Proof of concept of a new option to preserve and evaluate kidney grafts from cadaveric donors: en-bloc dual kidney specimen hypothermic oxygenated machine perfusion model from an animal DCD.

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Background

Increasing use of donors after cardiac death (DCD) lead to a new interest in organ perfusion. Sometimes in case of unavailability of multiple systems for organ perfusion or in case of contemporary multiple donors some organ could be statically cold stored instead than perfused possibly determining impaired function. Here we present a hypothermic oxygenated machine perfusion applied to an en-bloc dual kidney retrieved from an animal (pig) DCD model.

Methods

After the pig was dead, abdominal organs bloc was retrieved. After separation of the liver and pancreas, the bloc, composed by kidneys, aorta and inferior vena cava was prepared at the back-table and perfused with perfusion solution (Celsior 1l) added with heparin (10.000UI).

Back-table surgery consisted in accurate ligation of collateral branches from aorta and inferior vena cava, ligation of perirenal fat, proximal aortic stump ligation and distal aortic stump cannulation (Fig 1a). Perfusion was performed with PerKidney machine perfusion (PerLife, Aferetica s.r.l, Bologna, Italy). During the hypothermic oxygenated perfusion was set a target pressure (P) of 50 mmHg and a target flow (F) of 100ml/min. Normothermic perfusion, intended as a simulation of transplant, was performed setting a target P of 75 mmHg and a target F of 500ml/min.

Fig.1a. Backtable surgery: ligation of branches from aorta and inferior vena cava. Proximal aortic stump ligation and distal aortic stump cannulation

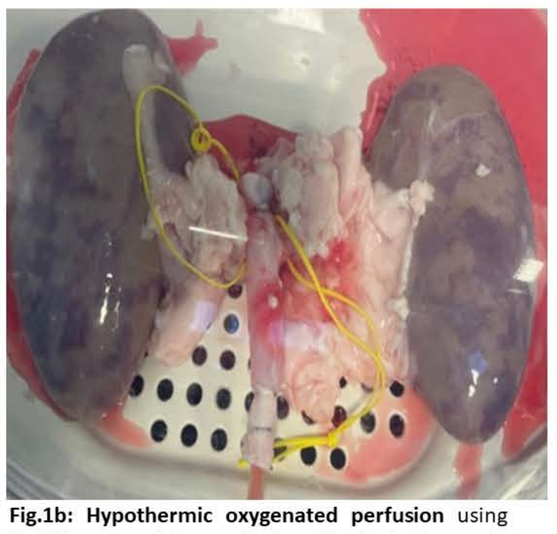

Fig.1b: Hypothermic oxygenated perfusion using PerKidney machine perfusion. Gradual change in color..

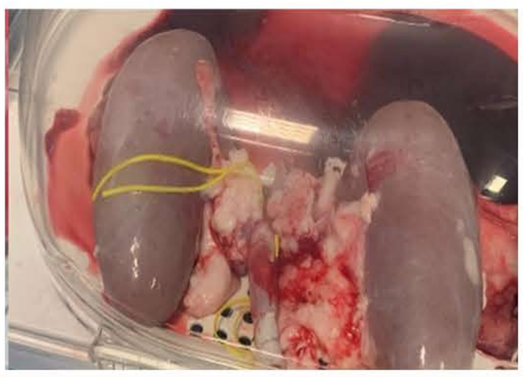

Fig.1c: Hypothermic oxygenated perfusion using PerKidney machine perfusion at steady state after 15 minutes.

