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RESPONSES OF PRE-OPTIC AREA TO INTRACEREBROVENTRICULAR THYROXINE AND THYROTROPIN IN DOG BRAIN

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Abstract : Electroencephalographic activity (EEG) of pre-optic area (POA) was recorded after intracerebroventricular (ICV) microinjection of thyroxine (T_4) and thyrotropin (TSH) in concious male dogs. Recordings were made for two hours following microinjections. Biphasic responses with increased amplitude were observed in both the treatments, but chronologically the responses obtained with T_4 & TSH were opposite to each other.

Key words : T_4 TSH POA biphasic EEG

INTRODUCTION

Significant amounts of intracellular thyroid hormones (1) and thyroid receptors (2) have been reported in the brain. In addition it has been suggested that TSH is a functional component of brain (3). The observation that the transport of T_4 across the blood-brain barrier is directed from brain to blood (4), has added new dimensions to the roles of T_4 and TSH in the brain. Experimental studies reveal the importance of POA in controlling thyroid activity (5,6). It was therefore decided to study and compare the EEG responses of POA obtained with ICV injections of thyroxine and thyrotropin.

METHODS

Ten male adult dogs (8-10 kg) were domesticated in well ventilated rooms and fed with bread, milk and water *ad-lib*. For stereotaxic implantation of electrodes and cannulae, the animals were anaesthetized with intraperitoneal injection of sodium pentobarbitol (35 mg/kg). Bipolar electrodes made of a pair of 350 µm diameter insulated stainless steel wires with their tips separated by about 0.3 mm, were stereotaxically implanted in POA. Similarly cannulae were implanted in the third ventricle. The stereotaxic coordinates used were as per atlas of dog (7), and implantation technique followed by Anand (8) and Antunes-Rodrigues and McCann (9). A screw placed in nasal bone served as the reference ground. After the animals recovered from the effects of surgical trauma, they were trained for EEG recording procedures in self restrained and undisturbed conditions. The dogs were divided into two groups of five each. First group was used for T_4 treatment and the second group given TSH. EEG activity of POA was recorded first after ICV microinjection (single shot 50 µl) of vehicle (pyrogen free, distilled water) to serve as control following this in the first group, T_4 (F.H. Hoffman La Roche) was given in a dose of 0.1 mg/dog and in the second group, TSH (FH Hoffman La Roche) was given in a dose of 50 µg/dog. EEG was recorded for half an hour prior to and 30, 60, 90, and 120 min after the vehicle and T_4 microinjection. Each dog was treated with vehicle on the first day and then next day at the same time T_4 or TSH was given, and so each dog served its own control. After the completion of the experiment electrode site was confirmed (10).

EEG records were analyzed visually and the range of maximum changes in frequency and voltage evaluated (10,11). The EEG changes of one dog from each group are shown in Fig. 1.

