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Incidence and Risk Factors Associated with Surgical Site Infection Following Different Types of Hepatobiliary Surgery

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ABSTRACT

Background:
Surgical site infection (SSI) is one of the most common healthcare-associated infections (HAIs). SSI following hepatobiliary surgery is not well described. This study aims to describe and assess factors associated with SSI following hepatobiliary surgery in Japan, using a Japanese national database for HAIs.

Methods:
Data on hepatobiliary surgeries performed between 2012 and 2014 were extracted from a national surveillance system for healthcare-associated infections, Japan Nosocomial Infections Surveillance (JANIS). Hepatobiliary surgery was divided into three types; pancreaticoduodenectomy (BILI-PD), liver resection (BILI-L) and others (BILI-O). Factors associated with SSI following three types of hepatobiliary surgery were assessed using multivariate logistic regression analysis.

Results:
The overall incidence of SSI following hepatobiliary surgery was 15.6% (2,873/18,398). Incidence of SSI following BILI-PD was 28.0%. It was significantly higher than that following BILI-L and BILI-O (8.8% and 15.5%, respectively). Among the four traditional risk factors included in the National Nosocomial Infections Surveillance (NNIS) modified risk index, American Society of Anesthesiologists (ASA) score were insignificant in predicting SSI in the final model for all of three types of surgery. Use of laparoscope was a protective risk factor in BILI-L and BILI-O, but not in BILI-PD. Additional risk factors were identified, including age in all types of hepatobiliary surgery and male gender in BILI-PD and BILI-O.

Conclusions:
Incidence of SSI and risk factors associated with SSI were significantly different among three types of hepatobiliary surgery. In order to accurately compare hospital performance regarding SSI following hepatobiliary surgery, dividing the operative procedure category in the surveillance system into three types is needed.

INTRODUCTION

- Incidence of SSI has long been risk stratified using the National Nosocomial Infections Surveillance (NNIS) risk index, which consists of three variables: the American Society of Anesthesiologist's (ASA) score, wound class, and duration of operation
- In NNIS and National Healthcare Safety Network (NHSN), hepatobiliary surgery is coded as a single operative procedure, BILI. It includes various types of surgeries, which are substantially different in the duration and range of organs manipulated during the operation, suggesting the need for sub-classification of operative procedures in this area
- The aim of this study was to describe the incidence and identify risk factors of SSI in patients who underwent different types of hepatobiliary surgery using the large cohort of surveillance data collected in the Japanese national surveillance system

METHODS

Study Design & Setting:
- Analysis of data on hepatobiliary surgeries performed in the year 2012, 2013 and 2014
- Extracted from a Japanese national surveillance system, Japan Nosocomial Infection Surveillance (JANIS)
- Hepatobiliary surgery was divided into the following three types:
  - Pancreaticoduodenectomy (BILI-PD)
  - Simple liver resection (without reconstruction of biliary duct) (BILI-L)
  - Others (BILI-O)

Statistics
- Risk factors for SSI were analyzed by univariate analysis
- Continuous variables were divided into quartiles and assessed prior to the multivariate analysis for the best modeling
- Multivariate analysis were done using a stepwise logistic regression model

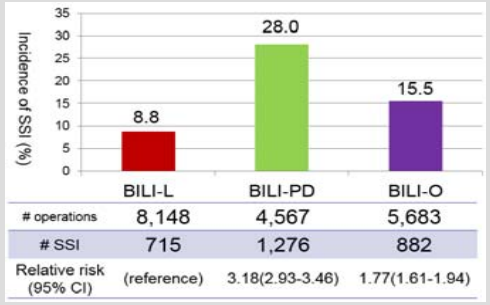
Variables collected in the JANIS system

NNIS risk index variables
- Duration of operation
- Wound class
- ASA score

Additional variables
- Age
- Gender
- Emergency
- Laparoscope use

RESULTS

1: Incidence of SSI following different types of hepatobiliary surgery



	BILI-L	BILI-PD	BILI-O
# operations	8,148	4,567	5,683
# SSI	715	1,276	882
Relative risk (95% CI)	(reference)	3.18(2.93-3.46)	1.77(1.61-1.94)

RESULTS

3: Multivariate analysis: risk factors for SSI

	Adjusted odds ratio (95% CI)		
	BILI-L	**BILI-PD**	**BILI-O**
Duration of operation (increase in 10 minutes)	1.03(1.03-1.04)	1.02(1.02-1.02)	1.03(1.02-1.03)
Wound class	1.41(1.07-1.86)	1.41(1.12-1.79)	1.71(1.44-2.03)
ASA score	----------	----------	----------
Laparoscope	0.52(0.41-0.66)	----------	0.60(0.48-0.76)
Age	1.01(1.00-1.02) (increase in 1 year)	1.36(1.16-1.58) (≥64 vs. ≤63)	1.21(1.11-1.33) (≥70 vs 63≤age≤69 vs ≤62)
Gender (male vs. female)	----------	1.37(1.20-1.58)	1.22(1.05-1.42)

