Statistical and fractal analyses of rat prostate cancer cell motility in a direct current electric field: Comparison of strongly and weakly metastatic cells

Siwy Z, Mycielska ME, Djamgoz MBA
EUROPEAN BIOPHYSICS JOURNAL WITH BIOPHYSICS LETTERS 32 (2003) 12-21

The problems addressed here comprised (1) possible differences in galvanotactic properties of strongly versus weakly metastatic rat prostate cancer cells, with MAT-LyLu and AT-2 as examples, respectively; (2) quantitative description of the responses of the MAT-LyLu cells to direct current (dc) electric fields (EFs) of physiological strength (0.3-3 V/cm); and (3) voltage and time dependency of the cells' responses to the dcEFs. These issues were studied by application of statistical and fractal analyses of the cells' trajectories. The results showed that the MAT-LyLu cells responded strongly to the applied dcEFs by migrating towards the cathode. On the other hand, the galvanotactic response of the AT-2 cells was weak and towards the anode. Further studies of the MAT-LyLu cell motility in dcEFs of increasing strength showed that their response consisted of two voltage domains. Weaker fields (~ 0.6 V/cm) induced "straightening" of the cells' trajectories without the cells showing a clear tendency to move along the applied field. Stronger fields (> 0.6 V/cm) made the cells' movement oriented with respect to the direction of the applied field, without further changing the trajectories' structure. The results also showed that the cells do not perform a directed movement instantaneously after switching on a dcEF of 3 V/cm; approximately 30 min lapsed before the cells were able to fully follow the direction of the applied field. Possible biophysical bases and pathophysiological significance of the results obtained are discussed.