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AFM nano-mechanics and calcium dynamics of prostate cancer cells with distinct metastatic potential.

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Abstract: ACKGROUND: Despite recent advances, it is not clear to correlate the mechanical compliances and the metastatic potential of cancer cells. In this study, we investigated combined signatures of mechanical compliances, adhesions, and calcium dynamics correlated with the metastatic potential of cancer cells. SCOPE OF REVIEW: We used the lowly (LNCaP) and highly (CL-1, CL-2) metastatic human prostate cancer cells. The AFM-based nanomechanics was performed to determine the elastic moduli and the cell-to-substrate adhesion. The intracellular calcium dynamics was evaluated by fluorescence spectroscopy. Cell migration and the distribution of cytoskeleton were evaluated using the wounded monolayer model and immunofluorescence, respectively. The elastic moduli, the calcium dynamics, and the migratory ability are greater in CL-1 and CL-2 than LNCaP. CL-1 and CL-2 also display a significantly larger area of cell-to-substrate adhesions while the LNCaP displays a limited adhesion. These properties were slightly reduced in CL-2 compared with CL-1 cells. The enhanced elastic moduli and calcium dynamics found in CL-1 and CL-2 can be consistently explained by the intensified tensile stress generated by actin cytoskeletons anchored at more focal adhesion sites. MAJOR CONCLUSIONS: Although the suppressed mechanical compliance of highly metastatic cells may not support the enhanced cancer metastasis, the enhanced adhesion and calcium dynamics are favorable for invasion and extra-vasation required for malignant progression. GENERAL SIGNIFICANCE: Our results suggest that the mechanical compliance alone may fail to indicate the metastatic progression, but the combined biomechanical signatures of mechanical compliance, adhesion, and calcium dynamics can provide critical clues to determine the metastatic potential of cells.