

Rat Circulatory Pressures (40488)

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The rat is probably the most frequently used research animal for a wide range of laboratory studies. In the course of a morphological study of the rat pulmonary circulation, normal perfusing pressures were planned as the basis to replicate the pulmonary circulation. There have been published reports of isolated systemic arterial pressures (1-4) and isolated pulmonary artery pressures (5-7), but no reports measuring right atrial, pulmonary artery, left atrial and aortic pressures simultaneously.

Materials and methods. *Rattus Norvegicus* (Sprague-Dawley) rats, both male and female, weighing 300-350 grams were used for these pressure measurements. They were anesthetized with 60 mg/kg of sodium pentobarbital intraperitoneally. A local anesthetic was used over the cutdown site for cannulation: carotid artery for aortic pressure, jugular vein for the right atrial pressure, and for tracheostomy. Following intubation the rat was placed on a small animal respirator using room air. Via a thoracotomy the pulmonary artery and left atrium were cannulated directly in the open-chested animal to measure pressures. The aortic and right atrial pressures were obtained through short PE 50 tubing and the pulmonary artery and left atrial pressures through short PE 90 tubing or 18-gauge teflon catheter needles. The pressures were measured using P37 Statham, P23db Statham, or Bell and Howell (Type 4-327-0109) pressure transducers zeroed at the midthoracic level of the supine rat.

Although only those animals are reported whose blood loss was negligible, a small volume replacement with either normal saline or whole blood was required in some animals to return lowered aortic pressures to pre-respirator baseline levels.

Results. The pre-respirator baseline values for aortic and right atrial pressures are pre-

sented in Table I for 13 animals. The aortic mean \pm SD was 108 ± 30 mmHg, and the right atrial mean pressure was 2.4 ± 1.9 mmHg. The full range of simultaneous recordings of right atrial, pulmonary artery, left atrial, and aortic pressures are presented in Table II. By use of the Student's *t* test method of comparing means, there are no differences found between the baseline values for aortic and right atrial pressures and the simultaneously obtained pressure measurements with the chest open and on a respirator. At this time the pulmonary artery mean pressure was 16 ± 5 mmHg, and the left atrial mean pressure was 5.8 ± 1.7 mmHg. Figure 1 shows an example of the simultaneously obtained pressures.

Discussion. The systemic arterial pressures measured in this study are comparable to previously published aortic pressure data. For *Rattus Norvegicus* (Holtzman) using optical manometry (1) under pentobarbital sodium the systolic and diastolic pressure averages were 129 and 91 mmHg, and for *Rattus Norvegicus* (Sprague-Dawley) using an aortic cuff and mercury manometry (2) without anesthesia the systolic average pressure was 130 mmHg. These values are similar to the presented aortic systolic average of 124 mmHg and aortic diastolic average of 96 mmHg. The data presented here for aortic systolic and diastolic pressures is at variance with the average systolic and mean pressures given for *Rattus* species (4) using a strain gauge with an implanted arterial catheter without anesthesia, but the ranges for aortic systolic, diastolic and mean pressures overlaps the raw

TABLE I. BASELINE PRESSURES BEFORE TRACHEOSTOMY AND THORACOTOMY.

| | Aortic systolic | Aortic diastolic | Aortic mean | Right atrial mean |
|------|-----------------|------------------|-------------|-------------------|
| Mean | 125 | 99 | 108 | 2.4 |
| SD | 30 | 30 | 30 | 1.9 |
| N | 13 | 13 | 13 | 13 |

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TABLE II. SIMULTANEOUS PRESSURE MEASUREMENTS.

| | Aortic systolic | Aortic diastolic | Aortic mean | Right atrial mean | Left atrial mean | Pulmonary artery systolic | Pulmonary artery diastolic | Pulmonary artery mean |
|------|-----------------|------------------|-------------|-------------------|------------------|---------------------------|----------------------------|-----------------------|
| Mean | 124 | 96 | 105 | 3.3 | 5.8 | 21 | 12 | 16 |
| SD | 27 | 21 | 21 | 1.6 | 1.7 | 6.6 | 4.8 | 5.4 |
| N | 13 | 13 | 13 | 13 | 13 | 11 | 11 | 11 |

