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Differential Cardiac Responses To Activation of Right and Left Cardiovascular Reflexes

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DIFFERENTIAL CARDIAC RESPONSES TO ACTIVATION OF RIGHT AND LEFT CARDIOVASCULAR REFLEXES

by

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LIFE

Marva Charlyne Worthen was born in North Little Rock, Arkansas, January 21, 1941.

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

The homeostatic control of the cardiovascular system is remarkable in that heart rate and systemic blood pressure are maintained, within narrow limits, at certain normal levels. Even following large increases, as occur in exercise, or decreases, as occur in hemorrhage, the blood pressure is adjusted back to or in the direction of the control value. This regulation occurs as a result of the control of certain peripheral reflexes in the cardiovascular system. Heymans and Neil (1) have extensively reviewed the history of cardiovascular reflex mechanisms. Since much of the original work in the area was performed by Germans and written in that language, and since repeated references have been made to these classical experiments, the following historical review will contain several references to citations in the Heymans and Neil monograph.

Awareness of the pressoreceptor reflexes came with the discovery of the aortic depressor nerve in 1866 by Cyon and Ludwig (1). As early as 1836, Sir Astley Cooper noted that occlusion of the common carotid arteries resulted

in tachycardia and systemic hypertension, but he attributed the effects to cerebral anemia (1). Francois-Franck observed a bradycardia, following an induced pressure rise in the perfused carotido-cephalic circulation. He, like Cooper and others before him, ascribed the response as due to a direct effect of blood pressure on the medullary centers (1). This explanation was accepted until 1923, when Hering localized the site of activation of the reflex to nerve endings in the carotid sinus region of the dog. He found that stimulation of the central end of the cut sinus nerve resulted in reflex bradycardia and hypotension and that section of both sinus nerves caused systemic hypertension (1). He therefore documented the fact that these nerves are tonically active. Since that time, the carotid sinus reflex has been extensively investigated from many approaches.

One of the methods of study involves occlusion of the common carotid artery. This procedure results in an initial 40% or more decrease in pressure within the carotid sinus in the dog and a return to within 10-35% of the initial value within 30 seconds (2). Considerable backflow occurs via the Circle of Willis and occipital arteries from anastamotic vessels. Even though the pressure decrease within the sinus following carotid occlusion is counteracted by backflow from anastamotic vessels, the pulsatile pressure has a greater effect on the carotid sinus reflex response than a steady pressure of the same mean value (3). Bronk and Stella (4) had also shown that the baroreceptors respond

to the rate of change of pressure. Therefore, common carotid occlusion results in a decrease in tonic activity of the sinus nerve, resulting in responses opposite to those noted upon stimulation the sinus nerve.

The effect of supracollicular and intercollicular transections on the carotid occlusion response has been noted by Manning, 1962 (5), and Reis, 1964 (6). In both cases, the reflex response to carotid occlusion was reduced or abolished after transection.

Vagal afferents mediating pressor and acceleratory reflexes were first observed by Knoll, 1881 (1). Literature concerning reflexes mediating both pressor and depressor responses has been reviewed by Aviado and Schmidt (7). They cite evidence for activation of pressor and accelerator responses from vagal afferents. These fibers have receptors in the aortic body and possibly in the great veins and right auricle which respond to volume increases (Bainbridge and Mc Dowall reflexes) (8). Pressor responses have also been noted upon stimulation of the central end of the cut abdominal vagus in the cat (9). These experiments also yielded a blood pressure rise of 30 mm Hg. Many observations have been made on the cardiovascular responses to vagal afferent discharge and both pressor and depressor responses have been noted. The responses seem to depend somewhat upon stimulation parameters. The literature is very confusing with regard to vagal afferents. Neither the origin, mode of activation nor physiologic significance of these fibers have been clearly

defined (10).

The carotid occlusion responses have not been studied with regard to demonstrating the effects of occlusion of the left side in comparison with the right. Efferent sympathetic outflow has been shown to be unequally distributed in the right and left sympathetic trunks (11).

It is the purpose of this thesis to examine the responses of right versus left carotid occlusion, and right versus left central vagal stimulation, and to show the effects of supracollicular lesions on these responses.

CHAPTER II

MATERIALS AND METHODS

Thirty-three mongrel dogs of both sexes, 8-13 kilograms, were used in this study. They were anesthetized with 3 mg/kg of Sernylan and 80-100 mg/kg of Chloralose. A midline incision was made in the throat, both vagi and common carotid arteries exposed and desheathed by gross dissection, and a loose ligature placed around each. The trachea was cannulated and the dog was placed on artificial respiration. The femoral artery was catheterized for blood pressure recording. Standard limb lead electrocardiograms were recorded from needle electrodes inserted into the four limbs. These were used in some cases for heart rate determinations.

When lesions were made, the animal was placed in a Kopf stereotaxic apparatus and carefully aligned. A midline incision was made in the scalp and the central portion of the skull was exposed and cleaned of overlying tissue. A cautery was used to separate tissue with minimum bleeding. Holes were drilled in the skull over the area to be lesioned and the overlying bone removed with rongeurs for a distance of 12 to 14 mm lateral to the midline on

each side. The dura was punctured with a dural hook and retracted to allow placement of a bank of electrodes --- 1, 3 and 5 or 1, 3, 5, 7, 9, and 11 mm lateral to the midline in either the right or left side. The electrodes were lowered to the base of the skull, at which point an H-bottom-(H_b) reading was taken. A 200 milliamp current was passed through each electrode for 30-60 seconds from an RF generator. The bank of electrodes was then raised 2 or 3 mm and the lessions were repeated. Lesions were placed in the brain stem from the H_b position to H_b plus 10 mm. The anterior-posterior coordinate was R 16.0 (12). Histological examination revealed that this area was in the posterior hypothalamus and upper midbrain.

Carotid occlusion was effected by clamping the common carotid arteries in the neck with bulldog clamps. To study the relative contributions of right and left carotid occlusion, one side was initially occluded for 20-30 seconds. This occlusion was maintained while the other common carotid artery was then clamped for the same period of time. The cervical vagi were ligated and cut distal to the tie. The central end was stimulated with a Porter electrode, using parameters of 5 volts, 5 milliseconds, and a frequency of 30 cycles/sec. The stimulation was monitored by a Tektronix Type 502 dual beam oscilloscope. The nerves were periodically covered with warm mineral oil.

Femoral artery pressure was measured with a Statham P23Db transducer. The signal transducer output was amplified in a Honeywell carrier amplifier

and recorded photographically in a Midwestern Instruments recording oscillograph. The femoral artery pressure pulses were also fed into an electronic circuit which integrated the number of pulses per unit time, thus producing a DC signal which was proportional to heart rate (13). This signal was recorded continuously on the Midwestern oscillograph. The photographic paper was processed and developed in a single unit Consolidated Electrodynamics oscillogram processer.

The experimental procedure was as follows:

1. Following a suitable control period, one common carotid artery was occluded for a period of 20-30 seconds. The other carotid was then occluded, with the first carotid clamp maintained in place. This process was repeated several times before and after vagotomy. Initial occlusion alternated between the right and left carotid arteries.

2. After bilateral vagotomy, the central ends of the cut right and left vagus nerves were stimulated.

3. Lesions were made on one side of the brain; carotid occlusions and central vagal stimulations were then repeated.

4. Lesions were then made on the other side of the brain and the procedure in (3) was repeated.

The animal was sacrificed by giving an overdose of barbiturate and/or disconnecting the respirator. The brains from 5 dogs were removed and

stained for identification of the lesioned area. In the analysis of the carotid occlusion data, unilateral responses were expressed in terms of percentage change of the total response to bilateral carotid occlusion. Each determination had its own control. In some cases, occlusion responses were expressed as absolute percentage changes over control, as were the responses to right and left vagal stimulation.

CHAPTER III

RESULTS

A. Carotid Occlusion Responses before and after Vagotomy

Figure 1 is a reproduction of an actual record of the response to right carotid occlusion (RCO) followed by left carotid occlusion (LCO). The control heart rate was 180 beats per minute. Following RCO the rate increased to 195 and upon subsequent LCO to 215 beats per minute. The contribution of RCO to the total response with bilateral carotid occlusion (BCO) was 42.8 per cent. The blood pressure rose from a control of 210/172 mm Hg to 240/198 upon RCO and 330/260 in response to BCO. RCO contributed approximately 28 per cent to this total response. The pulse pressure increased from a control of 38 mm Hg to 42 upon RCO and 70 following BCO. These increases could be due to increased contractility of the cardiac musculature and/or distensibility changes as a result of the very high mean pressure.

A record of LCO followed by RCO is shown in figure 2. Control values were: heart rate = 180 beats per minute and blood pressure = 200/164 mm Hg. Upon LCO the heart rate increased to 185 beats per minute and blood pressure

to 210/170 mm Hg. The response to BCO was 212 beats per minute and a blood pressure of 328/258 mm Hg. The contribution of LCO to the total response was 15.6 per cent for heart rate and approximately 6.5 per cent for blood pressure. Note that the heart rate and blood pressure responses were greater to RCO than LCO.

In some animals, the cardiovascular responses to LCO and RCO were equal and in others the systolic and diastolic pressure increases were greater in response to LCO. However, the average results in 13-19 dogs indicate that the contribution to the total response obtained by BCO is significantly greater from the right side than from the left (Table I), except for the systolic pressure response ($P = 0.058$). The first table compares right versus left responses before and after vagotomy. The same "sidedness" effect was noticed following bilateral cervical vagotomy (Table I and figure 3). After vagotomy, there was a decrease in the per cent contribution of occlusion of either side to BCO. Using a significance criterion of $P = .03$, it is obvious from Table II that all the differences before lesions are significant. This table compares the responses of the same side before and after vagotomy.

All control values increased after bilateral vagotomy (Table IV). The per cent increase in systolic and diastolic pressures in response to unilateral carotid occlusion was decreased by vagotomy. This change in response was greater upon LCO. The per cent increase in heart rate was also lessened, but

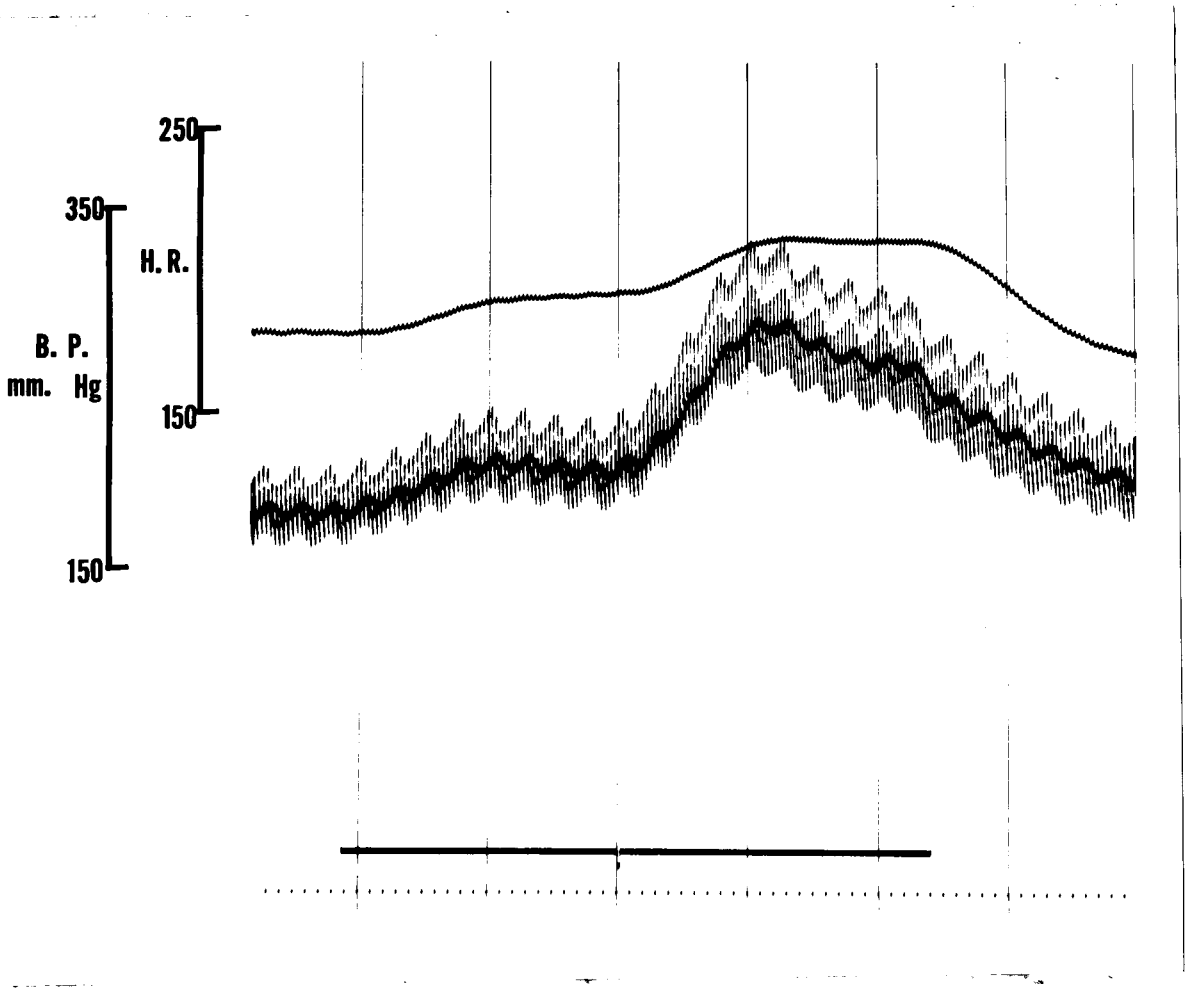

FIGURE 1

RESPONSE TO RIGHT CAROTID OCCLUSION

FOLLOWED BY LEFT CAROTID OCCLUSION

Top to Bottom:

