

The analysis of correlation between frailty index and postoperative complications of aged patients with nodular goiter

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Abstract

Objective: To explore the correlation between frailty index (FI) and postoperative complications of aged patients with nodular goiter (NG).

Methods: A total of 120 aged patients with NG undergoing operative treatment from May 2013 to October 2015 in our hospital were selected. All of them were divided into 3 groups according to the FI as follows: nonfrail group ($FI < 0.2$), intermediately frail group ($0.2 \leq FI < 0.4$), and frail group ($FI \geq 0.4$). Clinical data of patients about general data, body mass index, American Society of Anesthesiology (ASA) classification, hospital stays, and postoperative complications were examined. Then, the correlations between the indexes above and FI were examined.

Results: Frailty index and the ASA classification have some relevance ($r = .265$, $P = .007$). The postoperative complication rates of total nonfrail group, intermediately frail group, and frail group were, respectively, 4 cases (11.4%), 11 cases (31.4%), and 24 cases (48.0%). With the increase in FI, the incidence of postoperative complications and hospital stays had also significantly increased. The area under receiver operating characteristic curve examining frailty's ability to forecast postoperative complications was 0.815 (95% CI: 0.675–0.954, $P = .000$).

Conclusion: The level of frailty index is a risk factor for postoperative complications of aged patients with NG. The preoperative frailty index evaluation can provide reference evidence for the treatment of aged NG patients undergoing surgery.

KEYWORDS

frailty index, nodular goiter, postoperative complication

1 | INTRODUCTION

Nodular goiter (NG) is an important public health problem and is characterized by excessive growth and structural and/or functional transformation of 1 or several areas within the normal thyroid tissue. In the Knudsen survey, the prevalence of multinodular thyroid was

found in 23% of the population, increasing in women from 20% to 46% with increasing age and in men from 7% to 23%.¹ Among these nodules, available data suggest that approximately 5% are toxic, 10% are warm, and 85% are cold.^{1,2} Despite the high incidence, treatment options remain limited for NG, including iodine supplementation, surgery, and ¹³¹I therapy.³ A major hindrance in the use of iodine supplementation, however, is that it may induce thyrotoxicosis in predisposed individuals.^{4,5} Due to this drawback, iodine

Dr. Li and Nie contributed equally to this study.

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supplementation in the context of NG is disregarded as an option, in Europe (except in Germany) and in North America.^{6,7} Surgery remains the treatment of first choice for NG.³ As the elderly population increases, the incidence of NG also increases. Generally, elderly patients have more comorbidities. As the number of preoperative comorbidities increases, more postoperative complications develop. Thyroidectomy for patients over 70 years old was associated with an increased postoperative complication rate and prolonged hospital stay,⁸ whereas the risk for airway problems increased after thyroidectomy for substernal goiter in elderly patients.⁹

Frailty is defined as frailty phenotype or as an accumulation of deficit measure in a frailty index (FI) score.¹⁰ Frailty has been shown to increase risk for postoperative delirium,¹¹ institutionalization, and mortality¹² in cardiac surgery patients as well as postoperative institutionalization,¹³ complications,¹⁴ and mortality¹⁵ in general surgery patients. FI has been proposed as an index of deficits which summarizes health deficits across a range of symptoms, signs, diseases, disabilities, and laboratory abnormalities.¹⁶ So identifying FI in older patients before surgery may be necessary to optimize treatment and predict the treatment outcomes.

Although there is a growing body of literature on frailty in developed countries, research is scarce in developing countries, such as China, which has the world's largest oldest-old population. Therefore, the purpose of this study was to explore the correlation between FI and postoperative complications of aged patients with NG, in order to provide reference evidence for clinical care.

2 | METHODS AND SUBJECTS

2.1 | Subjects

A total of 120 aged patients with NG undergoing operative treatment were selected from May 2013 to October 2015 in Third Hospital of Changsha, Changsha, Hunan Province, China. All patients were aged ≥ 60 years. Patients were excluded according to the

following criteria: (i) abnormal renal function or hepatic function, (ii) history of serious cardiovascular disease, (iii) abnormal coagulant function or hemorrhagic tendency. All subjects were provided with informed consent forms separately, and the study was carried out in compliance with the Helsinki Declaration II and the Chinese Standards for Good Clinical Practice. The study protocol was approved by the ethics committee of the Third Hospital of Changsha (Changsha, China).