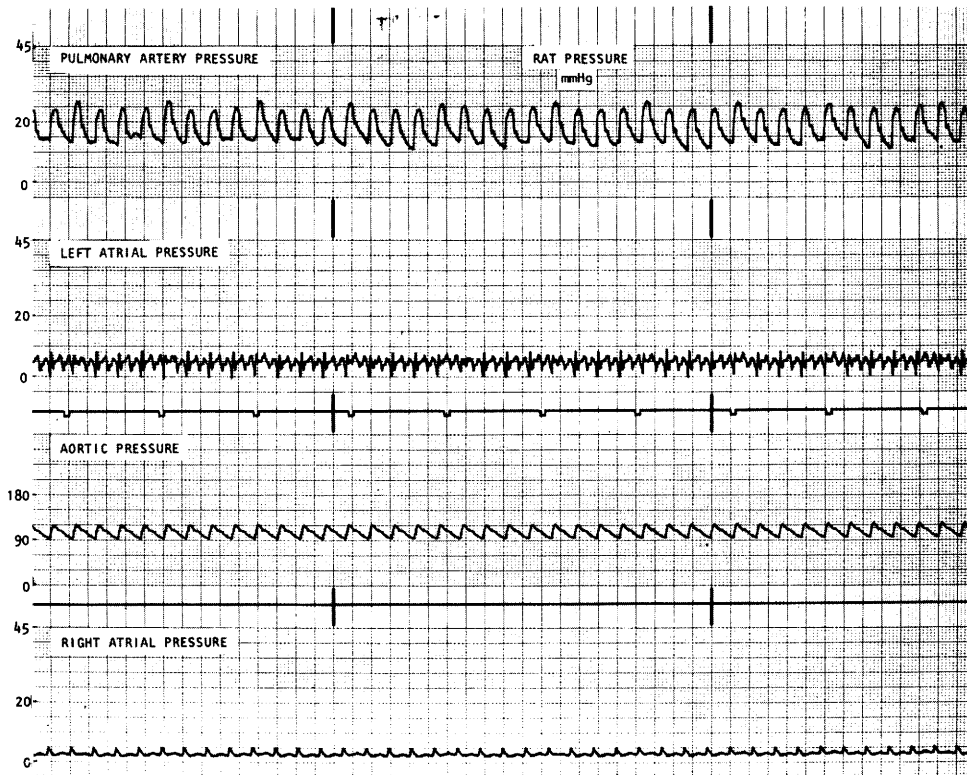


FIG. 1. The simultaneous tracings of the pulmonary artery, left atrial, aortic, and right atrial pressures are shown in this figure. The paper speed is 25 mm/second.

values given. However, this study was for only four rats, and the size of the animals may have been different from those presented in this study.

The pulmonary artery pressures measured in this study are similar to the 1972 study of Herget (5) which showed a pulmonary systolic pressure of 23 ± 5 , diastolic pressure of 12 ± 4 , and mean pressure of 18 ± 4 . However, in the 1974 study published by Herget, the pulmonary artery systolic pressure measured was 26 ± 3 , which is higher than that measured in his earlier study, or the pulmonary artery pressure of 21 ± 6.6 measured in this study. The values for pulmonary artery pressures recorded by Hayes (7) are much

higher, having a pulmonary systolic pressure of 36 ± 14 , diastolic of 8 ± 3 , and a mean of 22 ± 5 .

These rat pressures, particularly the pulmonary arterial and left atrial pressures, would be of interest to those investigators interested in utilizing the rat in experimental physiologic studies. Those investigators attempting anatomic studies of the circulatory system could use these pressures as guidelines for physiologic vascular distending pressures of the systemic and pulmonary circulations. Although they were obtained under general anesthesia, most studies would not be possible otherwise, with the exception of the systemic arterial pressure.

Summary. Direct pressure measurements were obtained simultaneously in the aorta, right atrium, pulmonary artery and left atrium on anesthetized, open-chest rats on a respirator. Mean pressures in the aorta were 105, right atrium 3.3, pulmonary artery 16, and left atrium 5.8 mmHg. The aortic pressure is comparable to previously published values. These vascular pressures should provide helpful guidelines to those investigators utilizing the rat in experimental physiological studies.

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