MEASUREMENT OF REGIONAL PERFUSION AND OXYGEN SATURATION DURING HUMAN SIMULTANEOUS PANCREAS-KIDNEY TRANSPLANTATION – CORRELATION WITH INTRAVITAL MICROSCOPY

J.M. Fertmann, H. Arbogast, E. Sajzewa, A. Tarabichi, W.D. Illner, W. Land and J.N. Hoffmann

Division of Transplant Surgery, Department of Surgery, Klinikum Grosshadern,
Ludwig-Maximilians-University Munich, Germany

Purpose

In the current study we evaluated the combined use of flow-coded ultrasound (FCU) and near-infrared Laser-Doppler flowmetry (NILDF) with Remission spectroscopy (RS) for measurement of regional perfusion and oxygen saturation (Oxygen2see, LEA Medizintechnik, Germany) of the reperfused kidney and pancreas during allogenic Kidney Tx and simultaneous pancreas-kidney transplantation (SPK).

Patients and Methods

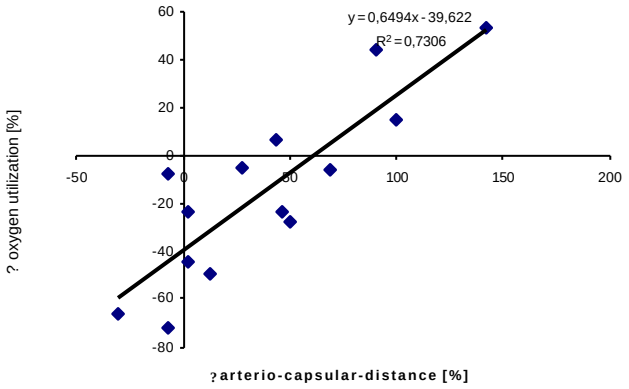
- A total of 15 patients was studied (10 male/ 5 female).
- The flat probe for combined measurements of NILDF and RS was placed above the transplanted organs after reperfusion at 2min, 5min, 10min, 15min and 30min. Laser-light dopplershift caused by moving erythrocytes is used to record blood flow and velocity. White-light absorption by hemoglobin serves to measure relative Hb-concentration (rHb) and oxygen saturation (SO_2).

Fig.1: (left) Oxygen2see device with combinedNILDF/RS probe, (right) Cytoscan device with probe

- Simultaneously, flow-coded ultrasound measurements were performed (Wingmed, Israel). Kidney arterio-capsular distance (ACD) was determined.
- Intravital microscopy (Cytoscan, Cytometrics, USA) was selectively used.

Results

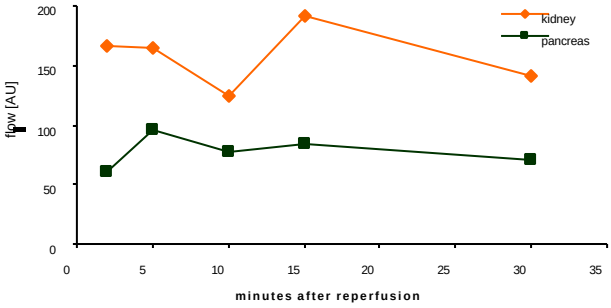
Fig.2: Correlation between oxygen utilisation(NILDF) and kidney ACD (FCU) in patients with kidney Tx and SPK (?% vs. 30min)



* *p<0.01 (Pearson coeff. 0.855)*

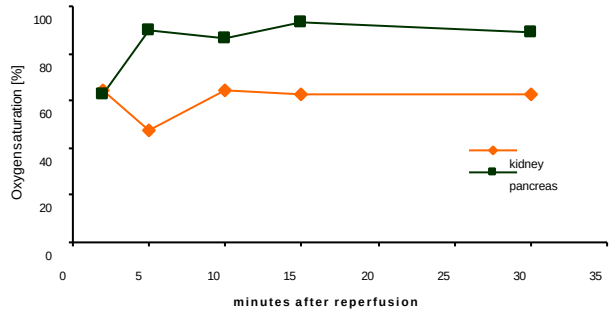
- Reperfusion parameters measured by NILDF/RS correlated well with ACD assessed by flow-coded ultrasound.
- Changes in oxygen utilisation showed the most significant correlation ($p<0.01$) in linear regression analysis. With decreasing perfusion and subsequently higher ACD values, an increase in oxygen utilisation was observed.

Fig. 3: representative flow curve of Tx-kidney and –pancreas during reperfusion

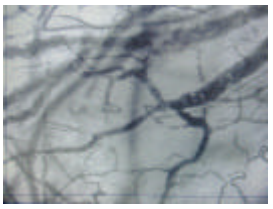


- Our preliminary results show a distinct pattern of reperfusion that was mainly due to specific organ architecture (high flow organ vs. low flow organ) (Fig.3).
- Interestingly, reperfused pancreas allografts tended to have a higher oxygen saturation as compared to reperfused kidneys (Fig. 4).

Fig. 4: representative oxygen saturation of Tx-kidney and –pancreas during reperfusion



- Intravital microscopy was shown to be technically difficult on kidney surfaces, since it can only be used after local kidney decapsulation that correlated with subsequent bleeding.



- On the pancreas surface, intravital microscopy is feasible (Fig. 5). Changes in microcirculation can be elegantly observed during reperfusion in vivo. To allow valid conclusions on I/R injury, more patients should be studied.

Fig. 5: Sample intravital microscopy scan of pancreas reperfusion

Conclusions

- The combined use of NILDF and RS allows continuous and non-invasive monitoring of organ reperfusion and oxygen metabolism during allogenic simultaneous pancreas-kidney transplantation, and may be a tool to estimate I/R-injury in vivo.
- Since alterations in regional perfusion are reflected by NILDF and FCU with a high correlationship, both methods could be used to quantify microcirculatory changes.
- Intravital microscopy could allow to visualize ischemia/ reperfusion injury also in the transplant setting. Observed differences in local organ perfusion could be due to differences in the duration of ischemia, changes in macrohemodynamics (mainly during pancreatic reperfusion), and use of protective agents. Further measurements are needed to draw valid conclusions.