



**Is there Life After Death?
Using Lungs from Non-Heart-Beating
Donors for Transplant**

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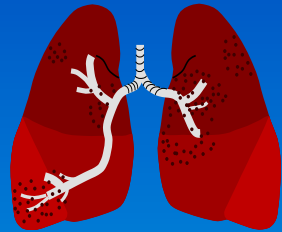
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HEAVEN IS REAL

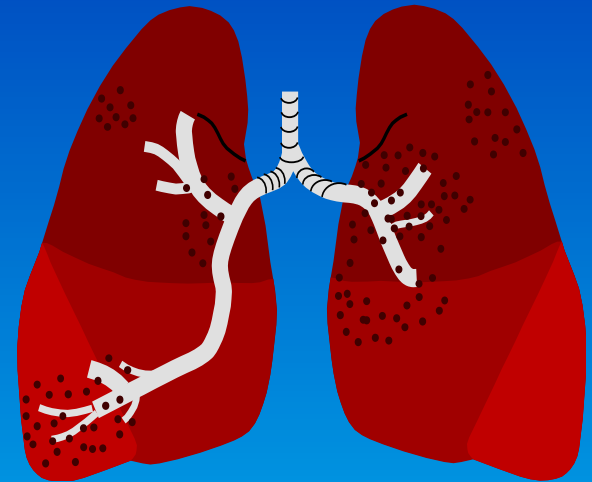
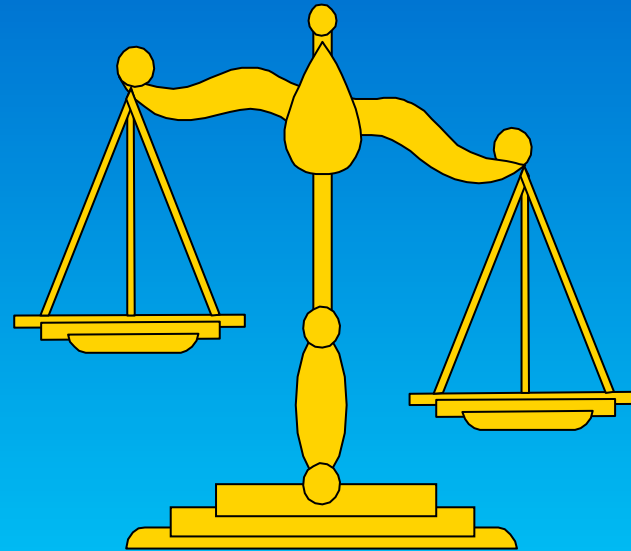
A DOCTOR'S
EXPERIENCE OF
THE AFTERLIFE



Non-Heart Beating Donors for Lung Transplant



supply



demand

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Who is an Organ Donor?

- **brain-dead individuals on ventilator**
 - intubated before brain death
- **living donors**
 - usually related, not always
 - kidney, liver, bilateral lung lobes
- **donation after cardiac death (DCD)**
 - kidney, liver, a few lungs

Non-Heart Beating Donors for Lung Transplant

How many U.S. transplants?

<u>Organ</u>	<u>#/year</u>
Kidney	16,000 (6,000 living)
Liver	6,000 (300 living)
Heart	2,200
Lung	1,400
Corneas	50,000

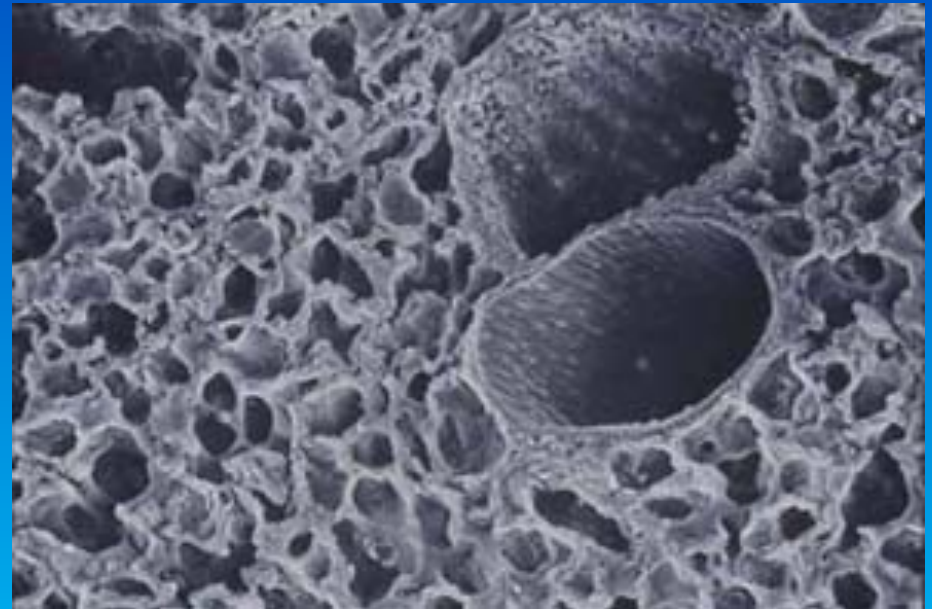
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What is a Non-Heart-Beating Donor (NHBD)?

