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Nationwide Surveillance of Antimicrobial Susceptibility Patterns of Pathogens Isolated from Surgical Site Infections (SSI) in Japan

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ABSTRACT

Background: To investigate trends of antimicrobial resistance in pathogens isolated from SSI, Japanese surveillance committee conducted the first nationwide surveillance.
Methods: 7 main organisms from SSI were collected at 27 medical centers in 2010, and were shipped to a central laboratory for antimicrobial susceptibility testing. **Results:** A total of 702 isolates from 586 patients with SSI were included. *S.aureus* (20.4%) and *E. faecalis* (19.5%) were the most common isolates, followed by *P.aeruginosa* (15.4%) and *B. fragilis* group (15.4%). MRSA among *S.aureus* was 72.0%. Vancomycin MIC 2 μg/mL strains accounted for 9.7%. In *E.coli*, 11 of 95 strains produced extended spectrum β-lactamase (*K.pneumonia* 0/53 strains). Resistant *E.coli* strains were 8.4% to ceftazidime (CAZ), and 26.3% to ciprofloxacin (CPFX). None of *P.aeruginosa* strains produced metallo-β-lactamase. In *P. aeruginosa*, the resistance rates were 7.4% to tazobactam/piperacillin (TAZ/PIPC), 10.2% to imipenem (IPM), 2.8% to meropenem, cefepime, and CPFX, and 0% to gemtamicin. In *B.fragilis*, the rates were 28.6% to clindamycin, 5.7% to cefmetazole, 2.9% to TAZ/PIPC and IPM, and 0% to metoronidazole (*B.thetaiotaomicron*; 59.1%, 36.4%, 0%, 0%, 0%). Significantly higher rate of *Enterobacteriaceae* (p=0.020) and *B.fragilis* group (p=0.004) were observed within 7 d after surgery, and isolation of MRSA (p<0.001) and *P.aeruginosa* (p=0.081) increased during subsequent period. MIC_{90} of *P.aeruginosa* isolated 15 d or later after surgery rose in TAZ/PIPC, CAZ, IPM and CPFX. In patients with American Society of Anesthesiologists (ASA) score ≥3, the resistance rates of *P.aeruginosa* to TAZ/PIPC and CAZ were higher than those in patients with ASA≤2. **Conclusions:** Although the MRSA rate remained high and ESBL producing strains increased, many agents had high activity against SSI isolates. Timing of isolation from surgery and the patient's physical status affected the selection of resistant organisms.

BACKGROUND

Since 1998, Japanese Healthcare Associated Infections Surveillance (JHAIS) has published nationwide surgical site infection (SSI) surveillance data including incidence of SSI according to Natinal Nosocomial Infections Surveillance (NNIS) risk index category.

In 2010, Japanese surveillance committee consist of Japanese Society of Chemotherapy, Japanese Association for Infectious Diseases and Japanese Society for Clinical Microbiology conducted the first nationwide surveillance of antimicrobial susceptibility in organisms isolated from SSI.

MATERIALS AND METHODS

Seven main organisms (*Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter cloacae*, *Pseudomonas aeruginosa*, *Bacteroides* fragilis group, *Staphylococcus aureus*, *Enterococcus faecalis)* isolated from SSI were collected in 27 medical centers in Japan between Apr 2010 and Dec 2010, and were shipped to a central laboratory (Research Center for Anti-infective Drugs of the Kitasato Institute).

Antimicrobial susceptibility testing was conducted according to recommendations issued by the Clinical and Laboratory Standards Institute (CLSI). Thirty-one different antibacterial agents employed (especially, minocycline, vancomycin, teicoplanin, linezolid, clindamycin, erythromycin, sulfamethoxazole-trimethoprim, arbekacin, rifampin for MRSA and metronidazole, clindamycin, cefmetazole and 5 kinds of carbapenems for *B.fragilis* group).

Survey items concerning patient's characteristics was as follows: age, sex, primary disease, type of surgery, type of SSI (incisional, organ/space), isolated material, American Society of Anesthesiologists (ASA) physical status classification score, and duration of therapeutic antibiotic use and postoperative hospital stay until organisms isolation.

RESULTS

A total of 702 isolates (incisional 328, organ/space 374 strains) were included in the investigation. *S.aureus* (20.4%) and *Enterococcus faecalis* (19.5%) were the most common isolates. *Pseudomonas aeruginosa* (15.4%) and *Bacteroides fragilis* group (15.4%) were third with *Echerichia coli*, *Enterobacter cloacae* and *Klebsiella pneumonia* accounted for 13.5%, 8.8%, and 7.7% of isolates, respectively.

Three hundreds thirty six strains were isolated from lower gastroenterological surgery, 190 strains from hepatobiliary and pancreatic surgery, 73 strains from upper gastroenterological surgery, 68 strains from general surgery including breast surgery, and 30 strains from thoracic surgery (cardiovascular and respiratory tract).

Leading isolates were *S.aureus* in upper gastroenterological surgery, general surgery and thoracic surgery, *E.faecalis* in hepatobiliary and pancreatic surgery and *B.fragilis* group in lower gastroenterological surgery.

