

Exercise-induced angiogenesis in the CNS of Dahl Salt-sensitive and SSBN.13 consomic rats

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Keywords: angiogenesis, consomic, chromosomal substitution, exercise, plasticity

Chromosomal substitution strains of rat, also termed consomic rats, are potentially powerful rodent models for the investigation of behavioral and neural plasticity. Consomic animals are created by the introgression of a chromosome of interest from a non-disease strain onto the genetic background of a disease strain. The current study compared a consomic strain, SSBN.13, to the Dahl salt-sensitive (SS) parent strain to determine the effect of introgression of this chromosome on vascular plasticity, specifically angiogenesis, in the central nervous system (CNS). Vascular plasticity in muscle of SS animals is impaired. A possible mechanism for this deficit is a faulty renin-angiotensin system as SS animals have been shown to have low plasma renin activity. Introgression of the Brown Norway (BN) chromosome 13, known to contain a renin gene, onto the genetic background of the SS can rescue, to some extent, the angiogenic response to electrical stimulation in the periphery. In the present study, we sought to determine if vascular plasticity is impaired in the CNS of the SS animal and whether introgression of the Brown Norway chromosome 13 rescues any observed deficits. Rats were maintained on a low (0.4%) salt diet and were allowed to voluntarily exercise for 30 days. Following this period, both exercising animals and inactive controls were sacrificed and motor cortex, hippocampus, and cerebellum were sliced into 20 μm thick sections. Sections were stained and imaged using unbiased stereological techniques. Blood vessel density was calculated using a point grid placed atop randomly selected images and counting the number of points falling on or within blood vessels ($[(\text{points bv}/\text{points ROI}) * 100]$). Results showed that neither SS nor SSBN.13 animals underwent exercise-induced angiogenesis in the motor cortex or cerebellum. However, SS VX animals showed significant angiogenesis in the hippocampus with a 31.5% increase in blood vessel density compared to their IC counterparts. Similarly, exercised SSBN.13 animals showed a trend toward greater blood vessel density than SSBN.13 IC animals with an increase of 28.7%. These results indicate that under low-salt conditions, both SS and SSBN.13 strains of animals are capable of vascular plasticity, but that the effect is regionally dependent and perhaps due to other physiological processes such as neurogenesis.