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Adult Comorbidity Evaluation-27 as a predictor of postoperative complications, two-year mortality, duration of hospital stay, and readmission within 30 days in patients with squamous cell carcinoma of the head and neck

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Abstract

The Adult Comorbidity Evaluation (ACE)-27 is a validated scoring system for comorbid conditions. We have evaluated the correlation between it and the duration of hospital stay, readmission within 30 days, complications, and two-year survival in patients having primary surgical treatment for squamous cell carcinoma (SCC) of the head and neck. We studied patients with SCC who had selective neck dissection, resection of the tumour, and reconstruction between 2007 and 2013. Patients who had palliative procedures were excluded. We studied the casenotes of 231 patients and recorded the following outcome measures: TNM staging, ACE-27 score, number of days spent in hospital, readmission within 30 days, complications, and mortality at two years.The relation between the ACE-27 score and duration of hospital stay was significant ($p = 0.000001$). The relations between complications and ACE-27 score, and complications and tumour stage, were also significant ($p < 0.002$, and $p < 0.008$, respectively). Two year mortality is significantly related to stage of tumour and ACE-27 score ($p = 0.001$ and $p = 0.000246$ respectively). We conclude that ACE-27 is a validated, relevant, scoring system for patients being operated on for SCC of the head and neck. It is a better prognostic indicator of two-year mortality than TNM stage, and is a good reflection of complications. We therefore suggest that it is used when discussing surgical outcomes, taking consent from newly-diagnosed patients, and when calculating the costs of head and neck oncological surgery.

Keywords: ACE-27 score; preoperative assessment; oral squamous cell carcinoma

Introduction

The TNM staging system has long been used as the most reliable predictor of survival from cancer; however, it takes no account of the presence of unrelated comorbid conditions, which may have an important impact on both patients' recovery from treatment and their long term survival. We aimed to find out whether a scoring system based on the presence of comorbid conditions may be a more accurate way of predicting disease-free survival.

Many measures of adult comorbid conditions are used to aid the management of patients with cancers of the head and neck. Those used in multidisciplinary teams in head and neck surgery in the UK include the ECOG/WHO/Zubrod scale,

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the ASA (American Society of Anesthesiologists) grade, the Karnofsky scale, and ACE-27. The ability to predict which patients may have major complications after operations for head and neck cancer enables more appropriate planning of treatment and informed consent, and may assist future planning of socioeconomic healthcare.

In 1974 Kaplan and Feinstein[1] devised a scoring system to assess comorbidity in patients with diabetes mellitus. This was modified by Piccirillo et al for use specifically in adult patients with cancer.[2] The resulting ACE-27 index consists of 12 categories that are related to organ systems, and 27 subcategories, each of which quantify a specific disease, or disease within that organ system. The severity of each condition is indexed, and the overall score (0 = none, 1 = mild, 2 = moderate, and 3 = severe) is based on the coexisting condition that scores worst. More than two grade 2 scores results in an overall score of 3.

In 2004 Piccirillo et al[3] published an analysis of 17 712 patients with various cancers (new cancers of prostate, respiratory tract, gastrointestinal tract, genitourinary system, breast, gynaecological, and head and neck). Cancers of the head and neck made up 6% of the group studied. The authors trained medical registrars to use the system and then analysed the data. Their results showed that an increased ACE-27 score correlated with a reduction in two-year survival.

Ankola et al[4] made a similar analysis of 288 patients between 2002 and 2011 and found that patients with a HPV-DNA-associated oropharyngeal cancer and a lower ACE-27 score had better overall survival than patients without HPV-DNA.[4] However, they did not find a significant difference in survival in patients with a higher ACE-27 score in the same groups.

Datema et al in 2010 used the Lee Cardiac Risk Index and ACE-27 as retrospective predictors of cardiovascular complications in operations on the head and neck in 135 patients.[5] They commented on the ability of these scoring systems to predict the incidence of major cardiovascular complications (in patients over the age of 70), and the health and socioeconomic implications of being able to plan for such events. They also had an unexpected finding in that the two scoring systems had comparable predictive performances.

