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VENTRICULAR FUNCTION IN *Homarus americanus*

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The lobster heart consists of an elongated boxlike structure of striated muscle with lateral valved ostea, admitting blood from the pericardium, and a number of exiting cephalic, caudal, and ventral arteries. It is readily approached dorsally beneath the caudal portion of the carapace. Although there is information on the anatomy, histology, and electrophysiology of the heart, information on ventricular function has not been uncovered.

The animals were kept in an aquarium with well aerated running sea water and were very lively. They were studied nearly immersed in running sea water, restrained on a board with two loops of rubber tubing, and were quieter when their eyes were covered. A 2 x 3 cm oval portion of the carapace over the pericardium was removed. A 1.2 mm O.D. polyethylene tube was inserted through the pericardial membrane into the ventricle and connected to a Statham ultra low volume (P23Gb) transducer. No anticoagulant was employed but the catheter was cleared at intervals with small volumes of 1.6% saline. The first derivative of ventricular pressure was obtained using a differentiator built with a Nexus SA-3A operational amplifier. This had a time constant of about 1 msec. Epinephrine 10 to 100 μg, Serotonin 100 μg, K^+0.01 to 0.1 mEq were injected into the pericardial cavity. On several occasions after K^+ standstill, cardiac massage was instituted with a finger over the defect in the carapace. K^+0.5 mEq was injected into the distal tail to measure circulation time.

It was found that the position of the lobster tail influenced the tenseness of the pericardium and consequently the end diastolic pressure. The best results were obtained when the pericardium was neither protuberant nor depressed. Preparations ceased functioning suddenly because of catheter displacement, catheter clotting, or vigorous struggling with tearing of the pericardium. There were the following preliminary findings:

1. Ventricular pressure varied from 10/0 to 20/0 mm Hg, the rate approximated 80-90, and the dp/dt varied from 250 to 500 mm Hg/sec (Figure 1).

2. The dp/dt divided by the instantaneous pressure (IP), a measure of contractility, varied from 38 to 60 (Figure 2). This is approximately the magnitude for the dog or human heart.

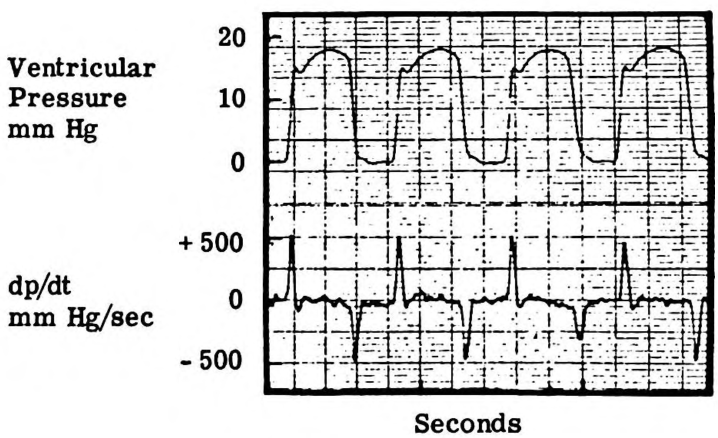

Figure 1

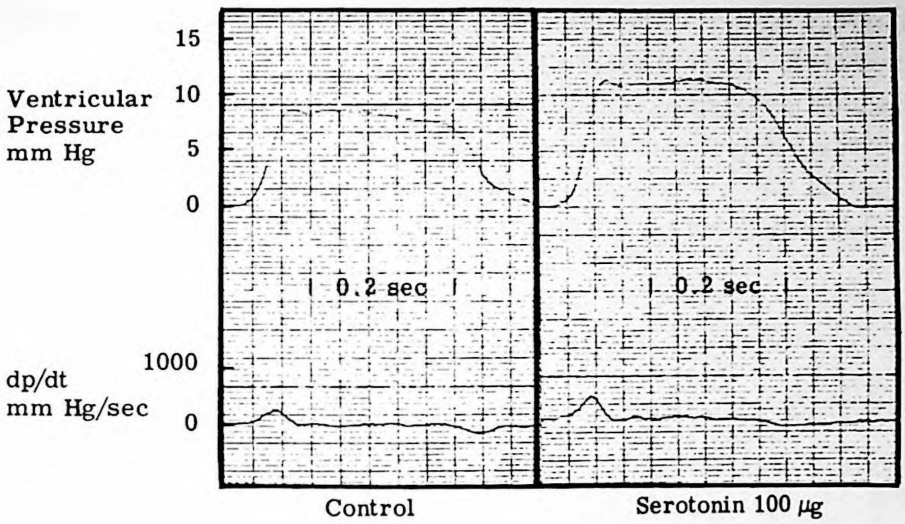

Figure 2

3. Serotonin increased the ventricular pressure and made variations more prominent. The $\frac{dp/dt}{IP}$ was increased from 38-52, indicating an intropic effect (Figure 2). Serotonin may be the neuromuscular transmitter for decapod crustaceans (Zeit. f. Naturforsch. 96:58, 1954).