1) Heart Rate
2) Blood Pressure
3) Signal Marker --- On = RCO; Code 1 = LCO
4) One second time Marker
   Vertical Lines = 10 sec time intervals

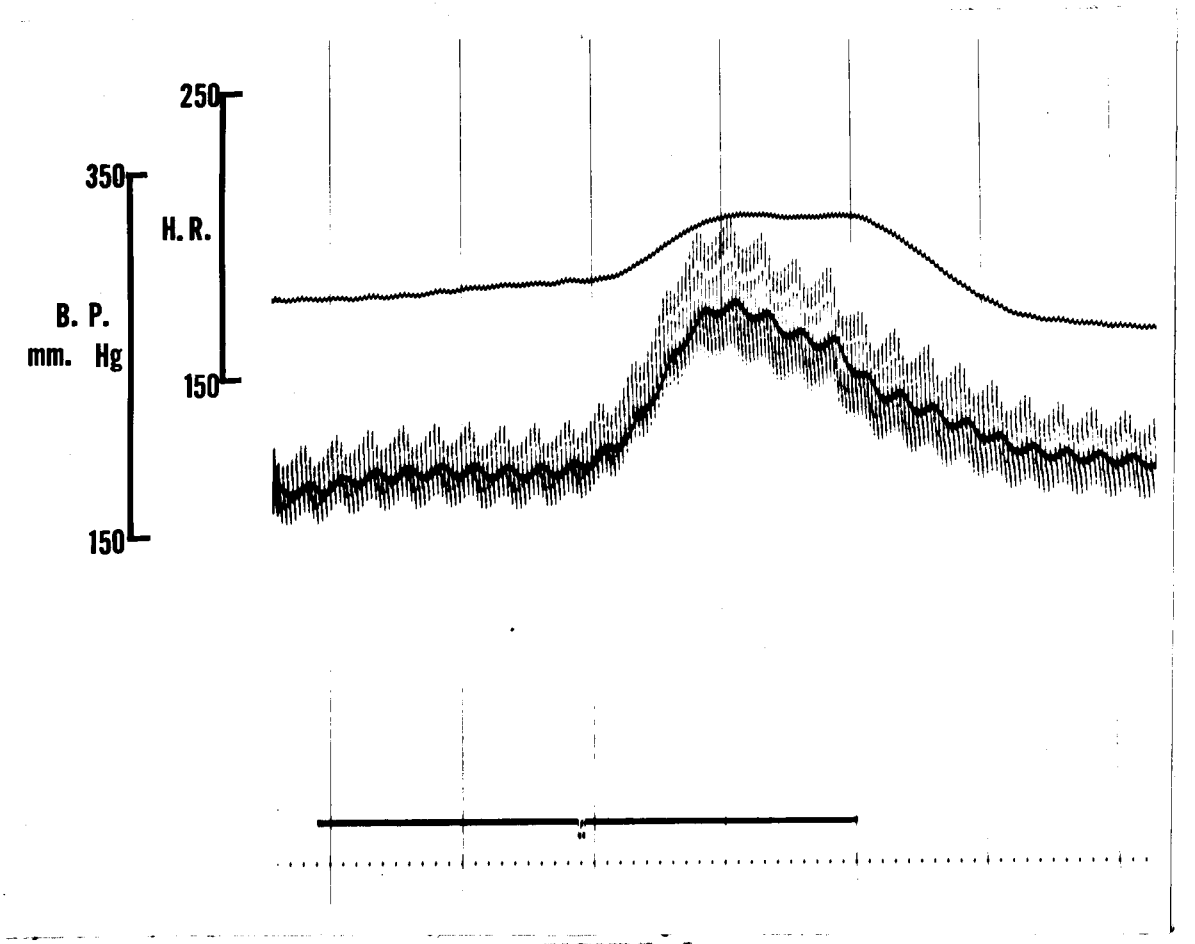

FIGURE 2

RESPONSE TO LEFT CAROTID OCCLUSION FOLLOWED BY RIGHT CAROTID OCCLUSION

Top to Bottom:

1) Heart Rate
2) Blood Pressure
3) Signal Marker --- On = LCO; Code 2 = RCO
4) One second time Marker

Vertical Lines = 10 sec time intervals

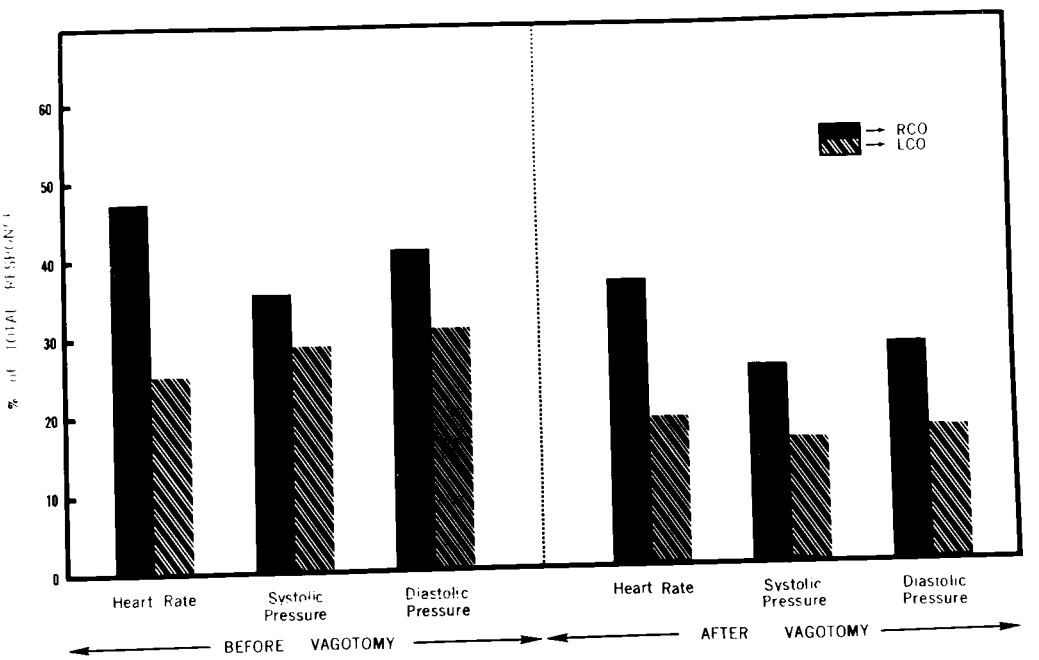

FIGURE 3

COMPARISON OF RESPONSES TO LEFT AND RIGHT CAROTID OCCLUSIONS BEFORE AND AFTER VAGOTOMY

RCO - Right Carotid Occlusion

LCO - Left Carotid Occlusion

Bars represent the contribution of each side to the bilateral carotid occlusion response, which is taken as 100 per cent.

TABLE I

SIGNIFICANCE OF THE DIFFERENCES BETWEEN RESPONSES TO RIGHT AND LEFT CAROTID OCCLUSION BEFORE AND AFTER VAGOTOMY AND BEFORE AND AFTER LESIONS

	HEART RATE			SYSTOLIC PRESSURE			DIASTOLIC PRESSURE		
Procedure	# of Obs.	Mean % of Total Resp.	S.E.	# of Obs.	Mean % of Total Resp.	S.E.	# of Obs.	Mean % of Total Resp.	S.E.
Before Vag.*									
RCO	28	47.6	2.6	44	35.6	2.2	44	41.2	2.7
LCO	26	25.1	2.4	43	30.8	2.0	43	31.2	2.2
		P = .0005			P = .058			P = .005	
After Vag.*									
RCO	46	36.5	2.6	59	25.8	1.8	54	28.0	1.8
LCO	44	18.6	1.7	49	16.0	1.4	49	17.6	1.6
		P = .0005			P = .0005			P = .0005	
Before Lesions†									
RCO	42	22.0	1.9	50	22.4	0.5	51	22.5	1.8
LCO	39	10.2	1.7	43	12.0	1.2	46	12.4	1.5
		P = .0005			P = .0005			P = .0005	
After Lesions†									
RCO	31	28.0	4.3	37	26.4	2.0	38	32.0	3.5
LCO	30	13.9	3.6	34	12.2	1.3	35	11.1	1.3
		P = .01			P = .0005			P = .0005	

RCO = Right Carotid Occlusion
LCO = Left Carotid Occlusion
Vag. = Vagotomy
Resp. = Response

P = Probability
S.E. = Standard Error
Obs. = Observations
* Averaged from 13-19 dogs
† Averaged from 9 dogs

TABLE II

SIGNIFICANCE OF THE DIFFERENCES IN RESPONSES TO UNILATERAL CAROTID OCCLUSION BEFORE AND AFTER VAGOTOMY AND BEFORE AND AFTER LESIONS

	HEART RATE			SYSTOLIC PRESSURE			DIASTOLIC PRESSURE		
Procedure	# of Obs.	Mean % of Total Resp.	S.E.	# of Obs.	Mean % of Total Resp.	S.E.	# of Obs.	Mean % of Total Resp.	S.E.
RCO									
Before Vag.	28	47.6	2.6	44	35.6	2.2	44	41.2	2.7
After Vag.	46	36.5	2.6	59	25.8	1.8	54	28.0	1.8
		P = .0025			P = .0025			P = .0025	
LCO									
Before Vag.	26	25.1	2.4	43	30.8	2.0	43	31.2	2.2
After Vag.	44	18.6	1.7	49	16.0	1.4	49	17.6	1.6
		P = .025			P = .0005			P = .0005	
RCO									
Before Les.	42	22.0	1.9	50	22.4	0.5	51	22.5	1.8
After Les.	31	28.0	4.3	37	26.4	2.0	38	32.0	3.5
		P = .15			P = .025			P = .01	
LCO									
Before Les.	39	10.2	1.7	43	12.0	1.2	46	12.4	1.5
After Les.	30	13.9	3.6	34	12.2	1.3	35	11.1	1.3
		P = .475			P = .475			P = .25	

Les. = Lesions
Other abbreviations are the same as for Table I.
Values before and after lesions were averaged from 9 dogs.
Values before and after vagotomy were averaged from 13-19 dogs.

the response to RCO was affected more in this case. The systolic and diastolic pressure increases in response to BCO were enhanced and the heart rate response depressed by vagotomy (TABLE IV). Note that the responses in Table IV are expressed in terms of per cent of control rather than per cent of the total response.

