Title: RENAL AND HEMODYNAMIC EFFECTS OF DOPAMINE IN INFANTS FOLLOWING CORRECTIVE CARDIAC SURGERY

Authors: K.M. Outwater, M.D., S. Treves, M.D., P. Lang, M.D., A.R. Castaneda, M.D., R.K. Crone, M.D.

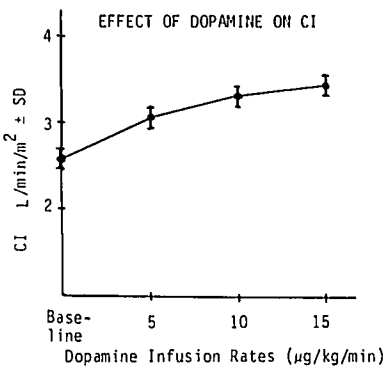
Affiliation: Departments of Anesthesia, Radiology, Cardiology, and Cardiovascular Surgery, The Children's Hospital, 300 Longwood Avenue, Boston, Massachusetts 02115.

Introduction. Although dopamine has become the agent of choice for the treatment of low cardiac output, there is little objective data about hemodynamic and renal effects of dopamine in infants. We evaluated the effects of dopamine on six infants following repair of congenital heart defects.

Methods. Six infants, ages 3 to 13 mo (median 10 mo) were studied postoperatively following repair of ventricular septal defect (2), tetralogy of Fallot (2), and atrioventricular canal (2). After a 2 hr stabilization period, measurements were made of cardiac output (CO), heart rate (HR), mean arterial pressure (MAP), mean pulmonary artery pressure (PA), left atrial pressure (LA), right atrial pressure (RA), systemic vascular resistance (SVR), pulmonary vascular resistance (PVR), and urine output (UO). Glomerular filtration rate (GFR) was measured by injecting T_{99} DTPA, 50 μc_i, and sampling blood for isotope counting at 30, 60, and 120 min. GFR was calculated as: rate of clearance x injected dose/initial concentration, then corrected for body surface area. A dopamine infusion was begun at 5 μg/kg/min and increased to 10 and 15 μg/kg/min every 4 hr. Renal and hemodynamic measurements were repeated at each infusion rate.

Results. Cardiac index (CI) increased from 2.6 ± 0.4 L/min/m² (mean ± SD) at baseline to 3.4 ± 0.4 L/min/m² on a dopamine infusion of 15 μg/kg/min ($p < 0.05$) (Fig. 1). There was no significant difference between CI at baseline versus 5 or 10 μg/kg/min.

Figure 1.



There were no significant changes from baseline in HR, MAP, RA, LA, PA, SVR, or PVR at any dopamine infusion rate. No arrythmias were noted.

There was no significant change in GFR or UO at any dopamine infusion rate. Although there was a trend towards a higher GFR at 5 and 10 μg/kg/min, it did not reach significant levels (Fig. 2).

Discussion. Dopamine has been used extensively in adults with low cardiac outputs. In normal adults, CO and GFR increase with dopamine infusion rates of 2-5 μg/kg/min.[1] In patients with congestive heart failure, urine flow and creatinine clearance increase at 5-10 μg/kg/min. At higher infusion rates, renal blood flow may be reduced, presumably due to predominance of alpha effects of dopamine at higher rates.[1]

The dose response of dopamine in infants and children has not been well defined. Experimental evidence in immature animals suggests that infants might require more dopamine to achieve the same inotropic effects seen in adults. This speculation was confirmed in a small study of infants following cardiac surgery. There have been no similar studies evaluating the renal effects of dopamine in infants.

We found in six children that a significant increase in CO occurred at a dopamine infusion rate of 15 μg/kg/min but not at lower rates, confirming previous findings. We show that such relatively high doses do not lead to a reduction in GFR or UO.

Summary. Doses of 15 μg/kg/min or more of dopamine may be required to produce a significant increase in cardiac output in infants. When used in this dose range, there are no adverse effects on GFR or UO.

References.

1. Goldberg, LI, Hsich YY, Resnekow L. Newer catecholamines for treatment of heart failure and shock. Prog Cardiovasc Dis 29:327, 1977.
2. Driscoll DJ, Gillette PC, Ezrailson EG, Schwartz A. Inotropic response of the neonatal canine myocardium to dopamine. Pediatr Res 12:42, 1978.
3. Lang P, Williams RG, Norwood WI, Castaneda AR. The hemodynamic effects of dopamine in infants after corrective cardiac surgery. J Pediatr 96:630, 1980.

Figure 2.