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Predictive factors for death and long-term outcomes in elderly critically ill patients following tracheotomy: a retrospective analysis

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Abstract

Objective To explore the factors influencing death in elderly critically ill patients within 3 months and 6 months after tracheotomy and to discuss the long-term quality of life of patients and the burden on caregivers by disease type.

Methods This retrospective study included 160 elderly patients with tracheostomies. The study aimed to analyze the risk factors associated with mortality at 3 and 6 months post-tracheotomy using both single-factor analysis and multifactor logistic regression. The subjects were categorized into three groups based on the type of disease. Kaplan–Meier survival curves and log-rank tests were utilized to assess differences in survival rates among these groups. Furthermore, the Personal Activities of Daily Living (PADL) scale, the SF- 12 scale, and the Zarit Burden Interview (ZBI) were administered to analyze and compare the quality of life among the patients.

Results The PSI score (95% CI: 1.008–1.036), total dose of vasoactive drugs (95% CI: 1.001–1.007), and the number of medical consultations (95% CI: 0.418–0.929,) were identified as independent risk factors for mortality within three months following tracheotomy in elderly patients. Additionally, the PSI score (95% CI: 1.001–1.026, $P < 0.05$) and the total dose of vasoactive drugs (95% CI: 1.001–1.007, $P < 0.05$) were also independent risk factors for patient death within six months. No significant differences were observed in the survival rates among the three subgroups followed up for six months, significant differences were noted in the PADL, ZBI, and SF- 12 scores among these subgroups.

Conclusion The quality of life and risk factors for mortality within six months following tracheotomy in critically ill elderly patients warrant careful consideration. Caregivers face varying challenges due to different underlying conditions, particularly in cases involving severe pneumonia and cardiac insufficiency, which require increased social awareness.

Keywords Elderly, Critically ill patients, Tracheotomy, Quality of life, Risk factors

Introduction

Elderly patients with respiratory failure following acute exacerbation of underlying diseases often require intensive care unit admission for rescue treatment involving tracheal intubation. A small percentage, ranging from 5 to 10%, of mechanically ventilated patients opt for tracheostomy [1]. The aging organ function and compromised immune system of elderly patients often lead delayed removal from tracheal intubation. Tracheotomy

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can facilitate better clinical airway management and aid in the weaning process. However, clinical observations have revealed a high mortality rate among elderly and very elderly critically ill patients who undergo tracheostomy [2]. Decision-making regarding further tracheostomy in such cases is complex for family members, and doctors struggle to provide clear guidance. While some studies suggest that early tracheotomy in severely ill patients may reduce the incidence of ventilator-associated pneumonia and shorten the duration of mechanical ventilation, it does not impact short-term all-cause mortality [3]. Many very elderly critically ill patients have a short life expectancy following tracheostomy due to underlying irreversible conditions, causing distress and psychological burden for both patients and their families. Research on the long-term survival outcomes of patients following tracheotomy is limited, with some studies indicating an increase in mortality rates over time and a significantly diminished quality of life for these individuals [4]. Some studies suggest that the Tracheostomy Well-Being Score (TWBS) could enhance the quality of life for posttracheostomy patients by enabling early intervention and improved management. However, further promotion of its clinical application is necessary [5]. A review of the literature revealed that there is a lack of research on the survival outcomes of critically ill elderly patients after tracheotomy. The aim of this study was to identify the risk factors for mortality within six months after tracheotomy in elderly critically ill patients while also analyzing their quality of life. The findings should provide insight for decision-making regarding tracheotomy surgery in elderly critically ill patients, ultimately improving their prognosis and enabling early intervention, Additionally, the societal implications of the burden faced by family members of these patients are often overlooked. This study derived its results from extensive follow-up, highlighting its significance for public health.