B. Carotid Occlusion Responses before and after Lesions

Averages from 9 animals indicate that the greater contribution of RCO to the total BCO response noted before and after vagotomy persists after lesions (Table I, figure 4). The contribution to the total response obtained by BCO is significantly greater from the right side than from the left (Table I). Upon compering the same side before and after lesions, one notices a tendency toward increased response to unilateral carotid occlusion after lesions, but these differences are not significant except for the systolic and diastolic pressure responses to RCO. The diastolic pressure response to LCO is the only response evidencing a slight decrease (Table II).

Table III is a summary of the tables in the appendix, in which are tabulated the individual responses to various experimental procedures.

Figure 5 illustrates in graphic form, the per cent increase in control response to BCO, and that part contributed by RCO and LCO before and after vagotomy.

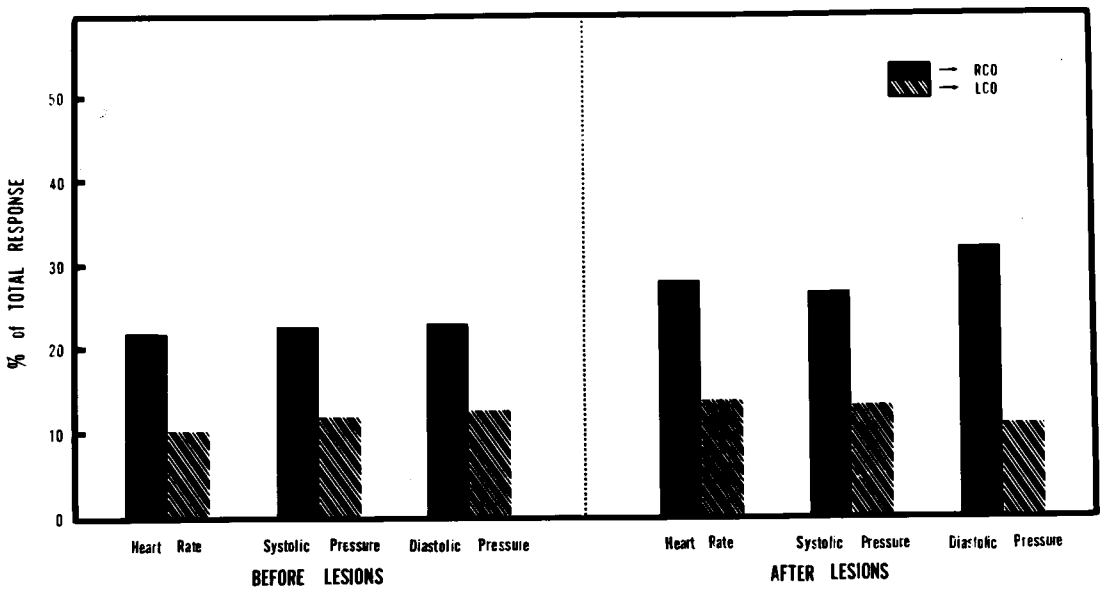

FIGURE 4

COMPARISON OF RESPONSES TO LEFT AND RIGHT CAROTID OCCLUSIONS BEFORE AND AFTER LESIONS

RCO - Right Carotid Occlusion

LCO - Left Carotid Occlusion

Bars represent the contribution of each side to the bilateral carotid occlusion response, which is taken as 100 per cent.

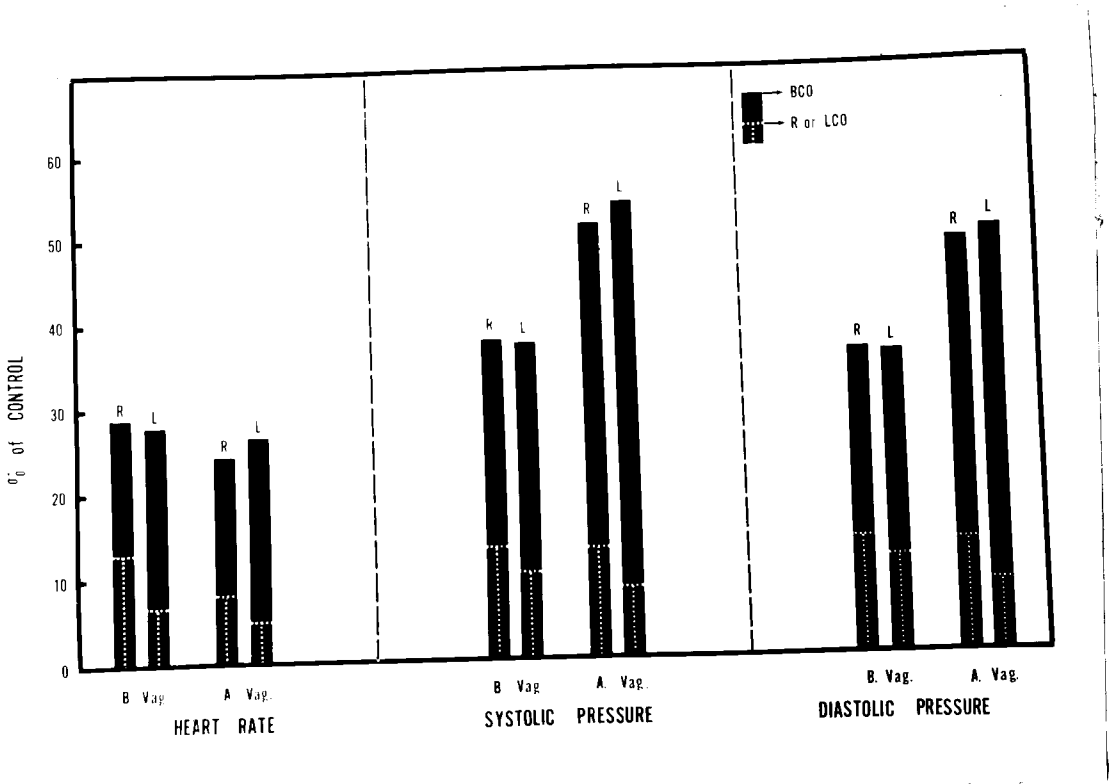

FIGURE 5

EFFECT OF VAGOTOMY ON THE RESPONSE TO RCO, LCO AND BCO

Black Bars --- Bilateral Carotid Occlusion Response

White Dots --- that part of the response contributed by

R - Right Carotid Occlusion

L - Left Carotid Occlusion

The responses are expressed as percentage change from control.

TABLE III

SUMMARY OF MEANS OF ABSOLUTE VALUES AND % CONTRIBUTION TO BILATERAL CAROTID OCCLUSION FROM THE RIGHT AND LEFT SIDES

Procedure	Control	RCO	BCO	%	Control	LCO	BCO	%
HEART RATE (beats/min)								
Before Vag.	158	179	203	47.6	156	165	199	25.1
After Vag.	174	188	216	36.5	171	179	216	18.6
Before Les.	166	174	198	22.0	165	169	199	10.2
After Les.	179	185	204	28.0	181	183	207	13.9
SYSTOLIC PRESSURE (mm Hg)								
Before Vag.	180	204	247	35.6	179	197	245	30.8
After Vag.	184	207	278	25.8	182	197	280	16.0
Before Les.	183	198	245	22.4	181	183	245	12.0
After Les.	154	170	216	26.4	156	164	227	12.2
DIASTOLIC PRESSURE (mm Hg)								
Before Vag.	142	161	192	41.2	139	155	189	31.2
After Vag.	150	170	222	28.0	149	161	223	17.6
Before Les.	147	159	195	22.5	145	151	195	12.4
After Les.	113	129	168	32.0	115	122	176	11.1

RCO Right Carotid Occlusion
LCO Left Carotid Occlusion
BCO Bilateral Carotid Occlusion
Vag. Vagotomy
Les. Lesions
% Resultant percentage contribution
Values before and after lesion were averaged from 9 dogs.
Values before and after vagotomy were averaged from 13-19 dogs.

TABLE IV

EFFECTS OF VAGOTOMY ON THE RESPONSES TO UNILATERAL AND BILATERAL CAROTID OCCLUSION†

HEART RATE Beats/min	Control Values		Response: % of Control			
	RCO	LCO	RCO	BCO	LCO	BCO
Before Vagotomy	157	156	13.3	29.0	6.6	27.9
After Vagotomy	174	171	8.0	24.1	5.0	26.5
% Change	10.5*	9.6*	5.3	4.9	1.6	1.4
SYSTOLIC PRESSURE mm Hg	**Control Values**		**Response: % of Control**			
Before Vagotomy	180	179	13.3	37.4	10.2	36.9
After Vagotomy	184	182	12.4	51.0	8.1	53.7
% Change	2.2*	1.6*	0.9	13.6*	2.1	16.8*
DIASTOLIC PRESSURE mm Hg	**Control Values**		**Response: % of Control**			
Before Vagotomy	142	139	13.8	35.7	11.2	35.4
After Vagotomy	150	174	13.1	48.1	8.4	49.9
% Change	6.3*	25.2*	0.7	12.4*	2.8	14.5*

† Average of 13-19 dogs

* Increase

TABLE V

SIGNIFICANCE OF THE DIFFERENCES IN RESPONSE TO RIGHT AND LEFT CENTRAL VAGAL STIMULATION

	HEART RATE			SYSTOLIC PRESSURE			DIASTOLIC PRESSURE		
Procedure	# of Obs.	Mean: % of** Control Resp.	S.E.	# of Obs.	Mean: % of** Control Resp.	S.E.	# of Obs.	Mean: % of** Control Resp.	S.E.
RCVS	64	23.7	2.4	65	45.6	4.1	65	44.2	4.0
LCVS	64	36.1	2.9	69	56.4	4.1	68	57.9	4.6
		P = .0025			P = .05			P = .0125	

* Average of 27 dogs

** All % changes represent increases from control

RCVS Right Central Vagal Stimulation

LCVS Left Central Vagal Stimulation

C. Responses to Central Vagal Stimulation

The cardiovascular responses to left central vagal stimulation (LCVS) were more pronounced than those to stimulation of the right central vagus (RCVS). The average difference from 27 dogs comparing LCVS vs RCVS were: heart rate - 11.3% greater; systolic pressure - 10.8% greater; and diastolic pressure - 13.7% greater. The heart rate and diastolic pressure differences were statistically significant (Table V).

Figure 6 is a reproduction of the original oscillogram showing the effect of LCVS before lesions. The control heart rate in this animal was very high --- 260 beats/minute. LCVS at 4 volts, 5 milliseconds, and 30 cycles/second did not affect the heart rate. The control blood pressure was 159/125 mm Hg. Pulse pressure was 34 and mean pressure 139 mm Hg. The response to LCVS was: blood pressure - 229/187, mean pressure 202 and pulse pressure - 42 mm Hg.

Following lesions (figure 7) the heart rate fell to 217 beats per minute and blood pressure to 126/80. Mean pressure was 100 and pulse pressure 46 mm Hg. The response to LCVS in this case, resulted in a marked heart rate increase to 270 beats per minute, blood pressure 265/210, mean pressure - 229 and pulse pressure of 55 mm Hg. The pulse pressure increase was probably due to distensibility changes since it increased after the mean pressure had risen, but could have been due to augmentation (14).

