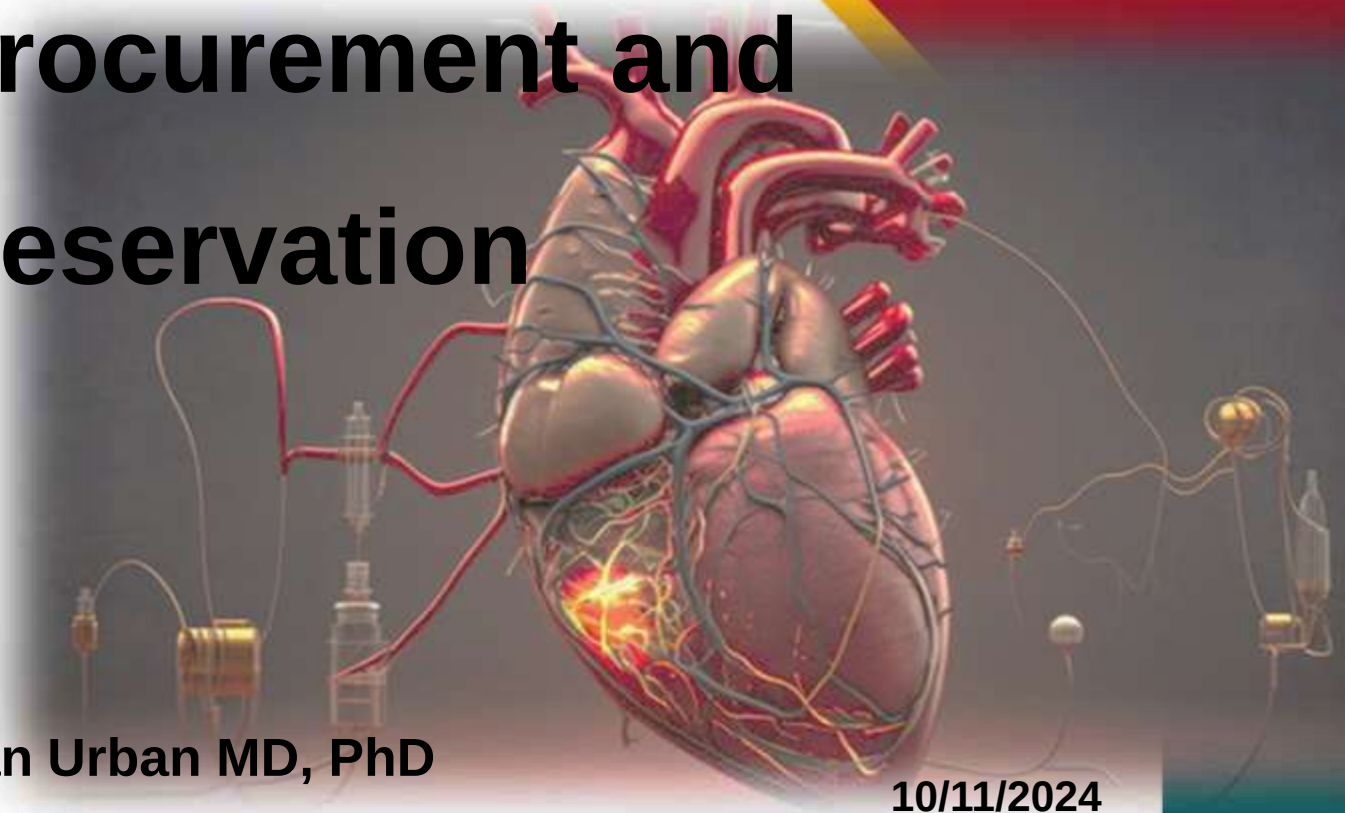
Advancements in Donor Heart Procurement and Preservation

University of Nebraska Medical Center



Marian Urban MD, PhD

10/11/2024

Disclosures

Nothing to disclose.

Process

Donor → Transport → Recipient

Uniform Determination of Death Act (UDDA)

UDDA Overview

The Uniform Declaration of Death Act was drafted in 1981 by a President's Commission study on brain death. It was approved by both the American Medical Association (AMA) and the American Bar Association (ABA) shortly after its publication. Health care is primarily handled on a state-by-state basis, so the intent of the Act was to provide a model for states to emulate.

