



Above and Beyond Age: Prediction of major postoperative adverse events in head and neck surgery



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Introduction

- Despite demographic changes in incidence of head and neck cancer (HNC), most patients diagnosed with malignancy remain seniors.
- Major postoperative adverse events (MPAE) following head and neck surgery are not infrequent and lead to significant morbidity.
- Increasing evidence suggests that frailty, defined as a status of decreased physiologic reserve, is a significant biomarker for survival and postoperative adverse events in oncology patients.
- Models with multiple predictor variables can refine cumulative risk but seldom are pragmatic as they add time to collect and are often more challenging to implement in the clinical setting.

Objectives

The objective of this study was to ascertain which factors are most predictive of major postoperative adverse events (MPAE) in patients undergoing head and neck surgery.

Methods

- A cohort study was carried out based on data from patients registered in the National Surgical Quality Improvement Program (NSQIP) from 2006 to 2018
- All patients undergoing non-ambulatory head and neck surgery based on Current Procedural Terminology codes were included
- Perioperative factors were evaluated to predict MPAEs within 30-days of surgery. Age was classified as both a continuous and categorical variable.
- Retained factors were classified by attributable fraction and C-statistic. Multivariate regression and supervised machine learning models were compared with age to predict MPAEs

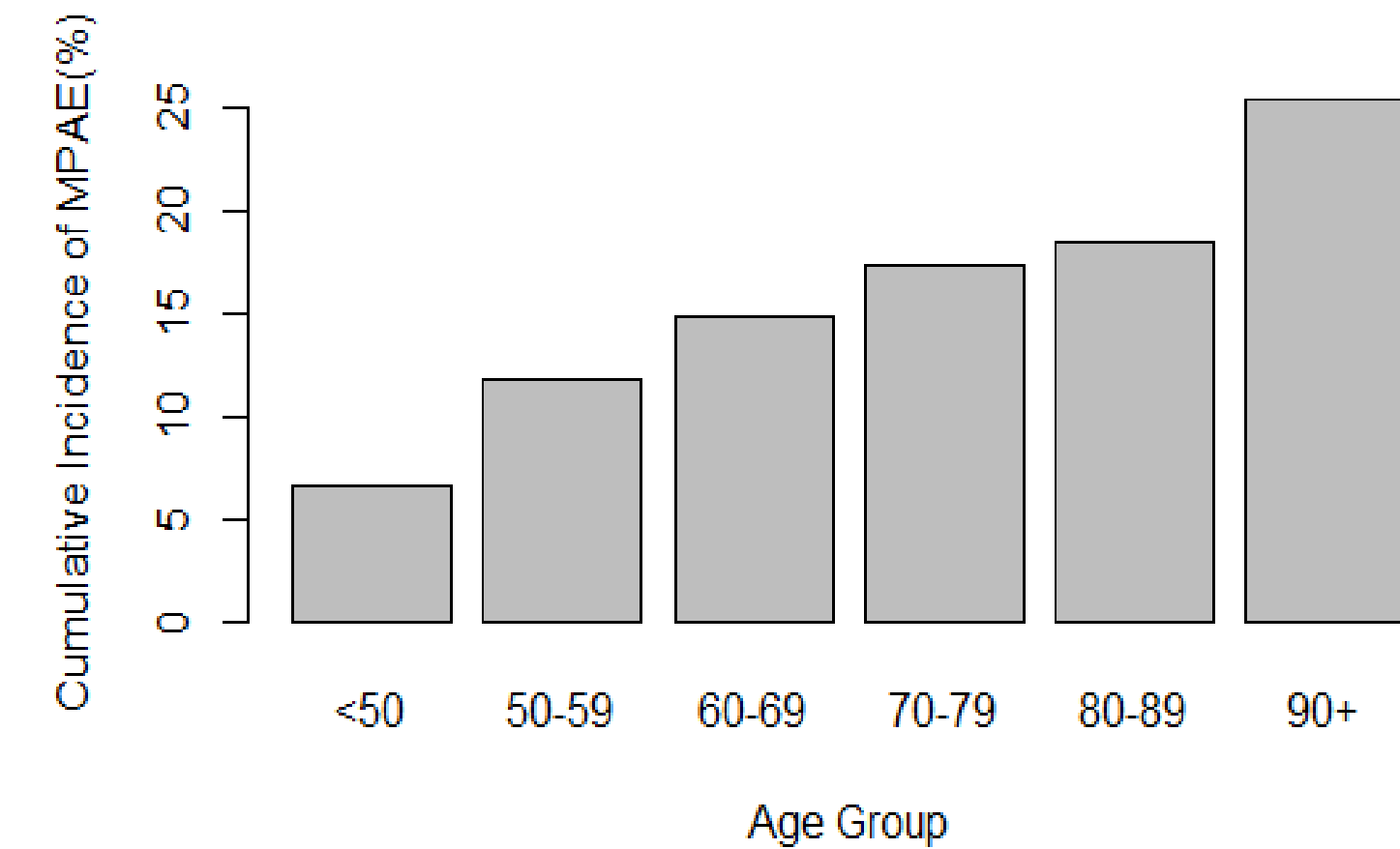
Results

- 43701 operations were analyzed with 5106 (11.7%) MPAEs occurring.
- The results of supervised machine learning indicated that prolonged surgeries, anemia, free tissue transfer, weight loss, wound classification, hypoalbuminemia, wound infection, tracheotomy (concurrent with index head and neck surgery), American Society of Anesthesia (ASA) class and sex as most predictive of MPAEs.

Retained perioperative factors using supervised machine learning and multiple logistic regression to predict major postoperative adverse events

Model	Predictor Variables	Performance	
		Score/Association to MPAE	Prevalence (%)
Supervised Machine Learning	Operative time (>500 minutes)	29.6	10.0
	Anemia (hematocrit <35)	23	10.6
	Free tissue transfer	22	10.0
	Recent weight loss	13.6	2.9
	Wound classification	13.6	2.1
	Hypoalbuminemia (<3.5g/dL)	9.7	4.9
	Preoperative Wound	9.3	2.4
	Tracheotomy (concurrent)	8.5	5.5
	ASA Class 3+	7.8	50.2
	Sex (male)	5.9	45.5

- On multivariate regression, ASA class (21.3%), hypertension on medication (15.8%), prolonged operative time (15.3%), sex (13.1%), preoperative anemia (12.8%) and free tissue transfer (9%) had the largest attributable fractions associated with MPAEs.
- Age was independently associated to MPAEs with an attributable fraction ranging from 0.6-4.3% with poor predictive ability (C-statistic 0.60).



Cumulative incidence of short-term major postoperative adverse events by age group

Comparison of models to predict major postoperative adverse events in the independent testing cohort

Model	AUC	ΔC Age (categorical)*	ΔC Age (continuous)**
Supervised Machine Learning	0.846 (0.837-0.855)	0.001 (P=0.92)	0.004 (P=0.75)
Multiple Logistic Regression	0.855 (0.847-0.864)	0 (P=1.00)	0.003 (P=0.91)
American Society of Anesthesia Score	0.693 (0.686-0.700)	0.007 (P=0.09)	0.016 (P=0.06)
Modified Frailty Index 5	0.592 (0.585-0.600)	0.035 (P<0.001)	0.037 (P<0.001)

Conclusion

- Surgical, comorbid and frailty-related factors were most predictive of short-term MPAEs following head and neck surgery.
- Age alone contributed a small attributable fraction and poor prediction of MPAEs.

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