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Research progress on frailty in elderly patients with gastrointestinal tumors based on Gobbens' integrated model

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Abstract: *The incidence of frailty is high among elderly patients with gastrointestinal tumors and is closely associated with various adverse outcomes. Frailty is not only a significant risk factor during the treatment and recovery of gastrointestinal cancer patients but also influences disease prognosis through physiological, psychological, and social factors. Based on Gobbens' comprehensive model of frailty, this paper reviews related studies from a multidimensional perspective, clarifying that frailty is a dynamic process resulting from the combined effects of physiological, psychological, and social factors. It provides an overview of the concept, assessment instruments, risk factors, and interventions for frailty, aiming to establish a theoretical basis for formulating precise and effective intervention strategies, thereby delaying the progression of frailty and improving patients' quality of life.*

Keywords: *Elderly patients; Gastrointestinal tumors; Frailty; Frailty integrated model; Research progress*

1. Introduction

According to the latest data from the National Cancer Center of China, colorectal cancer and gastric cancer rank the second and fifth in the incidence of malignant tumors in China, respectively [1]. Moreover, gastrointestinal tumors are one of the leading causes of death worldwide [2]. With the accelerating trend of population aging, the proportion of elderly patients with gastrointestinal tumors will continue to rise. As a core risk factor for frailty [3], aging leads to decreased muscle mass and hormonal levels with advancing age, which in turn reduces metabolic rate and repair capacity, ultimately resulting in fatigue and limited mobility. Studies have shown a high prevalence of frailty among elderly patients with gastrointestinal tumors, accompanied by a variety of adverse outcomes [4]. To further clarify the assessment and risk factors of frailty in elderly patients with gastrointestinal tumors and explore integrated intervention programs, this paper reviews the overview, assessment tools, risk factors, as well as preventive and interventional measures of frailty from a multidimensional perspective based on the integrated frailty model. It aims to provide a reference for the identification and intervention of frailty in elderly patients with gastrointestinal tumors and improve their survival outcomes.

The integrated frailty model [5] (Testing an Integral Conceptual Model of Frailty) is a conceptual framework proposed by Dutch scholar Gobbens et al. through literature research and multiple rounds of expert meetings. It defines frailty as a dynamically developing process that affects individuals with impaired function and increases the risk of adverse outcomes in patients. Its components include 13 factors: strength, endurance, balance, nutrition, mobility, activity capacity, sensory function, cognition, emotion, memory, coping ability, social relations, and social support, all of which are incorporated into the operational definition of frailty. This model breaks through the limitation of traditional models that focus only on physical factors, emphasizing the interaction between physical, psychological and social factors, so as to implement multi-target comprehensive management for patients and construct a tripartite alternating system of frailty: "physical–psychological–social". Meanwhile, the model highlights that frailty is a reversible or delayable process, whose core lies in the imbalance between the decline in an individual's intrinsic capacity and challenges from the external environment.

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2. Overview of Frailty

Frailty was initially applied in health assessment for older adults [6]. It is a clinical syndrome caused by decreased physiological reserve and multi-system dysfunction [7], characterized by increased vulnerability of the body and reduced homeostatic capacity. With sarcopenia as its core feature, it is a non-specific state resulting from the accumulation of age- and disease-related multi-organ deficits [8]. It manifests as persistent fatigue, muscle weakness, reduced mobility, and diminished quality of life, which may further lead to adverse health outcomes such as falls, disability, hospitalization, and death [9]. According to the severity of physical function, cognitive status and disease burden, frailty is classified into pre-frailty, frailty, and severe frailty; some models refine the grading to 5–7 levels. The core basis for classification includes characteristics such as decreased physical performance, multi-system imbalance, and increased disease susceptibility, which require identification through comprehensive assessment tools.

3. Assessment Tools for Frailty in Gastrointestinal Cancer Patients Under the Integrated Frailty Model

The integrated frailty model evaluates the occurrence and severity of frailty comprehensively from physiological, psychological, and social dimensions. Therefore, among more than 70 existing frailty assessment tools, this paper focuses on those based on the "physical–psychological–social" tripartite alternating frailty system.

3.1 Tilburg Frailty Indicator (TFI)

The TFI is a frailty assessment scale developed by Dutch scholar Gobbens et al. based on the integrated frailty model, mainly used to evaluate frailty status in older populations [5]. It provides a holistic assessment of frailty across three domains: physical, psychological, and social. The scale consists of 15 items: 8 items for physical frailty (score range 0–8), 4 items for psychological frailty (0–4), and the remaining items for social frailty (0–3). The cutoff for TFI is ≥5 points, with higher scores indicating more severe frailty.

