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Extreme living donation: A single center simultaneous and sequential living liver-kidney donor experience with long-term outcomes under literature review

Yücel Yankol[2], Cihan Karataş[3], Turan Kanmaz[3], Burak Koçak[3], Münci Kalayoğlu[3], Koray Acarlı[1]

[1] Organ Transplantion Center, Memorial Şişli Hospital, Istanbul, Turkey
[2] Transplant Center-Department of Surgery, Loyola University, Chicago Stritch School of Medicine, Maywood, IL, United States
[3] Organ Transplantion Center, Koç University Hospital, Istanbul, Turkey

ABSTRACT

Objective: Living liver and kidney donor surgeries are major surgical procedures applied to healthy people with mortality and morbidity risks not providing any direct therapeutic advantage to the donor. In this study, we aimed to share our simultaneous and sequential living liver-kidney donor experience under literature review in this worldwide rare practice.

Material and Methods: Between January 2007 and February 2018, a total of 1109 living donor nephrectomies and 867 living liver donor hepatectomies were performed with no mortality to living-related donors. Eight donors who were simultaneous or sequential living liver-kidney donors in this time period were retrospectively reviewed and presented with their minimum 2- year follow-up.

Results: Of the 8 donors, 3 of them were simultaneous and 5 of them were sequential liver-kidney donation. All of them were close relatives. Mean age was 39 (26-61) years and mean BMI was 25.7 (17.7-40). In 3 donors, right lobe, in 4 donors, left lateral sector, and in 1 donor, left lobe hepatectomy were performed. Median hospital stay was 9 (7-13) days. Two donors experienced early and late postoperative complications (Grade 3b and Grade 1). No mortality and no other long-term complication occurred.

Conclusion: Expansion of the donor pool by utilizing grafts from living donors is a globally-accepted proposition since it provides safety and successful outcomes. Simultaneous or sequential liver and kidney donation from the same donor seems to be a reasonable option for combined liver-kidney transplant recipients in special circumstances with acceptable outcomes.

Keywords: Simultaneous living liver-kidney donation, living donor hepatectomy, living donor nephrectomy, complications

INTRODUCTION

During the last three-four decades, liver and kidney transplantations have become the most effective treatment options for end stage liver and kidney failure starting with the first case reported by Margreiter et al. in 1984. In addition, combined liver-kidney transplantation is well-established as a definitive therapy with the potential to provide complete recovery for certain liver-kidney diseases (1). The gap is still high between organs from deceased donors and number of patients awaiting organs all over the world. Transplantation from living donors provides an alternative way to solve the problem and save the patient's life. Transplanting multiple grafts from a single living donor might be a potentially useful strategy for a group of patients especially for pediatric or lower-risk recipients in western countries but might be the only chance for a recipient in a region with insufficient deceased donor support. This rare practice is a topic of both clinical and ethical interest, but there is not too much published data in the literature. In addition, most of the publications focus on the recipient outcomes and there are few studies focusing on donor outcomes (1-4). As an experienced liver and kidney transplant center in a region with insufficient deceased donor support, we aimed to share our combined and sequential living liver-kidney donors' experience under literature review. According to our English literature search and knowledge, this is the only center with the highest number of case experience in the literature till the end of 2020.

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Corresponding Author
Yücel Yankol
E-mail: yyankol@yahoo.com

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MATERIAL and METHODS

Between January 2007 and February 2018, a total of 1109 living donor nephrectomies and 867 living liver donor hepatectomies were performed with no mortality to living-related donors. After committee approval from the Institutional Ethical Review Board (09.30.2019), our center data reviewed and eight donors who were simultaneous or sequential living liver-kidney donors were found in this time-period. Eight cases were retrospectively reviewed and presented with their at least 3- year follow-up. In addition, their recipients' results were reviewed. Hand assistant donor nephrectomy was the standard procedure for living donor nephrectomy in our center. Open living donor hepatectomy performed to all living liver donors. Complications were scored with the modified Dindo-Clavien classification of surgical complications and adapted donor morbidity classifications (5,6).

