

## Research Article

# Selection Differences between Cardiac and Non-Cardiac Thoracic Surgeons in Lung Transplantation

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Received: August 13, 2014; Accepted: November 07, 2014; Published: November 07, 2014

## Abstract

Lung transplantations in North America are performed by cardiovascular (CV) and non-cardiovascular thoracic (TS) surgeons. In addition to differences in the type of surgeon performing the transplantation, there also exist well established differences in institutional volume. Anecdotal experience suggests that there are differences in selection of acceptable donors and recipients. We sought to elucidate surgical background and center volume influences on lung transplantation. We performed a web-based survey of CV and TS surgeons identified through their institutional affiliations at a North American training center. Surgeon practice type and center volume were compared. A total of 854 surveys were distributed with 45 (5.3%) responses received. The preferences of CV and TS surgeons were congruent in most respects, but CV and TS surgeons differed in selection of donors and recipients. CV surgeons accepted older recipients (Table 1, Figure 1,  $p=0.004$ ) and tended towards accepting older donors. High volume centers transplanted older recipients (Table 2,  $p = 0.005$ ), older donors (Table 2,  $p = 0.003$ ) and patients with a longer cold ischemic time (Table 2,  $p=0.026$ ) than low volume centers. It is imperative to gain insight into the factors that influence donor and recipient selection as to optimize organ allocation and usage.

**Keywords:** Lung transplant; Elderly; Physician bias; Frailty index

## Introduction

As the world's median population grows older, the age limits of when to offer a particular surgical intervention will increase. Since the adoption of the Lung Allocation Score in 1995, the volume of lung transplants in patients over 70 years old has increased, with survival rates similar to patients in the 60-69 demographic [1]. This is despite the increasing donor age and comorbidities over the past decade [2,3]. Additionally, selecting lungs by expanded donor criteria, which include organs from donors over age 60, has been shown to have no effect on recipient survival compared to standard donor criteria [2]. In contrast to the improvements in access to marginal organs, elderly Americans remain less likely to receive transplants than other groups [3]. We were interested in factors that influence donor and recipient selection among North American lung transplant surgeons, and what barriers may exist to offering transplants to older, but eligible, patients. Although center volume is frequently cited as a quality measure, recent literature in heart transplantation suggests that additional variables may play a substantial role in outcomes [4]. Lung transplantation is potentially even more idiosyncratic, performed in the US by both cardiovascular (CV) and non-cardiovascular Thoracic Surgeons (TS). Anecdotal experience has suggested that CV and TS surgeons differ in selection of appropriate lung transplant recipients as well as suitable donors. We sought to elucidate affects that surgical practice type and center volume influences may have on lung transplantation selection.

## Methods

We performed a web-based survey on self identified CV and TS surgeons through their institutional affiliation with a North American

training center. An IRB approved survey was created and distributed via email as a link to a Google Document live form (Google, Mountain View, CA). Responses were collected in a blinded fashion. The approved survey is included as an Appendix. Question themes included recipient criteria (age, BMI), donor criteria (PaO<sub>2</sub>, ischemic time), operative data (single vs. double lung transplant), surgeon practice type (CV or TS) and center volume (centers performing >20 lung transplants per year were classified as high volume).

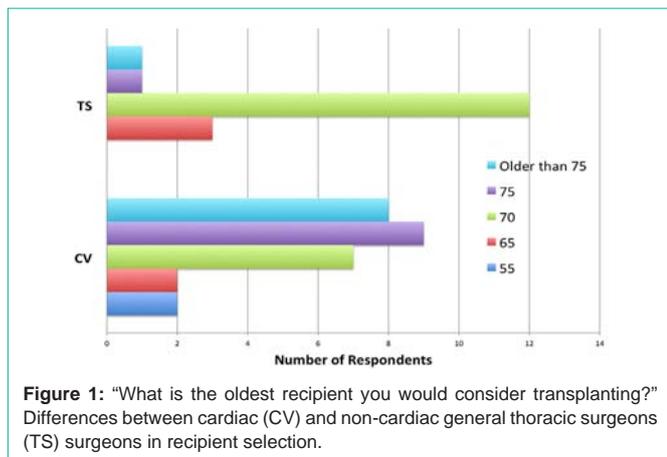
For statistical analyses, we used JMP 9 (SAS Institute Inc, Cary, NC) for Windows (Microsoft, Redmond, WA). Unless otherwise noted, results are reported as means with associated p values. Ordinal and nominal data were analyzed with the chi square test. Continuous data were analyzed with the independent sample t test. A value of  $p \leq 0.05$  was considered significant.

