Original Article

Can ACS-NSQIP score be used to predict postoperative mortality in Saudi population?

ABSTRACT

Background: Various scoring systems help in classifying the patient's risk preoperatively and hence to decide the best available treatment option. ACS-NSQIP score has been introduced in clinical practice for few years. This study was done to find out whether there is any difference between predicted mortality from ACS-NSQIP score and observed mortality in Saudi population.

Methods: This prospective observational study was conducted at Security Forces Hospital, Riyadh, Kingdom of Saudi Arabia. We included patients undergoing elective and emergency surgical procedures in our hospital. Thirty days mortality data was collected and then observed to expected (O/E) mortality ratio was calculated. The sample size for our study was nine hundred and three (903) patients.

Results: The mean ACS-NSQIP mortality risk score (%) for the study was 0.49. Expected number of mortalities was 4.42 while observed mortalities were 11, yielding an O/E ratio of 2.48 (*p-value 0.000*). We did not find a significant difference between expected and observed mortalities except for ASA class 3 and 4 patients where expected numbers of mortalities were lower than observed (p-value < 0.05).

Conclusion: ACS-NSQIP can be reliably used for postoperative mortality prediction especially in lower risk groups.

Key words: ACS-NSQIP, postoperative mortality, risk assessment, scoring system

Introduction

The occurrence of permanent disability or mortality from surgical procedures typically ranges from 1 to 3.6% in developed countries. These perioperative deaths mainly happen in high risk patients group. It is therefore very important to stratify the patient risk preoperatively and hence decide about the best possible surgical procedure and postoperative care. Postoperative adverse outcomes could not reliably be predicted by clinical judgment alone.[1] Various preoperative risk assessment tools have been developed to help in identifying high risk patients.[2] These tools complement investigations like cardiopulmonary exercise testing (3) and biomarkers assays.[3,4] Examples of these risk assessment tools or scoring systems include ASA, P-Possum, APACHE II and Surgical Apgar score etc.[5-8]

ACS-NSQIP (American college of Surgeons - National surgical quality improvement program) is a risk calculator which was

Access this article online	
Website: www.saudija.org	**Quick Response Code**
DOI: 10.4103/sja.sja_734_21	

How to cite this article: Huda AU, Yasir M, Sheikh N, Khan AZ. Can ACS-NSQIP score be used to predict postoperative mortality in Saudi population? Saudi J Anaesth 2022;16:172-5.

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Submitted: 03-Oct-2021, **Revised:** 14-Oct-2021, **Accepted:** 10-Nov-2021, **Published:** 17-Mar-2022

developed based on data of over 4.3 million operations in USA from 2013 to 2017. ACS-NSQIP have been found to be effective in improving the quality of surgical care and also reducing complications.[9] The objective of this study is to find out whether there is any difference between predicted mortality from ACS-NSQIP score and observed mortality in Saudi patients having surgical procedures.

Materials and Methods

This was a prospective observational study that was done at Security Forces Hospital, Riyadh, Kingdom of Saudi Arabia. Ethical review committee approved (Registration number: H-01-R-069) this study. Initially, data for patients undergoing elective and emergency surgeries over a period between July 2019 to November 2019 was collected. We excluded pediatric (aged under 18 years) patients from this study. ACS-NSQIP was calculated for all eligible patients. It uses 20 patient specific variables (e.g., age, BMI, ASA) and the planned procedure (CPT code) to predict logistic model-based outcomes for different surgical procedures.[10] All the preoperative and operative variables which were required to calculate ACS-NSQIP score were entered into online calculator and the predicted mortality was documented in anesthesia chart of individual patient.

Actual mortality data was collected from hospital monthly mortality reports. Patients outcome was also followed using our online patient record system. If the patient progress and outcome could not be accessed by online system, we contacted patients/relatives via telephone provided in medical record.

Data was entered in Microsoft Excel and analyzed using SPSS version 21.0. Descriptive analysis was carried out. Mean with standard deviations and frequencies were calculated for continuous and categorical variables respectively.

ACS-NSQIP score for mortality of all the participants was calculated using the scoring system. Expected number of mortalities was calculated by multiplying mean risk score of each group with number of patients in that group. Observed to expected number of mortalities ratio was calculated. Binomial test was applied to assess the difference between expected and observed number of mortalities. *P* value less than 0.05 was considered significant.

Results

A total of 903 patients who underwent surgical procedure were included in the analysis. Mean age of the participants was 43.5 ($\pm$17.5) years and 54% (488) were male. Majority of the patients belonged to ASA class II (47%), followed by class I (31.9%). Class III and IV were 17.5% and 3.7% respectively. Most of the patients were recruited from general surgery (34.7%) followed by urology (22.1%) and orthopedics (21.5%). Other specialties were; plastic surgery (7.1%), vascular surgery (4.9%), neurosurgery (3.8%), Gynecology (2.5%), ENT (1.4%) Thoracic (1%) and Faciomaxillary (1%). Thirty nine (39.5) percent of total patients were done as emergency cases.