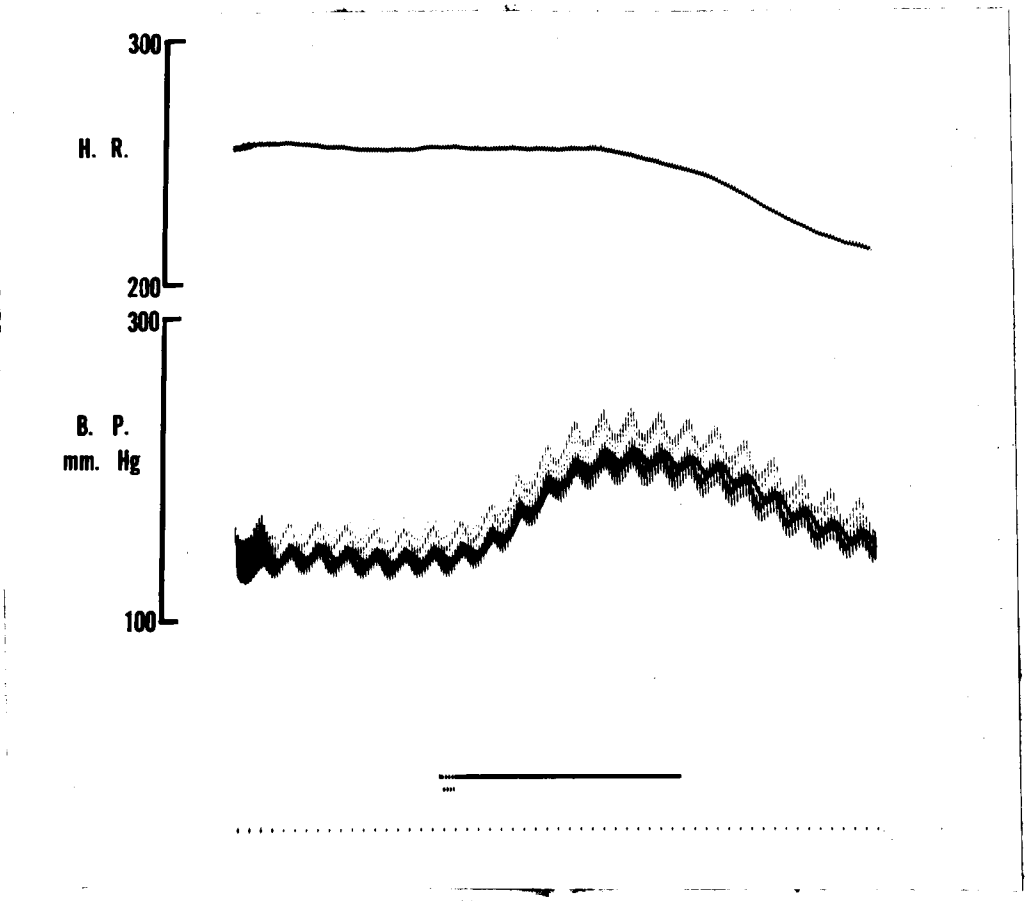

FIGURE 6

RESPONSE TO LEFT CENTRAL VAGAL STIMULATION BEFORE LESIONS

Top to Bottom:

1) Heart Rate
2) Blood Pressure
3) Signal Marker
4) One second time marker

On signal - The left central vagus nerve was stimulated at 4 volts, 5 milliseconds and 30 cycles per second.

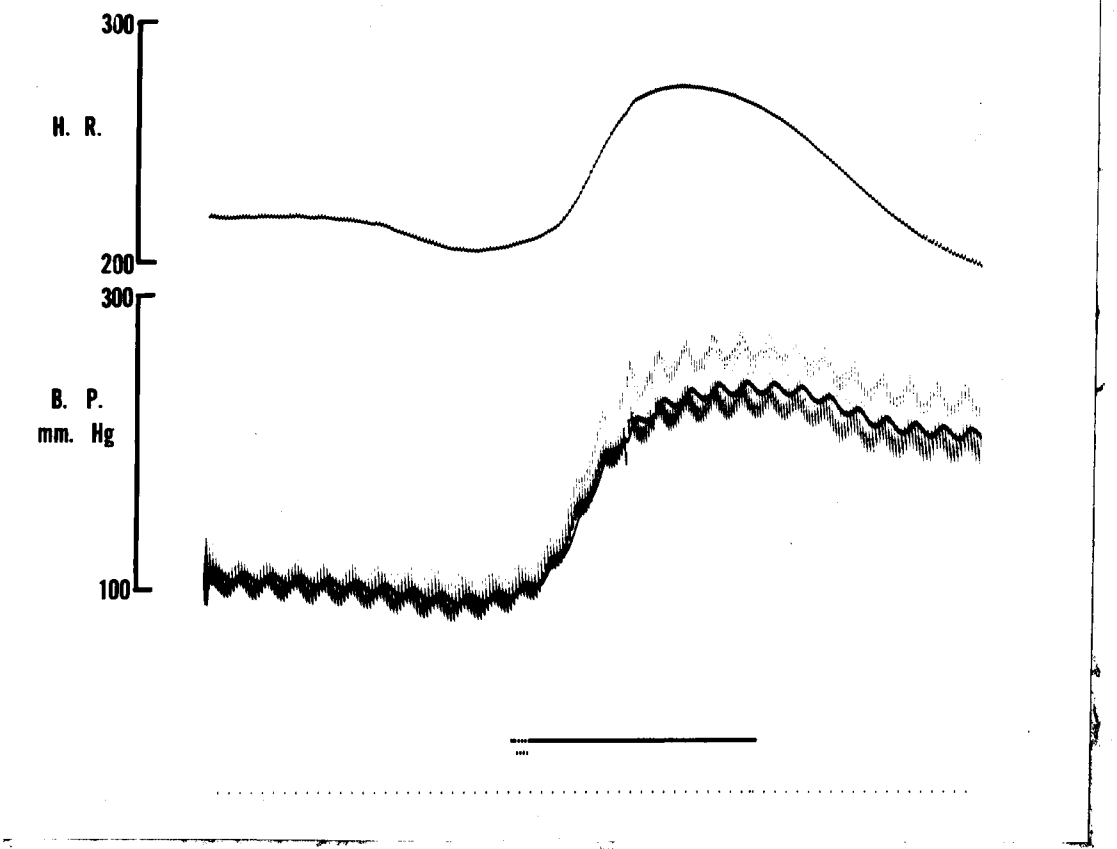

FIGURE 7

RESPONSE TO LEFT CENTRAL VAGAL STIMULATION AFTER LESIONS

Top to Bottom:

1) Heart Rate
2) Blood Pressure
3) Signal Marker
4) One second time marker

On signal - The left central vagus nerve was stimulated at 4 volts, 5 milliseconds and 30 cycles per second.

TABLE VI

SIGNIFICANCE OF THE DIFFERENCES BETWEEN RESPONSES TO RIGHT AND LEFT CENTRAL VAGAL STIMULATIONS BEFORE AND AFTER LESIONS AND TO DIFFERENCES IN RESPONSE OF UNILATERAL CENTRAL VAGAL STIMULATION BEFORE AND AFTER LESIONS*

	SYSTOLIC PRESSURE			HEART RATE			DIASTOLIC PRESSURE		
Procedure	# of Obs.	Mean: % of** Control Resp.	S.E.	# of Obs.	Mean: % of** Control Resp.	S.E.	# of Obs.	Mean: % of** Control Resp.	S.E.
Before Lesions									
RCVS	31	52.1	7.6	26	26.4	4.3	31	51.8	7.0
LCVS	34	55.0	6.1	27	36.0	5.3	33	58.6	7.2
		P = .04			P = .1			P = .25	
After Lesions									
RCVS	26	86.0	5.1	26	29.3	2.6	26	97.7	6.8
LCVS	26	97.8	5.9	26	42.2	3.2	26	108.9	7.2
		P = .1			P = .0025			P = .15	
RCVS									
Before Les.	31	52.1	7.6	26	26.4	4.3	31	51.8	7.0
After Les.	26	86.0	5.1	26	29.3	2.6	26	97.7	6.8
		P = .0005			P = .3			P = .0005	
LCVS									
Before Les.	34	55.0	6.1	27	36.0	5.3	33	58.6	7.2
After Les.	26	97.8	5.9	26	42.2	3.2	26	108.9	7.2
		P = .0005			P = .15			P = .0005	

* Average of 9 dogs
** All % changes represent increases from control
RCVS Right Central Vagal Stimulation
LCVS Left Central Vagal Stimulation

Nine animals were used in the lesion experiments. Comparison of the response to RCVS versus LCVS indicates no statistically significant difference between responses except for the heart rate response after lesions (Table VI). In all instances, however, the response to LCVS was greater and therefore lent support to the observations noted in Table V.

One of the more dramatic findings was the 34 to 50 per cent increase in systolic and diastolic pressure following supracollicular lesions, when responses to stimulation of the same side were compared before and after lesions (Table VI, figure 8). The heart rate responses, although greater following lesions were, nevertheless, not statistically significant.

The effect of the lesions was to increase the control heart rate by a negligible amount (1-3 beats per minute). The control systolic and diastolic pressures were decreased by 42 and 39 mm Hg respectively. Although the starting or control levels were much lower, the stimulation responses were less than, but within 5 mm Hg of the pre-lesion response values (Table VII). The heart rate responses overshot the pre-lesion values by 11 to 17 beats per minute.

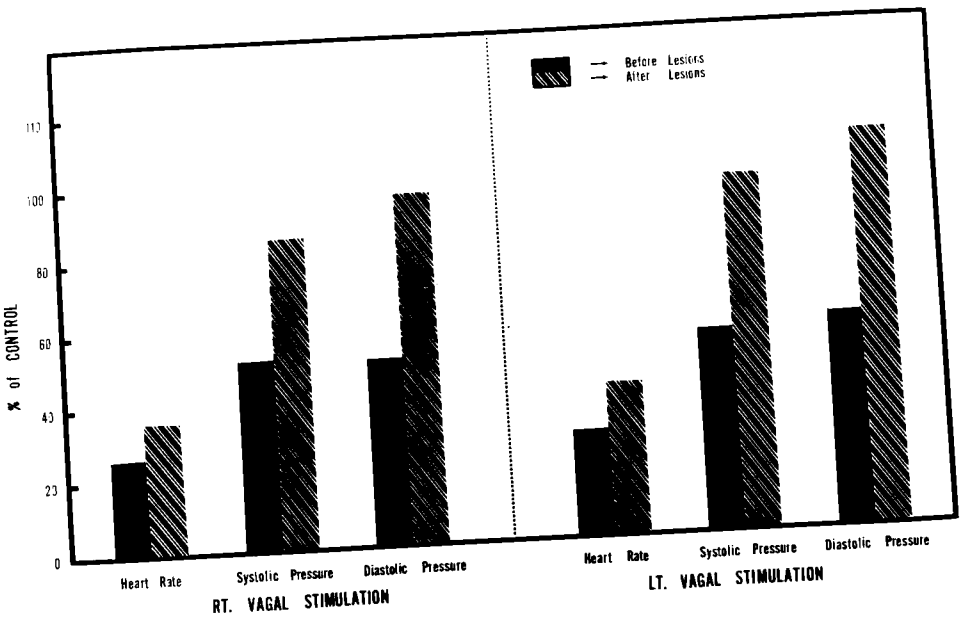

FIGURE 8

EFFECT OF LESIONS ON RESPONSES TO RIGHT AND LEFT CENTRAL VAGAL STIMULATION

TABLE VII

SUMMARY OF MEANS OF ABSOLUTE VALUES AND % OF CONTROL RESPONSES TO RIGHT AND LEFT CENTRAL VAGAL STIMULATION*

PROCEDURE	CONTROL	RCVS	%	CONTROL	LCVS	%
Heart Rate						
Before Lesions	180	224	26.4	170	226	36.0
After Lesions	181	235	29.3	178	243	42.2
Systolic Pressure						
Before Lesions	186	272	52.1	181	277	55.0
After Lesions	144	270	86.0	139	276	97.8
Diastolic Pressure						
Before Lesions	144	214	51.8	140	215	58.6
After Lesions	105	209	97.7	107	215	108.9

RCVS Right Central Vagal Stimulation

LCVS Left Central Vagal Stimulation

% Responses to Central Vagal Stimulation expressed as a percentage of the control value

* Averages from 9 dogs

CHAPTER IV

DISCUSSION

A. Effects of Vagotomy on Carotid Occlusion

RCO has been shown (Table I) to exert a significantly greater influence on the heart rate and diastolic pressure responses than LCO before vagotomy. The increase in diastolic pressure indicates a peripheral vasoconstriction. Table III shows that the systolic pressure rose slightly more than diastolic in response to RCO, LCO and BCO. These pulse pressure rises could result from distensibility changes consequent on the high mean pressure or from cardiac augmentation (14). The variability of this function would tend to explain the fact that the systolic pressure differences were not significant.

Following vagotomy, RCO is still more influential (Table I). The qualitative changes remain as before vagotomy (Table IV). Vagotomy increased control values of all the measured parameters and also the pressure responses to BCO. The tonic efferent inhibitory vagal influence on the heart has been removed, as well as the reflex inhibition of the aortic depressor nerves (1).

