BMJ Open

Effects of frailty on patients undergoing head and neck cancer surgery with flap reconstruction: a retrospective analysis

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To cite: Wang Y, Zheng Y, Wen Z, *et al*. Effects of frailty on patients undergoing head and neck cancer surgery with flap reconstruction: a retrospective analysis. *BMJ Open* 2022;**12**:e062047. doi:10.1136/bmjopen-2022-062047

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-062047).

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Received 25 February 2022
Accepted 22 November 2022

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ABSTRACT

Objectives To establish the implications of frailty as a predictor of outcome in patients with head and neck cancer requiring flap repair.

Design Retrospective cohort.

Data source We captured data from patients above 60 years old undergoing head and neck tumour resection and free flap reconstruction surgery between June 2019 and June 2020 at the Department of Oral and Maxillofacial Surgery, Sun Yat-sen Memorial Hospital, Sun Yat-sen University. The data contain all treatment information.

Outcome variables Surgery repeated in 30 days, postoperative complications, hospital length of stay, postoperative main biochemical standards.

Exposure variables Age, sex, smoking history, alcoholism history, American Society of Anesthesiologists score, National Nosocomial Infection Surveillance score and Clinical T staging were exposure variables. The frailty index is the main variable.

Result A total of 254 patients were included in this study. Among them, 124 patients were classified as frail, while 130 patients were classified as non-frail. We found that frail patients stayed in the hospital longer than non-frail patients after surgery (p=0.018). According to the data of 26 frail patients who directly entered the intensive care unit (ICU), we found that these patients had a lower leucocyte count (p=0.005).

Conclusions Frailty is a useful predictor of outcomes in patients undergoing head and neck cancer surgery with flap reconstruction. Frailty can be a clinical tool used to identify high-risk patients and guide perioperative care to optimise patient outcomes. Frail patients have better outcomes if they directly enter the ICU.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ We have retrospectively gathered perioperative period data from 254 subjects with research value about hospitalisation.
- ⇒ This is the first frailty study in head and neck cancer surgery with flap reconstruction, compared with most studies focusing on the age.
- ⇒ We developed and used a tool to predict the postoperative prognosis of such patients, and the calculation method of frailty index was simple and efficient.
- ⇒ Due to the insufficient number of patients, we did not include patients with higher frailty index for analysis.

INTRODUCTION

In recent years, the elderly population has been projected to increase in most countries. In addition, the tumour prevalence is increasing in this population. Individuals typically accumulate functional and physiological deficits as they age. All these factors lead to an increasing number of elderly patients undergoing surgical procedures, raising interest in better identifying patients who are more likely to have poor outcomes, independent of age. All these factors have direct or indirect impacts on the outcome of surgery but have not been confirmed as predictors of surgical outcome.[1] Fried *et al* suggested that frailty is highly prevalent with increasing age.[2] Frailty, a measure of physiological age, is more reliable at predicting life expectancy and adverse perioperative outcomes than chronological age. Frailty, which is defined as a decrease in physiological reserves, as well as multisystem impairments that are separate from the normal process of ageing, has been identified as a predictor of surgical complications.[3]

In head and neck cancer surgery departments, tumour resection has increasingly required flaps to reconstruct maxillofacial facial defects. These surgeries usually have features, such as longer surgery times, long bed stay after surgery and a high risk of postoperative complications.[4–6] Surgeons need an accurate but simpler method to evaluate patients' physical status and predict postoperative outcomes. There was a certain consensus on the perioperative treatment of head and neck tumour surgery, but it was only for several elements of perioperative care and cannot be used for specific populations such as the frail elderly.[7]

There were many methods to evaluate patients' preoperative frailty that are used in surgery departments internationally. Makary

Table 1 Tumour site and flap type of all patients

		Frailty index		
	Total	**0**	**1**	**P value**
Tumour localisation				0.394
Tongue	87	43	44	
Gums	44	25	19	
Jaw	34	17	17	
Buccal	35	18	17	
Oropharynx	14	8	6	
Floor of mouth	16	11	5	
Palate	18	8	10	
Lip	2	0	2	
Neck	2	0	2	
Skin	2	0	2	
Flap				0.796
Anterolateral thigh flap	113	56	57	
Fibula flap	63	36	27	
Posterior tibial flap	29	14	15	
Major myocutaneous flap	12	5	7	
Submental flap	13	6	7	
Forearm flap	13	8	5	
Trapezius muscle flap	6	3	3	
Free latissimus dorsi myocutaneous flap	3	2	1	
Local flap	2	0	2	
Tracheostomies				0.521
No	14	6	8	
Yes	240	124	116	

et al evaluated frailty based on an age-associated decline in five domains: shrinking, weakness, exhaustion, low physical activity and slowed walking speed.[8 9] Hanna *et al* evaluated frailty based on Vizient and assigned a code of ‘debility’ if the patient displayed any 1 of 31 functional disabilities based on the International Classification of Diseases diagnosis.[10]