Living liver donor (7) and living kidney donor (8) selection criteria, donor evaluation, surgical techniques and post-operative follow-up plans have been described separately in our previous publications. Donors were both approved by multidisciplinary living liver donor and living kidney donor institutional donor committees. All donors were the only suitable donor candidates for the recipients. Candidates were informed on all procedures, surgical complication risks of living donation and expected outcomes of the recipient with their family member. In addition, they were informed that they could stop the evaluation at any time. In addition, timing for living kidney donation was also discussed with them, and all agreed to the simultaneous or any time sequential kidney donation after living liver donation. Simultaneous or sequential donation was mostly decided according to recipient health condition. Open living donor hepatectomy and nephrectomy performed when donation was simultaneous. When the donation was sequential, hand-assisted laparoscopic donor nephrectomy was performed for kidney donation following open living donor hepatectomy.

RESULTS

Of the 8 donors, 6 (75%) were females and 2 (25%) males. Mean age was 39 years (range 26-61) and mean BMI was 25.7 (range 17.7-40). Of the 8 donors, 6 (75%) were parents, 1 (12.5%) was the grandparent and 1 (12.5%) was the cousin. Of the 8 donors, 3 (37.5%) were performed right lobe donor hepatectomy (RLH), 4 (50%) were performed left lateral sector hepatectomy (LLH) and 1 (12.5%) was performed left lobe donor hepatectomy (LDH). Six (75%) of them donated the left kidney and 2 (25%) of them donated the right kidney. Of the 8 donors, 3 (37.5%) of them were simultaneous donation and 5 (62.5%) of them early sequential kidney donation between 4 to 11 days after living liver hepatectomy. Median hospital stay was 9 days with a range of 7 to 13 days (Table 1). Median follow-up was 6 years (3-11.5 years). Of the 8 donors, only 2 (25%) donors experienced early and late postoperative complications during the at least three-year follow-up period. One of them was a simultaneous left lobe liver and left kidney donor to his grandson, and he was re-operated due to bleeding from left donor nephrectomy area 8 hours after the first surgery (Grade 3b). He was discharged without any problems on postoperative 9th day. The other donor's complication was a small wound infection treated with local drainage and antibiotic treatment (Grade 1). No other long-term complication and problem occurred in 8 donors during their at least three-year follow-up period (Table 1).

Table 1. Memorial Şişli Hospital simultaneous and sequential liver kidney donor experience

	Age	Sex	Liver graft	K	Sim/Seq-(d)	H-stay (d)	Donor Compl.	F-up year	Recipient Relation	Rec. Age	Recipient Primary Disease	Recipient Complication
1	33	F	Right	R	Sim	7	No	10.5	Cousin	49	Crn. HCV/ CKD	No
2	61	M	Left	L	Sim	9	Bleeding	8.5	Grand-father	1	PHO Type 1	Graft lost-(Chr Rej-K)
3	35	F	LLS	R	Sim	7	No	6	Mother	2	PHO Type 1	MOF -6 day
4	26	M	LLS	L	Seq-4 day	7	No	5	Father	2.5	PHO Type 1	No
5	33	F	LLS	L	Seq-5 day	10	No	4	Mother	7.5	Caroli/ ARPKD	No
6	35	F	LLS	L	Seq-25 day	8-1	No	2	Mother	9	PHO Type 1	No
7	47	F	Right	L	Seq-18 day	11-2	No	2	Mother	22	PHO Type 1	No
8	45	F	Right	L	Seq-11 day	11	Wound infection	2	Mother	14	PHO Type 1	Biliary Leak (ERCP stent)

K: Side of kidney, Sim: Simultaneous, Seq: Sequential, d: Day, H-stay: Length of hospital stay, Compl: Complication, Rec: Recipient, LLS: Left lateral sectorectomy, PHO: Primary hyperoxaluria, ARPKD: Autosomal recessive polycystic kidney disease, Crn. HCV: Chronic hepatitis C infection, CKD: Chronic kidney disease, Chr Rej: Chronic rejection.

