

## CHAPTER IV

### RESULTS

The results obtained from this study was clearly shown that the effect of fastigial nucleus stimulations and lesions are related directly to ABP and HR alterations.

#### Neuroanatomical study of fastigial nucleus

Detailed investigations of fastigial nucleus was undertaken from serial coronal cresyl violet-stained sections at the level of inferior cerebellar peduncle under light and stereozoom microscope. This part of the study was aimed to revealed microscopic structures of neurons in the nucleus and their boundaries in the white matter of cerebellum. This will provide the precise anatomical location and coordinates for neurophysiological studies.

The rostral pole of the fastigial nucleus was first observed as a small group (diameter about 150  $\mu\text{m}$ .) of medium-sized neurons scattering in the white matter of cerebellum at the level of inferior cerebellar peduncle (Fig. 2 - P 3.2 and Fig.3A.). Medial boundary of the nucleus is 375  $\mu\text{m}$ . lateral to the midline. Likewise, the Nucleus dentatus (ND) and Nucleus interpositus (NIP) were also clearly observed, laterally and superior to the inferior cerebellar peduncle respectively. The ND is the large group of densely packed and medium-sized neurons adjacent to the smaller group of NIP. Neurons of nucleus vestibularis lateralis (NVL) was observed scattering close to the lateral border of the fourth ventricle.

The fastigial nucleus was gradually larger caudally along with the ND, NIP and NVL. The largest part of the nucleus (diameter

Fig.2. Atlas of the tree shrew brain prepared by drawings and photographs between the plane p 2.7 to p 4.4 according to stereotaxic zero reference point showing the precise position and shape of the fastigial nucleus. The section run from rostral (R) to caudal (C).



