

Title : PULMONARY AND SYSTEMIC CIRCULATIONS AND VASODILATOR DRUGS

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Introduction. The magnitude of decrease in blood pressure caused by a given dose of vasodilator drug should be related to the pre-existing vascular tone (degree of pre-existing active vasomotion, constriction versus dilation). The vascular tone of pulmonary vessels can be altered by alveolar hyperoxia, hypoxia and by pulmonary hypertension caused by mitral valve obstruction. The purpose of this experiment was to examine the effect of infusion of sodium nitroprusside (SNP) and nitroglycerine (NTG) on blood pressure within the pulmonary circulation compared to the systemic circulation during the above cited pulmonary conditions, and to determine if one of the two drugs has a more specific effect on the pulmonary circulation.

Methods. Mongrel dogs were anesthetized with pentobarbital 25 mg/kg, intubated, and mechanically ventilated with a constant minute ventilation with 100% O₂. Following a left thoracotomy, the left lower lobe (LLL) bronchus was ligated, cannulated and ventilated independently but synchronously with the rest of the lung (RL) with 100% O₂. Systemic (P_{sa}) and left atrial (LA) pressures (P_{la}) were measured directly. Two methods were used to increase P_{pa}: 1) In 6 dogs a second catheter with an inflatable balloon at the tip was inserted into the LA, and P_{la} was increased by LA balloon inflation; 2) In 6 dogs RL was ventilated with 10% O₂ (F_IO₂=0.1) while LLL was ventilated with 100% O₂ (F_IO₂=1.0). The experimental sequence consisted of measuring P_{sa} and P_{pa} before (control values), and after SNP and NTG infusion (~30% decrease in P_{sa} was the infusion end point) while (a) the animals breathed 100% O₂, (b) the animals breathed 100% O₂ and the LA balloon was inflated, and (c) LLL F_IO₂=1.0 and RL F_IO₂=0.1. All results are expressed as mean ±SE and were analyzed by paired t analysis with p<0.05 considered significant.

Results. Table 1 and 2 show that we achieved a fairly uniform and consistent decrease in systemic arterial pressure. During 100% O₂ breathing, infusion of SNP and NTG caused little change in P_{pa}. During mitral valve obstruction (LA balloon inflation), and with a greatly increased control P_{pa}, infusion of SNP and NTG again caused little change in P_{pa}. During ventilation of most of the lung with F_IO₂=0.1, and with a greatly increased control P_{pa}, infusion of SNP and NTG caused as much of a percent decrease in P_{pa} as in P_{sa}. Both SNP and NTG decreased

Table 1: P_{pa} and P_{sa} Changes Following SNP Infusion

	P _{sa}	% decrease	P _{pa}	% decrease
100% O ₂				
Control	123±8		14±1	
SNP	82±4	33±3	12±1	10±3*
LA Balloon				
Control	100±3		30±1	
SNP	71±2	30±2	27±1	9±3*
Hypoxia				
Control	118±7		23±1	
SNP	80±8	32±6	15±1	33±3

*p<0.05 from % decrease P_{sa}

Table 2: P_{pa} and P_{sa} Changes Following NTG Infusion

	P _{sa}	% decrease	P _{pa}	% decrease
100% O ₂				
Control	124±7		14±1	
NTG	84±3	32±2	12±1	15±4*
LA Balloon				
Control	100±4		31±1	
NTG	71±4	29±2	27±1	13±4*
Hypoxia				
Control	111±2		23±2	
NTG	87±5	22±3	17±1	25±3

*p<0.05 from % decrease P_{sa}

the P_{pa} by the same amount (no statistically significant differences) during the three different pulmonary conditions. The change in cardiac output during all drug infusions ranged from an 18% decrease to a 14% increase. The calculated systemic and pulmonary vascular resistances during all drug infusions always decreased, (7% to 38%).

Discussion. In this experiment vascular tone was changed in three ways: 100% O₂ breathing, mitral valve obstruction, and alveolar hypoxia. During 100% O₂ breathing and mitral valve obstruction, infusion of vasodilator drugs had much less of an effect on the pulmonary circulation than on the systemic circulation. However, when pulmonary vascular tone was increased by alveolar hypoxia, infusion of vasodilator drugs had equal effects on the pulmonary and systemic circulations. Thus, these experiments indicate that differences in the cause and degree of pre-existing vascular tone of the vessels of the pulmonary and systemic circulations will cause vasodilator drugs to have differential effects on these circulations. Lastly, under the conditions of these experiments, SNP and NTG are equally effective in decreasing P_{pa}.