

The possible role of CGRP-immunoreactive thalamo-amygdala projections in emotionally evoked changes of vegetative traits

Abstract

Injections of calcitonin gene-related peptide (CGRP) into the amygdala evoke fear-related behaviors and antinociceptive effects. In the present study we therefore characterized CGRP-containing amygdaloid afferents by injecting the retrograde tracer FluoroGold (FG) into subnuclei of the amygdala and adjacent divisions of the extended amygdala, namely, the lateral (LA) and central (CE) amygdaloid nuclei, interstitial nucleus of the posterior limb of the anterior commissure (IPAC), and the amygdalostratial transition area (AStr). The distribution of retrogradely FG-labeled neurons and colocalization of CGRP-immunoreactivity with FG-labeling were mapped in the posterior paralaminar thalamic complex and parabrachial nuclei. The analysis of the posterior thalamus revealed that about 50% of CGRP-containing neurons projected to the AStr, the projections originating in the posterior intralaminar nucleus, parvicellular subparafascicular nucleus, and peripeduncular nucleus.

However, the percentage of CGRP-containing thalamic neurons projecting to the adjacent LA, medial part of the CE, and ventrocaudal part of the caudatoputamen rapidly dropped to 3–9%. There were no double-labeled cells after injections into the lateral and capsular parts of the CE and the IPAC. Thus, the AStr received the heaviest CGRP-containing projection from the posterior thalamus. CGRP-containing parabrachial neurons projected to the AStr and lateral, capsular, and medial parts of the CE, the projections originating in the external, crescent, and central parts of the lateral parabrachial nucleus and external part of the medial parabrachial nucleus. The results demonstrate a distinct projection pattern of CGRP-containing thalamic and parabrachial neurons to subnuclei of the amygdala and extended amygdala. The impairment of freezing caused by injections of a CGRP antagonist into the amygdala is an evidence, that CGRP is involved in the conjunction of sound and pain (Kocorowski and Helmstetter, 2001). Eventually the projections from the PoT to the AStr play an important role regarding the aversive emotional and autonomous component of pain (Gauriau und Bernard, 2004).

Neonatal transient hyperthyroidism cause reduced anxiety and increased startle response due to changes of the amygdala morphology (Yilmazer-Hanke et al., 2004). If this treatment is able to influence fear-related behaviour, it could be possible to affect the regulation of blood pressure (BP), heart rate (HR) and body temperature (BT). These parameters were studied in the home cage, in an unknown area and during the fear-sensitized acoustic startle response (ASR) test, using telemetry. Control groups received either saline or remained untreated.

During the unknown area and the fear-sensitized ASR tests, we observed a continuous increase in BT in all groups reaching the highest level after footshocks. The BP and HR showed a rapid increase after placing the animals into the unknown area and startle chamber followed by a continuous decline. Presentation of footshocks again induced a steep increase in BP and HR followed by a decline, whereas the increase in the ASR-amplitude was delayed.

During the measurements in the cage and the tests there were no significant differences between the groups, merely trends of differences between the treated and untreated animals, except for the measurements during the night after the tests within the unknown area. In this case there were differences between the heart rate of untreated and saline treated animals and differences between the body temperature of the treated animals. The level and course of heart rate was similar to the blood pressure. The findings indicate that changes in vegetative responses to emotional stimuli are not only induced by neonatal transient hyperthyroidism itself but also by injections and handling stress, because thyroxine- and saline-treated animals displayed only minor differences in their vegetative parameters.