- someone who dies because circulation has stopped
- sometimes organs can be retrieved from NHBDs
- limitation for most organs is ischemic time
- the lung is different

Rationale

- the lung parenchyma does not rely on blood flow for cellular respiration
- few metabolic functions means low energy requirements
- huge blood reserve after arrest



Hypothesis

If lung cells remain viable after circulatory arrest, then the lung may be suitable for transplant, even if retrieved at substantial intervals after circulatory arrest and death

Non-Heart Beating Donors for Lung Transplant

Proof of Concept

A Strategy to Increase the Donor Pool: Use of Cadaver Lungs for Transplantation

Thomas M. Egan, MD, C. Jake Lambert
Karl S. Ulicny, Jr, MD, Blair A. Keagy,
Division of Cardiothoracic Surgery, University of North C

A shortage of suitable donors is a serious obstacle to widespread application of isolated lung transplant for end-stage lung disease. We hypothesized that tissue likely remains viable for a sufficient period of time to allow for safe postmortem retrieval of lung transplantation. Studies were conducted in a nonsurvival model of canine lung allotransplantation. Donor animals were sacrificed, and subsequent lung harvest was delayed for 1 hour, 2 hours, or 4 hours. Pulmonary resection was then performed in a standard fashion, flushed in lung block with modified Euro-Collins solution. Lungs were then stored for 4 hours before single allotransplantation. Recipient animals were maintained on anesthesia and followed up for 8 hours. By occlusion of the pri-

Cadaver Lung Donors: Effect of Preharvest Ventilation on Graft Function

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Robert L. Reddick, MD, and Benson R. Wilcox, MD

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The pulmonary donor pool would increase substantially if lungs could be safely transplanted after cessation of circulation. To determine whether ventilation of cadaver lungs could improve graft function, canine donors were sacrificed and then ventilated with 100% oxygen (n = 6) or 100% nitrogen (n = 6); 6 served as nonventilated controls. Four hours after death, the lungs were flushed with modified Euro-Collins solution and harvested. Controls were ventilated with 100% oxygen only during flush and harvest. Recipients were rendered dependent on the transplanted lung by occlusion of the right pulmonary artery and bronchus 1 hour after transplantation. Ventilation was maintained at a constant inspired oxygen fraction of 0.4. Four controls died of pulmonary edema

