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Süsal, C.; Kumru, G.; Döhler, B.; ...; ...; ...; ...; ...; ...; ...

Source / Izvornik: **Transplant international, 2020, 33, 849 - 857**

Journal article, Published version

Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

<https://doi.org/10.1111/tri.13628>

Permanent link / Trajna poveznica: <https://um.nsk.hr/um:nbn:hr:184:488707>

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VIEW POINT ARTICLE

Should kidney allografts from old donors be allocated only to old recipients?

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SUMMARY

In several deceased donor kidney allocation systems, organs from elderly donors are allocated primarily to elderly recipients. The Eurotransplant Senior Program (ESP) was implemented in 1999, and since then, especially in Europe, the use of organs from elderly donors has steadily increased. The proportion of ≥ 60 -year-old donors reported to the Collaborative Transplant Study (CTS) by European centers has doubled, from 21% in 2000–2001 to 42% in 2016–2017. Therefore, in the era of organ shortage it is a matter of debate whether kidney organs from elderly donors should only be allocated to elderly recipients or whether < 65 -year-old recipients can also benefit from these generally as “marginal” categorized organs. To discuss this issue, a European Consensus Meeting was organized by the CTS on April 12, 2018, in Heidelberg, in which 36 experts participated. Based on available evidence, it was unanimously concluded that kidney organs from 65- to 74-year-old donors can also be allocated to 55- to 64-year-old recipients, especially if these organs are from donors with no history of hypertension, no increased creatinine, no cerebrovascular death, and no other reasons for defining a marginal donor, such as diabetes or cancer.

Transplant International 2020; 33: 849–857

Key words

kidney clinical, expanded donor pool, donation, outcome

Received: 20 September 2019; Revision requested: 6 November 2019; Accepted: 22 April 2020; Published online: 22 May 2020

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Correction added on 1 July 2020, after first online publication: One of the authors was inadvertently omitted and has been included in this version of the article.

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Introduction

Although high donor age is one of the strongest factors that adversely influence death-censored graft survival in kidney transplantation [1–4] (Fig. 1), shortage of available organs has resulted in a continuously increasing use of kidney organs from elderly donors. The percentage of ≥ 60 -year-old deceased kidney donors reported to the Collaborative Transplant Study (CTS) from Europe was 21% during 2000–2001 and as high as 42% during 2016–2017 (Fig. 2a). This trend was accompanied by a similar increase in

recipient age; the percentage of ≥ 60 -year-old recipients was 22% during 2000–2001 and 39% during 2016–2017 (Fig. 2b). The median age of deceased kidney donors in Eurotransplant (ET) countries rose from 46 in 2000 to 54 years in 2017 [5,6]. As many as 69% of kidneys from ≥ 65 -year-old deceased donors were allocated in 2017 via the ET Senior Program (ESP) to ≥ 65 -year-old recipients [7]. The percentage of kidney transplantations via ESP increased from 9% in 2000 to 17% in 2017 [5,7]. Therefore, the optimal use of organs from elderly donors represents an increasingly important issue in organ transplantation.

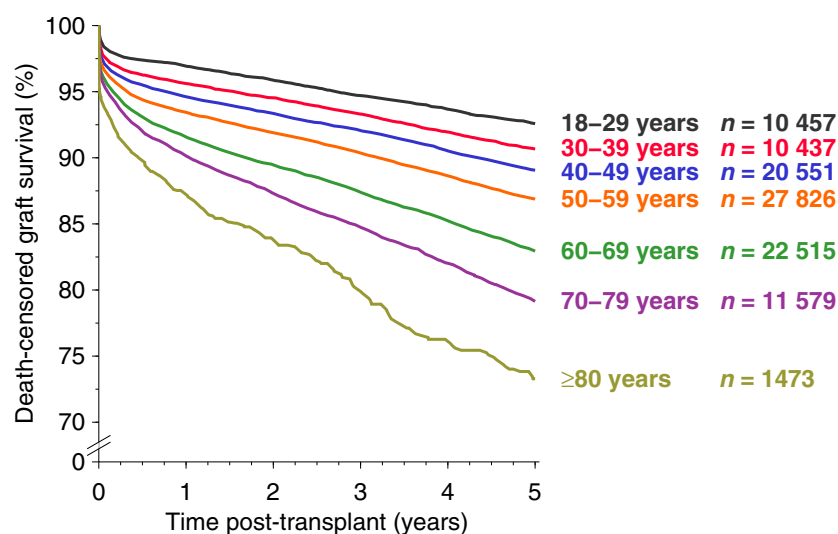


Figure 1 Impact of donor age on death-censored graft survival in first adult kidney-only transplantations performed in Europe during 2000–2017 and reported to CTS (log-rank $P < 0.001$).