R



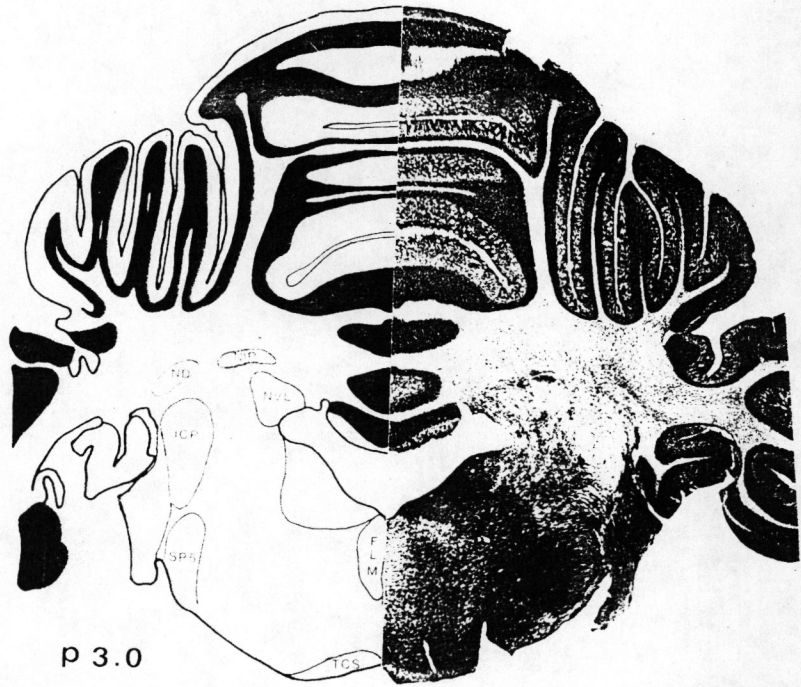
p 2.7



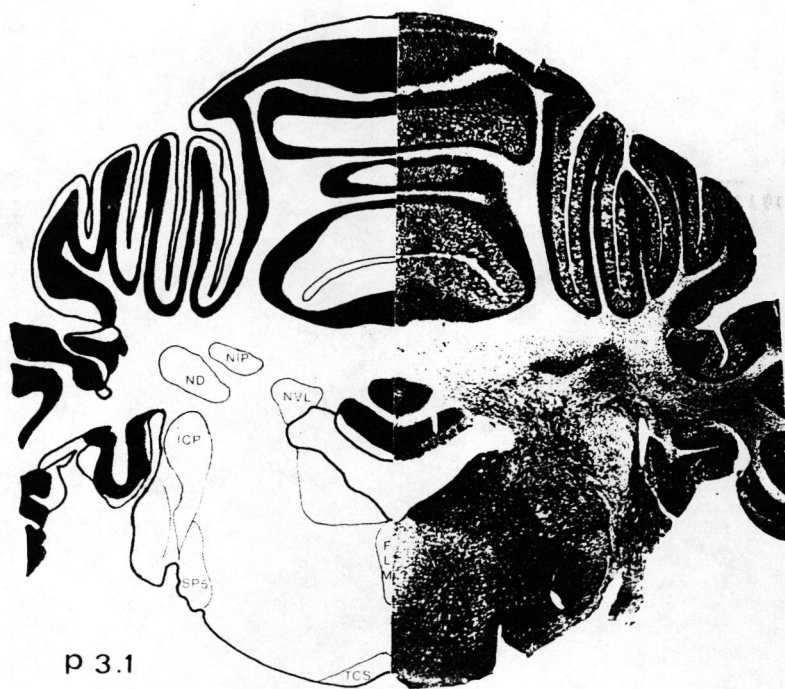
p 2.8



p 2.9



p 3.0



p 3.1

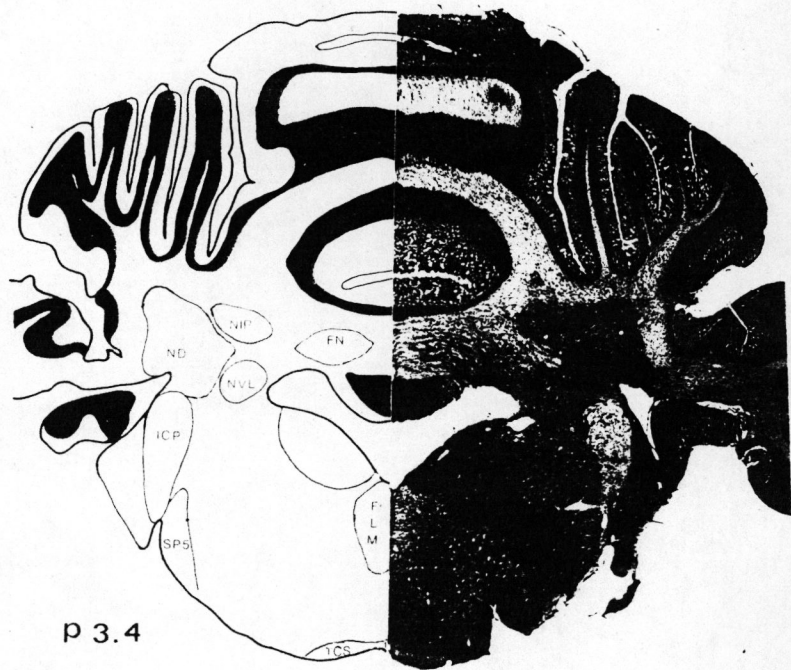


p 3.2





p 3.3



p 3.4



p 3.5



p 3.6

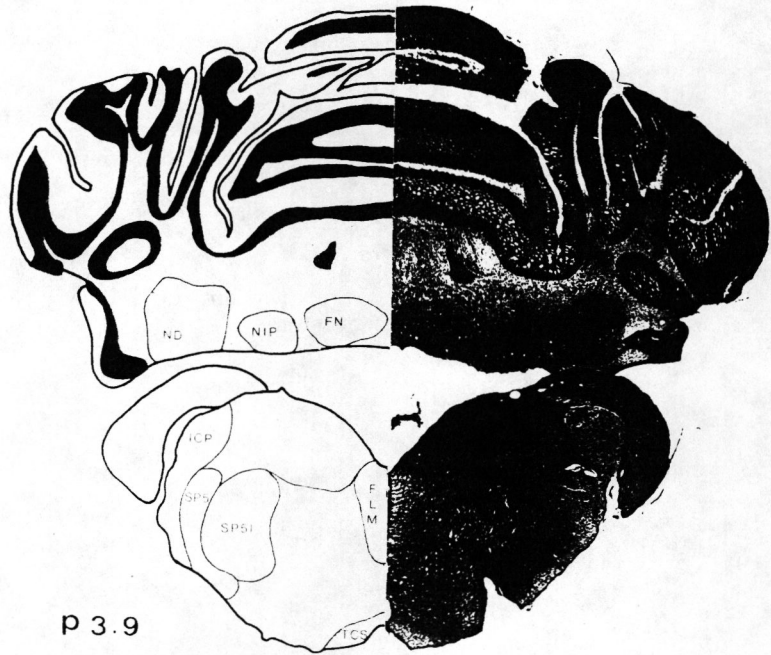


p 3.7



p 3.8





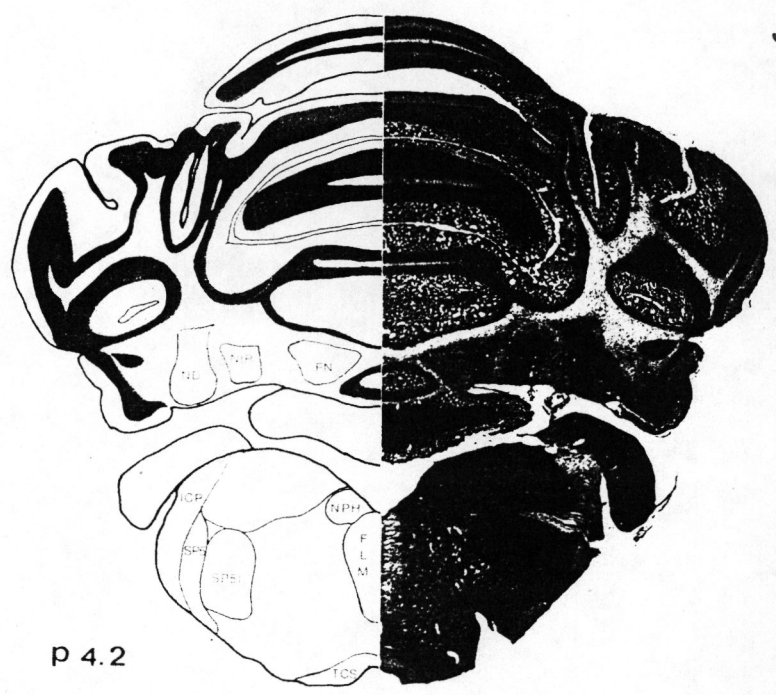
p 3.9



p 4.0



p 4.1



p 4.2



p 4.3



p 4.4

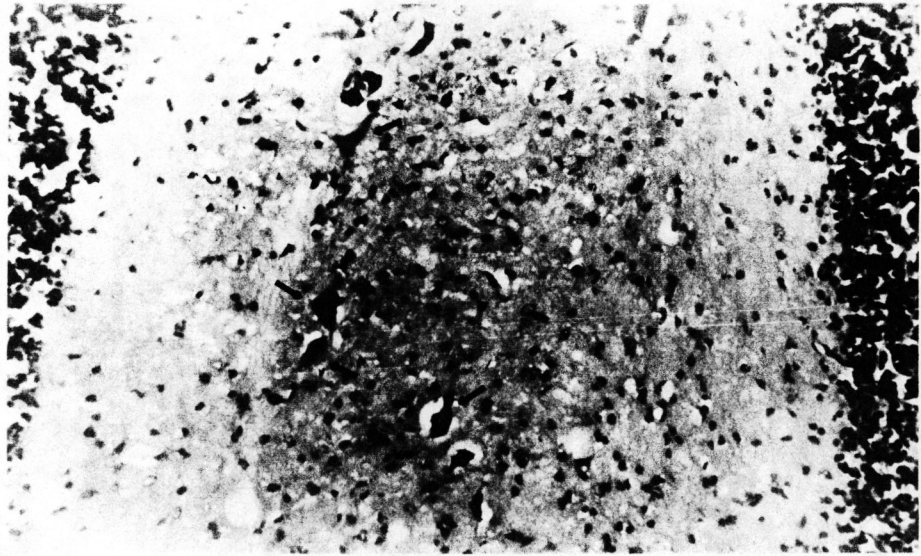
C



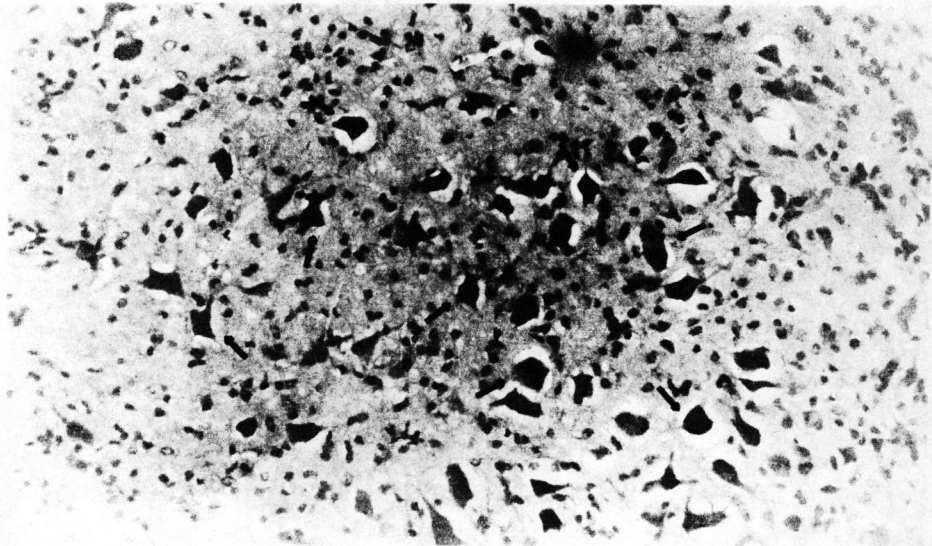
Fig.3. Typical appearance of the distribution of neurons in the FN of tree shrew

- A. neurons (at arrow) at the level P 3.2
- B. neurons (at arrow) at the level p 3.8
- C. neurons (at arrow) at the level p 4.4

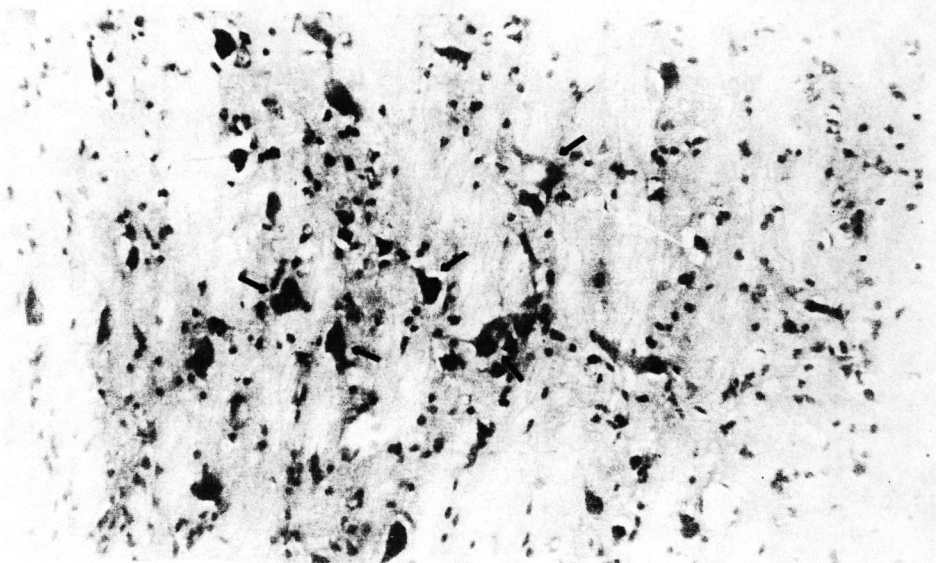
A



B



C





about 500  $\mu\text{m}$ .) was observed at the level of the rostral part of open medulla Fig.2 - p3.8). The nucleus consisted of scattered neuron of small and medium size (Fig. 3B.) At this level the medial boundary of the nucleus is very close (about 50  $\mu\text{m}$ .) to the medline. The NIP and ND were observed laterally, while the NVL was disappeared. Then, the nucleus gradually smaller caudally until the caudal pole was observed at the level of spinal tract of the trigeminal nerve (SP5) (fig. 2 - p.4.4). At this level cluster of neurons was observed in the nucleus (Fig.3C.). Thus the fastigial nucleus approximately 1,200  $\mu\text{m}$ . long.

#### Influence of FN stimulation on ABP and HR

The stimulations were performed in four separated area namely, W.ant.rFN, rFN, mFN, and the caudal portion of the nucleus (cFN).

##### 1. Effect of stimulation of W.ant.rFN on ABP and HR

Electrical stimulation of W.ant.rFN produced significantly increase in ABP and HR in area as far as 550  $\mu\text{m}$ . from the rostral pole of the nucleus. Fig.4. shows the site of stimulation in the W.ant.rFN at 180  $\mu\text{m}$ . anterior to FN. From stimulus response curve obtained from eight experiments ; the minimum ABP response was at 0.01 mA. At this stimulus current, the SP, MAP and DP were increased 2.09 % ( $\pm$  3.38), 2.26 % ( $\pm$  3.38) and 2.40 % ( $\pm$  4.18 ) above resting values, respectively. Then, the response increase related directly with stimulus current are reach maximal response at 0.3 mA. ; the increase in SP, MAP and DP were 46.82 % ( $\pm$  16.36), 59.39% ( $\pm$  20.57) and 69.62 % ( $\pm$ 25.27), respectively. Then, the response was gradually decrease until the current is at 0.6 mA. After that, the response was relatively unchanged (Table.2, Fig. 5.). The change in PP was variable, in some stimulus intensities the PP was decreased. However, in others there was a greater rise in SP with a corresponding rise significantly in PP which produced are increase of 14.04 % ( $\pm$  16.94) at 0.7 stimulus current (table 3, Fig.6.). The response from





Fig.4. Photograph shows the stimulation site in white matter anterior to rostral pole of the fastigial nucleus (white arrow) which elicited FPR.

Table.2. The mean  $\pm$  SD for percentage change in systolic pressure (SP), mean arterial pressure (MAP) and diastolic pressure (DP) during electrical stimulation of unilateral white matter area anterior to rostral pole of the FN (W.ant.rFN).

Intensity (mA.)	% SP, % MAP and % DP increase by stimulation of W.ant.rFN, mmHg $\pm$ SD		
	% SP	(n = 8) % MAP	% DP
Control	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
0.01	2.09 $\pm$ 3.38	2.26 $\pm$ 3.83	2.40 $\pm$ 4.18
0.02	5.56 $\pm$ 8.71	6.62 $\pm$ 10.68	7.49 $\pm$ 12.31
0.03	8.70 $\pm$ 12.32*	10.99 $\pm$ 15.45*	12.84 $\pm$ 17.96*
0.04	12.55 $\pm$ 14.83*	15.34 $\pm$ 17.46*	17.58 $\pm$ 19.55*
0.05	16.70 $\pm$ 14.96*	20.85 $\pm$ 17.86*	24.20 $\pm$ 20.27*
0.06	26.94 $\pm$ 19.66*	32.90 $\pm$ 23.38*	37.68 $\pm$ 26.74*
0.07	25.85 $\pm$ 15.56*	34.53 $\pm$ 19.59*	41.57 $\pm$ 23.45*
0.08	28.88 $\pm$ 18.02*	38.19 $\pm$ 23.40*	45.84 $\pm$ 28.15*
0.10	31.79 $\pm$ 20.07*	41.44 $\pm$ 26.38*	49.40 $\pm$ 32.03*
0.15	41.93 $\pm$ 18.19*	53.44 $\pm$ 20.65*	62.91 $\pm$ 23.30*
0.20	43.12 $\pm$ 13.62*	54.72 $\pm$ 14.64*	64.09 $\pm$ 17.35*
0.30	46.82 $\pm$ 16.36*	59.39 $\pm$ 20.57*	69.62 $\pm$ 25.27*
0.40	46.07 $\pm$ 17.41*	57.72 $\pm$ 20.13*	66.67 $\pm$ 23.06*
0.50	46.99 $\pm$ 15.56*	57.39 $\pm$ 17.24*	65.47 $\pm$ 19.16*
0.60	44.87 $\pm$ 13.75*	52.95 $\pm$ 13.56*	59.13 $\pm$ 14.45*
0.70	44.48 $\pm$ 10.78*	51.59 $\pm$ 9.81*	57.26 $\pm$ 12.32*
0.80	46.08 $\pm$ 11.23*	53.40 $\pm$ 10.56*	59.15 $\pm$ 12.40*

n, number of tree shrews

\* p < 0.05 from resting control

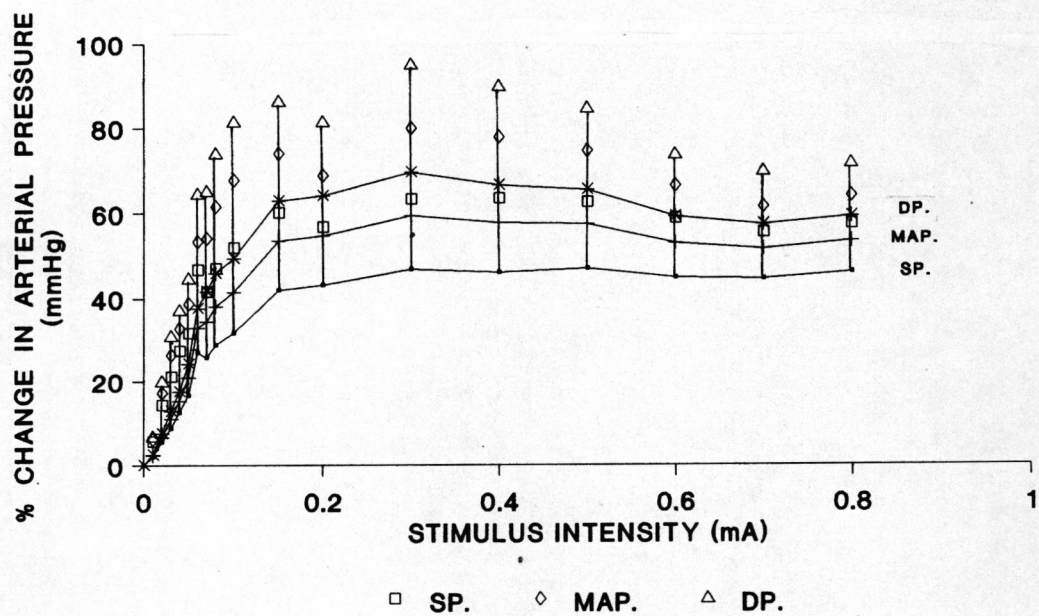


Fig.5. Dose response curve of white matter anterior to rostral pole of the fastigial nucleus stimulation. Showing percentage SP, MAP and DP change after stimulation with various intensities. Values are mean  $\pm$  SD.



