Original Research Paper

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Performance of National Nosocomial Infection Surveillance System (NNIS) Risk Index in Predicting Surgical Site Infections

Medical Science

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ABSTRACT

Back ground:*Hospital acquired infection remains a major health care problem not only in in India but also in other developed countries.No surveillance system exists in the country to predict and stratify the risk of surgical site infections (SSIs). The aim was to know the performance of NNIS composite risk index score system in Indian general surgical patients at career institute of medical sciences hospital,luck now.*

Method:*This is a prospective observational study conducted over a period of 11/2year fromDecember 2014 to July 2016 at Institute of medical science hospitallucknow. All the cases of department general surgery operated either on elective or emergency basis were included. Their ASA category was noted from anaesthetist chart while operative duration and wound class was determined by operating surgeon. Surgical site infection (SSIs) was assessed by surgeon and NNIS risk index score was calculated. All the data were collected complied, analyzed and following observations were made.*

Results:*A total of268 patients were included in the study. Age ranged from3.3-76 years with mean and standard deviation34.44± 19.16 years. Of 268 cases 151 were males and 117were females. Patients were grouped into ASA category score <3 and ≥3. The incidence of SSIs rate of 20.8%, 22.3%, 41.9% and 50.0% were associated with NNIS risk index score 0, 1, 2 and 3 respectively. There was increasing trend of SSIs with rising NNIS risk index score from 0-3*

Conclusion: *The findings of the present study validate that NNIS risk index is good predictor of SSIs in general surgical cases. Thus it can be applied for assessment of risk for SSIs in general surgical cases*

Introduction

Surgical site infections (SSIs), pneumonia, wound dehiscence; urinary tract infection (UTI), sepsis and mortality are the most common serious consequences of operative interventions. [1,2]SSIs cause prolonged hospitalization, increase mortality and morbidity and huge economic burden to the patient and the state.[3]Surveillance of SSIs with feedback of appropriate data to surgeons has been shown to be an important component of strategies to reduce SSIs 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.[4]The above system of risk stratification is not out of limitations because by a single factor we cannot predict the overall outcome. Recently 'National Nosocomial Infections Surveillance' (NNIS) system has recommended composite risk index (scoring system) to predict SSIs and stratify the patient in different risk categories. It consists of two host and one operation related risk factors. These are American Society of Anesthesiologists (ASA) score, wound class and length of surgery. The aim of study was to validate the performance of NNIS risk index scoring system in predicting the SSIs, in general surgical patients.

Material and methods

This is a prospective observationalstudy conducted over a duration of 1.5 years (December 2014-July 2016)) at career institute of medical sciences,Lucknow. All general surgical cases operated on elective or emergency basis and met the criteria of inclusion, were included.*Inclusion criteria* were , patients who gave consent for participation in the study , survived and came for regular follow up for 30 days in cases without prosthesis and 1 year with prosthesis.*Exclusion criteria*were, patients who did not consent for participation in the study, lost in follow up or died <24 hours of surgery. Patients ASA was noted from anesthetist chart while operative duration and wound class was determined by operating surgeon. Patients were followed up to 30 days without and 1 year with prosthesis. Surgical site infection (SSIs) was assessed by surgeon and surgical wound was classified according to the traditional wound-classification system as given in material and method section and NNIS risk index scoring (ASA, length of surgery, wound class) were calculated as given in table 2.

Physical Status Classification System refers to the American Society of Anesthesiology(ASA) class and is a numerical quantification of disease severity in patients undergoing general anesthesia which was *introduced by the American Society of Anesthesiologists* (*ASA, 1999).* This classification is a relatively standardized scoring scheme developed to stratify anesthesia risk. Studies have demonstrated that ASA class is a useful indicator of host susceptibility to infection for epidemiological purposes. The stratification of ASA is as follows: *0 – Allocated when the ASA cannot be established, 1 – A normal healthy patient, 2 – A patient with mild systemic disease,3 – A patient with severe systemic disease , 4 – A patient with severe systemic disease that is a constant threat to life ,5 – A moribund patient who is not expected to survive without the operation.* ASA score ≥ 3 are allotted 1 point.

The length of surgery is demonstrated as a risk factor for SSIs. The > 75th percentile of the allotted time is given as score 1 point. The category of surgical procedure, duration and 75th percentile of assigned is given below in table 1 which was taken for study.