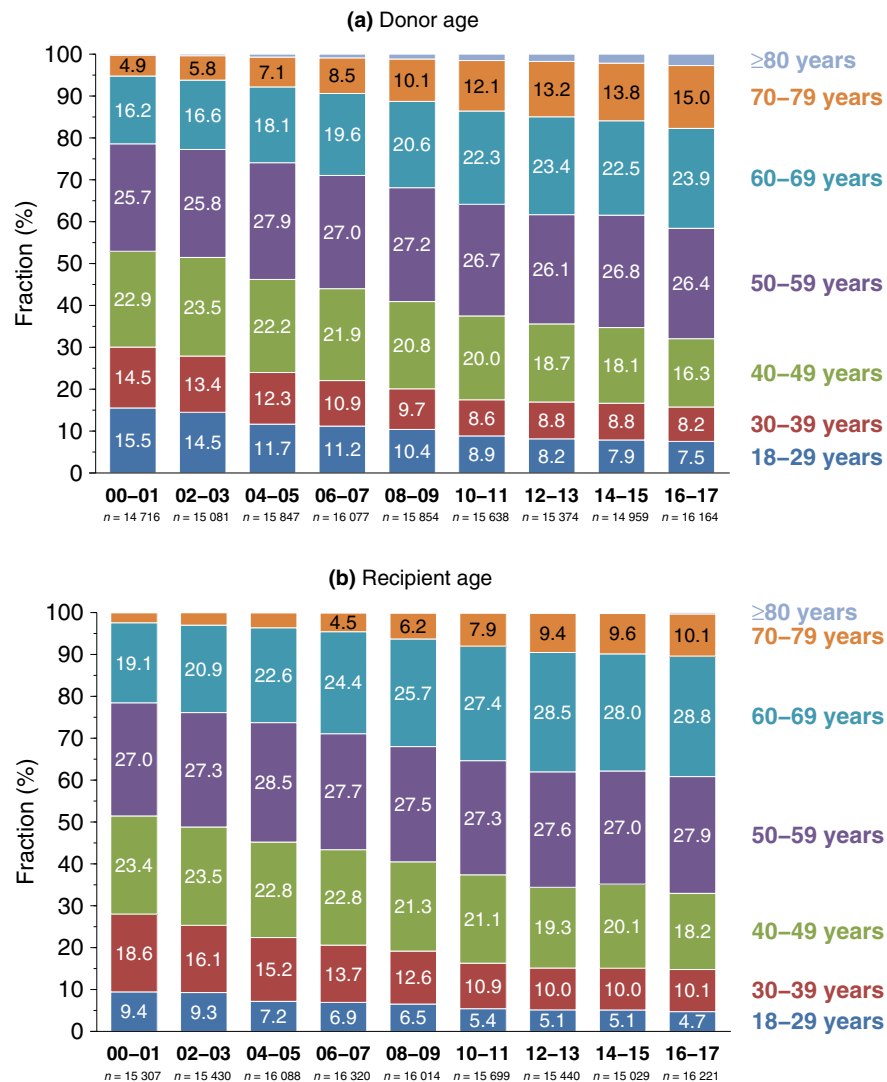


Figure 2 Transplant year-related age distribution of (a) adult deceased kidney donors and (b) adult recipients from 2000 to 2017 in transplantations performed at European centers and reported to CTS.

History of hypertension, increased creatinine, and cerebrovascular death are additional factors that decide the quality of a deceased donor kidney organ [8]. Besides the donor age above 60 years, the presence of two of these factors is also accepted to define an expanded criteria donor (ECD) in the donor age-group 50–59 years. Compared to standard criteria deceased donor (SCD) kidney transplantation, ECD kidney transplantation is associated with inferior graft and patient survival [8–10]. On the other hand, in the era of organ shortage and improving graft survival rates, allocation of kidneys from donors aged ≥ 65 years, who do not have additional ECD characteristics, to patients under the age of 65 years may increase the chance of transplantation with acceptable outcomes for this group of <65-year-old recipients. During a CTS-initiated

European Expert Meeting in April 2018, the question of whether the use of kidney organs from elderly donors should only be limited to ≥ 65 -year-old recipients was discussed in detail. A pro/con debate between Uwe Heemann from Munich and Jens Lutz from Mainz (currently in Koblenz) stimulated the discussion.

Different views

Arguments in favor of allocating kidneys from 65- to 74-year-old donors only to ≥ 65 -year-old recipients (Jens Lutz)

According to an analysis of the Australian and New Zealand Dialysis and Transplant (ANZDATA) Registry data, <60-year-old recipients of ECD kidneys had an

excess risk of all-cause mortality and death with functioning graft due to cardiovascular death as compared to recipients of SCD kidneys [11]. This is a strong argument against the use of organs from elderly donors in young recipients. The presence of circulating donor-specific HLA antibodies (DSA) and longer cold ischemia time (CIT) were identified as independent risk factors for failure of ECD grafts [9]. A recent study in a Dutch cohort showed a lower hazard ratio for graft loss with ECD kidneys in ≥ 60 -year-old than < 60 -year-old recipients [10]. These findings suggested that caution is required in the allocation of ECD kidneys to < 60 -year-old recipients.

Eurotransplant Senior Program is an allocation scheme based on matching kidneys from ≥ 65 -year-old deceased donors to ≥ 65 -year-old recipients with a negative cytotoxic cross-match but without consideration of HLA matching [12]. Apart from a more efficient use of kidneys from elderly donors, ESP aims to reduce CIT of ECD organs by local, regional, or national allocation. Early analyses revealed that ESP allocation did not affect graft and patient survival negatively [13–16]. Compared to 60- to 64-year-old patients who received a kidney from a donor of any age, in ≥ 65 -year-old ESP recipients CIT was reduced and the median waiting time was shortened from 4.6 to 3.6 years. Availability of elderly donors had doubled since initiation of the ESP in 1999. However, 5-year results revealed lower death-censored graft survival rates in ESP patients than in 60- to 64-year-old patients who received a kidney from a donor of any age, but similar death-censored graft survival rates compared to recipients of any age who received an organ from a ≥ 65 -year-old donor [17].

