ORGANS FROM DCD (M1 & M2) REANIMATED WITH HPP + O_2 AND TESTED BY MAGNETIC RESONANCE IMAGING

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The necessity of a specific treatment for kidneys from DCD ? YES : THE PERFUSION! As demonstrated :

Phase I : NHBD Maastricht III
(immediate cannulation after cardiac arrest)

Phase II : NHBD Maastricht II (without perfusion)
(DBTL ; 30' absence of circulation ≠ WI)

Phase III : NHBD Maastricht II (with perfusion)
(DBTL ; 30' absence of circulation ≠ WI)

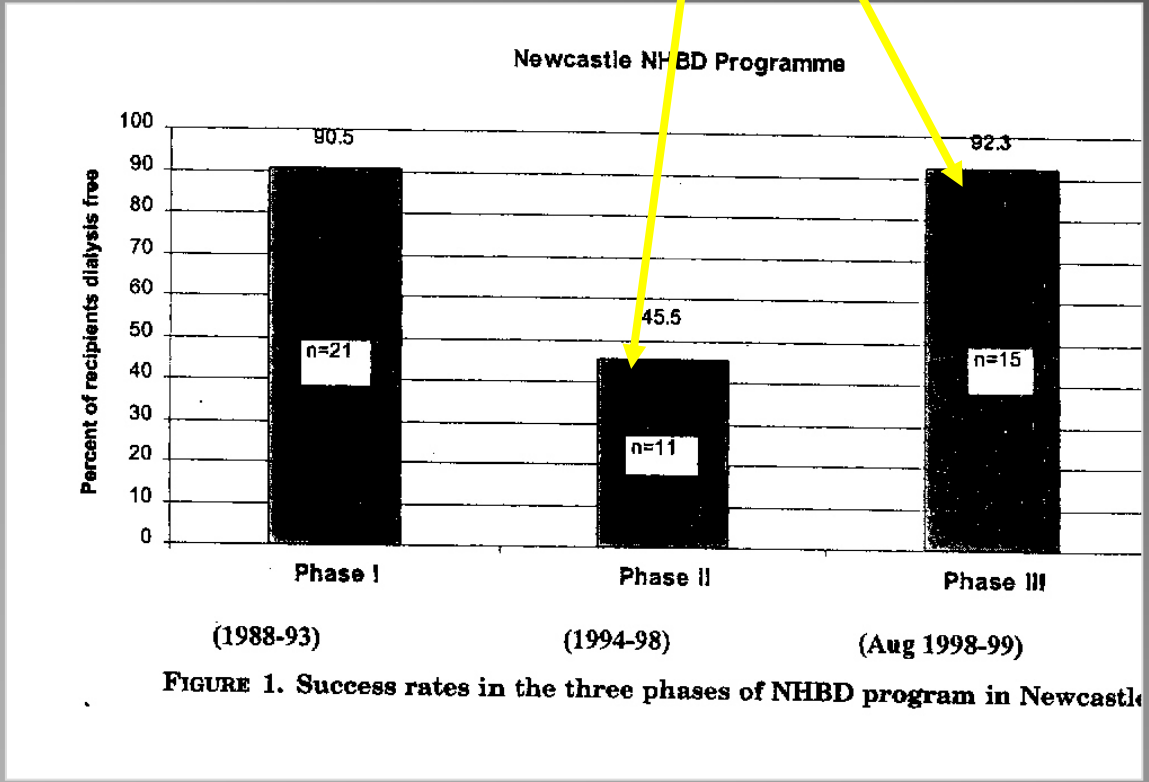

FIGURE 1. Success rates in the three phases of NHBD program in Newcastl

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What we can do and what we know in the reanimation of those organs ?

1. We conduce their reanimation with HPP + O_2 which is necessary for marginal organs.

2. We control it through Magnetic Resonance Diagnosis.

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FOR MARGINAL ORGANS EVALUATION : THE ONLY WAY IS PERFUSION

The Geneva's technique of perfusion for marginal organs follows an International consensus.

