

# Comparison of experienced and inexperienced centers in cadaveric organ preparation for transplantation

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## Abstract

**Aim:** The aim of this study is to compare the experienced centers with inexperienced centers due to the harvesting of cadaveric organs. Despite the improvements in medical treatments, the most effective treatment method for chronic renal failure and liver cirrhosis is organ transplantation. Organ transplantation preparation has some differences depending on whether the donor type is live or cadaveric. The perfusion, extraction, packaging and transport of cadaveric organs require special care and procedures.

**Material and Methods:** Liver and kidney cadaveric organs which were harvested and sent by external centers were evaluated before transplantation in Antalya Medicalpark Organ Transplantation Department between January 2016 and August 2018. Organs were evaluated as good or bad in three groups according to perfusion, surgical extraction technique and packaging method. The external centers who harvested and transport the organs were divided into two groups as experienced or inexperienced centers according to the number of organ transplantations performed by them in one year.

**Results:** Antalya Medicalpark Organ Transplantation Department admitted 17 cadaveric liver and 82 cadaveric kidney organs from external centers for transplantation between January 2016 and August 2018. According to the evaluation of packaging, 12 liver cadaveric organs were considered as good and 5 of them as bad. The packaging of 3 of the incoming kidneys was considered poor. According to the evaluation of extraction, 7 kidneys were considered as bad. Injury in the renal artery and vein hilus level, inappropriate cut in the ureter from the renal pelvis, short cuts of renal arteries, dissection were the injuries we encountered. According to the evaluation of perfusion, 6 kidneys that were clotted in the renal vein were considered to be poor.

**Conclusions:** Organ extraction operations and organ preservation procedures directly affect transplant success. Therefore the harvesting team should control all the stages and procedures from extraction to packaging carefully.

**Keywords:** Cadaveric Organ Transplantation; Harvesting; Errors.

## INTRODUCTION

The most effective treatment of chronic renal failure and liver cirrhosis is organ transplantation (1,2). There is a multidisciplinary study in organ transplantation, especially in cadaveric donor-derived organs (3,4). Although the number of patients waiting at the transplantation list increase day by day, there is no desired increase in cadaveric donation (5). In our country, organ donation from cadavers is unfortunately not at the desired levels (6). According to the International Registry of Organ Donation and Transplantation (Irodat) data, in 2017; 3.342 kidney transplants were made in Turkey. Of these transplants, 2.649 (79.2%) were from live donors and 693 (20.8%) were from cadaveric donors. At the same time in 2017; 1.446 liver transplantations were carried out in Turkey.

One thousand eighty-seven (75.1%) of these transplants were from live donors, 359 (24.9%) were from cadaveric donors (7). According to IRODat data, 19,854 kidney transplants were performed in the USA in 2017. Of these transplants, 14,037 (70.6%) were cadaveric transmitters and 5.817 (29.4%) were live (8). According to the data of IRODat, 3.269 kidney transplants were performed in Spain in 2017 and 2,937 (89.8%) of these transplants were cadaveric donors. One thousand two hundred forty-three liver transplants were made in Spain in the same year and 1.226 (98.6%) of them were made from cadaveric donor and 17 (1.4%) of them were made from live donor.

In the literature, there are few articles about harvesting of organs from cadaveric donor. In this study, we will evaluate

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the deficiencies in the extraction of the organs coming from the external centers with a certain classification and score, and share our 6 years of surgical experience in the harvesting operation performed in our own center.

## MATERIAL and METHODS

Liver and kidney cadaveric organs which were harvested and sent by external centers and the organs harvested by one same surgeon in our clinic were evaluated before transplantation in Antalya Medicalpark Organ Transplantation Department between January 2016 and August 2018.

Organ extraction centers are classified according to their experience. The center is classified as inexperienced center if the number of transplantations is less than 20 kidneys and 10 livers per year. Such a classification has not been described in the literature. These classifications were determined by the center of the study.

Organs were evaluated as good or bad in three groups according to perfusion, surgical extraction technique and packaging method. In the literature, no studies have been found about the classification of organs according to harvesting, perfusion and packaging errors.

The perfusion is classified as bad if clotted blood is obtained from the veins while the organ is being reperfused during the back table. The perfusion is classified as good if reperfusion fluid is clear and free from clotts during back table.

Surgical extraction technique rated as poor if there are superficial capsule lacerations for the liver, parenchymal injury, vascular injuries or portal vein thrombus. No liver laceration, no parenchymal damage, no damage to the portal hilus and arteries rated as good. For kidney; the cut in the renal artery or vein from 1 to 1.5 cm from the hilum, dissection of the renal artery and short cut of the ureter after leaving the renal pelvis were considered to be bad (injuries that would not complicate the anastomosis of the renal artery and vein were not included in the study).

