

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 (CH_2) resonance (at 1.3 ppm) to methyl (CH_3) resonance (at 0.9 ppm) was directly proportional to the percentage of apoptosis and strongly and positively correlated with PI staining after Cd treatment ($r^2= 0.9868$, $P < 0.01$). 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.