

# ***Innervation of the pineal gland in the rat: A chromatolysis study***

\* Hadi J. Ali M.B.Ch.B., M.Sc.

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## ***Abstract***

**Back ground:** The innervations of the pineal gland from the superior cervical ganglion have shown some form of a chromatolysis reaction.

**Objective:**

- 1-Tracing the innervations of the pineal gland by removing the target tissue (the pineal gland in this study) i.e. (pinealectomy) and removal of the superior cervical ganglion i.e. (ganglionectomy).
- 2- The localization and total number of the neurons which project into the rat pineal gland
- 3-The effect of pinealectomy on the SCG after a different time interval.

**Methods:** Twenty five albino rats were used in this study, Pinealectomy was done, then after a different time interval ganglionectomy was done, in order to study the Chromatolysis in their cell body.

**Result:** The present study has demonstrated that the chromatolysis reaction in the neurons following Pinealectomy confirms the innervations of the pineal gland from the SCG. The present study has demonstrated that the most obvious the Chromatolysis reaction occurred one day after pinealectomy.

**Conclusion:** This study confirms the innervations of the pineal gland from the SCG, the study shows that the distribution of the Chromatolysis neurons; of all age group occurred in all parts of the ganglion; although it was more abundant in the rostral 2/3.

**Key words:** Pineal gland, Pinealectomy, Superior cervical ganglion (S.C.G.) Ganglionectomy Chromatolysis

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## ***Introduction***

The retrograde cell reaction (Chromatolysis reaction) is a well established method for studying neuronal projections. However this method has not been employed in the study of the innervations of the pineal gland. It would be suspected that following Pinealectomy some neurons within the SCG which are involved in the innervations of the pineal gland would show some form of a Chromatolysis reaction.

## ***Method***

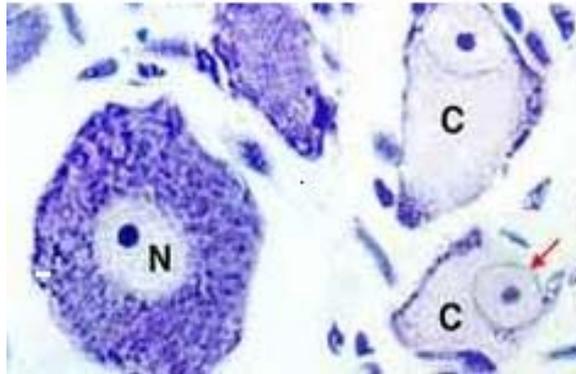
Twenty five albino rats (*Rattus norvegicus*), both sexes, were used in this study. The pineal glands of 20 rats were removed from these animals at the age of 12 weeks. The animals were kept alive and sacrificed after different time intervals (i.e. 1 day, 1 week, 2 weeks, 3 weeks, 4 weeks, and 6 weeks), for the

removal of the SCG (ganglionectomy) in order to study the Chromatolysis reaction on their neurons.

1. Sham operations: 2 animals were used.
2. The control animals: 3 animals were used.
3. Processing for light Microscope: A) Fixation). B) Dehydration. C) Clearing. D) Embedding. E) Sectioning. F) Staining: - cresyl fast violet was used to stain the tissues.  
- Quantization and localization of the Chromatolysis neurons in the SCG

## ***Results***

Some cell bodies show no structural alterations, others swell while their nuclei become eccentric and the larger Nissl bodies dispersed (chromatolysis) and some cells subsequently die. These phenomena are regarded as successive stages of severity of the cell reaction. Picture <sup>(1)</sup>.



**Picture 1:- Changes in the shape & size of the perikaryon: normal neuron (N), Chromatolysis (C).**

In the sham operated animals, no Chromatolysis neurons were found. Similarly no sign of Chromatolysis were found in the neurons of SCG of the control animal

One day post pinealectomy: the total number of the neurons were (14150), the average number of the chromatolytic neurons were (250) and the percentage of the chromatolytic neurons to the total number of the neurons were (1.77). . (Table 1 & fig. 1). The percentages in the three parts of the ganglia were (40.4%, 46.4%, and 13.2%) (Rostral to caudal) (Table 2& fig. 2). The Chromatolysis neurons were distributed all over the SCG. However they were more abundant in the rostral 2/ 3.

One week post Pinealectomy the total number of the neurons were (15415), the average number of the chromatolytic neurons were (120) and the percentage of the chromatolytic neurons to the total number of the neurons were (0.78 ) (Table 1 & fig. 1).