Mean ACS mortality risk score (%) for whole sample was 0.49. Expected number of mortalities was 4.42 while observed mortalities were 11, yielding an O/E ratio of 2.48 (p-value 0.00). We developed two risk categories based on ACS mortality score %; category I (0-1.0) and category II (more than 1.0). There was no significant difference in the expected and observed mortalities in categories I, while observed mortality was significantly higher than expected mortality in risk category II [Table 1].

With respect to ASA class, we did not find a significant difference between expected and observed mortalities except for ASA class 3 and 4 where expected numbers of mortalities were lower than observed (p-value $<$0.05) [Table 2].

We also assessed the predictability of ACS mortality scores with respect to surgical specialties. We found that for most of the included specialties including general surgery, urology, thoracic, plastic surgery, Faciomaxillary and neurosurgery, there was no significant difference in the observed and expected number of mortalities (p-values $>$0.05) [Table 3].

Discussion

For any scoring system to be regarded as perfect, it needs to be simple, reproducible, objective and appropriately applicable to all surgical patients. ASA scoring system is the most widely used preoperative assessment tool as it is simple and easy to use.[5] However, it has usually been questioned due to its subjectivity and inability to reliably predict postoperative mortality for individual case.[11]

ACS-NSQIP provided healthcare services with tools, analyses, and reports to make informed decisions about improving quality of care.[9] It could be applied to multiple surgical specialties with the goal of discrete output.[12] ACS NSQIP tool has been tested with variable results in different surgical specialties including colorectal, pancreatic, reconstruction, gynecological, orthopedics, urologic and neurosurgical operations.[13-19] Dahlke *et al.*[20] showed favorable predictive accuracy of the

Table 1: Risk category specific comparison of expected and observed mortality by ACS

Risk category (ACS score %)	Number of patients	Mean Risk score %	Expected number of mortalities	Observed number of mortalities	O/E ratio	*P*
Risk categories based on quartile of risk scores %						
I Up to 1.0	841	0.08	0.672	5	7.44	0.50
II more than 1.0	62	6.10	3.782	6	1.586	00
Overall	903	0.49	4.42	11	2.48	
Risk categories based on emergency vs elective						
Elective	546	0.99	5.40	2	0.37	00
Emergency	357	0.98	3.49	9	2.57	00

Table 2: Comparison of expected and observed mortalities with respect to ASA class, duration of surgery and laparotomy

ASA class	Number of patients	Mean Risk score %	Expected number of mortalities	Observed number of mortalities	O/E ratio	*P*
1	288	0.13	0.374	0	0	0.31
2	424	0.1	0.42	0	0	0.16
3	158	0.79	1.24	5	4.03	0.04
4	33	7.28	2.4	6	2.5	00

Table 3: Comparison of expected and observed mortalities with respect to specialty

Specialty	Number of patients	Mean Risk score %	Expected number of mortalities	Observed number of mortalities	O/E ratio	*P*
Neuro surgery	34	0.63	0.21	0	0	0.93
ENT	12	0.92	0.11	1	9.0	0.00
GS	308	0.32	0.98	5	5.1	0.19
Thoracic	9	0.61	0.054	0	0	0.99
VS	43	3.94	1.69	1	0.61	0.00
Urology	199	0.38	0.75	1	0	0.55
Gynecology	22	0.05	0.011	1	0	0.02
Orthopedics	192	0.28	0.53	2	3.77	0.00
PS	64	0.02	0.013	0	0	0.93
Faciomaxillary	9	0.02	0.002	0	0	0.99

ENT: Ear, nose and throat, GS: General surgery, VS: Vascular surgery, PS: Plastic surgery

tool in general and colon surgery group of patients. In another study by Mogal *et al.*,[21] ACS-NSQIP was found to have good accuracy in outcome prediction for patients undergoing pancreaticoduodenectomy. While some other studies found limited predictive value of ACS-NSQIP in patients undergoing other types of surgeries. Cologne *et al.*[22] reported that this tool could not reliably predict the risk after laparoscopic colectomy. Also, it did not reliably predict complications in patients having knee and hip replacements, soft tissue sarcoma resection, and total laryngectomy.[15,23,24] We in our study found that ACS NSQIP reliably predicted postoperative mortality in patients undergoing general surgery, urology, thoracic, plastic surgery, Faciomaxillary and neurosurgery.

There is limited literature available regarding the accuracy of ACS NSQIP in acute care surgeries. There are many variables that can affect the risk estimations in patients undergoing emergency surgery compared to elective surgery.[25] Hyder *et al.*[26] showed that ACS NSQIP slightly underestimated the risk of emergency general surgery (EGS) compared to risk of elective surgery. While these differences were statistically significant, these were small with observed to expected mortality ratio of 1.03 for EGS. So they concluded that this tool is applicable to both types of surgeries. In our study, ACS NSQIP as overall did not reliably predict the postoperatively irrespective of whether it was elective or emergency surgery.

Our sample size included variety of surgical specialities which provide good representation of our practice, although small number of observed deaths may affect the power of study. A future study with larger sample is recommended. In conclusion, ACS-NSQIP can be reliably used for postoperative mortality prediction especially in lower risk groups.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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