ACSNSQIP Risk Calculator in Indian Patients Undergoing Surgery for Head and Neck Cancers: Is It Valid?

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Abstract

Pre-operative assessment is vital to determine patient-specific risks and minimize them in order to optimize surgical outcomes. The American College of Surgeons National Surgical Quality Improvement Program (ACSNSQIP) Surgical Risk Calculator is the most comprehensive surgical risk assessment tool available. We performed this study to determine the validity of ACSNSQIP calculator when used to predict surgical complications in a cohort of patients with head and neck cancer treated in an Indian tertiary care center. Retrospective data was collected for 150 patients with head and neck cancer who were operated in the Department of Head and Neck Oncology, Amrita Institute of Medical Sciences, Kochi, in the year 2016. The predicted outcome data was compared with actual documented outcome data for the variables mentioned. Brier's score was used to estimate the predictive value of the risk assessment generated. Pearson's *r* coefficient was utilized to validate the prediction of length of hospital stay. Brier's score for the entire calculator was 0.32 (not significant). Additionally, when the score was determined for individual parameters (surgical site infection, pneumonia, etc.), none were significant. Pearson's *r* value for length of stay was also not significant ($p = .632$). The ACSNSQIP risk assessment tool did not accurately reflect surgical outcomes in our cohort of Indian patients. Although it is the most comprehensive tool available at present, modifications that may improve accuracy are allowing for input of multiple procedure codes, risk stratifying for previous radiation or surgery, and better risk assessment for microvascular flap reconstruction.

Keywords Head and neck cancer · Risk assessment · ACSNSQIP

Introduction

Pre-operative assessment is vital to determine patient-specific risks and minimize them in order to optimize surgical outcomes. In addition to routine pre-operative assessment, thorough clinical and laboratory evaluation, electrocardiogram, and chest X-ray, there has been an increasing interest in risk assessment tools or nomograms, which aim to predict an individual's risk of specific

complications. Accurate risk assessment tools allow surgeons to provide their patients with specific and reliable risk-adjusted estimates of post-operative complications and also for hospitals or healthcare systems to allocate resources and audit clinical outcomes.

The American College of Surgeons National Surgical Quality Improvement Program (ACSNSQIP) Surgical Risk Calculator [1] is the most comprehensive surgical risk assessment tool available, derived from compilation of tens of thousands of patient hospital records. It was derived and subsequently validated with the intention of estimating likelihood of unfavorable surgical outcomes, such as pulmonary complication, cardiac complications, and perioperative mortality [2].

The ACSNSQIP calculator has been designed for use across multiple surgical disciplines, with specific Current Procedural Terminology (CPT) codes for a variety of surgeries. External validation for head and neck surgery has been limited, with only a few studies available in published literature [3, 4], neither of which found the calculator reliable.

No part of this work has not been presented previously in any form.

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We performed this study to determine the validity of ACSNSQIP calculator when used to predict surgical complications in a cohort of patients with head and neck cancer treated in an Indian tertiary care center.

Materials and Methods

Retrospective data was collected for patients with head and neck cancer who were operated in the Department of Head and Neck Oncology, Amrita Institute of Medical Sciences, Kochi, between July and December 2016. A total of 260 major surgeries were performed during this period. Of these, only patients whose charts contained all the data required for completion of the ACSNSQIP calculator assessment were included in the study ($n = 150$). Post-operative notes and discharge summaries were evaluated for details of morbidity, mortality, and readmission.

The morbidities predicted by the ACSNQIP were pneumonia, surgical site infection, venous thromboembolism, return to operating room, and length of stay. The details of operative procedures included in the study are shown in Table 2. The ACSNSQIP calculator assessments were filled out online (<http://www.riskcalculator.facs.org>) and the risk assessment for each patient was generated.

Statistical Analysis

The predicted outcome data was compared with actual documented outcome data for the following variable: pneumonia, surgical site infection, venous thromboembolism, and length of hospital stay. Brier's score was used to estimate the predictive value of the risk assessment generated. Pearson's r coefficient was utilized to validate the prediction of length of hospital stay (Fig. 1).

Fig. 1 Chart showing number of actual complications vs predicted complications for each individual post-operative complication

Results

Data from one hundred and fifty patients were included in our analysis. The median age of patients was 55 years (range 28–72 years), and 66% of the patients included were male. The mean ASA score was 2, with their comorbidities shown in Table 1. The surgeries performed were shown in Table 2.

The number of predicted complications compared to the actual observed complications is shown in Fig. 2. The parameters that were underestimated were 30-day surgical site infection, 30-day return to operation theater (surgical re-exploration), and cardiac complications. The total number of predicted complications was 24, while the number of observed complications was 48; this was an error of 100%.

The parameters that were overestimated were pneumonia and venous thromboembolism. The percentage error for each is shown in Fig. 2. The highest percentage error was for 30-day return to operation theater (8%). The mean duration of hospital stay predicted was 4.5 days, which was significantly lower than the observed stay of 10 days (Fig. 3).