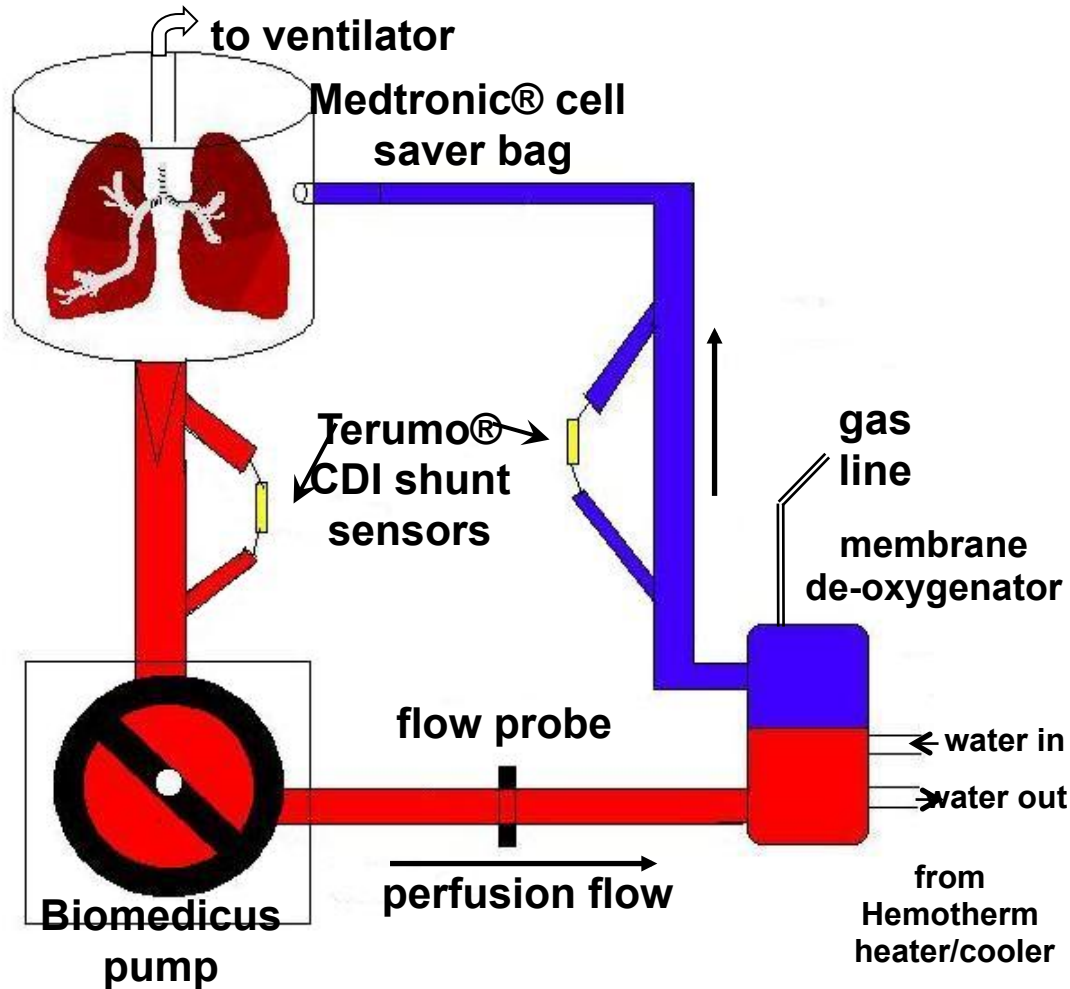
shortly after occlusion of the native lung. The mean arterial oxygen tensions in the oxygen-ventilated, nitrogen-ventilated, and control groups at the end of 8 hours were 81 mm Hg (n = 4), 88 mm Hg (n = 3), and 55 mm Hg (n = 2), respectively. Postmortem oxygen ventilation improved early recipient survival and gas exchange. Postmortem nitrogen ventilation improved early gas exchange and delayed recipient death compared with nonventilated controls. The mechanics of ventilation appears to confer a functional advantage independent of a continued supply of oxygen. Transplantation of lungs harvested from cadavers after cessation of circulation might be feasible.

(Ann Thorac Surg 1993;55:1185-91)

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Ex-vivo human lung perfusion circuit

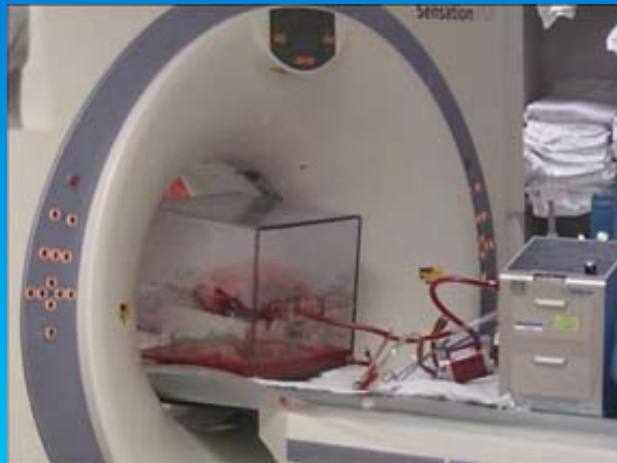


- perfusate is de-oxygenated by ventilating membrane with CO₂ / N₂
- lungs slowly rewarmed to 37°C
- flow slowly increased to 40% donor cardiac output
- PA pressure < 20 mm Hg ventilated with TV= 7cc/kg donor weight