- Hypothermic perfusion (2° – 4 ° C)
- Pulsatile perfusion (max. Syst. P. < 50 mmHg/ Dia. P. 15 mm Hg)
- Optimization of flow (0.5 ml/g/min) (lower is probably enough)
- pO2 : 500 mmHg : ≥100 kPa (lower in study)
- Duration of perfusion : 8 H.
- Perfusion medium : UW-MP
- Biological and perfusionnal tests: **REPLACED BY NMR TESTS**

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Because of NMR we have to use a MRI compatible technology

That means

1. Compatibility of the materials with magnetic fields
2. Compatibility with the technology of perfusion
3. Compatibility with geometry & physic of the MRI machine

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OUR MOBILE PERFUSION MACHINE MR COMPATIBLE
[Magnetic field (3T) + usable size of the bore (45 cm Ø)]

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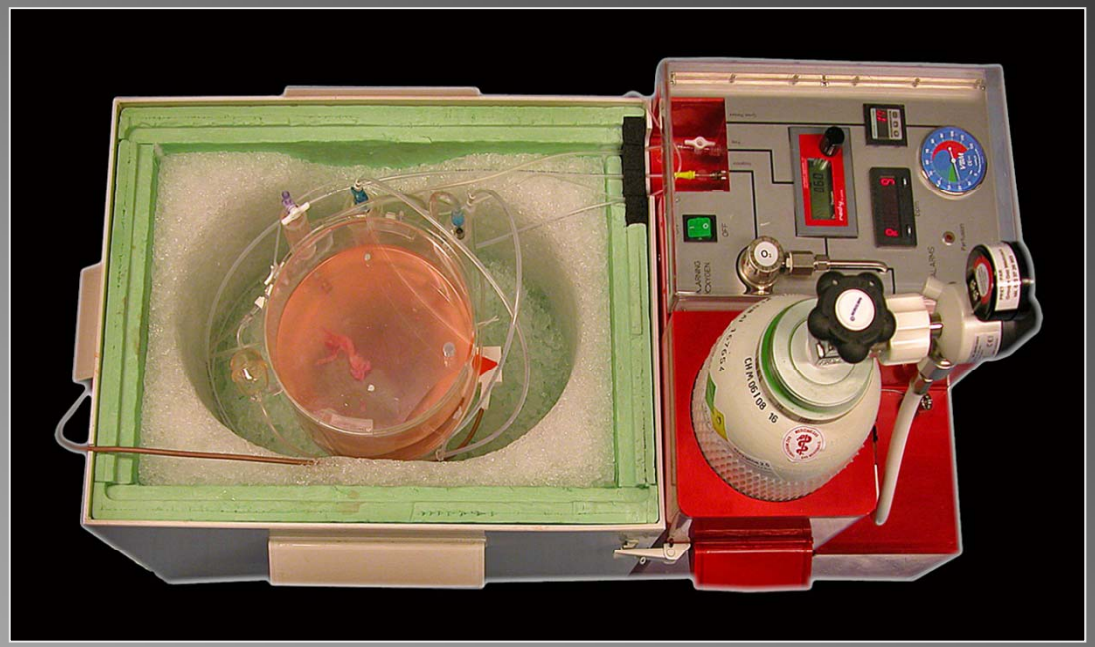
8 h. of Perfusion are necessary for the reanimation of MI, MII (and MIII with expended criteria kidneys).

AFTER 8 H., DURING PERFUSION :

MR IMAGING AND SPECTROSCOPY ARE REALIZED.



^{31}P NMR spectroscopy to define the viability of the organs:

ATP production.

T2 sequence for tumor research and other major pathology.

Gadolinium perfusion sequence to establish the intra renal circulation.