The UDDA offers two definitions for when an individual may legally be declared dead:

1. Irreversible cessation of circulatory and respiratory functions; or
2. Irreversible cessation of all functions of the entire brain, including the brain stem.

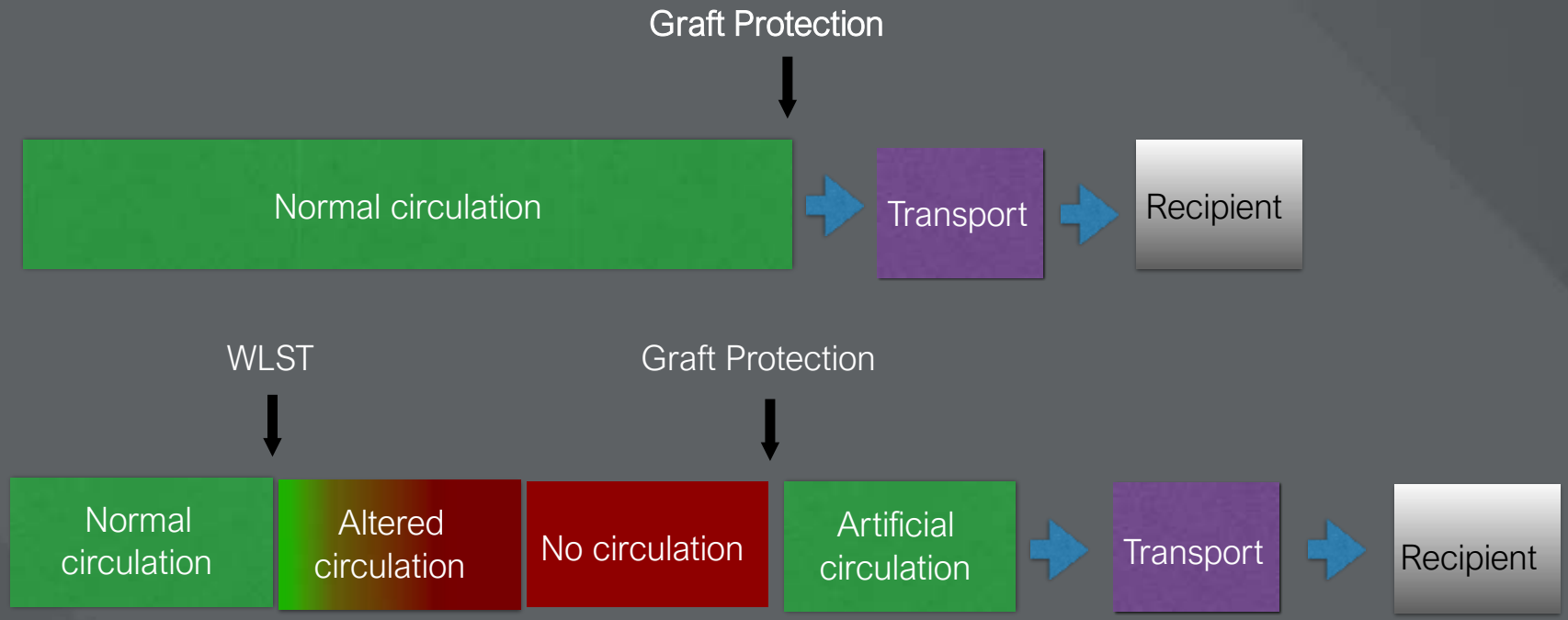
The most common type of death is the first one, in which the heart has stopped beating and/or the patient is no longer breathing (usually followed by brain death). But sometimes (as in the second definition), an individual may be kept "alive" through the use of ventilators and feeding tubes even though there is zero brain activity. Most states consider brain dead individuals legally dead and remove them from life support, although the body's other life functions may be maintained until organs are harvested for donation.