Non-Heart Beating Donors for Lung Transplant

***Ex-vivo* evaluation of human lungs**

- gas exchange
- bronchoscopy
- CT scan



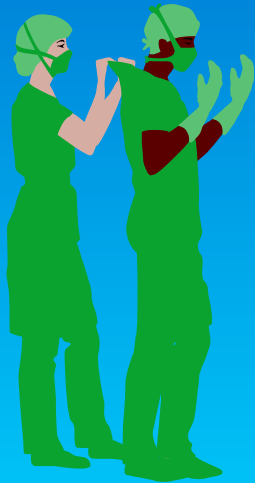
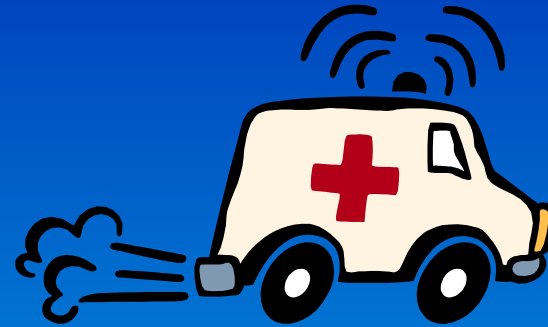
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Non-Heart Beating Donors for Lung Transplant



- HRSA awarded a grant to CDS and UNC to investigate the NHBD donor pool
- *Ex-vivo* Evaluation of Human Lungs from Non-Heart Beating Donors for Transplant

Non-Heart Beating Donors for Lung Transplant



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Non-Heart Beating Donors for Lung Transplant

Where are the challenges?



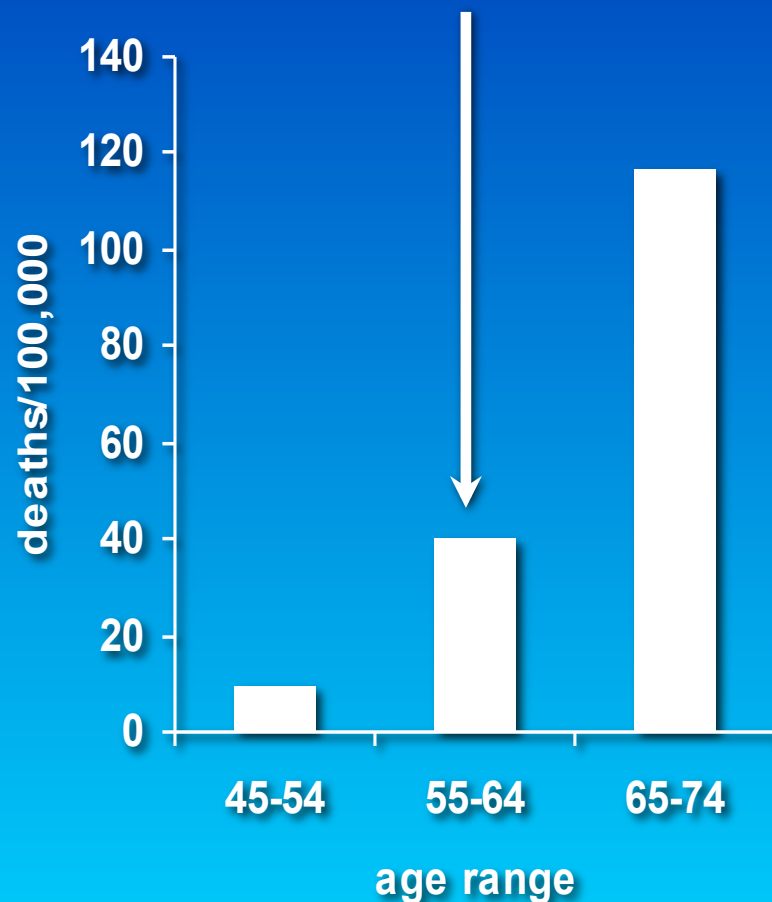
- **Emergency Medical Services (EMS)**
- **County Medical Examiners (ME)**
- **Organ Procurement Organizations (OPO)**

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How many recipients are there?

