Title: TRANSVASCULAR FLUID DYNAMICS AND RENAL RESPONSE TO ANESTHESIA AND EXTENSIVE SURGERY

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Introduction. It is generally held that extensive surgery and anesthesia cause transvascular fluid shifts and a deterioration of kidney function (1). The goal of the present investigation was to reevaluate the interrelation between perioperative fluid dynamics and renal function using sensitive and selective tracer techniques (2).

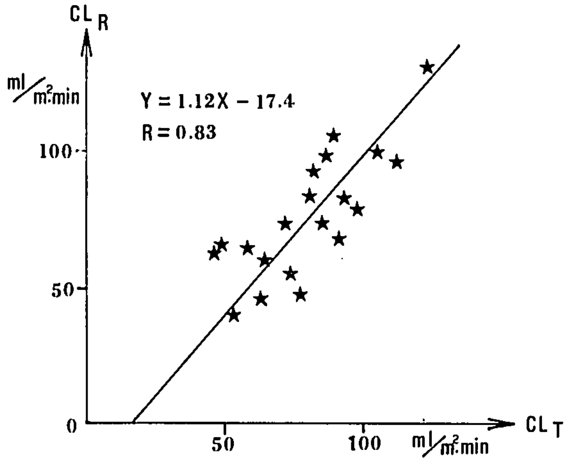
Methods. Institutional approval was granted and informed consent obtained from 10 patients with normal kidney function scheduled for major abdominal surgery. Each was premedicated with flunitrazepam (0.03 mg/kg p.o.). Anesthesia consisted of thiopental, fentanyl, pancuroniumbromide and controlled ventilation with nitrous oxide-oxygen. Cardiac output was determined using the thermodilution technique. 4 hours before and after surgery a glucose-electrolyte solution was administered at a rate of 3 ml/kg/h. Intraoperative fluid losses were replaced by cristalloids at a rate of 12 ml/kg/h, blood losses by bank blood and albumin solutions. Radioisotope studies were done in the 4-hour periods before and after surgery. Determinations of plasma volume (PV) were performed with I-125 albumin. In order to avoid an error from albumin leakage, blood samples were drawn up to 15 min after injection and the measured radioactivity was extrapolated to t_0. Cr-51-EDTA was used to evaluate the extracellular fluid volume (ECF) and both total and renal clearances. To keep the measuring error low, the activity of the Cr-51-EDTA injection was determined by a scintillation counter in calibrated geometry. Assuming a biexponential slope, the total plasma clearance was calculated dividing the applied activity by the integral of the plasma activity curve. Renal clearances were calculated from the Cr-51 urine activity and the numeric integral of plasma activity disappearance in this period. The extracellular fluid volume was calculated as the product of the mean transit time for Cr-51-EDTA in plasma ($\bar{t}$) and the total plasma clearance. Colloid osmotic pressure (COP) was determined using an oncometer (Thomae, BMT 900).

Results. After surgery an increase in ECF, cardiac index (CI) and the glomerular filtration rate (GFR) was observed while mean arterial pressure (MAP) and $\bar{t}$ remained at preoperative control levels (Table). However, both COP and PV were decreased. There was a highly significant correlation ($p < 0.001$) between total plasma clearance (CL_T) and the renal clearance (CL_R) of Cr-51, indicating near complete tracer excretion via the urine (Figure).

Discussion. The principal finding of this non-compartimental tracer analysis is the postoperative increase in GFR, in spite of a moderate reduction in plasma volume. This could be partly due to the observed increase in CI and the decrease in COP. However, also changes in the neurohumoral environment and expansion of the ECF may have contributed to this phenomenon. The latter concept is supported by the absence of significant changes in $\bar{t}$. Thus, in contrast to previous reports, a considerable increase in GFR seems to be part of the integrated response to extensive surgery. Accordingly, inadequate postoperative increases of the filtration function of the kidney should be readily recognized and raise suspicion of incipient renal failure.

	Preop.	Postop.
GFR (ml/min/m²)	73 ± 14	91 ± 18**
ECF (L)	16.4 ± 5.8	18.7 ± 3.8*
$\bar{t}$ (min)	128 ± 25	121 ± 24
PV (L)	3.4 ± 0.2	3.1 ± 0.6*
COP (mmHg)	24 ± 3	20 ± 3*
CI (L/min/m²)	3.1 ± 0.3	3.8 ± 0.5*
MAP (mmHg)	92 ± 10	92 ± 8

Mean ± S.D.; * $p < 0.05$, ** $p < 0.01$ (Student's t-test for paired data).



References.
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