Methods

A retrospective study was conducted on elderly critically ill patients who were admitted to the intensive care unit of Hefei Hospital Affiliated with Anhui Medical University between December 2018 and December 2022. The inclusion criteria were as follows: (1) aged 65 years and older; (2) APACHE II score of 15 points and above; (3) underwent tracheotomy surgery during hospitalization due to treatment needs; and (4) successful weaning from the machine after tracheotomy and subsequent discharge from the ICU. The exclusion criteria were as follows: (1) had a history of tracheostomy with an unblocked tube, (2) had suicidal tendencies or mental disorders, or (3) died before leaving the ICU after tracheostomy. A total of 160 patients met the inclusion criteria. Patients were categorized into three groups based on the main diagnosis necessitating artificial airway establishment: Group A (45 patients) with respiratory disease due to cerebrovascular disease (cerebral infarction and cerebral hemorrhage) requiring tracheotomy; Group B (77 patients) with pulmonary infection and cardiac insufficiency; and Group C (38 patients) with tracheotomy due to postoperative complications hindering weaning. The study was conducted in accordance with medical ethics standards and was approved by the hospital ethics committee; the ethical approval number is 2024-scientific research- 094.

Observation indicators: Following a review of the pertinent literature, we gathered comprehensive clinical data such as age, sex, education level, diagnosis, CCI score, duration of hospitalization, duration of mechanical ventilation, SOFA score, PSI score, and APACHE II score. The vasoactive drugs utilized in our facility include dopamine and norepinephrine. The total dosage of vasoactive drugs administered to patients prior to tracheotomy is calculated as the sum of the dopamine dose and ten times the norepinephrine dose. Additionally, laboratory examination data (including albumin, BNP, PCT, etc.) and information on the patient's family status (number of children, number of medical treatments and consultations) were collected. The latter includes the total number of hospital visits by the patient and the number of phone consultations by family members.

Three scales were used in this study: the PADL, SF- 12, and ZBI. The PADL scale, developed by the Australian scholar Surya Shah in 1989, is based on the Barthel Index Scale and provides a detailed assessment of daily living activities such as eating, defecation, and other activities [6–8]. The SF- 12 scale, validated in China by the University of Hong Kong in 2004, is used to evaluate the quality of life of patients and has shown strong correlations with health scales. With only 12 items, it is concise and suitable for elderly patients [9–11]. The ZBI assesses caregiver burden in two dimensions, role burden and personal burden, and was developed by Zarit et al. in the 1980 s. This scale, comprising 22 items rated on a 5-point scale, measures the degree of caregiver burden, with higher scores indicating greater burden [12, 13].

Follow-up and prognosis assessment: All research subjects were followed up at 3 months and 6 months after discharge from the intensive care unit. Given the advanced age of the patients, most found it challenging to complete the questionnaires independently. Therefore, patients and family members collaborated to provide responses. Follow-up was conducted using telephone questionnaires and WeChat applets for questionnaire collection, which were primarily completed during hospital review appointments. In cases where information could not be gathered through these

Table 1 Clinical data between the death group and the survival group following up for 3 and 6 months

Characteristic	3 months				6 months			
	Nonsurvivors	Survivors	t/x^2	*P*	Nonsurvivors	Survivors	t/z/x^2	*P*
n	22	138			31	107		
Male sex(%)	12 (54.55)	62 (48.44)	0.71	0.40	17(54.84)	50(46.73)	0.63	0.43
Age(years)	73.63 ± 7.59	74.03 ± 7.93	1.38	0.17	74.00 ± 7.68	76.57 ± 7.72	1.63	1.11
Education level(years)	8.23 ± 3.65	7.88 ± 3.73	0.41	0.68	8.35 ± 3.38	7.69 ± 3.71	0.89	0.37
CCI score	11.36 ± 3.85	10.63 ± 4.11	0.78	0.43	13.12 ± 5.55	9.49. ± 3.14	0.67	< 0.01*
Hypertension,n(%)	10 (45.46)	59 (42.75)	0.06	0.81	15(48.39)	43(40.19)	0.66	0.42
Diabetes n(%)	11 (50.00)	43 (31.16)	3.01	0.08	14(45.16)	37(34.58)	1.16	0.28
Duration of ICU(d)	9.50 ± 2.67	9.18 ± 2.49	0.55	0.58	9.71 ± 2.58	9.11 ± 2.46	1.18	0.24
APACHEII score	16.50 ± 4.21	14.22 ± 5.01	2.03	0.045*	15.38 ± 4.59	13.76 ± 4.88	1.66	0.09
PS score	163.41 ± 39.99	132.14 ± 41.81	3.28	< 0.01*	171.71 ± 41.31	135.03 ± 40.40	2.01	0.046*
SOFA score	10.73 ± 4.26	11.02 ± 4.15	0.31	0.76	11.32 ± 4.16	10.87 ± 4.32	0.52	0.61
Vasoactive drug (mg)	359.09 ± 136.48	272.48 ± 146.45	2.60	0.01*	332.58 ± 147.44	269.18 ± 140.81	2.18	0.03*
duration of mechanical ventilation(h)	168.84 ± 36.54	170.67 ± 32.45	3.60	0.73	168.64 ± 31.50	170.24 ± 41.34	2.50	0.65
partial pressure of oxygen(mmHg)	79.00 ± 13.40	80.99 ± 13.79	0.63	0.53	77.65 ± 14.41	81.10 ± 12.44	1.32	0.19
PCT	6.53 ± 5.17	5.92 ± 4.98	0.53	0.60	5.72 ± 4.99	6.13 ± 5.01	0.40	0.69
BNP	4643.18 ± 6056.01	4101.23 ± 5464.04	0.42	0.61	5443.23 ± 6711.19	3706.73 ± 5014.32	0.42	0.61
albumin (g/L)	24.14 ± 3.64	23.75 ± 3.87	0.43	0.67	23.48 ± 3.31	23.80 ± 3.94	0.41	0.68
Hb(g/L)	83.59 ± 15.29	7.88 ± 3.73	0.38	0.70	84.19 ± 16.09	81.66 ± 15.15	0.81	0.42
Number of children	3.14 ± 0.99	3.01 ± 1.01	0.53	0.60	3.13 ± 0.9\2	3.01 ± 1.03	0.58	0.56
Medical consultations	1.27 ± 1.20	2.21 ± 1.63	2.60	0.01*	1.74 ± 1.61	2.36 ± 1.61	1.87	0.69

