External Validation of SENIC and NNIS Scores for Predicting Wound Infection in Colorectal Surgery

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Abstract

Objective: We aimed to identify the ratio of Surgical Site Infection (SSI) and also the validity of the National Nosocomial Infection Surveillance (NNIS) and Study on the Efficacy of Nosocomial Infection Control (SENIC) risk indexes in colorectal surgery, among Turkish population. Background: Some problems have been reported with the power of NNIS risk index to predict the risk of surgical site infection. We aimed to validate the NNIS and SENIC risk indexes in colorectal surgery. Methods: Between January 2003 and December 2006, surgical site infection surveillance was performed to 107 patients who undergo colorectal surgery with NNIS and SENIC risk scales. The mean patient age was 48 years (range, 17 to 86), and 61.7% of the group (66) was female. For this patient cohort, 6 (5.6%) were diagnosed with incisional SSI. While the mean Body Mass Index (BMI) of all patients was 26.6; mean value of BMI among the patients with SSI was 27.8. Results: 6 insitional surgical site infection were observed during the study. According to Receiver Operating Characteristic (ROC) curve analyze neither NNIS with a value of 0.70, nor SENIC with a value of 0.67 are perfect risk indexes. Conclusion: As a result both NNIS and SENIC is a good risk indexes but not perfect. Scarcely when NNIS and SENIC is used together to predict the SSI they forecast the development of infection better. But there is a lot of other factors that effect the development of SSI, so for excellent surveillance risk index those factors known by everyone must be added to risk index scales.

Keywords: National Nosocomial Infection Surveillance (NNIS), Study on the Efficacy of Nosocomial Infection Control (SENIC), Colorectal Surgery, Validation

1. Introduction

Surgical site infection (SSI) is the most frequently reported infection among surgical patients, accounting for 14% to 16% of all nosocomial infections among hospitalized patients. (10) These infections are associated with significant morbidity and considerably extend the length of hospital stay.

Surveillance has been described as a preventative measure for reducing such infections. (3) A successful surveillance system that uses standard definitions, which feedback data on-site-specific, risk-adjusted SSI rates may provide a measure of quality performance for surgeons and hospitals and contribute to the prevention of hospital acquired infections. (11)

For many years wound contamination class was the only factor that was well described for predicting the risk for SSI. During the Study on the Efficacy of Nosocomial Infection Control (SENIC) Project, an index was developed that provided a better assessment of the risk of SSI than had the traditional wound classification system. In 1991, a modification of the SENIC risk index by Culver et al. led to the National Nosocomial Infections Surveillance (NNIS) System risk index. (3)

SSI in patients undergoing colorectal resection have been specifically studied, with similar general findings.
However, there has been wide discrepancy in the reported incidence of incisional SSI following colorectal surgery, ranging from 3 to 30%. Additionally, there has been no clear consensus on the risk factors contributing to SSI following colorectal surgery, which has limited the data’s value to surgeons involved in quality improvement programs hoping to address specific variables that could reduce this risk.(12)

Several authors have recognized that risk adjustment needs to be improved and tailored to be procedure specific. Other’s have presented results of studies to identify procedure specific risk factors for SSI for example, in cesarean sections and colorectal surgery. Therefore in this study we aimed to identify the ratio of SSI and also the validity of the NNIS and SENIC risk indexes in colorectal surgery, among Turkish population.

2. Methods

Between January 1, 2003 and December 31, 2006, we collected and analyzed data prospectively from patients who underwent colorectal operations. Patients were followed up from admission to 30 days after the date of surgery. Patients who were discharged before the 7th day after surgery were contacted by telephone at home.

SSI was diagnosed using the ASEPSIS score and scores more than 20 points indicated infection where as 20 or less points were determined as disturbance of healing. The definition for the acronym ASEPSIS is A, additional treatment; S, serous discharge; E, erythema; P, purulent exudate; S, separation of deep tissue; I, isolation of bacteria; and S, stay as inpatient for >14 days. (15) The components of the NNIS (4) surgical patient risk index used in this study were as follows: 1) Preoperative American Society of Anesthesiologists (ASA) score; 2) The traditional surgical wound classification; 3) T time “defined as the 75th percentile of the duration for operative procedure and the components of the SENIC(7) surgical patient risk index used in this study were as follows: 1) The traditional surgical wound classification; 2) number of coexisting diagnoses; 3) Site of surgery; 4) duration of surgery over 2 hours.

2.1. Statistical Analysis

Scoring system validation comprised two activities. These are discrimination and calibration. Model discrimination was measured by the area under the receiver–operator characteristic (aROC) curve. Calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test and the corresponding calibration curves. (1) All statistical analysis in this study was performed using SPSS software (version 11.0, SPSS Inc., Chicago, IL). (12)

3. Results

During the 4-year period, 107 patients were identified who underwent elective colorectal resection performed. Demographic and clinical characteristics of the study patients are shown in Table 1. The mean patient age was 48 years (range, 17 to 86), and 61.7% of the group (66) was female. For this patient cohort, 6 (5.6%) were diagnosed with incisional SSI. While the mean Body Mass Index (BMI) of all patients was 26.6; mean value of BMI among the patients with SSI was 27.8.

