Original article

Prediction of surgical site infection and other adverse postoperative outcomes

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Abstract

Background: To predict surgical site infection, hospital acquired pneumonia, wound dehiscence, and mortality based on SENIC index in Nepalese perspective in surgical patients.

Methods: A Retrospective study was conducted at Department of Surgery, Tribhuvan University Teaching Hospital (TUTH), Kathmandu, Nepal from October 2007 to September 2008. Surgical-infection risk factors assessed by the traditional wound-classification system (clean, clean-contaminated, contaminated, and dirty-infected wound) and by the SENIC risk index (length of intervention more than 2 hours, more than three discharge diagnoses, abdominal surgery, and contaminated or dirty infected wound) were compared by Receiver Operating Characteristic (ROC) curve.

Results: The SENIC index showed a good ability to predict SSI, Hospital Acquired pneumonia, wound dehiscence and in hospital mortality. If the index score is higher, the outcome is poorer. By using SENIC index score the area under ROC curve for SSI, pneumonia, wound dehiscence and in hospital mortality was 82.2±4.8, 90.5±2.4, 85.1 ±4.7 and 96.9±1.2 % respectively with sensitivity above 95% for all the parameters.

Conclusion: This study shows that the SENIC risk index results are reproducible, and the index can be used to predict rates of SSI and other adverse postoperative complications in developing countries as well.

Key Words: Prediction, SENIC Index, surgical site infection

Introduction

Surgical site infection (SSI), pneumonia, wound dehiscence; urinary tract infection (UTI), sepsis and mortality are the most common serious consequences of operative interventions.[1] SSIs results in increasing rates of morbidity, prolonged hospitalization, mortality and considerable socio-economic costs.[2] Surveillance of surgical-site infections (SSIs) with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSI risk. For prediction of SSIs, the traditional wound classification system, which stratifies each wound into one of four categories (clean, clean-contaminated, contaminated, and dirty infected), has been available since 1964.[3] This system of risk stratification is not out of limitations because by a single factor we cannot predict the overall outcome. A simple index was developed during the 'Study on the Efficacy of Nosocomial Infection Control' (SENIC) project.[4] This index has been practiced in the west and recently 'National Nosocomial Infections Surveillance' (NNIS) system is coming up. Our study aims to predict surgical site infection, hospital acquired pneumonia, wound dehiscence and mortality based on SENIC index in Nepalese perspective in surgical patients.

Materials and Methods

A retrospective study was conducted at Department of Surgery, Tribhuvan University Teaching Hospital (TUTH), Kathmandu, Nepal from October 2007 to September 2008.

Inclusion criteria were hospital stay >48 hours and operative intervention done at TUTH. Exclusion criteria were: primary operation done outside TUTH, incomplete data keeping, inability to retrieve the record file and loss of follow up (up to 30 days). Hospital infection was diagnosed according to Centers for Disease Control and Prevention (CDC Criteria).[5] The SENIC index was computed by scoring one point for each of the following four risk factors: abdominal surgery, duration of surgery longer than two hours, contaminated or dirty-infected surgery, and more than two diagnoses (Table1).

Table 1. Study on the efficacy of nosocomial infection control (SENIC)

Risk Factor	Score*
None	0
Surgery longer than 2 hours	1
Contaminated or dirty wound	1
Abdominal Surgery	1
Discharge diagnoses 3 or more	1

** Index Scoring (0-4)*

The outcome parameters for this study were SSI, lower respiratory tract infection, wound dehiscence and in-hospital death. The ability of the index to predict each adverse outcome was assessed by estimating the area under the receiver operating characteristic (ROC) curve using the nonparametric method. Values for area under the ROC curve were compared by the procedure proposed by DeLong et al.[6] The ROC curve allows estimation of the proportion of outcomes correctly classified according to a diagnostic tool or a predictive measurement, such as the SENIC index. The maximum area under the ROC curve is 1, or 100%: the closer this value is to 100%, the better the index. SPSS 14.0 was the software used for data analysis. *P* value <0.05 was considered to be significant.