methods, door-to-door follow-up was implemented. The study comprised a total of 160 patients, with 22 patients lost to follow-up at the 6-month mark, resulting in clinical data from 138 patients.

Statistical analysis

The statistical analysis of the data was conducted using IBM SPSS 25.0 software. All the data were tested for normality and homogeneity of variance. Continuous variables that followed a normal distribution are presented as ($\overline{x}$±s), while count data are expressed as frequencies. The independent sample t test was utilized to compare continuous variables for two groups, analysis of variance for three groups, and the χ^2 test and Fisher's exact probability method for categorical variables. The Mann–Whitney U test was employed for nonnormally distributed data. Univariate analysis was used to identify risk factors for death within 3 or 6 months after tracheostomy in severely ill elderly patients, followed by binary logistic regression analysis to determine independent risk factors. The ROC curve, Kaplan–Meier survival curve, and log-rank tests were used to compare intergroup differences in the risk of death. A two-tailed *p* value < 0.05 was considered to indicate statistical significance.

Results

Analysis of risk factors for death within 3 months after tracheostomy in elderly patients

A total of 160 elderly patients who underwent tracheostomy were monitored after they left the ICU; 22 patients were dead (death group), and 138 patients were alive (survival group) at the 3-month mark. Univariate analysis revealed significant differences between the two groups in terms of the APACHE II score, PSI score, total dose of vasoactive drugs, and number of medical consultations (Table 1). These four risk factors were further analyzed through multifactor logistic regression, which revealed that the PSI score (OR = 1.022, 95% CI: 1.008 ~ 1.036, P < 0.01), total dose of vasoactive drugs (OR = 1.004, 95% CI: 1.001 ~ 1.007, P < 0.05), and number of medical consultations (OR = 0.623, 95% CI: 0.418 ~ 0.929, P < 0.05) were independently associated with patient mortality within 3 months after tracheostomy. ROC curve analysis demonstrated that the areas under the curve (AUCs) for predicting patient death based on these indicators were 0.74, 0.67, and 0.65, respectively.