For the packaging procedure; placing the graft directly in ice, direct contact with ice or insufficient cold chain was considered as poor. The packaging was considered as good if the organs were placed in at least 3 sterile plastic bags with sufficient perfusion fluid so that there is no air gap between them and without direct contact with ice; if there was label indicating that the organ was left or right and if there was a clear note about the vascular anomaly and a detailed clamp time.

Medical Park Hospital Complex Ethics Committee approval was obtained for this study. Ethics committee no: 009/2018)

SPSS version 16 was used as statistical analysis. Fisher's chi-square test was used.  $P < 0.05$  was considered as statistical significant.

## RESULTS

Seventeen cadaveric liver and 82 cadaveric kidney

grafts which were harvested and transported by external centers were admitted to Antalya Medicalpark Organ Transplantation Department between January 2016 and August 2018. Six livers and 6 unilateral kidney grafts from 6 cadavers, only 11 liver grafts from 11 cadavers, 40 kidneys (bilateral) from 20 cadavers 36 kidneys (unilateral) and from 36 cadavers were accepted to our clinic. Two livers from the cadaveric donor were not used. Fatty liver more than %35 percentages was detected in one liver while in the other unused liver, there was portal vein thrombus due to the harvesting procedure error. Four kidneys from the cadaver donor were not used. Two kidneys were in contact with ice and frozen. The other 2 kidneys were not used because renal cell cancer was detected in 1 of 2 kidneys sent from the same cadaveric donor.

There were eight transplantation centers who performed the cadaveric donor operations and sent the donor organs to our unit were taken to this study. Seven of those transplantation centers were classified as inexperienced center while as 1 was experienced center.

Liver Conditions According to the Harvesting, Perfusion and Packaging Procedures And According to the Experience of Transplantation Centers

We accepted totally 15 livers (8 from experienced centers and 7 from inexperienced centers) to our clinic between January 2016 and August 2018.

According to the packaging process; all the livers; 8 livers originated from experienced centers and 7 livers originated from inexperienced centers were classified as in good condition. There was no contact with ice in the organs.

According to the extraction process; only 1 liver from experienced transplantation center and 4 livers from inexperienced transplantation centers; totally 5 livers were classified as in bad condition while as 10 livers classified as in good condition. The liver from the experienced center had only parenchymal laceration. Three of the livers from inexperienced centers had capsule injuries bigger than 5x5 cm and at least 2 cm deep parenchymal injury (Figure 1). One liver from inexperienced center had new thrombus in portal vein which possibly occurred during portal vein cannulation. This liver was not used.

Kidney Conditions According to the Harvesting, Perfusion and Packaging Procedures And According to the Experience of Transplantation Centers

We accepted totally 82 kidneys (51 from experienced centers and 31 from inexperienced centers) to our clinic between January 2016 and August 2018.

In the packaging, 6 kidneys were in bad criteria, 2 were from experienced centers and 4 were from inexperienced centers. Four kidneys packaged in contact with the ice directly, 1 kidney was wrapped with compress and 1

kidney was in the liquid which was almostly turned to ice. There was no statistical difference between experienced centers and inexperienced centers according to the packaging procedures.



**Figure 1.** Parenchymal injury in the liver from external center.



**Figure 2.** Parenchymal injury in the liver from external center

According to the extraction process, 13 kidneys were in poor criteria. Three of these kidneys were accepted from experienced centers and 10 of them were from inexperienced centers. Renal artery was cut short in 9 kidneys. There was dissection in renal artery in 3 kidneys. The ureter was cut short in 2 kidneys (Figure 3).

One kidney revealed both intimal dissections in the renal artery and a short cut in the ureter. It was determined that 4 kidneys were sent after performing the backtable procedure by the harvesting team.



**Figure 3.** Thrombus in portal vein

According to the perfusion process, totally 16 kidneys; 6 kidneys from the experienced center, 10 kidneys from the inexperienced center had clotted blood during the perfusion at the back table. (Figure 4) and revealed as in bad criteria. There was no statistical difference between experienced centers and inexperienced centers according to the perfusion process. (The distribution of the accepted organs is shown in Table 1.)



