Title: HEMODYNAMIC EFFECTS OF AMRINONE FOR LOW CARDIAC OUTPUT IMMEDIATELY AFTER CARDIOPULMONARY BYPASS: EFFECTIVE AS A BOLUS?

Authors: R.F. Grayson, M.D. and D.A. Kass, M.D.

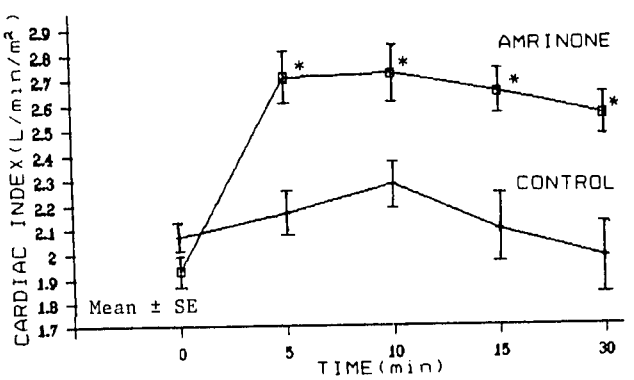
Affiliation: Department of Anesthesiolgy and Critical Care Medicine, Division of Cardiac Anesthesia, Department of Medicine, Johns Hopkins Hospital, Baltimore, MD 21205

Introduction Decreased ventricular inotropy with low cardiac output is a frequent and occasionally life threatening problem immediately following cardiopulmonary bypass (CPB). The new bipyridine inotrope amrinone is recommended for the short term treatment of cardiac failure.[1] Intraoperative use of amrinone immediately post CPB needs investigation. This study, therefore, measured the magnitude and time course of hemodynamic changes resulting from a bolus intravenous injection of amrinone in anesthetized patients with low cardiac output immediately following CPB. Furthermore, we sought to clarify whether amrinone, with its longer duration of action than the other IV inotropes,[2] could be useful when given only as a bolus instead of by continuous drip.

Methods Informed consent was obtained from all study patients following Institutional Review Board approval of the research protocol. Thirteen consecutive coronary artery bypass patients meeting the inclusion criteria were randomly assigned to either a study (amrinone) group (n=8) or a control (no amrinone) group (n=5). Inclusion required that the patients wean from CPB without inotrope or vasodilator support and have an initial post CPB cardiac index $\leq$ 2.2 L/min/m^2. Patients were monitored (arterial and pulmonary artery catheters) and anesthetized in the standard manner with fentanyl, diazepam, and pancuronium. Use of inhalation agents was only permitted pre-CPB. Our usual technique for CPB weaning was followed. The heart was filled to generate a systolic BP of 90-110 mmHg and baseline hemodynamics including cardiac index (CI), pulmonary artery occlusion pressure (PAo), heart rate (HR), mean arterial pressure (MAP), and systemic vascular resistance (SVR) were measured 5 minutes post CPB. This baseline PAo ("preload") for each patient was maintained as constant as possible with volume infusion during the study period. Repeat hemodynamic measurements were done 5,10,15, and 30 minutes following baseline for the control group. Amrinone 2mg/kg was administered over 3-4 minutes to the study group after baseline measurements, and repeat determinations made at 5,10,15, and 30 minutes post amrinone. All measurements were done with the patient momentarily off the ventilator to eliminate the hemodynamic fluctuations caused by positive pressure ventilation. No volume was infused during hemodynamic determinations. No other inotropes or vasodilators were permitted during the study period. Data were compared to baseline by paried t-test with $p < 0.05$ considered significant.

Results Amrinone significantly increased the cardiac index above baseline at all time intervals (see Table and Fig.). This occurred without a significant change in PAo, HR, or MAP. Calculated SVR fell as expected. Conversely, the control group experienced no significant change in CI, PAo, HR, or MAP from its baseline. In the patient with the lowest PAo (5 mmHg) amrinone infusion was stopped after 1.5 mg/kg because his MAP had fallen below 60 (to 55).

Discussion A prior study investigated the effects of IV drip amrinone in 1) awake patients 24 hours after cardiac surgery and 2) as a second or third line inotrope with some patients already on intra-aortic balloon assist.[3] The present intraoperative study showed amrinone to be effective as the first line inotrope in the immediate post CPB period. Furthermore the response to a single bolus was sufficient to obviate the need for a continuous drip of this or other inotropes. To minimize the confounding influence of varying loads and other drugs on the CI, however, the PAo was kept constant and patients with the worst ventricular function were presumably excluded from the study since, as noted above, successful weaning from CPB without other inotropes or vasodilators was required. We conclude that in patients with moderate ventricular dysfunction and normal PAo (6-12 mm Hg) post CPB, a single bolus of amrinone (2mg/kg) significantly improves CI without significantly altering HR or MAP provided PAo is maintained. The drug is effective as a bolus (administered slowly) due to its prolonged duration of action.



		CI	PAo	HR	MAP	SVR
AMRINONE						
Time(min)	0	1.93±.16	11±3	82±14	70±6	1382±164
	5	2.71±.54*	10±4	87±14	68±6	976±234#
	10	2.72±.59*	10±4	86±12	70±9	1034±338#
	15	2.64±.40*	11±4	86±14	72±10	1071±315#
	30	2.55±.37*	11±4	82±13	74±9	1094±347#
CONTROL						
Time(min)	0	2.07±.12	11±5	78±15	64±10	1115±251
	5	2.16±.24	11±3	79±18	66±10	1115±261
	10	2.28±.34	12±4	77±15	64±7	1023±267
	15	2.09±.47	12±5	80±16	71±4	1308±344
	30	1.97±.56	11±3	77±15	69±8	1346±339

Means+SD. * p<.01 vs. Amrinone at Time 0.
# p<.05 vs. Amrinone at Time 0.

References
1. Mancini D, et al: Am. J. Cardiol 56:8B-15B, 1985.
2. Edelson J,et al: Circ. 73(Suppl III)145-152, 1986.
3. Goenen M, et al: Am. J. Cardiol 56:33B-38B, 1985.