Recipients and Complications

Of the 8 recipients, 6 (75%) of them were pediatric patients (age range, 1-14 years) and 2 (25%) of them were adult patients (22 and 47 years). Most of the recipients' (6 recipients, 75%) primary disease was primary hyperoxaluria type 1. One of the pediatric recipients (aged 2 years) died due to multiple organ failure (MOF) in the early postoperative period (day 6). One of the pediatric recipients (aged 1 year) lost his transplanted kidney due to chronic rejection 14 months after transplantation, and he was re-transplanted from another related living kidney donor.

DISCUSSION

The gap is still increasing between deceased donors and organ failure patients. Living donor liver and kidney transplantation has become a worldwide solution to decrease the waiting list mortality. Over the past two decades, while living donor transplant attempts continued in Western countries, significant progress was achieved in eastern countries especially in living donor liver transplantation, where religious and cultural beliefs do not allow deceased donation to significantly contribute to the donor pool (9). Although living donor transplantation is a potentially life-saving operation for the recipient, with similar outcomes to deceased donor transplantation, living donor surgeries are major surgical procedures with morbidity and mortality risks, which is applied to healthy people. In addition, donor surgery does not provide any direct therapeutic advantage to the donor. The donor undertakes these risks to save the life of a loved one. Risk concerning the living donor in liver and kidney transplantation can be justified only when the recipient enjoys reasonable and visible positive results (2,9).

Living donor liver transplantation (LDLT) only makes sense if we can provide a safe donation environment with a low complication profile. Donor safety and complications continue to be major problems in LDLT. A worldwide survey including 11,553 living liver donors reported a donor risk of estimated mortality of 0.2%, transplant rate of 0.04%, and overall morbidity of 24% (10). For LDLT centers, the aim of zero donor mortality with donor complication rate <20%, Clavien-Dindo grade 1/2 and <5% Clavien-Dindo grade 3/4 complications have been considered acceptable (11). We reported our center living liver donation complication rates in our previous publication with no mortality in 939 living liver donor hepatectomies. Of the 939 donors, in 890 donors' followed-up at least 1-year overall early and late complication rate was 19.5%, including 2.9% life- threatening and nearly life- threatening complications. Right donors hepatectomy complication rate (23.3%) was higher than left donor (14.3%) and left lateral sector donor hepatectomy (11.5%) (7). In addition, long-term medical and psychosocial outcomes in living liver donors is always one of the hot topics in the field. There is growing international consensus that the long-term impact of living liver donation demands greater attention in both research and clinical arenas (12). Muzaale et al. (13) from the US have found in their long-term mortality risk comprehensive analysis that cumulative mortality in a US national cohort of living donors was similar to that in national samples of living kidney donors and healthy community residents at 2,5,9 and 11 years post donation. In addition, they reported that risk did not vary by type of donated graft. These findings suggest no decrease in longevity in the first decade after living liver donation (13). It is clear that greater experience and knowledge of LDLT will allow reduced donor and recipient morbidity.

According to the OPTN data from US, perioperative mortality after living donor nephrectomy is approximately 3 per 10,000 cases (0.03 %), and major and minor perioperative complications affect approximately 3% to 6% and 22% of the donors. Living kidney donation does not appear to increase long-term mortality compared with control groups, nor does appear to increase end-stage renal disease risk (14). Laparoscopic donor nephrectomy (LDN) has replaced open nephrectomy quickly after the initial report by Ratner et al. (15). LDN has been shown to be a safe and advantageous approach for procuring kidneys from living donors, not only because of better cosmetics, but also because of reduced morbidity and a short recovery. Like in our center nowadays, LDN is the worldwide accepted technique for living donor nephrectomy (8). Jacobs et al. (16) have reported emotional and financial experiences of kidney donors over the past 50 years. They examined long-term medical and psychosocial outcomes of 2455 living kidney donors, who had donated 5 to 48 years earlier at three US transplant center by mailing questionnaires. They concluded that most living kidney donors viewed their overall donation experience positively, however almost 10% of them reported at least one negative consequence related to donation. Recipient graft failure was associated with poor psychosocial outcome, defined as one or more of these consequences addition to some financial disadvantages (16).