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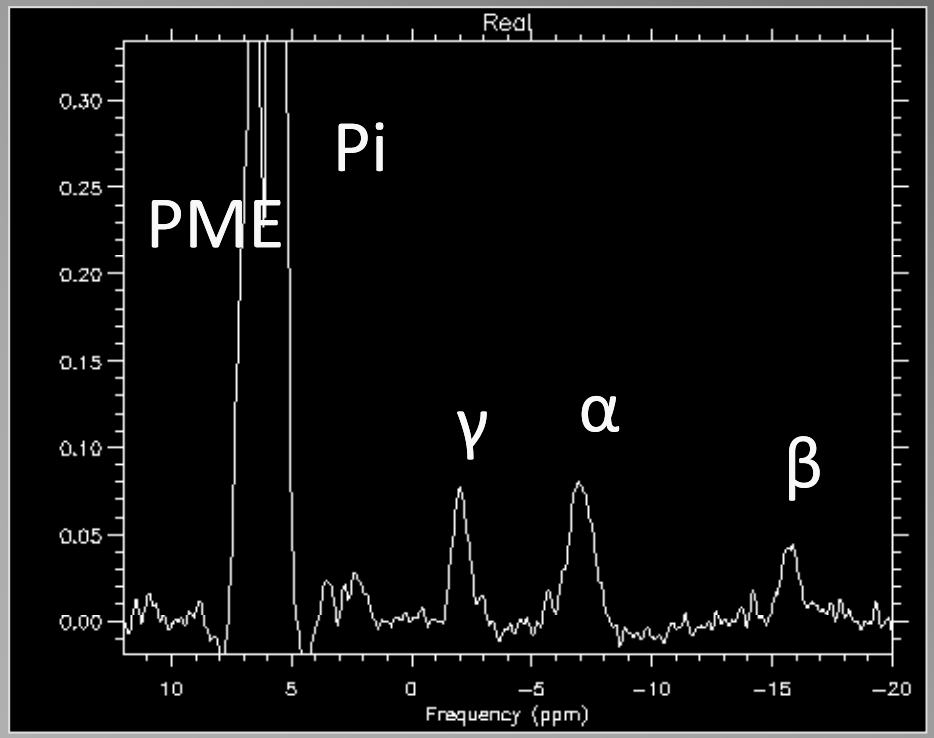
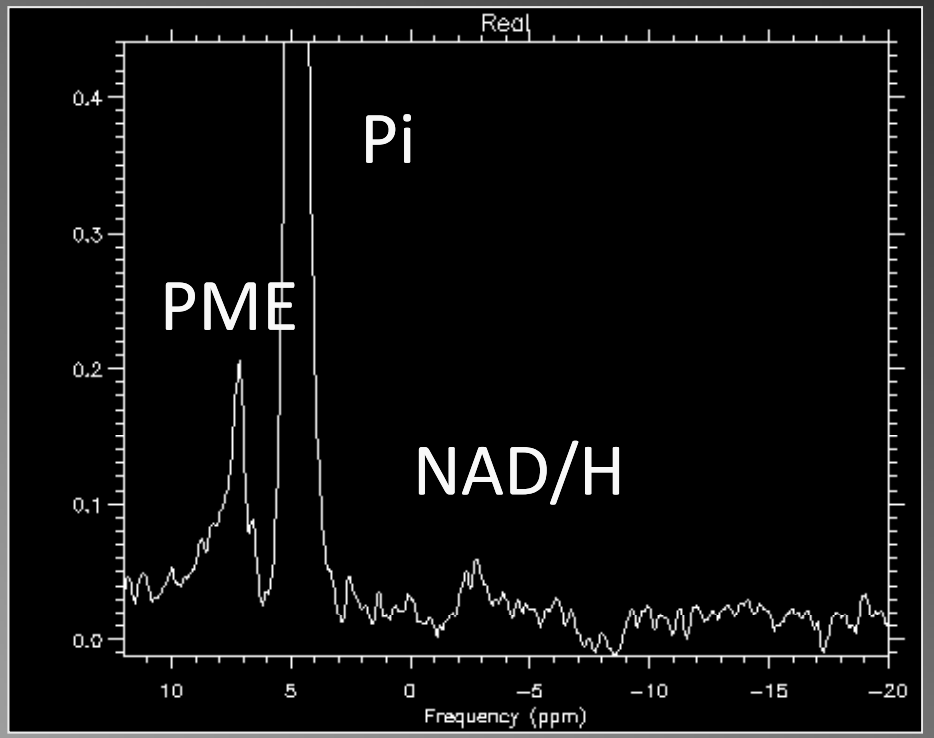
THE ABSOLUTE EVIDENCE OF VIABILITY