Another paper validated the use of ACE-27 and compared it with the ASA grading as a predictor of major complications.[6] Ferrier et al, in a retrospective univariate analysis of 117 patients, predicted that the site of the cancer, the need for adjuvant treatment, and a low haemoglobin concentration were associated with mortality at six months. They also found that a prolonged anaesthetic (over eight hours), low haemoglobin concentration preoperatively, low ASA grade, and low ACE-27 score were good predictors of postoperative complications.

In the present study we have compared TNM stage with ACE-27 score as predictors for; duration of hospital stay, readmission within 30 days, complications, and two year survival in patients with squamous cell cancer (SCC) of the head and neck.

Methods

We studied patients who had been diagnosed with histologically-confirmed SCC and who had been treated with selective neck dissection and resection and reconstruction of the tumour between 2007 and 2013. Patients who had palliative procedures were excluded. All patients were treated at the same hospital by the same operating team, with the same protocols for the use of antibiotics, steroids, and prophylaxis of venous thromboembolism.

We extracted the following information from patients' casenotes: TNM staging; ACE-27 score; duration of hospital stay; readmission within 30 days; complications; and mortality at two years.

Readmission was recorded simply as readmitted within 30 days or not. Complications were recorded and scored using the Clavien-Dindo grading system.[7] As this was a retrospective study we were limited by the quality of the record keeping, so only complications with a Clavien-Dindo grade of III and above were recorded.

Statistical analysis

Data were analysed using IBM SPSS (version 22.0.0.1, IBM Corp) and Apple Numbers (version 5.3) statistics program. The significance of differences in duration of stay were analysed with Pearson's correlation coefficient and linear regression; those in two-year mortality with the log rank test; and those in 30-day readmission and complications with the chi squared test. Probabilities of 0.05 or less were accepted as significant.

Results

A total of 252 patients were identified; of these 21 had palliative procedures and were therefore excluded, leaving 231 for the study. Table 1 shows the patients' clinical and personal details.

Table 1
Patients' details. Data are number (%) except where otherwise stated.

	No. of patients (n = 231)	Male (n = 145)	Female (n = 86)	Mean (SD) age (years)
ACE-27 score:				
0	41 (17)	23	18	53.8 (15.2)
1	50 (22)	33	17	64.9 (8.05)
2	99 (43)	58	41	63.19 (11.87)
3	41 (17)	31	10	63.14 (10.39)
TNM stage:				
1	27 (12)	15	12	59.59 (11.39)
2	55 (24)	27	28	60.05 (12.02)
3	42 (18)	26	16	61.33 (11.96)
4	107 (46)	77	30	63.70 (12.31)

Mean (SD) age of total men = 62.4 (11.05) and women = 61.1 (13.8).

Table 2
Correlation between ACE-27 score and disease stage, and duration of hospital stay. Data are number (%) except where otherwise stated.

	No. of patients	Mean (SD) duration of hospital stay (days)
ACE-27 score:		
0	41 (17)	11.92 (3.97)
1	50 (22)	15 (9.32)
2	99 (43)	19.4 (9.18)
3	41(17)	33.19 (26.24)
TNM stage:		
1	27 (12)	16.3 (7.32)
2	79 (34)	17.3 (10.29)
3	19 (8)	24.6 (25.0)
4	106 (46)	21.3 (13.0)

Duration of stay

Table 2 shows the association between ACE-27 score and stage of disease, and ACE-27 score and duration of hospital stay.

Readmission within 30 days

Nineteen patients were readmitted within 30 days, giving a readmission rate of 8%. When they were grouped according to ACE-27 scores, three of the 19 had an ACE-27 score of 0 (7% readmission rate); three had an ACE-27 score of 1 (6% readmission rate); eight had an ACE-27 score of 2 (8%); and five had an ACE-27 score of 3 (13%). These results did not differ significantly.