Although the per cent of control response to BCO is increased following vagotomy, the per cent increase due to unilateral occlusions and the heart rate response to BCO decrease. The variability of the effects of vagotomy on BCO have been noted by other workers (15). This suggests the possibility that pressor responses to unilateral occlusion and heart rate responses to unilateral and bilateral carotid occlusion result largely from inhibition of vagal efferents. Pressure responses to BCO would result from facilitation, activating a direct sympathetic outflow. The decreased responses are more predominant on the left side for blood pressure changes and on the right side for heart rate responses. This finding supports the idea of a unilateral influence of the presoreceptor nerves on the cardiac vagal center, with lesser contralateral effects (16). The observation (Table I) that the sum of per cent contributions of RCO plus LCO is less after vagotomy than before, supports the assumption that unilateral occlusion responses are effected to some extent through vagal efferent inhibition and/or through sympathetic fibers in the vagus nerve (17). If one compares occlusion of the same side before and after vagotomy (Table II), the possibility of vagal mediation of unilateral responses becomes more evident.

B. Effects of Lesion on Carotid Occlusion

The dominant influence of RCO persists in the vagotomized animal before and after supracollicular lesions (Table I). These observations along with

those in the previous section are in line with findings of a predominant accelerator activity in the right sympathetic trunk in the dog (11), in the right medulla in the cat (18) and in the right hypothalamus in the dog (19, 20).

Supra-collicular lesions result in a substantial decrease in control blood pressure --- 29 mm Hg systolic and 34 mm Hg diastolic. Peiss (21) cites supporting evidence:

> "It has been my experience that midcollicular transection results in a 20-40 mm Hg decrease in mean arterial pressure. Similar data have been reported by Wang and Chai (27), in whose experiments mean arterial pressure declined 29, 41 and 42 mm Hg, respectively, after midbrain transection in cats under chloralose, pentobarbital or ether anesthesia."

Contrary findings have been reported by Bard (22). Reis (6) and Manning (23) have shown that in cats, midcollicular transection results in a fall in blood pressure and inhibits the pressor response to carotid occlusion of one carotid artery, while slowing the heart rate. This supports the findings in this thesis. In most instances, after placement of electrodes in the brain and also following lesions, a decrease in heart rate and blood pressure was observed in response to unilateral carotid occlusion. In most instances, however, these responses returned to control values and sometimes even increased by a slight amount. This effect was noticed more in response to LCO. The lesions, in these experiments, were definitely not extensive enough to interrupt all descending supracollicular pathways, but those which were destroyed certainly

were involved in the enhancement of cardiovascular responses to unilateral carotid occlusion. Release of a tonic influence on blood pressure also occurred.

C. Stimulation of the Central Vagal Nerves and the Effects of Lesions

LCVS resulted in a greater per cent increase in heart rate and blood pressure than RCVS. There are large numbers of non-myelinated fibers in the vagus nerves and about 75 per cent of those in the cervical and 90 per cent in the abdominal vagi are sensory (10). Stimulation of these fibers results in cardiovascular and other reflexes. They have also been shown to respond to many sensory modalities --- mechanical, thermal and chemical (10). The actual physiologic significant of these afferent fibers remains to be defined.

Supracollicular lesions result in a fall in control blood pressure, as previously stated. Interestingly enough, central vagal stimulation still results in a maximum pressure response almost equal to the pre-lesion response. This effect seems to represent a sort of "ceiling" response. Some pathways with tonic pressor influence seem to have been inhibited, but a "pre-set" maximum obtainable pressure and heart rate were not influenced. Examples of the "ceiling" effect can be observed in figure 6 and 7. In figure 6, the heart rate is very close to the "ceiling" value or maximum obtainable rate and therefore does not respond to subsequent central vagal stimulation. However, in fig. 7, following lesions, the heart rate has dropped tremendously and is not close to

its maximum value. As a result, a profound heart rate increase is noted upon LCVS. Blood pressure is higher before lesions than after, and like the heart rate effect, it too, rises a greater amount after lesions, in response to LCVS.

One can conclude on the basis of these experiments that stimulation of the afferent limbs of the cardiovascular reflexes, like stimulation of central and peripheral sympathetic outflows, is unevenly distributed. However, unlike direct stimulation of the sympathetic outflow, one side of the reflex limb is dominant with regard to both heart rate and blood pressure.

One can further conclude from the lesion procedures, that some collicular or supracollicular structure or structures exert tonic influence on the control blood pressure in vagotomized dogs and also greatly affects the response to unilateral carotid occlusion. Whether this "modulator" activity occurs above or below the midbrain remains to be shown. The observation that only the response to unilateral carotid occlusion is abolished after lesions suggests that this "modulator" site is supracollicular. Facilitation, resulting from BCO, would then excite enough neurons to activate sympathetic outflow.

CHAPTER V

SUMMARY

1. In dogs under Sernylan and Chloralose anesthesia, it has been demonstrated that right carotid occlusion contributes a greater proportion to the increases in heart rate, systolic pressure and diastolic pressure in response to bilateral carotid occlusion than does occlusion of the left common carotid artery. This phenomenon was observed both before and after vagotomy and before and after supracollicular lesions.

2. The percentage contribution of the carotid occlusion response of either side to bilateral carotid occlusion was decreased by vagotomy. Supracollicular lesions did not significantly affect these percentages except for the diastolic pressure response to right carotid occlusion.

3. All control values were increased by vagotomy, whereas all the per cent increases in control response to unilateral carotid occlusion were lessened. The heart rate response to bilateral carotid occlusion was also decreased in magnitude following vagotomy. The percentage of control response of systolic pressure and diastolic pressure to bilateral carotid occlusion, however, were increased by vagotomy.

4. Averages from twenty-seven (27) dogs indicated that the increased heart rate, systolic pressure and diastolic pressure response to left central vagal stimulation were significantly greater than the same responses to right central vagal stimulation.

5. In nine (9) dogs, the heart rate and pressure increases were not significantly different in response to right or left central vagal stimulation before on after lesions, with one exception. The heart rate response to left central vagal stimulation was significantly greater than the response to right central vagal stimulation after lesions.

6. The systolic and diastolic pressure increases in response to either right or left central vagal stimulation were greatly enhanced by the lesions. The slight heart rate increases were not statistically significant.

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TABLE VIII

HEART RATE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
171	200	225	53.6	165	180	222	26.3
178	188	200	45.6	175	180	195	33.4
175	185	200	40.0	175	180	195	33.4
175	182	193	38.8	170	175	189	26.2
170	182	190	60.0	170	175	187	29.4
100	130	175	40.0	100	105	164	7.8
102	145	170	64.0	102	106	170	6.0
106	132	180	35.1	110	115	169	8.5
115	136	180	32.3	115	120	175	8.4
161	190	227	44.4	155	185	225	42.8
170	200	230	50.0	175	190	230	27.3
161	200	225	61.0	175	200	225	50.0
165	180	220	27.3	168	180	210	28.5
167	190	205	60.5	159	173	195	38.9
166	194	205	72.0	172	172	199	0
169	191	215	47.8	170	185	210	37.5
167	187	207	50.0	105	119	165	23.4
110	140	170	50.0	103	115	155	23.1
105	130	162	43.9	189	195	205	36.4
190	204	206	87.5	180	185	210	16.7
180	190	213	30.3	206	210	245	10.2
180	190	208	35.7	139	160	228	26.0
209	224	245	41.7	180	190	220	25.0
143	175	229	37.2	185	195	215	33.2
180	197	217	45.9	155	164	187	28.0
185	197	215	40.0	150	160	190	25.0
155	170	180	60.0				
155	170	194	38.5				
				MEAN			
157.5	178.5	203.1	47.6	155.7	165.9	199.2	25.1

CONT = Control
RCO = Right Carotid Occlusion
LCO = Left Carotid Occlusion
BCO = Bilateral Carotid Occlusion
% = % of total response to BCO

TABLE IX

HEART RATE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
155	170	185	50.0	152	162	190	26.3
152	170	190	47.5	152	160	187	22.8
152	167	187	43.0	152	160	185	24.2
150	167	185	48.5	152	160	189	21.6
200	215	248	31.2	195	200	250	9.1
210	240	250	75.0	205	212	245	17.5
205	223	245	45.0	209	220	247	29.0
195	210	275	66.5	208	220	244	33.2
192	216	252	40.0	168	192	252	28.6
188	204	252	55.5	168	192	252	28.6
168	192	252	28.6	180	192	252	16.7
180	192	252	28.6	168	192	240	33.4
155	175	218	31.7	155	160	220	7.7
160	190	220	50.0	160	165	225	7.7
130	144	172	33.4	134	140	175	14.6
135	149	178	34.1	135	145	180	24.4
135	150	180	33.4	135	145	175	25.0
136	150	180	31.8	142	147	180	13.3
205	220	245	37.5	205	212	245	17.5
205	219	244	36.0	204	210	240	16.7
209	220	244	31.4	204	210	238	17.7
205	215	239	29.4	203	209	239	16.7
205	215	235	33.3	184	190	220	16.7
180	190	210	33.3	180	193	220	32.5
180	190	211	23.3	197	205	239	19.0
200	217	256	30.4	240	252	265	48.0
199	200	234	2.9	150	155	181	16.1
215	240	244	86.0	175	192	205	56.7
135	136	156	4.8	175	184	205	30.0
159	180	195	58.3	165	166	210	2.2
165	175	202	27.0	165	170	210	11.1
175	185	205	33.3	130	133	175	6.6
175	180	205	16.7	137	140	184	6.4
160	180	193	60.6	170	175	210	12.5

TABLE IX (continued)

HEART RATE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
165	180	187	68.1	155	161	190	17.1
170	183	205	37.1	195	195	238	0.0
160	165	181	23.8	185	194	235	18.0
200	210	240	25.0	185	190	230	11.1
190	205	235	33.3	177	187	230	18.8
184	200	230	34.8	152	154	194	4.7
179	200	229	42.0	148	152	200	7.7
141	145	179	10.5	153	160	205	13.4
145	160	199	27.8	155	162	210	12.7
150	167	205	30.9	170	172	200	6.7
155	170	209	27.8				
			MEAN				
174	188	216	36.5	170.7	179.3	216.0	18.6

CONT = Control
RCO = Right Carotid Occlusion
BCO = Bilateral Carotid Occlusion
LCO = Left Carotid Occlusion
% = % of total response to BCO

TABLE X

SYSTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
193	245	350	33.0	190	215	335	17.2
200	216	250	32.0	200	215	245	33.3
200	215	250	30.0	200	215	245	33.3
200	215	245	33.3	195	210	240	33.3
195	211	242	34.0	195	207	240	26.7
175	200	256	30.8	185	195	270	11.8
185	200	255	21.4	185	195	260	13.3
188	205	254	25.7	190	197	252	11.3
193	205	250	21.0	190	196	268	7.7
170	200	242	41.7	170	195	242	34.8
160	190	240	37.5	170	193	245	30.6
170	220	240	71.5	168	195	250	33.0
130	152	187	43.8	150	162	204	22.2
185	212	239	50.0	184	195	225	26.8
180	205	220	62.5	185	200	240	27.3
185	213	240	51.0	186	206	245	33.9
182	215	243	54.0	164	189	235	35.2
171	213	242	59.0	165	204	240	52.0
167	202	237	50.0	162	200	235	52.0
165	200	235	50.0	164	200	235	50.6
160	165	195	14.3	165	172	198	21.2
164	173	215	17.7	163	195	215	61.5
160	170	205	22.2	160	171	189	55.0
144	191	239	49.5	156	180	215	40.7
156	190	225	49.3	150	175	240	27.8
155	194	211	69.6	160	185	225	38.4
150	170	232	24.3	152	190	220	56.0
150	160	225	13.3	160	182	250	24.4
145	160	210	20.0	150	165	225	20.0
183	198	230	32.0	132	160	227	29.5
180	190	220	25.0	183	200	230	36.1
200	223	280	28.8	180	193	220	32.6
196	216	264	29.4	193	210	267	23.0
220	244	300	30.0	220	238	308	20.5

TABLE X (continued)

SYSTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
222	246	300	30.8	210	222	286	15.8
215	243	290	37.4	210	230	288	25.6
200	235	325	28.0	200	210	315	8.7
195	225	320	24.0	195	200	304	46.0
194	223	300	27.3	200	210	260	16.6
198	205	260	11.6	232	247	293	24.6
229	253	302	32.8	230	245	285	27.2
230	250	289	33.8	150	155	160	50.0
149	155	163	43.0	153	159	170	35.3
150	158	170	40.0				
			MEAN				
180	204	247.4	35.6	179.1	197.3	245.1	30.8