ATP PRODUCTION IN THE KIDNEY AT 3° C DURING PERFUSION
(^{31}P CSI NMR spectroscopy)





pO2: ≥ 100 kPa

pO2 :< 50 kPa

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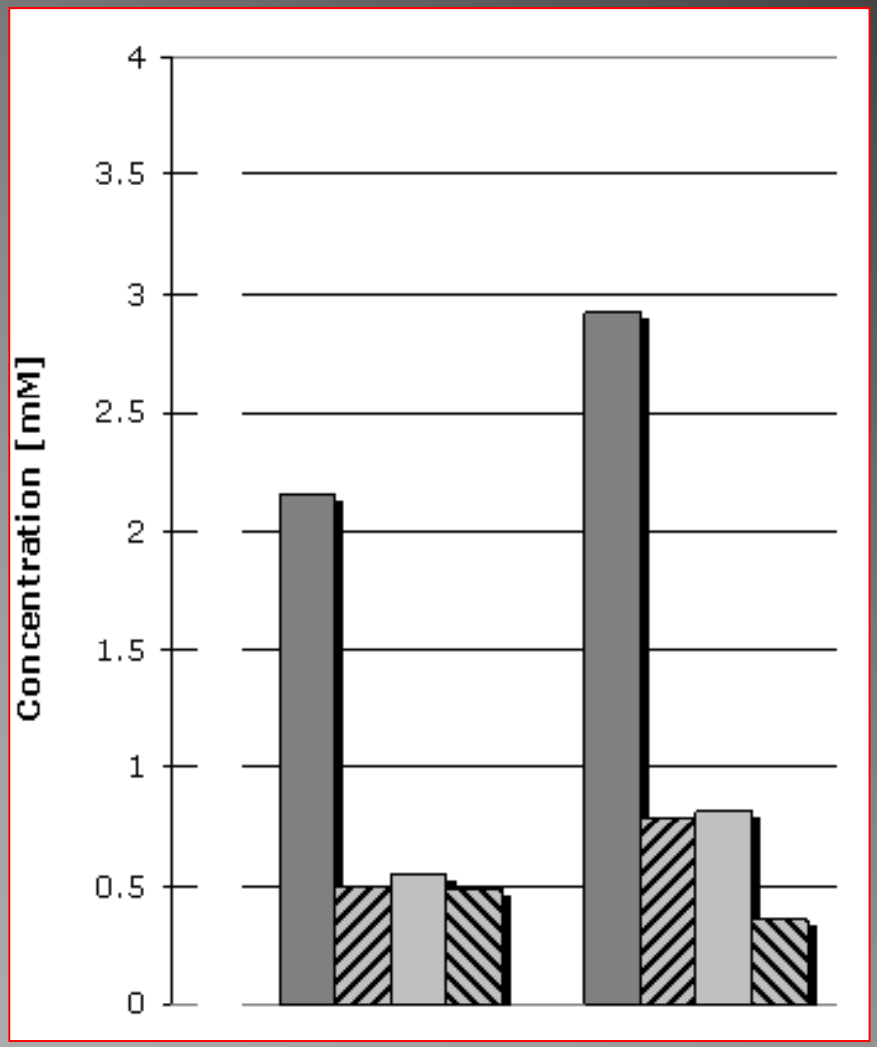
ATP PRODUCTION AS VIABILITY TEST

example, (LK) immediately perfused (30' WIT)



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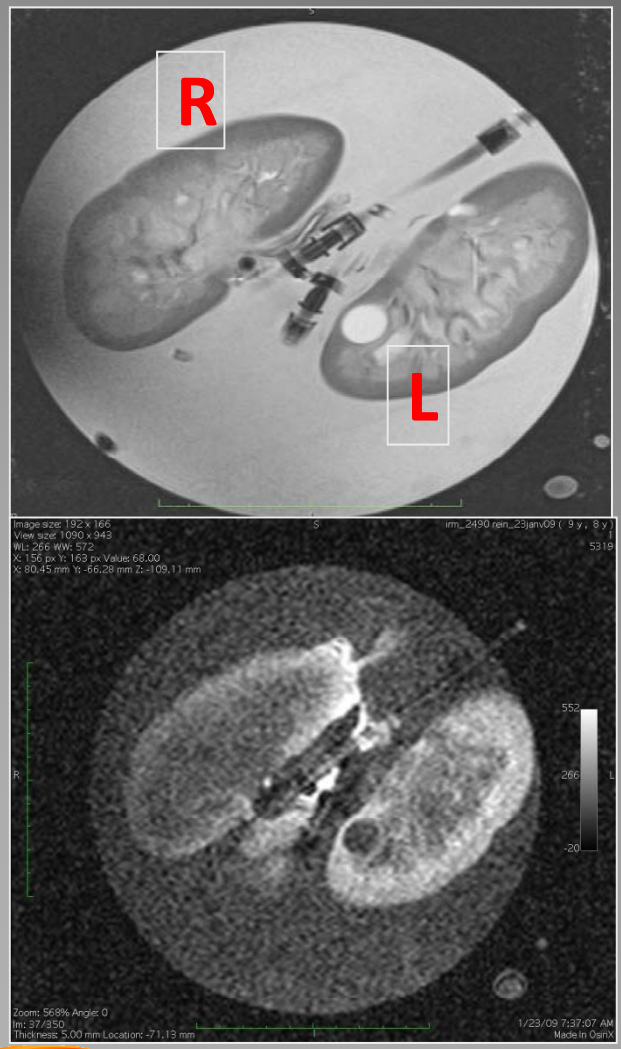
T2 sequence (resolution : 2 – 3 mm)