2.2 | Methods

Height and weight were measured to the nearest 0.5 cm and 0.1 kg, in women wearing light indoor clothing and no shoes. Body mass index (BMI) was calculated as weight (kilograms) divided by the square of the height (meters). Data collected included sociodemographic information, self-reported medical conditions, hospital stays, complications, surgical procedure, and postoperative complications, and the subjects were followed up for 1 year. Frailty measurements were taken by an assistant who was trained. The frailty index containing 70 deficits, which was developed by the Canadian Study of Health and Aging (CSHA), was applied in this study.¹⁷ FI was calculated as the number of deficits divided by 70. In this way, more deficits result in a higher score for the frailty index. The patients were divided into 3 groups according to the FI as follows: nonfrail group ($FI < 0.2$, 50 cases), intermediately frail group ($0.2 \leq FI < 0.4$, 35 cases), and frail group ($FI \geq 0.4$, 50 cases).

2.3 | Statistical analysis

All statistical procedures were carried out with SPSS for Windows version 19.0 (SPSS, Inc., Chicago, IL, USA). Continuous variables were summarized as mean and standard deviation (SD) and categorical variables as the number (percent). For comparison between groups of nonfrail, intermediately frail, and frail, Student's *t* test for continuous variables and chi-square tests for categorical variables

TABLE 1 Comparison of common data among 3 groups, n (%)

Characteristic	Nonfrail group (n = 35)	Intermediately frail group (n = 35)	Frail group (n = 50)	F/χ^2	P
Age (y)	66.3 \pm 7.1	65.8 \pm 7.6	67.4 \pm 6.7	0.971	.412
Gender (male/female)	9/26	10/25	14/36	0.081	.960
BMI (kg/m ²)	25.5 \pm 3.9	25.3 \pm 4.1	24.8 \pm 4.5	0.123	.904
Operation time (min)	67.4 \pm .5	66.9 \pm 7.8	68.1 \pm 6.3	1.492	.232
Hypertension (n, %)	14 (20.0)	14 (20.0)	25 (50.0)	1.220	.338
Diabetes (n,%)	8 (22.9)	7 (20.0)	13 (26.0)	1.431	.319
Operation type					
Unilateral total thyroidectomy	6 (17.1)	7 (20.0)	11 (22.0)	0.544	.997
Unilateral subtotal thyroidectomy	5 (14.3)	4 (11.4)	6 (12.0)		
Bilateral subtotal thyroidectomy	16 (45.7)	17 (48.6)	22 (44.0)		
Total/subtotal thyroidectomy	8 (22.9)	7 (20.0)	11 (22.0)		
Duration of disease	4.1 \pm 3.1	4.2 \pm 2.8	4.0 \pm 2.9	1.033	.457

BMI, body mass index.

were performed. Ranked data were analyzed with the use of Kruskal-Wallis chi-square test. Spearman's correlations were applied to analyze the associations between FI and postoperative complications. Receiver operating characteristic (ROC) curve was used to evaluate the predictive value of FI on postoperative complications. The accepted level of statistical significance was $P < .05$.

3 | RESULTS

The characteristics of the subjects are listed in Table 1. The mean age of the study population is 65.5 ± 7.8 years, with 32 of male gender. Thirty-five subjects belonged to "nonfrail group," thirty-five subjects belonged to "intermediately frail group," and fifty subjects belonged to "frail group." No statistical difference was observed in American Society of Anesthesiology (ASA) classification in nonfrail group, intermediately frail group, and frail group (Table 2). In Spearman's correlation analysis, FI was associated with ASA score ($r_s = .265$, $P = .007$, data not shown). Table 3 shows that an increasing FI is correlated with an increasing postoperative hospital stay. Higher rates of postoperative complications are associated with increasing FI, including hemorrhage, recurrent laryngeal nerve injury, hypocalcaemia, hypothyroidism, deep-vein thrombosis, systemic inflammatory response syndrome (SIRS). The area under the ROC curve of the occurrence of perioperative complications in frail group was 0.815 (95% CI: 0.675-0.954; $P = .000$), significantly higher than the nonfrail group indices (0.5). The analysis of Spearman correlation showed positive correlations between FI and perioperative complications ($r_s = .519$, $P = .023$, data not shown).

