Trends in Deceased Donor Kidney Availability and Utilization in the Kingdom of Saudi Arabia

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Abstract

Objectives: We investigated trends in deceased donor kidney availability and utilization in Saudi Arabia, wait list changes, and recipient characteristics.

Materials and Methods: Ten-year registry data from the Saudi Center for Organ Transplantation were analyzed, including consent/discard rates, numbers of kidneys from deceased donors versus expanded criteria and standard criteria donors, wait list characteristics, dialysis characteristics, and causes of chronic kidney disease.

Results: Annual mean number of deceased donor transplants remained almost constant over the 10-year period (mean of 129). Use of kidneys from expanded criteria donors increased (from 16%-28%), which was associated with higher frequency of delayed graft function (36.2% vs 16%; \(P = .002\)) and acute rejection (5.4% vs 19.6%; \(P = .001\)) versus kidneys from standard criteria donors. Donor consent rate (34%) and cold ischemic time (12.3 hours) remained constant. Numbers of patients on wait lists remained fairly constant (mean of 2825), although those on dialysis on wait lists decreased from 24% to 17% (\(P < .0001\)). Overall wait list numbers remained level or even dropped despite increased patients on dialysis (from 7%-10% annually). Between 2008 and 2016, prevalence of patients > 65 and > 75 years rose by 4.2% and 2.4% and prevalence of diabetes mellitus in patients on dialysis increased by 59.2%. Of kidneys consented in 2016, 14.7% were not recovered, mainly because of sudden cardiac arrest (60%). Of total transplanted kidneys, proportion from deceased donors decreased from 51% (2008-2010) to 22.1% (2014-2016). Only 13% of recipients were older than 55 years, although they comprised 25% of the dialysis population, with patients < 18 years (comprising 2.2% of the dialysis population) receiving 15% of kidneys.

Conclusions: Deceased donor transplants remained almost constant; however, their proportion of total transplanted kidneys decreased, while transplants with extended criteria kidneys increased. Wait list totals decreased, with relatively less elderly patients and more children being transplanted.

Key words: Diabetes mellitus, Expanded criteria donors, Renal transplantation

Introduction

The first kidney transplant procedure to be conducted in Saudi Arabia was in 1979. This was from a living related donor. The second phase of Saudi transplant history involved the use of deceased donor kidneys offered to us by Eurotransplant. This phase lasted from 1980 to 1984. These offered kidneys were by the nature of the agreement suboptimal, but we were grateful to receive them due to the enormous shortage of donated kidneys in Saudi Arabia at that time. Nevertheless, we learned a great deal from that experience and had the opportunity to write about different aspects of the use of suboptimal or marginal kidneys, including use of cyclosporine in patients with delayed graft function, results of using suboptimal (marginal) kidneys, outcomes in transplanted kidneys with long cold ischemia times, the use of a 3rd-hand kidney (a kidney donated by a kidney recipient who developed brain death after a road traffic accident), and the transmission of human immunodeficiency virus infection through solid-organ transplant.

The first locally deceased donor kidney to be retrieved in Saudi Arabia took place in 1984. The donor family was a Saudi family, and the team asking for consent was pleasantly surprised at how relatively easy it was to get them to consent for donation. The medical team that took part in this effort was
personally thanked by the late Prince Sultan bin Abdulaziz, who was the Minister of Defense at the time (with the venture undertaken at the flagship Ministry of Defense hospital).

With the establishment of the Saudi National Kidney Foundation, which later became the Saudi Center for Organ Transplantation, the numbers of deceased-donor kidneys transplant procedures increased, and Saudi Arabia has become a leading Islamic country in deceased-donor kidney procurement and transplant. Unfortunately, the donation of organs has not kept pace with the rising demand, as is the case globally, with procurement rates decreasing as has been reported in the United States.ông.

In this study, we aimed to analyze the trends in deceased donor kidney availability and use for transplant in the Kingdom of Saudi Arabia, explain these trends, and compare them to those seen internationally.

