SATELLITE CELL ACTIVATION IN GROWTH AND REGENERATION

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At birth, skeletal muscle fibers are associated with a pool of cells, still capable of replicating capacities, called satellite cells. Mitotically quiescent in the adult, their activation, proliferation and differentiation can be initiated in response to extrinsic factors during growth and regeneration. We compared the postnatal development of muscles in heavy- (HW) and lightweight (LW) turkey strains and showed that the improved muscle growth of the HW turkey may not only be attributable to radial fiber growth but also to hyperplastic process. The properties of satellite cells from HW and LW muscles were compared for their responsiveness to stress such as stretching and for their in vitro proliferative capacity. Our findings indicate that the differences in muscle growth rate between HW and LW muscles are related to an intrinsic dissimilarity in the rate of satellite cell proliferation and/or in their ability to respond to environmental factors. To address the question of satellite cell activation in ordinary and post traumatic myogenesis, we used desmin-LacZ transgenic mice and examined the transgene activation and the expression of myogenic regulatory factors. After birth, satellite cells were only evidenced by MyoD whereas after freeze trauma, satellite cell activation led to MyoD, myogenin and transgene expression. Our results strongly suggest that satellite cells promote distinct pathways of myogenic response during growth and regeneration.

Concerning the environmental factors, which could be implicated in the early events of skeletal muscle regeneration, we have investigated the effect of macrophages on in vitro satellite cell myogenesis in the turkey and mouse. We demonstrated that macrophages enhance muscle satellite cell proliferation and delay their differentiation. These findings support the hypothesis that extrinsic factors originating from blood-borne cells may contribute to muscle regeneration.

ENERGETICS AND PERFORMANCE MEASURES AS THEY RELATE TO LOCOMOTION

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Measurement of energy expenditure at rest has long been a mainstay of ecological physiology. With improved technology and a recognition that many important events occur when animals are active, measurements of metabolic rate during forced (or sometimes voluntary) locomotor activity have also become common. Such measurements allow estimation of the energetic cost of various activities, including the percentage of the total daily energy budget that is attributable to locomotion; this quantity varies greatly among organisms. Maximal oxygen consumption during forced locomotion sets an upper limit to the intensity of activity that can be sustained aerobically, and bridges the gap between energetics and direct measures of locomotor performance ability. The most common performance measures are sprint speed and endurance, but jumping, clinging, gliding, maneuverability, and acceleration have also been quantified. When maximal performance is desired, protocols are designed to eliminate variation in motivation; how successful such efforts are is often difficult to know. Intuitively, we expect that both energetic efficiency during locomotion and maximal locomotor abilities should be of substantial ecological importance, but in fact we have relatively little information to address these predictions. An argument can be made that performance abilities should be more important than energetic efficiency, simply because performance often impinges on life-or-death situations, whereas efficiency is more likely to have (possibly small) incremental effects on survival or reproductive output. On the other hand, efficiency matters whenever locomotion occurs, whereas behavioral "choices" (e.g., whether an animal runs away when it encounters a predator) may often act as a "filter" between performance (e.g., how fast an animal can actually sprint) and various selective agents. Studies of the mechanistic bases of performance variation and of its selective importance are conducted both at the levels of individual variation within populations and interspecific variation within clades. Population studies have strongly implicated both heritability of locomotor performance traits and their selective importance. Lab studies of individual variation have further shown relationships between performance and such traits as social dominance, which are difficult to quantify in the field. Lab studies have also demonstrated correlations between lower-level morph-physiological traits and various measures of performance, both among individuals and among species. Phylogenetically based comparative studies of the ways that "multiple solutions" (lineage-specific effects) to selective "problems" can overcome potential trade-offs in abilities (e.g., speed vs. stamina) are now in progress. Artificial selection experiments targeted at performance are proposed as one important new direction.