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Do older patients utilize excess health care resources after liver transplantation?

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ABSTRACT

Introduction. Liver transplantation is a highly effective treatment for end-stage liver disease. However, there is debate over the practice of liver transplantation in older recipients (age ≥ 60 years) given the relative shortage of donor grafts, worse post-transplantation survival, and concern that that older patients may utilize excess resources postoperatively, thus threatening the economic feasibility of the procedure. **Aim.** To determine if patients ≥ 60 years of age utilize more health resources following liver transplantation compared with younger patients. **Material and methods.** Consecutive adult patients who underwent primary liver transplantation (n = 208) at a single center were studied over a 2.5-year period. Data were collected on clinico-demographic characteristics and resource utilization. Descriptive statistics, including means, standard deviations, or frequencies were obtained for baseline variables. Patients were stratified into 2 groups: age ≥ 60 years (n = 51) and < 60 years (n = 157). The Chi-Square Test, Mantel-Haenszel Test, 2-sample test and odds ratios were calculated to ascertain associations between age and resource utilization parameters. Regression analyses were adjusted for model for end-stage liver disease score, location before surgery, diabetes mellitus, donor age, cold ischemia time, albumin, and diagnosis of hepatitis C. **Results.** Recipients ≥ 60 years of age have similar lengths of hospitalization, re-operative rates, need for consultative services and readmission rates following liver transplantation, but have longer lengths of stay in the intensive care (hazard ratio 1.97, p = 0.03). **Conclusion.** Overall, liver transplant recipients ≥ 60 years of age utilize comparable resources following LT *vs.* younger recipients. Our findings have implications on cost-containment policies for liver transplantation.

Key words: Liver transplantation. Health services for the aged. Resource utilization.

INTRODUCTION

End-stage liver disease (ESLD) is associated with a poor quality of life and shortened life expectancy. For example, the 6-year survival for patients with compensated and decompensated cirrhosis is just 54 and 21%, respectively.[1] LT is a highly effective treatment for ESLD, with 1-year and 5-year survival rates approximating 90 and 70%, respectively, in the current era of transplantation.[2]

With the proven efficacy of liver transplantation (LT) in conjunction with a growing aged population, there is increased demand for hepatic grafts in older patients. This need is compounded by worldwide epidemics such as viral hepatitis, hepatocellular carcinoma and non-alcoholic fatty liver disease which increasingly afflict patients over 60 years of age.[3,4]

Despite the growing demand for LT, deceased-donor rates have been relatively stagnant in many countries, and live-donation rates have declined since 2001 over legitimate safety concerns.[2,5] The deficit in supply of hepatic grafts has forced an ongoing re-evaluation of how best to allocate organs. To be compatible with societal values, allocation systems such as that used in LT must achieve justice, equi-

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ty, accessibility and transparency. Furthermore, allocation systems must harmonize with health systems to contain costs. Current worldwide economic hardships have ushered a renaissance in cost-effectiveness research in all areas of medicine, and transplant programs are increasingly held accountable for resource consumption among organ recipients.

Despite analyses that LT is cost-effective compared to accepted treatments in medicine, LT has always been criticized for being too costly. The average cost of LT and early postoperative care in the first post-operative year is well over $100,000 US dollars.[4,6] Without detailed knowledge of health-care resource utilization patterns and risk factors for excess consumption, there is a danger that in the era of cost-containment in medicine, life-saving liver transplants could be withheld in subsets of patients who need them in an effort to ration health-care resources.

Older patients have often been a target of discrimination in health-care, and might be a vulnerable group with respect to access to LT. Unfortunately, there are numerous examples in medicine where older patients are treated inequitably when it comes to allocating health-care resources, and that includes access to costly treatments.[5,6] Very often, however, an older patient who is well-selected for a high-risk treatment can benefit just as well as a younger patient, and LT is no exception. For instance, in an analysis of the United Network for Organ Sharing (UNOS) database, Aloia, *et al.* found that recipients over the age of 60 years who lacked 3 or more risk factors such as mechanical ventilation, diabetes mellitus (DM), HCV, renal insufficiency and combined donor and recipient age of 120 years or more, had comparable survival outcomes to younger recipients.[7]

Although survival outcomes are acceptable in carefully chosen older recipients, more research is needed to ascertain if older recipients consume a disparate amount of resources following LT. Washburn, *et al.* reported on 222 adult recipients of a primary liver allograft, and found that recipient age was not associated with excess resource utilization, but higher model for end-stage liver disease (MELD) score was.[8] This latter finding is refuted in a study from Kings' College Hospital by Foxton, *et al.*, in which MELD score over 24 was significantly associated with prolonged hospitalization and ICU stay. Unfortunately, the analysis by Foxton, *et al.* was not suitable to determine if recipient age over 60 years influenced resource utilization as the vast majority of the 402 patients in their analysis were below the age of 60 years. It is certainly conceivable that a higher MELD score in an older patient may result in greater postoperative health-care expenditure than in a younger patient, but this remains to be proven.