Materials and Methods

The registry data from the Saudi Center for Organ Transplantation over the past 10 years was analyzed in terms of trends in consent rate, discard rates (before and after recovery), numbers of deceased donor kidneys used for transplant, numbers of expanded criteria donors (ECD) versus standard criteria donors (SCD), trends in wait list numbers and ages of patients, numbers of patients on dialysis and their ages, and causes of chronic kidney disease as they affect kidney transplant.7 Descriptive statistics were generated with SPSS software (SPSS: An IBM Company, version 22, IBM Corporation, Armonk, NY, USA). Approval was obtained from the internal review board of the Saudi Center for Organ Transplantation.

Results

Numbers of patients on active transplant wait lists over the 10-year study period are shown in Table 1 and Figure 1. These numbers stayed stationary or even dropped despite the numbers of patients on dialysis increasing from 7% to 10% annually, reaching 16 315 in 2016. Table 1 and Figure 2 show percent of patients on wait lists over the past 7 years.

The mean frequency of death of patients on wait lists dropped from 19% annually in the 3-year period from 2007 to 2009 to 10% annually in the 3-year period from 2010 to 2012. There were no records of mortality available after 2012. Figure 3 shows the widening gap between numbers of patients on dialysis and those on active wait lists from 2010 to 2016.
Trends in age and diabetes among dialysis patients
Along with the trend of decreasing numbers of patients on wait lists, we also noticed 2 probably related trends. First was the increasing age of patients on dialysis. Figure 4 shows that the prevalence of patients on dialysis under the age of 45 years stayed relatively stationary, whereas it rose significantly in those over 56 years old, who now account for 47.9% of the total dialysis population (Figure 5).

The prevalence of patients over the age of 65 years rose by 4.2% from 20.7% to 24.9% in 2016, and prevalence of patients over the age of 75 years increased by 2.4% between 2008 and 2016 to reach 8.4% (Figure 5). Furthermore, it should be noted that the mean age of dialysis patients in Saudi Arabia rose by 10 years from 55 to 65 years, while the mean age of patients on wait lists remained at 51.9 years.

Second, we also noticed the increasing prevalence of patients on dialysis with diabetes mellitus. Prevalence of diabetes mellitus was reported as 35.5% in 2008 and 40% in 2016. However, diabetes mellitus accounts for over 55% of incidences of end-stage renal disease. The number of patients on dialysis with diabetes mellitus rose by 59.2% between 2010 and 2016 (from 3950 to 6200; Figure 6).

Consented, utilized, and discarded kidneys
The frequency of obtaining a family consent for donation remained stationary throughout the 10-year period at around 33.4%. The mean number of kidneys from deceased donors transplanted in Saudi Arabia is 129 kidneys per year. This number has not changed significantly over the past 10 years (Figure 7). However, over the same period of time, the number of patients on dialysis rose by 70%.

In 2016, 204 kidneys were consented, of which 30 (14.7%) were not recovered for the reasons shown in Table 2 (including 18 due to sudden cardiac arrest and 8 due to preexisting renal disease). On the other hand, 11 (5%) were discarded in the Kingdom of Saudi Arabia after recovery. The reasons are shown in Table 3.

In the Kingdom of Saudi Arabia, the total number of transplants performed with kidneys from deceased donors is 2963, with 7625 performed with kidneys...
from living donors. The annual number of deceased-donor transplants is dropping but that of living-donor transplants is rising (Table 4 and Figure 8). For total kidney transplants, the proportion of those conducted from deceased donors dropped from 51% (2008-2010) to 22.1% (2014-2016).

Age of donors and recipients
The mean age of donors was 37.4 years, and the mean age of recipients was 35.9 years. Only 13% of recipients were over the age of 55 years, although they comprise 25% of the dialysis population. On the other hand, patients under the age of 18 years, who comprise only 2.2% of the total dialysis population, received 15% of the kidneys.

Use of expanded criteria donor kidneys
Of all kidneys utilized over the 10-year period, 20% were kidneys from ECDs; there was a noticeable rise from 16% in the 3-year period of 2007 to 2009 to 28% in the 3-year period of 2014 to 2016. Of the 13 transplant centers in the Kingdom of Saudi Arabia, only 4 routinely accept ECD kidneys, with these centers performing more than 75 kidney transplants per year.