Complications

We were unable to obtain complete records for 14 patients, and so the notes for 217 were examined for specific information about admission to ICU, readmission, discharge, and diagnoses. Five patients died in hospital, and complications were recorded in 78, giving an overall complication rate of 38%. Fig. 1 shows the relation between complications and ACE-27 score, and Fig. 2 shows that between complications and stage of tumour.

Table 3 shows complications according to the ACE-27 score. There were 14 different complications (Clavien-Dindo grading 3 and above) recorded, with wound complications and pneumonia being the most prevalent.

Two-year mortality

According to the staging of the tumours, two-year mortality was as follows: stage 1 = 22%, stage 2 = 14%, stage 3 = 12.5%, and stage 4 = 54%. Fig. 3 is a Kaplan–Meier curve that shows the relation between stage of tumour and mortality over time.

With regards to the relation between ACE-27 score and two year mortality; patients with a score of 0 had a 17% 2 year mortality rate, a 23% mortality rate with a score of 1, a 25% mortality rate with a score of 2, and a 65% mortality rate with an ACE-27 score of 3 (Fig. 4).

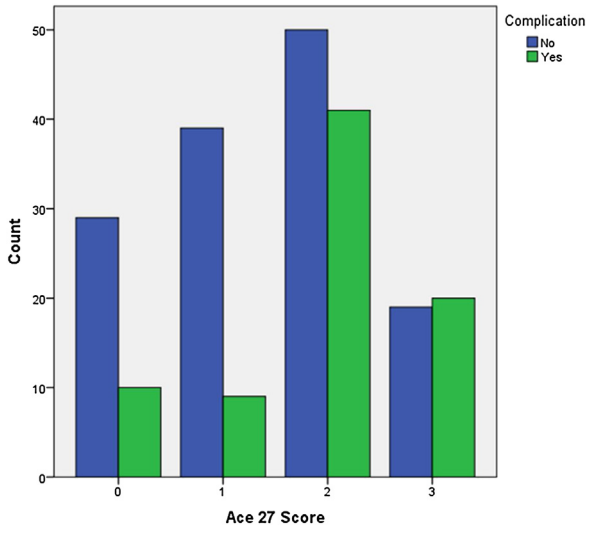

Fig. 1. Relation between complications and ACE-27 score.

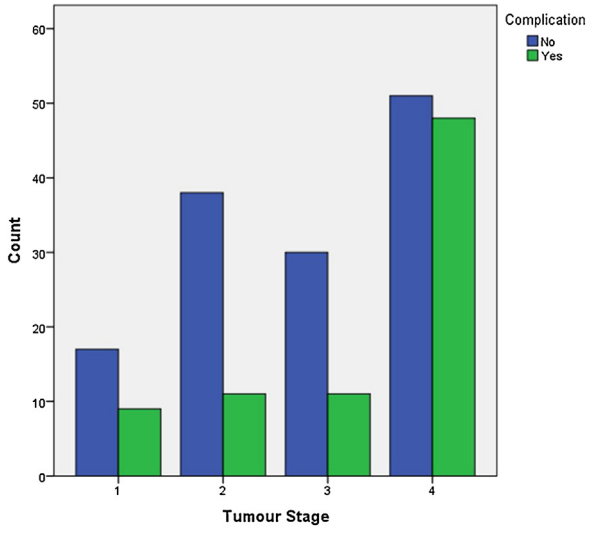

Fig. 2. Relation between complications and stage of tumour.

Duration of stay

The relation between ACE-27 score and duration of hospital stay was significant (p = 0.000001), but that between stage of disease and duration of stay was not (p = 0.678). A linear regression analysis that compared ACE-27 score with duration of stay gave $R^2 = 0.1767$ (p = 0.0273) with stage of tumour, and R2 = 0.0193 (p = 0.01) with duration of stay.