CONT = Control
RCO = Right Carotid Occlusion
LCO = Left Carotid Occlusion
BCO = Bilateral Carotid Occlusion
% = % of total response to BCO

TABLE XI

SYSTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
190	205	245	27.2	190	200	245	18.2
185	205	240	36.4	180	195	238	25.9
181	205	241	40.0	182	197	240	25.9
187	200	240	24.5	180	195	240	21.6
210	220	300	11.1	200	205	290	5.6
188	225	275	42.5	200	202	275	2.7
209	212	275	4.5	195	205	275	12.5
195	210	275	18.7	180	185	270	5.6
165	180	250	17.7	170	190	255	23.5
160	170	240	12.5	155	179	244	27.0
170	185	245	20.0	175	180	240	7.7
175	187	242	17.9	175	182	242	10.4
231	305	322	81.0	241	255	335	14.9
245	288	335	47.0	220	250	325	28.5
215	255	325	36.4	192	200	310	6.8
180	219	254	52.7	179	190	250	15.5
170	185	240	21.4	169	175	240	8.5
160	180	235	26.6	150	167	235	20.0
145	185	234	45.0	150	175	235	29.4
170	170	280	0.0	155	177	270	20.0
165	170	275	4.6	170	182	270	12.0
162	180	270	16.7	165	180	255	16.7
181	200	295	16.7	185	195	289	9.6
200	214	285	16.5	189	205	290	15.8
185	211	290	17.3	185	198	280	13.7
180	202	298	18.6	184	191	289	6.7
155	175	264	18.4	160	185	262	24.4
155	185	250	31.6	150	200	250	50.0
220	226	300	7.5	208	212	306	4.7
206	228	300	23.4	204	210	300	6.3
196	232	304	33.4	194	216	300	20.7
200	232	300	32.0	198	216	300	17.6
206	238	308	31.4	212	230	310	18.8
210	238	308	28.6	200	220	300	20.0
163	300	293	28.5	170	186	295	12.8

TABLE XI (continued)

SYSTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
173	202	290	27.0	170	190	290	16.7
168	200	293	25.6	170	184	285	17.7
176	199	283	21.2	170	190	282	17.9
168	193	277	23.0	180	202	340	13.7
187	210	280	25.0	190	220	330	21.4
197	220	310	20.3	176	176	290	0.0
194	204	330	7.4	180	206	270	28.9
155	168	270	11.3	162	180	222	30.0
160	180	236	26.3	173	190	230	29.9
162	190	252	31.1	212	218	352	4.3
164	194	265	29.7	210	220	346	7.3
168	190	224	39.2	190	200	355	12.5
164	184	234	28.5	175	180	295	4.1
174	199	232	43.1	160	162	260	2.0
172	190	230	31.3				
224	254	370	65.2				
218	250	366	21.6				
220	250	360	21.4				
200	212	260	20.0				
184	200	274	17.7				
192	210	272	22.5				
190	225	345	22.6				
173	200	270	27.8				
184	190	269	7.0				
			MEAN				
184.4	240.3	278.3	25.8	182.2	196.9	280	16.0

CONT = Control
RCO = Right Carotid Occlusion
LCO = Left Carotid Occlusion
BCO = Bilateral Carotid Occlusion
% = % of total response to BCO

TABLE XII

DIASTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
156	200	270	38.6	160	180	268	18.5
170	185	210	37.5	167	180	210	30.2
165	180	215	30.0	165	185	215	40.0
170	182	210	30.0	165	180	205	37.5
165	180	212	31.9	162	177	205	35.0
145	160	175	50.0	152	155	165	23.0
150	160	160	100.0	150	155	175	7.2
152	165	174	59.1	155	160	190	14.3
155	170	210	27.3	155	160	175	25.0
137	162	188	49.0	135	160	190	45.5
130	155	190	41.6	140	155	195	27.3
140	176	195	65.5	140	160	200	33.3
100	132	162	51.6	125	137	175	24.0
145	162	180	48.5	149	160	180	35.5
150	165	175	60.0	147	160	186	33.3
150	167	180	56.6	150	165	190	37.5
145	170	195	50.0	130	150	195	30.8
135	169	198	54.0	130	160	195	46.2
135	160	195	41.5	129	160	190	50.7
135	153	190	32.7	130	160	194	46.8
120	125	155	14.3	125	132	155	23.3
126	132	165	15.4	123	155	165	70.6
125	135	165	25.0	125	140	155	50.0
95	141	175	57.5	125	148	173	48.0
111	148	160	75.5	101	130	175	39.2
110	147	150	92.5	113	140	160	57.5
110	133	180	30.8	106	145	165	66.0
100	110	160	16.7	105	125	170	30.8
94	110	150	28.6	100	112	160	20.0
150	166	190	40.0	88	105	154	25.8
147	160	180	39.4	150	160	190	25.0

TABLE XII (continued)

DIASTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
160	183	230	32.9	146	153	180	20.6
161	182	229	30.9	155	170	220	23.1
160	180	220	33.3	160	174	224	21.9
160	180	220	33.3	150	160	206	17.9
170	190	228	34.5	164	182	220	32.1
165	190	260	26.3	160	170	225	15.4
160	182	226	33.3	140	145	210	7.1
125	137	160	34.3	140	150	200	16.7
140	160	210	28.6	170	180	220	20.0
138	154	200	25.8	170	175	214	11.4
167	185	225	29.3	119	122	130	27.3
170	184	217	29.8	118	124	138	30.0
116	125	135	47.4				
			MEAN				
141.6	161.2	192.1	41.2	139.2	154.8	188.5	31.2

CONT = Control
RCO = Right Carotid Occlusion
LCO = Left Carotid Occlusion
BCO = Bilateral Carotid Occlusion
% = % of total response to BCO

TABLE XIII

DIASTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
161	180	212	37.2	160	170	215	18.2
160	180	210	40.0	155	170	210	27.3
156	178	210	40.8	156	170	210	26.0
156	175	210	35.2	155	170	210	27.3
180	195	260	18.8	178	183	253	6.7
168	195	240	37.5	175	180	240	7.7
180	185	240	8.3	170	180	233	15.9
170	189	242	26.4	162	165	240	3.9
135	150	200	23.1	140	155	205	23.0
130	140	200	14.3	130	150	200	28.6
145	157	205	20.0	145	150	200	9.1
145	159	200	25.5	145	155	200	18.2
174	235	260	70.9	183	193	260	13.0
183	212	255	40.0	175	190	240	23.1
180	200	210	66.7	164	168	235	5.6
149	178	215	44.0	145	155	210	15.4
140	151	202	17.7	135	144	202	13.4
130	150	199	29.0	122	135	195	17.8
120	150	200	37.5	120	145	195	33.4
134	140	215	7.4	125	145	211	23.3
130	140	215	11.7	137	152	212	20.0
137	148	215	14.1	135	150	205	21.4
147	160	221	17.5	153	165	225	16.7
165	175	225	16.7	157	170	225	19.1
159	177	225	27.3	153	163	220	14.9
150	170	227	26.0	152	162	225	13.7
101	115	129	50.0	105	120	180	20.0
100	122	175	29.4	100	135	175	46.7
180	190	230	20.0	172	180	230	13.8
170	196	240	23.4	172	178	240	8.8
156	188	240	38.1	152	170	248	18.8
156	180	246	26.7	154	170	238	19.0
160	190	244	35.7	168	184	248	20.0
166	190	216	48.0	160	178	240	22.5
140	167	246	25.4	140	158	248	16.7

TABLE XIII (continued)

DIASTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER VAGOTOMY

CONT	RCO	BCO	%	CONT	LCO	BCO	%
148	170	245	22.7	140	157	246	16.0
140	166	246	24.5	140	153	238	13.3
146	164	234	20.2	140	154	246	13.2
140	162	232	23.9	150	173	184	67.6
166	186	247	24.7	164	190	280	22.4
170	190	270	20.0	144	144	234	0.0
160	170	260	10.0	130	154	218	27.2
125	144	220	20.0	120	130	176	17.8
122	136	190	20.6	132	138	190	10.3
115	138	202	26.4	168	172	220	7.4
128	150	210	26.8	168	170	220	3.7
130	143	184	24.1	160	165	280	4.6
146	150	190	9.1	145	156	238	11.8
170	198	224	51.8	125	125	210	0.0
172	198	236	40.6				
174	200	240	39.4				
160	185	275	21.7				
148	165	221	23.3				
135	145	210	13.3				
			MEAN				
150.1	169.8	222.5	28.0	148.5	161.0	222.6	17.6

CONT = Control
RCO = Right Carotid Occlusion
LCO = Left Carotid Occlusion
BCO = Bilateral Carotid Occlusion
% = % of total response to BCO

TABLE XIV

HEART RATE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
205	215	235	33.3	205	205	235	0.0
204	215	237	33.3	205	205	235	0.0
187	194	220	21.2	185	185	219	0.0
185	190	215	16.7	185	185	220	0.0
141	145	179	10.5	152	154	194	4.8
145	160	199	27.8	148	152	200	7.7
150	167	205	30.9	153	160	205	13.5
155	170	209	27.8	155	162	210	12.7
169	180	225	19.6	168	170	221	37.7
170	180	217	21.3	170	170	215	0.0
165	170	195	16.7	170	172	200	6.7
170	184	205	40.0	165	170	195	16.7
164	175	200	30.6	164	164	194	0.0
160	167	187	25.9	166	170	195	10.3
169	178	205	25.0	166	166	200	0.0
161	170	185	37.5	165	180	215	30.0
168	175	188	35.0	195	199	250	7.3
179	194	221	35.7	204	208	227	17.4
198	206	229	25.8	187	189	210	8.7
185	185	203	0.0	190	190	212	0.0
191	191	205	0.0	125	125	155	0.0
186	189	212	11.5	120	123	155	8.6
135	136	148	13.0	120	124	155	11.4
120	130	154	29.4	130	134	175	8.9
121	130	155	26.5	130	135	180	10.0
135	147	175	30.0	114	114	136	0.0
130	140	173	23.3	115	115	135	0.0
115	115	127	0.0	142	142	150	0.0
115	115	137	0.0	135	135	155	0.0
144	145	163	5.3	200	205	212	41.7
140	142	155	13.3	184	190	209	24.0
195	200	216	23.8	185	187	205	10.0

TABLE XIV (continued)

HEART RATE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
184	190	210	23.1	148	156	192	18.2
185	191	205	30.0	160	170	204	22.7
144	157	192	27.1	160	170	202	23.8
165	170	197	15.6	199	203	230	12.9
155	171	200	35.6	208	210	230	9.1
195	205	230	28.6	186	190	210	16.7
205	216	235	36.7	190	192	222	6.3
204	210	220	37.5				
194	194	217	0.0				
190	190	215	0.0				
			MEAN				
166.1	173.7	197.6	22.0	165.4	168.6	199.1	10.2

CONT = Control
RCO = Right Carotid Occlusion
BCO = Bilateral Carotid Occlusion
LCO = Left Carotid Occlusion
% = % of total response to BCO

TABLE XV

HEART RATE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
185	185	220	0	184	182	220	0
180	189	219	23.1	180	177	219	0
165	170	205	12.5	165	165	205	0.0
165	170	205	12.5	168	168	210	0.0
185	197	220	34.3	178	185	210	21.9
177	190	215	34.2	180	185	212	15.6
194	195	215	4.8	185	193	205	40.0
187	200	215	46.4	190	190	210	0.0
185	192	210	28.0	185	175	210	0
175	183	210	22.9	180	176	205	0
187	195	205	44.4	185	190	232	10.6
198	203	225	18.5	192	195	232	7.5
192	210	223	58.1	190	191	215	4.0
185	193	216	25.8	186	187	220	2.9
180	187	210	23.3	178	183	200	22.7
177	177	195	0.0	185	185	205	0
182	185	205	13.0	137	136	140	0
136	141	141	100.0	139	136	145	0
139	145	146	85.7	146	150	165	0
135	135	152	0	190	197	215	28.0
135	135	137	0	194	200	215	28.6
190	195	220	15.6	190	200	217	37.0
193	200	219	27.0	192	200	216	33.3
191	197	215	25.0	175	185	200	40.0
195	200	217	22.7	172	181	192	45.0
170	181	200	36.7	175	187	190	80.0
175	180	195	25.0	175	175	187	0
175	185	190	66.6	200	200	230	0
170	177	185	46.6	210	210	228	0
202	206	228	15.4	223	217	244	0
214	214	226	0				
220	216	240	0				
			MEAN				
179.3	185.3	203.9	28.0	181.0	183.4	206.5	13.9