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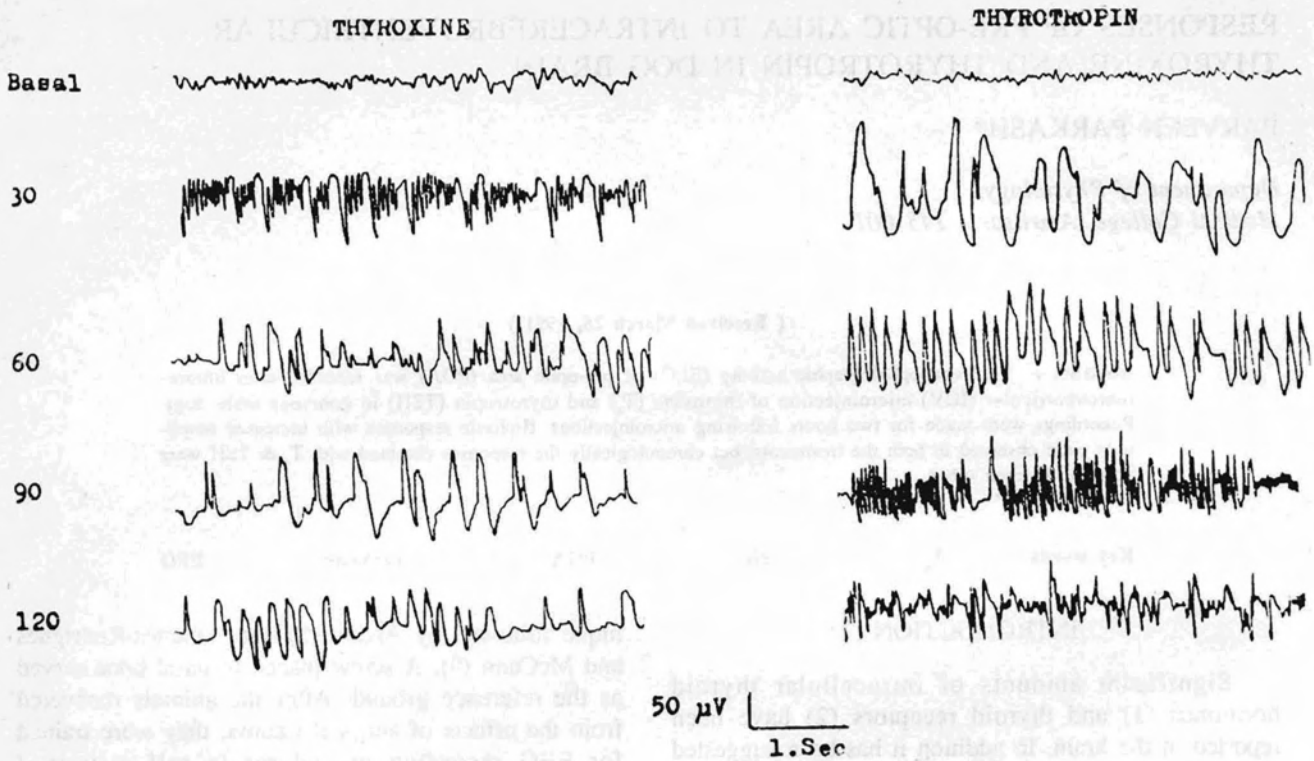

Fig. 1 : Showing comparative effect of intracerebroventricular thyroxine and thyrotropin on the electrical activity of pre-optic area.

RESULTS

Changes after T_4 treatment : Frequency and voltage of the basal record was in the range of 10-15 Hz, 5-30 µV. The first responses after T_4 injection were in the form of spike-wave-discharge complexes (Fig. 1). The amplitude and duration of individual complex varied from 25-55 µV and 0,6-0.25 sec. After one hour the discharge component disappeared and sharp waves and spikes (5-12 Hz, 30-80 µV) were seen dominating the record. Amplified slow waves (50-100 µV, 3-4. 5 Hz) appeared after 90 min, and the extent of slowing and potentiation decreased after two hours, However some bursts of slow waves (6-8 Hz, 50-75 µV) with duration of 0.4-2.5 sec continued to recur.

Changes after TSH treatment : Frequency and voltage of the basal record varied from 10-15 Hz and 5-25 µV. Within half an hour following TSH injection markedly amplified 50-275 µV, slow waves (2-5 Hz) appeared. After one hour the slow waves regressed, and regular spikes (4-7 Hz, 80-200 µV) appeared (Fig.1) Lateron, after 90 min these spikes were replaced by discharges (20-30 Hz, 30-120 µV), with discharge duration varying from 1.2-3 sec. Still later slow waves (5-7 Hz, 20-35 µV) intermingled with discharge components (15-20 Hz, 15-20 µV) of 0.1-0.25 see duration.

DISCUSSION

The EEG responses obtained from PAO following ICV injections of thyroxine and thyrotropin suggest that these hormones are probably taken up by the ependymal elements lining the ventricular system, making them available for specific targets (12), POA being one of them. Biphasic changes in EEG records were seen after both the injection, but the sequence of changes was opposite to each other. Biphasic desynchronization-synchronization was observed after giving T_4 and biphasic synchronization-desynchronization following TSH injection. In T_4 group maximum

amplitude of responses seen during the second hour was maximum, while in TSH group maximum amplitude was observed in the first hour. On the basis of Elul's hypothesis (13), which states that amplitude of EEG is an index of cooperative behaviour of neurons, both the hormones showed similiar trend in their effect in terms of neuronal population affected, the difference being in the time of their occurence.

So, qualitatively T_4 and TSH evoked similar type of responses with the extent of this effect being more with TSH. When analyzed chronologically, the events were just opposite to each other in the context of their happenings.

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