The aROC of NNIS was 0.70, compared with the SENIC score which had an aROC of 0.67 (Figure 1). If aROC is 1 this means that the procedure analyzed is perfect so the SENIC and NNIS are good but not perfect. After the ROC curve analyze calibration of models were assessed. The overall percentage for NNIS was 68.8, and the overall percentage of SENIC was 61.5 (Table 2). Where NNIS shows the infection 68.8% of patients and SENIC shows 61.5%.

4. Discussion

Surveillance systems aim to provide feedback to hospitals and stimulate infection control activities. An adequate method for risk adjustment is important for the comparison of hospitals’ specific rates. (3) Researchers in a number of countries have found that the NNIS risk index performed favorably for prediction of SSI. (9,2)

Not all experts concede that the NNIS risk index is the best method for the risk stratification of all surgical procedures. For example, several studies have shown that the NNIS risk index does not necessarily work well for patient undergoing cardiothoracic procedures; as a result, the authors of these studies have proposed modifications that improve risk scoring systems. (5)

Data from the NNIS system suggest that approximately 50% of all SSIs diagnosed in the United States are superficial incisional SSIs. (7) Therefore only incisional SSIs are included to the recent study.

Our rate of incisional SSI for elective colorectal resections (5.6%) is lower than predicted by general review of the literature. Although there is a wide range of frequencies reported, from 3% to 30%, the average rates for wound infections reported is roughly 10%. There are a number of potential explanations for these discrepancies. (6,13) First, the emergent patients were excluded from the study, only elective colon and rectum resections were evaluated. Second, mechanical bowel preparation were performed to all patients the day before the operation.

Although Topaloğlu et al. (14) were found that the correlation of SENIC score with postoperative wound infection is higher than NNIS, according to discrimination
Table 1. Demographic and clinical characteristics of patients.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>NNIS</th>
<th>Infection (+)</th>
<th>Infection (-)</th>
<th>Characteristics</th>
<th>Number (%)</th>
<th>Characteristics</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>Male</td>
<td>41(38.3)</td>
<td>0</td>
<td>71(66.4)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Female</td>
<td>66(61.7)</td>
<td>1</td>
<td>32(29.9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2(1.9)</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2(1.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;25</td>
<td>25(23.3)</td>
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<td>1</td>
<td>88(82.2)</td>
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<td></td>
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<tr>
<td></td>
<td>25-30</td>
<td>65(60.7)</td>
<td></td>
<td>2</td>
<td>13(12.1)</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>30+</td>
<td>17(15.8)</td>
<td></td>
<td>3</td>
<td>5(4.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4(31-40)</td>
<td></td>
<td>5(41)</td>
<td>1(0.9)</td>
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<tr>
<td>ASA</td>
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<td></td>
<td></td>
<td>1</td>
<td>16(15)</td>
<td></td>
<td></td>
</tr>
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<td>2</td>
<td>55(51.4)</td>
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<td></td>
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<td></td>
<td></td>
<td>3</td>
<td>35(32.7)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>1(0.9)</td>
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<tr>
<td>SENIC</td>
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<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2(1.9)</td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
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<td></td>
<td>Stomachache</td>
<td>0</td>
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</table>
| BMI: Body Mass Index; ASA: American Society of Anesthesiologists; NNIS: National Nosocomial Infection Surveillance; ASEPSIS: A, additional treatment; S, serous discharge; E, erythema; P, purulent exudate; S, separation of deep tissue; I, isolation of bacteria; and S, stay as inpatient for >14 days.; SENIC: Study on the Efficacy of Nosocomial Infection Control.

Table 2. Performance summary of the NNIS and SENIC systems according to Hosmer-Lemeshow goodness-of-fit test.

<table>
<thead>
<tr>
<th>Infection (+)</th>
<th>Infection (-)</th>
<th>Overall percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NNIS</td>
<td>86.2</td>
<td>49</td>
</tr>
<tr>
<td>SENIC</td>
<td>46.6</td>
<td>78.4</td>
</tr>
</tbody>
</table>

NNIS: National Nosocomial Infection Surveillance; SENIC: Study on the Efficacy of Nosocomial Infection Control; Infection (+): Observed Surgical Site Infection; Infection (-): no surgical site infection observed.

Figure 1. ROC curve analysis.

Analysis with aROC curve, in recent study, neither NNIS nor SENIC are perfect risk indexes. But when compare them with each other NNIS is more reliable than SENIC (0.67) with aROC value of 0.70.

As a result both NNIS and SENIC is a good risk indexes but not perfect. Scarcely when NNIS and SENIC is used together to predict the SSI they forecast the development of infection better. But there is a lot of other factors that effect the development of SSI, so for excellent surveillance risk index those factors known by everyone must be added to risk index scales.

5. References