Table.3. The mean  $\pm$  SD for percentage change in pulse pressure (PP) during electrical stimulation of unilateral white matter area anterior to rostral pole of the FN (W.ant.rFN), rostral portion of the FN (rFN) and middle portion of the FN (mFN).

Intensity (mA.)	% PP change by stimulation of the FN, mmHg $\pm$ SD					
	W.ant.rFN		rFN		mFN.	
	(n = 8)		(n = 12)		(n = 4)	
	% PP		% PP		% PP	
Control	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00
0.01	1.61	$\pm$ 3.07	0.11	$\pm$ 0.35	0.00	$\pm$ 0.15
0.02	3.61	$\pm$ 5.79	0.61	$\pm$ 1.85	-0.08	$\pm$ 0.05
0.03	2.47	$\pm$ 4.52	-0.99	$\pm$ 3.67	4.72	$\pm$ 7.82
0.04	3.58	$\pm$ 5.52	4.67	$\pm$ 13.94	4.35	$\pm$ 5.00
0.05	3.47	$\pm$ 6.55	-0.16	$\pm$ 17.36	4.42	$\pm$ 1.67*
0.06	5.95	$\pm$ 11.43	3.13	$\pm$ 8.92	-1.52	$\pm$ 5.12
0.07	-1.80	$\pm$ 12.05	6.86	$\pm$ 13.82	0.89	$\pm$ 3.31
0.08	1.15	$\pm$ 9.87	8.36	$\pm$ 15.91	-3.10	$\pm$ 10.75
0.10	2.97	$\pm$ 7.10	10.33	$\pm$ 9.94*	-0.10	$\pm$ 14.20
0.15	6.46	$\pm$ 11.72	9.62	$\pm$ 14.07*	-2.72	$\pm$ 7.63
0.20	5.02	$\pm$ 15.98	9.89	$\pm$ 14.85*	-2.77	$\pm$ 10.35
0.30	6.42	$\pm$ 12.13	15.27	$\pm$ 12.02*	-3.82	$\pm$ 18.56
0.40	2.59	$\pm$ 16.09	13.78	$\pm$ 12.94*	-5.58	$\pm$ 23.23
0.50	8.55	$\pm$ 12.61*	5.70	$\pm$ 24.50	7.54	$\pm$ 20.88
0.60	11.69	$\pm$ 14.47*	15.58	$\pm$ 16.28*	16.19	$\pm$ 19.62*
0.70	14.64	$\pm$ 16.94*	16.01	$\pm$ 15.16*	10.07	$\pm$ 25.30*
0.80	13.41	$\pm$ 16.23*	17.53	$\pm$ 16.45*	11.75	$\pm$ 17.60*

n, number of tree shrews

\*  $p < 0.05$  from resting control

+ indicates an increase in the variable

- indicates a decrease in the variable

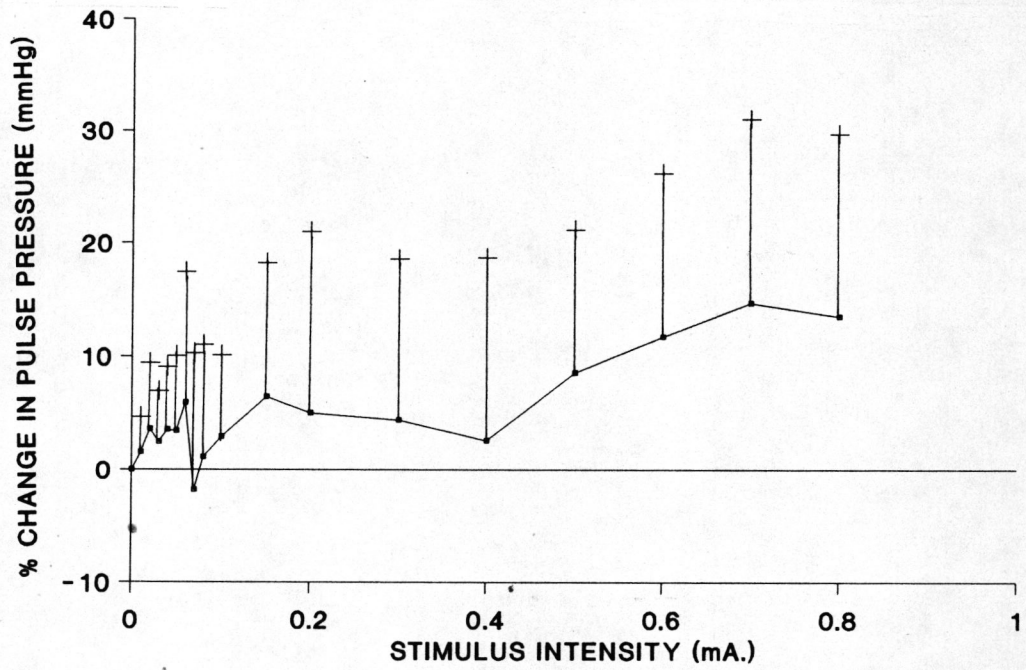


Fig.6. Dose response curve of white matter anterior to rostral pole of the fastigial nucleus stimulation. Showing percentage PP change after stimulation with various intensities. Values are mean  $\pm$  SD.



threshold stimulus, the mean latency to onset of excitation was 2.38 ( $\pm 0.86$ ) S.

The minimum HR response of this area was at 0.01 mA. which produced the HR increase of 0.12 % ( $\pm 0.32$ ). Then, the response was dependent on stimulus intensity and reach maximum response at 0.6 mA. which produced an increase of 13.56 % ( $\pm 9.11$ ). After that the response was gradually decrease and relatively unchange after 0.8 mA. (Table.4, Fig.7.).

Typical FPR response of W.ant.rFN stimulation at 0.4 mA. was shown in Fig.8. It consisted of a low elevation of ABP followed by a rapid elevation until it reached the maximum response. After that, the response was plateau.

## 2. Effect of stimulation of rFN on ABP and HR

Electrical stimulation of rFN elicited pressure response a significantly increase in ABP with simultaneous tachycardia. Stimulation was made from rostral pole of FN to 430  $\mu$ m. caudally. Fig.9. shows the site of the stimulation in rFN at 200  $\mu$ m. posterior to rostral pole of FN. Data obtained from excitatory site in twelve tree shrews were used to construct stimulus-response curves. The minimum FPR response was also at 0.01 stimulus current which produced the SP, MAP and DP increase of 0.17 % ( $\pm 0.56$ ), 0.19 % ( $\pm 0.63$ ) and 0.21 % ( $\pm 0.69$ ) above resting values, respectively. the pattern of response is similar to those of W.ant.rFN but the maximal stimulus response was shown at 0.4 mA. which produced SP, MAP and DP increase of 38.60 % ( $\pm 11.98$ ), 45.43 % ( $\pm 13.84$ ) and 50.53 % ( $\pm 15.72$ ), respectively, this was less than those of W.ant.rFN. After that, the response was plateau (Table. 5, Fig. 10.). In some stimulus intensities the PP was decreased. However, in others there was a greater rise in SP with a corresponding rise in PP which produced an increase of 16.01 % ( $\pm 15.16$ ) at 0.7 stimulus current (Table 3,



Table.4. The mean  $\pm$  SD for percentage increase in heart rate (HR) during stimulation of white matter anterior to rostral pole of fastigial nucleus (W.ant.rFN), rostral fastigial nucleus (rFN) and middle fastigial nucleus (mFN).

Intensity (mA.)	% HR increase by stimulation of FN, bpm $\pm$ SD					
	W.ant.rFN (n = 8)		rFN (n = 12)		mFN (n = 4)	
Control	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00
0.01	0.12	$\pm$ 0.32	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00
0.02	1.28	$\pm$ 2.38	0.08	$\pm$ 0.28	0.00	$\pm$ 0.00
0.03	2.29	$\pm$ 3.48	0.33	$\pm$ 0.59*	0.00	$\pm$ 0.00
0.04	3.87	$\pm$ 6.89	1.06	$\pm$ 1.45*	0.00	$\pm$ 0.00
0.05	3.67	$\pm$ 4.56*	1.38	$\pm$ 2.19*	0.25	$\pm$ 0.43
0.06	4.33	$\pm$ 6.17	2.16	$\pm$ 2.21*	0.74	$\pm$ 1.28
0.07	5.38	$\pm$ 8.11	2.20	$\pm$ 2.26*	0.86	$\pm$ 1.50
0.08	5.19	$\pm$ 7.75	2.46	$\pm$ 1.82*	1.20	$\pm$ 0.99*
0.10	5.18	$\pm$ 5.34*	2.92	$\pm$ 2.91*	1.21	$\pm$ 1.12*
0.15	6.59	$\pm$ 5.77*	5.25	$\pm$ 4.58*	1.31	$\pm$ 1.58
0.20	6.20	$\pm$ 4.31*	5.21	$\pm$ 5.11*	2.61	$\pm$ 3.70
0.30	8.75	$\pm$ 7.83*	5.60	$\pm$ 8.97	5.37	$\pm$ 5.44
0.40	10.91	$\pm$ 9.47*	5.35	$\pm$ 5.13*	4.94	$\pm$ 3.70*
0.50	12.58	$\pm$ 9.94*	7.14	$\pm$ 10.30*	6.56	$\pm$ 5.45*
0.60	13.56	$\pm$ 9.11*	7.77	$\pm$ 9.85*	7.41	$\pm$ 7.21*
0.70	11.61	$\pm$ 8.35*	9.10	$\pm$ 10.66*	6.88	$\pm$ 4.75*
0.80	12.30	$\pm$ 8.99*	11.29	$\pm$ 12.64*	7.27	$\pm$ 5.45*

n, number of Tree shrews

\*  $p < 0.05$  from resting control

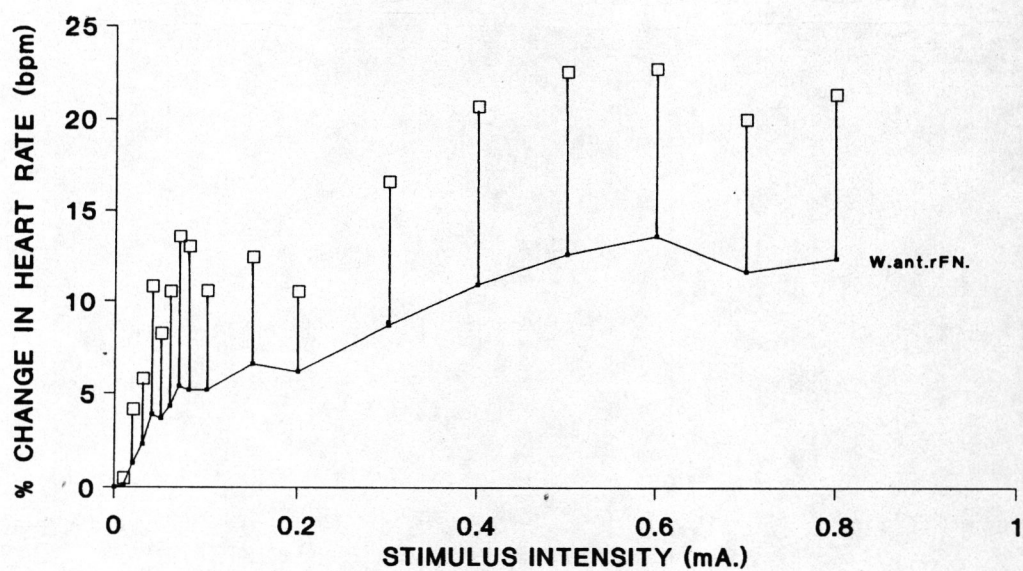


Fig.7. Dose response curve of white matter anterior to rostral pole of the fastigial nucleus stimulation. Showing percentage HR change after stimulation with various intensities. Values are mean  $\pm$  SD.