In China, many researchers have localized the TFI and verified its utility in community and hospital settings. A study [10] reported that the Chinese version of the TFI showed good internal consistency (Cronbach's $\alpha = 0.830$), confirming its high reliability in Chinese populations after cultural adaptation. As a multidimensional, self-rated frailty tool for older adults, its key advantages include comprehensiveness, ease of use, and good reliability and validity. Its main limitations are reliance on subjective reports, lack of objective indicators, and inapplicability to individuals with severe cognitive or functional impairment.

3.2 Groningen Frailty Indicator (GFI)

The Groningen Frailty Indicator (GFI) is a tool used to screen for frailty in older adults [11]. It covers four dimensions: physical, psychological, social, and cognitive, with a total of 15 items and a total score ranging from 0 to 15. A score of ≥4 points indicates frailty, with higher scores representing more severe frailty. The Chinese version of the GFI has demonstrated good reliability and validity [12]. The GFI is a simple and comprehensive multidimensional self-rated tool that simultaneously assesses physical, psychological, and social frailty. However, its reliance on subjective self-report limits precise grading of frailty severity.

4. Risk Factors for Frailty in Gastrointestinal Cancer Patients from an Integrated Frailty Perspective

4.1 Sociodemographic Factors

4.1.1 Age

Studies have shown that physiological degeneration and aging are closely associated with the development of frailty [13,14]. Sahin [4] investigated 120 older patients who underwent surgery for gastrointestinal cancer and found a correlation between age and FI score.

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With advancing age, human tissue repair capacity declines, predisposing individuals to fatigue and limited mobility. Coupled with tumor invasion, surgical treatment, chemotherapy, and radiotherapy, patients exhibit higher frailty scores and more severe frailty.

4.1.2 Gender

A study by Yao et al [15] demonstrated that the occurrence of frailty in older adults is influenced by both gender and age. Among individuals aged 80 years and older, the prevalence of frailty was higher in men, which may be attributed to faster decline in physiological function and more prominent health issues in men at advanced ages, as well as gender differences in amyloid-β metabolism, making men more susceptible to age-related cognitive impairment. In contrast, among those aged 75–79 years, women showed a higher prevalence of frailty, presumably due to heavier chronic disease burden and related psychosocial factors in this age group [16].

4.1.3 Body Mass Index (BMI)

Findings have shown that low body mass index (BMI), low prognostic nutritional index (PNI), and high systemic immune-inflammation index (PII) levels increase the risk of frailty in elderly patients with colorectal cancer [17]. Elderly patients with gastrointestinal tumors often experience hypoalbuminemia and nutritional metabolic disorders due to impaired intestinal function and the hypermetabolic state induced by the tumor. Such conditions exacerbate age-related muscle loss, leading to weight loss and sarcopenia.

4.1.4 Behavioral and Lifestyle Factors

In a survey of patients with rheumatoid arthritis, Liu [18] found that with increasing severity of metabolic syndrome, drinkers had a higher risk of frailty than non-drinkers. Another cohort study [19] reported that the prevalence of frailty in young men was mainly associated with unhealthy lifestyle behaviors, such as staying up late, smoking, sedentary behavior, and alcohol consumption.

4.2 Physiological Factors

4.2.1 Nutritional and Metabolic Factors

Nutritional and metabolic imbalance is one of the causes of frailty in elderly patients with gastrointestinal tumors. Bakir [20] conducted face-to-face interviews with 72 elderly patients (38 frail and 34 pre-frail) preoperatively, at discharge, and 30 days post-discharge. The results showed that Mini Nutritional Assessment scores, serum albumin levels, and dietary energy intake were significant determinants of frailty severity. Individuals with metabolic syndrome are also more susceptible to frailty [21].

4.2.2 Genetic and Hereditary Factors

Genetic and hereditary factors represent an important mechanism underlying frailty [22]. Studies have suggested that the neuromuscular junction pathway and related genes may serve as biomarkers of aging and longevity [23], among which polymorphisms in the HDAC9 and PPP3CA genes are particularly associated with frailty. Specifically, rs2476601 in the PTPN22 gene may act as a genetic risk factor for frailty [24].

4.3 Psychological Factors

A cross-sectional study by Gong et al [25] showed that frail elderly patients had a fourfold increased risk of depression, and depressed individuals were four times more likely to become frail. Frailty syndrome is associated with higher depression and anxiety scores [26].

