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Strategies for expanding the lung donor pool and increasing the number of transplants in Turkey

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Abstract

Aim: Lung transplantation is the treatment of choice in end-stage lung diseases. However, the shortage of organ donors is a significant challenge. This study analyzes lung donor characteristics and evaluates strategies to expand the donor pool in Turkey.

Materials and Methods: Data from 136 cadaveric lung donors offered to our clinic between 2021 and 2023 were examinedincluding donor characteristics such as age, medical history, cause of death, and laboratory results. The donors were divided into two groups: accepted versusrejected.

Results: This study evaluated 136 out of 959 deceased donors in Turkey, representing 14.1% of all deceased donors between 2021 and 2023. Fifty-three deceased donors were offered to the lung transplant clinic in 2021, 44 in 2022, and 39 in 2023. Among these, 25 donors were accepted for transplantation, and 111 were rejected .The mean age of the donors was 37.5 years. The patients in the rejected group were significantly older than the patients in theaccepted group. The most common cause of death of the deceased donors was intracranial hemorrhage. Significant differences were observed between the groups in terms of PaO_2/FiO_2 ratios were lower than 300 mm-Hg in the majority of the patients in the rejected group. Furthermore, patients in the rejected group had a higher prevalence of hypertension and a history of smoking in the rejected group.Microbial growth was observed in 22.42% of total donors, with a higher rate in the accepted group. Transoesophageal echocardiography (TOE) or transthoracic echocardiography (TTE) was used for cardiac evaluation of donor.

Conclusion: The decline in donor availability and lung transplants in Turkey highlights the need for expanding donor criteria, including marginal donorsAdditionally, increasing public awareness and strengthening healthcare infrastructure are crucial to improving deceased donor organ donation rates and solid organ transplantation rates in Turkey.

Introduction

Lung transplantation is universally recognized as a life-saving therapeutic intervention and the gold standard treatment for patients with end-stage lung diseases [1]. The limited availability of deceased organ donors significantly restricts access to lung transplantation and leads to elevated waiting-list mortality rates, posing a critical challenge both globally and in Turkey. Increasing the number of available donors has therefore emerged as a paramount priority in the field of lung transplantation. The COVID-19 pandemic, which emerged globally in early 2020, disrupted organ donation and transplantation processes, significantly reducing donation rates in Turkey [2, 3]. This decline, driven by resource diversion, quarantine measures, and shifts in public perception, exacerbated challenges for patients on the waiting list for lung lung transplantation.

In the post-pandemic period, various strategies have been tried to increase organ donation rates. Donor characteristics areidentified as a critical factor in improving donor availability and promoting organ donation [4-6]. Analyzing these characteristics provides insights into barriers to organ donation and supports the development of targeted solutions to optimize donor profiles. Key factors influencing organ donation include donor age, cause of death, medical history, and organ viability. Additionally, socialawareness, supportive health policies, and educational programs play an essential role in promoting organ donation rates.

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On of the main objectives is to promote awareness for organ donation in a society.

This study aims toexplore the initiatives undertaken in Turkey to increase organ donations for lung transplantation, with a particular focus on identifying donor characteristics and analyzing their impact on donation rates. Additionally, the study aims toaddress the current challenges in organ donation, propose potential solutions, and discuss future strategic directions.

Materials and Methods

Study design and primary outcome variables

This retrospective study evaluates the demographic, medical, and laboratory characteristics of deceased donorlung donationsto identify factors influencing donor selection and transplant eligibility. The primary outcome variable is the successful acceptance of donors for lung transplantation. The study variables include demographic characteristics, donor medical history, and laboratory results.

Deceased donor lung donationsoffered to our Lung Transplant Clinic between January 2021 and December 2023 were analyzed. Data were collected from the form provided by the Turkish Donor and Organ Tracking System (TDIS). The demographic details of the donors, such as gender, age, height, weight, blood type, and causes of death (including suicide, gunshot wound, poisoning, intracranial hemorrhage, drowning, and traumatic intracranial hemorrhage), were examined. In addition, hospitalization status, hospital admission information, hospital type (state hospital, private hospital, university hospital, or research and training hospital), and the results of their most recent tests of the deceased donors were analyzed. The medical history of the donors, including conditions like congenital heart disease, hypertension, diabetes mellitus, neurological disorders, and malignancy, were also evaluated.Furthermore, microbial culture tests (trachea, blood, urine), antibiotic use, WBC count, C-reactive protein (CRP), and procalcitonin levels were also evaluated. Transoesophageal echocardiography (TOE) or transthoracic echocardiography (TTE) results were reviewed, and the differences between donors with an ejection fraction (EF) <55 and those with EF ≥ 55 were analyzed. Additionally, findings on the CT scan were examined for any pathological findings. Demographic differences between accepted and rejected donors were investigated. The donor evaluation process and acceptance criteria were carried out as outlined in our previous [5].