Research of a major pathology



Gd-perfusion

Incidence of small tumors in elderly patients
(more than 50 years old)

- 50 % of kidneys have a cystic tumor of < 3 cm 15 % of malignant tumors are cystic.

  Charlier E. et al. Prog Urol 1997;7(3):484-495

- In Europa Kidney Cancer is the 6th in frequency

- Secondary cancer in kidney is very frequent specially regarding the small size tumors.

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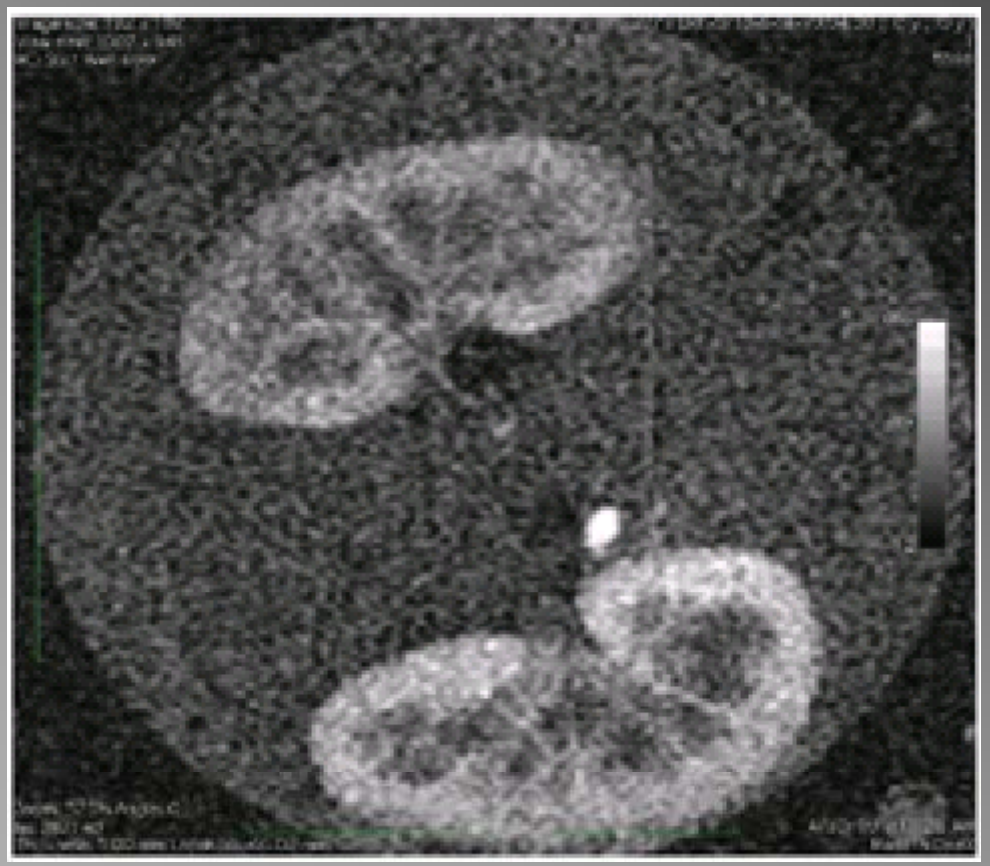
KIDNEY FUNCTION' PRONOSTIC : the Gd-perfusion sequence to visualize the intra renal circulation



