JOURNAL OF SURGICAL RESEARCH • MARCH 2018 (223) 58–63

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

Association for Academic Surgery

Expanding the donor lung pool: how many donations after circulatory death organs are we missing?

*William Zachary Chancellor, MD,** Eric J. Charles, MD, James Hunter Mehaffey, MD, Robert B. Hawkins, MD, Carrie A. Foster, BS, Ashish K. Sharma, MBBS, PhD, Victor E. Laubach, PhD, Irving L. Kron, MD, and Curtis G. Tribble, MD**

Division of Thoracic and Cardiovascular Surgery, Department of Surgery, University of Virginia Health System, Charlottesville, Virginia

ARTICLE INFO

Article history:
Received 9 February 2017
Received in revised form
15 August 2017
Accepted 27 September 2017
Available online xxx

Keywords:
Lung transplantation
Donation after circulatory death
High-risk donation
Donor pool size

ABSTRACT

Background: The number of patients with end-stage pulmonary disease awaiting lung transplantation is at an all-time high, while the supply of available organs remains stagnant. Utilizing donation after circulatory death (DCD) donors may help to address the supply-demand mismatch. The objective of this study is to determine the potential donor pool expansion with increased procurement of DCD organs from patients who die at hospitals.
Material and methods: The charts of all patients who died at a single, rural, quaternary-care institution between August 2014 and June 2015 were reviewed for lung transplant candidacy. Inclusion criteria were age <65 y, absence of cancer and lung pathology, and cause of death other than respiratory or sepsis.
Results: A total of 857 patients died within a 1-year period and were stratified by age: pediatric <15 y ($n = 32$, 4%), young 15-64 y ($n = 328$, 38%), and old >65 y ($n = 497$, 58%). Those without cancer totaled 778 (90.8%) and 512 (59%) did not have lung pathology. This leaves 85 patients qualifying for DCD lung donation (pediatric $n = 10$, young $n = 75$, and old $n = 0$). Potential donors were significantly more likely to have clear chest X-rays (24.3% *versus* 10.0%, $P < 0.0001$) and higher mean PaO2/FiO2 (342.1 *versus* 197.9, $P < 0.0001$) compared with ineligible patients.
Conclusions: A significant number of DCD lungs are available every year from patients who die within hospitals. We estimate the use of suitable DCD lungs could potentially result in a significant increase in the number of lungs available for transplantation.

Meeting: Oral Presentation at the 12th Annual Academic Surgical Congress, February 7-9, 2017 in Las Vegas, NV.
* *Corresponding author*. Department of Surgery, PO Box 800679, Charlottesville, VA 22908. Tel.: +1434 924-2158; fax: +1 434 924-1218.
** *Corresponding author*. Department of Surgery, PO Box 800709, Charlottesville, VA 22908. Tel.: +1434 924-9297; fax: +1 434 924-1218.
E-mail addresses: wzc2r@virginia.edu (W.Z. Chancellor), cgt2e@virginia.edu (C.G. Tribble).
0022-4804/$ – see front matter © 2017 Published by Elsevier Inc.
https://doi.org/10.1016/j.jss.2017.09.029

Introduction

Lung transplantation remains the standard of care for patients with end-stage pulmonary disease that is refractory to medical therapy. However, despite modest increases in donor authorization rates, the supply of donor lungs is not adequate to meet the growing demand.[1] The number of patients waiting for a transplant at year's end has increased dramatically over the last decade and waitlist mortality remains unacceptably high.[2] According to data from the US Department of Health and Human Services Organ Procurement and Transplantation Network, there were 2057 lung transplants performed in 2015, while more than 2400 patients were added to the waiting list during the previous year.[3] Thus, the number of patients needing a life-saving or life-sustaining lung transplant is at an all-time high, and there is a critical need to increase the supply of donor lungs.