The annual organ donation and lung transplantation numbers were obtained from the official website of the Public Awareness Platform for Transplantation, Dialysis and Follow-up Systems of the Ministry of Health of the Republic of Turkey. The numbers of donors presented to our lung transplantation clinic were compiled annually from our internal TDİS (Transplantation and Donor Service) [6].

Sample size calculation

The sample size was determined based on prior studies evaluating lung donor characteristics and acceptance criteria. The study includes all lung donors presented to our center between January 2021 and December 2023, meeting predefined inclusion criteria.

Sampling method

A non-probability consecutive sampling approach was used, including all available lung donors during the study period without any random selection.

Statistical analysis

Statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables (e.g., gender, cause of death, smoking status) were summarized as frequencies and percentages.Continuous variables (e.g., age, PaO_2/FiO_2 ratio) were presented as means and standard deviations (for normally distributed data) or medians and interquartile ranges (for non-normally distributed data).Chi-square test was used to compare categorical data, and independent samples t-test or Mann-Whitney U test was used for continuous data depending on the normality assumption (Shapiro-Wilk test). Logistic regression analysis was conducted to identify predictors of donor acceptance.

Results

A total of 136 donors were evaluated in the study, accounting for 14.1% of all deceased donors (136/959) in Turkey. Among these, 53 out of 305 (17.3%) donors in 2021, 44 out of 349 (13.4%) in 2022, and 39 out of 305 (12.7%) in 2023 were offered to our lung transplant clinic (Table 1).

The study comprised 111 rejected donors and 25 accepted donors. The mean age was 37.5 years (range: 10–63 years. The patients in the rejected group weresignificantly older (40 years, range: 10–63) than thepatients in the accepted group (30 years, range: 15–51). Male donors donated 66.67% of the organs in the rejected group and 48% of the organs in the accepted group. There were no significant differences in height or weight of the donors between the groups.

The most common cause of death was intracranial hemorrhage (ICH), accounting for 79 out of 136 cases (58.09%). In the rejected group, 63 out of 111 deaths (56.76%) were due to ICH, with 16 out of 25 deaths (23.42%) resulting from traumatic ICH. In the accepted group, 64% of deaths (16 patients) were attributed to ICH, while 24% (6 patients) were caused by drowning. Other causes included gunshot wounds, which accounted for 15 patients (11.03%) overall, with 12 patients (10.81%) in the rejected group and 3 patients (12%) in the accepted group. The PaO_2/FiO_2 ratio <300 mmHg was observed in 35.29% of total donors, significantly higher in the rejected group (41.44%) than in the accepted group (8%) ($p = 0.001$).

Donors were referred from state hospitals (25%), private hospitals (18.38%), university hospitals (15.44%), and education and research hospitals (ERH, 41.18%). The accepted group had a lower proportion of ERH donors (12%) compared to the rejected group (38.74%).

In terms of medical history, 75% of donors had no comorbidities. Hypertension was the most common comorbidity(12.5% total, 14.41% in rejected, 4% in accepted). Smoking history was more prevalent in the rejected group (37.84% vs. 24%). Positive microbial culture

Table 1. Trends in deceased donors, lung transplants, and transplant activities at our clinic.

Years	Number of deceased donors in Türkiye	Number of lung transplants in Türkiye	Offered donor (%)*	Number of performed lung transplants in our clinic (%)**
2017	554	42	101 (18.1%)	26 (25.7%)
2018	598	43	145 (24.2%)	25 (17.2%)
2019	619	33	129 (20.8%)	16 (12.4%)
2021	305	21	44 (17.3%)	10 (22.7%)
2022	289	11	47 (15.2%)	5 (10.6%)
2023	305	15	45 (12.7%)	7 (15.5%)

* Indicates the percentage of the offered donor to the deceased donor in Turkey. ** Indicates the usage percentage of the "Offered Donor".

tests were detected in 22.42% of donors. It washigher in the accepted group (32% vs. 22.79% in rejected).