Results

Out of 400 patients, 245 were eligible for final data analysis. Amongst the 245 patients, 104(42.4%) were male and 141(57.6%) female. The median age was 35 (± 15.8) years. The median duration of hospital Stay was 6 days with Interquartile Range from 3-9days.There was strong association between SSI and total duration of Hospital Stay (*P*=0.001).The common comorbid conditions were hypertension, COPD, IHD etc (Table 2). Emergency appendectomy, Open cholecystectomy, Modified Grahms' omental patching followed by others were the common operations performed (Table 3). Eighty four (34.3%) of the patients had contaminated or dirty wounds. There were a total of 163(66.5%) abdominal operations and 82(33.5%) non-abdominal operations. Seventeen (6.93) of the patients had more than 3 discharge diagnoses. Fifty five (22.4%) of the patients had operative time of more than 2 hours. A total of 32(13.06%) patients developed SSI (Table 4). For the index rates of SSI, hospital acquired pneumonia, wound dehiscence and in hospital death increase as the score increases (Table 5). The SENIC index predicted all the adverse outcomes with sensitivity above 80% (Table 6). Based on SENIC index, the area under ROC curve for SSI, in hospital mortality and hospital acquired pneumonia was 82.2%, 90.5% and 96.9% respectively (Fig. 1,2).

Table 2. Comorbid conditions

Comorbid Conditions	N (%)
Hypertension	20(8.2)
COPD	4(1.6)
Ischemic Heart Disease	3(1.2)
Diabetes Mellitus	3(1.2)
Acute Renal Failure	2(0.8)
RHD	2(0.8)
Others	5(2)

Table 3. Name of operations

Name of Operations	N (%)
Emergency appendectomy	42(17.1)*
Open Cholecystectomy	38(15.5)*
Modified Grahms Omental patching	33(13.5)
Hemithyroidectomy	30(12.2)
Subtotal thyroidectomy	22(9.0)
Total mastectomy + Axillary Clearance	21(8.6)
Jejunum/Ileum resection anastomosis	19(7.8)
Laparotomy and Appendectomy	14(5.7)
Others(less than 10 Procedures by class)	26(10.6)

Table 4. SSI based on the type of wound

Type of the wound		Surgical Site Infection
	Clean	2/82(2.4%)
	Clean Contaminated	2/79(2.53%)
	Contaminated	4/31(12.9%)
	Dirty	24/53(45.2%)
Total		32/245(13.06%)

Table 5. Risk of different adverse postsurgical outcomes according to the SENIC index

Index Score	Total no. of outcomes	No.(%) of Adverse outcomes SSI	Hospital Acquired Pneumonia	Wound Dehiscence	In Hospital Death
SENIC					
0	56	1(1.7)	0(0)	0(0)	0(0)
1	98	1(1.02)	0(0)	0(0)	0(0)
2	57	11(19.3)	6(10.5)	3(5.3)	0(0)
3	27	15(55.5)	10(37.3)	2(7.4)	6(22.2)
4	7	3(42.8)	3(42.8)	1(14.28)	5(71.4)

Table 6. Area under the ROC Curve for SENIC index

Outcome	Area under the ROC curve (%) ± SE	Sensitivity (%)	Specificity (%)
SSI	82.2±4.8	95	75.8
Pneumonia	90.5±2.4	100	75
Wound Dehiscence	85.1 ±4.7	100	76
Mortality	96.9±1.2	100	76

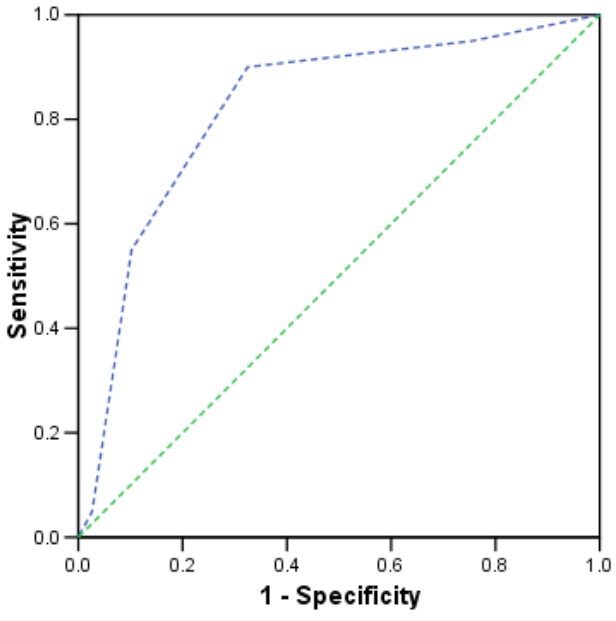

Fig 1. ROC curve for SSI and in hospital mortality using SENIC index (Dashed line for SSI, straight line for in hospital mortality and diagonal line is reference line.)