Readmission within 30 days

These differences were not significant.

Table 3
Complications according to ACE-27 score. Data are number of patients except where otherwise stated.

Complication	ACE- 27 score			
	0 (n = 39)	1 (n = 48)	2 (n = 91)	3 (n = 39)
Wound infection/dehiscence	4	3	15	9
Delerium	0	0	1	3
Pneumonia	1	2	13	7
Stroke	0	0	0	3
Failed microvascular flap	1	0	4	4
Heart failure	0	0	3	4
Postoperative bleed	0	1	2	2
Ileus	0	1	0	1
Myocardial infarction	0	1	3	2
Pulmonary embolus	0	0	0	1
Diarrhoea	1	0	0	0
Seroma	2	0	2	0
Deep vein thrombosis	0	1	2	0
Death	0	0	2	3
Complication rate (%)	24	18	43	46

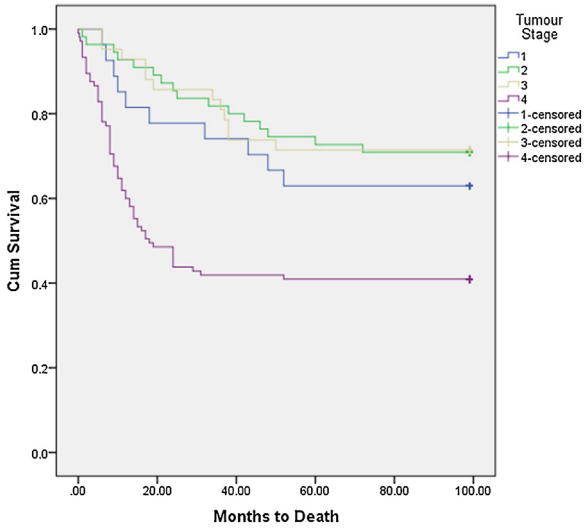

Fig. 3. Relation between stage of tumour and mortality over time.

Complications

The relations between complications and ACE-27 score, and between complications and stage of tumour, were significant (complications and ACE-27 score = chi squared 14.984, p = < 0.002) and ACE-27 score and stage of tumour = chi squared 11.964, p < 0.008, respectively).

Mortality within two years

The associations between mortality within two years and stage of tumour, and mortality within two years and ACE-27 score, were significant p = 0.000246 and P = 0.001 respectively.

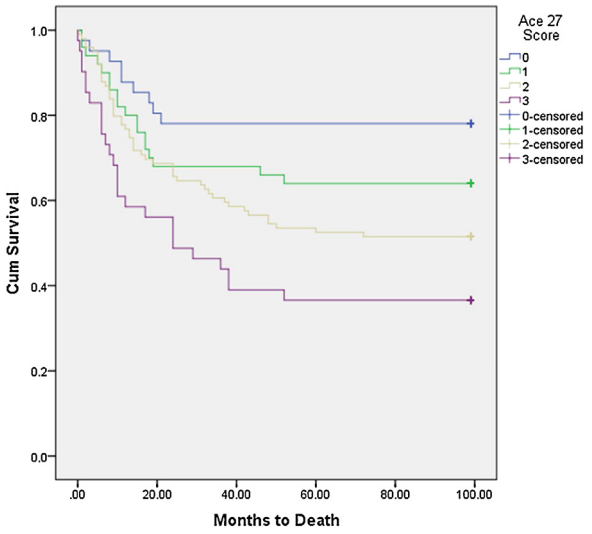

Fig. 4. Relation between ACE-27 score and mortality over time.