Pathological findings in CT scans were seen in 22.06% of donors. TOE/TTE was not performed in 5.88% of the deceased donors, and EF <55% was detected in 7.35% of all donors, with a higher proportion in accepted donors (12% vs. 6.31% in rejected, p = 0.035).

Complete demographic data and comparison of the clinical and demographic characteristics of the patients weresummarizedin Table 2.

Discussion

According to data obtained from the Turkish Transplantation, Dialysis, and Follow-up Systems Public Awareness Platform, a significant decline in the number of deceased donors was observed in Turkeybetween 2021 and 2023. The number of deceased donors decreased from 554 in 2017 to 305 in 2023. Consequently, the total number of lung transplants in Turkey decreased from 33 in 2019 to 10 in 2023. A similar decline has been observed at Koşuyolu High Specialization Training and Research Hospital, where the number of transplants decreased from 26 in 2017 to 7 in 2023. In 2023, lung donors accounted for 12.7% of all donors, compared to over 20% before the pandemic. In the organ donation system, organs such as the heart, kidneys, and liver are offered individually, which may have led donors to refrain from donating lungs due to concerns about the impact of the pandemic on lung organs [7].

There are several studiessuggesting that donors with a partial oxygen pressure (PaO_2) level below 300 mmHg can still be accepted for lung donation. According to the results of thesestudies, PaO_2 levels did not affect graft survival. This finding indicates that the use of donors with lower PaO_2 levels could substantially increase the donor pool, potentially reducing the number of patients waiting for transplants and saving more lives. Although, it is undeniable that PaO_2 is an important criterion in donor evaluation, its importance is not as critical as previously believed, especially in comparison to other evaluation criteria [8]. For instance, factors such as the overall donor health, lung function, age, history of smoking , and evaluation of the function of other organ systems may have a more decisive impact on transplant success. Therefore, rather than viewing PaO_2 levels as an insurmountable barrier, considering them as part of a broader evaluation process may help expand the potential donor pool and offer more opportunities to patients. There has been longstanding hesitancy regarding the use of lungs from donors aged 65 and above, largely due to concerns about the physiological aging process in the lungs. This includes decreased elasticity which results in reduced functional capacity and exercise tolerance, as well as increased residual volume. The aging lung is also more susceptible to infections due to altered immunologic homeostasis and impaired mucociliary clearance. Additionally, older lungs may have a higher risk of previous damage from infections or noxious agents, resuting inthe fibrotic scarring. Especially smoking accelerates this process through telomere reductionand oxidative stress-induced DNA damage. Recent studies have demonstrated the feasibility of using lungs from older donors with proper screening. Donors with a smoking history below 20 pack-years without severe chronic lung disease could still be eligible for transplantation according tointernational donor acceptance trends [9]. We believe that healthy lungs from older donors could also be used in our country. Evaluating this potential could reduce the number of patients waiting for transplants and save more lives. Careful selection and appropriate evaluation of older donorswill be an important step toward improving lung transplant success.

Smoking is a significant problem jeopardizing the lung health in our country. However, the view that lungs from donors with a history of smoking should be rejected has been questioned in recent studies. Successful outcomes have been achieved in both our clinic and worldwide in donors with a smoking history of more than 20 pack-years. Lungs from smokers are generally associated with a modest risk of postoperative lung/graft dysfunction (PGD) but have not been shown to increase recipient mortality. This finding suggests that using lungs from smokers is a safe option and may significantly expand the donor pool [10]. The presence of positive microbial cultures is nota reason for rejecting a lung graft. What is critical is the antibiotic resistance profile of the microorganism. There is very limited information in the literature regarding the transmission of microorganisms from the donor to the recipient and the subsequent development of pneumonia after transplantation. Few studies available suggest that microbial transmission from lung donors to recipients does not lead to pneumonia [11]. Studies on the potential safety of using lung allografts from MDR (multidrug-resistant) bacteria-infected donors, with appropriate prophylaxis, indicate that this could expand treatment options for patients with advanced lung disease awaiting transplantation. However, caution should be exercised in the case of donor lungs infected with MDR Klebsiella pneumoniae, which is associated with high mortality. In addition Stenotrophomonas

Table 2. Demographic data of donors.