Analysis of risk factors for death within 6 months after tracheostomy in elderly patients

Out of 160 patients, 22 were lost to follow-up, 31 died, and 107 survived. Factors such as the CCI score, PSI

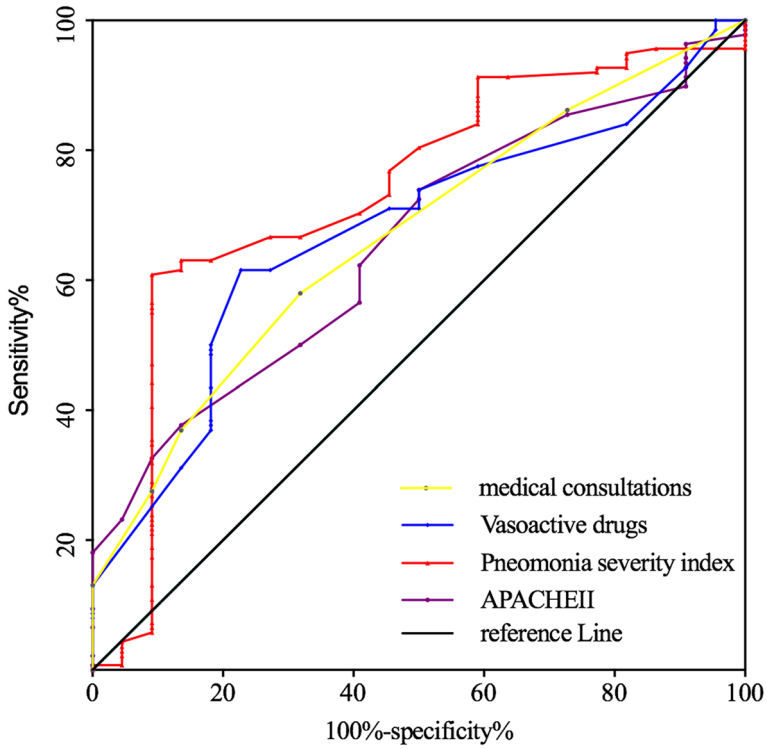

Fig. 1 ROC curve analysis of the medical consultations, Vasoactive drugs, Pneomonia severity index, APACHEII in patients at three months of follow-up

score, and total vasoactive drug dose were significantly different between the death and survival groups. Multifactor logistic regression analysis revealed that the CCI score (OR = 1.301, 95% CI: 1.147–1.476, $P < 0.01$), PSI score (OR = 1.013, 95% CI: 1.001–1.026, $P < 0.05$), and total vasoactive drug dose (OR = 1.004, 95% CI: 1.001–1.007, $P < 0.05$) were independent risk factors for death within 6 months. The areas under the curve for predicting patient death were 0.71, 0.63, and 0.62 for the CCI score, PSI score, and total vasoactive drug dose, respectively (Figs. 1, 2 and Tables 2 and 3).

The general data among three groups of patients, classified by disease type, was compared. Patients were categorized into three groups based on the primary disease at ICU admission: the cerebrovascular disease group (Group A), the heart failure + severe pneumonia group (Group B), and the postoperative complications group (Group C). No significant differences were found in terms of sex, age, education level, APACHE II score, CCI score, or other general indicators among the three patient groups. Additionally, there was no significant difference in the number of patient deaths within 3 or 6 months after tracheostomy between the two groups (Table 4).

During the follow-up period, the mortality rate increased over time in all three groups of patients. In the cerebrovascular disease group, out of 45 patients, 6 died within 3 months after tracheostomy and 7 died within 6 months after tracheostomy, resulting in a mortality rate of 15.56%. In the heart failure + severe pneumonia group, 13 patients were dead at the 3-month follow-up, and totally 20 were dead at the 6-month follow-up, for a mortality rate of 25.97%. In the postoperative complications group, out of 38 patients, 3 were dead at the 3-month follow-up, and 4 were dead at the 6-month follow-up, resulting in a mortality rate of 14.29%. The Kaplan–Meier survival curves and log-rank tests were used to compare survival rates among the groups, and no significant differences in survival rates were detected (chi-square value 4.287, P = 0.12). Please refer to image 3 for more details (Fig. 3).

The quality of life and caregiver burden among the three groups of patients were assessed in terms of PADL scores to evaluate daily living abilities. Analysis of variance revealed a statistically significant difference in PADL scores among the groups (F = 5.84, P = 0.004). Pairwise comparisons indicated that Group A had significantly lower scores than did Group C (P = 0.001). Group B also had significantly lower scores than did Group C (P = 0.031). Additionally, Group A had significantly lower scores than did Group B (P = 0.001). No significant difference was detected between Group B and Group C (P = 0.118). Caregiver burden was

