

Lung and Heart Transplantation

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최초의 흉부외과 수술



 그래서 주 하느님께서는 사람 위로 깊은 잠이 쏟아지 게 하시어……..사람에게서 빼내신 갈빗대로 여자 를 지으시고 그를 사람에게 데려오시자……. -창세기 2장 21절



Saints Cosmas and Damian (~A.D 287)



Vladimir P. Demikhov (1916~1998)

- The first experimental lung transplantation: 1940s~50s
- The first experimental heart-lung transplantation
- Two head-dog



History of LTx

- 1963: James Hardy
 1st human LTx: 18 days
- •1983: Joel Cooper
 - •1st successful single LTx
- •1986: Joel Cooper
 - •1st successful double LTx



Adult and Pediatric Lung Transplants Number of Transplants by Year and Procedure Type



ANTATION

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NOTE: This figure includes only the lung transplants that are reported to the ISHLT Transplant Registry. As such, this should not be construed as representing changes in the number of lung transplants performed worldwide.

1st LTx in Korea

- The first operation
 - 1996
 - Right single LTx
- Recipient
 - M/53
 - IPF
- Donor
 - M/18
 - Traffic accident
- Survival : 82 days
 - Cause of death : aspergillosis



Number of Solid Organ Transplants from the Brain Death Donors



Indication

Recipient considerations

I. High (>50%) risk of death due to lung disease within 2 years if lung transplantation is not performed;

II. High (>80%) likelihood of surviving at least 90 days after lung transplantation;

III. High (>80%) likelihood of 5-year post-transplant survival from a general medical perspective provided there is adequate graft function.

Absolute contraindications

• Recent history of malignancy

- A 2-year disease-free interval combined with a low predicted risk of recurrence after lung transplantation, for instance in skin cancers other than melanoma
- A 5-year disease-free interval should be demonstrated in most cases, particularly hematologic malignancy, sarcoma, melanoma, or cancers of the breast, bladder, or kidney
- Poorly controlled significant dysfunction of another major organ system
 - Heart, liver, kidney or brain disease unless a multi-organ transplant is being considered
- **Uncorrected coronary artery disease** with end-organ ischemia or dysfunction and/or coronary artery disease not amenable to revascularization
- An unstable medical condition (acute sepsis, myocardial infarction, and liver failure)
- Uncorrectable bleeding disorder
- **Poorly controlled infection** with a virulent and/or resistant microbes;
- Evidence of active Mycobacterium tuberculosis infection
- A chest wall or spinal deformity expected to cause severe restriction after transplantation
- Class II or III **obesity** (BMI≥35.0 kg/m²)
- Current non-adherence to medical therapy
- Psychiatric or psychological issues
- Inadequate social support system
- Functionally limited with inability to participate in a rehabilitation program
- A history of illicit substance abuse or dependence (e.g., alcohol, tobacco, marijuana, or other illicit substances)

Relative contraindications

- Age
 - **65 years** in association with low physiological reserve and/or other relative contraindications
 - Although no limitation, >75 years of age are less likely to be candidates for lung transplantation
- Class I **obesity** (BMI 30.0 to 34.9 kg/m2), particularly central obesity
- Significant malnutrition
- Significant osteoporosis
- **Extensive prior chest surgery** with lung resection
- Mechanical ventilation and/or extracorporeal life support (ECLS)
 - Carefully selected candidates without other acute or chronic organ dysfunction may be successfully transplanted
- **Colonization** with resistant or highly virulent pathogens;
- Candidates infected with hepatitis B and/or C
 - Without significant clinical, radiological, or biochemical signs of cirrhosis or portal hypertension and who are stable on appropriate therapy
- Patients infected with **HIV**
 - Controlled disease with undetectable HIV-RNA, and adherent with anti-retroviral therapy (cART)
- Extrapulmonary conditions that have not resulted in significant organ damage
- Diabetes mellitus, systemic hypertension, epilepsy, central venous obstruction, peptic ulcer disease, or gastroesophageal reflux

Adult and Pediatric Lung Transplants Recipient Age by Year (Transplants: January 1987 – June 2017)