Cold ischemia time > 16 h, dialysis vintage, overweight, and kidney retransplantation were associated with delayed graft function (DGF) and primary non-function within the ESP population [18]. Moreover, CIT > 15 h, DGF, and kidney retransplantation were significant risk factors for poor graft survival, suggesting that ESP results could further be improved by keeping the CIT short and paying attention to DSA, as increasingly practiced. HLA typing prior to allocation and virtual cross-matching have become clinical routines and that are able to prevent prolongation of CIT also in ESP.

Higher Kidney Donor Risk Index (KDRI) scores in ESP kidneys were associated with reduced graft survival and increased serum creatinine levels at discharge [19], indicating that donor quality should be assessed while selecting organs for older recipients who usually have a high degree of comorbidity. Lai *et al.* reported that survival after kidney transplantation did not differ with

kidneys from 50- to 59-year-old or over 60-year-old expanded criteria donors, when a biopsy-driven selection was performed in over 60-year-old donors. They speculated that biopsy-driven pretransplantation selection could achieve similar outcomes with ECD kidneys as compared to kidneys from nonbiopsied younger donors [20]. Histopathologic evaluation of donor kidney and evaluation of the KDRI score may lead decision-making to choose dual transplantation, improve transplant outcomes, and decrease discard rates in ESP [21–24]. On the other hand, a biopsy-driven selection of the donor organ can prolong CIT, and consequently, the benefit of ESP could be lost. There seem to exist also region-specific differences in outcomes as ≥ 65 -year-old recipients of kidneys from ≥ 65 -year-old deceased donors in the United States (U.S.) showed significantly lower allograft survival rates and a higher incidence of death with functioning graft than patients transplanted via ESP [25]. Determination of reasons for these international differences is also important in order to understand the risk factors for adverse outcomes in elderly recipients.

In conclusion, as compared to SCD kidneys, ECD kidneys were not associated with increased mortality or graft failure in ≥ 65 -year-old recipients in Europe, and marginal kidney grafts according to KDRI or graft biopsy had only a minor influence on long-term outcome in older recipients. As the relative risk of graft loss and mortality with ECD versus SCD kidneys were reported to be higher in young than old recipients, Jens Lutz stimulated the discussion with the statement that kidneys from 65- to 74-year-old donors should only be allocated to ≥ 65 -year-old recipients.

Arguments in favor of allocating kidneys from 65- to 74-year-old donors also to < 65 -year-old recipients (Uwe Heemann)

A Dutch cohort study of 3597 deceased donor kidney transplant recipients revealed that ≥ 65 -year-old recipients of kidneys from ≥ 65 -year-old donors did not experience a survival benefit compared to those remaining wait-listed on dialysis [26]. Renal function was inferior in elderly recipients (≥ 65 years) of kidneys from elderly (≥ 65 years) compared to young (< 65 years) donors, and only 53% of them were alive with a functioning graft after 5 years, indicating that elderly recipients do not benefit from elderly donor organs. Mezrich *et al.* also reported that elderly patients who received ECD kidneys had significantly lower 5-year patient and graft survival rates than elderly recipients of SCD allografts. In

contrast, 5-year patient and graft survival rates did not significantly differ between recipients of ECD and SCD kidneys in the group of 40- to 59-year-old transplant recipients [27]. Solá *et al.* compared <60-year-old recipients who received grafts from ≤60 versus >60-year-old donors and found better renal function in recipients of kidneys from ≤60-year-old donors. However, 1-, 5-, and 10-year patient and graft survival rates were also similar [28]. In a paired matched analysis between 823 recipients from ≥65-year-old deceased donors and wait-listed dialysis patients, the risk of death was 2.66 times higher for patients in the dialysis group [1]. Importantly, the highest death-censored graft survival benefit was found in 55- to 64-year-old recipients. Similarly, Pérez-Saéz *et al.* [29] reported in <65-year-old recipients a higher benefit in patient survival of kidney transplantation from ≥75-year-old donors over remaining on dialysis.

Uwe Heemann concluded that patients younger than 65 years should not be precluded from kidneys of donors older than 65 years. Recipients with low life expectancy without transplantation, such as lack of vascular or peritoneal access, extremely long waiting time due to blood group, rare HLA alleles or preformed antibodies, and high burden of comorbidities, may especially benefit from kidneys of elderly donors.

Discussion of pro/con arguments

Using the U.S. Renal Data System and U.S. Scientific Renal Transplant Registry databases, Ojo *et al.* [30] analyzed in 2001 patients awaiting a deceased donor kidney transplant and found an increase of 5 years in life expectancy in recipients of kidneys from marginal donors than patients who remained on dialysis without transplantation. Merion *et al.* [31] reported in 2005 that due to excess mortality in the perioperative period, the cumulative survival of ECD recipients did not equal the survival of non-ECD transplanted or wait-listed patients until 3.5 years post-transplantation. However, significant survival benefit was observed in >40-year-old recipients of ECD kidneys, non-Hispanics, nonsensitized patients, and patients with diabetes or hypertension. The group advised that ECD kidney transplantation should be offered to candidates older than 40 years in organ procurement organizations with long waiting times (>1350 days).

