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External Validation of SENIC and NNIS Scores for Predictıng 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 theNNIS and SENIC risk indexes in colorectal surgery. Methods: Between January 2003 and December 2006, surgical site ınfection 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 patiens with SSI was 27.8.Results: 6 insicional surgical site infection were observed during the study. According to Receiver Operating Characteric (ROC) curve analyze neither NNIS with avalue of 0.70, nor SENIC with a value of 0.67 are perfect risk indexes. Conclusion: As a result both NNIS and SENIC ıs 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, acconting 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 prevantive measure for reducing such infections. (3) A succesfull surveillance system that uses standart definitions, which feedsback 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 assesment 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 cesaerean 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

Betwen 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 fallows: 1) Preoperative American Society of Anesthesiologists (ASA) score; 2) The traditional surgical wound classification; 3) T time "defined as the 75 th percentile of the duration for operative procedure and the components of the SENIC(7) surgical patient risk index used in this study were as fallows: 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 patiens with SSI was 27.8.

The aROC of NNIS was 0.70, compered with the SENIC score which had an aROC of 0.67 (**Figure 1**). İf aROC is 1this 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 assesed. 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 to feedback to hospitals and stimulate infection control activities. An adequate method for risk adjustment is important for the comperison 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 cardiothorasic procedures; as a result, the authers of these studies have proposed modifications that improve risk scoring systems. (5)

Data from the NNIS system suggest that approimately %50 of all SSIs diagnosed in the United States are superficial insicional SSIs. (7) Therefore only insicioinal 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 patiens were excluded from the study, only electicve 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 corelation of SENIC score with postoperative wound ınfection is higher than NNIS, according to discrimination

Table 1. Demographic and clinical characteristics of patients.

Characteristics	Number (%)	Characteristics	Number (%)	Characteristics	Number (%)
Gender		NNIS		Infection (-)	101(94.4)
Male	41(38.3)	0	71(66.4)	Infection (+)	6(5.6)
Female	66(61.7)	1	32(29.9)		
		2	2(1.9)		
		3	2(1.9)		
BMI		ASEPSIS		Age	20-95(av.58.4)
<25	25(23.3)	1(0-10)	88(82.2)		
25-30	65(60.7)	2(11-20)	13(12.1)		
30>	17(15.8)	3(21-30)	5(4.7)		
		4(31-40)	0		
		5(41)	1(0.9)		
ASA		SENIC		Symptoms	Stomachace
1	16(15)	0	58(54.2)		Constipation
2	55(51.4)	1	42(39.3)		
3	35(32.7)	2	5(4.7)		
4	1(0.9)	3	2(1.9)		
		4	0		

BMI: Body Mass Index; **ASA**: American Society of Anesthesiologists; **NNIS**: National Nosocomial Infection Surveillance; **ASEPSİS**: 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.

	Infection (+)	Infection (-)	Overall percentage
NNIS	86.2	49	68.8%
SENIC	46.6	78.4	61.5%

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

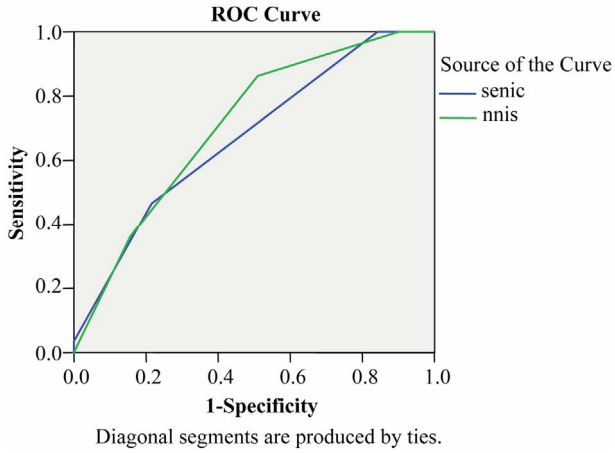

Figure 1. Roc curve analysis.

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

As a result both NNIS and SENIC ıs 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

[1] A. C. A. Clements, E. N. C. Tong, A. P. Morton and M. Whitby, "Risk Stratification for Surgical Site Infections in Australia: Evaluation of the US National Nosocomial Infection Surveillance Risk Index," *Journal of Hospital Infection*, Vol. 66, No. 2, 2007, pp. 148-155. doi:10.1016/j.jhin.2007.02.019

[2] J. I. Barrasa Villar, I. Domingo Cuevas, F. Vizmanos Sevilla, "Use of the NNIS Index for Determining the Intrinsic Risk of Surgical Infection," *Medicina clínica Facultad de Medicina de Barcelona* , Vol. 107, No. 20, 1996, pp. 767-771.

