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Session Title : Multi-organ recovery video session

Kidney

Jeong Kye Hwang
The Catholic University of Korea Eunpyeong St. Mary's Hospital, Republic of Korea

Introduction[1] Brain death criteria were established by a committee at Harvard Medical School in the late 1960s and define an irreversible loss of brain and brainstem activity caused by extensive and irreversible central nervous system damage subsequent to trauma, hemorrhage, or infarction. Clinical criteria defining brain death include coma with cerebral unresponsiveness, apnea, absence of brainstem reflexes, and persistence of these conditions for 6–24 h. Brain death leads to considerable systemic changes, including the so-called autonomic storm, arterial hypo- and hypertension, massive coagulopathy, and abnormalities in electrolyte balance. A general understanding of the decedent's abnormal physiology is important to allow the surgeon to assess the conduct of the case and coordinate compensatory plans with the procurement team. **Profound effect of brain death** Judicious management of donor cardiac output, peripheral vascular resistance, and perfusion pressure determine the quality of organs from brain dead donors. Fluid resuscitation, inotropic support, and hormonal substitution are usually used for stabilization. The autonomic storm following brain death leads to a dramatic increase in plasma catecholamine levels. Moreover, brain death is associated with the so-called anterior and posterior pituitary failure, leading to dysfunction of the hypothalamic–pituitary axis. In addition, systemic and local inflammatory consequences following brain death have been increased extensively. i) a direct release of inflammatory cytokines from the ischemic brain and brainstem after brain death; ii) a secondary release from circulating lymphocytes and macrophages as a consequence of the catecholamine storm; iii) endothelial cell activation; iv) a bacterial translocation as a consequence of gut ischemia. ***Kidney*** Organ donors are at risk for renal failure from the prehospital events they suffered (e.g. trauma, hypotension, toxins), hospital events (e.g. sepsis, nephrotoxic agents such as antibiotics), or the treatment regimen they underwent (e.g. fluid restriction). Donors are at risk for multi-organ system failure with DIC and microthrombi formation in the kidneys as well. Procedures requiring intravenous contrast in deceased donors like cardiac catheterization may cause "contrast-induced nephropathy." Thus, aggressive adjunctive therapies directed at maintaining isovolemia, enhancing urine output, and providing protection from toxic effects might have some utility. The serum BUN, creatinine, and hourly urine output are monitored to give the best indication of the likelihood of kidney donation by a deceased donor. **Technical**

considerations of organ procurement in heart beating organ[1,2] ***General preparation*** Successful organ recovery requires close coordination between all surgical teams participating in the organ procurement process. The primary donor surgeon should introduce the procurement team to the operating room staff and briefly review the steps of the procedure with all participating teams so that recovery can proceed in a synchronized and expeditious manner. Cardiothoracic organs (heart and lung) are removed first as they are the most susceptible to I/R injury, followed by small bowel, liver, pancreas, and kidneys. ***Abdominal organs*** The organ procurement procedure can be divided into three main sequences:[3]

- Organ dissection with intact donor circulation
- In situ flushing through aortic infusion
- Back-table procedure.

There are two distinct techniques for the procurement of abdominal organs. First, the "rapid perfusion technique with dissection in the cold," which reduces operating time and is recommended for hemodynamically unstable donors and when procuring organs from circulatory death donors (DCD). In this approach, the abdominal aorta is isolated and cannulated, with no further dissection until core cooling of the organs is achieved in situ. The aim is to minimize organ ischemia by rapid aortic cannulation, exsanguination, and cold perfusion. Second, in the standard "warm dissection technique" an anatomical dissection is performed prior to cannulation and perfusion. Some evidence suggests that this technique is associated with more parenchymal and vascular damage due to vasospasm, potentially leading to inferior initial graft function. A recovery period of 30–60 min after dissection might be able to reverse some of these adverse effects. Dissection in the cold on the other hand might be complicated by a more challenging anatomy. Irrespective of the technique, multi-organ procurement should be performed meticulously such that all organs can be removed without being compromised. The basic principles of the donor operation include dissection of the great vessels of the chest and abdomen, isolation of the aorta in preparation for cross-clamping, perfusion and core cooling in situ, and rapid recovery to prevent ischemia. ***Kidney procurement[4]*** If the pancreas is not to be recovered, the duodenum and pancreas are mobilized to the left side to expose the IVC, aorta, right kidney, and right ureter. When the pancreas is recovered, the retroperitoneal organs may be more easily exposed. The right ureter is visible at the level of the right common iliac artery and dissected and transected near the bladder. The tip of the right ureter is held with mosquito forceps. In the same manner as in the right ureter, the left ureter is dissected after the mobilization of the descending and sigmoid colons. Thereafter, both ureters are proximally dissected while preserving the peri-ureteric vessels and tissues. Of note, the lower polar artery should be preserved to prevent ureteric complications such as stricture and leakage. After ureter dissection, the aorta and IVC are transected at the iliac bifurcation level and are pulled upward with mosquito forceps to separate them from the lumbar spines. Afterward, the proximal ends of the aorta and IVC are transected and separated from the lumbar spines. The en bloc kidneys are recovered after the dissection of the retroperitoneal neurofibrous tissues (Fig. 1). **Fig.1. The two kidneys are removed en bloc with the cava and aorta. The lateral attachments of the kidney is divided, and the ureters are traced caudally and transected distally near the bladder junction (A). The aorta and inferior vena cava are divided at their bifurcations. The ureters and these vessels are retracted cephalad and anteriorly, along with the two kidneys (B), and dissection proceeds along their posterior aspects, anterior to the surface**

of the vertebral bodies and psoas muscle (C). The kidneys are placed en bloc in a cold preservation solution and separated on the back table. The left renal vein is dissected at its junction with the IVC. The aortic wall is then divided longitudinally with the inspection of the renal artery orifices from within the aortic lumen (Fig. 2). The posterior aortic wall is then divided between the renal artery orifices. This completes the division of the right and left kidneys **Fig.2. The left renal vein is identified and divided at its junction with the inferior vena cava. The aortic wall is divided longitudinally down its center aspect, which allows for inspection of the renal artery orifices** **Reference** 1 Kirk, A. *Textbook of organ transplantation*. (John Wiley & Sons, Inc., 2014). 2 Humar, A., Payne, W. D. & Matas, A. J. *Atlas of organ transplantation*. (Springer, 2006). 3 Nickkholgh, A. *et al.* Intestinal transplantation: review of operative techniques. *Clin Transplant* **27 Suppl 25**, 56-65, doi:10.1111/ctr.12190 (2013). 4 Hwang, H. P. *et al.* Organ procurement in a deceased donor. *Korean J Transplant* **34**, 134-150, doi:10.4285/kjt.2020.34.3.134 (2020).