

肌肉萎缩引起肌电功率谱变化的理论和实验研究

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为了通过肌电分析实现肌肉萎缩的无创检测,建立了一种数学模型研究肌肉萎缩后,其肌电信号功率谱的相应变化,并用大鼠的后肢卸载肌肉萎缩实验模型初步验证了数学模型分析的结论。该模型根据肌肉萎缩后肌纤维横截面积减小以及肌肉由于卸载而出现持续性收缩的性质,采用中心导体模型及其电缆方程和肌电的线性系统模型建立起肌肉萎缩和生理肌电功率谱变化之间的数学关系。通过数字仿真和动物实验均发现了肌肉萎缩引起肌电幅度增加和功率谱高频成分降低的现象。结果表明数学模型和动物实验结果吻合,采用的数学模型能较好地阐述肌肉萎缩和肌电功率谱变化之间的关系。肌肉萎缩后肌电功率谱发生相应改变这一性质将为肌肉萎缩的无创检测提供一种新的方法。

THE THEORETIC AND EXPERIMENTAL STUDY ON THE CHANGE OF EMG POWER SPECTRUM CAUSED BY MUSCLE ATROPHY

Aiming at non-invasive detection of muscle atrophy by EMG analysis, a mathematical model is constructed to study the change of EMG power spectrum after muscle atrophy, and also a rat's hindlimb unloading muscle atrophy experimental model is made to validate the results from mathematical analysis. Based on the decrease of cross-sectional area of muscle fiber and un-loaded contraction of atrophic muscle, the mathematical correlation between muscle atrophy and change of EMG power spectrum is studied by center conductor model, its electrical circuit equations and EMG systematic linear model. By numeric simulation and animal experiment, the increase of EMG amplitude and the decrease of high frequency components of EMG power spectrum resulting from muscle atrophy are discovered. So the theoretic model analysis is consistent with the animal experimental results. This model can correctly explain the correlation between muscle atrophy and change of power spectrum. The change of EMG power spectrum caused by muscle atrophy will probably provide a new non-invasive detection method of atrophy.

关键词

肌肉萎缩(Muscle atrophy); 肌电功率谱(EMG power spectrum); 后肢卸载(Hindlimb unloading); 无创检测(Non-invasive detection)