Discussion

Operations for SCC of the head and neck are complex, and carry appreciable risks of morbidity and mortality. Most patients (60%) had an ACE-27 score of 2 or 3, and we think that this is an accurate reflection of the coexisting morbidity that affects this group of patients. This figure is in contrast with that reported by Ferrier et al in whose study group 71% had an ACE 27 score of 0 or 1.[6]

Our results show that there is a significant association between ACE-27 score and duration of stay in hospital. We found an overall readmission rate of 8%, which is similar to the national figure of 7.0%.[8] With the current cuts in spending on health, and the economic climate, as well as the continued pressure on beds, there is considerable influence being brought to bear to reduce the duration of stays in hospital. The approximate cost of a bed in a ward/day and an ITU bed/day are £400 and £2000, respectively. Financial costs of the stay in the ward alone will not take into account allocation of manpower to care for sicker patients, increasing numbers of investigations, and allocation of resources. We conclude that the current allocations for patients with head and neck cancer may well need to be overhauled and made more appropriate for those patients at higher risk based on higher ACE-27 scores (for example, 2 or 3). The evidence from this paper shows a likelihood of development of complications that will require additional investigations, and potentially higher levels of care, longer hospital stays, and higher readmission rates.

The type and number of complications in our group are comparable with those described by McMahon at al,[9] with wound complications and pneumonia being the most common. We found that a higher ACE-27 score indicated a significantly higher risk of complications and increased postoperative mortality, and we think that this can be useful both when deciding what course of treatment to offer

to a patient, but also when discussing treatment options with patients so that they are able to make informed decisions.

Although the legal standpoint on informed consent has changed recently, we question whether predictions of mortality from longitudinal data should be used during the process of requesting consent. On the one hand it allows for the best available evidence to arm the clinician with the statistical data so that the patient can make an informed decision but, on the other hand, it can also deter the patient from having any treatment at all. Recent legal cases such as Montgomery v Lanarkshire Health Board have highlighted that important risks with high morbidity and mortality should be mentioned to the patient when asking for consent, no matter how low the risk, as against the previous standpoints of Bolithero and Bolam. Are we moving to a position where we should be using robust long-term survival data and scoring systems to give patients risks of death?

Conclusion

Comorbidity has a considerable impact on the outcome of operations for cancer of the head and neck. ACE-27 is a straightforward score by which to categorise these conditions, and is a more accurate method of predicting outcomes of such resections than the TNM system. We hope that the ACE-27 system can be incorporated into the preassessment of patients with SCC, and improve our ability to predict their outcomes.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patients' permission

No ethics approval or patients' permission required.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.bjoms.2019.01.004.

References

1. Kaplan MH, Feinstein AR. The importance of classifying initial comorbidity in evaluating the outcome of diabetes mellitus. *J Chronic Dis* 1974;**27**:387–404.
2. Piccirillo JF, Tierney RM, Costas I, et al. Prognostic importance of comorbidity in a hospital-based cancer registry. *JAMA* 2004;**291**:2441–7.
3. Piccirillo JF, Costas I, Claybour P, et al. The measurement of comorbidity by cancer registries. *J Registry Manag* 2003;**30**:8–14.
4. Ankola AA, Smith RV, Burk RD, et al. Comorbidity, human papillomavirus infection and head and neck cancer survival in an ethnically diverse population. *Oral Oncol* 2013;**49**:911–7.
5. Datema FR, Poldermans D, Baatenburg de Jong RJ. Incidence and prediction of major cardiovascular complications in head and neck surgery. *Head Neck* 2010;**32**:1485–93.
6. Ferrier MB, Spuesens EB, Le Cessie S, et al. Comorbidity as a major risk factor for mortality and complications in head and neck surgery. *Arch Otolaryngol Head Neck Surg* 2005;**131**:27–32.
7. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004;**240**:205–13.
8. Blunt I, Bardsley M, Grove A, et al. Classifying emergency 30-day readmissions in England using routine hospital data 2004-2010: what is the scope for reduction? *Emerg Med J* 2015;**32**:44–50.
9. McMahon JD, MacIver C, Smith M, et al. Postoperative complications after major head and neck surgery with free flap repair — prevalence, patterns, and determinants: a prospective cohort study. *Br J Oral Maxillofac Surg* 2013;**51**:689–95.