	Total (n= 136)	Rejected (n= 111)	Accepted (n= 25)	p value
Gender (male), n (%)	86	74 (66.67%)	12 (48%)	0.080
Age, years	37.0 (10-63)	40 (10-63)	30(15-51)	**0.017**
Height, cm	170 (140-190)	170 (140-190)	170 (155-182)	0.880
Weight, kg	75 (40-97)	75 (40-97)	70 (45-82)	0.063
Blood type n (%)				
0	47 (34.56%)	42 (37.84%)	5 (20%)	
A	64 (47.06%)	49 (44.14%)	15 (60%)	
B	17 (12.5%)	13 (11.71%)	4 (16%)	
AB	8 (5.88%)	7 (6.31%)	1 (4%)	
Cause of death n (%)				0.951
Suicide (Hanging)	3 (2.21%)	3 (2.70%)	-	
Gunshot wound	15 (11.03%)	12 (10.81%)	3 (12%)	
Intoxication	4 (2.94%)	4 (3.60%)	-	
ICH	79 (58.09%)	63 (56.76%)	16 (64%)	
Drowning In Water	3 (2.21%)	3 (2.70%)	-	
Traumatic ICH	32 (23.53%)	26 (23.42%)	6 (24%)	
Apnea test				
Not performed n (%)	31 (22.79%)	27 (24.32%)	4 (16%)	
Performed n (%)	105 (77.21%)	84 (75.68%)	21 (84%)	
Hospital admission	354 (46-381)	310 (46-667)	523 (186-681)	
Last test result	351 (40-686)	319 (47-569)	461 (40-686)	
PaO_2/FiO_2 ratio <300 mmHg, n	48 (35.29%)	46 (41.44%)	2 (8%)	**0.001**
Hospital status n (%)				0.514
State hospital	34 (25%)	30 (27.03%)	4 (16%)	
Private	25 (18.38%)	20 (18.02%)	5 (20%)	
University	21 (15.44%)	18 (16.22%)	3 (12%)	
ERH	56 (41.18%)	43 (38.74%)	13 (12%)	
Background n (%)				
No features	102 (75%)	81 (73.00%)	21 (84%)	
HT	17 (12.5%)	16 (14.41%)	1 (4%)	
Neurological	8 (5.88%)	5 (4.50%)	3 (12%)	
CHD	5 (3.68%)	5 (4.50%)	-	
DM	5 (3.68%)	4 (3.60%)	1 (4%)	
Malignancy	1 (0.74%)	1 (0.90%)	-	
Cardiac arrest n (%)				0.874
Yes	31 (22.79%)	25 (22.52%)	6 (24%)	
No	105 (77.21%)	86 (77.48%)	19 (76%)	
Smoking history n (%)				0.191
Yes	48 (35.29%)	42 (37.84%)	6 (24%)	
No	88 (64.71%)	69 (62.16%)	19 (76%)	
Intubation Duration	5 (1-21)	5 (1-21)	5 (1-12)	0.680
Microbial Reproduction				
No, n (%)	103 (75.74%)	86 (77.48%)	17 (68%)	0.318
Yes, n (%)	33 (24.26%)	25 (22.42%)	8 (32%)	
Trachea	19 (13.97%)	16 (14.41%)	3 (12%)	0.522
Blood	11 (8.08%)	8 (7.2%)	3 (12%)	0.327
Urine	5 (3.6%)	3 (2.7%)	2 (8%)	0.228
Antibiotic, n (%)				
Yes	116 (85.29%)	97 (87.39%)	19 (%76)	0.129
No	20 (14.71%)	14 (12.61%)	6 (%24)	
WBC (10^3/ µl)				
Hospital admission	17.3 (3.3-71)	17.6 (3.3-71)	15 (4.5-34.2)	0.098
Last test result	16.8 (2.68-45.3)	15.7 (2.68-36.7)	21.2 (4.9-45.3)	0.124