However, a relatively simple method is still lacking in the head and neck cancer surgery department. We

Table 2 Different preoperative factors and surgery outcomes between frail patients and non-frail patients

		Frailty index		
	Total	**0**	**1**	**P value**
Sex				0.231
Male	167	90	77	
Female	87	40	47	
Age $(\bar{x} \pm s)$	68.97±6.64	67.77±5.87	70.23±7.17	0.003*
History of alcohol abuse				0.863
No	210	108	102	
Yes	44	22	22	
Smoking history				0.273
No	174	85	89	
Yes	80	45	35	
ASA score				0.333
1	19	11	8	
2	115	60	55	
3	111	57	54	
4	9	2	7	
NNIS score				0.157
0	6	2	4	
1	100	59	41	
2	144	68	76	
3	4	1	3	
Clinical T staging				0.703
1	10	4	6	
2	109	53	56	
3	29	20	19	
4	96	53	43	
Surgery repeated in 30 days				0.733
No	233 (91.7)	120 (92.3)	113 (91.1)	
Yes	21 (8.3)	10 (7.7)	11 (8.9)	
Postoperative complications				0.273
No	140 (55.1)	76 (58.5)	64 (51.6)	
Yes	114 (44.9)	54 (41.5)	60 (48.4)	
Number of postoperative complications				0.312
0	140 (55.1)	76 (58.5)	64 (51.6)	
1	92 (36.2)	43 (33.1)	49 (39.5)	
2	17 (6.7)	9 (6.9)	8 (6.5)	
3	5 (2.0)	2 (1.5)	3 (2.4)	
Number of tubes				0.903
0	96 (37.8)	48 (36.9)	48 (38.7)	
1	132 (52.0)	71 (54.6)	61 (49.2)	
2	24 (9.4)	11 (8.5)	13 (10.5)	
35	2 (0.8)	0 (0.0)	2 (1.6)	
Hospital length of stay (M (P_{25}, P_{75}))	11 (9, 13)	10 (9, 13)	12 (9, 14)	0.067
Hospital length of stay (M (P_{25}, P_{75}))				0.018*
Shorter than 11 days	142 (56.3)	82 (63.6)	60 (48.8)	
Longer than 11 days	110 (43.7)	47 (36.4)	63 (51.2)	

Continued

Table 2 Continued

		Frailty index		
	Total	**0**	**1**	**P value**
White cell count $(\bar{x} \pm s)$	12.74±4.15	12.35±3.56	13.18±4.67	0.112
Haemoglobin level $(\bar{x} \pm s)$	106.45±15.13	106.23±14.16	106.68+16.15	0.815
Potassium level $(\bar{x} \pm s)$	3.62±0.43	3.66±0.42	3.59±0.44	0.243
Albumin level $(\bar{x} \pm s)$	27.59±5.00	27.05±4.44	28.15±5.45	0.083

*represents statictical significance (p<0.05)
ASA, American Society of Anesthesiologists; NNIS, National Nosocomial Infection Surveillance.

Table 3 Multivariate regression analysis of frailty index in each surgical outcome

	OR/β	95% CI	P value
Surgery repeated in 30 days	1.360	0.252 to 3.525	0.527
Postoperative complications	1.305	0.762 to 2.238	0.332
Number of postoperative complications			
1	0.721	0.404 to 1.258	0.267
2	1.063	0.377 to 2.997	0.909
3	0.565	0.051 to 6.277	0.642
Number of tubes			
1	1.045	0.599 to 1.825	0.876
2	0.904	0.342 to 2.386	0.838
3	–	–	0.909
Hospital length of stay (M (P_{25}, P_{75}))	1.852	1.082 to 3.170	0.025*
White cell count ($\bar{x} \pm s$)	1.312	0.294 to 2.330	0.012*
Haemoglobin level ($\bar{x} \pm s$)	1.679	−2.012 to 5.369	0.896
Potassium level ($\bar{x} \pm s$)	−0.048	−0.156 to 0.060	0.384
Albumin level ($\bar{x} \pm s$)	1.218	0.032 to 2.404	0.044*