4. Epinephrine had no predictable effect. On one occasion there was an increase in pressure and bradycardia but this was not repeated in other preparations.

5. K^+ gave bradycardia and in larger doses asystole (Figure 3). Injected in the tail, cardiac irregularity began 1 minute 10 seconds later.

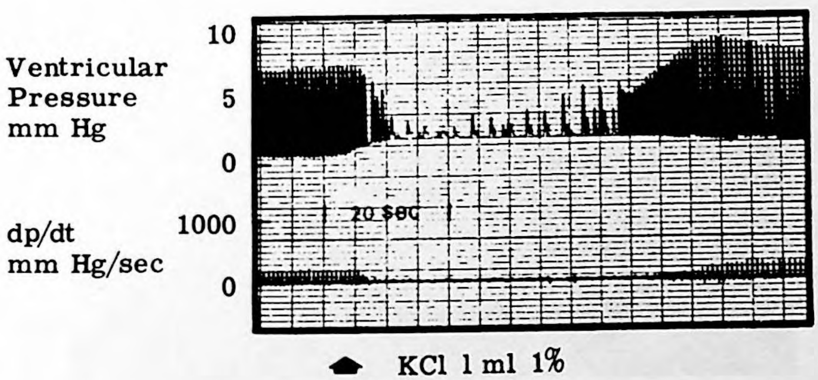

Figure 3

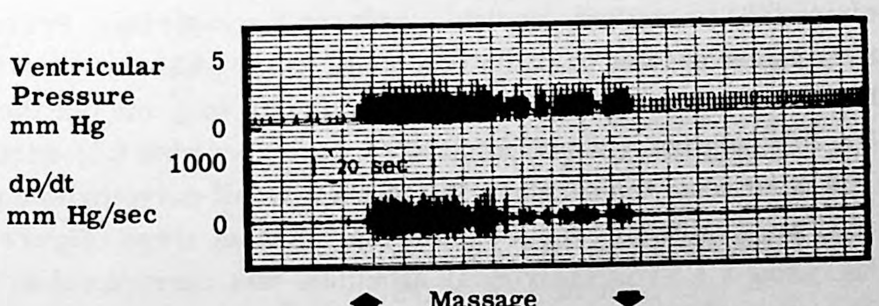

Figure 4

6. Cardiac massage caused resumption of a beat after prolonged potassium standstill and gave definite support to the blood pressure (Figure 4).

7. No flow could be detected by a small electromagnetic probe on the larger cephalic artery. To measure cardiac output some whasout method would probably be best, the material being injected directly into the ventricle and its dilution being measured.

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HEMODYNAMIC STUDIES IN *Squalus acanthias*

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Dogfish were restrained on their backs and supplied with fresh sea water pumped into their mouths or spiracles. The heart was exposed through a longitudinal midline incision dividing the pectoral girdle caudally (Figure 1). A square wave electromagnetic probe, 20 or 25 mm in circumference, was placed on the aortic conus to measure cardiac output ($\dot{Q}_B$). (Flow meter: Carolina Electronics). The flow pulse was integrated on line with an operational amplifier circuit to

Figure 1

obtain the stroke volume (SV) (submitted, Medical Research Engineering). Pressures were obtained by appropriately placed needles or catheters. Ventricular washout curves were obtained by means of a needle thermistor passed through the ventricular wall and out the aortic conus to the ventral aorta. For this purpose, resistance changes were recorded following a ventricular injection of 0.25 to 0.5 ml of room temperature saline via a small polyethylene spray catheter. Ejection fractions (EF) were calculated from the thermal washout steps (Figure 2).

Electrical pacing, using a 1.5 volt ventricular stimulus, was carried out at rates from 2 to 60/min in preparations that exhibited bradycardia or standstill. Persistent ventricular fibrillation was treated with 0.1 ml saturated KCl injected directly into the ventricle. Epinephrine, 1 μg