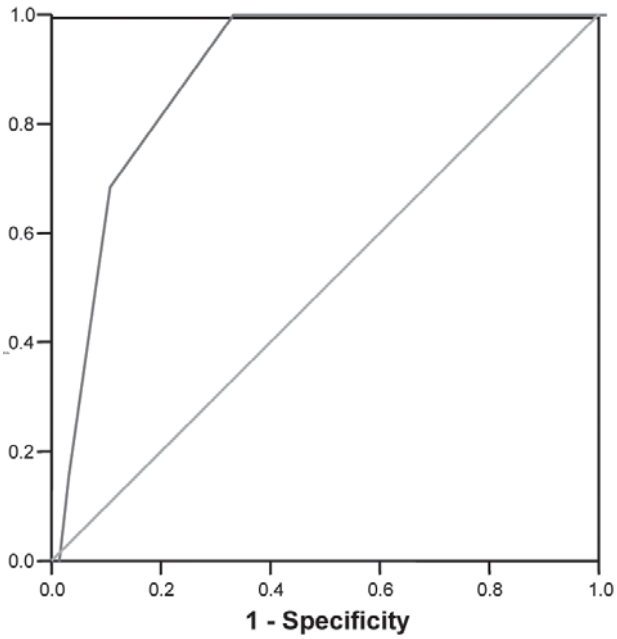

Fig 2. ROC curve for hospital acquired pneumonia using SENIC index

Discussion

In our department the incidence of SSI based on the traditional wound classification is nearly similar to that reported in other literatures.[7] Our results show that the SENIC index is a good predictor of SSI and other adverse postsurgical outcomes. The outcome best predicted by the index is in-hospital mortality and not SSI, as it would have been expected. This could be because the risk of infection and severity of illness, which is the most important determinant of mortality, are closely related.[1] Our results differed slightly from those reported by Victoria Valls in the incidence of SSI: infection rates for patients with zero to four risk factors were 1.7, 1.02, 19.3, 55.5 and 42.8 per 100 interventions in our study and 1.1, 3.1, 25.4, 35.3 and 100 per 100 interventions in Valls' study.[7] In our context, SSI in score 4 is less than that with score 3. The reason behind this is that in patients with score 4, the mortality is highest even within 24 hours postoperatively.

Miguel Delgado-Rodrý´guez et al reported the incidence of SSI in patients with SENIC score 0 to 4 to be 4.9, 5.7, 14.5, 29.8, 33.3% respectively.[1] In our study, for SENIC score 0-4 prediction of Hospital acquired pneumonia was 0, 0, 10.5, 37.3, 42.8% respectively. Similarly, prediction of in Hospital mortality for SENIC Score of 0-4 was 0, 0, 0, 22.2 and 71.4%.

These findings differ slightly from that of Miguel Delgado-Rodrý´guez et al. On literature search, no similar study was found using the SENIC index for prediction of Wound dehiscence. Ours is the first study using the SENIC index for prediction of wound dehiscence.

The SENIC risk index is not the only index developed to control for intrinsic risk of wound infection. Some other indices have been created, mostly based on Haley's study. Culver et al[8] developed the "patient risk index score" from data of the National Nosocomial Infections Surveillance (NNIS) System. This index uses the American Society of Anesthesiologist (ASA)'s system of scores[8] instead of the number of discharge diagnoses. In addition, the NNIS index replaces the cutoff point of a 2- hour length of procedure with the 75th percentile of the distribution of lengths for each given procedure. NNISS index has been implemented in many hospitals in the United States making many USA hospitals as NNISS hospitals. But in our context SENIC index might be one of the simple, reliable index for prediction of surgical site infection and other adverse postoperative outcomes.

Conclusion:

This study shows that the SENIC risk index results are reproducible, and the index can be used to predict rates of SSI and other adverse postoperative complications in developing Countries as well.

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