16131

An Acoustical Indicator of the Systolic End Point in Rat Blood Pressure Determinations.*

J. R. CHITTUM, H. C. HILL, JR., AND K. S. GRIMSON.
From the Department of Surgery, Duke University School of Medicine, Durham, N. C.

An electrical device for determining the systolic end point of rat blood pressures has been described by Skeggs and Leonards.[1] It consists of a small carbon telephone transmitter button placed in series with an ammeter in a low voltage wheatstone bridge circuit. Pressure on the button decreases its resistance resulting in deflection of an ammeter needle. Pressure is transmitted from the tail to the button by means of a simple lever system. Engorgement of the tail vessels and increase of size with pressure on the button occur at the systolic blood pressure level following release of occlusion of the base of the tail by an air cuff. At the moment of decrease in electrical resistance and sweep of the ammeter needle, blood pressure is read from a manometer in the air cuff system.

This electrical end point device of Skeggs and Leonards requires alternate visual observation of an ammeter needle and of a sphygmomanometer. The modification to be described was devised to facilitate and improve accuracy of readings by permitting simultaneous visual and auditory observation. A set of headphones and an amplifier circuit was substituted for the ammeter. Decrease of resistance within the carbon button at the end point is heard as a change of tone permitting undivided visual attention to the sphygmomanometer.

Acoustical Indicator. The circuit for the acoustical indicator is illustrated in Fig. 1. A sensitive carbon button similar to that of the Skeggs and Leonards apparatus is placed in the grid circuit of a 1LE3 triode amplifier tube. The neon lamp employed is of low wattage (¼ watt) and has no internal resistor. The fixed condenser has a capacity of 0.002 Mfd. A variable resistor of 5,000 ohms is placed in series with the carbon button and another variable resistor of 7,500 ohms is put in series with the cathode and the neon lamp. A fixed carbon resistor of 270,000 ohms is required in series with the plate of the triode tube. The headphones have a resistance of 3,000 ohms.

The circuit operates on direct current from batteries. A switch is provided to disconnect all batteries except the 120 v power supply when the apparatus is not in use. This circuit produces a rapidly interrupted current audible in the headphones as a distinct tone. The tone can be varied to a higher or lower pitch by changing the two variable resistors permitting adjustment for maximum change of pitch when engorgement of the vessels of the rat's tail produces pressure on the carbon button.

Method of Use. The technique of taking rat blood pressures with the acoustical indicator is similar to that used when employing the ammeter circuit. The rat tail is adjusted in the carbon button holder and then the acoustical indicator is switched on. The pressure in the air cuff is elevated above the expected blood pressure and then slowly released. The tone in the headphones rises during inflation of the cuff and decreases with release of the cuff pressure until the systolic end point is reached when the pitch again increases. The end point is indicated by a smooth, rapid increase in pitch which, after attaining its maximum height, will be maintained until the cuff pressure is lowered 20 to 70 mm Hg below the systolic pressure. Artifacts produced by movements of the tail are distinguishable as rapid, transient changes in pitch.

Unfortunately it has not been possible to obtain blood pressure readings without producing vasodilatation of the tail by preparing the rat. The conventional method of obtaining

* This research was supported by a grant from the Ciba Pharmaceutical Products, Inc., Summit, N. J.

