Machine Perfusion or Cold Storage in Deceased-Donor Kidney Transplantation

TO THE EDITOR: In 2009, we reported the results of an international randomized, controlled trial in which hypothermic machine perfusion of deceased-donor kidneys significantly reduced the risk of delayed graft function, as compared with cold-storage preservation. We also observed that graft survival at 1 year was significantly better after machine perfusion.[1] Since preservation-related effects have been shown to affect early function only, we decided to extend the follow-up period to see whether the substantial graft-survival advantage would persist 3 years after transplantation.

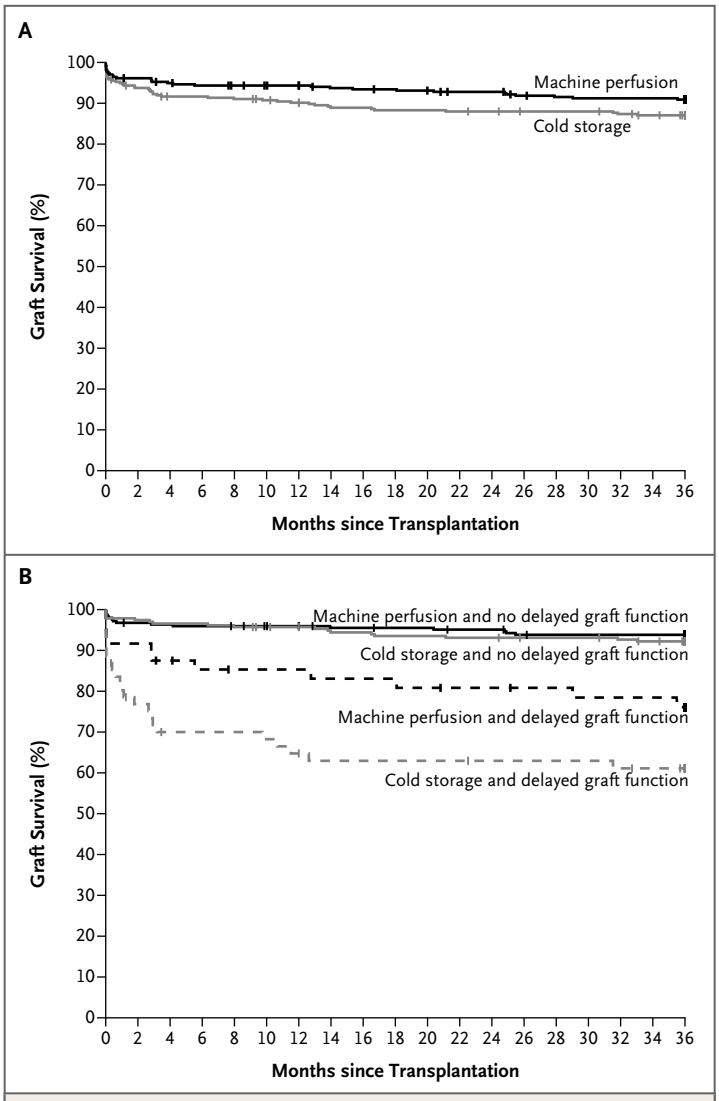

Figure 1. Graft Survival of Deceased-Donor Kidneys at 3 Years.
Panel A shows graft survival in 672 recipients in the main data set, with a hazard ratio for graft failure in the machine-perfusion group of 0.60 (95% confidence interval, 0.37 to 0.97; P=0.04). Panel B shows the post hoc analysis of a subgroup of 588 recipients of kidneys donated after brain death, with data split according to whether delayed graft function developed in the recipient. Delayed graft function was defined as the need for dialysis in the first week after transplantation.

In our study, one kidney of each donor was randomly assigned to machine perfusion, and the contralateral organ was assigned to cold storage. For the present analysis, we contacted all 60 collaborating transplantation centers. We collected 3-year follow-up data from all 672 recipients of consecutive kidneys donated after brain death or after cardiocirculatory death in the main data set, as well as 164 recipients of kidneys donated after cardiocirculatory death in the extended data set. End points were 3-year graft survival, patient survival, and serum creatinine level. We performed statistical analyses using the methods that were reported previously.[1]

Overall, 3-year graft survival was better for machine-perfused kidneys (91% vs. 87%; adjusted hazard ratio for graft failure, 0.60; P=0.04) (Fig. 1A). Three-year graft survival after machine perfusion was also superior to that after cold storage for kidneys donated after brain death (91% vs. 86%; adjusted hazard ratio, 0.54; P=0.02) but not for kidneys donated after circulatory death. The 3-year graft-survival advantage after machine perfusion was most pronounced for kidneys recovered from donors who had expanded criteria for donation[2] (86% vs. 76%; adjusted hazard ratio, 0.38; P=0.01) (see the figures in the Supplementary Appendix, available with the full text of this letter at NEJM.org). Delayed graft function had a profound effect on graft survival of kidneys donated after brain death (Fig. 1B). There were no significant between-group differences in the rate of survival of patients and serum creatinine levels at 3 years.

We conclude that 3 years after transplantation, the survival of kidneys donated after brain death remained significantly better after machine perfusion than after cold-storage preservation, especially in kidneys recovered from expanded-criteria donors. Delayed graft function was associated with a notably lower rate of graft survival

of kidneys donated after brain death. Despite the large reduction in delayed graft function by machine perfusion in kidneys donated after circulatory death that we reported previously,[3] we found no beneficial effect of machine perfusion on graft survival in this subgroup. This finding could suggest a different type of delayed graft function in kidneys donated after circulatory death, as compared with those donated after brain death.

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Disclosure forms provided by the authors are available with the full text of this letter at NEJM.org.

1. Moers C, Smits JM, Maathuis MH, et al. Machine perfusion or cold storage in deceased-donor kidney transplantation. N Engl J Med 2009;360:7-19.
2. Metzger RA, Delmonico FL, Feng S, Port FK, Wynn JJ, Merion RM. Expanded criteria donors for kidney transplantation. Am J Transplant 2003;3:Suppl 4:114-25.
3. Jochmans I, Moers C, Smits JM, et al. Machine perfusion versus cold storage for the preservation of kidneys donated after cardiac death: a multicenter, randomized, controlled trial. Ann Surg 2010;252:756-64.

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CORRECTIONS

Iron Overload in Human Disease (January 26, 2012;366:348-59). Several minor wording changes were made in Panel A of Figure 3 (page 356), and the following sentence was added to the legend: "Patients with a genetic diagnosis of hereditary hemochromatosis should have ferritin levels monitored and, if levels are more than 1000 ng per milliliter, should be considered for liver biopsy." The article is correct at NEJM.org.

Long Interdialytic Interval and Mortality (December 22, 2011; 365:2436-8). In the final paragraph of the authors' reply letter (page 2438), the fourth sentence, beginning, "For example," should have ended, ". . . as compared with 17.0, 19.4, 22.5, 17.7, 19.8, 19.1, and 18.0 in the TTS group," rather than ". . . as compared with 17.0, 22.5, 17.7, 19.8, 19.1, and 18.0 . . . ." We regret the error. The article is correct at NEJM.org.

The Signature Features of Influenza Pandemics — Implications for Policy (June 18, 2009;360:2595-8). In Panel D of the figure (page 2596), the time point for the far left tick mark on the x axis should have been December 1968, and subsequent time points should have spanned the period from January 1969 through May 1970, rather than January 1968 through May 1969. The article is correct at NEJM.org.

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