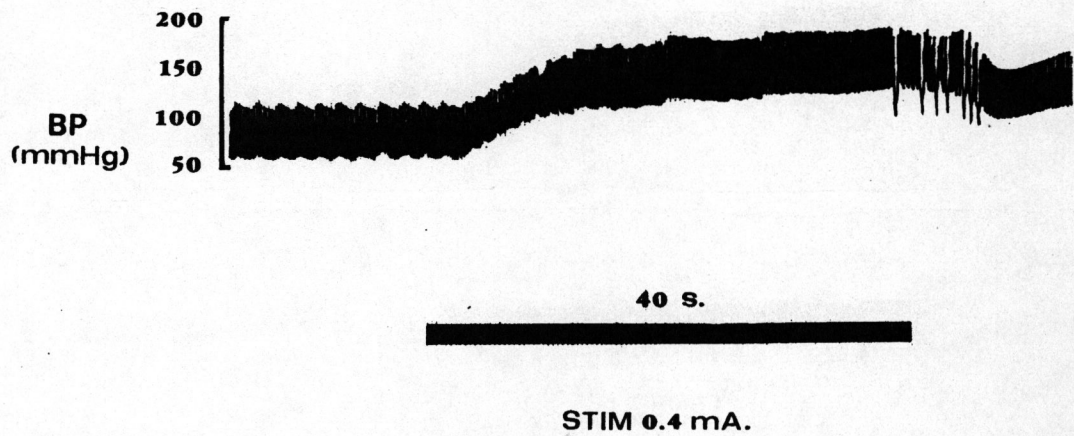


Fig.8. Tracing showing pattern ABP response after stimulation of white matter anterior to rostral pole of fastigial nucleus (with a 40 - S., 50 Hz., 0.1 mS. duration and 0.4 mA.).





Fig.9. Photograph shows the stimulation site in rostral fastigial nucleus (white arrow) which elicited FPR.

Table.5. The mean  $\pm$  SD for percentage change in systolic pressure (SP), mean arterial pressure (MAP) and diastolic pressure (DP) during electrical stimulation of unilateral rostral portion of the FN (rFN).

Intensity (mA.)	% SP, % MAP and % DP increase by stimulation of rFN, mmHg $\pm$ SD		
	% SP	(n = 12) % MAP	% DP
Control	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00	0.00 $\pm$ 0.00
0.01	0.17 $\pm$ 0.56	0.19 $\pm$ 0.63	0.21 $\pm$ 0.69
0.02	0.49 $\pm$ 0.85*	0.42 $\pm$ 0.74*	0.36 $\pm$ 0.74
0.03	1.59 $\pm$ 1.23*	2.40 $\pm$ 2.13*	3.03 $\pm$ 3.00*
0.04	7.52 $\pm$ 9.62*	8.42 $\pm$ 9.22*	9.11 $\pm$ 9.50*
0.05	10.91 $\pm$ 8.86*	14.50 $\pm$ 13.12*	17.29 $\pm$ 17.30*
0.06	14.19 $\pm$ 11.83*	17.78 $\pm$ 15.83*	20.66 $\pm$ 19.37*
0.07	18.40 $\pm$ 17.32*	22.64 $\pm$ 20.87*	25.93 $\pm$ 24.03*
0.08	23.14 $\pm$ 20.04*	27.66 $\pm$ 23.18*	31.15 $\pm$ 25.89*
0.10	25.73 $\pm$ 16.52*	30.43 $\pm$ 20.68*	34.16 $\pm$ 24.41*
0.15	32.01 $\pm$ 13.42*	38.19 $\pm$ 14.49*	42.77 $\pm$ 15.54*
0.20	34.71 $\pm$ 10.80*	41.46 $\pm$ 12.83*	46.43 $\pm$ 14.89*
0.30	37.53 $\pm$ 13.19*	43.61 $\pm$ 14.84*	48.09 $\pm$ 16.26*
0.40	38.60 $\pm$ 11.98*	45.43 $\pm$ 13.84*	50.53 $\pm$ 15.72*
0.50	39.14 $\pm$ 14.83*	44.92 $\pm$ 17.03*	49.16 $\pm$ 18.81*
0.60	38.23 $\pm$ 16.93*	44.20 $\pm$ 18.41*	48.55 $\pm$ 19.72*
0.70	39.05 $\pm$ 14.90*	45.26 $\pm$ 16.91*	49.85 $\pm$ 18.80*
0.80	36.73 $\pm$ 13.73*	43.50 $\pm$ 16.07*	48.54 $\pm$ 18.25*

n, number of tree shrews

\* p < 0.05 from resting control

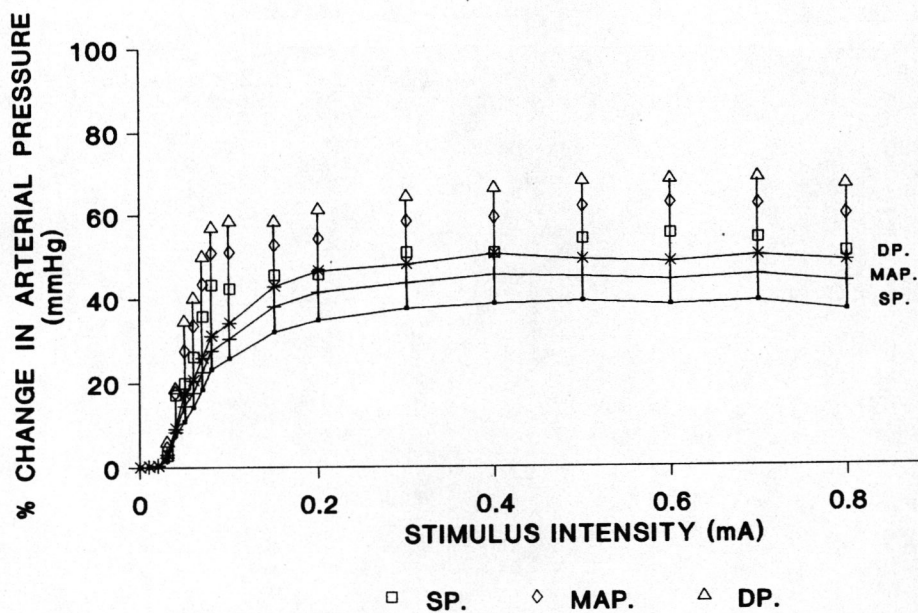


Fig.10. Dose response curve of rostral fastigial nucleus stimulation. Showing percentage SP, MAP and DP change after stimulation with various intensities. Values are mean  $\pm$  SD.



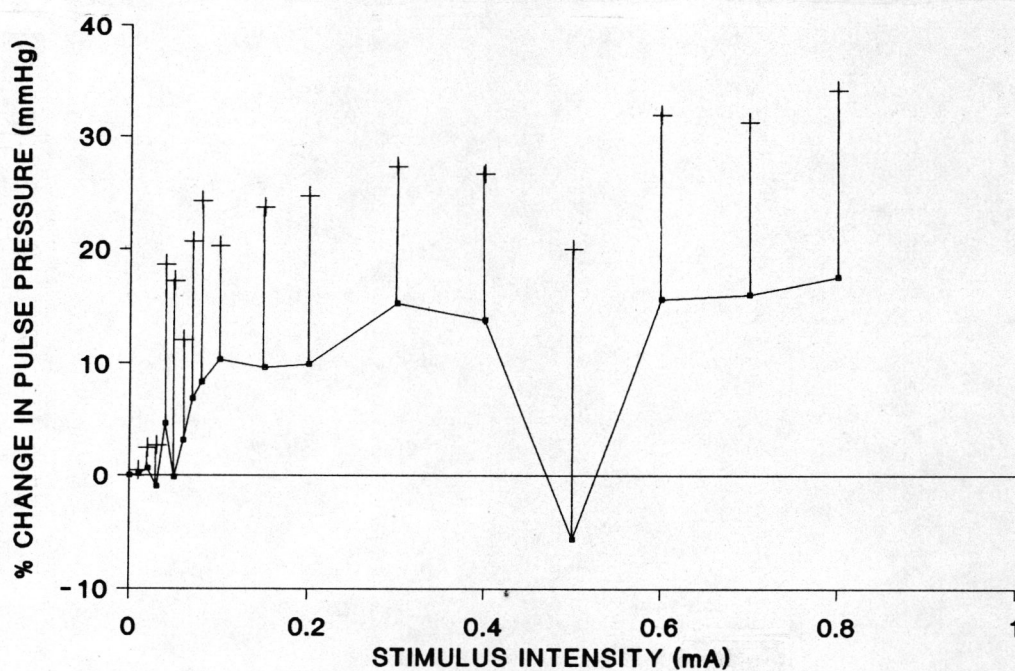


Fig.11. Dose response curve of rostral fastigial nucleus stimulation. Showing percentage PP change after stimulation with various intensity. Values are mean  $\pm$  SD.

Fig.11.). The response from threshold stimulus, the mean latency to onset of excitation was  $2.33 (\pm 1.31)$  S.

The HR response was increased steeply until 0.15 mA.-stimulus. Then, the response was maintained unchanged until 0.4 mA, after that the response gradually increase dependent on stimulus intensity (Table.4, Fig. 12.).

The tracing showing pattern ABP response after stimulation in the rFN was shown in Fig. 13. the FPR, when initially elicited by a 40-S stimulus train, 50 Hz. at 0.4 mA., typically consisted of a low elevation of ABP. After that, a rapid elevation of the ABP was occurred and the linear response was maintained up to the end of stimulation.