Given the lack of clarity in the literature on the impact of recipient age over 60 years on resource utilization, we undertook a study to determine whether older patients do, in fact, consume more health resources after LT *vs.* younger patients; and to identify prognostic factors for excess resource consumption among older recipients.

MATERIAL AND METHODS

Patient population and data collection

We identified all patients 18 years of age and older at London Health Sciences Center, London, Canada, who underwent primary LT between January 2007 and September 2010.

Data were collected on demographic, clinical and laboratory variables. MELD score with UNOS modification was calculated based on laboratory parameters drawn within 24 h of LT using the formula available at www.mayoclinic.org/meld/mayomodel6.html. For the purposes of this study, patients with hepatocellular carcinoma were not awarded additional MELD points.

The location of patients prior to transplantation was stratified into 1 of 4 categories: home, hospital ward, intensive care unit (ICU) but not ventilated, and ICU requiring ventilation. Donor grafts were categorized as deceased after brain death, deceased after cardiac death, and live. Health-care resources parameters that were measured included length of stay following LT, length of stay in ICU, reoperation, consultative services used in post-LT care, and readmission within 90 days of transplant. The date of the completion of the transplant operation was treated as day 1 of hospitalization. Only consultative services other than hepatology, hepatobiliary surgery, intensive care, nutrition and physical therapy were quantified.

All patients received ongoing post-transplantation care at our center. In the rare patient who did not return to our center for follow-up if they lived outside of our jurisdiction, outside medical records, including notices of death, were captured by our liver transplant coordinators. For the purposes of the study, mortality data was last updated in January 2011.

Statistical analysis

Descriptive statistics, including means and standard deviations for continuous variables, and frequencies for categorical variables, were obtained for baseline variables. Patients were stratified into 2 groups: age ≥ 60 years and < 60 years. The Chi-Square test, Mantel-Haenszel test, 2-sample test and odds ratios were calculated to ascertain associations between age and resource utilization parameters. Regression analyses were adjusted for pre-LT MELD score, location pre-LT, pre-existing diabetes, donor age, cold ischemia time, pre-LT albumin, and diagnosis of HCV. Analysis was performed using SAS version 10.1.3 (SAS Inc., Cary, N.C.). Statistical significance was set at < 5% for all analyses.

RESULTS

208 patients fulfilled inclusion criteria (age < 60 years, n = 157; age ≥ 60 years, n = 51). Baseline characteristics are summarized in table 1. Subjects in the younger age group had a mean age of 49.5 (8.6) years, whereas subjects in the older group had a mean age of 64.0 (2.7) years. Patients in both groups had comparable MELD scores at time of transplant, underlying diagnoses, location pre-LT and donor characteristics. Pre-existent DM was noted to be more common in the older recipient group. As of January 2011, 19 deaths (9.1%) occurred at a mean time of 5.51 months from transplantation.

Table 2 shows the association between age and LOS, readmission within 90 days, and number of consultative services used in post-transplant care. Over all, there was no statistically ignificant difference in LOS or readmission (Table 3) within 90 days in the two patient groups. Although the unadjusted hazard ratio for number of consultative services achieved statistical significance, the adjusted HR of 1.97 (p = 0.05) was non-significant.

The mean number of days in the ICU for patients < 60 years old was 5.5 (8.6) days *vs.* 9.3 (20.7) days in the older group. The length of stay in the ICU was significantly associated with age ≥ 60, with Wilcoxon 2-sample test yielding p value of 0.028.

Table 1. Clinic-demographic characteristics.

Variable mean (SD) or frequency (percent)	Age < 60 years (n = 157)	Age ≥ 60 years (n = 51)	All (n = 208)
• Age	49.5 (8.6)	64.0 (2.7)	53.1 (9.8)
• Male sex	121 (77.1%)	40 (78.4%)	161 (77.4%)
• Diabetes mellitus	25 (15.9%)	12 (23.5%)	37 (17.8%)
• Liver diagnosis			
Hepatitis C	22 (14%)	11 (21.6%)	33 (15.9%)
Hepatitis C and alcohol	18 (11.5)	2 (3.9%)	20 (9.6%)
Alcohol	15 (9.6%)	7 (13.7%)	22 (10.6%)
Non-alcoholic fatty liver	13 (8.3%)	7 (13.7%)	20 (9.6%)
Autoimmune liver disease	27 (17.2%)	6 (11.8%)	33 (15.9%)
Other	62 (39.5%)	18 (33.3%)	80 (38.5%)
• Hepatocellular carcinoma	26 (16.6%)	5 (9.8%)	31 (14.9%)
• MELD score	20.0 (9.6)	21.7 (9.9)	20.4 (9.7)
• Location pre-transplant			
Home	85 (55.2%)	21 (51.0%)	110 (54.2%)
Hospital ward bed	45 (29.2%)	14 (28.6%)	59 (29.1%)
ICU not ventilated	13 (8.4%)	6 (12.2%)	19 (9.4%)
ICU ventilated	11 (7.1%)	4 (8.2%)	15 (7.4%)
• Donor type			
Brain death	128 (81.5%)	44 (86.3%)	172 (82.7%)
Cardiac death	22 (14.0%)	6 (11.8%)	28 (13.5%)
Live	7 (4.5%)	1 (2.0%)	8 (3.9%)
• Donor age	44.7 (18.7)	45.0 (17.7)	44.8 (18.4)
• Cold ischemia time (min)	402.5 (164.7)	405.6 (154.4)	402.3 (161.9)

Table 2. Associations between age and resource utilization after transplantation.

