Machine learning-based quality control for contraction of cultured human-induced pluripotent stem cell-derived cardiomyocytes

Ken Orita[1], Kohei Sawada[2], Nobuyoshi Matsumoto[1], Yuji Ikegaya[1]

[1]Grad. Sch. Pharm. Sci., Tokyo Univ., [2]Grad. Sch. Pharm. Sci., Tokyo Univ.

Human-induced pluripotent stem cell-derived cardiomyocytes (hiPSC-CMs) are expected to take place of animal models for the assessment of drug-induced cardiotoxicity because of no possible prediction errors arising from species differences. However, currently, the qualities of hiPSC-CMs are inconsistent among product lots and must be controlled by well-trained experimenters. This labor-intensive process prevents high throughput screening. To tackle this problem, we developed an automated method for controlling the qualities of the contraction of cultured hiPSC-CMs using machine learning.

After 5–7 days of culture of hiPSC-CMs, a total of 556 bright-field videos of the hiPSC-CMs were obtained. The contractile qualities of the hiPSC-CMs were inspected by four well-trained experimenters and were labelled as either 'normal' (n = 366 videos) or 'abnormal' (n = 190 videos). The contractile properties of hiPSC-CMs were measured using the absolute changes in the pixel intensity between video frames, and these dimensions were reduced to 2 using uniform manifold approximation and projection (UMAP). We then trained the support vector machine (SVM) algorithm to classify normal or abnormal hiPSC-CMs. We found that fast Fourier transformation and data augmentation improved the classification scores of SVM. In summary, we demonstrated that the machine learning approach is applicable to the control of contractile qualities of hiPSC-CMs.