### 3. Effect of stimulation of mFN on ABP and HR

Electrical stimulation of mFN produced significantly increase in ABP and HR. Stimulation was made in the mFN region ranging between 430-640  $\mu$ m. posterior to rostral pole of FN. Fig. 14. shows an example of the site of stimulation in the mFN at 490  $\mu$ m. posterior to rostral pole of FN. Data obtained from excitatory site in four tree shrews were used to construct stimulus-response curves. Minimal stimulus current was at 0.02 stimulus current, which produced the SP, MAP and DP increase of 0.51 % ( $\pm 0.61$ ), 0.67 % ( $\pm 0.80$ ) and 0.80 % ( $\pm 0.94$ ) above resting values, respectively. Pattern of the responses was found similar to those of W.ant.rFN and rFN stimulation but the response seemed to be slightly weaker and the intensity that yielded a maximal response was at 0.4 mA. increase in SP, MAP and DP were 36.93 % ( $\pm 11.56$ ), 47.32 % ( $\pm 12.18$ ) and 55.03 % ( $\pm 13.15$ ), respectively. After that, the response was gradually decrease until 0.5 mA. which it reached the plateau (Table.6, Fig.15.). The change in PP was variable in some stimulus intensities the PP was decreased. However, in others there was a greater rise in SP with a corresponding rise PP which produced an increase of 6.19 %



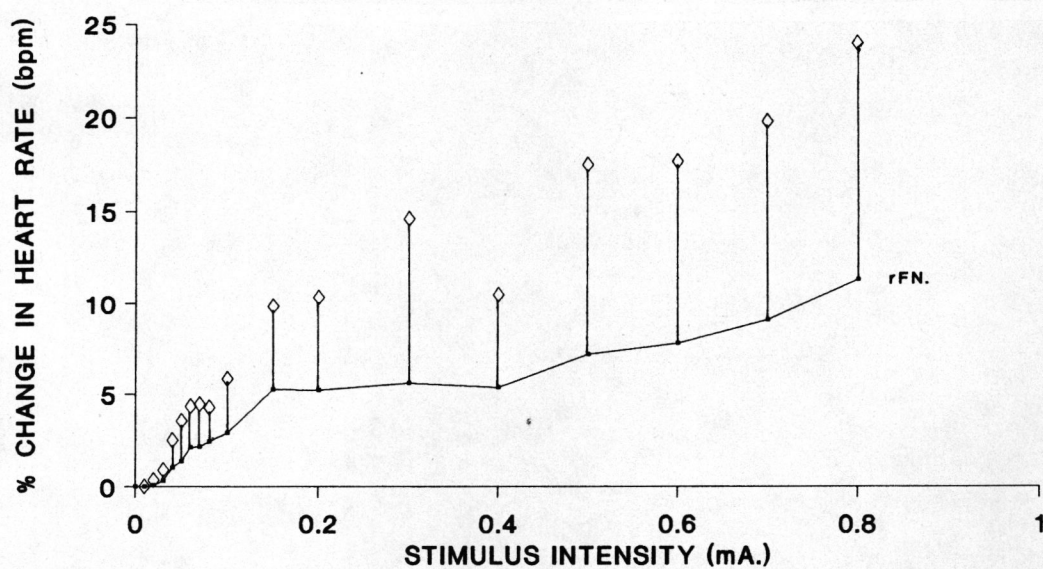


Fig.12. Dose response curve of rostral fastigial nucleus stimulation. Showing percentage HR change after stimulation with various intensities. Values are mean  $\pm$  SD.



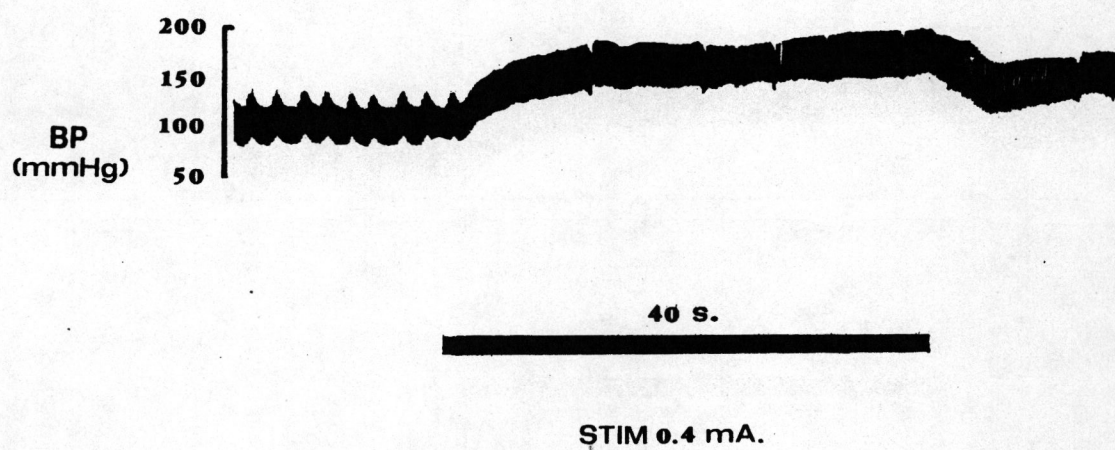


Fig.13. Tracing showing pattern ABP response after stimulation of rostral fastigial nucleus (with a 40-S, 50 Hz., 0.1 mS. duration and 0.4 mA.).



Fig.14. Photograph shows the stimulation site in midde portion of the fastigial nucleus (white arrow) which elicited FPR.

Table.6. The mean  $\pm$  SD for percentage change in systolic pressure (SP), mean arterial pressure (MAP) and diastolic pressure (DP) during electrical stimulation of unilateral middle portion of FN (mFN).

Intensity (mA.)	% SP, % MAP and % DP increase by stimulation of mFN, mmHg $\pm$ SD					
	(n = 4)					
	% SP		% MAP		% DP	
Control	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00
0.01	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00	0.00	$\pm$ 0.00
0.02	0.51	$\pm$ 0.61	0.67	$\pm$ 0.80	0.80	$\pm$ 0.94
0.03	1.76	$\pm$ 1.34*	1.75	$\pm$ 1.45*	1.74	$\pm$ 1.55*
0.04	2.48	$\pm$ 2.03*	2.10	$\pm$ 1.48*	1.83	$\pm$ 1.20*
0.05	2.95	$\pm$ 1.64*	3.05	$\pm$ 1.72*	3.11	$\pm$ 1.79*
0.06	4.59	$\pm$ 2.91*	6.21	$\pm$ 4.52*	7.41	$\pm$ 5.86*
0.07	6.95	$\pm$ 4.18*	8.57	$\pm$ 5.36*	9.77	$\pm$ 6.28*
0.08	8.73	$\pm$ 5.46*	11.21	$\pm$ 7.65*	13.02	$\pm$ 9.80*
0.10	12.40	$\pm$ 3.85*	16.18	$\pm$ 4.11*	18.98	$\pm$ 4.78*
0.15	26.48	$\pm$ 4.09*	34.51	$\pm$ 4.14*	40.52	$\pm$ 4.41*
0.20	26.07	$\pm$ 6.43*	35.09	$\pm$ 8.19*	40.17	$\pm$ 10.41*
0.30	33.93	$\pm$ 7.33*	43.63	$\pm$ 9.02*	50.94	$\pm$ 12.00*
0.40	36.93	$\pm$ 11.56*	47.32	$\pm$ 12.18*	55.03	$\pm$ 13.15*
0.50	33.93	$\pm$ 8.81*	38.31	$\pm$ 8.66*	41.57	$\pm$ 11.63*
0.60	33.49	$\pm$ 5.22*	35.68	$\pm$ 3.48*	37.34	$\pm$ 7.04*
0.70	33.70	$\pm$ 9.25*	37.22	$\pm$ 5.65*	39.87	$\pm$ 8.26*
0.80	31.65	$\pm$ 6.98*	34.46	$\pm$ 3.95*	36.64	$\pm$ 9.01*

n, number of tree shrews

\*  $p < 0.05$  from resting control



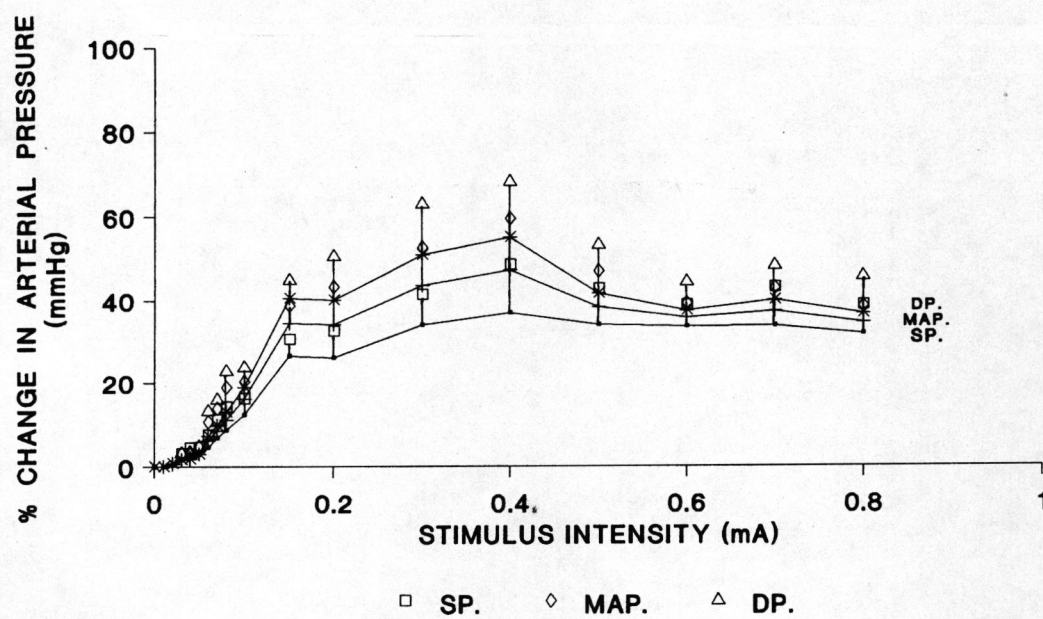


Fig.15. Dose response curves of middle portion of the fastigial nucleus stimulation. Showing percentage SP, MAP and DP change after stimulation with various intensities. Values are mean  $\pm$  SD.

( $\pm 19.62$ ) at 0.6 stimulus current Table 3, Fig.16.). The response from threshold stimulus, the mean latency to onset response was 3.00 ( $\pm 1.41$ ) S.

The minimum HR response of these area was at 0.05 stimulus current which produced an increase of 0.25% ( $\pm 0.43$ ). then, the response of HR was dependent on stimulus intensity (Table.4, Fig.17.).

The tracing of the mFN stimulation was shown in Fig.18. The FPR, was elicited by a 40-S stimulation train, 50 Hz, which showed low elevation of ABP followed by rapid elevation and reach plateau until the end of stimulation.

#### 4. Effect of Stimulation of cFN on ABP and HR

Electrical stimulation of cFN in this study have not effects on the responses of ABP and HR.

#### 5. Comparison Between W.ant.rFN, rFN and mFN Stimulation on ABP and HR

The response of W.ant.rFN, rFN and mFN showed an increase in ABP during stimulation, which was accompanied by an increase in HR. Pattern obtained from those three areas stimulation are more or less similar. All of them show a rapid increase in ABP until they reach maximal value. The response was in plateau in the case of rFN while it was gradually decrease first prior to reach in plateau in the case of W.ant.rFN and mFN (Fig.19.). Patterns of HR response in W.ant.rFN, rFN and mFN stimulation was quite similar, first HR was increase rapidly until reaching a short plateau. Then, the HR was increase again dependent on stimulation. In case of rFN stimulation, HR was increase again dependent on stimulus. While it was gradually decrease first prior to reach in plateau in the case of W.ant.rFN and mFN (Fig.20.). reach plateau (Fig.17.).

