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Title : THE RENAL EFFECTS OF DOPAMINE AND DOBUTAMINE

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Introduction. It is the purpose of the present study to compare the renal effects of dopamine and dobutamine in patients following open cardiac operations in whom drug infusion rates were adjusted to achieve equal cardiac outputs.

Materials and Methods. Informed consent was obtained preoperatively from 12 patients scheduled for open cardiac operations. Consent procedures and study techniques conformed to appropriate ethical standard and had institutional approval. Hemodynamic and renal function were measured using standard techniques and calculation as previously described.[1] Briefly, measurements were performed within 24 hours of surgery after the patients were completely rewarmed and stabilized. Cardiac output was measured in duplicate by indocyanine green, pulmonary capillary wedge pressure by Swan-Ganz catheter. Glomerular filtration rate (GFR) was measured by the clearance of inulin, and effective renal plasma (ERPF) flow by the clearance of para-aminohippurate (PAH). The order of drug administration was alternated and dose response data obtained. Subsequently drug dosage was stabilized and inulin and PAH administration were begun. Following a 60 minute equilibration period a one hour renal clearance study was performed, and cardiac function measured. Administration of the second drug was initiated, and the infusion rate increased until the cardiac output matched that obtained previously. Renal function measurements were repeated, finally duplicate hemodynamic measurement were performed for use in the subsequent analysis. Data are reported as the mean ± S.D., p values by paired t-test.

Results. At a dopamine infusion rate of 5.3 ± 1.43 µg/kg/min and a dobutamine infusion rate of 3.2 ± 0.7 µg/kg/min, the cardiac indices (CI) were matched ($p = 0.6$); the mean arterial pressure (MAP), heart rate, left ventricular stroke work index and systemic vascular resistance index (SVRI) were not significantly different. Wedge pressure and stroke volume index were both lower on dobutamine ($p < 0.05$).

Under these conditions no differences were observed in GFR, ERPF, renal blood flow, filtration fraction, renal fraction or renal vascular resistance (RVR). By contrast urine (U) flow, sodium excretion (Na X), potassium excretion (K X), and total cation excretion were all significantly higher on dopamine and the urine was more dilute during dopamine administration, as measured by the urinary/plasma (U/P) osmolality and inulin ratios.

	Dopamine	Dobutamine	P
CI (L/min/m^2)	2.7±0.7	2.7±0.7	0.6
MAP (torr)	87±9.	83±9.	0.1
SVRI (units · m^2)	28±6.9	27±8.	0.2
GFR (ml/min/1.73m^2)	90±29	80±29	0.1
ERPF (ml/min/1.73m^2)	375±119	357±126	0.5
RVR (unit)	120±50	126±73	0.6
U Flow (ml/min)	2.8±2.7	1.0±0.3	0.04
Na X (mEq/min)	0.32±0.39	0.07±0.10	0.05
K X (mEq/min)	0.15±0.06	0.10±0.03	0.02
U/P inulin	48±29	83±32	0.006

Discussion. Our data indicate that, in postoperative patients with depressed cardiac function, differences in the direct renovascular actions of these agents will be dominated by their effects upon the systemic circulation. This finding is compatible with the observations of Leier et al[2] who demonstrated a superior hemodynamic and renal response to dobutamine in patients with cardiomyopathic heart failure. The marked increase in urine flow and sodium excretion with dopamine administration has previously been attributed to dopamine's renal vasodilatory effects; our data indicate that dopamine exerts a direct tubular effect inhibiting salt and/or water reabsorption. One possible explanation for our results would be that PAH extraction decreased with progressive dopamine administration, but not with dobutamine. However, this seems unlikely as our studies were performed with low plasma PAH concentrations (0.6±0.2 mg/dl). Furthermore, in earlier studies dopamine increased both glomerular filtration rate and renal plasma flow; neither variable differed in our study.

In summary, under conditions of equivalent systemic hemodynamics dopamine and dobutamine have similar effects upon glomerular filtration rate and renal hemodynamics. Dopamine administration results in a significant diuresis and natriuresis which appears to be due to a tubular mechanism independent of the renovascular effects of the drug.

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References

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