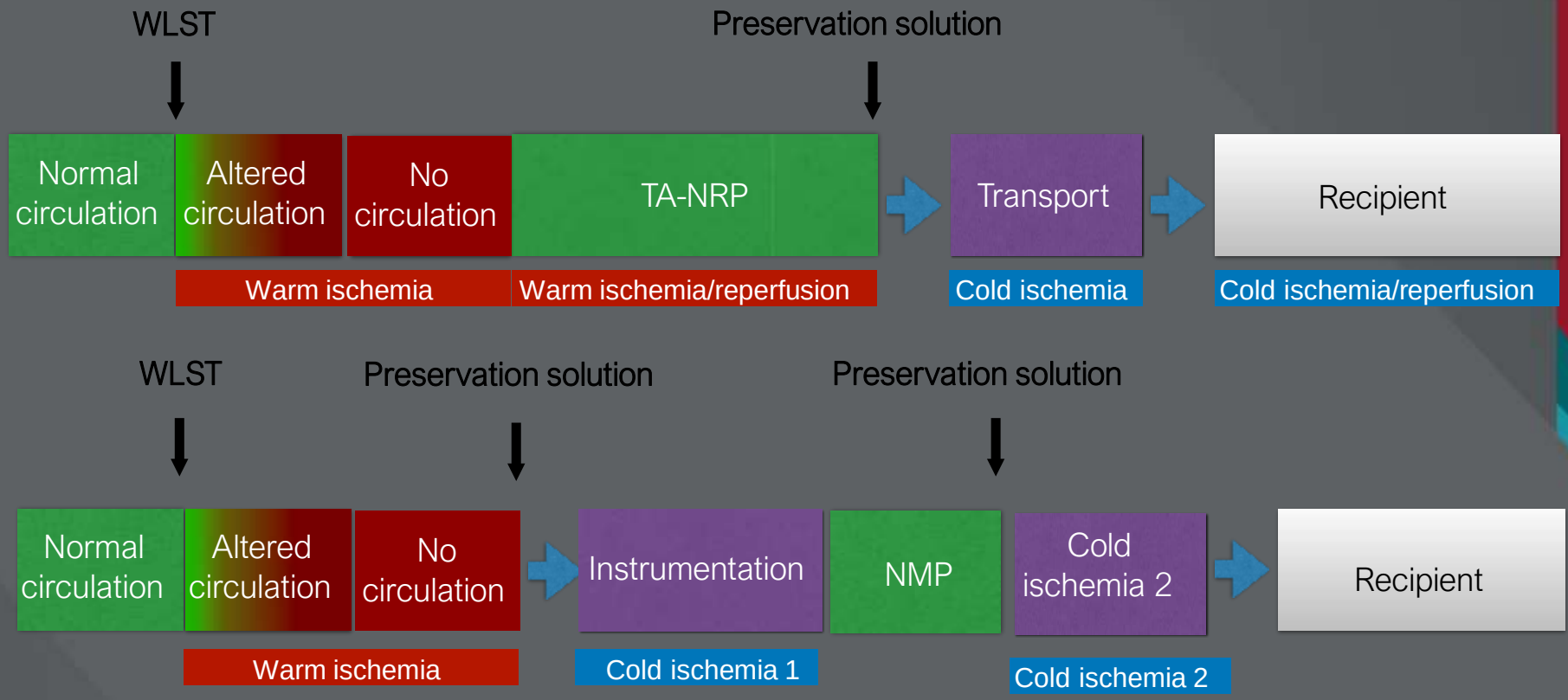
Donor

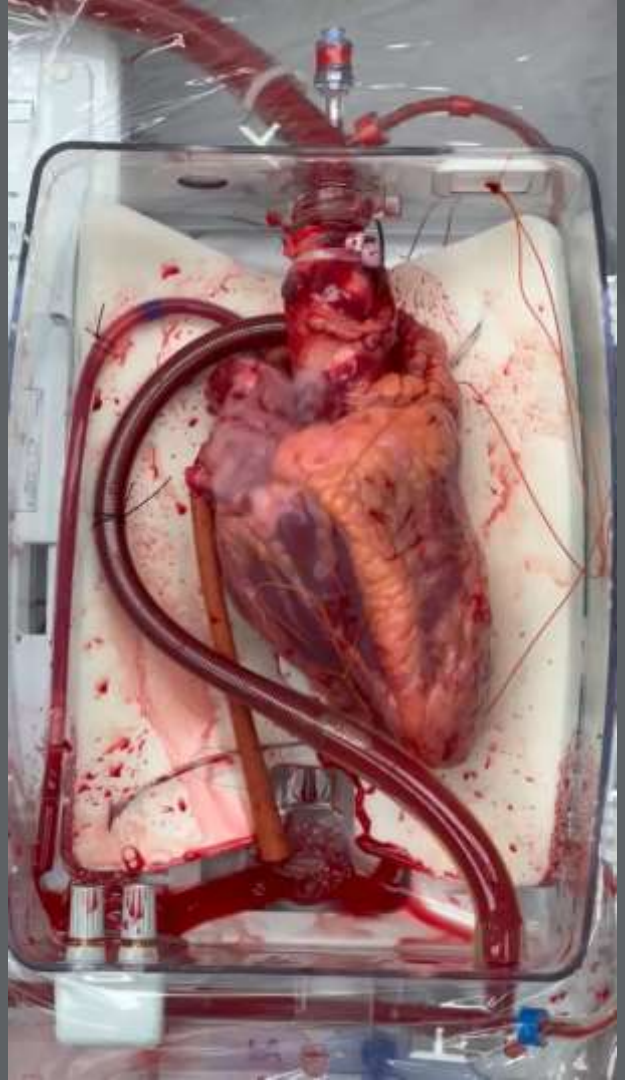
Brain dead

Transport  Recipient

Circulatory dead


Graft Protection
Normal circulation
Transport
Recipient
WLST
Graft Protection
Normal circulation
Altered circulation
No circulation
Artificial circulation
Transport
Recipient

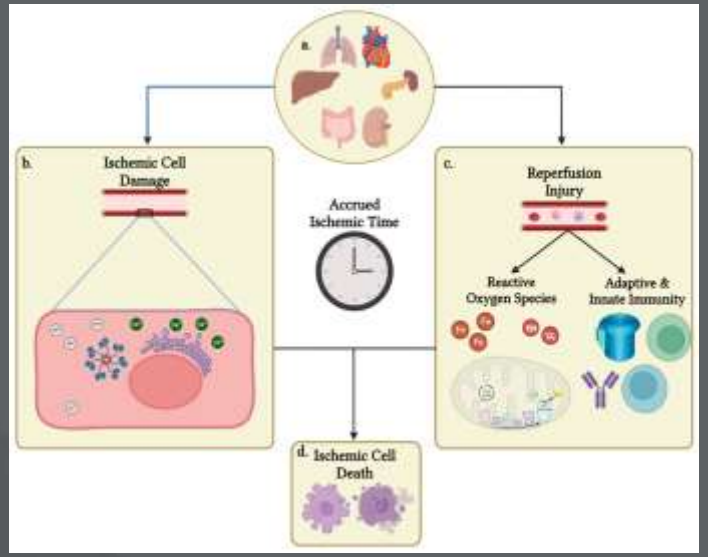

WLST
Preservation solution
Normal circulation
Altered circulation
No circulation
TA-NRP
Transport
Recipient
Warm ischemia
Warm ischemia/reperfusion
Cold ischemia
Cold ischemia/reperfusion
WLST
Preservation solution
Preservation solution
Normal circulation
Altered circulation
No circulation
Instrumentation
NMP
Cold ischemia 2
Recipient
Warm ischemia
Cold ischemia 1
Cold ischemia 2



