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ORIGINAL ARTICLE

Organ Transplantation in Turkey: Experience of Organ Transportation by Airway

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Abstract

Transplantation is a multidisciplinary treatment that covers all procedures that allow live cells or tissues to be transferred from donor to recipient and live in recipient to function. Transplantation network is not only innovative technological techniques that reduce damage to organs due to ischemia time, a complex system of activities that standardization process must take into account more variables. In our study, in organ transplants performed between January 2017 and December 2019, the transport system of organs organized by the Ministry of Health was examined. In this period, 208 organs were transferred, 172 of which were by airplane ambulance and 36 by ambulance helicopter. Within the transported organs; the liver was in the first place as a total of 76 organs, 61 of which were transferred by plane and 15 by helicopter. The heart was in second place as a total of 75 organs, 63 of which were transferred by plane and 12 by helicopter. The lung was in third place as a total of 42 organs, 38 of which were transferred by plane and 4 by helicopter. Considering the flight times, for organ transfer, the average flight time was 77 minutes by plane, and the average flight time was 102 minutes by helicopter. The cold ischemia period, which begins with removal of organ from patient and put it in protective fluids, is most important criteria for organ transplant success. Considering that acceptable cold ischemia time for lungs 4 hours, heart 4 hours, kidney 18 hours and liver 11 hours, we think that average transport times by air transport contribute in success of organ transplants. When the data were analyzed in our study, it is seen that many organs have been successfully transferred with convenient flight times to transplant centers in different regions.

Keywords

Transplantation, Organ transplant, Organ transportation

Introduction

Transplantation is a treatment option that provides significant benefits in patients followed up with diagnosis of end-stage organ dysfunction, in parallel with developments in clinical and basic medical sciences in recent years. Due to transplantation is a multidisciplinary approach that requires different teams to work together before and after transplantation, medical developments have increased success of tissue or organ specific transplantations [1]. With better understanding of organ and tissue functions, development of surgery techniques, pharmacological developments especially immunology and immunosuppressive drugs and standardization of follow-up criteria in post-transplantation period, successful results increase day by day [2]. Appearing notion of brain death and transplantation of cadaveric donors transplantation provided transplantation of various tissues and increasing donor pool [3].

Although notion of transplantation dates back to the third century AD, realization of this dream has reached in the end of the 20th century [4]. The first successful organ transplant which taken renal from the twin sibling of the recipient and allowed the recipient to live for 8 years was underwent in 1954 by Joseph Murray [5]. Organ transplantation has gained momentum since the 1960s with the discovery of immunosuppressive drugs. In Turkey, the first live donor kidney transplantation was realized by Dr. Mehmet Haberal at the end of 1975. The first live segmental liver transplantation was also was

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realized by Dr. Mehmet Haberal in 1990 [6]. Although the first national law on organ transplants performed in 1979, transplantation centers established in the 1990s in Turkey. Nowadays, all organ transplantation centers and procedures controll by Ministry of Health. Information about transplantation numbers, donors and centers in the last 10 years may be found on the website of the Ministry of Health [1]. According to these data, there are 99 public and private organ transplants and 58 tissue typing laboratories which affiliated 9 coordination center and licensed in 31 cities in Turkey. Most centers are limited to solid organ transplantation kidney renal transplantation. 9 of organ transplant centers are located in Adana region, in Adana, Gaziantep, Kayseri, Kahramanmaras and Mersin. All of 15 centers in Ankara region are in Ankara, except for one center in Eskisehir. At coordination of Antalya; there are 3 centers in Antalya, 2 in Konya and 1 in Isparta. One of 5 centers in Bursa region operates in Balıkesir and one in Canakkale. Elazıg, Malatya, Sanlıurfa and Van organ transplantation centers are in Diyarbakır region. The centers in Erzurum and Sivas are under the control of Erzurum. Most organ transplantation centers are affiliated to Istanbul region and there are 43 centers. 3 centers in Kocaeli and centers in Tekirdag, Edirne and Adapazarı are also affiliated to Istanbul region. There are a total of 11 organ transplantation centers in Izmir region, one in Aydın, one in Denizli and one in Kutahya. Also, Trabzon organ transplant center is working at coordination of Samsun [1].

Transplantation network is not only innovative technological techniques that reduce damage to organs due to ischemia time, a complex system of activities that standardization process must take into account more variables. [7] Organ supply managementaims to design number and locations of centers, to plan, implement and control supply in an efficient and economically feasible method. Location of hospitals, location of transplant center, organs treated by transplant center, transportation institutions and transportation of patients to out of region centers are main variables to be considered [8]. Cold ischemia time of organ is the most critical factor to consider. There is an inverse rate that relates time of organ was outside donor's body and chance of a successful transplant [9]. If transport time between hospital and transplant centers exceeds cold ischemia time, another transplant center must be located, otherwise transplant cannot be performed [10].

Scientific literature has focused on locating health centers or optimizing organ transplant supply chains. Integration is required between location of health centers and optimization of organ supply chain networks and provision of alternative transportation modes of due to time and cost [9]. Also, in literature it has not adequately referred uncertainties such as distribution of demand and supply in system, processing operating times and ischemic times.

Organ transportation by airway is essentially necessary for long distances and geographical reasons. Multimodal transport chain should be designed to provide aircraft that may operate independently of adverse weather conditions and to ensure temperature of storage unit safely monitored. Organ should be transported from donor hospital to the nearest airport and from airport to transport center by highway as soon as possible [11].

Materials and Methods

In our study, in organ transplants performed between January 2017 and December 2019, the transport system of organs organized by the Ministry of Health was examined. Data such as organ types, flight duration, cities where donor located and transplant centers are included in the study.