The distribution of these neurons in the three parts of the ganglion was (33.33%, 50%, and 16.67%) (Table 3). (Rostral to caudal) respectively. (Table 2 & fig. 2). . The distribution of the neurons was similar to the previous interval (i. e they were distributed

all over the SCG and they were more abundant in the rostral 2/3).

In these set of experiments, the average number of the Chromatolysis neurons Within the SCG declined gradually. The longer the post operative interval, the fewer Chromatolysis neurons were seen.

Two weeks post pinealectomy: the total number of the neurons were (19255), the average number of the chromatolytic neurons were (100) and the percentage of the chromatolytic neurons to the total number of the neurons were (0.52). (Table 1 & fig. 1).

The distribution of these neurons in the three parts of the ganglion was (40%, 50%, and 10%) (rostral to caudal) respectively (Table 2& fig. 2) .

Three weeks post Pinealectomy the total number of the neurons were (19240), the average number of the chromatolytic neurons were (100) and the percentage of the chromatolytic neurons to the total number of the neurons were (0.52). . (Table 1 & fig. 1). The distribution of these neurons in the three parts of the ganglion was (35%, 55%, and 10%)

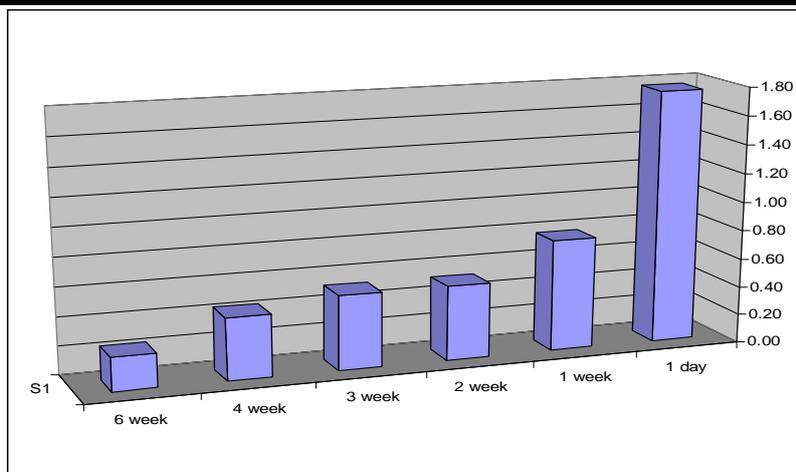
(rostral to caudal) respectively. (Table 2& fig. 2). Four weeks post Pinealotomy the total number of the neurons were (15655), the average number of the chromatolytic neurons were (68) and the percentage of the chromatolytic neurons to the total number of the neurons were (0.43) .(Table 1 & fig. 1)The distribution of these neurons in the three parts of the ganglion was (44.12%, 29.41% and 26.47%) (rostral to caudal) respectively. (Table 2& fig. 2).

Six weeks post Pinealotomy the total number of the neurons were (18070), the average number of the chromatolytic neurons were (43) and the percentage of the chromatolytic neurons to the total number of the neurons were (0.24) .(Table 1 & fig. 1).The distribution of these neurons in the three parts of the ganglion was (23.26%, 46.51%, and 30.23%) (Rostal to caudal) respectively. (Table 2& fig. 2).

**Table 1: The total number of the Chromatolysis neurons in each post Pinealotomy interval compared to the total number of the neuronal population in the SCG.**

post Pinealotomy interval	1 day	1 week	2 weeks	3 weeks	4 weeks	6 weeks
total number of neurons	14150	15415	19255	19240	15655	18070
average number of Chromatolysis neurons	250	120	100	100	68	43
% of the Chromatolysis neurons to the total no.	1.77	0.78	0.52	0.52	0.43	0.24

**Fig 1: the percentage of the Chromatolysis neurons in each post Pinealotomy interval compared to the total number of the neuronal population in the SCG.**