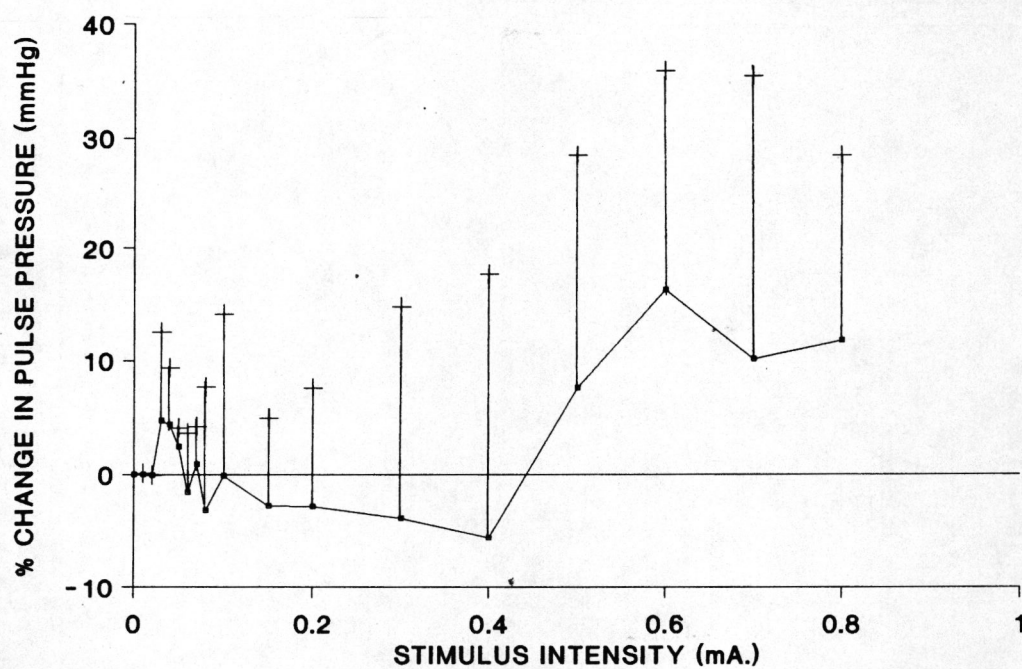


Fig.16. Dose response curve of middle portion of the fastigial nucleus stimulation. Showing percentage PP change after stimulation with various intensities. Values are mean  $\pm$  SD.



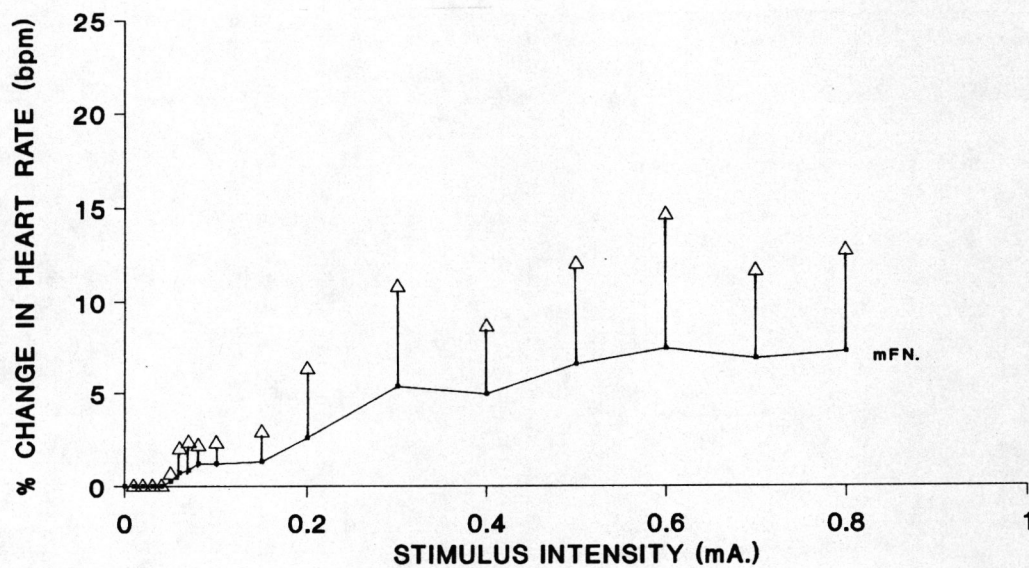


Fig.17. Dose response curve of middle portion of the fastigial nucleus stimulation. Showing percentage HR change after stimulation with various intensities. Values are mean  $\pm$  SD.

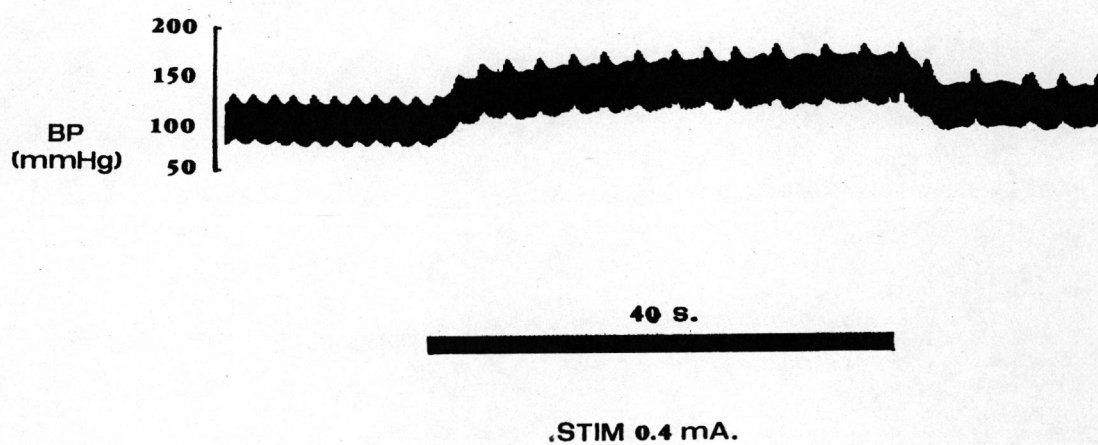


Fig.18. Tracing showing pattern ABP response after stimulation of middle portion of the fastigial nucleus (with a 40-S., 50 Hz., 0.1 mS. duration and 0.4 mA.).

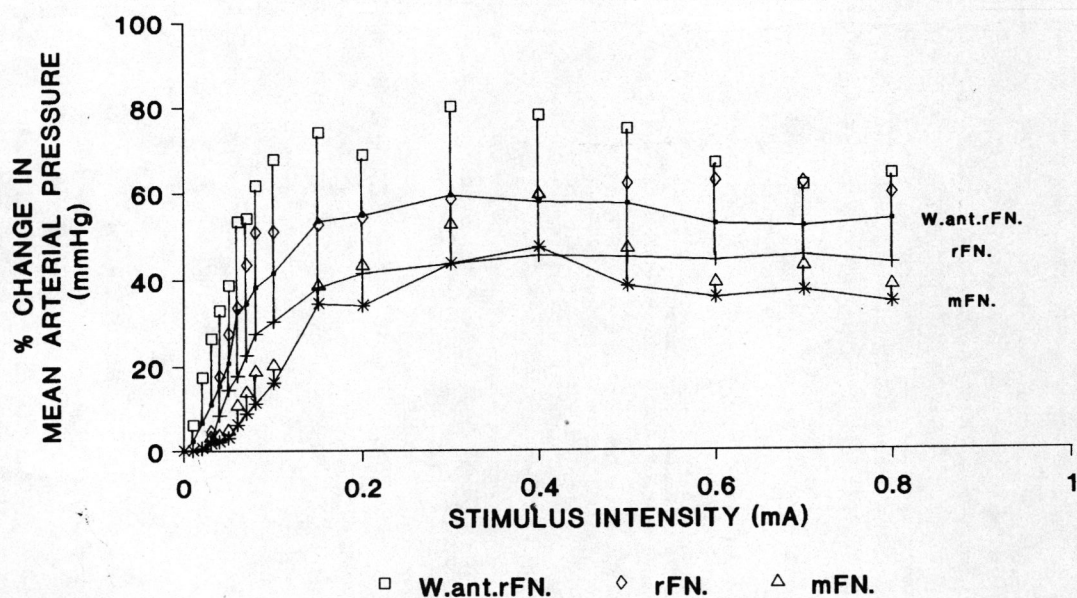


Fig.19. Comparison of dose response curves of W.ant.rFN, rFN and mFN stimulation. Showing percentage MAP change after stimulation with various intensities. Values are mean  $\pm$  SD.



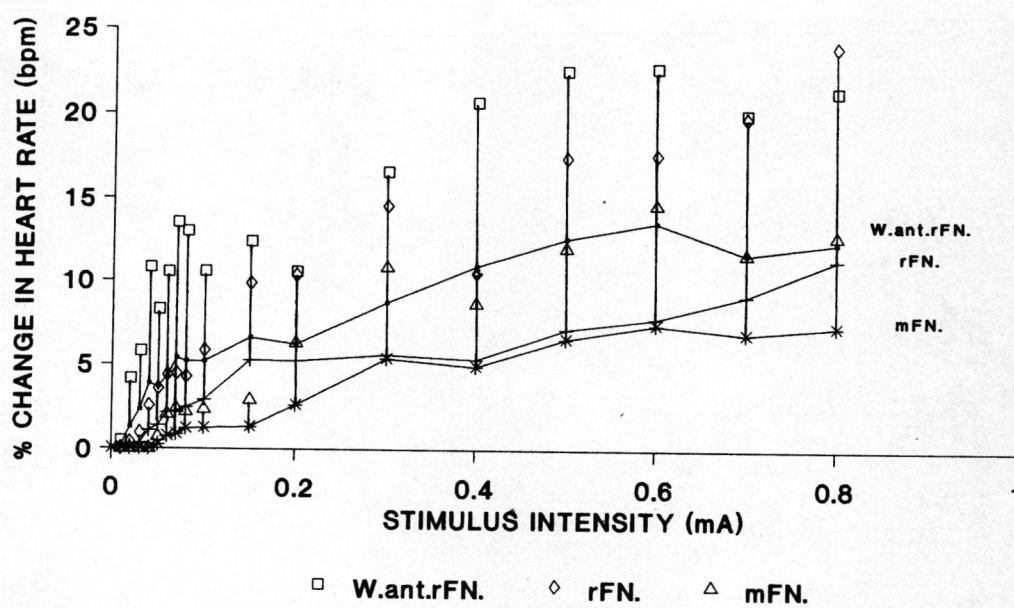


Fig.20. Comparison of dose response curves of W.ant.rFN , rFN and mFN stimulation. Showing percentage HR change after stimulation with various intensities. Values are mean  $\pm$  SD.