Transplant Recipient Age: KONOS 2010 - 2017



Indication for lung transplantation

- Obstructive
 - Emphysema
 - α -1 antitrypsin deficiency
 - Obliterative bronchiolitis
- Suppurative
 - Cystic fibrosis
 - Bronchiectasis
- Interstitial
 - Idiopathic pulmonary fibrosis
 - Sarcoidosis
 - Connective tissue disease
 - Eosinophillic granulomatosis
 - Occupational lung disease
 - Hypersensitivity pneumonitis
 - Drug intoxicity
 - Lymphangioleiomyomatosis (LAM)

Indication for lung transplantation

- Obstructive
 - FEV1<25% predicted and/or
 - PaCO2>55 mmHg and/or
 - Cor pulmonale
 - Preference to patients on oxygen therapy
- Suppurative
 - FEV1< 30% predicted or
 - FEV1>30% with
 - Increased number of hospitalization
 - Rapid fall in FEV1
 - Massive hemoptysis
 - Increased cachexia
 - PaCO2> 50 mmHg
- Pulmonary fibrosis
 - Symptomatic and progressive disease
 - Abnormal pulmonary function without symptoms
 - Vital capacity < 60~70% predicted
 - DLCO corrected < 50~60% predicted

Indication for lung transplantation

- Pulmonary hypertension
 - NYHA III or IV
 - Cardiac index $< 2L/min/m^2$
 - Right atrial pressure> 15 mmHg
 - Mean pulmonary arterial pressure> 55 mmHg
- Eisenmenger syndrome
 - NYHA III or IV
 - Progressive symptom

Diagno e 2017) HALEY LU RICHARDSON COLE SPROUSE TOTAL (N=58,925) Diagnosis 5) COPD 18,030 (30.6%) IIP 15,164 (25.7%) CF 9,096 (15.4%) **ILD-not IIP** 3,276 (5.6%) A1ATD 2,862 (4.9%) Retransplant 2,376 (4.0%) IPAH 1,702 (2.9%) **Non CF-bronchiectasis** 1,599 (2.7%) **Sarcoidosis** 1,454 (2.5%) **PH-not IPAH** 903 (1.5%) LAM/tuberous sclerosis 555 (0.9%) OB 507 (0.9%) CTD 503 (0.9%) THENRY LIONSCATE COSFILMS Cancer 37 (0.1%) Other 861 (1.5%) ISHLT . INTERNATIONAL SOCIET

Adult Lung Transplants Major Diagnoses by Year (Number)



Indications of LTx in Korea: KONOS Data 2010 - 2014

	2010	2011	2012	2013	2014
Asbestosis					1
Bronchiectasis	1	5	6	1	2
Cystic fibrosis			1		
Eisenmenger SD	1				
COPD/Emphysema	1				
IPF	7	9	12	22	25
LAM	1	5	2	1	2
РРН		1	1	3	
BO after Tx		1	3	5	5
Unknown	1	2			
기타	6	12	12	14	20
Total	18	35	37	46	55

Complication

- Ischemia-reperfusion injury
 - the most worrisome complication in <u>early postoperative course</u>
 - Characteristics
 - progressive lung injury over the first few postoperative hours
 - noncardiogenic pulmonary edema
 - <u>mild and transient edema in most cases</u>
 - Causes
 - poor preservation of the graft
 - Prolonged ischemic time
 - Aspiration in the donor lung
 - <u>Treatment</u>
 - Mechanical ventilatory support: minimizing inhaled tidal volume
 - Diuresis
 - NO inhalation
 - ECMO

Anastomotic complications

- Bronchial dehiscence and necrosis
- the early use of sirolimus

Acute rejection

- Lung : susceptible to acute rejection among all solid organ transplants
- up to 50% of patients within the first month
- present with cough, <u>desaturation</u>, low grade fever
- pulmonary edema pattern or normal in X-ray
- Diagnosis
 - transbronchial biopsy via bronchoscopy
- <u>Treatment</u>
 - IV pulse dose steroids
 - optimization of the cyclosporine and azathioprine doses

