Tissues, Pathology, and Diagnostic Microscopy

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N-acetylcysteine counteracts oxidative stress and protects alveolar epithelial cells from lung contusion-induced apoptosis in rats with blunt chest trauma

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Blunt chest trauma is a common clinical problem in emergency medicine and trauma care [1]. Lung contusion affecting 17-25% of adult patients with trauma, is the most frequently diagnosed intrathoracic injury caused by blunt chest trauma [2]. Recent studies emphasized the role of inflammatory process and oxidative mechanisms have demonstrated the protective effects of anti-inflammatory and anti-oxidant agents in lung contusion after blunt trauma [3]. Despite these studies, the relationship between antioxidants and alveolar cell apoptosis in blunt trauma-related lung contusion remains to be elucidated. The aim of the present study was to investigate the frequency of apoptosis in the pulmonary epithelial cells of rats following lung contusion caused by blunt chest trauma and to determine the protective effect of N-acetylcysteine (NAC) on the peroxidative and apoptotic changes as well as alterations of surfactant protein D (SP-D) expression, mainly synthesized by alveolar type II cells in the contused lungs.

Rats were randomly divided into three groups: control, contusion and contusion + NAC groups. All groups was performed a moderate lung contusion except the control. Daily intramuscular NAC treatment (150 mg/kg) was administered immediately after blunt chest trauma and was continued for two additional days. Lung tissue samples were obtained to evaluate tissue malondialdehyde (MDA) level, histopathology and epithelial cell apoptosis by terminal deoxynucleotidyl transferase dUTP nick-end labelling (TUNEL) assay and active caspase-3 immunostaining. Furthermore, we evaluated expression of surfactant protein D (SP-D) in lung tissue, immunohistochemically.

Blunt chest trauma-induced lung contusion caused severe histopathological injury, increase in the MDA level, the numbers of TUNEL and active caspase-3 positive epithelial cells, whereas decrease in the numbers of SP-D positive alveolar type II cells. NAC treatment effectivelly attenuated histopathologic, peroxidative and apoptotic changes as well as alterations of SP-D expression in lung tissue (Figures 1,2 and Table 1).

The above findings indicate that the beneficial effects of NAC administrated following blunt chest trauma is mediated through regulation of oxidative stress and apoptosis.

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	Control	Contusion	Contusion + NAC	p value
Alveolar disruption/oedema/haemorrhage score	0.50 (0-1)	2.50 (2-3)[a]	1.25 (1-1.25)[b]	0.0001
Leukocyte infiltration score	1.00 (0-1)	2.25 (2-2.75)[a]	1.50 (1.25-1.50)[b]	0.0001
MDA level (µmol/L)	1.35±0.16	2.78±0.41[c]	1.38±0.12[d]	0.0001

[a]p<0.05 vs control, [b]p<0.05 vs contusion group, [c]p<0.001 vs control, [d]p<0.001 vs contusion group

Table 1. The effects of the blunt chest trauma and NAC treatment on lung histology, MDA levels and the alveolar epithelial cells apoptosis. Values are expressed as mean±S.D and median (min-max), n=6.

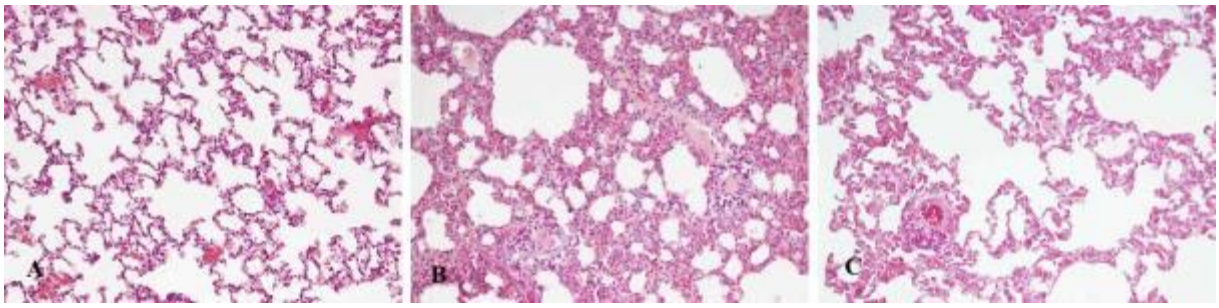

Figure 1. Photomicrographs of the histological examinations of the rat lung tissues. (A) Control, (B) Contusion, (C) Contusion+NAC. Hematoxylin-eosin; X40.

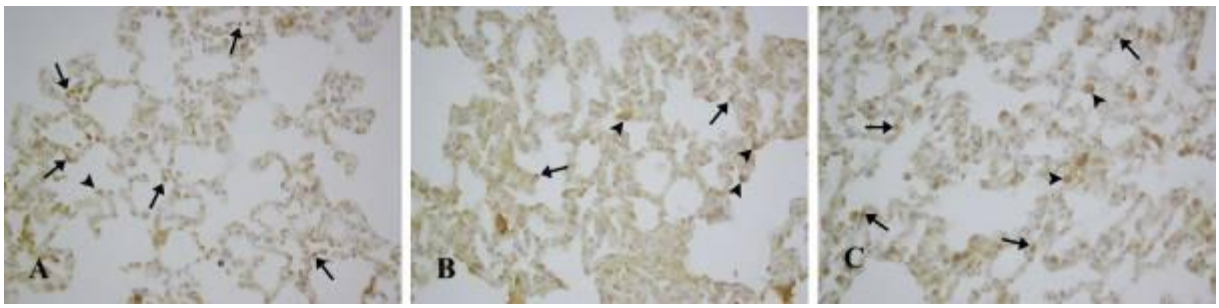

Figure 2. Photomicrographs of the immunohistochemical staining for SP-D (X40) in the lung tissues. (A) Control, (B) Contusion, (C) Contusion+NAC. Arrows; alveolar type II cells, arrow heads; alveolar macrophages.