However, the maximal stimulus current for eliciting excitation was considerable greater during stimulation of the rFN and mFN ; (0.4 mA.) than during stimulation of W.ant.rFN region ; (0.3 mA.). Moreover, it was found that the increase of MAP during stimulation with 0.15 mA stimuli (five time threshold), the stimulus current was not spreaded to the other areas which produced an increase of 53.44% ( $\pm$  20.65), 38.15% ( $\pm$  14.49) and 34.51% ( $\pm$  4.14) of MAP response during the stimulation of W.ant.rFN, rFN and mFN, respectively. Stimulation of W.ant.rFN produced the maximal effects on MAP and HR response, while the response seemed to be slightly weaker of rFN and mFN stimulation. This difference in MAP is statistically significance ( $p < 0.05$ ), and no significant different ( $p > 0.05$ ) between rFN and mFN stimulation. However, the difference in HR is not statistically significance ( $p > 0.05$ ). Since, the latency of the response in those three area were not significant difference ( $p > 0.05$ ).

#### Influence of FN lesion on ABP and HR.

In the present study, attempts were made to produce electrolytic lesions of the entire FN and the adjacent white matter in acute anaesthetized tree shrews, in order to : (1) determine whether specific physiologic deficits were associated with such lesions, (2) study the nature of attenuation and accommodation, if any.

The result are based on two groups of data derives from experiments with lesion sites are in the vicinity of the rostral region or W.ant.rFN as identified histologically. Typically effective co-ordinates lesion were restricted to areas 3.20 to 4.00 mm. (rostral FN) and 2.40 to 3.20 mm. (W.ant.rFN) posterior to stereotaxic zero reference point. When the area between these two regions of the FN was lesioned either changes or very small and inconsistent cardiovascular responses were evoked.

### 1. Effect of Unilateral rFN - Lesion on ABP

Seven animals were divided into groups based on the sites of the nucleus destroyed. Complete rFN lesions were obtained from four animals while partial rFN lesions were obtained from three animals. Recordings of ABP and response were performed in normal condition prior to lesion and after lesion.

Complete unilateral lesion of rFN causes a significant ( $p < 0.05$ ) decrease in resting ABP. The decrease was observed clearly during the lesion, SP  $-11.79\%$  ( $\pm 6.65$ ), MAP  $-14.16\%$  ( $\pm 7.32$ ) and DP  $-15.93\%$  ( $\pm 8.18$ ). After lesion, ABP started to increase toward normal condition (Table.7, Fig.21.). In case of partial rFN lesion (180  $\mu$ m posterior to the rostral pole) the response was weaker than those of the complete one (Table.8, Fig.22.). A typical ABP response is seen in Fig.23.

Unilateral lesion of the rFN as defined in detail elsewhere. A lesion site is seen in Fig.24. Damage in all instances consisted of a region lying dorsal to the fourth ventricle at a site just caudal to the rostral pole of FN.

### 2. Effect of W.ant.rFN-Stimulation of unilateral rFN-lesion animals.

Stimulation of W.ant.rFN was performed in both complete and partial unilateral lesion of rFN. In case of complete lesion, the stimulation produced no response. A positive response was shown in case of partial lesion, the increase in ABP and HR was insignificant to those of normal stimulation, MAP  $56.41\%$  ( $\pm 41.93$ ) and HR  $5.11\%$  ( $\pm 3.41$ ) (Table.8., Fig.22).



Table 7. Time course of percentage SP, MAP and DP change after lesion in rostral fastigial nucleus.

	Time course (S.)						
	Resting	10	20	30	40	50	60
% change in SP	0.00	-5.29*	-8.84*	-11.79*	-9.61*	-6.98*	-5.69*
	<u>+0.00</u>	<u>+3.83</u>	<u>+6.02</u>	<u>+6.65</u>	<u>+8.87</u>	<u>+5.13</u>	<u>+5.29</u>
% change in MAP	0.00	-7.14*	-11.25*	-14.16*	-11.46*	-8.20*	-6.48*
	<u>+0.00</u>	<u>+3.09</u>	<u>+7.74</u>	<u>+7.32</u>	<u>+7.91</u>	<u>+4.95</u>	<u>+4.89</u>
% change in DP	0.00	-8.55*	-13.07	-15.93*	-12.83*	-9.09*	-7.08*
	<u>+0.00</u>	<u>+3.77</u>	<u>+9.33</u>	<u>+8.18</u>	<u>+8.29</u>	<u>+5.89</u>	<u>+5.37</u>

Values are mean  $\pm$  SD ; n, number of tree shrews

\*  $p < 0.05$  from resting control.

- indicates a decrease in the variable

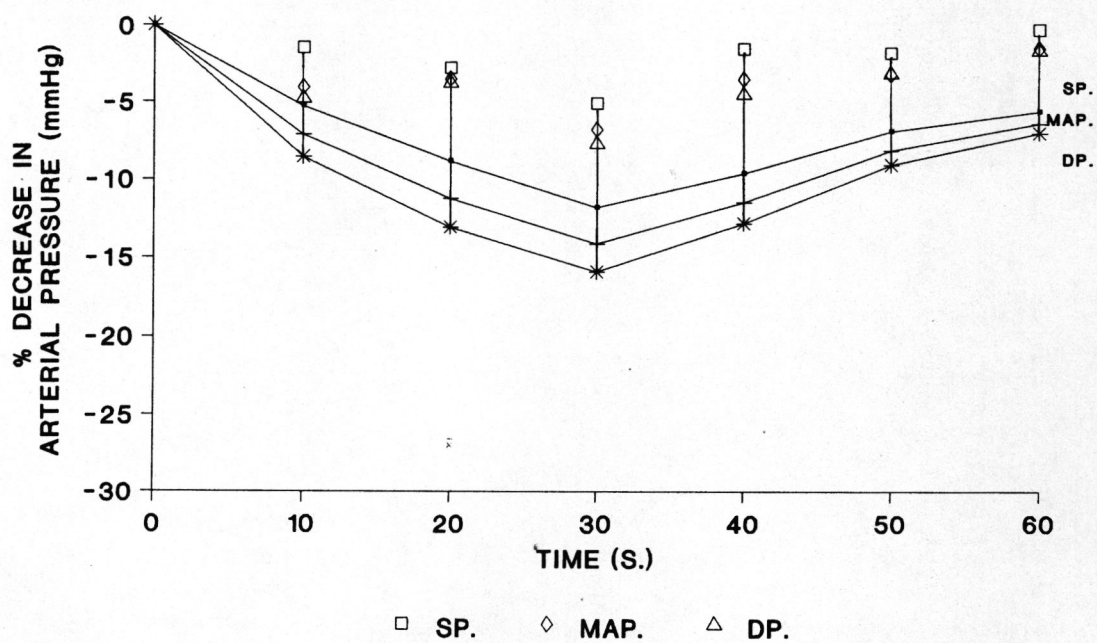


Fig.21. Time course of percentage SP, MAP and DP change after lesion in the rostral fastigial nucleus (with 0.35 mA.DC. lasting 30-S.). Values are mean  $\pm$  SD.

Table 8. Comparison of percentage MAP change after unilateral rostral fastigia nucleus lesion in area of -rFN and -180 um.rFN and ipsilateral white matter anterior to rostral pole of fastigial nucleus - evoked responses compared to the intact control.

group	(n)	% MAP	% HR
		change	change
		mm Hg $\pm$ SD	beats/min $\pm$ SD
Stim. of w.ant.rFN in intact FN	(8)	58.44 $\pm$ 20.65	6.59 $\pm$ 5.77
<u>Lesion of - rFN</u>	(4)	-14.16 $\pm$ 7.32*	
Postlesion stim. of w.ant.rFN		0.00 $\pm$ 0.00**	0.00 $\pm$ 0.00**
<u>Lesion of -180 um.rFN</u>	(3)	-9.00 $\pm$ 1.94*	
postlesion stim. of w.ant.rFN		56.41 $\pm$ 41.93***	5.11 $\pm$ 3.41***

\* p<0.05 from resting (paired t-test)

\*\* p<0.05 from intact FN (unpaired t - test)

\*\*\* p>0.05 from intact FN (unpaired t - test)

N, number of tree shrews tested

SD, standard deviation

+ indicates an increase in the variable

- indicates a decrease in the variable



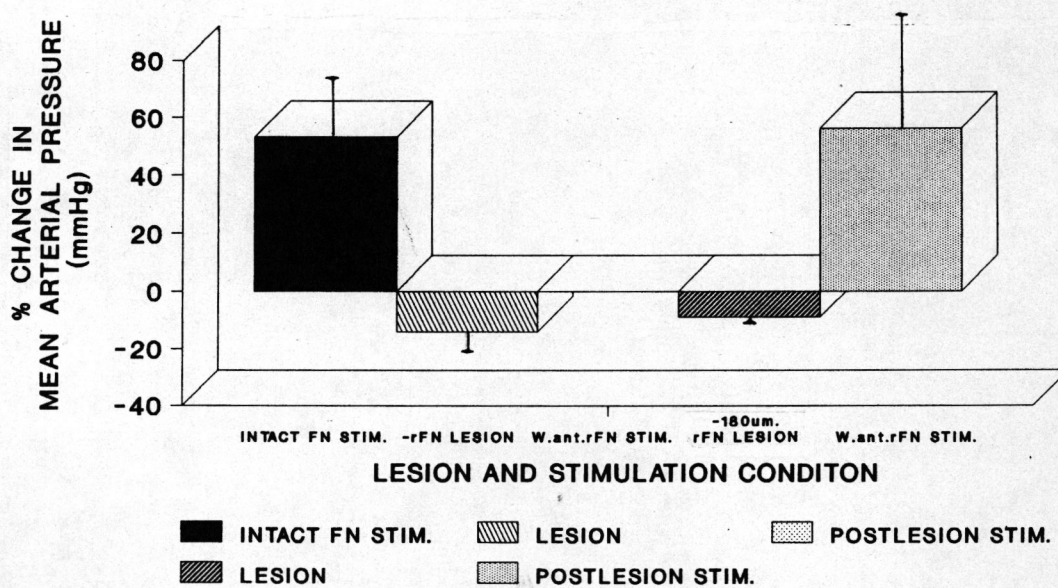


Fig.22. Histogram shows comparison of percentage MAP change after unilateral rostral fastigial nucleus lesion in area of -rFN and -180  $\mu$ m. rFN and ipsilateral white matter anterior to rostral pole of the fastigial nucleus - evoked responses compared to the intact control. Values are mean  $\pm$  SD.

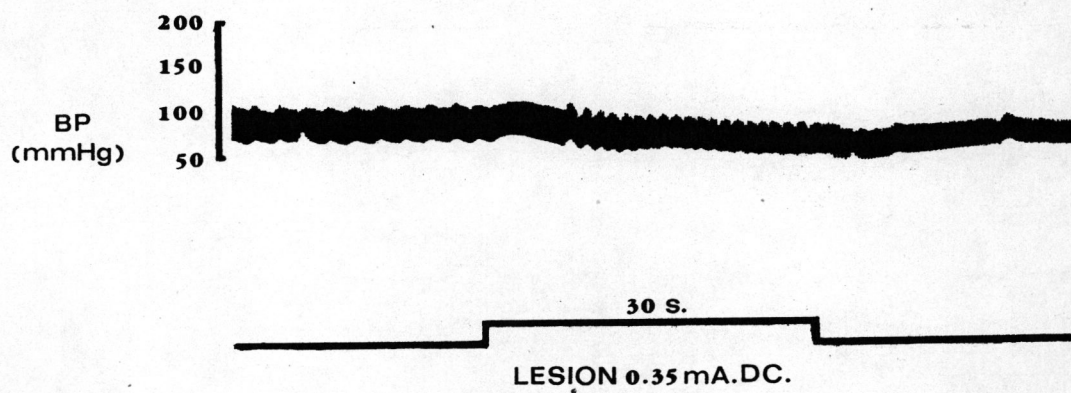


Fig.23. Tracing shows pattern of ABP response after lesion in the unilateral rostral fastigial nucleus.