Current data from the CTS study indicate that the previously reported higher mortality associated with ECD kidneys [11] is not restricted to <60-year-old recipients (Fig. 3). Furthermore, as discussed further below in detail, the CTS data support the assumption

that nowadays good quality kidneys from ≥65-year-old donors can also be allocated to <65-year-old recipients with good outcomes. The main challenge hereby is accomplishment of the appropriate donor–recipient matching to obtain the best patient and graft survival. In the U.S. study mentioned above [25], ≥65-year-old recipients of kidneys from ≥65-year-old deceased donors had significantly lower allograft survival rates and a higher incidence of death with functioning graft than patients transplanted via ESP. However, in contrast to the findings for all-cause graft loss and death with functioning graft, death-censored graft loss was not statistically different between ESP and US patients in the multivariable analysis [25]. When ≥50-year-old first graft recipients transplanted during 2010–2017 at European CTS centers were analyzed, deceased donor kidney transplants from 65- to 79-year-old donors demonstrated lower, but still good 3-year death-censored graft survival rates than kidneys from 50- to 64-year-old donors (Fig. 4a). In all subgroups of 50- to 74-year-old recipients, kidneys from ≥65-year-old donors showed similarly good 3-year death-censored graft survival rates (log-rank with trend $P = 0.41$; Fig. 4b). Transplant centers belonging to the ET region were excluded from this analysis in order to avoid a possible influence of the ESP program. Inferior death-censored graft survival was observed only in ≥50-year-old recipients of kidneys from ≥80-year-old donors (Fig. 4a).

Further in-depth analysis of data from the CTS indicates that allocation of so-called Category I donor kidneys from 65- to 74-year-old donors with no history of hypertension, no increased creatinine, no cerebrovascular death, and no other reasons for defining a marginal donor to younger recipients aged 55–64 years results in similar death-censored graft survival rates as transplantation of kidneys from 55- to 64-year-old donors to 55- to 64-year-old recipients (Fig. 5a) [32], importantly, without a difference in mortality (Fig. 5b). As approximately one-quarter of the 65- to 74-year-old donors belongs to this “nonmarginal” category, it seems that this allocation strategy can be used to expand the donor pool with a more favorable use of organs as compared to the strict “old to old” matching. In this analysis, the donors after cardiac death were not excluded (35% in Category I and 13% in Category II of 65- to 74-year-old donors; 18% in 55- to 64-year-old donors).

Currently, approximately 50% of graft losses are due to death of the patient with a functioning graft, and because of the shortage of deceased donor organs, the lifetime of a transplant in young and elderly recipients needs to be also considered during organ allocation.

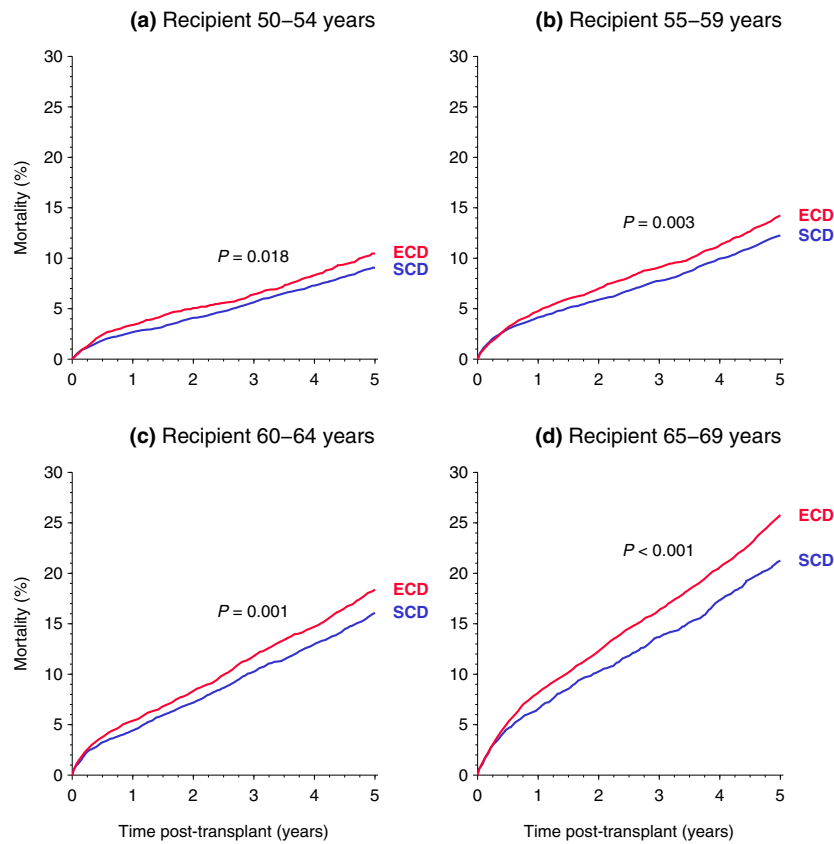


Figure 3 Cumulative incidence of all-cause mortality in European recipients of standard criteria donor (SCD) and expanded criteria donor (ECD) kidneys, stratified by recipient age. First deceased donor kidney-only transplantations performed between 2000 and 2017 were analyzed. Log-rank *P* values of Kaplan–Meier analyses are shown.