• Infectious complications

- <u>leading cause of early postoperative deaths</u>
- predispose to acute allograft rejection
- Bacterial infections
 - the most common in the early posttransplant period
 - use of broad spectrum antimicrobial prophylaxis
 - \rightarrow antibiotic regimen based on the recipient and donor sputum culture
- Viral infections
 - particularly <u>CMV</u> infection
 - highest risk: R(-) + D(+)
 - 12-week regimen of IV ganciclovir in high-risk mismatch
- Fungal infections
 - <u>Aspergillus</u>
 - Mortality: ~ 60% in aspergillus pneumonia
 - Treatment: combination of systemic and inhaled antifungal agents
 - Preventention
 - » oral voriconazole or inhaled abelcet
 - » Systemic antifungals
 - Candida

• Post-transplant Lymphoproliferative Disorder (PTLD)

- Immunosuppression after organ transplantation
 - \rightarrow B-cell proliferation
 - \rightarrow B-cell mutation
 - \rightarrow malignant formation (lymphoma)

Chronic rejection

- Terminology
 - Obliterative bronchitis (OB)
 - Bronchiolitis obliterans (BO) ± syndrome (BOS)
- Chronic lung allograft dysfunction (CLAD)
 - BOS
 - Restrictive allograft syndrome (RAS)
 - Neutrophilic reversible allograft dysfunction (NRAD): responder to azithromycin
- **–** Tx
 - Prevention: infection, GERD
 - Drug change: to sirolimus, everolimus
 - Retransplantation

Survival

Adult Lung TransplantsKaplan-Meier Survival by Procedure Type for PrimaryTransplant Recipients(Transplants: January 1990 – June 2016)





Adult Lung Transplants

Cause of Death (Deaths: January 1990 – June 2017)

Cause of Death	0-30 Days (N=3,707)	31 Days - 1 Year (N=6,724)	>1 Year - 3 Years (N=6,619)	>3 Years - 5 Years (N=3,941)	>5 Years - 10 Years (N=4,992)	>10 Years (N=2,097)
OB/BOS	11 (0.3%)	309 (4.6%)	1,729 (26.1%)	1,176 (29.8%)	1,234 (24.7%)	464 (22.1%)
Acute Rejection	118 (3.2%)	119 (1.8%)	102 (1.5%)	24 (0.6%)	23 (0.5%)	4 (0.2%)
Lymphoma	1 (0.0%)	141 (2.1%)	112 (1.7%)	55 (1.4%)	93 (1.9%)	60 (2.9%)
Malignancy, Non-Lymphoma	5 (0.1%)	201 (3.0%)	554 (8.4%)	478 (12.1%)	761 (15.2%)	301 (14.4%)
CMV	3 (0.1%)	132 (2.0%)	58 (0.9%)	10 (0.3%)	6 (0.1%)	1 (0.0%)
Infection, Non-CMV	693 (18.7%)	2,313 (34.4%)	1,374 (20.8%)	694 (17.6%)	835 (16.7%)	344 (16.4%)
Graft Failure	888 (24.0%)	1,102 (16.4%)	1,252 (18.9%)	704 (17.9%)	804 (16.1%)	312 (14.9%)
Cardiovascular	445 (12.0%)	369 (5.5%)	292 (4.4%)	184 (4.7%)	293 (5.9%)	142 (6.8%)
Technical	439 (11.8%)	237 (3.5%)	61 (0.9%)	18 (0.5%)	36 (0.7%)	14 (0.7%)
Multiple Organ Failure	471 (12.7%)	817 (12.2%)	338 (5.1%)	158 (4.0%)	233 (4.7%)	109 (5.2%)
Other	633 (17.1%)	984 (14.6%)	747 (11.3%)	440 (11.2%)	674 (13.5%)	346 (16.5%)

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Percentages represent % of deaths in the respective time period.

