of year 5 we see that the youngest group has the lowest survivability, and in a study released by Johns Hopkins we see that at year 20 the youngest group has the highest survivability (Kilic et. al., 2012). Further research should be done to look into the underlying causes of this survival curve. A better understanding of this survival curve can provide a protocol for physicians to use when dealing with heart transplant patients of varying ages.
Sources Cited:


15.