Fig.24. Photograph shows the lesion site (white arrow) in the rostral fastigial nucleus which produced depressor response.



### 3. Effect of unilateral W.ant.rFN lesion on ABP

Seven animals were divided into groups based on the sites of the nucleus destroyed. complete W.ant.rFN lesion were obtained from four animals while partial W.ant.rFN lesion were obtained from three animals. Recording of ABP and response was performed in normal condition prior to lesion and after lesion.

Complete unilateral lesion of W.ant.rFN cause a significant ( $p < 0.05$ ) decrease in resting ABP. The decrease was observed clearly during the lesion, SP - 22.32 % ( $\pm 10.74$ ), MAP - 25.35 % ( $\pm 13.41$ ) and DP -27.92 % ( $\pm 15.78$ ). After lesion, ABP started increase toward normal condition (Table. 9, Fig.25.). In case partial W.ant.rFN lesion (200  $\mu$ m. anterior to the rostral pole) the response was weaker than those of the complete one MAP -14.29 % ( $\pm 16.88$ ) (Table.10, Fig.26.). A typical ABP response is seen in Fig. 27.

Unilateral lesion of the W.ant.rFN as defined in detail elsewhere. A lesion site is seen in Fig.28. Damage in all instances consisted of region lying dorsal to the fourth ventricle at a site just anterior to the rostral pole of FN.

### 4. Effect of rFN-stimulation of unilateral W.ant.rFN-lesion animals.

Stimulation of rFN was performed in both complete and partial unilateral lesion of W.ant.rFN. In case of complete lesion, the stimulation produced no response positive response was shown in case of partial lesion, the increase in ABP and HR was insignificant to those of normal stimulation, MAP 36.48 % ( $\pm 8.02$ ) and HR 3.22 % ( $\pm 2.11$ ) (Table.10, Fig.26.).

Table 9. Time course of percentage SP, MAP and DP change after lesion in white matter anterior to rostral pole of the fastigial nucleus.

	Time course (S.)						
	Resting	10	20	30	40	50	60
% change in SP	0.00	-8.13*	-18.61*	-22.32*	-21.12*	-18.93*	-16.34*
	+0.00	+3.37	+10.20	+10.74	+13.37	+11.30	+9.78
% change in MAP	0.00	-10.37*	-21.71*	-25.35*	-21.98*	-18.73*	-16.06*
	+6.00	+4.91	+12.38	+13.41	+17.77	+16.41	+13.20
% change in DP	0.00	-12.19*	-24.35*	-27.92*	-22.68*	-18.63*	-15.82*
	+0.00	+6.28	+14.33	+15.78	+21.75	+21.58	+16.60

Values are mean  $\pm$  SD ; n, number of tree shrews

\*  $p < 0.05$  from resting control.

- indicates a decrease in the variable

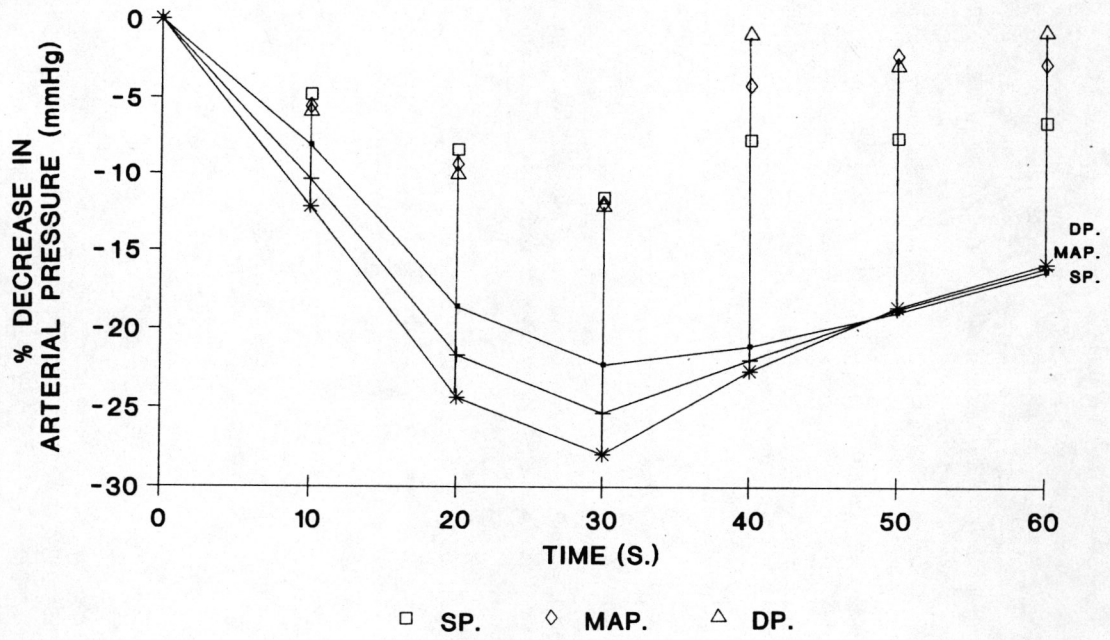


Fig.25. time course of percentage SP, MAP and DP change after lesion in the white matter anterior to rostral pole of the fastigial nucleus (with 0.35 mA. DC. lasting 30-S.). Values are mean  $\pm$  SD.



Table 10. Comparison of percentage MAP change after unilateral white matter anterior to rostral pole of fastigial nucleus lesion in area of + rFN and + 200 um. rFN and ipsilateral rostral fastigial nucleus -evoked responses compared to the intact control.

group	(n)	% MAP	% HR
		change	change
		mm Hg $\pm$ SD	beats/min $\pm$ SD
Stim of rFN in intact FN	(12)	38.19 $\pm$ 14.49	5.24 $\pm$ 4.58
<u>Lesion of + rFN</u>	(4)	-25.35 $\pm$ 13.41*	
Postlesion stim of rFN		0.00 $\pm$ 0.00**	0.00 $\pm$ 0.00**
<u>Lesion of +200 um.rFN</u>	(3)	-14.29 $\pm$ 16.88*	
postlesion stim of rFN		36.48 $\pm$ 8.02***	3.22 $\pm$ 2.11***

\*  $p < 0.05$  from resting (paired  $t$ -test)

\*\*  $p < 0.05$  from intact FN (unpaired  $t$  - test)

\*\*\*  $p > 0.05$  from intact FN (unpaired  $t$  - test)

N, number of tree shrews tested

SD, standard deviation

+ indicates an increase in the variable

- indicates a decrease in the variable

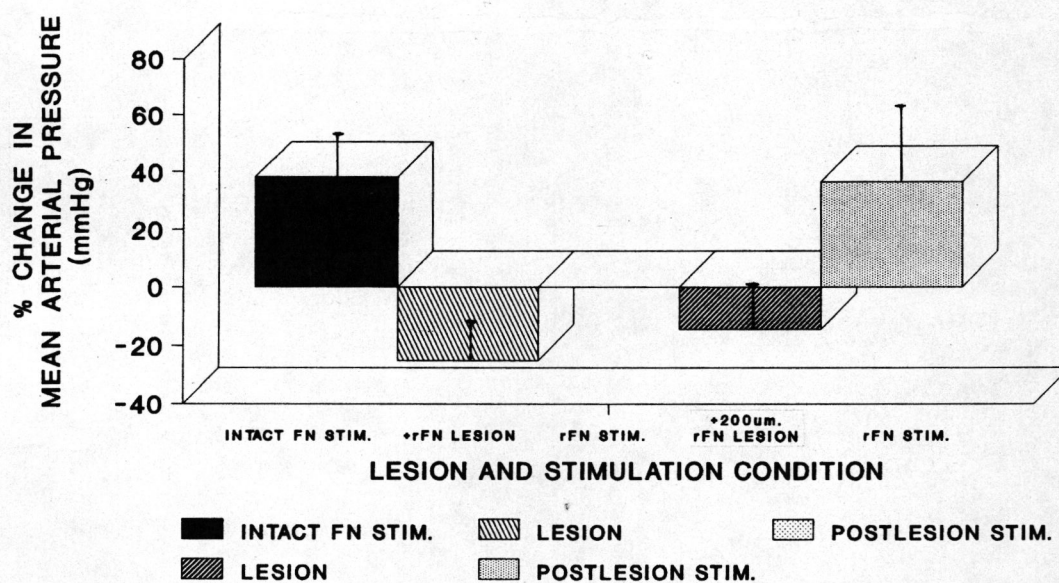


Fig.26. Histogram shows comparison of percentage MAP change after unilateral white matter anterior to rostral pole of the fastigial nucleus lesion in area of +rFN and +200 um.rFN and ipsilateral rostral fastigial nucleus - evoked responses compared to the intact control. Values are mean  $\pm$  SD.

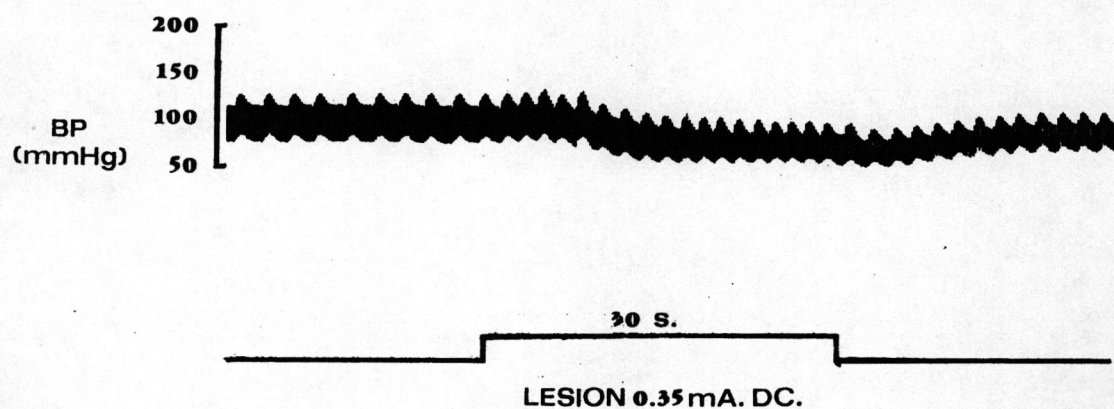


Fig.27. Tracing shows pattern of ABP response after lesion in the unilateral white matter anterior to rostral pole of the fastigial nucleus.





Fig.28. Photograph shows the lesion site (white arrow) in the white matter anterior to rostral pole of the fastigial nucleus which produced depressor response.