Waiting List

뇌사 장기기증 절차



Lung Allocation Score (LAS) of UNOS

Table 1. Parameter estimates for waiting list model

CHARACT	ERISTIC (X)	β and conditions
Age at offer		0.0084*age
Bilirubin (mg	/dL)	$0.0432*(bilirubin - 1)$, if bilirubin ≥ 1
Bilirubin incr	ease of at least 50% ¹	1.4144, if diagnosis group B
Body mass in	dex (BMI) (kg/m ²)	0.1261*(20 - BMI), if BMI < 20 kg/m ²
Cardiac index	prior to any exercise (L/min/m ²)	0.5435, if cardiac index < 2 L/min/m ²
Central venou	is pressure (CVP) (mmHg) at rest, prior to any	0.0174*(CVP - 7), if CVP > 7 mmHg and diagnosis
exercise		group B
Continuous n	nechanical ventilation, if candidate is hospitalized	1.6771
Creatinine (se	erum) (mg/dL)	0.5034*creatinine, if candidate at least 18 years old at
		time of offer
Diabetes (reg	ardless of insulin dependency)	0.4680
Diagnosis ²	Group A	0
	Group B	1.5774
	Group C	1.2314
	Group D	0.6260
Diagnosis	Bronchiectasis (in Group A)	0.6681
detailed	Eisenmenger's syndrome (in Group B)	-0.6279
	Lymphangioleiomyomatosis (in Group A)	-0.3163
	Obliterative bronchiolitis (not retransplant) (in	0.4453
	Group D)	0.2001
	Pulmonary librosis, not idiopathic (in Group D)	-0.2091
	sarcoldosis with PA mean pressure > 30 mmHg (in group D)	-0.4578
	Sarcoidosis with PA mean pressure \leq 30 mmHg (in	0.9331
T 1 5 1	group A)	0.1020*(00.ENO)/10. CENC + 000/ 11'
Forced vital c	capacity (FVC) % predicted	0.1829*(80-FVC)/10, if $FVC < 80%$ and diagnosis
E		group D
Functional sta	atus	-0.44/1, if no assistance needed with activities of daily living
Oxvgen need	to maintain adequate oxygen saturation (88% or	0.0213*O ₂ , if diagnosis group B;
greater) at res	t (L/min)	0.1188*O ₂ , if diagnosis groups A, C or D
pCO ₂		$0.1105*pCO_2/10$, if $pCO_2 > 40$
pCO ₂ increas	e of at least 15% ³	0.2331
Pulmonary ar	tery (PA) systolic pressure at rest, prior to any	0.4155*(PA systolic - 40)/10, if PA systolic > 40
exercise (mm	Hg)	mmHg and group A;
		0.0462*PA systolic/10, if diagnosis groups B, C or D
Six-minute w	alk distance (feet) obtained while the candidate was	
receiving sup	plemental oxygen required to maintain an oxygen	-0.0845*six-minute walk distance/100
saturation of	88% or greater at rest.	

Table 2. Parameter estimates for post-transplant model

CHARACTH	ERISTIC (Y)	α and conditions
Age at transp	lant (years)	$0.0247*(age - 45.9972602)$, if candidate age \geq
		46 years
Cardiac index	c prior to any exercise (L/min/m ²)	0.3499, if cardiac index $< 2 \text{ L/min/m}^2$
Continuous m	nechanical ventilation, if candidate is hospitalized	0.6094
Creatinine at	transplant (mg/dl)	0.0896 *creatinine, if candidate age ≥ 18 years
Creatinine inc	crease $\geq 150\%^4$	0.7709
Diagnosis ⁵	Group A	0
	Group B	0.6116
	Group C	0.3627
	Group D	0.4641
Diagnosis	Bronchiectasis (in Group A)	0.1889
detailed	Eisenmenger's syndrome (in Group B)	0.9147
	Lymphangioleiomyomatosis (in Group A)	-1.5194
	Obliterative bronchiolitis (not retransplant) (in	1 2051
	Group D)	-1.2031
	Pulmonary fibrosis, not idiopathic (in Group D)	-0.0724
	Sarcoidosis with PA mean pressure > 30 mmHg (in	0.0438
	group D)	-0.0438
	Sarcoidosis with PA mean pressure \leq 30 mmHg (in	0 1380
	group A)	-0.1567
Functional sta	atus: If no assistance needed to perform activities of	-0 1900
daily living		-0.1900
Oxygen need to maintain adequate oxygen saturation (88% or		0.0748*O ₂ , if diagnosis group A;
greater) at rest (L/min)		0.0164*O ₂ , if diagnosis groups B, C or D
Six-minute w	alk distance (feet) obtained while the candidate was	
receiving sup	plemental oxygen required to maintain an oxygen	0.0005*(1200 - six-minute walk distance)
saturation of	88% or greater at rest.	