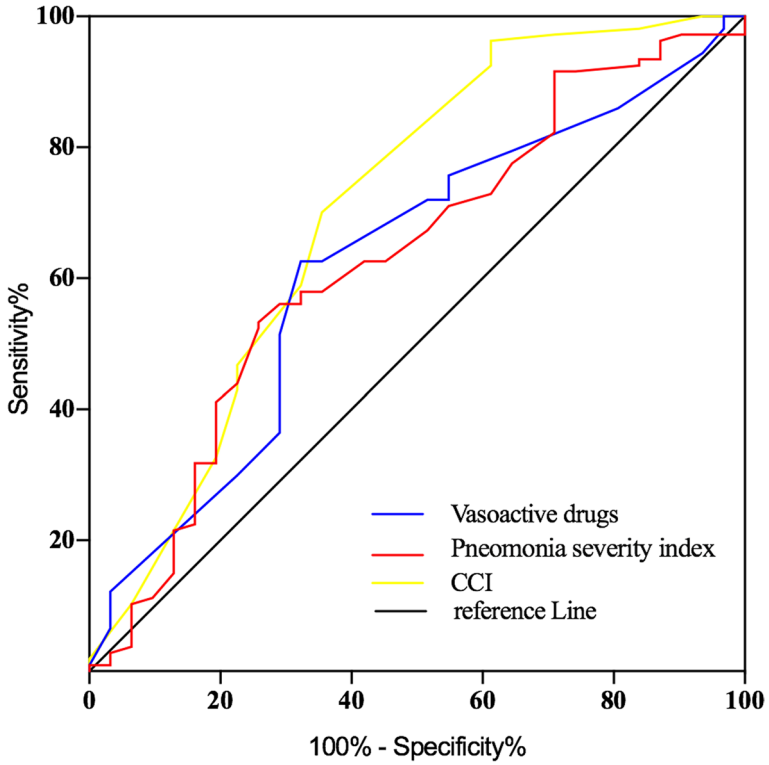

Fig. 2 ROC curve analysis of Vasoactive drugs, Pneomonia severity index, CCI in patients at six months of follow-up

Table 2 Multivariate logistic regression analysis of patient death at within 3 months after tracheostomy

Variable	Regression coefficient	S.E	Wald	P	OR	95% CI		AUC
APACHEII score	0.099	0.054	3.308	0.069	1.104	0.992	1.229	0.60
PSI score	0.022	0.007	9.999	0.002	1.022	1.008	1.036	0.74
Vasoactive drug	0.004	0.002	5.712	0.017	1.004	1.001	1.007	0.67
Medical consultations	− 0.473	0.203	5.397	0.02	0.623	0.418	0.929	0.65

Table 3 Multivariate logistic regression analysis of patient death within 6 months after tracheostomy

Variable	Regression coefficient	S.E	Wald	P	OR	95% CI		AUC
CCI score	0.263	0.064	16.807	< 0.01	1.301	1.147	1.476	0.71
Vasoactive drug	0.004	0.002	6.253	0.012	1.004	1.001	1.007	0.62
PSI score	0.013	0.006	4.753	0.029	1.013	1.001	1.026	0.63

evaluated using the results of the ZBI, and analysis of variance revealed a statistically significant difference among the three groups (F = 4.901, $P = 0.009$). Pairwise comparisons revealed that Group C had significantly lower scores than did Group B ($P = 0.046$). Group B also had significantly lower scores than did Group A ($P = 0.017$). However, the difference between Group C and Group A was not statistically significant ($P =$