Ischemic heart preservation

Static cold storage with ice

Limitations of static cold storage with ice

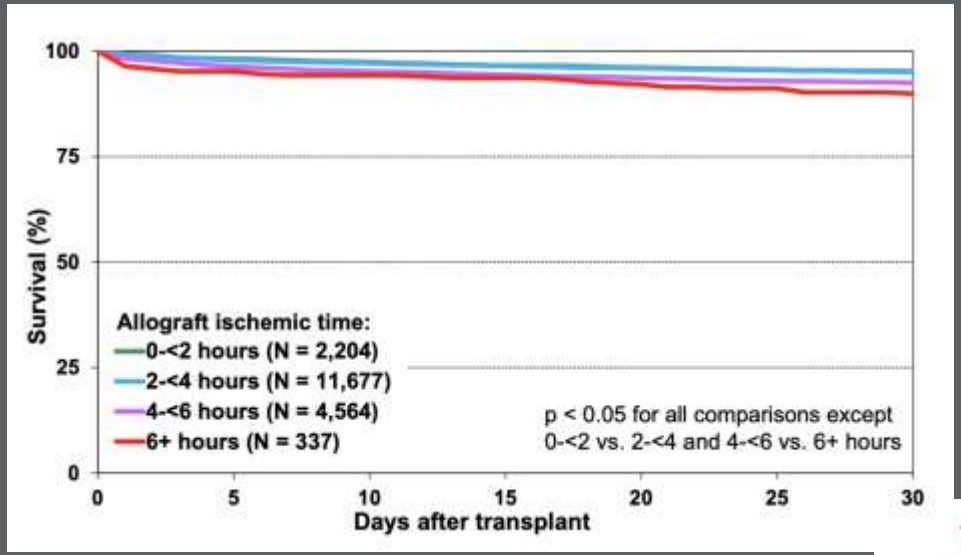


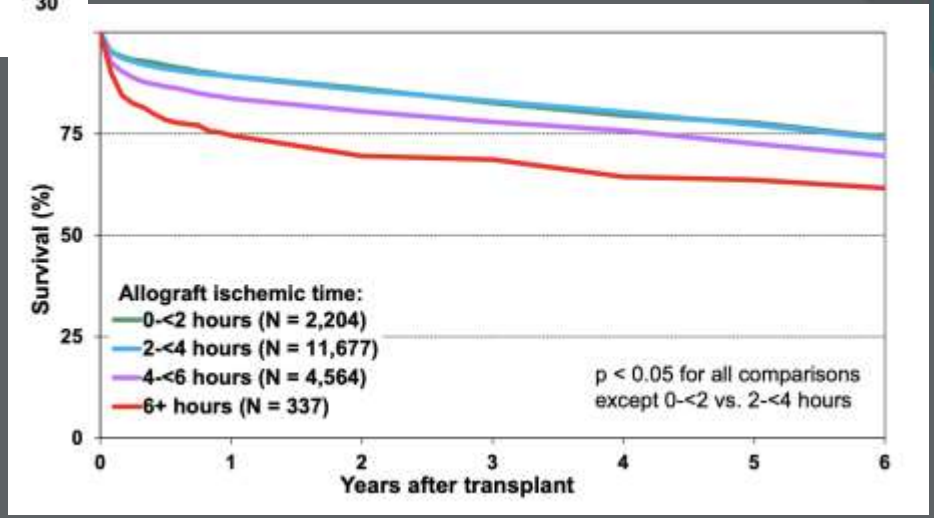
Ischemia + Ischemia/reperfusion

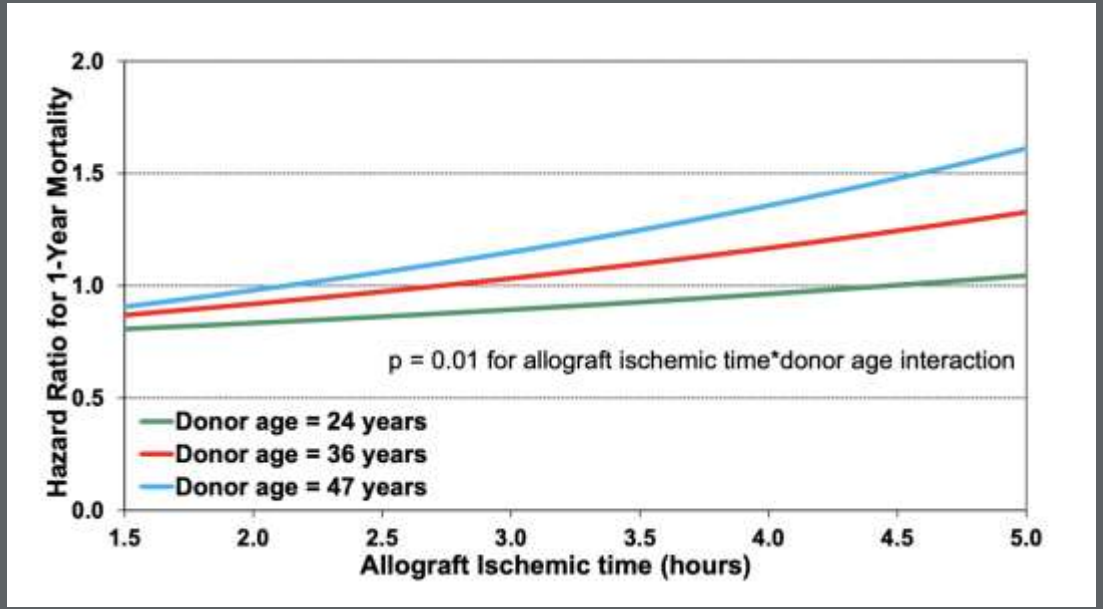
Freezing injury

Static Cold Storage with Ice

- Multi-center clinical study found that average organ temperature during transportation (n=186) was below 2°C, and after 6 hours below 0°C
- < 1°C: Irreversible suppression of diastolic function
- < 0°C: Proteins denature


100
75
50
25
0
Survival (%)
Allograft ischemic time:
0-<2 hours (N = 2,204)
2-<4 hours (N = 11,677)
4-<6 hours (N = 4,564)
6+ hours (N = 337)
p < 0.05 for all comparisons except
0-<2 vs. 2-<4 and 4-<6 vs. 6+ hours
0
5
10
15
20
25
30
Days after transplant


75
50
25
0
Survival (%)
Allograft ischemic time:
0-<2 hours (N = 2,204)
2-<4 hours (N = 11,677)
4-<6 hours (N = 4,564)
6+ hours (N = 337)
p < 0.05 for all comparisons
except 0-<2 vs. 2-<4 hours
0
1
2
3
4
5
6
Years after transplant


Hazard Ratio for 1-Year Mortality
2.0
1.5
1.0
0.5
0.0
p = 0.01 for allograft ischemic time*donor age interaction
Donor age = 24 years
Donor age = 36 years
Donor age = 47 years
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Allograft Ischemic time (hours)

Ischemic heart preservation

Uncontrolled cold storage

Controlled cold static storage

GUARDIAN Clinical Results

US Multi-Center Analysis Of The Global Utilization And Registry Database For Improved Heart Preservation (GUARDIAN) Registry: 1-year Transplant Survival Analysis M.

Leacche, J. Philpott, S. Pham, Y. Shudo, M. Kawabori, J. Jacobs, S. Silvestry, J. Schroder, E. Molina, D. Meyer, D. D'Alessandro

KEY FINDINGS

The use of SherpaPak is superior to ice transport in 1-year post transplant survival in matched cohorts (from 89% to 96%, p=0.03)

•Survival benefit is potentially due to reduced incidence of severe PGD (from 12% vs 3%, p=0.005) and reduced post transplant circulatory support