Variable for age ≥ 60 years	Unadjusted hazard ratio (95% CI)	p-value	*Adjusted hazard ratio (95% CI)	p-value
LOS	1.45 (0.80-2.65)	0.222	1.18 (0.60-2.33)	0.629
Consultative services	1.97 (1.10-3.55)	0.024	1.89 (1.00-3.56)	0.050
Readmission	1.07 (0.60-1.88)	0.827	1.07 (0.58-1.96)	0.829

*Adjusted for MELD score, location pre-transplant, pre-existing diabetes, donor age, cold ischemia time, albumin, diagnosis of HCC, and diagnosis of hepatitis C. LOS: Length of stay. CI: Confidence interval.

Table 3. Reoperation after transplantation.

Age (years), n = 157	Reoperation	Unadjusted odds ratio (95% CI)	p-value	Adjusted odds ratio (95% CI)	p-value
< 60	40/160 (25.0%)	-	-	-	-
≥ 60	11/46 (23.9%)	0.94 (0.44-2.03)	0.880	0.90 (0.38-2.13)	0.816

CI: Confidence interval.

DISCUSSION

Recipients ≥ 60 years of age have similar lengths of hospitalization, reoperative rates, consumption of consultative services and readmission rates following LT, but have longer LOS in the intensive care. However, as the distribution of the LOS in the ICU was associated with high variance in the patients ≥ 60 years of age, the significant association between older age and number of days in the ICU was likely from a small group of outliers. This error could have likely been overcome by a larger sample size of older subjects.

While the cost-effectiveness of LT is well-accepted, this study highlights the need to further explore resource utilization disparities in older recipients so as to maintain the economic viability of LT in this patient population. Our analysis clearly supports policies which continue to offer LT to older patients, and we find no conclusive evidence that resource utilization is greater in recipients over 60 years of age.

Our study has a number of strengths and limitations. The main flaw in our study is that it is based on a single-center experience, which limits the external validity of our findings. Having said that, our analysis adds to a general deficit in knowledge on resource consumption patterns among older LT recipients, and research is such an area is vital to help shape current and future policies in transplant medicine. Another limitation to our study is that criteria for keeping patients in the ICU may be confounded by a multitude of factors. Although clear indications for ICU stay include the need for intensive monitoring, mechanical ventilation or inotrophic support in the postoperative setting, some intensivists may elect to keep patients with difficult intraoperative courses or excess comorbidities in the ICU longer after LT for observation. It is entirely possible that older recipients may be more likely than younger patients to be retained in the ICU longer as a precautionary measure. Similarly, criteria to involve other consultative services such as cardiology or neurology in the care of postoperative patients may vary with members of the transplant team. Once again, its plausible that older patients may be more likely to receive consultative services over concern that they may be at higher risk for severe postoperative complications. This latter point also applies in the pre-transplant assessment, and it is plausible that higher rates of resource consumption were not noted in older subjects by virtue of the fact that they had thorough assessments before listing.

Although any single-center dataset has limited generalizability, a strength of our study is that a reasonably large sample size was collected over several consecutive months. Furthermore, given that the same transplant and intensive care teams were involved in postoperative care, issues such as broad variances in treatment across institutions or health systems is not present to impact resource utilization patterns. Moreover, as all of our patients had the same insurance coverage due to a single-payer system as per Canadian laws, potential biases such as the socioeconomic status of patients did not confound our results.

CONCLUSIONS

Although larger studies with a prolonged follow-up period are needed to verify the conclusions of our study, overall our findings resoundingly support a practice that does not restrict LT in patients over 60 years of age. Perhaps the broader issue underlying this study is that ageism may be deeply entrenched in attitudes toward health-care expenditure, both on a societal level, and in the health-care community. Some factions of society may argue that years of potential life gained is less in older recipients, and hence liver organs should be allocated preferentially to younger patients. However, it is our opinion that it should be physiology, and not age, that guides medical decision-making and cost-containment efforts in LT and other higher-risk, costly treatments.

AUTHOR ROLES

- Neil Shankar: collected data.
- Mamoun AlBasheer: collected data.
- Paul Marotta: designed study, wrote the paper.
- William Wall: designed the study.
- Vivan McAlister: designed the study.
- Natasha Chandok: designed study, wrote the paper.

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