Table 4 Comparison of general data among the three groups of patients

Characteristic	(Group A)	(Group B)	(Group C)	F/× 2	P
n	45	77	38		
Mortality at 3 months,n(%)	6 (13.3)	13 (16.9)	3 (7.9)	1.74	0.42
Mortality at 6 months,n(%)	7(15.6)	20 (25.9)	4 (10.5)	3.66	0.16
Male sex (%)	22 (48.9)	38 (49.4)	14 (36.8)	1.78	0.41
Age(years)	75.09 ± 7.82	76.53 ± 8.20	75.11 ± 7.49	0.66	0.52
Education level(years)	7.38 ± 3.63	8.13 ± 3.70	8.16 ± 3.81	0.68	0.51
CCI score	10.29 ± 3.68	10.88 ± 4.40	10.94 ± 3.86	0.37	0.69
Hypertension,n(%)	20 (44.4)	38 (49.4)	11 (28.9)	4.36	0.11
Diabetes,n(%)	16 (35.6)	24 (31.2)	14 (36.8)	0.46	0.80
Renal dysfunction,n(%)	8 (25.0%)	10(24.4)	6(21.4)	1.16	0.76
APACHEII score	15.64 ± 3.52	13.66 ± 4.92*	14.97 ± 6.16	2.51	0.84
SOFA score	10.47 ± 4.39	11.26 ± 4.24	11.03 ± 3.70*	0.52	0.60
Hb(g/L)	82.42 ± 14.92	81.78 ± 15.41	83.71 ± 16.80	0.20	0.82
Albumin(g/L)	23.36 ± 4.72	24.00 ± 3.38	23.95 ± 3.55	0.43	0.65
Duration of mechanical ventilation(h)	156.64 ± 36.54	169.89 ± 76.54	161.86 ± 38.55	0.65	0.82
Widow,n(%)	12(37.5)	21(51.2)	12(42.9)	3.20	0.36
Number of children	3.02 ± 1.06	3.02 ± 1.03	3.05 ± 0.93	0.01	0.98
Nursing home,n(%)	18(56.3%)	15(36.6%)	8(28.6%)	6.47	0.09

(*:compare with group A, $P < 0.05$)

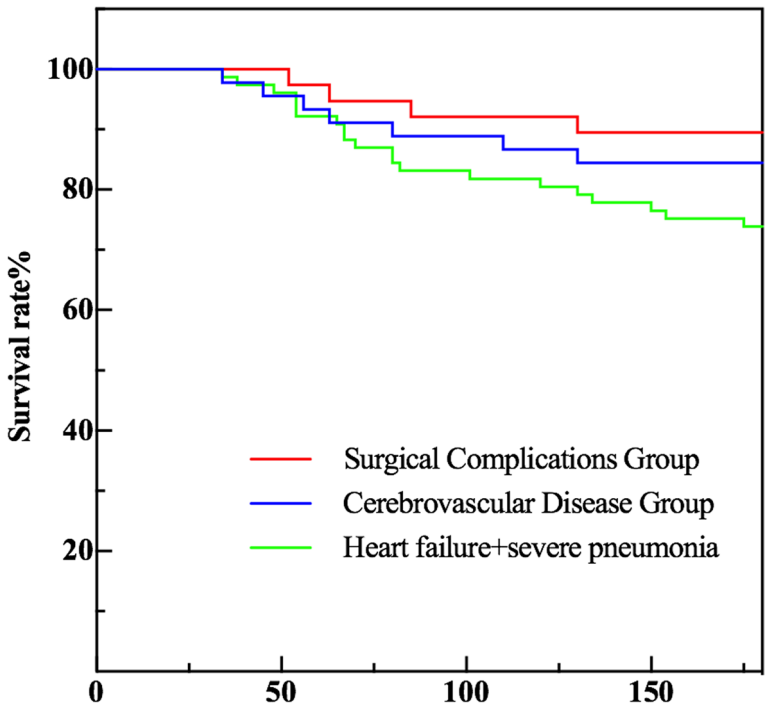

Fig. 3 Kaplan–Meier survival curve for cumulative survival rate of elderly tracheostomy patients with different causes

0.903). Due to the requirement of clear consciousness for completing the SF- 12 scale, patients in Group A were unable to complete the scale. Therefore, only scores from Groups B and C were analyzed, revealing no significant difference between the two groups ($P=$ 0.33). Please refer to Fig. 4 for more details.