First combined liver-kidney transplantation from a deceased donor was reported by Margreiter et al. in 1984 (17). Over the time, first simultaneous liver-kidney transplantation from the same living donor was reported by Haberal et al. from Turkey in 1992 (18). The recipient was a 23-year-old female with end-stage liver and kidney disease. The donor was her mother and donated her left lateral sector of the liver and right kidney. The donor was discharged on the 7th day with normal liver and kidney functions without complication. The recipient died due to sepsis after the 15th postoperative day. First successful living related combined living donor right liver lobe and kidney transplantation was reported by Marujo et al. from Brazil in 1999 (19). The recipient was a 53-year-old male, and the donor was his 26-year-old son. However, the donor's postoperative course was complicated by transient moderate hepatic insufficiency, he was discharged on postoperative 10th day from the hospital and fully recovered af-

ter 2 months from the donation. In addition, the recipient was discharged from the hospital on postoperative 18th day.

Transplanting multiple grafts from a single living donor is not a common worldwide practice. It might be a potentially useful strategy for a group of patients especially for pediatric or lower-risk recipients in western countries. On the other hand, it might be the only chance for a recipient in a region with insufficient deceased donor support. In addition, most of the reports focus on recipient outcomes, and most of the recipients are pediatric primary hyperoxaluria type 1 patients (20-32). No donor mortality and no life-treating complications were reported in these cases and case series. No additional mortality and life-treating complications were reported for adult recipients' donors (2, 18, 20, 25, 32) (Table 2).

There are few studies focusing on donor outcomes (1-4). Most of them are single-center series and only one of them is a registry-based cohort study with all living multi-organ donation from US reported by Henderson et al. (1) In this study, data from Scientific Registry of Transplant Recipients (SRTR) between March 1994 and June 2017 was analyzed. The study population consisted of 101 living multi-organ donors and their 133 recipients. Of the 101 donors, 52 of them were simultaneous living multi-organ donors and 49 of them were sequential multi-organ donors. Of the 52 simultaneous living multi-organ donors, there were no simultaneous liver-kidney donors (48 donated kidney-pancreas and 4 donated liver-intestine). No death and no intraoperative complication were reported. Of the 49 sequential multi-organ donors, 36 of them donated liver and kidney (21 donated a kidney than liver lobe and 15 donated liver lobe than a kidney). In addition, 5 donated lung-lobe and a kidney, 3 donated liver lobe and intestine, 4 donated a kidney and pancreas, 1 donated lung lobe and live lobe. No donor death reported related to donation and no intraoperative complication reported. One liver-kidney donor's death not related to donation reported 2.5 year after last donation. This report has the highest number of sequential liver- kidney donors in the English literature according to our knowledge (1).