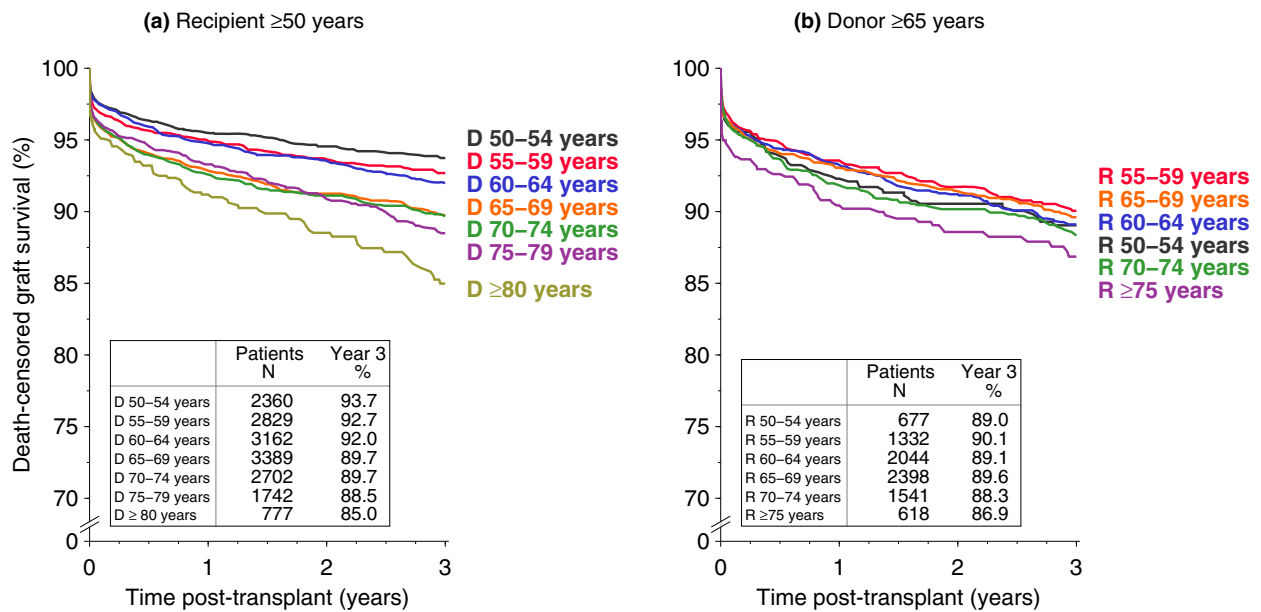


Figure 4 Influence of (a) donor age on death-censored graft survival in ≥ 50 -year-old recipients and (b) influence of recipient age on death-censored graft survival in patients who received a kidney graft from a ≥ 65 -year-old deceased donor. First graft recipients transplanted during 2010–2017 in Europe were analyzed. Current Eurotransplant countries were excluded. D, donors; R, recipients.

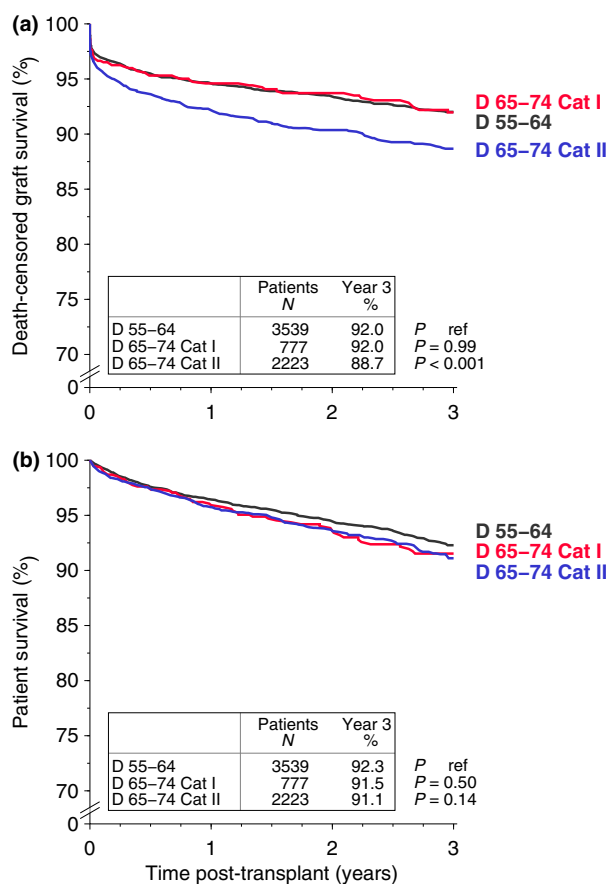


Figure 5 Death-censored graft (a) and patient (b) survival in 55- to 64-year-old recipients according to donor age, categorized by expanded criteria donor parameters. Category I: Donor age 65–74 years with no history of hypertension, no increased creatinine, no cerebrovascular death, and no other reasons for defining a marginal donor, such as diabetes or cancer. Category II: Donor age 65–74 years with history of hypertension or cerebrovascular death or increased creatinine or other reason(s) for defining a marginal donor. Patients transplanted during 2010–2017 in Europe were analyzed. Current Eurotransplant countries were excluded.