Brier's score for the entire calculator was 0.32 (not significant). Additionally, when the score was determined for individual parameters (surgical site infection, pneumonia, etc.), none were significant. Hence, the overall accuracy in predicting post-operative complications was low. Pearson's r value for length of stay was also not significant ($p = .632$).

Table 1 Distribution of patient characteristics and pre-operative comorbid illnesses according to the ACSNSQIP risk calculator format

Patient information	Mean + SD or n (%)
Total number of patients	150
Age, years	55.4 ± 87
Male/female	100 (66%)/50 (34%)
Height (m)	1.70 ± 0.44
Weight (kg)	65 ± 12.43
Independent functional status	148 (99%)
ASA score	2
Hypertension requiring medication	22 (15%)
Smoker within 1 year	66 (40%)
Diabetes	53 (36%)
Previous cardiac event	18 (12%)
Severe chronic obstructive pulmonary disease	2 (1%)
Congestive cardiac failure in previous 30 days	0 (0%)
Dialysis required	4 (3%)
Disseminated cancer	3 (2%)
Ventilator dependent	0 (0%)
Acute renal failure	1 (1%)
Ascites within previous 30 days	0 (0%)
Sepsis within previous 48 h	2 (1%)

Table 2 Distribution of surgeries performed

Surgery performed	n (%)
Total laryngectomy	20 (13%)
Radical oral cavity resection	26 (17%)
Thyroidectomy	45 (30%)
Skull base resection	12 (8%)
Parotidectomy	40 (27%)
Maxillectomy	7 (5%)

Discussion

The ACSNSQIP risk prediction in our cohort of one hundred and fifty patients treated in an Indian tertiary care center was inaccurate. It was unable to accurately predict the overall number of complications or the incidence of individual complications.

Another study conducted to validate the use of ACSNSQIP risk prediction in head and neck cancer was published by Prasad et al. [3], who found that the score did little to predict an individual patient's risk of complications but overall predicted a similar number of complications. In our study, however, a patient's individual risk and the overall incidence of complications in the cohort were both inaccurate.

Velanovich et al. [4] suspected that a distinct fallacy in the ACSNSQIP risk assessment scoring was that it minimized the impact of key surgical and non-surgical factors—how difficult the surgery was, how well it was performed, what was the post-operative process, nursing care and post-discharge care, and rehabilitation. Post-operative morbidity is often a complex interplay of all these factors, many of which are difficult to account for.

In our opinion, there are several possible reasons for the discrepancy in predicted and observed complications in our cohort that *can* be addressed. A major drawback is the inability to input multiple surgical codes. For a complex procedure, it is not possible to input multiple surgical codes such as total

Fig. 3 Actual vs predicted mean duration of hospital stay

laryngectomy, radical neck dissection, and anterolateral thigh flap; the options available are “total laryngectomy with radical neck dissection” (code 31365) or “free skin flap with microvascular reconstruction” (code 15757). Multiple procedures are likely to compound the risk of complications, which the calculator cannot account for.

Another drawback is the absence of a correction factor for prior radiotherapy, which is a significant cause of morbidity in the surgical bed post-operatively. This is known to impact wound healing, surgical re-explorations, and indirectly the length of hospital stay [5]. Patients who received previous chemoradiotherapy or previous surgery to the same region are also at a higher risk of local complications. The ACSNSQIP calculator takes none of these factors into consideration.

For patients who underwent microvascular reconstruction, the predicted rate of 30-day return to operation theater was extremely low (<5%), even in patients with comorbidities likely to impact microvascular circulation and healing, like cardiac disease, diabetes, hypertension, and history of smoking. Although none of the 15 patients in this study who had microvascular flap reconstruction had flap loss, 4 (26%) had re-explorations for suspected compromise. The protocol followed in our unit is re-exploration for any suspicion of flap compromise and variations in this protocol may explain the gross mismatch in predicted and observed re-explorations within 30 days.

The predicted length of hospital stay was significantly lower than the observed length of stay for all procedures. For total thyroidectomy, the calculator shows same day discharge; however, we insist on overnight stay and observation. For radical oral cavity resections, the predicted duration of stay was 2 days, while observed stay was around 4 days. This is likely to vary heavily based on the healthcare system; if the hospital discharges patients to a nursing care facility or has the facility to provide nursing home visits, the duration of hospital stay required would be significantly less. Our hospital discharges patients directly home, almost always without any nursing care or facilities available; hence, the hospital stay required would be longer.

Fig. 2 Percentage error in calculation for each post-operative complication

Conclusion

The ACSNSQIP risk assessment tool did not accurately reflect surgical outcomes in our cohort of Indian patients. Although it is the most comprehensive and organized risk assessment tool available at present, modifications that may improve accuracy are allowing for input of multiple procedure codes, risk stratifying for previous radiation or surgery, and better risk assessment for microvascular flap reconstruction. Further study is required to optimize outcomes.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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