Monday, March 19, 1990
Poster Displayed: 2:00PM–5:00PM
Author Present: 2:00PM–3:00PM
Hall C, New Orleans Convention Center
Cardiac Function: Basic

Left Ventricular Function in Chronic Potassium Depletion

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The effects of chronic potassium depletion within the clinical range upon ventricular function were assessed in normokalemic (N) and K^+-depleted (KD) dogs. Stroke volume index (SVI) and $d(LVP)/dt_{max}$ responses to rapidly increased preload and to bolus IV injection of 2.5 ug/Kg epinephrine were measured after five days of a control diet or a K^+ depletion regimen of 10 mEq/day K^+ with 50 mg of chlorthalidone. Blood K^+ levels were N= 4.09±.20 mEq/L and KD= 3.22±.15 (p= .002) for 8 and 9 dogs, respectively. Epinephrine elicited increases of $d(LVP)/dt_{max}$ for N from 3376±354 to 8327±344 and KD from 3010±244 to 6716±347. The effects of K^+ depletion (p=.0066) and EPI (p<.00001) were significant. After autonomic blockade with 0.1 mg/Kg atropine and 1.0 mg/Kg propranolol preload was elevated rapidly (20 sec.) by infusion of K^+ matched tyrodes to an end diastolic pressure of 24 mmHg. Elevated preload elicited peak normalized SVI responses of N = 1.550± .094 and KD = 1.236± .065 (p= .013). These results indicate that modest K^+ depletion within the clinical range results in significant depression of the cardiac mechanical responses to epinephrine and to elevated preload which may affect the management of patients with similar K^+ depletion, especially if cardiac function is otherwise impaired.

(Supported by HL21435 and HL11678)

VENTRICULAR ENDOCRINE FUNCTION IS REGULATED BY VENTRICULAR WALL DISTENSION

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During ventricular overload, the ventricles can produce atrial natriuretic peptide (ANP) in large quantity. We investigated the relationship among ventricular ANP gene expression, ventricular ANP storage, and the intra-ventricular pressure using adult rat as the animal model. The descending aorta of 124 rats were surgically semicoarctated to increase the left ventricular pressure from 5 to 25% in different experimental groups. The co-arctations in half of the rats were surgically released at the 14th day and some of those were coarctated for the second time another 14 days later. The hearts of the rats were examined at 2, 7, 14, and 21 days after each operation with at least 6 rats in each group. The ANP immunoreactivity was examined by light and electron microscopic immunocytochemistry and ANP mRNA by in situ hybridization. It was found that ANP immunoreactivity and the ANP-containing specific granules were increased from the second day of coarctation and the increment was in proportion to the increase of the intraventricular pressure and the duration. ANP immunoreactivity decreased following coarctation release and increased again following the second coarctation. ANP mRNA increased and decreased in the same manner but the changes appeared to proceed those for ANP immuno-reactivity. These findings indicate that ventricular ANP gene expression and ANP synthesis are likely to be regulated by the tension of the ventricular wall.

BEAT-TO-BEAT RECORDING OF INTRACELLULAR CALCIUM WITH AEQUORIN IN THE BLOOD-PERFUSED DOG HEART.

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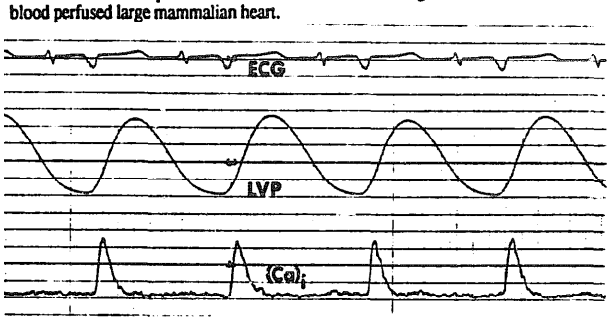
The bioluminescent indicator aequorin (AEQ) has been used to record intracellular calcium ($[Ca]_i$) transients in the isolated, buffer-perfused ferret heart. We have now been able to extend this technique to the isolated, blood-perfused dog heart. This model has the advantage of large size and the potential for recording $[Ca]_i$ during blood perfusion. AEQ was loaded into the myocytes of a small area of LV subepicardium in 10 dog hearts. Simultaneous ECG, LV pressure (LVP) and AEQ-generated light signal indicating $[Ca]_i$ were recorded, as shown in the figure below (heart rate = 69 beats/minute). This system, under buffer perfusion at 30° C, showed a variation in systolic and diastolic $[Ca]_i$ on a beat-to-beat basis. Signal-averaging was not required. Converting from buffer to whole blood perfusion did not interfere with the recording of $[Ca]_i$. Systolic $[Ca]_i$ reached its peak before the development of peak LVP. Diastolic $[Ca]_i$ returned to baseline before LVP returned to baseline. $[Ca]_i$ could be modulated through pharmacologic intervention: increasing the perfusate calcium increased the amplitude of the systolic $[Ca]_i$ signal, as did the addition of isoproterenol.

This is the first report of intracellular calcium recording in an isolated, whole-blood perfused large mammalian heart.



MALONDIALDEHYDE AND URIC ACID RELEASE AS A RESULT OF PTCA.

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The role of oxygen free radicals in the pathogenesis of endothelial and myocardial injury during PTCA has recently obtained much attention. The possible generation of these radicals was investigated by measuring the endproduct of lipid peroxidation, malondialdehyde (MDA), in plasma of 6 patients who underwent PTCA for proximal LAD stenosis. Also hypoxanthine (HX) and uric acid were measured by HPLC. The PTCA procedure was standardized at 4 inflations of 90 sec with a 3 minutes interval. Before PTCA a pepin catheter was inserted into the great cardiac vein to assess MDA production by calculating the difference between great cardiac vein and arterial MDA concentration (A-V).

Results:

During PTCA we found a progressive increase of MDA production which peaked 5 min after the last inflation. (1.59 ± 1.13 uM, mean ± SEM). The increase of uric acid A-V difference paralleled that of MDA in contrast to hypoxanthine A-V difference which peaked around the 2nd and 3rd inflation. So far, our results indicate that multiple coronary occlusions during PTCA in patients may lead to oxygen free radical generation most likely from endothelial origin.