The current analysis of European CTS data from 2000 to 2017 shows that failed transplants from ≥ 65 -year-old donors had functioned significantly longer in 55- to 64-year-old recipients than in ≥ 65 -year-old recipients (3.3 vs. 2.3 years).

Consensus

Considering all these facts, it was unanimously concluded that selected kidney organs from 65- to 74-year-old deceased donors should also be considered for 55- to 64-year-old recipients, especially if these organs are from donors with no history of hypertension, no increased creatinine, no cerebrovascular death, and no other reasons for defining a marginal donor, such as

diabetes or cancer. Otherwise, due to the continuous increase in donor age, a rigorous old-for-old allocation is expected to result in further prolongation of waiting time in 18- to 64-year-old recipients.

Additional aspects of transplantation of organs from elderly donors

Treckmann *et al.* and Moers *et al.* [33,34] reported that, compared to cold storage, recently applied machine perfusion procedures reduced the risk of primary nonfunction as well as DGF of kidney transplants and improved 1-year graft survival, while the survival advantage was highest in ECD kidneys and those with DGF, suggesting the possibility of a broader use of these as marginal categorized organs, for example, in younger patients. The same group reported a survival benefit of machine perfusion also for kidneys transplanted via ESP [35]. These promising observations, however, need further confirmation.

The quality of life (QoL) was reported to greatly improve after kidney transplantation [36,37], and this was also shown for patients who received grafts from in median 64-year-old donors [38]. Important is also the reduction of waiting time. According to data reported to CTS, there is a strong negative impact of dialysis time on graft survival if the patient received an organ from a ≥ 60 -year-old donor [39]. Analyzing kidney transplant recipients aged ≥ 60 years in the United States, Rose *et al.* [25] showed that the probability of patient survival with a functioning allograft at 5 years was higher with ECD transplants (≥ 65 -year-old donor) when the patient was transplanted within the first year after wait-listing as compared to delayed non-ECD transplantation performed ≥ 3 years after wait-listing. Therefore, QoL and waiting time are important aspects that must be considered in the discussion of pros and cons of transplantation of organs from elderly donors.

The immune system undergoes both morphologic and functional changes with aging, including modifications in T-cell phenotypes and functions. Age-related decline of immune functions, designated as immunosenescence, contributes to the increased susceptibility of elderly persons to infectious diseases, vaccination failures, and cancer [40]. Both acute and chronic rejections are less commonly seen in elderly recipients. Therefore, death is the leading cause of graft loss [41,42], in the majority of the cases due to infectious complications, while the prevalence of malignancy as cause of death is also increased [41,43]. As illustrated in Fig. 3, the mortality rate is potentiated by the use of ECD kidneys in all recipient age-groups.

Tullius *et al.* [44] reported a decrease in graft survival with increasing recipient age. However, when the analysis was censored for patient's death with a functioning kidney transplant, graft survival improved with each decade of increasing recipient age. This was even more surprising as elderly recipients had received less well-matched organs of poorer quality. At the same time, the frequency of acute rejections decreased dramatically with increasing age, emphasizing the effect of age on the vigor of the recipient's immune responses. In contrast to high recipient age, high donor age was associated more frequently with acute rejection episodes and grafts from elderly donors were shown to be more immunogenic, especially in the early period after transplantation [26,45,46]. Moreover, the presence of acute rejection episodes was reported to shorten graft survival in patients transplanted from >55-year-old deceased donors [47]. Analysis of immune responses in ESP kidney recipients versus <65-year-old patients receiving kidneys from <65-year-old donors with comparable HLA mismatches demonstrated that elderly patients receiving organs from elderly donors had elevated numbers of memory T cells, activated cytotoxic and alloreactive T cells, and higher levels of tumor necrosis factor- α [48]. Since death with a functioning graft due to infections is the dominant reason of early graft loss in elderly, more intense clinical immunosuppression to prevent or treat acute rejection in recipients of grafts from elderly donors is expected to be counterproductive and result in increased mortality. Therefore, it should rather be strived for improved HLA matching in

transplantation of such organs without prolonging the cold ischemia time extensively.

Authorship

No funding was obtained for the accomplishment of this manuscript except for the company grants received for the organization of the consensus meeting.

Funding

The authors have declared no funding.

Conflicts of interest

The authors have declared no conflicts of interest.

Acknowledgements

The consensus meeting on April 12, 2018, was supported by unrestricted grants of Alexion, Astellas, Biotest, BMT GmbH One Lambda, Chiesi, Dr. Franz Köhler Chemie, Immucor, Neovii, Novartis, Organ Assist, Organ Recovery Systems, Roche, and Sanofi. Unfortunately, we lost our long-time friend and co-author of this paper Xavier Rogiers during the revision process. He had chaired the pro/con debate during the expert meeting and participated in writing the first version of the manuscript. We are extremely grateful for his contributions not only to this paper but also to our field. He should rest in peace.