## Results

A total of 854 surveys were distributed with 45 (5.3 %) responses

**Table 1:** Differences between Cardiovascular (CV) and Non-cardiac Thoracic (TS) Surgeons in Recipient and Donor Selection.

	Cardiovascular	Non-Cardiovascular Throacic	p value
<b>Recipient Age</b>			
55	2	0	p = 0.004
65	2	3	
70	7	12	
75	9	1	
≥ 75	8	1	
<b>Donor Age</b>			
50	2	1	p = 0.54
55	5	4	
60	7	7	
≥60	14	5	



**Figure 1:** "What is the oldest recipient you would consider transplanting?" Differences between cardiac (CV) and non-cardiac general thoracic surgeons (TS) surgeons in recipient selection.

received. The preferences of CV and TS surgeons were congruent in most respects - including preference for single or double lung transplantation, re-transplantation, and limits on body mass index.

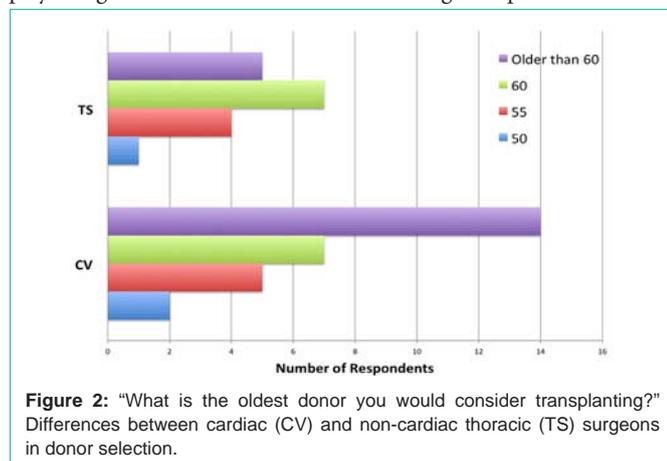
CV and TS surgeons differed in selection of donors and recipients. CV surgeons accepted older recipients (Table 1, Figure 1,  $p=0.004$ ) and tended towards accepting older donors (Table 1, Figure 2  $p=0.54$ ) relative to TS surgeons. Interestingly, neither CV nor TS surgeons as a group considered the upper limit of donor age to be the most important controversy in heart transplantation.

Among CV surgeons responding to the survey, 20/28 (71%) practiced at high volume centers; among TS surgeons responding to the survey, 10/17 (59%) practiced at high volume centers (Table 3). CV surgeons and TS surgeons were similarly distributed across high and low volume centers. High volume centers transplanted older recipients (Table 2,  $p = 0.005$ ), older donors (Table 2,  $p = 0.003$ ) and patients with a longer cold ischemic time (Table 2,  $p=0.026$ ) than low volume centers.

Responses from all survey questions can be viewed in the Appendix A.

## Discussion

Selection differences exist for the limits of acceptable age in both recipients and donors deemed suitable for lung transplantation. Our survey was congruent with previous reports that center volume plays a significant role in the selection of lung transplant donors and



**Figure 2:** "What is the oldest donor you would consider transplanting?" Differences between cardiac (CV) and non-cardiac thoracic (TS) surgeons in donor selection.