Table 1.category of surgical procedure, duration assigned and 75th percentile of assigned time

Category of surgical procedures	Time (hours)	75th percentile of time of operation (minutes)
Exploratory laparotomy	2	90
Lap cholecystectomy	1.5	67
Open cholecystectomy	2	90
Small and Large bowel surgery	3	135
Herniorrhaphy	2	90
Gastric surgery	3	135
Splenectomy	3	135
Mastectomy	3	135
Appendectomy(open)	2	90

Prostatectomy	4	180
Bile duct ,liver, pancreas	5	225
Nephrectomy	4	180
Other genitourinary	2	90
Other digestive	2	90

The Surgical Wound classification was adapted from the CDC Guideline for the Prevention of Surgical Site Infection, 1999. It is preferable that the degree of contamination is classified at the time of incision by the surgical team. The wound was classified on the basis of severity of contamination into Clean (category -1), Clean-Contaminated (category -2), Contaminated (category -3), Dirty-Infected (category-4)

Grading of NNIS score system includes three independent risk factors. These were ASA class, wound class .time taken to perform surgery. ASA class <3, class-1,2 wound and length of surgery <2 hours (or ≤75th percentile assigned time allocated to particular procedure) were given zero point while 1 point was allocated to each three risk factors , if there is ASA class ≥3 , wound class 3 and 4and surgery longer than 2 hours (or ≥75th percentile of assigned time) as given in table 1

Table 2. The National Nosocomial Infection surveillance (NNIS) risk index classification for predicting surgical site infection

Risk factor	Score ascribed	
	0	1
Physical condition of the patient according to the ASA classification	<3	≥3
Class of contamination of surgical wound according to National Research Council (NRC)classification	Clean or Clean contaminated wound (Class 1and 2)	Contaminated or Dirty wound (class 3 and 4)
Length of surgery(in term of the 75th percentile of the procedure)	≤75	≥75

Collected data analyzed manually and following results were obtained.

Results

Total of 268 patients were included in this study. Age ranged from3.3-76 years with mean of 34.44(± 19.16)years. Of 268 cases 151 were males and 117were females. Patients were grouped into ASA category score <3 and **≥3**. Out of 268 cases, 264 falls in ASA category <3 and 04 fall in ASA category ≥3. Of 264 cases of ASA category <3; 72,130 and 62 cases fall in ASA 0, 1, 2 respectively. Patient's stratification in wound class revealed that out of 286; 14, 105 and 149 cases fall in wound class1, 2,≥3 respectively. The incidence of SSIs rate of 20.8%, 22.3%, 41.9% and 50.0% were associated with NNIS risk index score 0, 1, 2 and 3 respectively. This observation shows increasing trend of SSIs with increasing NNIS risk index score(Table 3).

Table 3. Characteristics of Operated Patients

Characteristics	No. of cases(N)	SSI N (%)
Sex Male Female	 151 117	
Age group 0-18 19-64	 57 211	
ASA score	264	70 (26.5)
≤2	72	15 (20.8)
0	130	29 (22.3)
1	62	26 (41.9)
2	04	02 (50.0)
≥3		
Wound class Clean (class1) Clean contaminated(class <3) Contaminated/ dirty (class ≥3)	 14 105 149	 01 (7.1) 22 (20.9) 49 (32.9)

Data in parentheses () is percentage

Table 4. NNIS Risk index score and SSI

NNIS Risk Index score	Number of operations	SSI	
		Number of cases	Percentage (%)
0	077	17	21.50%
1	128	31	24.21%
2	060	24	43.30%
3	003	02	66.60%
Total	268	70	

Considering the SSIs and NNIS risk index score, there is increase in SSIs rate with increase in NNIS risk index score. SSIs rates were 21.5%, 24.16%.43.3% and 66.60% in NNIS risk index score 0, 1, 2, and 3(Table 4).

Table 5. Distribution of SSIs according to type of operation and NNIS risk index score

Operation	Total cases (N)	SSI N (%)	NNIS risk index Score and SSI							
			0		1		2		3	
			Heal. N	SSI N (%)	Heal. N	SSI N (%)	Heal. N	SSI N (%)	Heal. N	SSI N (%)
Hernia	11	3 (27.3)	4	1 (20.0)	4	2 (33.3)	----	----	----	---
Appendectomy	116	21 (18.1)	25	3(10.7)	57	9 (13.6)	15	6 (30.8)	1	1(50)
Gut surgeries*	44	15 (34.0)	6	1 (14. 8)	13	6 (31.5)	10	8 (44.4)	----	----
Cholecystectomy Open Lap	 14 27	 5 (35.7) 5 (18.5)	 8 9	 4 (33,3) 3 (25.0)	 1 10	 1 (50.0) 4 (28.5)	 --- 1	 ---- 1 (50.0)	 ---- -----	 ---- -----
Peptic ulcer perforation	20	5 (25.0)	----	----	7	1(12.5)	7	4 (36.4)	---	1(100)
GUT	28	13 (46.4)	7	4 (36.4)	4	4 (50.5)	4	5 (55.5)	---	----
Others	08	5 (63.5)	3	1(33.3)	3	2 (40.0)	2	2 (50.0)		
Total	268	72 (26.9)	62	17(21.5)	99	29(24.2)	34	29(43.3)	1	2 (66.6)

Lap=laparoscopic, Gut surgeries=Small and large bowel disease, Chole=cholecystectomies. GUT=genitourinary tract,Heal.=Healthy wound

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Distribution of SSIs according to type of operation and NNIS risk index score. There is increase in the rate of SSIs with increases NNIS risk index score. The SSIs rate in NNIS risk index score 0, 1, 2 and 3 are 21.5%, 24.2%,43.3% and 66.6% respectively (Table 5).