Of the 433 transplants using deceased donations done in 2008 to 2010, 68 (16%) were ECD and 365 (84%) were SCD. The frequency of delayed graft function was 36.2% and 16%, respectively ($P = .002$), and the frequency of acute rejections was 5.4% and 19.6%, respectively ($P = .001$).

Traumatic versus cerebrovascular accident causes of brain death
It is interesting to note that the prevalence of brain death from trauma dropped from 55% in 2007 to 2009 to 36% in 2014 to 2016, whereas brain death from cerebrovascular accident (CVA) rose from 36% to 47% during these same time periods (Table 5 and Figure 9).

Discussion
We found that the contribution from ECDs to the pool of deceased donors has increased over the years. Other studies reported similar findings. In one report, it was noted that the rate of SCD kidneys had declined each year from 1999 (78.1%) to 2008 (65.7%). Unfortunately, our center has not witnessed a significant rise in the number of kidneys from deceased donors over the years. Similar findings were reported by others except regarding increased kidneys donated after cardiac death. This does not apply in Saudi Arabia where donation after cardiac death does not take place.

Table 3. Reason for Discard After Kidney Recovery

<table>
<thead>
<tr>
<th>Reason</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetic changes</td>
<td>1</td>
</tr>
<tr>
<td>Global glomerulosclerosis</td>
<td>2</td>
</tr>
<tr>
<td>Infection</td>
<td>1</td>
</tr>
<tr>
<td>Atrophied kidney</td>
<td>1</td>
</tr>
<tr>
<td>Intrarenal hemorrhage</td>
<td>1</td>
</tr>
<tr>
<td>Renal stone</td>
<td>1</td>
</tr>
<tr>
<td>Blush discoloration/poor perfusion</td>
<td>2</td>
</tr>
<tr>
<td>Carcinoma</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 4. Annual Number of Deceased Donor and Living Donor Kidneys (2008-2016)

<table>
<thead>
<tr>
<th>Year</th>
<th>Deceased Donor</th>
<th>Living Donor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>166</td>
<td>228</td>
<td>394</td>
</tr>
<tr>
<td>2009</td>
<td>111</td>
<td>272</td>
<td>383</td>
</tr>
<tr>
<td>2010</td>
<td>156</td>
<td>349</td>
<td>505</td>
</tr>
<tr>
<td>2011</td>
<td>122</td>
<td>441</td>
<td>563</td>
</tr>
<tr>
<td>2012</td>
<td>118</td>
<td>506</td>
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<td>2013</td>
<td>66</td>
<td>462</td>
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<tr>
<td>2014</td>
<td>131</td>
<td>514</td>
<td>645</td>
</tr>
<tr>
<td>2015</td>
<td>144</td>
<td>618</td>
<td>762</td>
</tr>
<tr>
<td>2016</td>
<td>125</td>
<td>674</td>
<td>799</td>
</tr>
</tbody>
</table>

Table 5. Traumatic and Cerebrovascular Accident Causes of Brain Death

<table>
<thead>
<tr>
<th></th>
<th>2007 to 2009</th>
<th>2014 to 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain death due to trauma</td>
<td>55%</td>
<td>36%</td>
</tr>
<tr>
<td>Brain death due to cerebrovascular accident</td>
<td>39%</td>
<td>52%</td>
</tr>
</tbody>
</table>

Figure 8. Annual Number of Deceased Donor and Living Donor Kidneys From 2008 to 2016

Figure 9. Traumatic and Cerebrovascular Accident Causes of Brain Death

Abbreviations: DD, deceased donor; LD, living donor
Abbreviations: CVA, cerebrovascular accident
During the decade ending in 2005, increases in kidneys from deceased donations were mainly seen with ECDs (by 50%), donors after cardiac death (by 726%), and ECD plus donors after cardiac death (by 469%), whereas use of SCD kidneys only increased by 15%. Although numbers of patients on our wait lists have recently decreased, numbers in the United States doubled in the past decade.

Regarding use of kidney transplants using deceased donations done in the United States, numbers have remained stationary or even dropped slightly during the past 3 years. Concomitantly, the median time to transplant for adult patients increased from 2.7 years in 1998 to 4.2 years in 2008. The discard rate of kidneys from deceased donors has also increased.