*represents statictical significance (p<0.05)

selected the new five-factor modified frailty index, which includes diabetes mellitus, congestive heart failure, chronic obstructive pulmonary disease or current pneumonia, hypertension requiring medication and non-independent functional status. The new five-factor modified frailty index has been used in geriatric hip fractures but not in head and neck cancer surgery.[11]

PATIENTS AND METHODS

This work enrolled 254 patients who underwent maxillofacial tumour resection and free flap reconstruction surgery between June 2019 and June 2020 at the Department of Oral and Maxillofacial Surgery, Sun Yat-sen Memorial Hospital, Sun Yat-sen University.

The inclusion criteria of this study were as follows: (1) patients were 60 years or older; (2) patients had no

Table 4 Different surgery outcomes between direct to ICU group and non-direct to ICU group in frail group

		Direct to ICU after surgery		
	Total	**No**	**Yes**	**P value**
Sex				0.698
Male	47	38	9	
Female	77	60	17	
Age ($\bar{x} \pm s$)	70.23-±7.16	68.44±5.863	76.96±7.17	<0.001*
History of alcohol abuse				0.867
No	89	70	19	
Yes	35	28	7	
Smoking history				0.352
No	102	79	23	
Yes	22	19	3	
ASA score				0.209
1	8	7	1	
2	55	47	8	
3	54	40	14	
4	7	4	3	
NNIS score				0.380
0	4	4	0	
1	41	35	6	
2	76	57	19	
3	3	2	1	
Clinical T staging				0.202
1	6	3	3	
2	56	43	13	
3	19	17	2	
4	43	35	8	
Surgery repeated in 30 days				0.311
No	113	88	25	
Yes	11	10	1	
Postoperative complications				0.131
No	64	54	10	
Yes	60	44	16	
Number of postoperative complications				0.090
0	64	54	10	
1	48	35	13	
2	9	8	1	
3	3	1	2	
Number of tubes				0.030*
0	48	40	8	
1	61	49	12	
2	13	9	4	
3	2	0	2	
Hospital length of stay (M (P_{25}, P_{75}))	12 (9, 14)	11 (8.5, 13)	13 (11, 15.5)	0.006*
Hospital length of stay (M (P_{25}, P_{75}))				0.059
Shorter than 12 days	68	58	10	

Continued

Table 4 Continued

		Direct to ICU after surgery		
	Total	**No**	**Yes**	**P value**
Longer than 12 days	56	40	16	
White cell count ($\bar{x} \pm s$)	13.18±4.67	13.77±4.57	10.92±4.44	0.005*
Haemoglobin level ($\bar{x} \pm s$)	106.68±16.15	109.28±14.62	96.88±18.11	0.003*
Potassium level ($\bar{x} \pm s$)	3.59±0.44	3.60±0.44	3.55±0.46	0.597
Albumin level ($\bar{x} \pm s$)	28.15±5.45	28.60±5.54	26.43±4.84	0.056

*represents statictical significance (p<0.05)
ASA, American Society of Anesthesiologists; ICU, intensive care unit; NNIS, National Nosocomial Infection Surveillance.

Table 5 Multivariate regression analysis of direct to ICU group in each surgical outcome

	OR/β	95% CI	P value
Surgery repeated in 30 days	0.250	0.018 to 3.532	0.305
Postoperative complications	1.834	0.547 to 6.144	0.326
Number of postoperative complications			
1	0.591	0.163 to 2.140	0.424
2	1.225	0.088 to 17.142	0.880
3	0.031	0 to 2.066	0.105
Number of tubes			
1	0.609	0.175 to 2.120	0.436
2	0.305	0.042 to 2.228	0.242
3	–	–	0.970
Hospital length of stay (M (P25, P75))	1.146	0.381 to 3.444	0.809
White cell count ($\bar{x} \pm s$)	−2.301	−4.598 to −0.004	0.050*
Haemoglobin level ($\bar{x} \pm s$)	−10.561	−18.218 to −2.904	0.007*
Potassium level ($\bar{x} \pm s$)	0.025	−0.200 to 0.0234	0.875
Albumin level ($\bar{x} \pm s$)	−0.745	−3.366 to −1.877	0.575

*represents statictical significance (p<0.05)
ICU, intensive care unit.

synchronous malignancies; (3) head and neck tumour resection under general anaesthesia with endotracheal intubation; (4) flap reconstruction was performed in the surgery.

