The Role of the Medical Toxicologist in Organ Transplantation

Lewis R. Goldfrank · Stephen P. Wall · Rama B. Rao

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In our roles both in our primary specialties and as medical toxicologists (LRG and RBR), we appreciate the importance and complexity of achieving an adequate quality and quantity of organs for those who are in need of transplantation. Approximately 110,000 Americans are on the waiting lists for organs despite annual removal of more than 10,000 of these individuals who either die or become too sick to receive transplantation.

A recent report from the Institute of Medicine emphasized the potential benefit from pursuing Uncontrolled Donation after Circulatory Determination of Death (UDCDD) as a means to substantially increase the pool of potential organ donors [1]. This approach is utilized extensively in Spain [2, 3] and France [4]. It involves rapidly initiated and prolonged high-quality resuscitations, and if despite such efforts, a determination of death is made, immediate institution of preservation measures ensues allowing the deceased to remain a candidate for organ donation. As most cardiac arrests occur outside the hospital, employment of UDCDD in these countries significantly reduced waiting lists for organ recipients, yet this approach is almost never used elsewhere.

In the USA, donation follows Neurologic Determination of Death (DNDD), Controlled Donation after Circulatory Determination of Death (CDCDD), and Live Donation.

Both DNDD and CDCDD almost invariably occur following care in hospital intensive care units. UDCDD, as practiced in France and Spain, would expand the pool of potential donors and organs available for transplant. Several UDCDD pilot projects have been initiated in the USA with funding from the Division of Transplantation of the Health Resources Services Administration [5]. One UDCDD study designed in New York proposed to employ extracorporeal membrane oxygenation (ECMO) in the emergency department to optimize organ preservation in the newly deceased, a similar strategy funded by the National Institutes of Health, is being tested in Michigan [5].

One of the major limitations to prehospital organ preservation is the low number of enrollees in Organ Donor Registries. The European approach has been that of preservation without need for prior consent and subsequent transplantation after informed consent is obtained from authorized parties, a concept which is not currently practiced nor supported in the USA [6, 7]. For UDCDD programs to be successful in the USA, citizens in each state must designate their donor status prior to death in a manner that is legally recognized as binding and dually executed. The establishment of centralized advanced directives can assist medical providers and family in the rapid initiation of preservation in hospital settings. For those dying in the Emergency Department (ED), if first-person consent does not exist, the model also permits the use of third-party consent as is employed in determinations following DNDD.

As toxicologists, we have a special role. Understanding that xenobiotics can lead to death is our field of expertise, just as is the knowledge that the initial resuscitation and supportive toxicologic care will usually lead to successful resuscitation. If despite our efforts, failure occurs, a deceased patient often can become a donor after neurologic

L. R. Goldfrank (✉) · S. P. Wall
Department of Emergency Medicine, Bellevue Hospital Center
and NYU School of Medicine,
New York, NY 10016, USA
e-mail: lewis.goldfrank@nyumc.org

R. B. Rao
NewYork-Presbyterian Hospital, Weill Cornell Medical College,
New York, NY 10065, USA

or circulatory determination of death. Although some tissue injuries associated with toxins such as acetaminophen will limit liver transplantation due to hepatotoxicity, most other organs in the same individual can be subsequently utilized [8]. Other examples such as carbon monoxide [9–12] or cyanide [13–17] poisoning may lead to transplantation of many organs following death. There are many available examples of detailed reviews on the subject of successful organ donation of corneas, hearts, kidneys, livers, lungs, pancreas, and skin following lethal poisoning from a broad spectrum of xenobiotics [18–22].

As toxicologists, we may advocate that our hospitalized patients receive donated organs as may occur following acetaminophen overdose. We must assure the highest ethical standards in our commitment to our patients, maintaining proper boundaries between the needs of the poisoned patients we attend, and the needs of potential transplant recipients where our unsalvageable patients can become potential donors. Our knowledge of the xenobiotic involved in the fatal poisoning and its impact on various organs will be of great value to assure that we can preserve the option of donation for those dying following overdose, just as we do for those dying from other causes whether intentional or unintentional. Ideally, protocols should be in place so that there is no potential or perceived conflict of interest when such decisions are made.

What is evident is that the current organ donation system in the USA allows 18 patients on the organ waiting list to die every day. Toxicologists have significant responsibility to discuss organ donation with our families, coworkers, and patients and to consider becoming organ donors, when culturally permissible, to set an example for those considering registration. Our personal involvement in education, innovative research, critical decision making, and altruism can make a substantial difference in expanding the pool of potential organ donors. Toxicologists can attempt to save lives by the current neurologic or circulatory determination of death approaches. But if we wish to advocate for all impacted by these untimely deaths, we need to consider supporting and offering insight into the effect of the toxin and collaborating with programs that can provide opportunities for donation in the emergency department regardless of whether death is from neurological determination, expected as in CDCDD, or unexpected as in UDCDD. We are skilled at resuscitation, and we can advocate for ED-based organ preservation techniques such as ECMO that may preserve the right of the deceased to fulfill a personal wish to become an organ donor, if registered previously, or may offer family a chance to provide positive meaning to an otherwise emotionally traumatic event. If successful, we can contribute significantly to the pool of solid organs for those in

desperate need, so that waiting for solid organs may become an anachronism.

