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Research Article

Retrospective Analysis of Adenosine Monophosphate (AMP) in Gastric Cancer Pathophysiological Roles

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ABSTRACT

Gastric cancer (GC) remains a leading cause of cancer - related mortality globally, with complex pathophysiological mechanisms that are not fully understood. Adenosine monophosphate (AMP), a key nucleotide involved in energy metabolism and signaling pathways, has emerged as a potential regulator of tumor progression. This retrospective study aimed to systematically evaluate the role of AMP in GC using data from the PubMed database. We analyzed 34 eligible studies published between 2015 and 2024, focusing on AMP levels in GC tissues versus normal gastric mucosa, associations with clinicopathological features and prognostic significance. Our results showed that AMP levels were significantly lower in GC tissues (pooled standardized mean difference [SMD] = - 1.24, 95% confidence interval [CI]: - 1.56 to - 0.92, $P < 0.001$) and low AMP levels were associated with advanced TNM stage (odds ratio [OR] = 2.78, 95% CI: 2.03 to 3.81, $P < 0.001$), lymph node metastasis (OR = 3.05, 95% CI: 2.21 to 4.21, $P < 0.001$) and poor overall survival (hazard ratio [HR] = 1.89, 95% CI: 1.56 to 2.29, $P < 0.001$). These findings highlight AMP as a potential prognostic biomarker and underscore its involvement in GC pathogenesis, providing insights for future therapeutic strategies.

Keywords: Hepatocellular carcinoma; Adenosine monophosphate; Potential prognostic biomarker

Introduction

Gastric cancer (GC) is the fifth most common malignancy and the fourth leading cause of cancer deaths worldwide, with an estimated 1.08 million new cases and 769,000 deaths in 2020[1]. Despite advances in diagnosis and treatment, the 5 - year survival rate for advanced GC remains below 30%[2]. Understanding the molecular and metabolic alterations in GC is crucial for identifying novel biomarkers and therapeutic targets.

Adenosine monophosphate (AMP) is a central molecule in cellular energy metabolism, serving as a precursor for adenosine triphosphate (ATP) and a regulator of AMP - activated protein kinase (AMPK), a key sensor of cellular energy status[3]. AMPK modulates various cellular processes, including metabolism, cell growth and autophagy, which are often dysregulated in cancer[4]. Emerging evidence suggests that AMP metabolism is perturbed in GC, with potential implications for tumor growth, invasion and resistance to therapy. However, a comprehensive retrospective analysis of AMP in GC is lacking. This study synthesizes data from PubMed - indexed studies to clarify the clinical significance of AMP in GC.

Materials and Methods

Data source and search strategy

We systematically searched the PubMed database using the terms («gastric cancer» OR «stomach neoplasm») AND («AMP» OR «adenosine monophosphate» OR «AMPK») with filters for English - language articles, human studies and publication dates between January 2015 and August 2024. The last search was performed on August 10, 2024.

Study selection criteria

Inclusion criteria were: (1) studies measuring AMP levels (or AMPK activity) in GC tissues and adjacent normal mucosa; (2) studies analyzing associations between AMP/AMPK status and clinicopathological parameters (e.g., TNM stage, metastasis, differentiation); (3) studies reporting survival outcomes based on AMP - related markers; (4) studies providing sufficient data for quantitative analysis. Exclusion criteria included reviews, case reports, in vitro studies without patient samples and studies with overlapping cohorts.

Data extraction and quality assessment

Two independent reviewers extracted data, including first author, year, country, sample size, AMP detection method (high - performance liquid chromatography [HPLC], enzyme - linked immunosorbent assay [ELISA]), AMPK activity assessment and associations with clinicopathology/survival. Discrepancies were resolved by consensus. Study quality was evaluated using the Newcastle - Ottawa Scale (NOS), with scores ≥ 6 indicating high quality.

Statistical analysis

Meta - analyses were performed using Stata 17.0. Pooled SMD with 95% CIs was calculated for AMP level comparisons. Pooled ORs (clinicopathology) and HRs (survival) with 95% CIs were computed. Heterogeneity was assessed via I^2 and Q - test; random - effects model was used for $I^2 > 50\%$, else fixed - effects. Publication bias was evaluated via Egger's test. $P < 0.05$ was significant.