**Table 2:** Differences between low volume (< 20 transplants performed per year) and high volume lung transplant ( $\geq 20$  transplants performed per year) centers.

	Low Volume Center	High Volume Center	p value
<b>Recipient Age</b>			$p = 0.0054$
55	2	0	
65	3	2	
70	8	11	
75	2	8	
$\geq 75$	0	9	
<b>Donor Age</b>			$p = 0.0034$
50	3	0	
55	3	6	
60	7	7	
$\geq 60$	2	17	
<b>Upper limit of cold ischemic time</b>			$p = 0.0264$
3 hours	0	1	
4 hours	6	3	
6 hours	8	15	
$\geq 6$ hours	1	11	

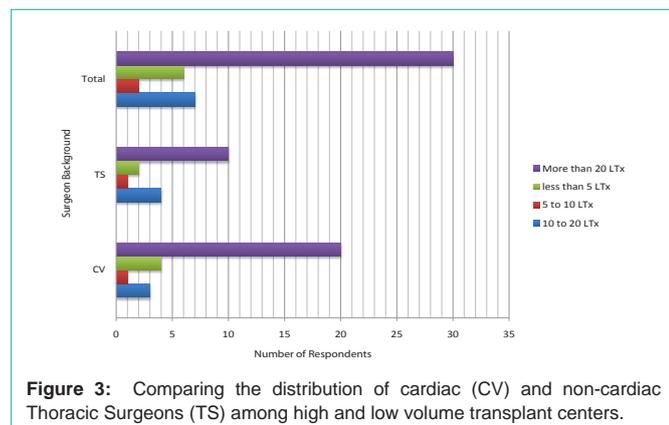
recipients [5]. The accumulation of expertise and multi-disciplinary approach at these centers certainly helps predispose physicians to perform procedures that would not be attempted at smaller centers. However, the most interesting result of this survey was that statistically significant differences exist between CV and TS surgeon. While we did not collect enough data for a regression analysis, the similarity of CV and TS surgeon distributions across high and low volume centers suggests these differences exist independently of center volume influence.

Our results suggest that CV surgeons are less reluctant to accept recipients over the age of 70, despite literature discouraging the use of age  $\geq 70$  as an absolute contraindication for transplantation [1]. We are curious as to what factors may influence this difference, particularly with regard to subconscious biases physicians acquire in clinical practice. The greater willingness of CV surgeons to operate on older patients may be partially due to positive experiences with older demographics. A retrospective analysis, published in 2011, concluded that cardiac surgery on patients over 80 years old showed considerable benefits in quality of life and long-term survival [6]. For comparison, one third of patients undergoing curative resections for early stage lung cancer ultimately die of disease recurrence (the mean age of diagnosis is 71) [7]. The psychological weight of these experiences may influence TS surgeons to be more cautious in decisions about lung transplantation.

## Study Limitations

The survey response rate does not necessarily reflect participation by transplant surgeons; the survey was distributed to all attending CV and TS surgeons affiliated with American and Canadian training programs. Respondents self-reported performing lung transplants, but the anonymous nature of the survey prevented validation.

Though CV and TS surgeons were distributed similarly with regard to institutional volume, individual responses were affected by said individual's association with high or low volume transplant centers. A pair-matching study, in which every CV surgeon was matched with a TS surgeon at a similar transplant center, could eliminate any confounding effects, but this was not possible given the voluntary nature of the survey.



**Figure 3:** Comparing the distribution of cardiac (CV) and non-cardiac Thoracic Surgeons (TS) among high and low volume transplant centers.

While we were pleased with our volume of responses, our survey results may not reflect the attitudes and preferences of all CV and TS surgeons practicing in the US and Canada.

## Conclusion

All physicians are influenced by biases they acquire in their clinical experiences. As the general population ages, it is imperative to gain insight into the factors that influence donor and recipient selection. Awareness of our biases and deference to standard criteria is an important first step. We must ask how to best determine appropriate donors and recipients.

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