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The role of microglia in synaptic rewiring by early-life adversity

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Vulnerability to stress-related emotional disorders is governed in part by early-life experiences, likely via modulation of immature brain circuits. We have shown in a rodent model that chronic early-life stress/adversity (CES; postnatal days (P)2-9) provokes major alterations in cognitive and emotional function, accompanied by aberrant connectivity between stress- and reward-related regions. Within the hypothalamus, CES causes an increase in the number of excitatory synapses onto corticotropin-releasing hormone (CRH)-expressing neurons in the paraventricular nucleus (PVN). However, the mechanisms by which early-life adversity causes this synaptic rewiring remain unknown. We hypothesize that microglia contribute to normal synaptic reduction on CRH neurons in the developing PVN, and that adverse early-life experiences interfere with this function. First, we determined that inhibition of microglia increased excitatory synapses onto CRH neurons, much like we see after CES. However, CES did not alter the overall number of microglia or CRH neurons in the PVN. To interrogate microglial function, we employed two-photon time-lapse imaging of PVN slices from dual-reporter transgenic mice with visible CRH neurons and microglia. This live-imaging revealed that microglial process dynamics were diminished at P8 in the PVN of CES mice, in conjunction with decreased microglial engulfment of excitatory synapses. Thus, microglia are potential contributors to early-life experience-dependent synaptic rewiring of stress-sensitive neurons, and future manipulation of microglial function during development may prevent stress-related emotional disorders in adulthood.

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