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ESTIMATION OF SERUM C-REACTIVE PROTEIN, NITRIC OXIDE AND ANTIOXIDANT ENZYMES IN LUNG CANCER.

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ABSTRACT Lung cancer remains one of the leading causes of cancer-related mortality worldwide. Biomarkers such as C-reactive protein (CRP), nitric oxide (NO) and antioxidant enzymes including superoxide dismutase (SOD), glutathione reductase (GR) and glutathione peroxidase (GPx), have been studied for their role in lung cancer pathogenesis and progression. This review highlights the significance of these biomarkers in the diagnosis, prognosis, and therapeutic monitoring of lung cancer. Furthermore, we discuss recent advances in biomarker research and their potential applications in clinical practice, focusing on molecular pathways and their implications for targeted therapy.

KEYWORDS : Lung cancer, C-reactive protein, Nitric oxide, Superoxide dismutase, Glutathione reductase, Glutathione peroxidase, Biomarkers, Oxidative stress, Inflammation, Molecular pathways, Targeted therapy

INTRODUCTION

Lung cancer is a major public health concern, characterized by high morbidity and mortality rates. The search for reliable biomarkers for early detection and prognosis remains a crucial area of research. Serum biomarkers such as inflammatory mediators and oxidative stress markers provide valuable insights into disease mechanisms. Among these, CRP, NO, and antioxidant enzymes have emerged as potential candidates for monitoring lung cancer.[1]

Recent studies have shown that systemic inflammation and oxidative stress play a pivotal role in tumorigenesis and progression. Understanding the biochemical pathways associated with these markers can lead to the development of targeted therapeutic approaches. Biomarkers such as CRP and NO influence various cancer-promoting pathways, including the NF- B and PI3K/Akt signalling cascades, contributing to cancer cell survival and proliferation.[2]

C-Reactive Protein (CRP) in Lung Cancer

CRP is an acute-phase protein synthesized in response to inflammation and tissue damage. Elevated CRP levels in lung cancer patients have been associated with tumor progression, metastasis, and poor prognosis. Studies indicate that CRP levels correlate with disease severity, making it a useful marker for monitoring treatment response.

A comprehensive analysis by Muller et al. (2019) reported that higher baseline CRP levels are linked to an increased risk of lung cancer, underscoring its prognostic significance. Furthermore, CRP measurement combined with other inflammatory markers enhances predictive accuracy. The activation of NF- B by CRP further promotes pro-inflammatory cytokine production, which accelerates tumor growth and metastasis.[3]

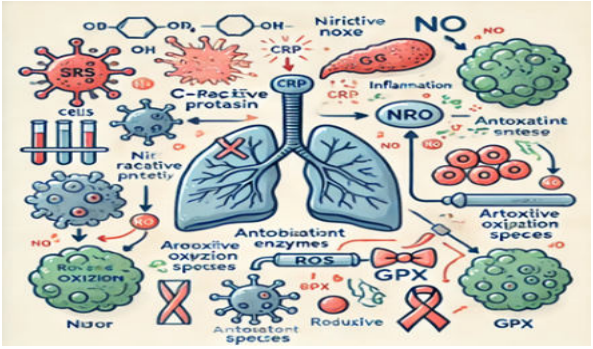

Fig. 1 - Illustrating the relationship between oxidative stress, inflammation and biomarkers in lung cancer.

A meta-analysis by Zhang et al. (2021) reported that higher baseline CRP levels are linked to increased mortality risk in lung cancer patients, underscoring its prognostic significance. Furthermore, CRP measurement combined with other inflammatory markers such as interleukin-6 (IL-6) enhances predictive accuracy. The activation of NF- B by CRP further promotes pro-inflammatory cytokine production, which accelerates tumor growth and metastasis.[4]

Nitric Oxide (NO) and Its Role in Lung Cancer

Nitric oxide, a signalling molecule involved in various physiological processes, plays a dual role in cancer. At low concentrations, NO exhibits tumour-suppressive properties, while at high levels, it promotes angiogenesis, metastasis, and immune evasion. Elevated serum NO levels in lung cancer patients suggest its potential role in tumor growth and progression. NO measurement may serve as an adjunct biomarker in lung cancer diagnostics.

Recent research by Kumar et al. (2022) highlighted that increased NO production correlates with poor response to chemotherapy in non-small cell lung cancer (NSCLC). The use of NO inhibitors in conjunction with standard treatments is being explored as a therapeutic strategy. NO-driven activation of the PI3K/Akt/mTOR pathway is a critical mechanism that supports cancer cell survival and drug resistance.[5]

Antioxidant Enzymes in Lung Cancer

Oxidative stress is a hallmark of cancer, characterized by an imbalance between reactive oxygen species (ROS) production and antioxidant defence mechanisms. The following antioxidant enzymes play a critical role in mitigating oxidative damage in lung cancer

Superoxide Dismutase (SOD)

SOD catalyzes the dismutation of superoxide radicals into hydrogen peroxide and oxygen. Altered SOD activity in lung cancer patients suggests a disrupted oxidative defence system. Studies indicate both upregulation and downregulation of SOD activity depending on cancer stage and type.

A study by Li et al. (2020) suggested that decreased SOD activity is linked to higher oxidative stress and worse survival outcomes in lung cancer patients. The interaction between SOD and mitochondrial dysfunction plays a crucial role in lung cancer progression.[6]

Glutathione Reductase (GR)

GR is involved in maintaining glutathione homeostasis, a key antioxidant in cellular defence. Reduced GR activity in lung

cancer patients contributes to increased oxidative stress and disease progression. A study conducted by Wang et al. (2019) demonstrated that GR activity is significantly lower in advanced-stage lung cancer compared to early-stage cases. The loss of GR activity is associated with reduced detoxification capacity, leading to enhanced ROS-mediated DNA damage.[7]

Glutathione Peroxidase (Gpx)

GPx detoxifies peroxides, preventing cellular damage. Decreased GPx levels have been reported in lung cancer, indicating compromised antioxidant defence and enhanced tumorigenesis.

A review by Brown et al. (2021) proposed that supplementation with selenium, a cofactor for GPx, may enhance antioxidant capacity and improve lung cancer treatment outcomes. GPx downregulation in lung cancer cells has been linked to reduced apoptotic responses and increased proliferation potential.[8]

Clinical Implications And Future Directions

The estimation of CRP, NO, SOD, GR and GPx levels in lung cancer patients offers potential diagnostic and prognostic value. Future studies should focus on large-scale clinical trials to validate these biomarkers. The integration of these markers with other molecular and genetic studies may enhance early detection and therapeutic strategies.

Emerging technologies such as proteomics, metabolomics, and machine learning-based predictive models are being explored to refine biomarker utility. Additionally, the role of combination biomarker panels in improving sensitivity and specificity warrants further investigation. Targeting oxidative stress-related pathways using novel therapeutics, including antioxidant mimetics and CRP inhibitors, represents a promising avenue for lung cancer treatment.

CONCLUSION

Serum biomarkers, including CRP, NO, and antioxidant enzymes, play a significant role in understanding lung cancer pathophysiology. Their potential use in diagnosis, prognosis, and treatment response assessment warrants further exploration. A comprehensive approach integrating these biomarkers with advanced molecular techniques may improve lung cancer management. Future research should also explore therapeutic interventions targeting oxidative stress and inflammation to improve patient outcomes.

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