[3] Christian Brandt, Sonja Hanmsen, Dorit Sohr, Franz

Dascher and Henning Rüden; "Finding a Method for Optimizing Risk Adjustment when Comparing Surgical-Site Infection Rates," *Infection Control and Hospital Epidemiology*, Vol. 25, No. 4, 2004, pp. 313-318. doi:10.1086/502398

[4] D. H. Culver, T. C. Horan and R. P. Gaynes, "Surgical Wound Infection Rates by Wound Class, Operative Procedure, and Patient Risk Index: Nasional Nosocomial Infections Surveillance System," *American Journal of Medicine*, Vol. 91, 1991; pp. 152-157. doi:10.1016/0002-9343(91)90361-Z

[5] J. Devrick, Anderson, F. Luke Chen, J. Daniel Sexton, "Complex Surgical Site Infetcions and the Devilish Details of Risk Adjustment: Important Implications for Public Reporting," *Infection Control and Hospital Epidemiology*, Vol. 29, No. 10, 2008, pp. 941-946.

[6] L. P. E. Eveline Geubbles, PhD; E. Diederick Grobbee, MD PhD; "İmproved Risk Adjustment for Comperison of Surgical Site Infection Rates," *Infection Control and Hospital Epidemiology*, Vol. 27, No. 12, 2006, pp. 1330-1339.

[7] Gaynes RP, Culver DH, Horan TC, Edwards JR, Ricards C, Tolson JS. "Surgical Site Infection (SSI) Rates in the United States, 1992-1998: the National Nosocomial İnfections Surveillance System Basic SSI Risk Index," *Clinical Infectious Diseases*, Vol. 33, 2001, pp. 69-77. doi:10.1086/321860

[8] R. W. Haley, D. H. Culver, W. M. Morgan, J. W. White, T. G. Emori, T. M. Hootan,. "Identifying Patient at High Risk of Surgical Wound Infection: a Simple Multivariate Index of Patient Susceptibility and Wound Contamination," *American Journal of Epidemiology*, Vol. 121, No. 2, 1985, pp. 6-15.

[9] A. M. Korinek. "Risk Factors for Neurosurgical Site Infections after Craniotomy: a Prospective Multicenter Study of 2944 Patients: the French Study Group of Neurosurgical Nfections, the SEHP and the C-CLİN Paris-Nord, Service Epidemiologie Hygiene et Prevention," *Neurosrgery*, Vol. 41, No. 5, 1997, pp. 1073-1079. doi:10.1097/00006123-199711000-00010

[10] Maria lea campos, MD, MSC, R. N. Zulmira Miotello Cipriaono,; Paulo Fontoura, MD, PhD. "Suitabılıty of the NNIS Index for Estimating Surgical-Site Infection Risk at a Small University Hospital in Brazil," *Infection Control and Hospital Epidemiology*, Vol. 22, 2001, pp. 268-272. doi:10.1086/501898

[11] N. Deborah Friedman, MBBS, FRACP; L. Ann Bull, PhD; L. Philip Russo, MClinEpid; Lyle Gurrin, PhD;Michael Richards, MBBS, FRACP, MD. "Performance of the National Nosocomial Infections Suveillance Risk Index in Predicting Surgical Site Infection in Australia," *Infection Control and Hospital Epidemiology*, Vol. 28, No. 1, 2007, pp. 55-59. doi:10.1086/509848

[12] L. Robert Smith, MD, K. Jamie Bohl, MD, T. Shannon McElearney, MD, M. Charles Friel, MD, M. Margaret, R. N. Barclay, G. Robert. *et al.* "Wound Infection After Elective Colorectal Resection," *Annals of Surgery*, Vol. 239, No. 5, 2004,.

[13] R. Tang, H. H. Chen, Y. L. Wang, *et al.* "Risk Factors for Surgical Site Infection after Elective Resection of the Colon and Rectum: A Single-Center Prospective Study of 2809 Consecutive Patients," *Annals of Surgery*, Vol. 234, No. 2, 2001, pp. 181-189. doi:10.1097/00000658-200108000-00007

[14] S. Topaloglu, M. Akın, H. Ozel, E. Polat, T. Akın, *et al.* "Correlation of Risk and Postoperative Assessment Methods in Wound Surveillance," *Journal of Surgical Research*, Vol. 146, No. 2, 2008, pp. 211-217. doi:10.1016/j.jss.2007.05.016

[15] Yoke-Fong Chıew And Jean-Claude Theıs. "Comparıson Of Infectıon Rate Usıng Dıfferent Methods Of Assessment For Surveıllance Of Total Hip Replacementsurgıcal Sıte Infectıons," *Australian and New Zealand Journal of Surgery*, Vol. 77, 2007, pp. 535-539.