2: Univariate analysis: Potential risk factors for SSI in BILI-L, BILI-PD and BILI-O

BILI-L

Variables	# procedures	# SSIs	Incidence of SSI (%)	p value
Duration (in minutes)				<.0001
<=200	2077	90	4.3	
201-281	1999	124	6.2	
282-388	2036	191	9.4	
>=383	2036	310	15.2	
Wound class				.0025
I	515	32	6.2	
II	7492	660	8.8	
III	124	20	16.1	
IV	17	3	17.7	
ASA score				.58
1	1136	86	7.6	
2	5851	523	8.9	
3	1142	105	9.2	
4	17	1	5.9	
5	2	0	0.0	
Age				.086
0-62	2160	168	7.8	
63-69	2062	181	8.8	
70-75	1951	168	8.6	
>=76	1975	198	10.0	
Gender				.042
Male	5535	510	9.2	
Female	2613	205	7.9	
Emergency				.84
Yes	74	6	8.1	
No	8074	709	8.8	
Laparoscope				<.0001
Yes	1662	86	5.2	
No	6486	629	9.7	

BILI-PD

Variables	# procedures	# SSIs	Incidence of SSI (%)	p value
Duration (in minutes)				<.0001
<=360	1156	249	21.5	
361-448	1130	284	25.1	
449-546	1150	318	27.7	
>=547	1131	425	37.6	
Wound class				<.0001
I	142	29	20.4	
II	4256	1185	27.8	
III	154	58	37.7	
IV	15	4	26.7	
ASA score				.025
1	620	150	24.2	
2	3256	939	28.8	
3	677	184	27.2	
4	14	3	21.4	
5	0	0	-----	
Age				.011
0-63	1164	282	24.2	
64-70	1225	350	28.6	
71-76	1199	357	29.8	
>=77	979	287	29.3	
Gender				<.0001
Male	2792	860	30.8	
Female	1775	416	23.4	
Emergency				.54
Yes	57	18	31.6	
No	4510	1258	27.9	
Laparoscope				.94
Yes	141	39	27.7	
No	4426	1237	28.0	

BILI-O

Variables	# procedures	# SSIs	Incidence of SSI (%)	p value
Duration (in minutes)				<.0001
<=170	1421	115	8.1	
171-252	1425	170	11.9	
253-372	1419	246	17.3	
>=373	1418	351	24.8	
Wound class				<.0001
I	370	31	8.4	
II	4995	774	15.5	
III	236	53	22.5	
IV	82	24	29.3	
ASA score				<.0001
1	956	101	10.6	
2	3791	645	17.0	
3	895	129	14.4	
4	36	6	16.6	
5	5	1	20.0	
Age				.0003
0-62	1570	198	12.6	
63-69	1275	188	14.8	
70-76	1443	249	17.3	
>=77	1395	247	17.7	
Gender				<.0001
Male	3330	571	17.2	
Female	2353	311	13.2	
Emergency				.22
Yes	246	45	18.3	
No	5437	837	15.4	
Laparoscope				<.0001
Yes	1042	92	8.8	
No	4641	790	17.0	

DISCUSSIONS

- When NNIS transitioned into NHSN, CDC reorganized some of the operative procedure categories for better stratification, including several types of vascular surgeries as independent procedures. However, hepatobiliary surgery remained in a single procedure category (BILI), even though it contained various types of surgery
- In Japan and other Asian countries, hepatobiliary disease is quite often experienced and surgeons aggressively treat the disease by resecting the lesion with adjacent organs, resulting in the extended and invasive operative procedures
- The incidence of SSI between sub-categorized operative procedures was significantly different
- Among the four variables included in the NNIS modified risk index (duration, wound class, ASA score, and laparoscope), ASA score was not significant in any of the sub-categorized procedures in the final model
- Age was a significant risk factor in all types of sub-categorized operative procedures
- Male gender was a risk factor in all types of hepatobiliary surgery in the univariate analysis, and remained significant in multivariate analysis in BILI-PD and BILI-O

CONCLUSIONS

- Incidence of SSI and risk factors associated with SSI were significantly different among three types of hepatobiliary surgery. In order to accurately compare hospital performance regarding SSI following hepatobiliary surgery, dividing the operative procedure category in the surveillance system into three types as well as incorporating additional risk factors such as age and gender is needed.

Funding: This study was supported in part by the grant from Ministry of Health and Welfare of Japan