We recorded every patient's new five-factor index. One point was assigned to each of the five comorbid variables, including diabetes mellitus, congestive heart failure, chronic obstructive pulmonary disease or current pneumonia, hypertension requiring medication and non-independent functional status. Non-independent functional status was defined within the National Surgical Quality Improvement Program as requiring assistance for any activities of daily living, including bathing, feeding, dressing and mobility.

For each item, the patients were scored as either a 0 (not meeting the frailty criteria) or a 1 (meeting the frailty criteria). The scores for the five tasks were summed, and patients with a score of 0 were classified as non-frail, while patients with a score above 1 were classified as frail. After surgery, we recorded the patients' information, such as postoperative complications, length of hospital stay and maintenance of the gastric tube when they left the hospital. Postoperative complications were defined as having a postoperative recorded case of septic shock, sepsis, deep vein thrombosis/thrombophlebitis occurrence, myocardial infarction, cardiac arrest, stroke/cerebrovascular accident complication, urinary tract infection, acute renal failure, on a ventilator for over 48 hours, pulmonary embolism, unplanned intubation, pneumonia, wound disruption, organ site/surgical site infection (SSI), deep incisional SSI or superficial SSI. The number of tubes that indicates the number of patients who maintained a stomach tube, a metal trachea cannula or peripherally inserted central catheters when they left the hospital were also recorded. Moreover, some inspection indicators were also statistically analysed in this study.

The statistical analyses were performed using SPSS V.20 (IBM). Comparisons were made by using a t-test for numerical data and the X^2 test for non-numerical data. For all postoperative outcomes, we used logistic regression for categorical variables and linear regression for continuous variables to assess the risk of each factor. A p value of <0.05 was considered to indicate statistical significance.

Patient and public involvement

Patients or the public were not involved in the design, or conduct, or reporting or dissemination plans of our research.

RESULTS

A total of 224 patients were included in this study. A total of 130 patients with a score of 0 were classified as non-frail, while 124 patients with a score above 1 were classified as frail. All surgeries were performed by or under the supervision of a chief surgeon and other surgeons within the team. Patients in both groups were not significantly different in both tumour site and flap type (table 1).

The study data are summarised in table 2. We found a significant difference in age between the frail group and the non-frail group in terms of preoperative factors. But in the factors of gender, smoking history, alcoholism history, American Society of Anesthesiologists score, National Nosocomial Infection Surveillance score and Clinical T staging, there was no statistical difference between the two groups. There were no significant differences between the non-frail group and the frail group in terms of surgery repeated in 30 days (p=0.733), postoperative complications (p=0.273), number of postoperative complications (p=0.312) or number of tubes (p=0.903).

There was a significant difference (p=0.018) between the two groups in hospital length of stay. The hospital length of stay was calculated after surgery. No significant differences were found between the two groups in the postoperative levels of white cell count, haemoglobin, potassium or albumin.

For the categorical variables of postoperative outcomes including surgery repeated in 30 days, postoperative complications, number of postoperative complications, number of tubes and hospital length of stay, we established logistic regression models to analyse various preoperative factors. For continuous variables of postoperative outcomes such as white cell count, haemoglobin level, potassium level and albumin level, we established linear regression models to analyse various preoperative factors. For each postoperative outcome model, we recorded the frailty index data for each model in table 3. In the model of hospital length of stay, OR of longer hospital stay was 1.85 between the frail group and non-frail group (95% CI 1.082 to 3.170; p<0.05). In the linear regression model, the frailty index is positively correlated with white cell count ($p<0.05$) and albumin level ($p<0.05$).

A total of 124 patients who scored above 1 and were considered frail were included in this study. We found that 26 patients were directed to the intensive care unit (ICU) after surgery. The study data are summarised in table 4. There were no significant differences between the direct to ICU group and the non-direct to ICU group in terms of surgery repeated in 30 days (p=0.311), postoperative complications (p=0.131) and number of postoperative complications (p=0.090). There was a significant difference between the two groups in hospital length of stay (p=0.006) and number of tubes (p=0.03). The hospital length of stay was calculated after surgery. No significant differences were found between the two groups in postoperative potassium (p=0.597) or albumin (p=0.056) levels. White cell count was significantly (p=0.005) higher in the non-direct to ICU group than in the direct to ICU group. Haemoglobin level was significantly (p=0.003) higher in the non-direct to ICU group than in the direct to ICU group.