**Figure 4.** Intimal dissections in the renal artery and a short cut in the ureter

Table 1. The Distribution of Accepted Organs

	Experienced Centers		Inexperienced Centers		P Value
	Total Errors		Total Errors		
	Yes	No	Yes	No	
Liver	1	8	5	3	p> 0.05
Kidney	3	48	10	21	P< 0.05

Table 2. Number of Cadaveric-Live Donation Ratios in 2017 in Turkey, USA and Spain

Country	Population	p.p.m Cadaveric Donation			Kadaverik Liver Tx	Living Liver Tx	Kadaveric Kidney Tx	Living Kidney Tx
		Totally	Liver	Kidney				
Turkey	75.000.000	7	4.5	8.8	359	1.087	693	2.647
U.S.A	322.000.000	31.9	23.9	43.6	7.715	367	1.4037	5.813
Spain	46.550.000	46.9	36.3	63.0	1.226	17	2.937	332

## DISCUSSION

Organ Transplantation Legislation in our country is based on the Law article about the Harvesting, Storage and Transplantation of Organ and Tissue; numbered 2238, dated 29.05.1979 and published in the Official Gazette No. 16655 in 03.06.1979. Organ transplantation procedures are carried out in accordance with the Organ and Tissue Transplantation Services Ordinance which was published in the Official Gazette No. 28191 in 01.02.2012 (5,10). The increase in the number of kidney transplant centers, the state policies, and the development of knowledge levels of patients related to transplantation contributed to this increase. (11)

According to data from IRODAT 2017 cadaver donation rate per million population is 46.09 in Spain, 31.9 in the United States and only 7 in Turkey. Cadaveric kidney donation rates are 63 in Spain, 43.6 in the United States and 8.8 in Turkey. The cadaveric liver donation rates are 26.3 in Spain, 23.9 in the USA and 4.5 in Turkey (7-9). (Table 2) This data shows that our country is behind the developed countries in cadaveric donation lists. However, kidney transplantation from live donor is more common in our country. Because of the strong family relations in our country, live donor transplantations are higher than in Europe and other developed countries. When one of the family members develops organ failure, the rest of the family members give their organs to their loved ones without any hesitation. However, organ failure patients who don't have a blood type matching or suitable healthy conditioned member in their families have only chance for cadaveric transplantation. Again, in liver failure, vascular anomalies or fat in the liver and other health problems are handicaps for being donor candidates for family members. The only source for organ transplantation in these patients who don't have suitable donor candidate in their families is the cadaveric donation. Cadaveric donations should be increased in our country (12). The increase in the number of donors alone will not make sense if the experienced surgical teams do not exist. Therefore, all the processes

from cadaveric donor care to harvesting surgery and transport of them should be perfectly designed to present a well preserved vital organ to a recipient in need.

Harvesting surgeries are very important. Optimal removal of these operations without damaging the cadaveric organ directly affects the transplantation success.

The experience and success of the surgical team performing the cadaveric donor surgeries directly affect the graft and patient survival. The graft and patient survival is low if the incoming graft has not been removed and transferred in suitable conditions even if the team performing the receiver operation is successful. There are many factors affecting the graft status, but the importance of extraction technique isn't sufficiently emphasized (3). Early graft loss in cadaveric donor transplantations is caused mainly by the errors during harvesting process (3).

There are not enough articles in the literature about the errors in cadaveric surgical removal of organs and errors in transportation. Harvesting with or without sternotomy have been compared, but surgery-related injuries in organs have not been mentioned in Oruç et al.'s study (13). According to our knowledge, this study is the first publication comparing the experienced and non-experienced centers in the literature. This study shows how important these operations are in terms of both clinical and statistical results. This study emphasizes the need for experienced surgeons especially in countries with high cadaver donor rates and high cadaver donor requirements.

A certification program can be considered under the supervision of the Ministry of Health to standardize the quality of organ extraction operations. With a certification program on this subject, we think that surgeons will carry higher success rates with both training and post-training supervision. Cadaveric donation in our country is less than European and other developed countries so these operations should be performed with certain success to replace the high organ demand.

All liver capsule injuries in the livers sent to our center were localized in segment 5-6-7. During harvesting, liver capsule injuries mostly occur in areas adjacent to the peritoneum of segments 5 and 6 (14). If this area is released before the liver is perfused, the injury will be less. It is recommended that the liver and other organs are covered with ice at the time of perfusion during organ extraction (14). According to our harvesting experience, ice crystals can cause extensive laceration in the liver. In 3 harvesting operations we performed we observed laceration in the liver capsule due to the ice contact during perfusion. There was no ice-induced injury in the livers we accepted from the external centers. We are no longer putting ice onto the liver during harvesting operation, we are applying cold sponges and cold water and we recommend this method.

Major error we encountered in the kidneys from the external centers was the injuries near the renal hilus. If the renal artery is removed from the aortic aorta by the surrounding tissues with surrenal and gerota, the possibility of hilus injury is reduced. During the nephrectomy, the ureter should be cut at the most distal and a clamp should be placed. If the clamp is not inserted, the ureter is curled during nephrectomy and the ureter may be cut short by the renal pelvis due to the complexity of removal from the hilum. (In our center, once we cut short the ureter and after this bad experience, we preferred to put the clamp on the ureter and make nephrectomy.)

Another error we encountered in the organs from the external centers is about the back table procedure. If the organ is not enough perfused, it should be re-perfused back table procedure shouldnt be performed after extraction instead. The back table procedure should be performed by recipient's surgery team.