Patients with gastrointestinal tumors often develop anxiety, depression, and other negative emotions due to poor prognosis, severe treatment-related adverse reactions, and high medical costs. Such negative emotions reduce treatment motivation and psychological coping ability to a certain extent, impair treatment adherence, accelerate disease progression, and increase the risk of frailty.

4.4 Social Support Factors

Socioeconomic status is an important determinant of frailty [27], and loneliness is positively correlated with frailty [28]. A study by Sato et al. demonstrated that the “severely isolated” and “severely lonely” groups had the highest risk of incident frailty compared with the “non-isolated” and “non-lonely” groups

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[29].Social support influences the development of frailty. Elderly patients with gastrointestinal tumors, affected by disease and psychological distress, require sufficient family support and strong social assistance; otherwise, their risk of frailty increases.

4.5 Pharmacological and Medical Factors

Frailty and multiple comorbidities are major contributors to polypharmacy [30]. When exposed to stressors, individuals are more likely to experience adverse health events, including prolonged hospital stay, disability, and death [31].Elderly patients with gastrointestinal tumors undergo surgery, radiotherapy, chemotherapy, and other treatments. Surgery itself is a potent stressor that disrupts endocrine, metabolic, and immune functions, leading to a decompensated state and subsequent frailty.

5. Prevention and Intervention Strategies for Gastrointestinal Tumors Complicated with Frailty

5.1 Dietary Education and Nutritional Management

Relevant guidelines [32] recommend nutritional intervention for frail patients preoperatively to improve prognosis. Some scholars [9] implemented preoperative nutritional management in elderly patients with gastrointestinal cancer and frailty, the results showed that BMI, serum biochemical indicators, nutritional assessment, and frailty scores in the intervention group were significantly better than those in the control group. Meanwhile, malnutrition is a modifiable risk factor for frailty, and appropriate nutritional intervention may alleviate or even reverse frailty [33].

5.2 Exercise Management

A study by Berkel et al. showed that frail colorectal cancer patients who participated in 3 weeks of planned aerobic and resistance training preoperatively had lower postoperative complication rates [34]. Zopf et al [35] conducted a study in patients undergoing curative resection for colorectal cancer and planned adjuvant chemotherapy, in which the intervention group received a 6-month supervised aerobic exercise program consisting of four phases: preoperative exercise, postoperative bed exercise, postoperative seated exercise, and postoperative standing exercise. Compared with the control group, the intervention group showed significant improvements in cardiopulmonary fitness, some patient-reported health outcomes, and mental fatigue.

5.3 Psychosocial Management

Studies have found that anxiety and depression in elderly patients undergoing gastrointestinal tumor surgery are associated with increased postoperative mortality [36]. Oberoi [37] showed that 6 months of supportive expressive group therapy in patients with gastrointestinal tumors effectively reduced anxiety and depression, thereby indirectly improving frailty status. For patients with gastrointestinal tumors, psychological support alleviates anxiety and depression, fosters resilience, and promotes better treatment outcomes. Therefore, when providing care and interventions for frail older adults, helping them establish a positive psychological state and supportive social relationships can effectively improve frailty.

5.4 Combined Interventions

In a randomized controlled trial, multimodal perioperative rehabilitation management including nutritional support, exercise, and psychological care was administered to frail patients with gastrointestinal tumors [38]. The proportion of patients with early frailty increased over time in the intervention group, while the proportion of frail patients decreased, indicating that the intervention effectively slowed frailty progression, especially one week after discharge. Wada [39] applied preoperative nutritional and exercise interventions in frail gastric cancer patients scheduled for gastrectomy, which effectively reduced postoperative complications and average length of hospital stay. In summary, nutritional management improves nutritional status and relieves frailty; exercise enhances muscular and physical function and reduces postoperative complications; psychological support alleviates negative emotions and indirectly improves frailty. Combined intervention strategies achieve greater effects than single interventions.

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6. Summary and Prospects

Based on the integrated frailty theory, this review summarizes research on frailty in elderly patients with gastrointestinal tumors from a multidimensional perspective. It confirms that frailty is a dynamic process driven by physiological, psychological, and social factors, with high prevalence in elderly patients and close associations with adverse outcomes such as postoperative complications. This paper also introduces multidimensional assessment tools including the TFI and GFI, analyzes multiple risk factors. Future research may further optimize frailty assessment tools tailored for elderly patients with gastrointestinal tumors, explore personalized and interdisciplinary integrated intervention programs, and investigate potential influencing factors such as genetics, to provide more scientific evidence.

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