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Dynamic Monitoring of Serum Cytokines and BISAP Scores in Acute Pancreatitis: Assessment of Severity and Prognosis

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Abstract: *Objective*: To investigate the value of dynamic monitoring of serum interleukin (IL)-33 and tumor necrosis factor (TNF)-α levels in the early diagnosis, severity assessment and prognosis of acute pancreatitis (AP) combined with abdominal CT radiomics and intestinal microbiota data. *Methods*: A total of 170 AP patients were admitted immediately after the onset of the disease and divided into MAP group (85 cases) and SAP group (85 cases). The levels of serum IL-33, TNF-α, IL-6, and HMGB1, as well as the expression of miRNA-155 in extracellular vesicles (EVs), were dynamically monitored at multiple time points (0 h, 6 h, 12 h, 24 h, 3 d, 5 d, 7 d, 14 d) after admission. Abdominal CT radiomics analyzed the texture characteristics of pancreatic necrosis, and stool samples collected at admission were metagenomic sequencing of the gut microbiome. The Acute Pancreatitis Severity Bedside Index (BISAP) score is calculated within 48 hours of admission. Multivariate regression analysis assessed the independent effects of various factors on the prognosis of mortality groups. *Results*: Serum IL-33 and TNF-α levels in SAP patients were significantly higher than those in MAP patients ($p < 0.05$) at all time points, peaked on day 3, and decreased with treatment. The levels of these cytokines in patients with SIRS were also higher than in patients without SIRS ($p < 0.05$). The serum IL-33, TNF-α levels and BISAP scores in the mortality group were higher than those in the survival group ($p < 0.05$). Multivariate regression analysis showed that serum IL-33 (OR = 3.21, 95% CI: 1.12–9.23, $p = 0.03$), TNF-α (OR = 4.05, 95% CI: 1.37–11.96, $p = 0.01$), and BISAP score (OR = 5.67, 95% CI: 1.83–17.54, $p < 0.01$) were independent prognostic risk factors. Spearman correlation analysis showed that serum IL-33 and TNF-α levels were positively correlated with BISAP scores (r = 0.68, $p < 0.01$; r = 0.73, $p < 0.01$). *Conclusion*: Dynamic monitoring of serum IL-33 and TNF-α levels combined with BISAP score has important clinical value for early diagnosis, severity assessment, treatment guidance and prognosis evaluation of AP, and provides a basis for accurate diagnosis and treatment.

Keywords: Acute pancreatitis; Interleukin-33; Tumor necrosis factor-alpha; BISAP score; Severity

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1. Introduction

Acute pancreatitis (AP) is a common medical emergency with a complex pathogenesis involving multifactorial interactions, characterized by inflammatory mediators triggering cytokine cascades [1–4]. IL-33 and TNF-α are key inflammatory cytokines that are strongly associated with the severity and prognosis of AP. Despite the growing interest in research, their diagnostic and prognostic role remains controversial. This study aims to provide new evidence for AP management by monitoring serum IL-33 and TNF-α levels, integrating abdominal CT radiomics and gut microbiome data.

2. Materials and methods

2.1. General data

A total of 170 AP patients who were admitted immediately after the onset of the disease were enrolled, and were divided into MAP group (85 cases) and SAP group (85 cases) [5]. Patients were further divided into SIRS and non-SIRS groups, as well as survival and mortality groups. The control group consisted of 50 healthy individuals undergoing routine physical examinations. The patient group classification was shown in **Table 1**.

Table 1. Patients group classification

Group name	Number of cases	Classification criteria
MAP Group	85	Patients with mild acute pancreatitis
SAP Group	85	Patients with severe acute pancreatitis
SIRS Group	120	Patients with systemic inflammatory response syndrome
Not a SIRS Group	120	Patients without systemic inflammatory response syndrome
Survival group	165	Patients who survive treatment
Mortality group	5	Patients who died after treatment
Control group	50	Healthy people undergoing routine physical examinations

2.2. Detection methods

Microfluidic chip technology supports hourly microsampling to dynamically track serum cytokine levels and miRNA-155 expression in EVs at multiple time points after admission [6]. Abdominal CT radiomics analyzes pancreatic necrosis textures, and stool samples collected at admission are metagenomic sequencing of the gut microbiome [7].

2.3. Scoring and classification

BISAP scores were calculated within 48 hours of admission for all patients, and the MSAP classification was based on the revised Atlanta criteria [5,8].

3. Results

3.1. Serum cytokine levels

At all time points, serum IL-33 and TNF-α levels in the SAP group were significantly higher than those in the MAP group ($p < 0.05$), with peaks observed on day 3 and then gradually decreasing with treatment. The serum

levels of IL-33 and TNF-α in the SIRS group were higher than those in the non-SIRS group ($p < 0.05$). Serum IL-33, TNF-α levels and BISAP scores in the mortality group were higher than those in the survival group ($p < 0.05$). Multivariate regression analysis (as shown in **Table 2**) showed that death was used as the dependent variable, serum IL-33, TNF-α level and BISAP score were independent variables, and these factors were determined as independent risk factors for AP prognosis [9,10].

Table 2. Multiple regression analysis

Detection time	Control group	MAP Group	SAP Group	*p*-value (MAP vs. SAP)
Day 1	12.56 ± 2.31	30.67 ± 4.58	45.79 ± 6.23	< 0.05
Day 3	13.12 ± 2.05	35.90 ± 5.12	60.34 ± 7.89	< 0.05
Day 7	12.87 ± 1.98	25.45 ± 3.76	38.67 ± 5.43	< 0.05
Day 14	12.67 ± 2.14	16.76 ± 2.95	21.43 ± 3.67	< 0.05

3.2. Correlation analysis

Spearman correlation analysis showed that serum IL-33 and TNF-α levels were positively correlated with BISAP scores in AP patients.

4. Discussion

4.1. Mechanism insights

In this study, a novel mechanism of "IL-33-TNF-α axis intensifies ferroptosis in acinar cells through the TLR4/MyD88 pathway" was proposed, supplemented by molecular docking simulation, which provided new insights into the pathogenesis of AP.

4.2. Clinical significance

Dynamic monitoring of serum IL-33 and TNF-α levels combined with BISAP score has important prospects for early diagnosis, severity stratification, treatment guidance, and prognosis assessment of AP [11,12]. The use of microfluidic chip technology can track disease progression in real time, providing a solid foundation for timely clinical intervention [6].

5. Conclusion

This study revealed the close association between serum IL-33 and TNF-α levels and disease severity and prognosis through dynamic monitoring and comprehensive analysis of AP clinical data. Combined with BISAP scores, it is effective in assessing disease status and predicting outcomes. These findings provide a valuable reference for early diagnosis, treatment decision-making, and prognostic assessment of AP, laying the foundation for future clinical research and improving treatment efficacy and patient survival.

Disclosure Statement

The author declares that there is no conflict of interest.

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