Comparison of Amygdalar Neuronal Networks that Regulate Fear Behaviors among Vertebrates

Sushmita Adhikari1 and Dr. Laura L. Bruce1
1 University of Nebraska at Omaha, Omaha NE 68112; 2 Creighton University School of Medicine, Omaha NE 68102

ABSTRACT

The amygdala is the nucleus located in the medial temporal lobe. It is involved in regulating emotional behaviors, including behavior learning and motivation (Wright, 2013). It is also crucial for controlling basic survival skills such as feeding, flight, and fright. The lateral amygdalar complex (BLC) receives input from all sense and integrates it to produce an appropriate response. Lesions of the BLC reduce fear responses (Mathews et al., 2011; McDonald, 1998). The intermediate amygdala provides inhibitory feedback to the BLC and the central amygdala (CeA). This is the central amygdalar region.

Aims. The purpose of this study was to understand the expression of three genes, gpx3, gpc3, and prkcd, in the intermediate amygdala in different species such as zebrafish, chick, and mammals. These genes are responsible for fear extinction and are expressed in the intercalated neurons of the amygdala. The gpc3 gene is expressed in the lateral part of the central amygdala. A homologue of the central amygdala has been identified in the other species, and prkcd is expressed in the central amygdaloid complex in vitro.

METHODS

In situ Hybridization (ISH). The technique allows for precise localization of a specific segment of a gene within a histologic section. Genes are coded by different nuclear acids: guanine, adenine, thymine, uracil, and cytosine. A histologic section is made out of four different nuclear acids that are linked together to make a RNA strand. If the nuclear acid of that strand is broken, a complementary strand can be produced to bind to the RNA. Once the mRNA binds to the enzyme, the protein is produced. The mRNA is used to carry out the color changing reaction. Within the tissue, the dye dots are expressed to signal that a reaction has occurred and that the cell nucleus contains the particular mRNA segment.

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

RESULTS

In mice, gpc3 promotes the fear startle response, while expressing that gpa-/- animals show increased evidence of anxiety producing behaviors, so increased preference or motor avoidance.

CONCLUSIONS

The results suggest that gpa-/- animals exhibit excitatory and anxiety-producing behaviors. Mice exhibit greater and more persistent fear memories, whereas humans with gpa-/- mutations exhibit great deficit disorder and distorted speech (Bédard et al., 2007).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.

Preparation. The brain of the animal is dissected and placed in gelatin. The gelatin is placed in a freeze solution containing 4% formaldehyde and buffered saline (FBS).

Behavioral analysis. Mice are the general animals of 12-13 days old zebrafish larvae by using edge preference and box avoidance behaviors. Zebrafish are individually placed in wells that are differentiated by top vs. bottom, and edge vs. middle. For the 1st minute, the animals are placed in a big box to allow them to swim around. Then, the animals are placed in another box. The zebrafish are then observed for 10 minutes, the top has a black bar and the bottom has a moving ball. The placement of the fish is recorded every 30 seconds.