Although Kitajima et al. (20) from Japan reported a single-center experience with 3 sequential liver-kidney donors in 2017, the report primarily focused on the recipient's outcomes with limited additional information about the donors' outcomes. They reported no donor mortality and no serious donor complication. In 2017, Unek et al. (2) from Turkey reported their single-center experiences with 6 donors focusing on donor long-term outcomes. This is the highest single-center case number in the English literature till our report according to our literature search and knowledge. Of the 6 donors, 5 of them were simultaneous liver-kidney donation and 1 of them sequential kidney donation 11 days after liver donation for an adult recipient. Of the 6 donors, 4 of them donated right liver lobe, 1 donated left liver lobe and 1 donated liver left lateral sector. They reported no mortality and early postoperative ileus resolved with medical treatment as only early and late morbidity. Nair et al.(3) from the US in 2020 reported their experience with 5 sequential liver kidney donors. First 3 of them donated left liver lobe and 2 of them donatde liver left lateral sector. Their kidney donation intervals for these 5 donors were between 10 months to 6 years. They reported no mortality. They concluded that sequential liver-kidney donation can be safely performed when left-sided liver graft is utilized to maximize donor safety. According to our English literature search and knowledge, our case series seems to have the highest case number. Here, we reported 8 simultaneous and short-term sequential liver-kidney donors which focused on the donor outcomes with the literature review. Of the 8 donors, 3 of them were simultaneous liver- kidney donation (1 right liver lobe, 1 left liver lobe and 1 liver left lateral sector) and 5 of them sequential liver kidney donation with the 4 to 11day intervals (2 right liver lobe and 6 liver left lateral sector). Six of our recipients were pediatric and 2 of them were adult. Of the 8 donors, 2 of them experienced morbidity (Grade 3 and 1) with no mortality. In regions with insufficient deceased donor support like Turkey, living donors are the only chance for saving lives and this responsibility push the transplant providers to expand the limits for living donation.

Since the donor is healthy, the safety of the donor is of paramount importance. In addition, minimally invasive approaches are important for functional and cosmetic demands of the donors. Minimizing incision is an alternative, which has been reported in the literature with same outcomes (33,34). In the last two decades, pure laparoscopic or laparoscopic hand assistant donor nephrectomy has been established as the gold standard (28). Beginning with donor left lateral sector hepatectomy in 2002 by Cherqui et al. (35), laparoscopic and other minimally invasive approaches are being used today for living liver donation. This seems feasible and safe when performed by a surgeon who is highly experienced in both laparoscopic and hepatobiliary surgery and with an experienced transplant team (36-38). According to recent consensus guidelines, living donor laparoscopic left lateral sector hepatectomy adult to child liver transplantation may be regarded as standard procedures, but it is still limited to few highly specialized centers. First laparoscopic living liver donor hepatectomy cases from Turkey were reported by Karatas et al. including some of our authors in 2019 (39). In 2018, Gautier et al. from Russia reported the first case of laparoscopic left lateral sector hepatectomy and nephrectomy in the same donor. The donor was discharged on postoperative day 5 without any complications (4). In addition, in 2019, Angelico et al. from Italy reported two sequential laparoscopic living liver hepatectomy and living donor nephrectomy in the same donor. Both cases first underwent laparoscopic left lat-

Table 2. English literature review of simultaneous and sequential liver kidney donation