total COPD deaths = 13,000



total CF deaths = 400/year

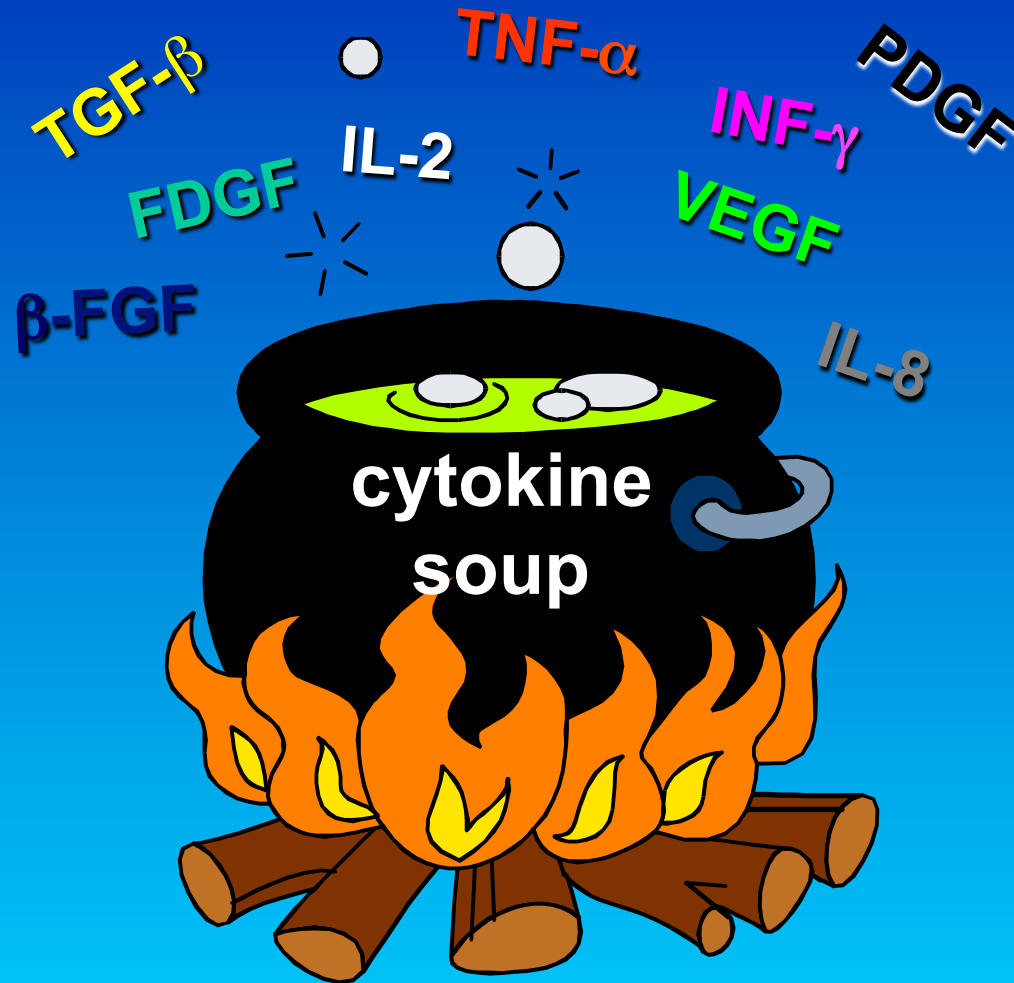
total IPF deaths = 40,000/year

total deaths related to
pulmonary hypertension
= 15,000/year

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Could NHBD lungs be better?



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Where are we now?

- **UNC awarded ARRA grant to perfect ex-vivo lung perfusion and plan a multi-center study of lung tx from NHBDs**
 - **we will use unsuitable lungs from conventional donors and DCDs**
- **the grant funds a study to learn about EMS attitudes about organ donation**
 - **develop a web-based teaching tool for EMS personnel that can be used nationally**

What Was the Plan?

- **All cardiac arrests that were terminated in the field and:**
 - **Not suspicious (by law enforcement)**
 - **Between 18 and 65 years of age**
 - **Drivers License with affirmed donation status**

What Was the Plan?

- Then, APP or DC:
 - Obtain family member phone numbers
 - Call Carolina Donor Services (CDS)
- CDS:
 - Calls family to obtain consent and history
 - Communicates with surgeon to accept or deny

What Was the Plan?

- **If accepted, then:**
 - **Second EMS unit dispatched to move the patient**
 - **Crew will ventilate patient en route**
 - **Crew may remain for harvest**
- **Estimated 2 patients to be screened per week**

Trainwreckology...

The study of impending failure and
the “I told you so”s that follow.

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Went for 3 Months

- 4 patients screened
- 2 accepted and had viable lungs
 - Size problems prohibited transplant (single hospital IRB)



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if you feel like a guinea pig...



you are... and we thank you !

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Next Steps

- **Memo to law enforcement completed**
- **NIH funding application is scored**
- **We await funding to restart the project**

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