1 Skeggs, L. T. and Leonards, J. R., PROC. SOC. EXP. BIOL. AND MED., 1946, **63**, 294.

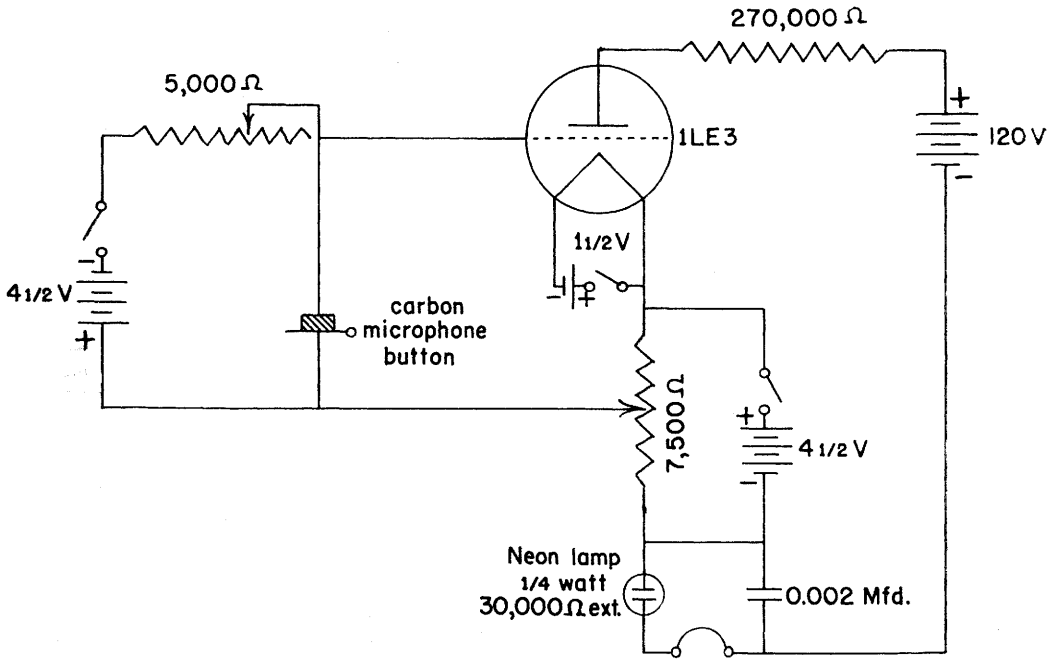

Fig. 1

vasodilatation is heating of the entire rat or of the tail alone. Williams, Harrison, and Grollman[2] have reported heating of the entire rat, exposing it to 40-42°C for 10 minutes before obtaining readings. They used the plethysmograph technique. Sobin[3] has reported equal success after heating the tail alone. Proskauer, Neumann, and Graef[4] have reported that heating elevates rat blood pressure. In our experience heating of the entire animal at 40-42°C for 10 minutes increased the rectal temperature on the average 3.3° Heating the tail alone at 42-45°C increased the rectal temperature on the average 1.9°C. However, heating either the entire animal or the tail alone produced comparable readings of systolic blood pressure.

Another method of obtaining readings is the use of a peripheral vasodilating agent. 2-Benzyl-4, 5-Imidazoline HCl (Priscol) dilates the tail vessels of the rat and permits determination of systolic blood pressure without increase of temperature of the rat. Administration of 3-4 mg/kg Priscol intramuscularly permitted blood pressure readings after 45 to 60 minutes which could be repeated at will during a period up to 9 or 10 hours after the drug.

Either heat to the entire rat or Priscol was used for the experiments below comparing 3 methods for blood pressure determinations, Grollman (plethysmographic), Skeggs and Leonards, and the acoustical modification.

Experimental Evaluation. Readings of the rat systolic blood pressure were compared using the Grollman plethysmograph technique, the ammeter circuit, and the acoustical indicator. (Table I). Simultaneous readings were obtained with the plethysmograph and one or the other electrical end point devices. Readings were repeated alternating the electrical methods thereby comparing all 3 methods in 6 to 7 minutes. Plethysmographic readings were consistently lower than obtained with either electrical device. The average difference in blood pressure was 3-5 mm Hg with heated rats and 9-10 mm Hg with unheated Priscol treated rats. Both electrical end point devices would often give blood pressure readings following Priscol preparation when they were unobtainable with the

[2] Williams, J. R., Jr., Harrison, T. R., and Grollman, A., *J. Clin. Invest.*, 1939, **18**, 373.

[3] Sobin, S. S., *Am. J. Physiol.*, 1946, **146**, 179.

[4] Proskauer, G. G., Neumann, D., and Graef, I., *Am. J. Physiol.*, 1945, **143**, 290.

TABLE I.
Comparison of Systolic Blood Pressure Readings by 3 Methods in Heated Normal Rats and in Priscol Treated Rats Without Heating.

	Rats heated 10 min. at 40°-41°C				Priscol treated		
Rat	Plethysmograph	Ammeter	Headphones		Plethysmograph	Ammeter	Headphones
1	108	112		*	90		104
	112	110			90		94
	112	114			88		92
	104		114		90	110	
	106		108		100	106	
	110		116		98	102	
2	98		102	*	100	112	
	98		98		98	104	
	96		96		90	108	
	90	90			96		102
	90	90			94		102
	88	88			90		98
3	116		122	†	70		88
	114		118		78		92
	114		120		84		104
	118	122			90	94	
	116	116			86	96	
	112	116			82	90	
4	84	88		†	80	94	
	82	84			90	90	
	84	84			86	92	
	78		82		82		96
	80		84		84		96
	78		82		80		94

* 3 mg/kg Priscol I.M. † 4 mg/kg Priscol I.M.

plethysmograph. This greater sensitivity was observed during the periods of minimum vasodilatation before and after the maximum effect. Frequently readings taken by the ammeter circuit and the acoustical indicator coincided. However, the acoustical indicator gave readings that averaged 1.25 mm Hg above those of the ammeter circuit when a series of 100 readings by each device was compared.

Conclusion. The acoustical modification of the Skeggs and Leonards apparatus described facilitates determination of the blood pressure of rats but can be used only after vasodilatation produced by heat or drugs. Priscol produces vasodilatation sufficient for repeated blood pressure determination during a 9- or 10-hour period.

We wish to express appreciation to A. A. Foster for directing our attention to the electrical circuit herein described and to L. T. Skeggs and J. R. Leonards for one of their electrical end point devices.

16132
Relaxin Content of Blood, Urine and Other Tissues of Pregnant and Postpartum Guinea Pigs.*

M. X. ZARROW.† (Introduced by Frederick L. Hisaw.)
From the Biological Laboratories, Harvard University, Cambridge, Mass.

Relaxin was first detected in the blood of pregnant rabbits and guinea pigs (Hisaw[1]) and was subsequently found in the blood of pregnant sows, dogs, cats, mares and women (Hisaw;[2] Brouha and Simonnet;[3] Pommerenke;[4] Abramson, Hurwitt and Lesnick[5]). Separation of the pubic bones which occurs

* Aided in part by a grant from the Donner Foundation to Prof. Frederick L. Hisaw.

† Present address, Department of Pharmacology, Yale University School of Medicine, New Haven, Conn.

1 Hisaw, F. L., PROC. SOC. EXP. BIOL. AND MED., 1926, **23**, 661.