폐이식 응급도

	- 다음 한 가지 이상 해당하는 경우				
🗆 응급도 0	□ 호흡부전증으로 인공호흡기 를 부착중인 환자				
	□ 체외막형 심폐기 를 가동중인 환자				
	- 다음 한 가지 이상 해당하는 경우				
□ 우근도 1	□ NYHA IV 이면서 산소 투여 없이 측정한 동맥혈 가스 검사상 PaO2 < 55mmHg				
	□ NYHA IV 이면서 평균 폐동맥혈압 > 65mmHg, 또는 평균 우심방 혈압 > 15mmHg				
	□ Cardiac index < 2L/min/m2인 경우				
	- 다음 한 가지 이상 해당하는 경우				
	□ 폐기능검사에서 1초 강제호기량(FEV1) < 25%				
	□ 산소 없이 측정한 동맥혈 가스 검사상 PaO₂ < 60mmHg				
	□ 평균 우심방혈압이 10-15 mmHg인 경우				
🗆 응급도 2	□ 평균 폐동맥압력이 55-65 mmHg인 경우				
	□ Cardiac index < 2-2.5 L/min/m2인 경우				
	□ 과거에 폐이식을 시행한 경우로 다시 폐이식이 필요한 경우				
	□ 과거에 폐용적 감소술을 시행한 경우로 상태가 악화된 경우				
	□ 폐암에서 폐이식이 적용된 경우				
※ 유의사항					
• 응급도 0과 1,2의	등록은 장기이식정보시스템(K-net) 등록후 24시간 내에 폐 응급도 서식을 KONOS로 통				
보함					
• 해당 응급도로 연	!장할 경우 8일 이내에 재등록토록 하여야 하고 동 내용은 마감일 24시간 이전에 서면으로				
통보하여야 하며	f, 변경된 응급도로 등록할 경우에도 장기이식정보시스템에 등록후 24시간 내에 응급도 서식				
을 KONOS로 통보함					

• 그 외는 응급도 3으로 떨어지오니 항상 유의하셔야 함

표 4-1-24. 이식자의 평균 대기시간 (폐) - 성별

(단위 : 일)

구분	2013	2014	2015	2016	2017
평균	91	96	118	116	116
남자	82	60	77	108	115
여자	106	149	178	131	119

표 4-1-26. 이식자의 평균 대기시간 (폐) - 혈액형별

(단위 : 일)

구분	2013	2014	2015	2016	2017
평균	91	96	118	116	116
А	106	68	80	86	118
В	80	89	176	76	128
Ο	99	154	155	244	106
AB	48	81	62	92	112

표 4-1-28. 이식자의 평균 대기시간 (폐) - 응급도별

(단위 : 일)

					(111.2)
구분	2013	2014	2015	2016	2017
평균	91	96	118	116	116
Status0	79	34	55	84	64
Status1	102	153	172	138	173
Status2	6		83	278	
Status3	190	207	205	97	83

The Fate of Patients on the Waiting List for Lung Transplantation in Korea

H.C. Paik, S.J. Haam, D.Y. Lee, G.J. Yi, S.W. Song, Y.T. Kim, C.H. Kang, K.M. Kim, S.I. Park, and S.H. Jheon