	Total (n= 136)	Rejected (n= 111)	Accepted (n= 25)	p value
CRP (mg/L)				
Hospital admission	6.2 (0.02-318)	6.3 (0.02-318.0)	3.41 (0.2-96.0)	0.175
Last test result	80.5 (0.33-422)	74.7 (0.33-422)	81 (8.2-34.3)	0.682
Procalcitonin				
No, n (%)	26 (19.12%)	23 (20.72%)	3 (12%)	0.272
Yes, n (%)	110 (80.88%)	88 (79.28%)	22 (88%)	0.751
Median	0.67 (0.01-72)	1.18 (0.01-72	0.67 (0.04-12.1)	
TOE/ TTE, n (%)				
Not performed	8 (5.88%)	7 (6.31%)	1 (4%)	
EF < 55	10 (7.35%)	7 (6.31%)	3 (12%)	0.281
EF ≥ 55	118 (86.76%)	97 (87.39%)	21 (84%)	
TOE/TTE (pathological finding), n (%)				
Not performed	8 (5.8%)	7 (6.31%)	1 (4%)	
Yes	14 (10.2%)	8 (8.11%)	6 (24%)	0.035
No	114 (83.8%)	96 (18.92%)	18 (72%)	
Pathological findings in CT, n (%)				
Yes	30 (22.06%)	21 (18.92%)	9 (36%)	0.063
No	106 (77.94%)	90 (81.08%)	16 (64%)	

ICH; intracranial hemorrhage, PaO_2; Partial pressure of oxygen; FiO_2; Fraction of inspired oxygen, ERH; education and research hospital, CHD; coronary heart disease, HT; hypertension, DM; diabetes mellitus, WBC; white blood cell, CRP; C-reactive protein, EF; ejection fraction, CT; computerized tomography, TOE: transoesophageal echocardiography, TTE: transthoracic echocardiography.

maltophiliais linked to the development of chronic lung allograft dysfunction (CLAD) in the recipients in the long term [11].

The duration of mechanical ventilation has been proven to increase lung damage. Prolonged mechanical ventilation can lead to barotrauma, volutrauma, and oxygen toxicity in the lungs, which can impair lung function. However, studies have shown that lung transplantation (LTx) from donors on mechanical ventilation for longer than 5 days yields outcomes comparable to those from donors on mechanical ventilation for shorter periods. These findings suggest that, under appropriatemanagement and careful selection, donors on prolonged mechanical ventilation could be utilized as a viable strategy to expand the donor pool for LTx [12]. In this context, the duration of mechanical ventilation is not the sole determining factor of lung damage. The condition of the lungs depends on a variety of factors, including the overall health of the donor, lung function, disease history, age, and other potential risk factors. Therefore, instead of automatically excluding donors with prolonged mechanical ventilation, a careful selection and evaluation process could allow the use of their lungs, leading to successful transplant outcomes. While prolonged mechanical ventilation increases the risk of lung damage, with appropriate prophylaxis and monitoring, these risks can be minimized, making the lungs from these donors a valuable resource for patients in need.

Conclusion

The decline in deceased donor numbers and lung transplants in Turkey emphasizes the urgent need to expand the donor pool. Strategies such as including marginal donors, evaluating lungs from older donors, and considering donors with a smoking history should be implemented based on international best practices. Public awareness campaigns, educational programs, and policy-driven incentive structures should be prioritized to increase organ donation rates. In addition to expanding donor criteria, social awareness and public engagement play a crucial role in increasing donation rates. Countries with high organ donation rates have implemented nationwide awareness campaigns and incentive-based donation programs. Future efforts in Turkey should prioritize similar initiatives to encourage organ donation. Additionally, refining donor evaluation protocols by incorporating broader clinical and laboratory parameters can help maximize the use of available donors.Evidence suggests that lower PaO_2 levels, older donor age, smoking history, and prolonged mechanical ventilation should not be viewed as absolute barriers but rather as modifiable factors within a comprehensive evaluation process. With careful selection criteria, appropriate prophylaxis, and monitoring, risks associated with microbial infections and other complications can be effectively managed, enhancing transplant success rates. By broadening donor criteria and enhancing social awareness, more patients in critical need can receive life-saving lung transplants, ultimately improving transplant accessibility and patient outcomes in Turkey.

Acknowledgments

None.