Table 1 Isolated organisms according to types of SSI

	Incisional SSI	Organ/space SSI	P-value
S.aureus	81 (24.7)	62 (16.6)	0.008
MRSA	53 (16.2)	50 (13.4)	
MSSA	28 (8.5)	12 (3.2)	
E.feacalis	55 (16.8)	82 (21.9)	0.085
Enterobacteriaceae	84 (25.6)	122 (32.6)	0.042
E.coli	37 (11.3)	58 (15.5)	
K.pneumonia	17 (5.2)	36 (9.6)	
E. cloacae	30 (9.1)	28 (7.5)	
P.aeruginosa	63 (19.2)	45 (12.0)	0.009
B.fragilis group	45 (13.7)	63 (16.8)	0.252

Table 2 Distribution of MICs against anti MRSA drugs in MRSA

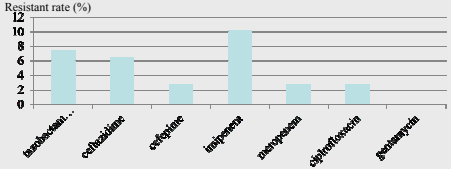
	% of organisms in each MIC					
	0.25	0.5	1 μg/mL	2 μg/mL	4 μg/mL	8
vancomycin		1.9	88.3	9.8		
teicoplanin	2.9	42.7	37.9	14.6		2.0
arbekacin	5.8	55.3	34.0	3.9		1.0
linezolid			24.3	71.8	3.9	

Table 3 Antibiotic resistant rate in *E.coli* and *K.pneuminia*

	Resistant rate (%)					
	cefazoline	cefmetazole	ceftazidime	cefepime	sulbactam/ ampicillin	Cipor-floxacin
E.coli 95 strains	37.9	5.3	8.4	1.1	20	26.3
K.pneumonia 53 strains	9.4	5.7	1.9	0	5.7	0

Incidence of ESBLproduction was 11.6% in *E.coli* and none of the strain produced in *K.pneumonia*

Figure 1 Antibiotic resistant rate of *P.aeruginosa* in each antibiotics



None of the strain produced metallo-β-lactamase in *P.aeruginosa*

Table 4 Antibiotic resistant rate in *B.fragilis* group

	Resistant rate (%)				
	clindamycin	cefmetazole	tazobactam /piperacillin	imipenem	Metroni-dazole
B.fragilis (n=70)	28.6	5.7	2.9	2.9	0
B.thetaio-taomicron (n=22)	59.1	36.4	0	0	0
Other *Bacteroides* (n=16)	43.8	43.8	0	0	0

Table 5 Organisms according to the duration of postoperative hospital stay until isolation

Organisms	% of isolation among all isolates		P-value
	Hospital stay ≦7 days	Hospital stay ≧8 days	
S.aureus	13.5	26.4	<0.001
MRSA	8.9	19.7	<0.001
MSSA	4.6	6.7	
E.feacalis	20.5	18.7	0.543
Enterobacteriaceae	33.6	25.6	0.020
E.coli	15.0	12.3	
K.pneumonia	8.3	6.9	
E. cloacae	10.4	6.4	
P.aeruginosa	12.8	17.6	0.081
B.fragilis group	19.6	11.7	0.004

Figure 2 MIC_{90} against *P.aeruginosa* in each antibiotics according to the duration of postoperative hospital stay and therapeutic antibiotic use until the isolation

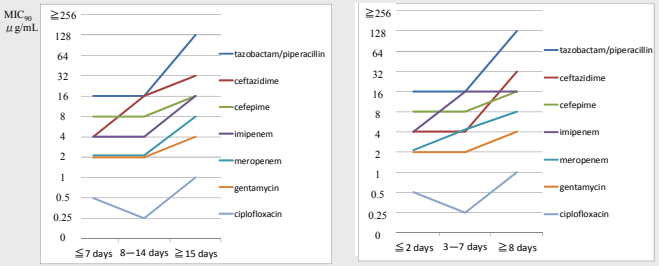
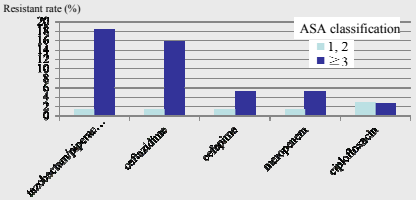


Figure 3 Antibiotic resistant rate in *P.aeruginosa* according to ASA physical status classification score



SUMMARY

MRSA among *S.aureus* was 72.0%. Vancomycin MIC 2 μg/mL strains accounted for 9.7%. In *E.coli*, 11 of 95 strains produced extended spectrum β-lactamase (*K.pneumonia* 0/53 strains). Resistant *E.coli* strains were 8.4% to ceftazidime (CAZ), and 26.3% to ciprofloxacin (CPFX). None of *P.aeruginosa* strains produced metallo-β-lactamase. In *P. aeruginosa*, the resistance rates were 7.4% to tazobactam/piperacillin (TAZ/PIPC), 10.2% to imipenem (IPM), 2.8% to meropenem, cefepime, and CPFX, and 0% to gemtamicin. In *B.fragilis*, the rates were 28.6% to clindamycin, 5.7% to cefmetazole, 2.9% to TAZ/PIPC and IPM, and 0% to metoronidazole (*B.thetaiotaomicron*; 59.1%, 36.4%, 0%, 0%, 0%).

Significantly higher rate of *Enterobacteriaceae* (p=0.020) and *B.fragilis* group (p=0.004) were observed within 7 d after surgery, and isolation of MRSA (p<0.001) and *P.aeruginosa* (p=0.081) increased during subsequent period.
MIC_{90} of *P.aeruginosa* isolated 15 d or later after surgery rose in TAZ/PIPC, CAZ, IPM and CPFX.
In patients with ASA score ≥3, the resistance rates of *P.aeruginosa* to TAZ/PIPC and CAZ were higher than those in patients with ASA≤2.

CONCLUSIONS

Although the MRSA rate remained high and ESBL producing strains increased, many agents had high activity against SSI isolates. Timing of isolation from surgery and duration of antibiotic use and the patient's physical status affected the selection of resistant organisms in *P.aeruginosa*.