LETTER TO THE EDITORS

Low-pressure machine perfusion of the kidney: role of colloidal support

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Dear Editors,

Hypothermic machine perfusion (HMP) has become a more and more established technique for the preservation of renal organ grafts. Several clinical studies have recently shown HMP to be associated with reduced rates of delayed graft function (DGF) and improved graft survival as compared to static cold storage [1,2].

Since renal machine perfusion has historically often been performed at perfusion pressures of 50–60 mmHg [3,4], the used perfusion solutions always contained colloidal substances that were necessary to prevent tissue edema along with the ongoing perfusion.

However, newer experimental research has argued in favor of a drastic reduction of perfusion pressures upon HMP from 60 mmHg to approximately 30 mmHg as being associated with significantly less endothelial damage and pro-inflammatory activation, while still promoting optimal reno-protection during preservation [5]. Accordingly, low-pressure perfusion has found its way into clinical practice [6,7]. We thus readdressed the technical necessity of colloids to maintain adequate vascular conductance in kidney perfusion, if done at low perfusion pressure.

Isolated pig kidneys were subjected to HMP for 20 h in a Lifeport® kidney transporter at a pulsatile pressure of 30/20 mmHg as described earlier, using Custodiol-N solution as a perfusate [8]. The principles of laboratory animal care (NIH publication no. 85-23, revised 1985) were followed.

In one group (MP + dex; $n = 5$), 50 g/l dextran 40 (MW 40 000 Da; AppliChem, Darmstadt, Germany) was added for colloidal support. Another group (MP; $n = 5$) was perfused with Custodiol-N solution without colloidal support. Kidneys that were simply cold-stored (CS) in Custodiol-N served as controls.

Renal perfusate flow during low-pressure hypothermic machine perfusion did not show differences between the two groups (30 ± 6 vs. 28 ± 7 ml/min after 1 h and 38 ± 6 vs. 35 ± 6 ml/min after 20 h of HMP; MP versus MP + dex, mean ± SD, resp.).

In both groups, we noted a slow and comparable increase of renal flow upon pressure constant perfusion from start to end of HMP. It thus appears rather unlikely that renal perfusion would be compromised by an increased edema development during noncolloidal perfusion.

The individual graft weight ratio after and before machine perfusion upon colloid-free versus colloid-containing perfusion averaged to 1.3 ± 0.1 in both groups.

Upon warm reperfusion in a standardized model [9], renal vascular flow did not show relevant variations over time. Cold-stored kidneys generally had lower flow values than kidneys after machine perfusion, although

Table 1. Renal function upon reperfusion.

	Renal flow (ml/min)	$Clearance_{crea}$ (ml/min)	$Clearance_{urea}$ (ml/min)	FENa (%)
CS	196 ± 44	3.1 ± 0.5	2.8 ± 0.5	68 ± 7
MP	259 ± 44	8.2 ± 2.0*	6.1 ± 1.4*	32 ± 11*
MP + dex	252 ± 34	7.7 ± 0.9*	6.7 ± 0.7*	39 ± 8*

Values expressed as means ± SEM of five experiments per group.

*$P < 0.05$ versus CS by parametric comparison of the means using INSTAT 3.01 (Graph Pad software Inc, San Diego, CA, USA).

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this difference did not quite reach statistical significance.

By contrast, HMP resulted in significant improvement of renal clearance and tubular cell function as judged by calculation of the fractional excretion of sodium (FE Na%) in comparison with simple cold storage (cf. Table 1). No effect was found concerning the addition of dextran to the machine perfusate.

It has to be kept in mind that implementation of one or the other colloidal substance might be advisable for other reasons than to prevent tissue edema, that is, specific pharmacodynamic properties of the substance. However, within the limits of this model, renal function after reperfusion in vitro was protected as effectively with as without addition of dextran as a colloid and it could be shown that overnight perfusion preservation with noncolloidal solution is possible at low perfusion pressure in hypothermia.

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Conflicts of interest

The authors have declared no conflicts of interest.

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