# UREA TRANSPORT IN KIDNEY OF SHEEP

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## Introduction

It is well known about ruminants that urea returned by the kidneys to blood circulation can be utilized in protein synthesis via urea recycling through digestive tract. The previous results from our laboratory demonstrated the capability of sheep kidney to significantly increase the tubular transport capacity for urea reabsorption under certain conditions (Leng et al., 1985). It was suggested (Goldberg et al., 1967) that urea transport in kidney derives the energy supply from anaerobic metabolism. Our experiment was designed to test the effects of iodoacetate, on inhibitor of anaerobic glycolysis, on the urea transport in nephron segments of sheep kidney.

## Materials and Methods

Young sheep of b.w. 18-21 kg were in closed circuit halothane anaesthesia surgically prepared for micro-puncture free-flow collections of tubular fluid from the left kidney (Knox and Gasser, 1974). The control group of animal (n=8) was given infusion of 0.15 mol NaCl into the left kidney in a rate 0.2 ml/min and the experimental one (n=7) was given iodoacetate 0.1 mmol/min/kg of b.w. for two hours. Inulin was infused to v. saphena. Clearance and micropuncture measurements were carried out during 2nd hour of infusion. Inulin and urea in plasma, urine and tubular fluid were determined by fluorometric methods of Vurek and Pegram (1966) and of Leng et al. (1986). Sodium and potassium in plasma and urine were measured by flame photometry.

## Results

### Whole kidney findings

Iodoacetate had no effects on fractional urea excretion ($FE_{urea}$) and amount of urea excreted ($U_{urea}V$) under conditions of stable and unchanged plasma urea level ($P_{urea}$). Urine flow rate (V), glomerular filtration rate (GFR) as well as excreted amounts of both sodium ($U_{Na}V$) and potassium ($U_KV$) were significantly increased during 2nd hour of iodoacetate infusion (table 1).

TABLE 1. PLASMA UREA LEVEL AND WHOLE KIDNEY FUNCTIONS OF LEFT KIDNEY DURING IODOACETATE INFUSION (MEAN ± SEM)

| | Control (n=8) | Experimental (n=7) |
|---|---|---|
| $P_{urea}$ (mmol/l) | 6.5 ± 0.33 | 6.6 ± 0.51 |
| V (ml/min) | 0.2 + 0.04 | 0.4 ± 0.08$^{++}$ |
| GFR (ml/min) | 20.2 ± 2.6 | 28.6 ± 2.3+ |
| $FE_{urea}$ (%) | 43.1 ± 5.6 | 38.9 ± 4.3 |
| $U_{urea}V$ (μmol/min) | 56.3 ± 11.3 | 65.5 ± 12.1 |
| $U_{Na}V$ (μmol/min) | 1.0 ± 0.06 | 11.2 ± 3.3$^{+}$ |
| $U_KV$ (μmol/min) | 1.7 ± 0.56 | 7.5 ± 1.58$^{+}$ |

*Abbreviations are explained in text.
$^{+}p < 0.05$ $^{++}p < 0.01$

### Micropuncture findings

Iodoacetate had no effect on single nephron glomerular filtration rate (SNGFR). The urea concentration in tubular fluid ($TF_{urea}$) and tubular fluid to plasma ratio of both inulin ($TF/P_{in}$) and urea ($TF/P_{urea}$) did not change in late proximal and early distal tubules while all these three parameters were significantly lowered in late distal tubule. There were no changes in both fractional deliveries of urea ($FD_{urea}$) and water ($FD_{H_2O}$) throughout nephron segments of sheep (table 2).

## Discussion

If the urea reabsorption in nephrons of sheep derives the energy from anaerobic glycolysis one would rather expect a huge increase in tubular fluid to plasma urea ratio in distal tubule and

TABLE 2. MICROPUNCTURE DATA ON THE UREA HANDLING BY NEPHRONS OF SHEEP KIDNEY DURING IODOACETATE INFUSION (MEAN ± SEM)

| | Late proximal | | Early distal | | Late distal tubules | |
|---|---|---|---|---|---|---|
| | Control (n=14) | Exp. (n=9) | Control (n=6) | Exp. (n=6) | Control (n=5) | Exp. (n=5) |
| SNGFR (nl/min) | | | 50.6 ± 7.9 | 51.48 ± 11.7 | | |
| $TF/P_{in}$ | 1.76 ± 0.1 | 1.82 ± 0.1 | 2.76 ± 0.4 | 2.77 ± 0.3 | 8.49 ± 0.7 | 6.3 ± 0.5+ |
| $TF_{urea}$ (mmol/l) | 8.64 ± 0.4 | 9.43 ± 0.4 | 12.98 ± 1.6 | 11.84 ± 1.1 | 23.76 ± 2.3 | 14.19 ± 1.8+ |
| $TF/P_{urea}$ | 1.31 ± 0.1 | 1.46 ± 0.1 | 2.18 ± 0.3 | 2.01 ± 0.2 | 3.9 ± 0.5 | 1.99 ± 0.3+ |
| $FD_{urea}$ (%) | 75.46 ± 2.3 | 81.64 ± 3.2 | 81.85 ± 8.7 | 74.91 ± 10.4 | 48.44 ± 8.8 | 31.27 ± 4.0 |
| $FDH_2O$ (%) | 58.73 ± 3.0 | 56.55 ± 3.4 | 40.47 ± 6.2 | 37.38 ± 3.0 | 12.19 ± 1.21 | 16.27 ± 1.4 |

* Abbreviations are explained in text. n = numbers of punctured tubules + $p < 0.05$

also the increase in fractional delivery of urea to distal parts of nephron due to iodoacetate. As it was demonstrated quite the opposite was found in our micropuncture study. Moreover the fractional urea excretion by whole kidney was not affected by iodoacetate. Thus presented micropuncture findings do not support the concept of active urea transport in kidney of sheep which would be dependent on energy derived from anaerobic metabolism.

(**Key Words**: Kidney, Urea Excretion, Micropuncture)

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