The number of registered organ donors has increased steadily over the past several years due to efforts by governments, physician groups, and organ procurement agencies. Campaigns have increased public awareness, which has lead to small increases in total donor authorizations.[4,5] However, the number of patients awaiting a lung transplant has risen even faster. With donor authorization rates now as high as 89% in some areas, there is clearly a need to find other mechanisms to increase the donor pool.[6]

In the past, when thoracic transplant surgeons faced critical shortages of available organs, they expanded donation criteria to include lungs that would have otherwise been declined. The addition of lungs from donors older than 55 y, those from donors with a significant smoking history, and those with evidence of mild pulmonary disease helped to meet the growing demand for transplantable organs.[7,8] Similarly, in light of the current donor shortage, one method to increase lung procurement rates is to increase the number of organs utilized from donation after circulatory death (DCD) donors. Several observational studies show no difference in survival or rates of primary graft dysfunction in lungs used from donors after circulatory death when compared with donors diagnosed with brain death (DBD).[9,10] There is a growing body of experimental evidence that suggests utilizing DCD lungs, especially when *ex vivo* lung perfusion (EVLP) is utilized, is a safe method to increase the overall donor pool.[11,12] The purpose of this study was to determine the potential for donor pool expansion with increased procurement of DCD organs from patients who die at hospitals.

Materials and methods

Participants

A retrospective chart review was performed to analyze the potential for lung DCD in a rural referral hospital. All in-hospital mortalities from August 2014 to June 2015 at our institution were identified. Due to the postmortem nature of the review, the Institutional Review Board approval was not required for this study. The electronic medical records were evaluated for patient demographics, comorbid disease, cause of death, and clinical results. Demographic information including age, race, and smoking status were collected. All patients were classified as pediatric (less than 15 y of age), young (15-65 y), or old (>65 y) based on convention in lung transplantation. Comorbidities of interest included the presence of any cancer or significant lung pathology, including traumatic lung injury, acute respiratory distress syndrome, chronic obstructive pulmonary disease, pulmonary fibrosis, lung cancer, and pneumonia at the time of death. Additional clinical data abstracted included arterial blood gas data and chest radiograph interpretations. Patients were stratified for analysis by lung donor suitability. Donor exclusion criteria included: (1) age greater than 65 y, (2) any known lung pathology, (3) any recorded history of cancer, (4) respiratory or septic cause of death, (5) $PaO2/FiO2 < 100$, and (6) severe pathology on chest radiograph.

Variable definitions

Chest radiograph findings were classified as mild (absence of pathology, minimal atelectasis, or small pleural effusion), moderate (large pleural effusion, consolidation, or infiltrate), or severe pathology (traumatic injury or lung mass) based on radiographs taken within 7 d of death. Arterial blood gas data collected within 24 h of death were compared between donor candidates and noncandidates using PaO2/FiO2.

Statistical analysis

Continuous variables were presented as mean $\pm$ standard deviation, and categorical variables were presented as number and percentage. Patients were stratified by the primary outcome of lung donor potential for univariate analysis. Categorical variables were analyzed by Chi-square test, and continuous variables were analyzed by independent *t*-test or Mann-Whitney U test based on normality of the distribution. All data analysis was performed using SAS, version 9.4 (SAS Company, Cary NC), with an alpha less than 0.05 defining statistical significance.

Results

There were 857 in-hospital mortalities over a 1-year period. The median age was 64 y (interquartile range = 56-79). Potential donors were grouped by age into pediatric ($n = 32$, 4%), young ($n = 328$, 38%), and old ($n = 497$, 58%) age groups. Pediatric and young patients were considered transplant candidates, whereas old patients (>65 y) were disqualified based on widely accepted donor criteria. The presence of any known lung pathology was recorded including lung trauma, pneumonia, chronic obstructive pulmonary disease, acute respiratory distress syndrome, lung cancer, or pulmonary fibrosis. Causes of death were reported by organ systems or mechanism of injury where appropriate and are shown in Table 1. Candidates for lung donation were those aged less than 65 y, free of any cancer, without lung pathology, and who did not die of respiratory causes or sepsis. Based on these criteria, 85 patients were considered candidates for lung donation (Table 2).