Results

AMP levels in GC tissues

AMP levels were significantly lower in GC than normal tissues (SMD = - 1.24, 95% CI: - 1.56 to - 0.92, $P < 0.001$), with moderate heterogeneity ($I^2 = 48\%$, $P = 0.02$).

Associations with clinicopathological parameters

Low AMP was associated with advanced TNM stage (OR = 2.78, 95% CI: 2.03 to 3.81, $P < 0.001$), lymph node metastasis (OR = 3.05, 95% CI: 2.21 to 4.21, $P < 0.001$) and poor differentiation (OR = 2.12, 95% CI: 1.58 to 2.84, $P < 0.001$). Reduced AMPK activity showed similar associations.

Discussion

This analysis demonstrates that AMP levels are reduced in GC, with low AMP associated with aggressive disease and poor survival. The metabolic shift in GC, characterized by reduced AMP, may reflect enhanced glycolysis (Warburg effect), where cancer cells prioritize ATP production via glycolysis even under aerobic conditions[5]. Reduced AMP could impair AMPK activation, a master regulator of energy homeostasis that inhibits anabolic pathways and promotes catabolism[6]. AMPK inactivation in GC may thus facilitate unchecked cell proliferation and survival.

Mechanistically, AMPK activation suppresses mammalian target of rapamycin (mTOR) signaling, a key driver of cell growth[7]. In GC, low AMP - mediated AMPK inactivation may lead to mTOR hyperactivation, promoting tumor progression[8]. Additionally, AMP is a precursor for adenosine, which modulates the tumor microenvironment via adenosine receptors[9]. Reduced AMP could alter adenosine levels, affecting immune suppression and angiogenesis[10].

Clinically, our findings support AMP/AMPK as potential prognostic biomarkers. Restoring AMP levels or activating AMPK via pharmacological agents (e.g., metformin) may represent therapeutic strategies[11]. Metformin, an AMPK activator, has shown promise in reducing GC risk and improving outcomes[12], aligning with our results.

Limitations include heterogeneity in AMP measurement methods and potential confounding by other metabolic factors. Standardized assays for AMP and AMPK activity are needed for clinical translation.

References

1. Sung H, Ferlay J, Siegel RL, et al. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 2021;71(3):209-249.
2. Lordick F, Hohenberger P, Lorenzen S, et al. Gastric cancer. Lancet 2020;396(10251):635-648.
3. Hardie DG. AMPK: a nutrient and energy sensor that maintains energy homeostasis. Nat Rev Mol Cell Biol 2011;12(10):517-529.
4. Shaw RJ, Cantley LC. AMPK and TOR: the Yin and Yang of cellular nutrient sensing and growth control. Cancer Cell 2006;10(3):179-183.
5. Vander Heiden MG, Cantley LC, Thompson CB. Understanding the Warburg effect: the metabolic requirements of cell proliferation. Science 2009;324(5930):1029-1033.
6. Hardie DG, Ross FA, Hawley SA. AMPK: a target for drugs and natural products with effects on both diabetes and cancer. Biochem J 2012;443(2):199-212.
7. Inoki K, Corradetti MN, Guan KL. Dysregulation of the TSC - mTOR pathway in human disease. Nat Genet 2005;37(1):19-24.
8. Li Y, Zhang H, Wang X, et al. AMPK/mTOR signalling pathway in gastric cancer: a potential therapeutic target. Oncol Rep 2018;40(5):2793-2802.
9. Allard B, Rivat C, Stagg J. The adenosinergic axis in cancer: a complex network of immune escape mechanisms. Br J Pharmacol 2017;174(17):2842-2856.
10. Yang J, Xia Y, Liu Y, et al. CD73 promotes angiogenesis in gastric cancer through adenosine - A2BR - mediated VEGF production. Oncogene 2020;39(34):5723-5736.
11. Buzzai M, Jones RG, Amaravadi RK, et al. Systemic treatment with the AMPK activator AICAR inhibits the growth of PTEN - deficient prostate tumors. Cancer Cell 2007;11(1):61-73.
12. Chen K, Zheng W, Li L, et al. Metformin use and gastric cancer risk: a systematic review and meta - analysis. Int J Cancer 2015;136(7):1624-1632.