In the multivariate logistic analysis and linear regression analysis, data of all postoperative outcomes are in table 5. In linear regression analysis, the direct to ICU group is negatively correlated with white cell count ($p<0.05$) and albumin level ($p<0.05$).

DISCUSSION

With the development of the economy, the ageing of the global population is increasing; and thus, there is a rising number of elderly people. The proportion of elderly people suffering from diabetes, hypertension and coronary heart disease is also increasing.[12] Previous studies have increasingly focused on the frailty of elderly individuals.[13] Especially in hospitalised patients, many scholars summarised the preoperative weakness of elderly patients through effective research to evaluate the prognosis of patients undergoing surgery.[3 9 11 14] With the increase in the elderly population, the proportion of elderly patients with head and neck tumours is gradually increasing.[15] The treatment of head and neck tumours mainly includes surgery, chemotherapy and radiotherapy, with surgery being the first choice.[16] Head and neck tumour surgery is mainly divided into surgical resection and flap repair, which have the characteristics of long operation times and a large amount of blood loss, so preoperative evaluation is particularly important.[17] It is difficult to identify high-risk patients only by age, and some studies have shown that some chronic diseases also influence the outcome of surgery.[18]

Previous studies have shown that there are many methods for the application of frailty in surgery, but it is cumbersome to evaluate the preoperative frailty of patients through grip strength, walking speed, and question and answer methods, which are also affected by the state of the patients at that time.[8 9] In this study, the new five-factor index was used to evaluate patient frailty mainly by analysing patients' preoperative systemic diseases and independent state. This method is simple, intuitive and stable, and is more convenient for evaluating the patients' preoperative frailty state.

We enrolled 254 patients who had undergone head and neck tumour surgery and evaluated them with the frailty index. A total of 124 patients were defined as being frail, and 130 patients were defined as being non-frail. The postoperative complications, reoperation rate within 30 days and the number of discharged tubes in the two groups were similar, but the postoperative discharge time in the frail group was significantly longer than that in the non-frail group. This finding proves that frail patients can tolerate head and neck cancer surgery with flap reconstruction. In terms of surgery prognosis, the number of postoperative complications was not significantly higher in the frail group than in the non-frail group, but the postoperative recovery time of frail patients was longer. This finding reminds surgeons to be more patient with the postoperative recovery of frail patients and to pay more attention to postoperative indicators.

In the data of the frail group, the postoperative complications, 30-day reoperation rate and number of discharged tubes between the direct to ICU group and the non-direct to ICU group were also relatively close. The postoperative discharge time was different in the preliminary statistical results, but after controlling for other variables, such as age, sex, smoking and drinking history, the postoperative discharge times of the two groups were similar. This finding proved that age, sex, and smoking and drinking history of the patients influenced the time of discharge. However, the white cell count of the direct to ICU group was relatively low, which may be related to the more appropriate application of antibiotics in the ICU. This reminds surgeons that they can send frail patients to the ICU or ask experienced ICU doctors for guidance.

CONCLUSION

In conclusion, frailty was a risk factor for the surgical treatment of head and neck cancer, including tumour ablation and simultaneous flap reconstruction, in elderly patients. The frailty index is a tool to predict the outcome of head and neck cancer surgery. The frail group had a longer hospital stay than the non-frail group. In comparing the direct to ICU group and the non-direct to ICU group, although the two groups had similar outcomes after surgery, elderly patients in the direct to ICU group had a better recovery.

Contributors Conception and design—YanW and ZH. Collection and assembly of data—YuepengW and YZheng. Data analysis and interpretation—ZW and YZhou. Manuscript writing—all authors. Final approval of manuscript—all authors. YanW is responsible for the overall content as the guarantor.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This study involves human participants and was approved by the Ethics Committee of Sun Yat-sen Memorial Hospital of Sun Yat-sen University (SYSEC-KY-KS-2021-173). Informed consent was waived because of the retrospective nature of the study.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Retrospective mining of clinical data is approved by our institutions, but sharing these datasets needs further legal and ethical approval that will delay or prohibit the sharing process. Data transfer agreement to a third party is possible upon reasonable request to the corresponding author, and upon the approval of our institutions and the third-party institution.

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