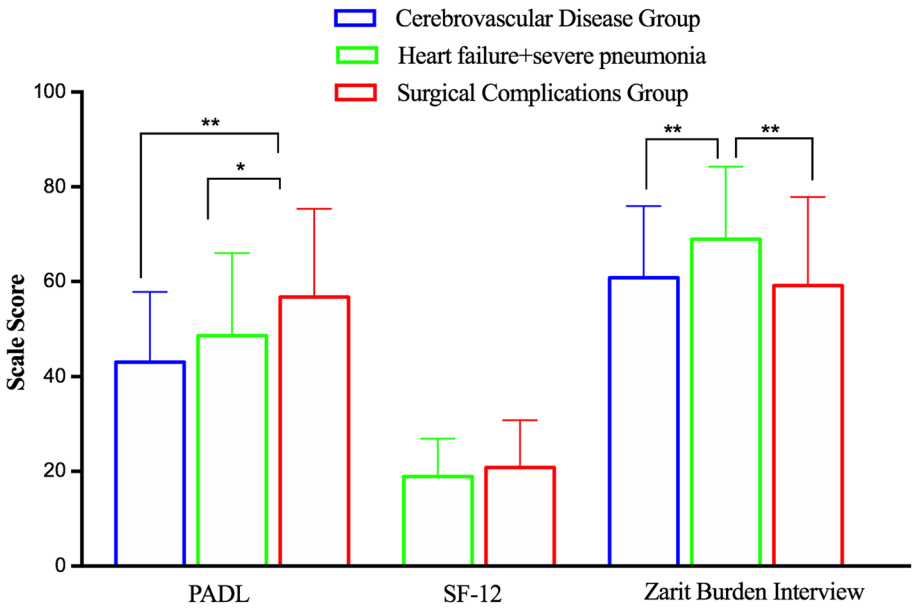

Fig. 4 PADL, SF- 12, Zarit Burden interview scores of elderly tracheostomy patients with different causes at six months of follow-up (**: $P < 0.01$, *: $P < 0.05$)

Discussion

The clinical data of 160 elderly critically ill patients in comprehensive ICUs, RICUs, and NICUs across two hospital districts were examined in this study over a 4-year period. The data revealed an increase in mortality rates following tracheostomy over time. Specifically, the mortality rate at three months was 13.8%, and that at six months was 19.4%, which was lower than rates reported in related literature. For instance, Cinotti et al.'s study indicated a 12-month mortality rate of 45.2% for patients who underwent tracheostomy and 51.5% for those who did not [14]. Additionally, Maria Vargas et al. observed that among critically ill patients who underwent elective tracheostomy in the ICU, the mortality rates were 15.8% at ICU discharge, 15.8% at 3 months, 33.5% at 6 months, and 55.9% at 12 months [15].

The decision to tracheotomize elderly patients, particularly those over 80 years old, is challenging for family members. While doctors emphasize that tracheotomy serves as a supportive measure for airway management and weaning, it is important to note that despite the procedure, mortality may still occur as a result of the underlying disease. Nevertheless, families often perceive tracheotomy as a means to significantly extend the patient's life. Hence, identifying risk factors is crucial for aiding doctors in their assessment and communication. Various studies have identified key predictors of mortality after tracheotomy, such as a SOFA score of 8 [15] and age of 70 years [16] on the day of the procedure. Additionally, some research has suggested that the SAPSII and APACHE II score are independent risk factors for mortality in tracheotomized ICU patients [17]. Notably, one study identified the PSI score, total vasoactive drug dosage, and frequency of medical consultations as independent risk factors for predicting mortality within 3 months after the procedure. At the 6-month follow-up, the total dose of vasoactive drugs and the PSI score were determined to be independent risk factors for mortality. While many studies have utilized the vasoactive drug score (VIS) to explore the relationship between vasoactive drugs and diseases, suggesting a positive correlation with mortality in critically ill patients [4, 18], we argue that the VIS is limited in its representation because it captures only a snapshot of vasoactive drug dosage. Therefore, our study is the first to use the cumulative dosage of vasoactive drugs administered throughout treatment as a predictive risk factor for elderly patients undergoing tracheostomy. Evaluating the prolonged state of severe microcirculatory shock remains challenging in clinical settings, as indicators such as lactic acid and blood pressure may not adequately reflect long-term disease severity due to fluctuations after treatment. While the APACHE II score and SOFA score can indicate disease severity, extremely high scores on the day of tracheotomy in elderly patients often signify a critical condition involving shock and multiple organ failure, leading clinicians to refrain from performing tracheotomy. Thus, the total dose of vasoactive drugs provides insight into vascular reactivity and disease severity over the entire treatment course, offering a more meaningful assessment of

prognosis accuracy and sensitivity. The frequency of medical consultations can indicate the caregiver's level of concern for the patient's physical well-being. Timely medical consultations have been shown to decrease the incidence of complications following tracheostomy in elderly patients. It is hypothesized that post-ICU discharge and effective communication between caregivers, patients, and medical staff may increase patient survival rates.