CONT = Control
RCO = Right Carotid Occlusion
LCO = Left Carotid Occlusion
BCO = Bilateral Carotid Occlusion
% = % of total response to BCO

TABLE XVI

SYSTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
180	188	195	53.3	180	176	305	
172	197	279	23.4	166	178	275	11.1
166	195	280	25.4	175	184	280	8.6
172	199	279	25.2	174	179	259	5.9
175	190	269	16.0	160	158	190	
160	157	179		160	160	200	0.0
155	160	195	12.5	160	164	200	10.0
160	167	202	16.7	160	164	202	9.5
160	168	202	19.0	155	155	205	0.0
145	152	190	15.6	150	153	195	6.7
154	160	195	14.6	225	205	260	
205	206	227	4.6	225	230	256	16.1
225	234	260	25.7	205	207	235	6.7
220	232	260	30.0	205	215	254	20.4
206	214	232	30.8	203	210	250	14.9
205	221	265	26.7	170	180	230	16.7
205	215	240	28.6	165	170	210	11.1
205	212	240	20.0	155	158	189	8.8
187	190	205	16.7	150	154	193	9.3
170	180	223	18.9	145	153	190	17.8
160	170	206	21.7	222	222	239	0
145	150	194	10.2	201	204	260	5.1
140	156	180	40.0	204	204	239	0
148	160	205	21.1	196	196	266	0
235	235	240	0.0	192	195	261	4.3
205	212	250	15.6	155	160	205	10.0
200	207	247	14.9	159	159	185	0
191	205	265	18.9	177	184	214	18.9
199	222	275	30.1	190	190	208	0
176	176	185	0	189	204	260	21.1
162	165	193	9.7	196	210	275	17.7
186	195	212	34.6	170	190	240	28.6

TABLE XVI (continued)

SYSTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS BEFORE LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
180	200	220	50.0	163	177	240	18.2
180	204	250	34.1	160	175	226	22.7
191	215	270	30.4	197	215	285	20.5
171	180	235	14.1	186	198	250	18.8
165	175	240	13.3	201	208	245	15.9
163	185	240	30.0	200	204	280	5.0
200	210	289	11.2	156	175	243	21.8
205	225	280	26.7	170	187	287	14.5
196	201	240	11.4	185	196	315	8.5
200	210	257	17.5	239	254	315	8.5
200	225	298	25.5	230	245	305	20.0
225	250	338	22.2	172	192	266	21.3
160	177	245	20.0	178	200	282	21.2
175	206	304	24.0				
186	207	312	16.7				
235	265	315	37.5				
224	256	310	37.2				
175	206	275	31.0				
171	200	287	25.0				
			MEAN				
183.8	197.8	244.6	22.4	181.5	182.5	244.7	12.0

CONT = Control
RCO = Right Carotid Occlusion
BCO = Bilateral Carotid Occlusion
LCO = Left Carotid Occlusion
% = % of total response to BCO

TABLE XVII

SYSTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER LESIONS

CONT	RCO	BCO	%	CONT	RCO	BCO	%
185	183	220		165	175	275	9.1
180	189	215	23.1	168	175	275	6.5
150	180	267	25.6	150	157	270	5.8
145	170	275	19.2	160	170	275	8.7
130	140	165	28.6	135	140	175	12.5
132	137	170	13.2	132	135	170	8.0
126	130	164	10.5	120	126	152	18.8
119	133	164	31.1	120	122	154	5.9
180	197	234	31.5	178	182	231	7.5
180	186	235	10.9	185	188	233	6.3
160	180	198	52.6	159	168	225	13.6
159	179	225	30.3	150	160	219	14.5
146	161	205	25.4	150	155	206	8.9
150	170	215	30.8	175	178	210	8.6
145	159	210	21.5	136	148	176	30.0
144	156	190	26.1	140	148	190	16.6
140	155	189	30.6	153	153	177	0
154	167	177	26.5	147	137	165	
145	167	191	47.8	136	141	160	20.8
150	155	189	12.8	175	193	280	17.1
144	152	170	30.8	170	198	275	26.7
125	128	150	12.0	170	186	261	29.3
174	187	262	14.8	165	183	250	21.2
169	188	258	21.3	159	169	214	18.2
163	185	275	19.6	160	165	205	11.1
168	185	262	7.4	155	156	192	2.7
158	180	220	35.5	151	155	185	10.8
155	170	204	30.6	205	220	311	14.2
156	170	195	35.9	223	229	337	5.3
150	160	191	24.4	159	162	316	1.9
195	228	327	25.0	185	192	269	8.3
215	250	335	29.2	145	157	234	13.5

TABLE XVII (continued)

SYSTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
168	200	228	53.3	138	150	230	13.0
175	190	220	33.3	121	128	187	10.6
150	169	222	26.4	115	121	190	8.0
148	160	233	14.1				
117	129	175	20.7				
120	130	195	13.3				
			MEAN				
154.5	169.9	216.4	26.4	156.1	164.3	226.7	12.2

CONT = Control
RCO = Right Carotid Occlusion
BCO = Bilateral Carotid Occlusion
LCO = Left Carotid Occlusion
% = % of total response to BCO

TABLE XVIII

DIASTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSION BEFORE LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
135	142	150	46.7	132	130	220	0
122	144	205	26.5	144	131	204	0
125	145	205	25.0	120	130	205	11.8
118	140	200	26.8	120	125	191	7.0
120	137	195	22.7	130	120	155	0
130	130	150	0.0	130	130	162	0.0
125	130	160	14.3	129	130	165	2.8
130	135	167	13.5	127	130	165	7.9
127	135	165	21.1	120	120	168	0.0
125	135	170	22.2	115	115	156	0.0
115	122	160	15.6	170	175	204	14.7
162	165	180	16.7	170	175	199	17.2
170	180	200	33.3	160	162	185	8.0
169	174	200	16.1	155	165	195	25.0
160	167	185	28.0	151	160	195	20.5
155	170	207	28.9	145	154	180	25.7
155	165	185	33.3	140	145	170	16.7
155	165	187	31.3	130	135	155	20.0
159	160	175	6.3	120	127	162	16.7
145	155	175	33.3	119	125	162	14.0
135	145	174	25.6	178	125	194	0
120	120	160	0.0	157	160	195	7.9
115	130	150	42.9	159	159	190	0
120	132	172	23.1	196	196	266	0
190	190	195	0	192	195	262	4.3
163	170	194	22.6	155	160	205	10.0
200	207	247	14.9	159	155	185	0
191	205	265	18.9	177	184	214	18.9
149	222	275	30.3	190	190	208	0
176	176	185	0	126	134	180	14.8
162	165	193	9.7	128	144	191	25.4

TABLE XVIII (continued)

DIASTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSION BEFORE LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
186	195	212	34.6	140	139	165	0
180	200	220	50.0	104	118	172	20.6
120	135	175	27.3	100	114	160	23.3
129	149	185	35.7	159	163	200	9.8
135	145	165	33.3	135	147	195	20.0
104	119	180	19.7	145	160	198	28.3
102	120	170	26.5	155	155	194	0
160	160	200	0	112	128	186	21.6
165	165	195	0	129	138	203	12.2
145	150	190	11.1	140	150	225	11.8
145	155	200	18.2	190	205	240	30.0
150	160	208	17.2	190	204	230	35.0
155	166	230	14.7	141	158	221	21.3
120	130	185	15.4	142	162	237	21.1
130	154	230	24.0	137	165	239	27.5
142	156	235	15.1				
194	213	243	38.8				
182	210	234	51.9				
142	174	230	36.4				
140	169	240	29.0				
			MEAN				
146.9	158.5	195.3	22.5	144.8	151.1	194.6	12.4

CONT = Control
RCO = Right Carotid Occlusion
BCO = Bilateral Carotid Occlusion
LCO = Left Carotid Occlusion
% = % of total response to BCO

TABLE XIX

DIASTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
120	130	203	12.0	120	130	210	11.1
120	145	210	27.8	120	125	205	5.9
110	135	200	27.8	110	119	205	9.5
118	135	200	20.7	110	119	200	10.0
100	110	140	25.0	100	105	140	12.5
97	101	135	10.5	96	100	134	10.5
95	95	105	0.0	87	95	120	24.2
86	102	105	84.2	94	95	125	3.2
145	157	190	26.7	144	145	190	2.2
135	145	190	18.2	145	147	187	4.8
125	140	156	48.4	125	130	180	9.1
124	140	183	27.1	118	125	175	12.3
115	130	165	30.0	123	128	175	9.6
119	135	175	28.6	122	130	176	14.8
118	130	175	21.1	105	115	145	25.0
110	144	154	77.3	109	115	154	13.3
106	124	152	39.1	110	110	134	0
105	120	129	62.5	112	112	144	0
103	126	145	54.8	91	93	117	7.7
100	110	145	22.2	130	140	210	12.5
100	105	128	17.9	124	150	210	30.2
80	81	101	4.8	120	140	206	23.3
125	140	203	19.2	116	135	195	24.1
120	140	204	23.8	115	127	170	21.8
119	140	200	25.9	119	125	160	14.6
123	137	200	18.2	110	115	150	12.5
116	135	175	32.2	110	112	142	6.3
113	130	161	35.4	150	155	235	5.9
111	125	150	35.9	166	157	250	0
107	120	147	32.5	115	130	241	1.2
145	160	230	17.6	125	129	181	7.1
152	175	245	24.7	104	115	192	12.5

TABLE XIX (continued)

DIASTOLIC PRESSURE RESPONSE TO UNILATERAL AND BILATERAL CAROTID OCCLUSIONS AFTER LESIONS

CONT	RCO	BCO	%	CONT	LCO	BCO	%
125	150	150	100.0	99	110	190	12.1
135	150	155	75.0	89	95	155	9.1
105	125	180	26.7	83	90	156	9.6
105	121	192	18.4				
85	99	145	23.3				
85	100	162	19.5				
			MEAN				
113.2	128.6	168.0	32.0	114.7	121.8	176.0	11.1

CONT = Control
RCO = Right Carotid Occlusion
BCO = Bilateral Carotid Occlusion
LCO = Left Carotid Occlusion
% = % of total response to BCO

TABLE XX

HEART RATE RESPONSE TO CENTRAL VAGAL STIMULATION BEFORE LESIONS

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Control Response	Control	Response	% Control Response
172	230	33.7	168	195	16.1
161	200	24.2	167	184	10.2
182	244	34.1	181	227	25.4
153	193	26.1	145	255	79.3
135	180	33.3	130	230	76.9
160	215	34.4	160	265	65.6
165	260	57.6	164	275	67.7
165	255	54.5	155	285	83.9
170	302	77.6	150	292	94.7
			160	240	50.0
150	207	38.0	150	215	43.3
199	250	25.6	195	257	31.8
180	275	52.8	185	235	27.0
125	135	8.0	125	160	28.0
119	124	4.2	116	135	16.4
120	125	4.2	119	131	10.1
			120	137	14.2
135	140	3.7	131	165	26.0
210	240	14.3	205	250	22.0
165	245	48.5	160	250	55.0
160	260	62.5	156	240	53.9
218	225	3.2	180	226	25.5
179	214	19.5	174	222	27.5
198	230	16.1	207	245	18.4
287	291	1.4	275	282	2.5
265	273	3.2	251	251	0
250	255	2.0	252	252	0
255	262	2.7			
		MEAN			
179.9	224.2	26.4	169.7	226.0	36.0

