Expression of the immediate early gene Arc in ventral tegmental neurons during aging.

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ABSTRACT

Accumulating behavioral evidence that neurons of the ventral tegmental area (VTA) of the midbrain are highly correlated with reward (e.g., Schultz et al., 2002; Buhler et al., 2004). Rewards are thought to play an important role in making predictions about the outcomes of future events which can guide behavior. Possible changes of the mesolimbic system during aging might lead to impairments in cognitive or behavioral flexibility. Recently, anatomical methods that monitor the expression of immediate-early genes (IEGs) are developed that may help in mapping the distribution of neurons expressing specific forms of patterned synaptic activity that are believed to underlie cognitive flexibility storage. To determine whether the IEG Arc is expressed in the VTA of young and old rats, we exposed two young and two aged male rats to a sexually receptive female rat in a sexually preferred location that is known to activate the VTA. There was no significant difference in the behavioral responses of the young and the aged animals, thereby showing that young and aged animals had similar levels of activation of the VTA. Using in situ hybridization and in situ hybridization in combination with a confocal microscopy technique, we confirm Arc expression in VTA neurons of young and aged animals. Under caged control and maximum electro-convulsive shock conditions, similar proportions of VTA neurons were no age differences. Arc expression in both young and aged animals were observed. These results demonstrate age-related changes in VTA neural activity which may affect the function and efficacy of the VTA and its projection sites. These alterations may reflect the decrease in learning observed in aged animals.

METHODS

Experimental Design: Young (9 mo.) and aged (24 mo.) Fischer-344 rats were divided into three groups:
1. 4 yo. young rats were used as caged controls (CC) and exposed to a sexually receptive female rat (SRR) in a sexually preferred location (BEHAV).
2. 4 yo. young rats were allowed to interact with a sexually receptive female rat in a sexually preferred location (BEHAV).
3. 2 yo. aged rats were exposed to a sexually receptive female rat in a sexually preferred location (BEHAV).

There were no notable behavioral differences observed between young and aged animals although the detailed behavioral scoring is not complete.

RESULTS

1. Arc Expression in Rostral VTA

There were no age differences in MECS or CC conditions. Aged animals showed significantly lower proportions of cells expressing Arc following behavior (p<0.01, T-test). There were no age differences in MECS or CC conditions.

2. Arc Expression in Middle VTA

There were no age differences in MECS or CC conditions. Aged animals showed significantly lower proportions of cells expressing Arc following behavior (p<0.01, T-test). There were no age differences in MECS or CC conditions.

3. Arc Expression in Caudal VTA

There were no age differences in MECS or CC conditions. Aged animals showed significantly lower proportions of cells expressing Arc following behavior (p<0.01, T-test). There were no age differences in MECS or CC conditions.

REFERENCES


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