Safety, quality, reliability, traceability, compatibility, efficiency of program and cost were observed when sending organs from donor hospitals to transplant centers. Air transport activities were assessed on basis of standards set country-wide. By road or air, with or without transplant team, it has been ensured that transfers were according to traceability methodologies, and also and standard conditions have also been provided in length and duration of transport.

Aircraft operated even under unfavorable meteorological conditions, cabin crew guaranteed 7 days and 24 hours operation and pilots with maximum flight experience were provided. In cases that there was not airport in the city where the organ donor was located, organ and transplant team arrived to the nearest airport by helicopter or land ambulance.

Results

In our study, data of organ transport by airway between January 2017 and December 2019 were examined. In this period, 208 organs were transferred, 172 of which were by airplane ambulance and 36 by ambulance helicopter (Table 1).

Within the transported organs; the liver was in the first place as a total of 76 organs, 61 of which were transferred by plane and 15 by helicopter. The heart was in second place as a total of 75 organs, 63 of which were transferred by plane and 12 by helicopter. The lung

Table 1: Number of organs transferred and distribution by years.

		N		(%)
Number of Organs Transferred	Plane	172		82.7
	Helicopter	36		17.3
Distribution by Years	2017	Plane 37	Helicopter 17	26
	2018	95	9	50
	2019	40	10	24

Table 2: Distribution of organ transferred and organ transferred centers.

Distribution of Organ Transferred		Plane	Helicopter	%
	Liver	61	15	36.5
	Heart	63	12	36
	Lung	38	4	20.2
	Kidney	8	5	6.3
	Cornea	1	-	0.5
	Small Intestine	1	-	0.5
Organ Transferred Centers	Ankara	65	6	34
	Istanbul	48	6	26
	Antalya	19	4	11
	Malatya	17	5	10.5
	İzmir	8	4	5.7
	Erzurum	5	4	4.3
	Kayseri	2	-	1
	Konya	2	1	1.5
	Bursa	3	1	2
	Adana	1	-	0.5
	Elazıg	1	2	1.5
	Gaziantep	1	-	0.5
	Eskisehir	1	-	0.5
	Sanliurfa	1	-	0.5
				0.5
	Diyarbakir	-	1	

Table 3: Average transferred times of organs.

Average Flight Time (minutes)		Plane 77	Helicopter 102
		Plane	Helicopter
According to Organs	Liver	84	107
Average Flight Time	Heart	73	104
(minutes)	Lung	66	91

was in third place as a total of 42 organs, 38 of which were transferred by plane and 4 by helicopter (Table 2). There were only 1 cornea and 1 small intestine in all organ transport groups. We consider that the reason of low number of kidneys and corneas in all organ transport groups, there are many centers that successfully transplant these organs in different region of our country. In addition, we assess that carrying organs is important in lung, heart, and liver transplants, because of fewer centers.

Considering the flight times, for organ transfer, the average flight time was 77 minutes by plane, and the average flight time was 102 minutes by helicopter (Table 3). These flight times included that return to transplant center with organ received by the transplant team. The cold ischemia period, which begins with removal of organ from patient and put it in protective fluids, is most important criteria for organ transplant success. Considering that acceptable cold ischemia time for lungs 4 hours, heart 4 hours, kidney 18 hours and liver 11 hours, we think that average transport times by air transport contribute in success of organ transplants.

Discussion and Conclusion

Time is the most determining factor in transplantation. For example, it is known that organ functions optimally, if lung is transplanted within 4 hours, heart is 4, kidney is 18 and liver is 11 [12,13]. Considering these periods, after organ donation is determined, medical coordinators should organize transfer of organ to target hospital by determining most suitable potential recipient. Studies in literature have shown that coordination between team that provide removal of organ and surgical team who perform transplant is insufficient, surgeon specialized in organ removal can not be provided, As a result, it causes transplantation process to be disrupted and transplant operation is not performed [11,13]. In addition, there is risk of damage to organ transported physically due to uncoordinated and this situation reduces success of transplant operations. Despite the fact that enblock removal during transplantation and various preventive medical treatments anddevelopment of *ex-vivo* methods, these prevention still do not eliminate need to move removed organ to transplant center as soon as possible. While organ damage is observed as 14% in organs removed and transplanted in same medical center, this rate rises to 29% in organs that transferred to different medical center [7]. For this reason,

in transplantation processes, logistics systems should involve transport of organs to target hospital as soon as possible, considering time of cold ischemia and protect organ. All communication and information network between doctors and transplantation coordination centers should be included in logistics systems. If the organ transplantation will be performed in donation center, logistic problems to be encountered in this process are minimal [7]. The main problem is that patients who wait for organs are operated in a hospital away from organ donation center. In such a case, organ needs to be moved intercity. The organs should be transported very quickly, considering time of cold ischemia under special transport/storage conditions [9]. If there is not surgeon that has authority to remove organ in organ donation center, transplant surgeons in target hospital should go to this center and remove organ and take it to their hospital. In this case, it is necessary to transfer not only donated organ, but also surgeons from transplantation team.

In Turkey, organ transplants process that managed and followed by the Ministry of Health draws attention with increasing success rate over time compared to other countries. With an increasing number of successful transplant centers in different regions of Turkey, importance of organ transport system increase day by day. Air transport is preferred for time and comfort.

When the data were analyzed in our study, it is seen that despite wide area and geographical difficulty in Turkey, many organs have been successfully transferred with convenient flight times to transplant centers in different regions. Successful survival results of various transplant centers support our study results.

In the selection of helicopter or plane transport, the distance between the donor center where the organ was taken and the transplant center is considered. Between nearcenters, organ is transferred by helicopter. In long distance and difficult weather conditions, organ transfer is preferred by plane.

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Conflicting Interest

The authors declare that there are no conflicts of interest.

Author Contributions

The authors contributed equally to this study.

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