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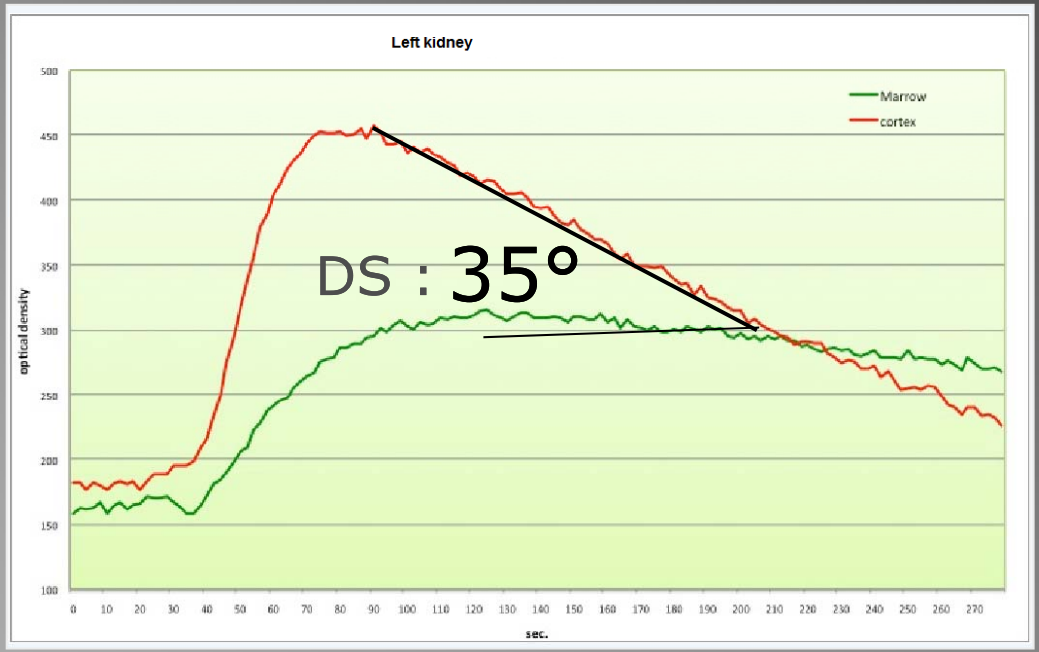
Osirix® analysis of Gd-perfusion: the cortical elimination of Gd measured by the Descending Slope (DS)