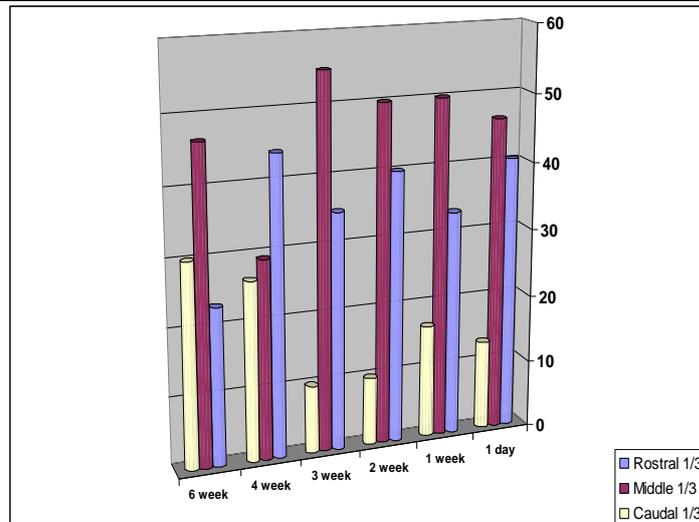


Post Pinealectomy interval

**Table 2 :The total number of Chromatolysis neurons, their number and the percentages of their distributions in the three parts of the SCG in each post Pinealectomy interval.**

Days	1 day	1 week	2 weeks	3 weeks	4 weeks	6 weeks
Average No.	250	120	100	100	68	43
Rostral 1/3 No.	101	40	40	35	30	10
Rostral 1/3 %	(40.4)	(33.33)	(40.00)	(35.00)	(44.12)	(23.26)
Middle 1/3 No.	116	60	50	55	20	20
Middle 1/3 %	(46.4)	(50.00)	(50.00)	(55.00)	(29.41)	(46.51)
Caudal 1/3 No.	33	20	10	10	18	13
Caudal 1/3 %	(13.2)	(16.67)	(10.00)	(10.00)	(26.47)	(30.23)

**Figure 2:- The total number of Chromatolysis neurons, their number and the percentages of their distributions in the three parts of the SCG in each post Pinealectomy interv**



Post Pinealotomy interval

## Discussion

The distribution patterns of neurons in the rat SCG that project to a number of spatially separated and functionally different target tissues were studied using fluorescent dyes to label retrograde neurons that project to the pineal gland (Flett D L 1991)<sup>(1)</sup>. Patrickson & Smith (1987)<sup>(2)</sup> using tracer substance such as HRP could not be used in our study of the role of the developing SCG in the innervations of the pineal gland; the reason being that the tracer would not be available in the neurons of the SCG for periods more than (24–36) hours following its injection into the pineal gland. On the other hand- Pinealotomy

would provide us with the tool by which this matter could be investigated. In the present study, the length of the post operative period following Pinealotomy appeared to be an important factor in determining the number of the Chromatolysis neurons seen in the SCG. Russel, J, Reiter (2005).<sup>(3)</sup> The earlier the post operative period, the more chromalolytic neurons were found.

The critical time for the developing SCG is not defined. The very marked Chromatolysis changes in the SCG of young animals, one day following Pinealotomy could be explained in the basis that Pinealotomy was done during the critical period. Cragg B.G. (1970)<sup>(4)</sup>. On the other hand the decline in the number of the Chromatolysis neurons seen in the SCG after longer post operative intervals may reflect the results of complete degeneration of Chromatolysis neurons.

Regeneration of the Nissels substance following axotomy was reported by many workers. Moreover, Cragg B.G.

(1970) suggested that even neurons prevented from reestablishing peripheral

contacts may show sign of recovery from the early Chromatolysis. In spite of this, degeneration and complete disintegration of the axotomized neurons were reported by many workers.

With regard to the localization and total number of the neurons which project into the rat pineal gland; Bower & Zigmond (1984) <sup>(5)</sup> have found that the injection of HRP into the rat pineal gland resulted in the labeling of about 250 neurons within the SCG. These neurons were distributed throughout the ganglia, but the majority is found in the rostral part of the ganglia. No labeled neurons were found in the middle or inferior cervical ganglia. Patrickson & smith (1987) using HRP as tracer substance have found a similar distribution of labeled neurons projecting in to the pineal gland from the rat SCG. In the present study, the average numbers of neurons which project in to the pineal gland, seen in the SCG, one day after Pinealotomy were around (250 + 5).

### **Conclusion:**

The work presented in this study showed that the method of tracing the innervations of the pineal gland by removing the target tissue (the pineal gland in this study) appeared to be justified and conclusive.

. The present study has also demonstrate that the distribution of these Chromatolysis neurons and all over the ganglion being inspected. However they were more abundant in the rostral 2/3 of these ganglions.

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*\*From the Department of anatomy, Al-Kindy College of Medicine, University of Baghdad. Iraq*

*Correspondence Address to :Dr. Hadi Jawad*

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