An important point after organ extraction is the packaging of the organ. Packaging procedure directly effects the organ survival. The organ should be placed in 3 separate sterile pouches. First pouchette contains the organ with perfusion solution (should not contain sponge, compress or ice around the organ) and the second bag should contain steril ice and a label indicating the direction of the kidney should be put. The organ should then be placed in the third bag and placed in the organ carrying bag of +4 degrees (15). Perfusion solution of 200-250ml for the organ before packaging and correct packaging will provide a better storage condition for transportation.

The number of waiting patients increases day by day. From the time of the declaration brain death to the time of organ transplantation, many people work extraordinarily usually after midnight. All the medical team should work in coordination in every step of transplantation. However, the most important point that should not be forgotten in organ transplantation is there must be a good donor and good donor team for good results (16). Any failure or disconnection in any place on the team will result in wastage of all work. As a result in recent years, national and regional organ transplantation coordination centers are working in a very coordinated way.

In case the organ is damaged or cannot be used due to an error in organ extraction, the situation should be reported to the regional coordination center and national coordination center and the harvesting surgeon should be warned. Meetings can be arranged at regular intervals and presentations about cadaveric organ extraction can be made by experienced surgeons Participation of harvesting surgeons to these meetings should be mandatory and errors during cadaveric transplantation procedures can be explained to surgeons. We believe that if harvesting operation is recorded by video and visually explained, errors will be reduced.

## CONCLUSION

Organ extraction operations directly affect transplantation success. No matter how succesfull the transplation surgery is, the graft that has not been prepared properly affects the survival of the patient with graft survival. The standardization of all processes from harvesting to transportation should be taken into consideration especially in our country where cadaver donor requirements are high.

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## REFERENCES

- Özbilgin M, Ünek T, Egeli T, et al. Complications in donors using right liver graft: analysis of 280 consecutive cases," *Transplant Proc.* 2017;49:580-6.
- Sarier M, Demir M, Goktas S, et al. Results of real-time multiplex polymerase chain reaction assay in renal transplant recipients with sterile pyuria. *Transplant Proc.* 2017;49:1307-11.
- Rueb J, Kuehn P, Viebahn R, et al. Predicting quality of deceased donor kidneys: The harvesting surgeon as a prognostic factor? *Transplant Proc.* 2013;45:1360-2.
- Sabuncuoğlu MZ. Does the establishment of organ transplant center effect the organ donation in the region? *SDU Tıp Fakultesi Dergisi* 2017;24:8-11.
- Yıldız İ, Sabuncuoğlu MZ, Solmaz FA, et al. Establishment of Suleyman Demirel University Medical Faculty Hospital organ transplant center. *SDU Tıp Fakultesi Dergisi* 2018;25:228-3.
- Yavuz HA, Tekin S, Yuksel Y, et al. Donors with hepatitis b surface antigen positivity. *Transplant Proc.* 2015;47:1312-4.
- <http://www.irodat.org/?p=databse&c=TR#data> access date: 2017
- <http://www.irodat.org/?p=databse&c=US#data> access date: 2017
- <http://www.irodat.org/?p=databse&c=ES#data> access date: 2017
- Tay M. Türkiye'de doku ve organ naklinin önemi. *Sağlık Akademisyenleri Dergisi.* 2016;3:106-10.
- Oruc A, Ersoy A, Yavuz A, et al. Kadavra vericiden böbrek nakli adaylarının çağrı sonrası merkezde elenme nedenleri. *Türk Nefroloji Diyaliz ve Transplantasyon Dergisi.* 2018;27:82-6.
- Topbaş E, Bingöl G. Türkiye'de kadavra donörden gerçekleştirilen organ nakline etki eden faktörler. *Nefroloji Hemşireliği Dergisi* 2016:1-12.

13. Cemalettin Koç. Kadavra donörlerde standart ve modifiye standart harvesting tekniklerinin karşılaştırılması. Uzmanlık Tezi. İnönü Üniverstesi Tıp Fakültesi. 2012.
14. Karaciğer Transplantasyonu. Bölüm 24. Karaciğer Transplantasyonunda Cerrahi Teknik. Özkardeşler T, Tekin İ, Ünek T. Ven Kitap 2015
15. Tekin A, Küçük kartallar T, Çakır M. Organ alınması. Türkiye Klinikleri Genel Cerrahi, Transplantasyon Özel Sayısı 2013;1:35-8.
16. Yüce L. Türkiye ' de Kadavra kaynaklı organ teminindeki sorunların çözümü : eğitimli organ nakil koordinatörleri a solution for problems in cadaveric donation in Turkey : educated transplant coordinators. SSK Tepecik Hast Derg. 2003;13:7-10.