ABSTRACT

Lung transplantation for end-stage lung disease results in prolonged actuarial survival and improved pulmonary function. However, the shortage of donor lungs has been a major limiting factor in transplantation. The purpose of this study was to analyze the waiting time and mortality rate for each disease entity. The medical records of all patients listed in The Korean Network for Organ Sharing (KONOS) from May 1996 to May 2011 were analyzed to identify waiting times and causes of death. During the study period, 146 patients (86 males and 60 females) of mean age of 46.6 years (range; 5 to 73 years) showed idiopathic pulmonary fibrosis (IPF: n = 61), chronic obstructive pulmonary disease (COPD: n = 19) or bronchiectasis (n = 15). Sixty-five patients (44.5%) underwent lung or heart-lung transplantation. Sixty-two patients (42.5%) expired during the waiting period, and 19 patients are still on the waiting list. The mortality rate while waiting was highest among patients with primary pulmonary hypertension (62.5%) followed by IPF (57.4%), and acute respiratory distress syndrome (ARDS) (55.6%). The mean time from diagnosis to registration in KONOS was 15.5 months among the expired and 13.2 months in the transplanted group (P = .455). The mean time on waiting list was 8.2 months in the expired group and 3.7 months in the transplanted group (P = .012). In the expired group, the mean survival time was significantly shorter among patients with ARDS (2.2 months, P = .004) compared to IPF (7.9 months), COPD (10.7 months), and primary pulmonary hypertension (PPH) (30.0 months). The high mortality rate (42.5%) during the waiting period in Korea may result from the lack of donors and the delay in registration.

LUNG transplantation (LTx) is a life-saving treatment for patients with end-stage lung disease. However, donor organ availability is a serious problem because only 15% to 20% of multiorgan donors are considered to be suitable for LTx.¹ Approximately 3000 LTx per year have been performed worldwide² since the first successful procedure in 1983.³ The LTx program in Korea started in July 1996.⁴ Until May 2011, five institutions have performed LTx. The purpose of this study was to review the characteristics waiting times, and mortality rates for each disease entity among patients awaiting LTx.

METHODS

We retrospectively reviewed the medical records of all patients awaiting LTx in five institutions and listed in The Korean Network for Organ Sharing (KONOS) from May 1996 to May 2011. The five institutions

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Heart transplantation

History of HTx

- •1964: James Hardy •1st Animal HTx
- •1967: Christiaan Bernard
 - •1st Human HTx: Survival for 18 days
- •1968: Norman Schumway
 - •1st HTx in USA
 - •< 3months, less than 1/3 patients
- •1983: Cyclosporine







First case of HTx in Korea



Adult and Pediatric Heart Transplants Number of Transplants by Year and Location

AND

ISHLT



NOTE: This figure includes only the heart transplants that are reported to the ISHLT Transplant Registry. As such, t he presented data may not mirror the changes in the nu mber of heart transplants performed worldwide.

Number of Solid Organ Transplants from the Brain Death Donors



Adult and Pediatric Heart Transplants Recipient Age by Year of Transplant



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Adult and Pediatric Heart Transplants Donor Age by Year of Transplant





Adult Heart Transplants Diagnosis



1/1982 - 6/2017

1/2009 - 6/2017



Adult Heart Transplants

% of Patients Bridged with Mechanical Circulatory Support* by Year and Device Type



Adult and Pediatric Heart Transplants Kaplan-Meier Survival (Transplants: January 1982 – June 2016)



Adult and Pediatric Heart Transplants Kaplan-Meier Survival by Age Group (Transplants: January 1982 – June 2016)



Adult Heart Transplants Cause of Death (Deaths: January 1994 – June 2017)