	Year	Number of cases	Liver Graft	Kidney Graft	Sim/Seq-(m,y)	Donor Death	Recipient Relation	Recipient Age	Recipient Prim. Disease Liver/Kidney
Haberal M et al. (18)	1992	1 (Turkey)	LLS	R-Op	Sim.	None	Mother	23 y	Crn. HBV/NS
Kitajima et al. (20) Sato S et al. (29) Nakamura M et al. (26) Motoyoshil et al. (27)	1996 2014	13 (Japan)	LLS (8)- Left (5)	L (5) NA (8)	Seq- 1.5 month to 4 year	None	Mother (7) Father (5) Sibling (1)	Ped (11) Adult (2)	PHO Type 1 (7) Caroli/ARPKD (2) Cong. L fibr/ARPKD (1) Cong. Cholestas/NA (1) Biliary Atresia/Jeune Synd (1) Alagille Synd./Aplastic KD (1)
Marujo WC et al. (19)	1999	1 (Brazil)	Right	NA	Sim.	None	Child	53 y	Cirrhosis/CKD
Unek T et al. (2) Astarcioglu L et al. (25)	2001 2009	6 (Turkey)	LLS(4) -Op Left(1)-Op Right(1) Op	R	Sim. (5) Seq .(1) – 11 d	None	Mother 2 Sibling 2 Child 1 Spouse 1	9 y	PHO Type 1 (5) Crn. HBV/CKD (1)
Pacheco-Moreira et al. (32)	2005	1 (Brazil)	Right	NA	Seq- 20 y	None	Sibling	Adult	Crn. HCV/NS
Rosenblatt GS et al. (30)	2006	1 (USA)	LLS-Op	L	Seq	None	Mother	1.5 y	PHO Type 1
Moray G, Haberal M et al. (22)	2002-2013	1 (Turkey)	NA	NA	Seq.-4 m	None	Relative	10 y	PHO Type 1
Mor E et al. (24)	2013	2 (Israel)	Right Right	L L	Seq-4.5m Seq-20 d	None	Father (2)	17 y 17 y	PHO Type 1 (2)
Kotb et al. (21)	2010 2014	4 (Egypt)	LLS 4 -Op	NA	Sim.	None	Mother (1) Siblings (1) NA (2)	Ped (4)	PHO Type 1 (4)
Khorsandi et al. (31)	2016	2 (UK)	LLS- Op	NA	Seq-6 m	None	NA	1 y/2 y	PHO Type 1 (2)
Henderson et al. (1) (US SRTR data)	1994-2017	36 (US)	NA	NA	Seq- NA	None	NA (All type)*	NA	NA
Angelico R et al. (28)	2008-2018	5 (Italy)	LLS (Lap) LLS (Lap) LLS 3 -Op	L (Lap) R(Lap) NA -3	Seq. 8 m Seq. 4 m Seq- NA	None	Mother 1 Father 1 NA-3	1.5 y 3 y Ped (3)	PHO Type 1 (5)
Ozer A et al. (23)	2017-2018	4 (Turkey)	LLS(3 Right(1)-	NA- Lap(3)	Sim. (1) Seq. (3)-4m	None	Mother (2) Father (2)	Ped (3) Adult (1)	PHO Type 1 (4)
Gautier et al. (4)	2019	1 (Russia)	LLS (Lap)	L (Lap)	Sim.	None	Mother	2 y	Cong. L fibrosis/ARPKD
Nair A et al. (3)	2020	5 (US)	Left 3 LLS 2	L 4 R 1	Seq- 11 month to 9 year	None	NA	NA	NA

LLS: Living liver left lateral sector donation, Left: Living liver left lobe donation, Right: Living liver right lobe donation, Sim.: Simultaneous living liver and kidney donation, Seq.: Sequential living liver kidney donation, R: Living right kidney donation, L: Living left kidney donation, KD: Kidney disease, Op: Open surgery, Chr: Chronic, L: Liver, ARPKD: Autosomal recessive polycystic kidney disease, PHO: Primary hyperoxaluria, d: Day, m: Month, Lap: Laparoscopic surgery, UK: United Kingdom, US: United States, Ped.: Pediatric.

eral sector hepatectomy and followed by laparoscopic donor nephrectomy. Intervals between the two surgeries were 4 and 8 months. No serious complications were reported with no morality (28). According to our literature review and supported by the literature reports, there were no cases of donor morbidity higher than Clavien-Dindo Grade 3 in the English language literature publications for simultaneous or sequential liver-kidney donors (1, 4). Minimally invasive approaches seem to be the close future of living liver donation.

Tong et al. have verified that the donors' well-being is depended on the recipients' well-being. Feeling of regret, sense of loss, or psychosocial complications were reported when the recipient died or had a poor outcome (16). Our clinical experience is similar to this conclusion. Most of the extreme donors reported in the literature were close relatives of the recipients, especially for pediatric recipients. Especially, these close relationships with recipients impact the decision made and motivate the donors during the extreme donation process. With good recipients' outcome, long-term psychosocial complications seems to be limited in this rare practice.