REFERENCES

- Lloveras J, Arcos E, Comas J, Crespo M, Pascual J. A paired survival analysis comparing hemodialysis and kidney transplantation from deceased elderly donors older than 65 years. *Transplantation* 2015; **99**: 991.
- Nyberg SL, Matas AJ, Kremers WK, *et al.* Improved scoring system to assess adult donors for cadaver renal transplantation. *Am J Transplant* 2003; **3**: 715.
- Summers DM, Johnson RJ, Hudson A, Collett D, Watson CJ, Bradley JA. Effect of donor age and cold storage time on outcome in recipients of kidneys donated after circulatory death in the UK: a cohort study. *Lancet* 2013; **381**: 727.
- Veroux M, Grosso G, Corona D, *et al.* Age is an important predictor of kidney transplantation outcome. *Nephrol Dial Transplant* 2012; **27**: 1663.
- Annual Report 2000 [Internet]. Eurotransplant International Foundation, 2001. Available from http://www.eurotransplant.org/cms/mediaobject.php?file=ar_20001.pdf (accessed July 1, 2019).
- Annual Report 2017 [Internet]. Eurotransplant International Foundation. 2018 [cited July 1, 2019]. Available from: <http://www.eurotransplant.org/cms/mediaobject.php?file=Annual+Report+2017+HR10.pdf>.
- Statistics Report Library. Report 2072P_All_ET_kidney [Internet]. Eurotransplant International Foundation, 2019. Available from <http://statistics.eurotransplant.org/reportloader.php?report=55949-6141-5854&format=html&download=0> (accessed July 1, 2019).
- Metzger RA, Delmonico FL, Feng S, Port FK, Wynn JJ, Merion RM. Expanded criteria donors for kidney transplantation. *Am J Transplant* 2003; **3**(Suppl. 4): 114.
- Aubert O, Kamar N, Vernerey D, *et al.* Long term outcomes of transplantation using kidneys from expanded criteria donors: prospective, population based cohort study. *BMJ* 2015; **351**: h3557.
- van Ittersum FJ, Hemke AC, Dekker FW, *et al.* Increased risk of graft failure and mortality in Dutch recipients receiving an expanded criteria donor kidney transplant. *Transpl Int* 2017; **30**: 14.
- Ma MK, Lim WH, Craig JC, Russ GR, Chapman JR, Wong G. Mortality among younger and older recipients of kidney transplants from expanded criteria donors compared with standard