Cause of Death	0-30 Days (N=7,048)	31 Days - 1 Year (N=6,076)	>1-3 Years (N=4,298)	>3-5 Years (N=3,693)	>5-10 Years (N=9,428)	>10-15 Years (N=6,759)	>15 Years (N=5,176)
Cardiac Allograft Vasculopathy	90 (1.3%)	212 (3.5%)	494 (11.5%)	483 (13.1%)	1,201 (12.7%)	834 (12.3%)	560 (10.8%)
Acute Rejection	294 (4.2%)	516 (8.5%)	413 (9.6%)	172 (4.7%)	177 (1.9%)	62 (0.9%)	28 (0.5%)
Lymphoma	2 (0.0%)	64 (1.1%)	104 (2.4%)	115 (3.1%)	312 (3.3%)	183 (2.7%)	109 (2.1%)
Malignancy, Other	4 (0.1%)	151 (2.5%)	529 (12.3%)	720 (19.5%)	2,036 (21.6%)	1,438 (21.3%)	985 (19.0%)
СМV	3 (0.0%)	58 (1.0%)	21 (0.5%)	6 (0.2%)	8 (0.1%)	4 (0.1%)	2 (0.0%)
Infection, Non-CMV	981 (13.9%)	1,928 (31.7%)	574 (13.4%)	389 (10.5%)	1,006 (10.7%)	736 (10.9%)	638 (12.3%)
Graft Failure	2,858 (40.6%)	1,074 (17.7%)	1,137 (26.5%)	888 (24.0%)	1,835 (19.5%)	1,176 (17.4%)	862 (16.7%)
Technical	500 (7.1%)	93 (1.5%)	31 (0.7%)	28 (0.8%)	94 (1.0%)	81 (1.2%)	68 (1.3%)
Other	312 (4.4%)	401 (6.6%)	338 (7.9%)	281 (7.6%)	719 (7.6%)	449 (6.6%)	381 (7.4%)
Multiple Organ Failure	1,243 (17.6%)	964 (15.9%)	261 (6.1%)	209 (5.7%)	650 (6.9%)	571 (8.4%)	486 (9.4%)
Renal Failure	30 (0.4%)	53 (0.9%)	57 (1.3%)	114 (3.1%)	516 (5.5%)	538 (8.0%)	509 (9.8%)
Pulmonary	189 (2.7%)	230 (3.8%)	175 (4.1%)	164 (4.4%)	429 (4.6%)	318 (4.7%)	252 (4.9%)
Cerebrovascular	542 (7.7%)	332 (5.5%)	164 (3.8%)	124 (3.4%)	445 (4.7%)	369 (5.5%)	296 (5.7%)
Total Deaths (N)							

ISHLT • INTERNATIONAL SOCIETY FOR HEART AND LUNG TRANSPLANTATION JHLT. 2018 Oct; 37(10): 1155-1206 Percentages represent % of deaths in the respective time period. Total number of deaths includes deaths with unknown causes.

Adult Heart Transplants

Cumulative Morbidity Rates in <u>Survivors</u> within 1, 5 and 10 Years Post Transplant (Transplants: January 1994 – June 2016)

Total N with Total N with Within Total N Within Within Outcome known 5 Years with known known 1 Year 10 Years response response response Severe Renal Dysfunction¹ 6.9% (N=38.588) 16.1% (N=22,131) 23.1% (N=9,000) 5.4% Creatinine > 2.5 mg/dl 12.7% 15.1% Chronic Dialysis 1.4% 2.9% 6.0% Renal Transplant 0.1% 0.6% 2.0% Diabetes² 21.0% (N=38,844)34.5% (N=22,396)Cardiac Allograft Vasculopathy 7.6% (N=35,766) 29.2% (N=16,921) 47.2% (N=5,787)



¹ Severe renal dysfunction = Creatinine > 2.5 mg/dl (

221 µmol/L), dialysis or renal transplant

² Data are not available 10 years post-transplant.

Adult Heart Transplants

Post Transplant Malignancy (Transplants: January 1994 – June 2016) Cumulative Morbidity Rates in <u>Survivors</u>

Malignancy/Type		1-Year Survivors	5-Year Survivors	10-Year Survivors
No Malignanc	y	37,928 (94.8%)	20,922 (84.0%)	8,451 (72.1%)
Malignancy (a	all types combined)	2,062 (5.2%)	3,981 (16.0%)	3,277 (27.9%)
Malignancy	Skin	677 (1.7%)	2,378 (9.5%)	2,189 (18.7%)
Type*	Lymphoma	203 (0.5%)	279 (1.1%)	211 (1.8%)
	Other	1,141 (2.9%)	1,545 (6.2%)	1,190 (10.1%)
	Type Not Reported	41 (0.1%)	38 (0.2%)	21 (0.2%)

"Other" includes: prostate (11, 31, 19), adenocarcinoma (7, 2, 1), lung (6, 5, 1), bladder (2, 3, 0), Kaposi's sarcoma (0, 2, 0), breast (1, 4, 2), cervical (2, 3, 2), colon (2, 4, 3), and renal (2, 6, 1). Numbers in parentheses are those reported within 1 year, 5 years and 10 years, respectively.

* Recipients may have experienced more than one type of malignancy so the sum of individual malignancy types may be greater than the total number with malignancy.



Skin malignancy includes melanoma and non-melanoma skin cancers.

Survival after HTx in Korea





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