Data Availability

All data generated or analyzed during this study are included in this published article. However, if requested, we can share the requested data of all our cases with the editor and the relevant reviewers.

Ethics Committee Approval

The study protocol was approved by the Ethical Committee of Clinical Research of Kartal Kosuyolu High Specialization Education & Research Hospital (No: 2024/20/963). This study was conducted according to the Helsinki principles, patients signed informed consent for participation, and nothing invasive of patients' privacy was done.

Consents to Participate

The study was a human organ/tissue transplant study, as it involved deceaded donors. We confirm that organs/tissues were not taken from prisoners. Each organ/tissue was taken from volunteer donors. And when these donors became brain dead, Written informed consent was also obtained from their first-degree relatives. And also, written informed consent was obtained for publication of this original article and all accompanying images from all patients who underwent transplantation and from whom that tissue/organ was taken.

Consent for Publication

Not applicable.

Author Contributions

SC, ES, ANH, MM, AET, MEC collected the data and drafted the manuscript. SC, MV edited the manuscript, participated in the study design and coordination. All authors read and approved the final manuscript.

Competing Interests

The authors declare that they have no competing interests.

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References

1. Yusen RD, Christie JD, Edwards LB, et al. International Society for Heart and Lung Transplantation. The Registry of the International Society for Heart and Lung Transplantation: Thirtieth Adult Lung and Heart-Lung Transplant Report--2013; focus theme: age. *J Heart Lung Transplant.* 2013;32(10):965-78. DOI: 10.1016/j.healun.2013.08.007.
2. Angelico R, Trapani S, Manzia TM, et al. The COVID-19 outbreak in Italy: initial implications for organ transplantation programs. *Am J Transplant.* 2020;20(7):1780-84. DOI: 10.1111/ajt.15904.
3. Uysal Yazıcı M, Torun EG. Effect of coronavirus pandemic on organ donation and transplantation in Turkey. *Turk J Med Sci.* 2021;51(5):2792-94. DOI: 10.3906/sag-2105-188.
4. Sahin MF, Beyoglu MA, Turkkan S, et al. Donor Lung Evaluation and Lung Transplantation in the COVID-19 Era. *Exp Clin Transplant.* 2022;20(9):842-48. DOI: 10.6002/ect.2020.0567.
5. Vayvada M, Taşçı AE. Donor selection for lung transplant in Turkey: Is it necessary to wait for an ideal donor? *Turk Gogus Kalp Damar Cerrahisi Derg.* 2021;29(3):339-46. DOI: 10.5606/tgkdc.dergisi.2021.19953.
6. https://organkds.saglik.gov.tr/dss/Default.aspx.
7. Putzer G, Gasteiger L, Mathis S, et al. Solid Organ Donation and Transplantation Activity in the Eurotransplant Area During the First Year of COVID-19. *Transplantation.* 2022 Jul 1;106(7):1450-1454. DOI: 10.1097/TP.0000000000004158.
8. Zafar F, Khan MS, Heinle JS, et al. Does donor arterial partial pressure of oxygen affect outcomes after lung transplantation? A review of more than 12,000 lung transplants. *J Thorac Cardiovasc Surg.* 2012;143(4):919-25. DOI: 10.1016/j.jtcvs.2012.01.044.
9. Darie AM, Levvey BJ, Shingles HV, et al. Impact of donor age ≥65 years on graft survival in large lung transplant cohorts. *J Heart Lung Transplant.* 2024; 12:S1053-2498(24)01942-9. DOI: 10.1016/j.healun.2024.11.002.
10. Diamond JM, Cantu E, Calfee CS, et al. The Impact of Donor Smoking on Primary Graft Dysfunction and Mortality after Lung Transplantation. *Am J Respir Crit Care Med.* 2024;209(1):91-100. DOI: 10.1164/rccm.202303-0358OC.
11. Abdulqawi R, Saleh RA, Alameer RM, et al. Donor respiratory multidrug-resistant bacteria and lung transplantation outcomes. *J Infect.* 2024;88(2):139-48. DOI: 10.1016/j.jinf.2023.12.013.
12. Sugimoto S, Kurosaki T, Otani Set al. Feasibility of lung transplantation from donors mechanically ventilated for prolonged periods. *Surg Today.* 2019;49(3):254-60. DOI: 10.1007/s00595-018-1730-z.