- criteria donors. *Clin J Am Soc Nephrol* 2016; **11**: 128.
12. Eurotransplant Manual Chapter 4 Kidney (ETKAS and ESP, version 8.0) [Internet]. Eurotransplant International Foundation, 2019. Available from <https://www.eurotransplant.org/cms/mediaobject.php?file=H4+Kidney+March+20191.pdf> (accessed July 1, 2019).
 13. Bentas W, Jones J, Karaoguz A, *et al.* Renal transplantation in the elderly: surgical complications and outcome with special emphasis on the Eurotransplant Senior Programme. *Nephrol Dial Transplant* 2008; **23**: 2043.
 14. Cohen B, Smits JM, Haase B, Persijn G, Vanrenterghem Y, Frei U. Expanding the donor pool to increase renal transplantation. *Nephrol Dial Transplant* 2005; **20**: 34.
 15. Giessing M, Budde K, Fritsche L, *et al.* "Old-for-old" cadaveric renal transplantation: surgical findings, perioperative complications and outcome. *Eur Urol* 2003; **44**: 701.
 16. Smits JMA, Persijn GG, van Houwelingen HC, Claas FHJ, Frei U, Ctr ESP. Evaluation of the eurotransplant senior program. The results of the first year. *Am J Transplant* 2002; **2**: 664.
 17. Frei U, Noeldeke J, Machold-Fabrizii V, *et al.* Prospective age-matching in elderly kidney transplant recipients—a 5-year analysis of the Eurotransplant Senior Program. *Am J Transplant* 2008; **8**: 50.
 18. Bahde R, Vowinkel T, Unser J, *et al.* Prognostic factors for kidney allograft survival in the Eurotransplant Senior Program. *Ann Transplant* 2014; **19**: 201.
 19. Schamberger B, Lohmann D, Sollinger D, Stein R, Lutz J. Association of kidney donor risk index with the outcome after kidney transplantation in the Eurotransplant Senior Program. *Ann Transplant* 2018; **23**: 775.
 20. Lai Q, Nudo F, Levi Sandri GB, *et al.* Survival after kidney transplantation does not differ with 50–59- or over 60-year-old expanded-criteria donors. *Transplant Proc* 2011; **43**: 1030.
 21. Fernandez-Lorente L, Riera L, Bestard O, *et al.* Long-term results of biopsy-guided selection and allocation of kidneys from older donors in older recipients. *Am J Transplant* 2012; **12**: 2781.
 22. Remuzzi G, Cravedi P, Perna A, *et al.* Long-term outcome of renal transplantation from older donors. *N Engl J Med* 2006; **354**: 343.
 23. Ruggenti P, Silvestre C, Boschiero L, *et al.* Long-term outcome of renal transplantation from octogenarian donors: a multicenter controlled study. *Am J Transplant* 2017; **17**: 3159.
 24. Tanriover B, Mohan S, Cohen DJ, *et al.* Kidneys at higher risk of discard: expanding the role of dual kidney transplantation. *Am J Transplant* 2014; **14**: 404.
 25. Rose C, Schaeffner E, Frei U, Gill J, Gill JS. A lifetime of allograft function with kidneys from older donors. *J Am Soc Nephrol* 2015; **26**: 2483.
 26. Peters-Sengers H, Berger SP, Heemskerk MB, *et al.* Stretching the limits of renal transplantation in elderly recipients of grafts from elderly deceased donors. *J Am Soc Nephrol* 2017; **28**: 621.
 27. Mezrich JD, Pirsch JD, Fernandez LA, *et al.* Differential outcomes of expanded-criteria donor renal allografts according to recipient age. *Clin J Am Soc Nephrol* 2012; **7**: 1163.
 28. Sola R, Guirado L, Lopez-Navidad A, *et al.* Is it appropriate to implant kidneys from elderly donors in young recipients? *Transplantation* 2010; **90**: 286.
 29. Perez-Saez MJ, Arcos E, Comas J, *et al.* Survival benefit from kidney transplantation using kidneys from deceased donors aged ≥ 75 years: a time-dependent analysis. *Am J Transplant* 2016; **16**: 2724.
 30. Ojo AO, Hanson JA, Meier-Kriesche H, *et al.* Survival in recipients of marginal cadaveric donor kidneys compared with other recipients and wait-listed transplant candidates. *J Am Soc Nephrol* 2001; **12**: 589.
 31. Merion RM, Ashby VB, Wolfe RA, *et al.* Deceased-donor characteristics and the survival benefit of kidney transplantation. *JAMA* 2005; **294**: 2726.
 32. CTS Newsletter 4:2016 [Internet]. Collaborative Transplant Study, 2016. Available from <http://www.ctstransplant.org/public/newsletters/2016/pdf/2016-4.pdf> (accessed July 1, 2019).
 33. Moers C, Pirenne J, Paul A, Ploeg RJ, Machine Preservation Trial Study G. Machine perfusion or cold storage in deceased-donor kidney transplantation. *N Engl J Med* 2012; **366**: 770.
 34. Treckmann J, Moers C, Smits JM, *et al.* Machine perfusion versus cold storage for preservation of kidneys from expanded criteria donors after brain death. *Transpl Int* 2011; **24**: 548.
 35. Gallinat A, Moers C, Treckmann J, *et al.* Machine perfusion versus cold storage for the preservation of kidneys from donors ≥ 65 years allocated in the Eurotransplant Senior Programme. *Nephrol Dial Transplant* 2012; **27**: 4458.
 36. Jofre R, Lopez-Gomez JM, Moreno F, Sanz-Guajardo D, Valderrabano F. Changes in quality of life after renal transplantation. *Am J Kidney Dis* 1998; **32**: 93.
 37. Wylde M, Morton RL, Hayen A, Howard K, Webster AC. A systematic review and meta-analysis of utility-based quality of life in chronic kidney disease treatments. *PLoS Medicine* 2012; **9**: e1001307.
 38. Lonning K, Heldal K, Bernklev T, *et al.* Improved health-related quality of life in older kidney recipients 1 year after transplantation. *Transplant Direct* 2018; **4**: e351.
 39. CTS Newsletter 1:2018 [Internet]. Collaborative Transplant Study, 2018. Available from <http://www.ctstransplant.org/public/newsletters/2018/pdf/2018-1.pdf> (accessed July 1, 2019).
 40. Martins PN, Pratschke J, Pascher A, *et al.* Age and immune response in organ transplantation. *Transplantation* 2005; **79**: 127.
 41. Jassal SV, Opelz G, Cole E. Transplantation in the elderly: a review. *Geriatr Nephrol Urol* 1997; **7**: 157.
 42. Mendonça HM, Dos Reis MA, de Castro de Cintra Sessa R, Câmara NO, Pacheco-Silva A. Renal transplantation outcomes: a comparative analysis between elderly and younger recipients. *Clin Transplant* 2007; **21**: 755.
 43. Au EH, Chapman JR, Craig JC, *et al.* Overall and site-specific cancer mortality in patients on dialysis and after kidney transplant. *J Am Soc Nephrol* 2019; **30**: 471.
 44. Tullius SG, Tran H, Guleria I, Malek SK, Tilney NL, Milford E. The combination of donor and recipient age is critical in determining host immunoresponsiveness and renal transplant outcome. *Ann Surg* 2010; **252**: 662.
 45. de Fijter JW, Mallat MJ, Doxiadis II, *et al.* Increased immunogenicity and cause of graft loss of old donor kidneys. *J Am Soc Nephrol* 2001; **12**: 1538.
 46. Reutzel-Selke A, Jurisch A, Denecke C, *et al.* Donor age intensifies the early immune response after transplantation. *Kidney Int* 2007; **71**: 629.
 47. Kerr SR, Gillingham KJ, Johnson EM, Matas AJ. Living donors >55 years: to use or not to use? *Transplantation* 1999; **67**: 999.
 48. Pratschke J, Merk V, Reutzel-Selke A, *et al.* Potent early immune response after kidney transplantation in patients of the European senior transplant program. *Transplantation* 2009; **87**: 992.