The role of glycogen in muscle function

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Already studies in the beginning of the last century revealed the importance of carbohydrate as a fuel during exercise and the importance of muscle glycogen on performance has subsequently been confirmed in numerous studies. However, the link between glycogen and impaired muscle function during fatigue is not well understood and a direct cause-and-effect relationship between glycogen and muscle function remains to be established. Interestingly the use of electron microscopy has revealed that although glycogen often is interpreted as if it is homogeneous distributed in the cell, a close examination of the glycogen granules reveals that they are located in distinct pools in the fibre. Further, each glycogen granule has its own metabolic machinery (glycolytic enzymes and regulating proteins), and the existence of this glycogenolytic complex is connected with the sarcoplasmic reticulum (SR) in close contact with key events in the excitation-contraction (E-C) coupling. These assemblies are dynamic and raise the possibility that feedback regulation from glycogen storage deposits located in connection to the SR and membrane may exist. In line, we and others have demonstrated that the SR function is closely associated with glycogen content and localization. Recently, we have been able to demonstrate a direct role of intramyofibrillar glycogen on SR Ca^{2+} release rate in trained humans. Together, these results demonstrate that distinct subcellular populations of glycogen have different roles in contracting single muscle fibres. This is consistent with the idea that the glycogen localization modulates the E-C coupling, thereby affecting muscle contractility and fatigability. Such an SR-glycogen arrangement may involve a regulation of the cytosolic Ca^{2+} levels and, in turn, the activation and energy utilization of skeletal muscle.