Some studies suggest that the quality of life of tracheostomy patients may be significantly compromised at 3–6 and 12 months following the procedure. This study focused on evaluating the quality of life of elderly critically ill patients who had undergone tracheostomy and were discharged from the ICU by examining three key dimensions: daily activity capabilities, quality of life, and caregiver burden levels. The daily activities of elderly critically ill patients after tracheostomy were assessed using the PADL score, while the SF- 12 scale was utilized to evaluate the patients'overall quality of life. Caregiver burden was evaluated using the ZBI result. The Bathel index, a commonly used standardized assessment method developed by Florence Mahoney and Dorothy Barthel, was employed for assessing PADL. This tool is widely recognized in the international rehabilitation medicine community for its simplicity, high reliability, and sensitivity, making it a valuable resource for assessing daily activity abilities in elderly and critically ill patients [19, 20]. The ZBI, developed by Zarit et al. in 1980 based on nursing burden measurement theory, consists of two dimensions: personal burden and responsibility burden. It comprises 22 items with a total score ranging from 0 to 88. Higher total scores indicate greater caregiver burden [21, 22]. The study data revealed that caregivers of patients in the severe pneumonia group with cardiac insufficiency exhibited significantly higher ZBI scores than did those in the cerebrovascular disease and postoperative complications groups. This statistically significant difference suggests that severe pneumonia and cardiac insufficiency have a greater impact on caregivers following tracheostomy. The reasons for this difference may be attributed to the following: 1. Patients in the severe pneumonia group with cardiac insufficiency often have poor cardiopulmonary function, leading to ICU-acquired weakness despite survival. Gastrointestinal congestion, reduced food intake, and slow nutritional improvement are common. Poor cardiopulmonary function also results in sleep disorders, making patients highly dependent on family members for comfort and care. 2. When patients with cerebrovascular disease are also bedridden, due to the severity of impaired consciousness in these patients, only basic nursing care is required, resulting in lower subjective dependence on caregivers compared to cardiopulmonary patients. 3. Most patients experiencing postoperative complications showed good recovery after controlling the original disease, with a faster return to autonomous ability than that in the other groups, as indicated by the lowest ZBI score. The SF- 12 scale, a simplified version of the SF- 36 scale, consists of 8 dimensions and 12 items, reducing respondent burden and being more appropriate for critically ill patients. Specifically designed for assessing the quality of life of elderly people, the SF- 12 scale covers body function, physiological functions, body pain, general health, status, vitality, social function, emotional function, and mental health. Higher scores indicate better quality of life [11, 23]. In this study, the cerebrovascular disease group could not be assessed using this scale, and the postoperative complications group had higher scores than did the cardiopulmonary dysfunction group, although the difference was not statistically significant, suggesting poor quality of life after tracheotomy. Despite its simplicity and ease of use, the scale lacked the detail and precision of the SF- 36 scale.

Limitations

This study is limited by being conducted at a single center, potentially limiting the generalizability of its findings to hospitals with different disease populations. Utilizing multicenter data could enhance the scientific validity of the results. Furthermore, accurately diagnosing the cause of death for patients who pass away outside medical facilities is challenging as is quantifying the quality of care provided by caregivers after ICU discharge. Additionally, increasing the sample size would strengthen the study's conclusions.

Conclusions

This study examined the risk factors for mortality in elderly critically ill patients who underwent tracheostomy and were discharged from the ICU, offering valuable insights for clinicians in terms of decision-making. This study assessed the daily activities, quality of life, and caregiver burden of these patients after ICU discharge, shedding light on their living conditions and the challenges faced by their families. Additional prospective multicenter studies are warranted to validate the scientific accuracy of these findings.

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Clinical trial number

Not applicable.

Authors' contributions
Jingjing Zhao and Yuan Zhan wrote the main manuscript text and Ting Chen, Gaoqiang Ling, Xiang Fang prepared figures. All authors reviewed the manuscript.

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Data availability
Due to the clinical nature, the data are available from the authors upon reasonable request.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with medical ethics standards and was approved by the hospital (Hefei Hospital Affiliated to Anhui Medical University) ethics committee; All research participants signed informed consent forms. In cases where participants were unable to delegate, their principals were contacted, and informed consent forms were signed by them. The ethical approval number is 2024-scientific research- 094.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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