There are a number of possible reasons for our findings of the low and decreasing numbers of patients on wait lists, both systemic and medical. The systemic reasons include the lack of motivation and training of some doctors who care for patients on dialysis to refer them to transplant centers that they are formally affiliated with. This reason could be coupled with lack of initiative on the part of transplant centers to actively carry out their duties toward the dialysis centers formally affiliated with them. Medical reasons include the rapidly increasing age of patients on dialysis, resulting in the reluctance by transplant centers to place older patients on wait lists for the limited numbers of deceased donor kidneys made available. In this regard, it should be noted that we found that, although the prevalence of patients on dialysis under 45 years stayed relatively stationary, it rose significantly in those over 60 years old, who now account for 46.7% of the total dialysis population. The prevalence of patients over the age of 75 years increased by 24% between 2008 and 2016, and prevalence of patients over age of 65 years rose by 5.1% from 20.7% to 25.8%.

In a United Kingdom registry study, similar to our findings, the number of patients on wait lists has fallen each year since 2008 to reach 6302 in 2012, a 10% drop. Furthermore, it should be noted that the mean age of dialysis patients in Saudi Arabia rose by 10 years from 55 to 65 years, whereas the mean age of patients on dialysis in the early 1980s was 34.2 years.

The other medical reason is the increasing prevalence of patients on dialysis with diabetes mellitus, with resulting reluctance by transplant centers to list patients with diabetes because of the limited number of deceased donor kidneys made available. We found that the prevalence of diabetes mellitus was 35.5% in 2008 and 40% in 2016. As shown in another study, the prevalence in the early 1980s was 4%. Currently, diabetes mellitus accounts for over 55% of incidences of end-stage renal disease compared with 40.5% in 1995.

The donor age in our study cohort remained stable at a mean age of 37.4 years, whereas in the UK registry study, age of donors increased (from 14% to 35% who were 60 years or over). About 50% of patients on wait lists for a kidney transplant in the United States are over 60 years old. Among this group, about 50% die before they receive a kidney transplant, especially those with diabetes, have blood group O, are black, or are over the age of 70 years.

Our findings suggest that kidneys from ECDs are associated with higher incidences of acute rejection and delayed graft function. Previous reports show similar findings. In our study, mean donor risk index over the past 3 years was 1.26. In 2008 in the United States, 32.04% of donors had a donor risk index of > 1.6. Our more favorable score can be explained by the lower age of our donors and less contributions of ECD kidneys in our donor pool. In another report, those in the highest donor risk index quintile (> 1.45) had an adjusted 5-year graft survival of 63%, compared with 82% in the lowest quintile (< 0.79), with overlap in the donor risk index distribution by expanded and not expanded criteria donor classification.

The drop in mortality rate among our wait list patients may simply reflect the increasing trend in the exclusion of older and diabetic patients from being investigated and placed on wait lists. Unfortunately, the rate of obtaining consent in our study remained low and constant at 34% throughout the study period. A recent study using data from the Organ Procurement and Transplantation Network showed that the overall consent rate was 68.9% with variations among different racial and ethnic groups (77% for whites, 54.9% for blacks, 67.5% for Hispanics, and 4.1% for Asians). Regarding men versus women, no differences were seen regarding brain dead donors, but the consent rate was higher if the case of death was traumatic versus CVA (75.5% vs 63.9%).

We have previously studied and described what differentiates a Saudi family likely to consent to organ donation from those unlikely to donate. We have also described the social and cultural issues in organ transplant in Islamic countries that a person...
asking for a consent from a Muslim family should be aware of.20

Although the cause of death over the past 10 years in our study was 44% for traumatic causes and 44% for CVA, changes were significant. In the last 3-year period in our study, it was 52% by CVA and 46% for trauma. A report from a single center in Saudi Arabia covering the period from 2001 to 2005 also confirmed the previous predominance of trauma as the cause of brain death (62%).21 In the United States, the rates were 56.1% for CVA and 43.9% for trauma.18 The changes only 6.7%.

In our study, 5% of kidneys were discarded after they were retrieved. Klein and associates reported that the discard rate after recovery increased from 12% in 1999 to 16% in 2008.8 In their series, 13.1% of the discarded kidneys in 2008 was due to in ability to find a recipient. The corresponding rate in our series was only 6.7%.

References