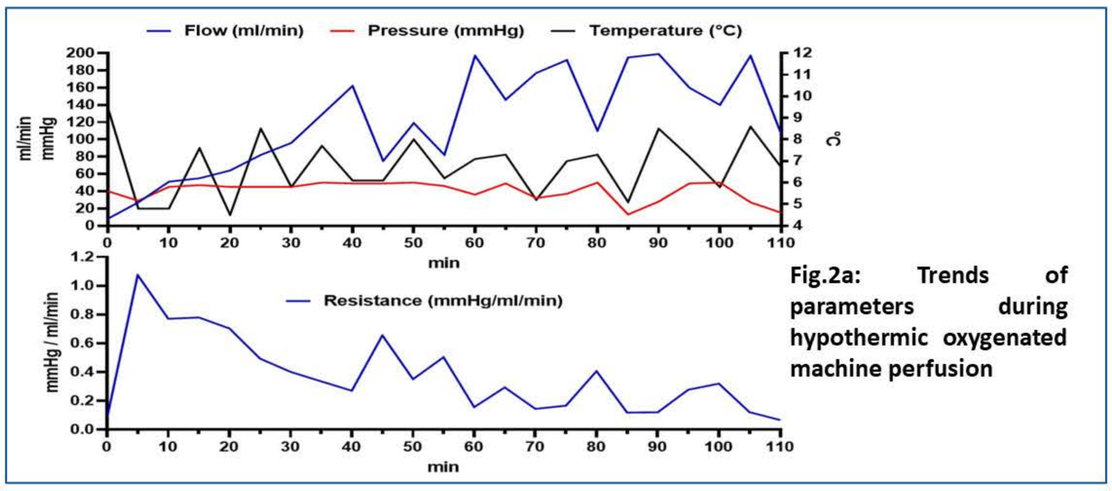

Fig.2a: Trends of parameters during hypothermic oxygenated machine perfusion

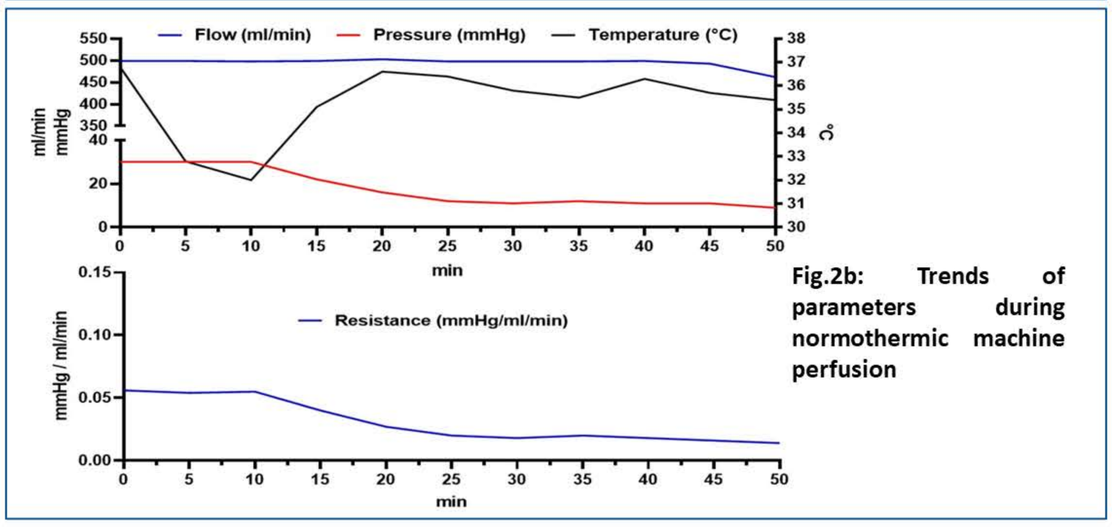

Fig.2b: Trends of parameters during normothermic machine perfusion

Results

No-flow period lasted 35 min. Back-table surgery lasted 27.5±3.5 min. Hypothermic perfusion lasted 110 min: mean temperature (T) during perfusion was 6.8±1.4 °C, mean F was 120.4±58.7 ml/min, mean P was 40.3±11.2 mmHg and mean resistance (R) was 0.37±0.26. R started at 1.07 constantly dropped down and concluded after 55 min at 0.06. Trend of parameters during hypothermic perfusion are reported in figure 2a. Normothermic perfusion lasted 49 min: mean T was 35.3±1.5 °C, mean F was 495±11 ml/min, mean P was 18±8 mmHg and mean R was 0.031±0.016. R started at 0.05 stably dropped down after 10 min at 0.01. During perfusion, kidneys gradually changed in color (Fig 1b-1c). Trends of parameters during normothermic perfusion are reported in figure 2b.

Conclusion

In this preliminary proof of concept on a large animal model, dual kidney en-bloc perfusion appears feasible. Decreasing of R, maintenance of F and P, changing in color and urine production are favorable characteristics supporting this option, potentially useful in case of lack of devices and contemporary donations. Larger experience is needed for precise setting of parameters during the perfusion, surgical preparation and setting of a standardized method to evaluate single parameters of each kidney of the en-bloc dual specimen.