CONCLUSION

In conclusion, the expansion of the donor pool by utilizing grafts from living donors is a globally-accepted proposition in experience hands, since it provides safety and successful outcomes. Under the literature review and with the addition of our limited case experience, simultaneous or sequential liver and kidney donation from the same donor seems to be a reasonable option for combined liver-kidney transplant recipients in special circumstances. Right recipient indication and appropriate donor evaluation with right time decision making, experienced team and meticulous surgical technique with close early and long-term follow-up are mandatory during this extreme donation process for good outcomes.

Ethics Committee Approval: Committee approval was received from the Memorial Şişli Hospital Institutional Review Board (09/30/2019) Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects" (amended in October 2013).

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Canlı vericilikte uç nokta: Literatür irdemesi eşliğinde uzun dönem sonuçları ile eş zamanlı ve birbirini takip eden canlı karaciğer-böbrek verici tek merkez deneyimi

Yücel Yankol[2], Cihan Karataş[3], Turan Kanmaz[3], Burak Koçak[3], Münci Kalayoğlu[3], Koray Acarlı[1]

[1] Memorial Şişli Hastanesi, Organ Nakil Merkezi, İstanbul, Türkiye
[2] Loyola Üniversitesi, Chicago Strich Tıp Fakültesi, Nakil Merkezi-Cerrahi Anabilim Dalı, Maywood, IL, Birleşik Devletler
[3] Koç Üniversitesi Hastanesi, Organ Nakli Merkezi, İstanbul, Türkiye

ÖZET

Giriş ve Amaç: Canlı karaciğer ve böbrek verici ameliyatları tamamen sağlıklı bireylere uygulanan cerrahi işlemlerdir. Bu cerrahiler vericiye doğrudan bir faydası olmayan, ölüm ve komplikasyon riski taşıyan büyük bir işlemdir. Bu çalışmamızda dünya genelinde çok yaygın olmayan eş zamanlı veya birbirini takip eden canlı karaciğer ve böbrek verici ameliyatı deneyimimizi literatür irdemesi ile birlikte paylaştık.

Gereç ve Yöntem: Ocak 2007-Şubat 2018 tarihleri arasında merkezimizde, alıcısı ile yakınlık ilişkisi olan vericilere toplam 1109 canlı böbrek verici ameliyatı ve 867 canlı karaciğer verici ameliyatı verici kaybı yaşanmadan gerçekleştirilmiştir. Bunlardan eş zamanlı veya birbirini takip edecek şekilde canlı karaciğer ve böbrek verici ameliyatı olan 8 verici minimum 2 yıllık takipleri ile incelenmiştir.

Bulgular: Bu 8 vericiden 3 tanesi eş zamanlı ve 5 tanesi birbirini takip edecek şekilde canlı karaciğer ve böbrek verici ameliyatı olmuşlardır. Hepsi alıcının yakın akrabasıydı. Ortalama yaş 36 (26-61) ve ortalama BMI 25,7 kg/m (17,7-40) idi. Vericilerden 3'üne sağ lob verici hepetektomisi, 4'üne verici sol lateral sektör hepatektomisi ve 1'ine sol lob verici hepetektomisi gerçekleştirilmiştir. Median hastanede kalış süresi 9 (7-13) gündü. Vericilerden 2'sinde erken dönemde komplikasyon gelişmiştir (Dindo Grade 3b ve Grade 1). Verici ölümü ve başka bir geç dönem komplikasyonu gelişmiştir.

Sonuç: Verici havuzunun genişletilmesinde canlı vericilerin güvenli olarak başarılı sonuçlar ile kullanılması dünya genelinde kabul görmektedir. Aynı vericinin eş zamanlı veya takip eden ameliyatlar ile karaciğer ve böbrek vericisi olması özel durumlarda kombine karaciğer ve böbrek alıcıları için güvenli bir seçenek olabilmektedir.

Anahtar Kelimeler: Eş zamanlı canlı karaciğer-böbrek vericisi, canlı verici hepatektomisi, canlı verici nefrektomisi, komplikasyon

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