TABLE XXI

HEART RATE RESPONSE TO CENTRAL VAGAL STIMULATION AFTER LESIONS

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Control Response	Control	Response	% Control Response
179	235	31.3	172	237	37.8
165	235	42.4	155	225	45.2
180	190	5.6	171	252	48.0
180	220	22.2	175	260	48.6
192	215	12.0	185	255	37.8
180	205	13.9	185	248	34.1
175	298	13.1	180	298	65.6
187	294	57.2	162	285	75.9
182	255	40.1	170	278	63.5
185	262	41.6	170	260	52.9
135	190	40.6	133	200	50.4
144	189	31.3	140	205	46.4
155	200	29.0	140	195	39.3
173	244	41.0	170	254	49.4
192	249	24.5			
180	255	41.67	175	244	39.4
			170	245	45.2
			166	240	44.6
172	244	41.9	155	241	55.5
170	240	41.2	165	230	39.4
205	239	16.6	245	246	0.4
200	229	14.5	200	245	22.5
225	235	4.4	215	224	4.2
195	230	33.3			
210	270	28.6	215	269	25.1
190	232	22.1	165	225	36.4
181	248	37.0	160	236	47.5
160	215	34.4	155	220	41.9
			MEAN		
180.5	235.3	29.3	172.8	243.0	42.2

TABLE XXII

SYSTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION BEFORE LESIONS

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Control Response	Control	Response	% Control Response
208	370	77.9	198	272	37.4
192	227	18.2	200	267	33.5
170	343	101.8	175	275	57.1
195	207	6.2	190	274	44.2
175	199	13.7	164	230	40.2
173	194	12.1			
142	211	48.6	140	250	78.6
250	335	34.0	241	332	37.8
225	315	40.0	215	349	62.3
203	353	73.9	187	339	81.3
170	244	43.5	184	266	44.6
200	248	24.0	197	257	30.5
154	227	47.4	160	234	46.3
150	289	92.7	170	206	21.2
194	196	1.0	190	262	37.9
230	230	0	215	231	7.4
162	190	17.3	170	200	17.6
			137	149	8.8
			172	204	18.6
			217	253	16.6
126	130	3.8	125	172	37.6
210	330	57.1	170	335	97.1
192	345	79.7	155	325	109.7
			160	325	103.1
			177	356	101.1
155	370	138.7	135	376	178.5
200	300	200	195	291	49.2
185	316	70.8	168	300	78.6
195	305	56.4	227	361	59.0
200	302	51.0	200	319	59.5

TABLE XXII (continued)

SYSTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION BEFORE LESIONS

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Control Response	Control	Response	% Control Response
169	274	62.1	188	310	64.9
180	330	83.3	192	365	90.1
225	292	29.8	195	275	41.0
192	260	40.6	180	242	34.4
175	245	40.0	161	230	42.9
173	260	50.3			
		MEAN			
186.1	272.2	52.1	180.9	277.4	55.0

TABLE XXIII

SYSTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION AFTER LESIONS

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Control Response	Control	Response	% Control Response
160	325	103.1	160	316	97.5
160	370	131.3	160	292	82.5
130	175	34.6	130	230	76.9
115	200	73.9	110	255	131.8
112	195	74.1	115	235	104.3
110	178	61.8	110	228	107.3
182	335	84.1	160	316	97.5
136	265	94.9	120	250	108.3
142	235	65.5	145	235	62.1
143	271	89.5	150	220	46.7
149	233	56.4	141	245	73.8
134	226	68.7	140	250	78.6
105	195	85.7	125	185	48.0
170	356	109.4	156	380	79.5
166	356	114.5	146	355	143.2
150	366	144.0	145	365	151.7
			135	350	159.3
155	275	77.4	145	275	89.7
133	229	41.9	135	255	88.9
205	361	76.1	186	362	94.6
181	312	72.4	171	325	90.1
171	305	78.4	170	266	56.5
156	277	77.7			
131	285	117.6	115	267	132.8
120	223	85.8	115	240	108.7
116	240	106.9	105	230	119.0
110	230	109.1	110	235	113.6
		MEAN			
143.9	269.9	86.0	138.5	275.5	97.8

TABLE XXIV

DIASTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION BEFORE LESIONS

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Control Response	Control	Response	% Control Response
153	240	56.9	146	192	31.5
145	197	35.9	146	184	42.5
120	225	87.5	125	185	48.0
152	175	15.1	153	230	50.3
145	170	17.2	140	200	42.9
143	167	16.8			
105	175	66.7	110	215	95.5
194	275	41.8	190	270	42.1
170	250	47.1	168	270	60.7
155	287	85.2	150	275	83.3
144	185	28.5	153	205	34.0
165	200	21.2	165	200	21.2
130	187	43.8	135	195	44.4
122	240	96.7	137	174	27.0
151	155	2.6	150	200	33.3
184	184	0	171	186	8.8
138	158	14.5	135	165	22.2
			120	128	6.6
			135	160	18.5
105	109	3.8	100	145	45.0
152	250	64.5	120	245	104.2
103	235	128.2	113	225	99.1
			110	225	104.5
			138	356	165.2
96	270	181.3	95	280	194.7
160	210	31.3	157	210	33.8
136	255	87.5	126	244	93.7
145	225	55.2	155	235	51.6

TABLE XXIV (continued)

DIASTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION BEFORE LESIONS

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Control Response	Control	Response	% Control Response
140	245	75.0	150	226	50.7
139	232	66.9	136	222	63.2
135	248	76.3	135	265	96.3
187	230	23.0	163	225	38.0
160	211	31.9	150	204	36.0
145	207	42.8	130	190	46.2
138	220	59.4			
		MEAN			
143.8	213.5	51.8	139.6	215.3	58.6

TABLE XXV

DIASTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION AFTER LESIONS

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Control Response	Control	Response	% Control Response
120	225	87.5	120	237	97.5
110	235	113.6	115	200	73.9
95	136	43.2	100	197	97.0
87	170	95.4	80	218	172.5
78	160	105.1	85	198	132.9
82	145	76.8	87	194	123.0
145	275	20.7	130	256	96.9
105	220	109.5	97	200	106.2
115	196	70.4	118	195	65.3
109	216	85.3	117	185	58.1
108	173	60.2	112	190	69.6
96	175	82.3	100	186	86.0
70	145	107.1	90	144	60.0
105	262	149.5	101	275	172.3
106	260	145.3	100	256	156.0
95	265	178.9	100	265	165.0
110	220	100.0	90	250	177.8
			110	230	109.1
99	190	91.9	95	206	116.8
155	280	80.6	145	280	93.1
137	240	75.2	145	260	79.3
135	235	74.1	120	195	62.5
120	215	79.2			
95	230	142.1	80	210	72.2
92	180	106.5	88	190	115.9
83	195	134.9	75	185	146.7
80	180	125.0	80	180	125.0
			MEAN		
105.1	208.6	97.7	106.9	214.7	108.9

TABLE XXVI

HEART RATE RESPONSE TO CENTRAL VAGAL STIMULATION

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Increase	Control	Response	% Increase
159	180	13.2	112	113	.9
105	110	4.8			
140	144	2.9	157	238	51.6
145	145	0	142	180	26.8
165	195	18.2	145	148	2.1
140	198	41.4	140	200	42.9
140	200	42.9	142	197	31.7
140	202	44.3	133	210	57.9
195	226	15.9	200	245	31.7
180	186	3.3	186	246	32.3
200	230	35.0	205	260	26.8
210	212	1.0	202	285	41.1
167	225	4.8	175	235	34.3
175	235	34.3	180	235	30.6
170	210	23.5	135	189	30.0
130	185	42.3	140	185	32.1
			115	190	65.2
167	190	13.8	150	200	33.3
160	175	9.4	150	214	42.7
185	210	18.9	170	199	17.1
138	215	55.8	154	240	55.8
172	230	33.7	168	195	16.1
161	200	24.2	167	184	10.2
153	193	26.1	145	255	75.9
135	180	33.3	130	230	76.9
140	180	28.6			
165	260	57.6	164	275	67.7
165	255	54.5	155	285	83.9
150	207	38.0	160	240	50.0
199	250	25.6	150	215	43.3
			195	257	31.8

TABLE XXVI (continued)

HEART RATE RESPONSE TO CENTRAL VAGAL STIMULATION

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Increase	Control	Response	% Increase
125	135	8.0	125	160	28.0
119	124	4.2	119	131	10.1
120	125	4.2	120	137	14.2
204	250	22.5	205	250	22.0
210	240	14.3			
160	260	62.5	156	240	53.8
218	225	3.2	180	226	25.6
179	214	19.6	174	222	26.7
198	230	16.2	207	245	18.4
		MEAN			
162.7	200.8	23.7	158.2	215.0	36.3

TABLE XXVII

SYSTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Increase	Control	Response	% Increase
210	320	52.4	250	256	2.4
243	280	15.2	210	252	20.0
214	270	26.2			
240	250	4.2	214	360	68.2
260	260	0.0	244	300	23.0
190	222	16.8	202	320	59.4
183	236	29.0	187	194	3.7
194	294	51.5	196	310	58.2
190	290	52.6	190	300	57.9
184	290	57.6	188	310	64.9
152	270	77.6	163	330	102.5
138	178	29.0	149	330	121.5
165	236	43.0	276	380	37.7
168	185	10.1	205	370	80.5
180	268	48.9	188	246	30.9
153	256	67.3	192	250	30.9
152	258	69.7	165	268	62.4
166	268	61.4	150	260	73.3
			150	240	60.0
212	360	69.8	206	300	45.6
190	270	42.1	180	278	54.4
			200	310	55.0
199	300	50.8	177	385	117.5
175	285	62.9	165	378	129.1
			155	370	138.7
152	205	34.9	152	220	44.7
139	222	59.7	144	290	101.4
208	370	77.9	198	272	37.4
192	227	18.2	200	267	33.5
195	207	6.2	190	274	44.2
175	199	13.7	164	230	40.2
173	194	10.8			

TABLE XXVII (continued)

SYSTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Increase	Control	Response	% Increase
250	335	34.0	241	332	37.8
225	315	40.0	215	349	62.3
170	244	43.5	184	266	44.6
200	248	24.0	197	257	30.5
154	227	47.4	160	234	46.3
		MEAN			
188.0	260.0	39.7	190.0	293.9	57.7

TABLE XXVIII

DIASTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Increase	Control	Response	% Increase
180	260	44.4	200	208	4.0
190	214	12.6	168	205	22.0
180	214	18.9			
200	204	2.0	172	280	62.8
208	208	0.0	192	244	27.1
150	180	20.0	166	254	53.0
150	195	30.0	156	160	2.6
160	236	47.5	160	250	56.3
150	230	34.8	150	248	65.3
140	228	8.6	150	250	66.7
128	230	79.7	136	280	105.9
115	160	39.1	119	275	131.1
140	200	42.9	244	290	18.9
140	152	8.6	170	306	80.0
144	220	59.7	132	170	28.8
123	208	69.1	150	202	34.7
120	208	73.3	128	218	70.3
116	218	87.9	120	210	75.0
			124	194	56.5
164	220	34.1	114	238	108.8
140	210	50.0	140	222	58.6
			150	230	53.3
165	240	45.5	150	300	100.0
150	225	50.0	140	288	105.7
			120	280	133.3
132	175	32.6	130	184	41.5
121	182	50.4	120	225	87.5
153	240	56.9	146	192	31.5
145	197	35.9	146	184	26.0
152	175	15.1	153	230	50.3
145	170	17.2	140	200	42.9
143	167	16.8			

TABLE XXVIII (continued)

DIASTOLIC PRESSURE RESPONSE TO CENTRAL VAGAL STIMULATION

Right Central Vagal Stimulation			Left Central Vagal Stimulation		
Control	Response	% Increase	Control	Response	% Increase
194	275	45.9	190	270	42.1
170	250	47.1	168	270	60.7
144	185	27.1	153	205	33.98
165	200	21.2	165	200	21.2
130	187	43.8	135	195	44.4
		MEAN			
151.4	207.7	37.3	151.3	233.1	57.2

APPROVAL SHEET

The thesis submitted by Marva Charlyne Worthen has been read and approved by three members of the faculty of the Graduate School.

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the thesis is now given final approval with reference to content, form and mechanical accuracy.

The thesis is therefore accepted in partial fulfillment of the requirements for the Degree of Master of Science.

May 25, 1965
Date

Clarence N. Lewis
Signature of Advisor