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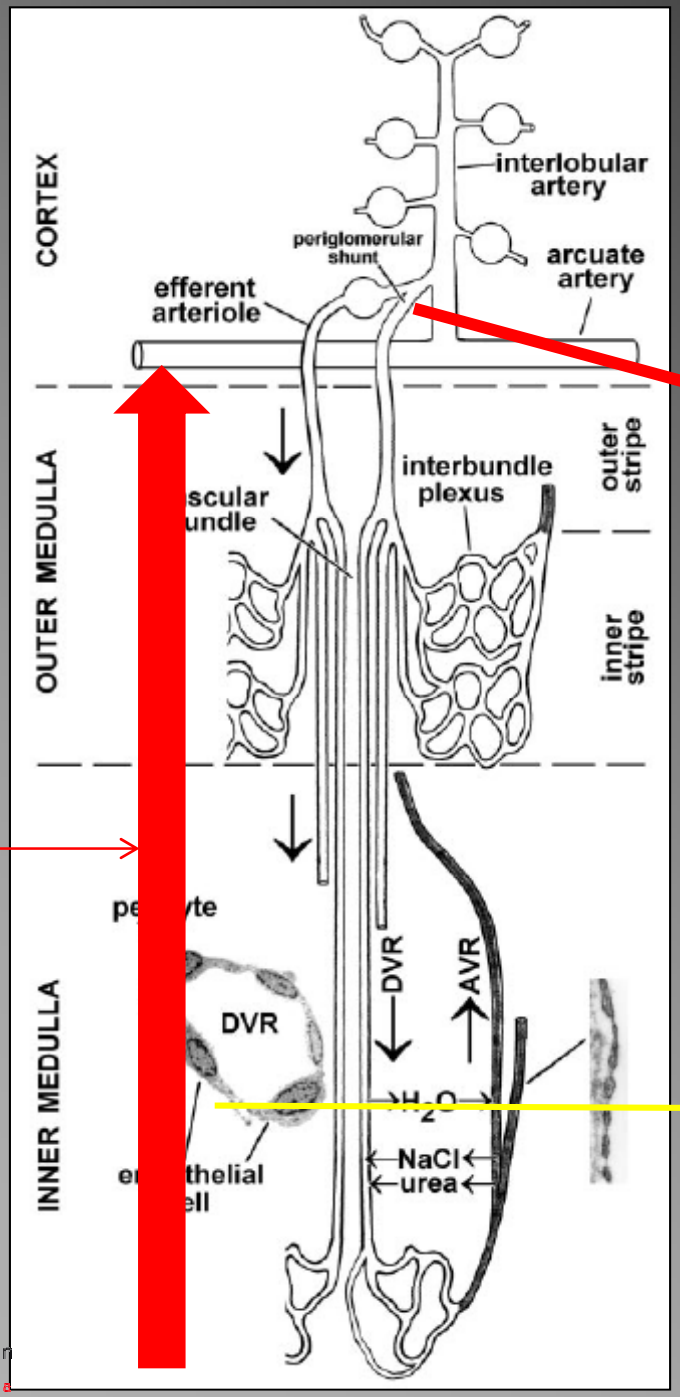
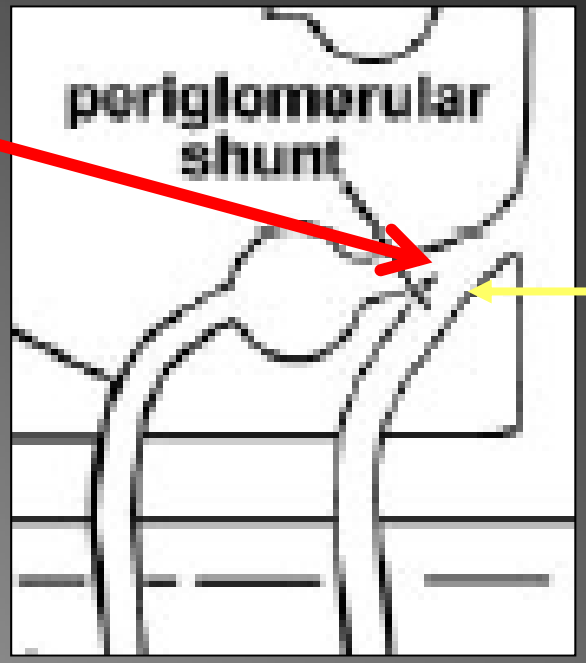
The intra renal microcirculation



Renal artery



NO

After T.L.Pallone
Am.J.Physiol.Renal Physiol.
284; 253-266;2003

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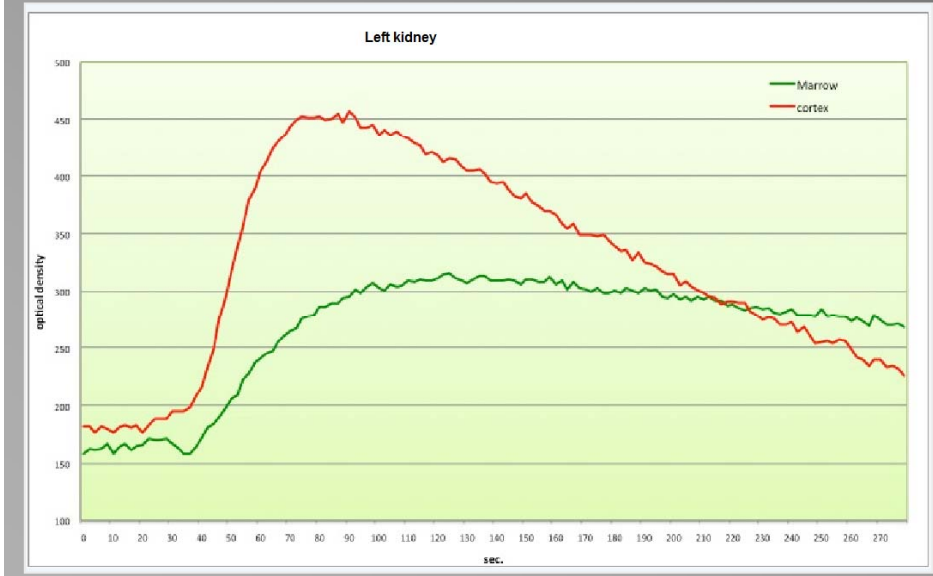
The Pallone' shunt effect may be observed during oxygenated HP Perfusion in case of probable DGF after transplantation.

no shunt



shunt

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HOW TO PROOVE THE VALIDITY OF THE **M R** EVALUATION ?

