Detection of apoptosis and necrosis in normal human lung cells using 1H NMR spectroscopy

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摘要

Abstract

Abstract: This study aimed to detect apoptosis and necrosis in MRC-5, a normal human lung cell line, by using noninvasive proton nuclear magnetic resonance (1H NMR). Live MRC-5 cells were processed first for 1H NMR spectroscopy; subsequently their types and the percentage of cell death were assessed on a flow cytometer. Cadmium (Cd) and mercury (Hg) induced apoptosis and necrosis in MRC-5 cells, respectively, as revealed by phosphatidylserine externalization on a flow cytometer. The spectral intensity ratio of methylene (CH2) resonance (at 1.3 ppm) to methyl (CH3) resonance (at 0.9 ppm) was directly proportional to the percentage of apoptosis and strongly and positively correlated with PI staining after Cd treatment ($r2 = 0.9868$, $P < 0.01$). In contrast, this ratio only increased slightly within 2-h Hg treatment, and longer Hg exposure failed to produce further increase. Following 2-h Hg exposure, the spectral intensity of choline resonance (at 3.2 ppm) was abolished, but this phenomenon was absent in Cd-induced apoptosis. These findings together demonstrate that 1H NMR is a novel tool with a quantitative potential to distinguish apoptosis from necrosis as early as the onset of cell death in normal human lung cells.