

In situ and Ex situ Extended Normothermic Machine Perfusion in Donation after Cardiac Death in Liver Transplantation.

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Introduction

Despite Spain's high organ donation rates, approximately 30% of livers are discarded, and around 10% of patients on the transplant waitlist are lost due to clinical deterioration. Donation after Circulatory Death (DCD) offers a promising solution, yet uncontrolled DCD (uDCD) remains underutilized. Normothermic regional perfusion (NRP) allows in situ organ viability assessment, while ex situ normothermic machine perfusion (NMP) can extend preservation time and improve functional evaluation. Although experience is limited, prolonged ex situ perfusion may enable organ reconditioning prior to transplantation.

Methods

Following ethical approval, we evaluated the feasibility of maintaining viability in livers deemed unsuitable for transplant by extending ex situ NMP beyond 24 hours. Grafts were perfused using the Perlife[®] system. The study included grafts from controlled donors and from uncontrolled donors maintained with normothermic regional perfusion (NRP). After procurement, grafts were assessed intraoperatively and transferred for NMP. Perfusion employed a blood-based circuit supplemented with anticoagulants, electrolytes, nutrients, and antibiotics, along with continuous veno-venous hemodialysis (CVVHD) for homeostasis. Liver viability was monitored through biochemical, hemodynamic, and histopathological parameters, assessed at baseline and at 8-hour intervals. Perfusion was stopped upon meeting predefined failure criteria.

Results

The livers were successfully maintained for 58 and 91 hours, respectively. The first case involved a young male cDCD donor with a cold ischemia time of 540 minutes; perfusion was halted due to hemodynamic instability, revealing histopathology showing variable coagulative necrosis, minimal steatosis, and biliary alterations. The second case involved a young male uDCD donor with a 630-minute cold ischemia; perfusion was discontinued due to worsening hemodynamic parameters, with histopathology demonstrating progressive sinusoidal congestion, edema, necrosis, and portal vein congestion over time.

Conclusions

Prolonged ex situ NMP with the PerLife[®] system is technically feasible and can sustain liver viability beyond 24 hours. This proof-of-concept suggests that previously non-transplantable DCD livers may be reconditioned for transplantation or therapeutic research, potentially increasing donor organ utilization and expanding the donor pool.