The kidneys from these experiments have been tested following the international histological score generally used for evaluation of viability.

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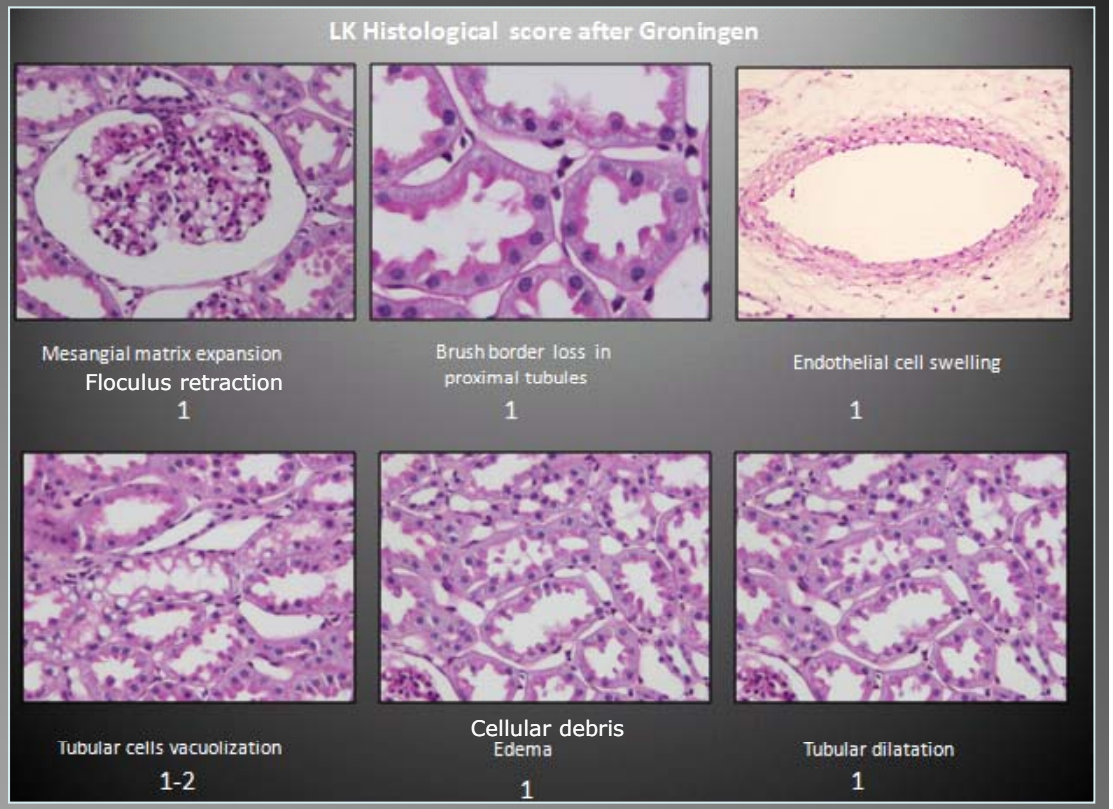
Histology of the kidney GGGP score

here after 20 h of perfusion

a. Retraction of the floculus
b. Mesangial matrix expansion
c. Brush border loss in proximal tubule
d. Edema
e. Tubular dilatation
f. Tubular cell vacuolization
g. Endothelial cell swelling
h. Lumina of tubules filled with cellular debris



Score : 1 None
2 Medium
3 Severe

Score: 9 (best possible:8)

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NMR score

established during perfusion

(necessitates 2 hours)

correlates with

Histological score
(that can be obtained
in best situation only after 48 hours !)

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CONCLUSION

NMR score can be used as an absolute criterion
to test the marginal organs.

Where is the precise cut-off between can be and cannot be grafted ?

That is the aim of our next researches

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A MULTIDEPARTMENTAL RESEARCH PROGRAM

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Mr. R. Ruttimann : Visceral Surgery Service. Geneva
Prof. L. Buhler : Visceral Surgery Service. Geneva

PhD, PD F. Lazeyras : Department of Radiology (CIBM). Geneva

Dr. PD S.Moll : Pathology Department . Geneva

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