4 | DISCUSSION

Nodular goiter occurs in up to 4% of the population in iodine-sufficient countries, and its frequency increases with age.¹⁸ Currently,

surgery appears to be the main treatment for NG. However, older patients are at increased risk for postoperative complications. As the aging population expands in China, older patients are increasingly presenting for surgical evaluation.¹⁸ The ASA is determined by a subjective estimate of organ system disease and likelihood of survival. However, in some previous studies, ASA score did not associate with postoperative mortality or morbidity.^{19,20} These results may be due to the fact that this system is primarily based on subjective clinical judgments.²¹ Many recent studies in risk assessment of the geriatric patient have focused on the creation of a frailty score or index.^{22,23} FI has been demonstrated to predict the postoperative outcomes in general surgery patients.¹⁴ The validity of the FI has been demonstrated in various populations as an effective tool among geriatricians and others for studying the determinants of aging and its implications for public health monitoring and intervention.^{24,25}

Compared with many Western nations, China has the world's largest aging population and high incidence of NG. Thyroidectomy and subtotal thyroidectomy are the major treatment for patients with NG.³ However, like all surgeries, they can be burdened by complications. Complications include hypocalcaemia, recurrent laryngeal nerve palsy, and hemorrhage. Generally, elderly patients have more comorbidities. As the number of preoperative comorbidities increases, a higher incidence of complications and recurrence develops. Surgical decision making in this population is challenging because of the heterogeneity of health status in older adults and the paucity of tools for predicting operative risk. Commonly used predictors of postoperative complications have substantial limitations; most are based on a single organ system or are subjective, and none estimate patient's physiologic reserves. Therefore, it is urgent to establish an effective risk assessment tool for thyroid surgery among elderly patients.

Frailty is increasingly recognized as a unique domain of health status that can be a marker of decreased reserves and resultant vulnerability in older patients. An individual's FI score reflects the proportion of potential deficits present in that person and indicates the likelihood that frailty is present. The FI assigns a score based on health status. FI has been reported to predict relevant postoperative complications in the previous study.^{26,27}

In our study, we evaluated 120 aged patients, admitted to our hospital between May 2013 and October 2015. These patients were with NG undergoing operative treatment. All of them were divided into 3 groups according to the FI as follows: nonfrail group, intermediately frail group, and frail group. Makary et al¹⁴ found that preoperative frailty was associated with an increased risk for postoperative complications and length of stay in older surgical patients. Consistent with their findings, our study showed that frailty

TABLE 2 Comparison of ASA classification among 3 groups, n (%)

	ASA 1	ASA 2	ASA 3	ASA 4
Nonfrail group (n)	0	23	11	1
Intermediately frail group (n)	0	16	17	2
Frail group (n)	0	21	26	3
Hc	4.907			
P	.086			

ASA, American Society of Anesthesiology.

TABLE 3 Comparisons of the hospital stay and complication between 3 groups, n (%)

	Nonfrail group (n = 35)	Intermediately frail group (n = 35)	Frail group (n = 50)	χ^2/F	P
Hospital stay after surgery ($\bar{x} \pm s$, d)	10.22 \pm 1.58	13.01 \pm 3.02*	14.85 \pm 4.13***	20.983	.000
Complications (n, %)	4 (11.4)	11 (31.4)	24 (48.0)*	12.578	.002

* $P < .05$, compared with nonfrail group.

** $P < .05$, compared with intermediately frail group.

characteristics are related to a higher rate of perioperative complications following thyroidectomy and subtotal thyroidectomy. Results found that frailty was related to increased postoperative complications and longer length of stay. This study suggests that FI is a useful tool for prediction of postoperative complications in our aging thyroidectomy or subtotal thyroidectomy Chinese patients. The FI can provide additional information to help physicians make more accurate predictions and help patients make more informed and personal choices.

The main reason this study is important is that it recognizes the ability of FI to predict postoperative complications of thyroidectomy and subtotal thyroidectomy. This scoring system was feasible to perform in a busy surgical practice, taking 10 minutes to conduct the assessment. Once a patient has been identified as frail, physicians can integrate frailty into their discussions of the risks and benefits of surgery, and patients can benefit from interventions to reduce risks, such as preoperative conditioning, nutrition, or even pharmacological therapy. Reducing postoperative complications in older patients is important because complications were associated with high 30-day mortality in patients aged 80 and older.²⁸

There are some limitations of this study. First, the sample size was too small. Moreover, most of the patients were institutionalized or living in urban locations, and it may have underrepresented economically marginalized groups. Finally, we did not evaluate the long-term outcomes and quality of life. Further studies focusing on the relationship between FI and postoperative complications in a more general Chinese population are urgently warranted.

5 | CONCLUSION

Frailty is common in central south Chinese older surgical patients. The frailty score defines older adults at higher risk for postoperative complications. Use of the FI before surgery can help inform clinical decisions among patients and clinicians.

CONFLICT OF INTEREST

The authors report no conflict of interests.

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