Title : THE INTRA-AORTIC BALLOON PUMP AND RENAL FUNCTION IN MAN

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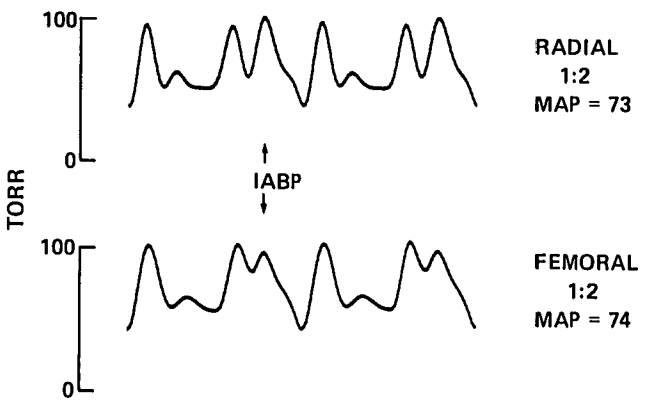
Introduction. In a recent report on postoperative acute renal failure (ARF) we noted that intra-aortic balloon pump (IABP) support was used in 15 of 17 patients who developed ARF.[1] Early in these studies two patients demonstrated profound deterioration of renal function following IABP removal. Subsequently, we have observed the development of ARF during IABP weaning or after removal in 10 patients. In eight other patients ARF developed during IABP support. The effects of IABP support upon renal function have not been defined in man. Improved renal function could result from improved systemic hemodynamics, or decreased catecholamine requirements. Alternately, depressed function could result from mechanical interference with renal perfusion. The present report will analyze the direct effects of IABP support upon renal function in man.

Methods. Hemodynamic and renal function were measured on postoperative day 5 ± 2. The majority of patients were maintained on a Datascope IABP unit. Measurements were performed on minimal support (minimal balloon filling every third heart beat (1:3)) and maximal support (balloon filling to 30-37.5 ml every heart beat (1:1)), after a one hour equilibration period. Measurements included: mean arterial pressure (MAP, torr), cardiac index (CI, l/min/m^2), left ventricular stroke work index (LVSWI, g-m/m^2), urine flow (V, ml/min). The clearances of inulin (C_{in}) and para-aminohippurate (C_{pah}, both ml/min /1.73 m^2) were used to estimate glomerular filtration rate and effective renal plasma flow, respectively. In 8 patients pressure was recorded simultaneously in the radial and femoral arteries. Approved consent procedures, measurement techniques, and calculations have been previously described.[1] Data are presented as mean ± SD, p values determined by paired t-test.

Results. When maximal IABP support was compared to minimal IABP support only slight improvement in hemodynamic function was observed, statistically significant ($p < 0.05$) for MAP and LVSWI, and approaching significance for CI and C_{pah}. Average V and C_{in} did not change. (Table)

The average of the arterial pressures recorded simultaneously above and below the balloon were identical, 79 ± 12 and 78 ± 13 torr, respectively. No differences were observed between single and dual-chamber balloons. The IABP pulse was consistently observed below the balloon. The waveform exhibited a slightly diminished amplitude and was closer to the native systolic peak, being completely superimposed in one patient. A sample tracing is shown below.

	IABP Support Minimal	Maximal	P
MAP	75 ± 7	77 ± 9	0.03
CI	2.6 ± 0.6	2.7 ± 0.6	0.07
LVSWI	19 ± 6	20 ± 5	0.01
V	1.0 ± 0.4	1.1 ± 0.4	>0.1
C_{in}	63 ± 33	64 ± 31	>0.1
C_{pah}	286 ± 126	322 ± 146	0.07



Discussion. These results indicate that the IABP does not interfere with, and may improve, renal perfusion. Furthermore, any improvement in systemic hemodynamics achieved by IABP usage will be transmitted to the infra-balloon circulation. A more significant effect of IABP support might have been demonstrated earlier in the postoperative period when hemodynamic state seemed more IABP dependent. These data cannot exclude impairment of renal function from IABP support in an occasional patient (emboli, aortic dissection, etc.). However, 7 of 8 patients who developed ARF while on IABP support had a systemic hemodynamic or toxic insult sufficient to explain this progression. The development of ARF in 10 patients following IABP weaning or removal suggests that slow deterioration in cardiac performance following withdrawal of IABP support may occur and cause impairment of renal function, a change not detectable by our acute protocol.

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References.

1. Hilberman M, Myers BD, Carrie BJ et al: Acute renal failure following cardiac surgery. J Thorac Cardiovasc Surg (In Press).