Discussion

Nosocomial infection is a major health problem not only in developing countries but in developed countries like USA and UK.[5,6] NNIS reported 18.7% rate of SSIs in a survey covering a period of 2 Years (1993-1995) from Brazil) [7,8] In contrast to above report some authors reported as low as 2.8% and as high as 20%.The incidence of SSIs differsfrom country to country and from hospital to hospital in the same country. It is in accordance to the different systems employed for the epidemiological control of hospital infections, clinical condition of the patients and the type of procedures performed. [8,9 ,10,11]The overall incidence of 26.11% of SSI was observed in this study. It is higher than the maximum reported by NNIS.[7,8] This may be because lack of resources and less adherence to the strict aseptic protocol. We do not have previous reliable data in our hospital to compare the rate of SSIs.

Present study also revealed that increase in NNIS risk index score is associated with increase in the rates of SSIs. Increase in NNIS score from 0-3 was associated with increased in SSI rate of 21.5% to 66% respectively. This observation is consistent with reports of previous workers who also demonstrated a similar trend of SSIs increase with increase in NNIS risk index score.[12, 13, 14]

It is argued by various authors that NNIS risk index score is applicable in only over all prediction of SSIs rates but it does not stratify when applied to individual type of surgeries. However; present study revealed that it is not only good SSIs predictor of global analysis but also of specific abdominal surgical procedures like hernia repair, appendicectomies,small and large bowel surgeries, peptic ulcer perforation and peritonitis surgeries, genitourinary tract surgeries and open cholecystectomies (Table 5). There was increase in SSIs rates with increase in NNIS index score from 0-3(Table 3). These findings were in agreement with previous study who favors NNIS risk index score system.[15]

Startling and colleagues,[15] Culver and co-workers [12]are among those who are notin favourof NNIS risk index scoring system for analysis of SSIs. Their argument was that, it is not equally effective in all individual procedures. In some specific procedures (26%), the method was quite efficient allowing the stratification of the population in three or four categories. While in other procedures (52%), the efficiency was reasonable with stratification of the population in two categories. However, in some procedures (22%), the efficiency of the method was very poor since the entire population was classified in just one category. Startling and colleagues[15]recommended that other specific risk factors should be included in the analysis of some surgeries (myocardium revascularization, nephrectomy, implant of ventricular shunt, transplant and hip prosthesis).A similar conclusion was also drawn by Culver and co-workers in their study. [12]

Among minimal access surgeries, the present study included only laparoscopic cholecystectomy in which NNIS risk index score have shown the rising trend of SSIs with rise in NNIS risk score. NNIs risk index hold promise for laparoscopic surgery too. While some authors like Gaynes and colleagues[16]had shown limitation in NNISrisk index scoring system in laparoscopic surgery because when NNIS was developed,most of the surgeries were performed as open method. Now the scenario of operative approach has changed (1992) with introduction of laparoscopy and endoscopy, a minimal invasive laparoscopic approach .This has reduced the incidence rate of SSIs. He suggested [16] that there is need to consider some more factors in the computation of the NNIS risk index associated with minimal access and stomach and colon surgeries.

Over all, there is no agreement on the prediction of risk of SSIs by NNIS risk index scoring system. Some authors are in favor [12-14, 17]while other are not in favor.[16,18,19]Those who are in favor recommend that NNIS risk index score system is good predictor of SSIs. They are in the impression that simple and uncomplicated structure of the NNIS risk index scoring system is the main advantage and this index should be adopted as a tool for epidemiological surveillance.[12-15] *In complete contrast*, authors of several studies are not in agreement that NNIS riskindex scoringsystem as good predictor of SSIs. They recommend either it should not be used or to be modified.[18,20,21] However, the present study validates that NNIS risk index score system isa good predictor of SSIs for overall and individual general surgeries.

Even though there is difference in opinion regarding the ability of various systems to predict risk of SSIs. Observations of this study support that NNIS risk index stratifies patients well in different categories and are good predictor of SSIs. This could be because NNIS risk index includes three variable (two patient related and one operator related) while traditional system involves only one variable i.e. contamination potential of surgical wound.Thus performance of NNIS risk index in predicting SSIs rates is more superior and reliable than traditional wound classification system.[17, 22, 23]

Conclusion

The observationof the present study validates that NNIS risk index is a good predictor of SSIs in general surgical cases. It is also equally effective in predicting overall SSIs and SSIs in variety of individual procedures. Thus it can be applied for assessment of risk for infection in general surgical cases.

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