References

1. Childress JF, Liverman CT (eds) (2006) Organ donation: opportunities for action. Committee on Increasing Rates for Organ Donation. Board on Health Sciences Policy. National Academies Press, Washington, DC
2. Fondevila C, Hessheimer AJ, Ruiz A, Calatayud D, Ferrer J, Charco R, Fuster J, Navasa M, Rimola A, Taura P, Gines P, Manyalich M, Garcia-Valdecasas JC (2007) Liver transplant using donors after unexpected cardiac death: novel presentation protocol and acceptance criteria. *Am J Transplant* 7:1849–1855
3. Sánchez-Fructuoso AI, Marques M, Prats D, Conesa J, Calvo N, Pérez-Contín MJ, Blazquez J, Fernández C, Corral E, Del Río F, Núñez JR, Barrientos A (2006) Victims of cardiac arrest occurring outside the hospital: a source of transplantable kidneys. *Ann Intern Med* 145:157–164
4. Fieux F, Losser MR, Bourgeois E, Bonnet F, Marie O, Gaudet F, Abboud I, Donay JL, Roussin F, Mourey F, Adnet F, Jacob L (2009) Kidney retrieval after sudden out of hospital refractory cardiac arrest: a cohort of uncontrolled non heart beating donors. *Crit Care* 13:R141
5. Wall SP, Kaufman BJ, Gilbert AJ, Yushkov Y, Goldstein M, Rivera JE, O'Hara D, Lerner H, Sabeta M, Torres M, Smith CL, Hedrington Z, Selck F, Munjal KG, Machado M, Montella S, Pressman M, Teperman LW, Dubler NN, Goldfrank LR (2011) NYC UDCDD Study Group. Derivation of the uncontrolled donation after circulatory determination of death protocol for New York city. *Am J Transplant* 11(7):1417–1426
6. Dubois JM (2009) Increasing rates of organ donation: exploring the Institute of Medicine's boldest recommendation. *J Clin Ethics* 20(1):13–22
7. Wall SP, Dubler NN, Goldfrank LR (2009) New York City Uncontrolled Donation after Cardiac Death Study Group. Translating the IOM's "boldest recommendation" into accepted practice. *J Clin Ethics* 20(1):23–26
8. Hantson P, Vekemans MC, Laterre PF et al (1997) Heart donation after fatal acetaminophen poisoning. *J Toxicol Clin Toxicol* 35:325–326
9. Hantson P, Vekemans MC, Squifflet JP, Mahieu P (1996) Organ transplantation from victims of carbon monoxide poisoning. *Ann Emerg Med* 27:673–674
10. Koerner MM, Tenderich G, Minami K et al (1997) Extended donor criteria: use of cardiac allografts after carbon monoxide poisoning. *Transplantation* 63:1358–1360
11. Shennib H, Adoumie R, Fraser R (1992) Successful transplantation of a lung allograft from a carbon monoxide poisoning victim. *J Heart Lung Transpl* 11:68–71
12. Smith JA et al (1992) Successful heart transplantation with cardiac allografts exposed to carbon monoxide poisoning. *J Heart Lung Transpl* 11:698–700
13. Brown PW, Buckels JA, Jain AB, McMaster P (1987) Successful cadaveric transplantation from a donor who died of cyanide poisoning. *Br Med J Clin Res* 294:1325
14. Hantson P, Squifflet JP, Vanormelingen P, Mahieu P (1999) Organ transplantation after fatal cyanide poisoning. *Clin Transpl* 13:72–73
15. Lindquist TD, Oiland D, Weber K (1988) Cyanide poisoning victims as corneal transplant donors. *Am J Ophthalmol* 106:354–355
16. Ravishankar DK, Kashi SH, Lam FT (1998) Organ transplant from a donor who died of cyanide poisoning. *Clin Transpl* 12:142–143

17. Swanson-Bieraman B, Krenzelok EP, Snyder JW et al (1993) Successful donation and transplantation of multiple organs from a victim of cyanide poisoning. *J Toxicol Clin Toxicol* 31:95–99
18. Rao RB (2010) Organ procurement from poisoned patients. In: Nelson LS, Lewin NA, Howland MA, Hoffman RS, Goldfrank LR, Flomenbaum NE (eds) *Goldfrank's toxicologic emergencies*, 9th edn. McGraw-Hill, New York, pp 479–480
19. Basu PK (1984–1985) Experimental and clinical studies on corneal grafts from donors dying of drug overdose: a review. *Cornea* 3:262–267
20. Hantson P, Vekemans MC, Squifflet JP, Mahieu P (1995) Outcome following organ removal from poisoned donors: experience with 12 cases and a review of the literature. *Transpl Int* 8:185–189
21. Hantson P, Vekemans MC, Vanormelingen P, De Meester J et al (1997) Organ procurement after evidence of brain death in victims of acute poisoning. *Transpl Proc* 29:3341–3342
22. Wood DM, Dargan PI, Jones AL (2003) Poisoned patients as potential organ donors: postal survey of transplant centres and intensive care units. *Crit Care (London)* 7:147–154