Ischemic to non - ischemic heart preservation

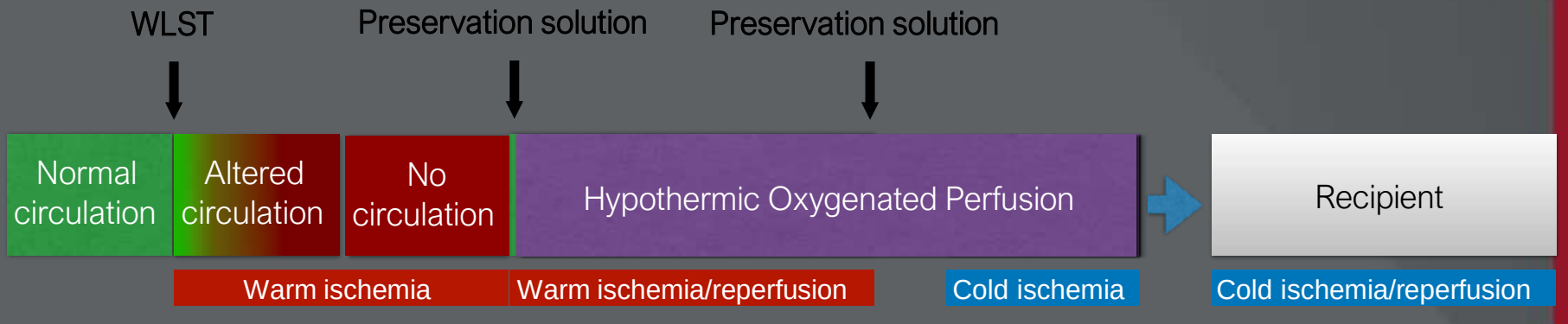
Non - Ischemic heart preservation

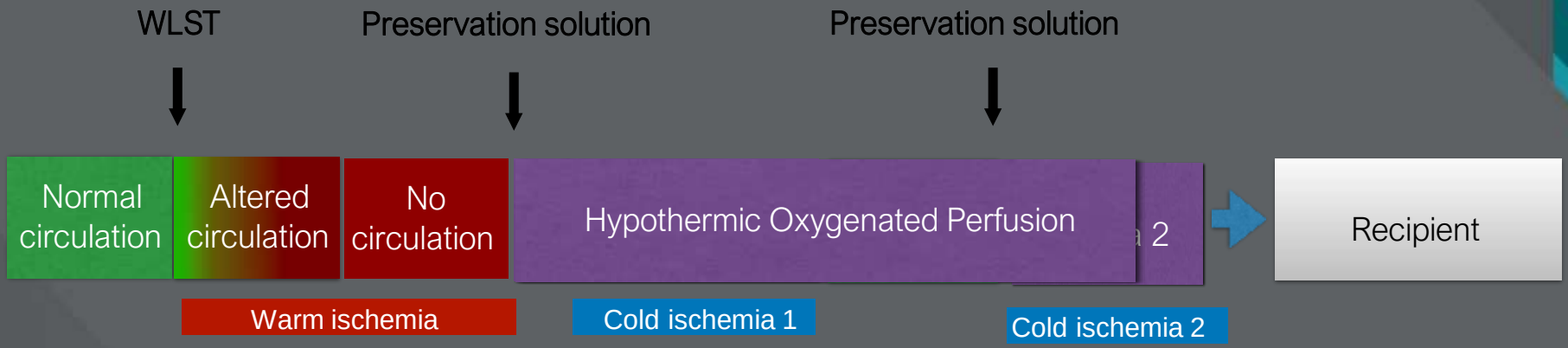
Normothermic

Trans-medics

Hypothermic

XVIVO


WLST
Preservation solution
Preservation solution
Normal circulation
Altered circulation
No circulation
Hypothermic Oxygenated Perfusion
Recipient
Warm ischemia
Warm ischemia/reperfusion
Cold ischemia
Cold ischemia/reperfusion


WLST
Preservation solution
Preservation solution
Normal circulation
Altered circulation
No circulation
Hypothermic Oxygenated Perfusion
2
Recipient
Warm ischemia
Cold ischemia 1
Cold ischemia 2

CASE ANECDOTES, COMMENTS AND OPINIONS

Successful clinical transplantation of hearts donated after circulatory death using direct procurement followed by hypothermic oxygenated perfusion: A report of the first 3 cases

Janne Brouckaert, MD,[a] Katrien Vandendriessche, MD,[a] Karlien Degezelle,[a] Kristof Van de Voorde,[a] Francis De Burghgraeve, MD,[b] Lars Desmet, MD,[c] Dirk Vlasselaers, MD, PhD,[c] Catherine Ingels, MD, PhD,[c] Dieter Dauwe, MD, PhD,[c] Erwin De Troy, MD,[c] Laurens J. Ceulemans, MD, PhD,[d] Dirk Van Raemdonck, MD, PhD,[d] Diethard Monbaliu, MD, PhD,[e] Bart Meyns, MD, PhD,[a] Raf Van den Eynde, MD,[f] Steffen Rex, MD, PhD,[f] Johan Van Cleemput, MD, PhD,[g] and Filip Rega, MD, PhD[a]

From the [a]Department of Cardiac Surgery, University Hospitals Leuven, Leuven, Belgium; [b]LCGO Leuven Cooperating Group for Organ Donation, University Hospitals Leuven, Leuven, Belgium; [c]Department of Intensive Care Medicine, University Hospitals Leuven, Leuven, Belgium; [d]Department of Thoracic Surgery, University Hospitals Leuven, Leuven, Belgium; [e]Department of Abdominal Transplantation Surgery, University Hospitals Leuven, Leuven, Belgium; [f]Department of Anesthesiology, University Hospitals Leuven, Leuven, Belgium; and the [g]Department of Cardiology, University Hospitals Leuven, Leuven, Belgium

University of Nebraska Medical Center℠

BREAKTHROUGHS FOR LIFE.®

University of Nebraska Medical Center