CIR ESP. 2010;88(5):319–327

CIRUGÍA ESPAÑOLA

www.elsevier.es/cirugia

Original article

Surgical site infection in a tertiary hospital. A prospective surveillance study (2001-2004)

Aurora Llanos Méndez,[a,] Carmen Díaz Molina,[b] and Rafael Fernández-Crehuet Navajas[c]*

[a]Agencia de Evaluación de Tecnologías Sanitarias de Andalucía, Consejería de Salud, Junta de Andalucía, Sevilla, Spain
[b]Hospital Universitario Reina Sofía, Servicio de Medicina Preventiva, Córdoba, Spain
[c]Cátedra de Medicina Preventiva y Salud Pública, Facultad de Medicina, Universidad de Córdoba, Córdoba, Spain

ARTICLE INFORMATION

Article history:
Received February 23, 2010
Accepted August 28, 2010

Keywords:
Infection control
Surgical site infection
Cross-infection

A B S T R A C T

Introduction: Surgical site infection (SSI) is a very common problem in hospital infection control. It represents a risk for the safety of the patient and therefore its reduction is a priority in Health Services. The aim of the study is to analyse the incidence of SSI in the surgical departments of a tertiary hospital.
Material and methods: A prospective cohort study was conducted on 14,455 patients admitted from January 2001 to December 2004. The cumulative incidence (CI) crude and adjusted for the National Nosocomial Infection Surveillance (NNIS) index and the incidence density (ID) of SSI were calculated.
Results: The CI of patients with SSI was 3.4% (95% CI: 3.0%-3.7%), the CI of SSI was 3.5% and the observed ID was 0.28/100 surgical patients/day. Surgical units with the highest CI were maxillofacial (6%), gastrointestinal (5.3%) and cardiovascular (5.1%). Adjusting for length of stay, urology and paediatric surgery recorded the highest incidence rates, while ophthalmology and neurosurgery had the least. Colorectal surgery had the highest parameters (CI=10%; ID=0.57), followed by myocardial revascularisation and hip prosthesis. Among the surgical units and operative procedures assessed, the CI of SSI increased with the NNIS index.
Conclusions: The CI and ID of SSI observed in this study were similar to those obtained in previous European surveillance projects, and lower than those recorded in our hospital in 1994 which reflects a higher level of vigilance and a higher awareness in applying control measures.

Infección quirúrgica en un hospital de tercer nivel. Estudio de vigilancia prospectivo (2001-2004)

Palabras clave:
Control de la infección
Infección quirúrgica

R E S U M E N

Introducción: La infección de localización quirúrgica (ILQ), superficial y profunda, es un problema muy frecuente dentro de la infección hospitalaria. Supone un riesgo para la seguridad del paciente y, por tanto, su reducción es una prioridad para los sistemas sanitarios.

*Corresponding author.
E-mail address: aurora.llanos.ext@juntadeandalucia.es (A. Llanos Méndez).

Infección cruzada

El objetivo del estudio fue analizar la incidencia de ILQ en los servicios quirúrgicos de un hospital de tercer nivel.

Material y métodos: Estudio de cohortes prospectivo sobre 14.455 pacientes ingresados desde enero de 2001 hasta diciembre de 2004. Se calcularon la incidencia acumulada (IA), cruda y ajustada por el índice del National Nosocomial Infection Surveillance (NNIS) y densidad de incidencia (DI) de ILQ.

Resultados: La IA de pacientes con ILQ fue 3,4% (IC 95%: 3,0-3,7%), la IA de ILQ 3,5% (IC 95%: 3,2-3,8%) y la DI 0,28/100 pacientes intervenidos-día. Las unidades con IA más elevadas fueron cirugía maxilofacial (6%), digestiva (5,3%) y cardiovascular (5,1%). Ajustando por la estancia, urología y cirugía pediátrica registraron las mayores tasas de incidencia, mientras que oftalmología y neurocirugía obtuvieron las menores. La cirugía de colon y recto tuvieron los parámetros más elevados (IA = 10%; DI = 0,57), seguido de la revascularización miocárdica y la prótesis de cadera. En el conjunto de las unidades y en los procedimientos investigados, la IA de ILQ aumentó con el índice NNIS.

Conclusiones: La IA y la DI de ILQ fueron similares a las obtenidas en los proyectos de vigilancia europeos e inferiores a las registradas en 1994 en este mismo hospital, reflejo de una mayor intensidad en la vigilancia y de una mayor concienciación en la aplicación de sus medidas de control.

Introduction

Among patients who underwent surgery, surgical site infection (SSI)–incisional, superficial and organ space–is the most common complication and cause of mortality, morbidity and increased costs. According to the American National Nosocomial Infection Surveillance (NNIS), it is responsible for between 14% and 16% of all nosocomial infections (NI), and is the third most common location. In addition, it is estimated that SSI is responsible for over 20 000 hospital deaths annually and an increase of hospital stay of 7.3 days, with an additional cost of $3152 per patient.[1,2]

Scientific evidence shows that the implementation of appropriate NI surveillance and control systems results in lower overall incidence figures, between 19% and 41%.[2,3] Therefore, these systems have been established in many countries, including targeted SSI Surveillance: Surgical Site Infection Surveillance (SSIS) in England,[4] NNIS in the USA,[5] Network for Prevention of Nosocomial Infections through Surveillance (PREZIES) in Holland,[2] Hospital in Europe Link for Infection Control through Surveillance (HELICS-SSI) in Europe,[6] and the Nosocomial Infection Surveillance and Control System (VICON) in 43 Spanish hospitals.[7] These programmes provide greater uniformity in the collection, analysis and presentation of data, allowing comparison between different centres and/or services.

Following the main action plan established by the *Plan de Calidad del Sistema Nacional de Salud* (Quality Plan for the National Health System of Spain),[8] the *Servicio Andaluz de Salud* (SAS–Andalusian Health Service) has defined a single plan of action for NI surveillance and control, which includes SSI in certain surgical proceedings.[9] The aim is to provide information needed to review or change practices where the results seem to indicate the need for improvements in the quality of care.

Under these guidelines, the objective of this study was to estimate the incidence of SSI and describe its epidemiological characteristics in the surgical services of a tertiary hospital.

Material and methods

A prospective cohort study from a representative sample of the population of patients admitted to surgical units in the Hospital Universitario Reina Sofía. These units have about 14 000 admissions and around 30 000 surgeries per year. Patients admitted for more than 24 hours between January 2001 and December 2004 were included. The sample size for each year was obtained from the number of patients admitted and the percentage of NI occurring in the previous year (5.3%-6.1%) with an α error of 5% and a δ error of 0.6. These patients were divided up by centre and service according to a random stratified sample with proportional allocation. The sample was obtained by simple random sampling.

Variables investigated

For the diagnosis of SSI, epidemiologists from the preventive medicine department, in collaboration with the nurses and doctor who treated the patient, followed the Centers for Disease Control and Prevention (CDC) criteria, for both surgical infections (superficial and deep), and organ and space infections.[1,10,11] Data were collected for each patient from up to two operations and four possible infections: location, culture and microorganism(s) isolated, classified according to the EPINE project.[12] Associated factors were recorded for each intervention: prior infection, general anaesthesia, ASA index,[13] emergency surgery, procedure duration, infection during surgery, surgical technique, previous treatments and perioperative antibiotic prophylaxis. Data were also collected for: age, sex, infection prior to admission, and the dates used to calculate the length of stay.

Collecting the information

A prospective surveillance system of daily monitoring of all patients during their hospital stay. All readmissions for infectious causes were studied to recover the infections that occurred up to 30 days after surgery, or 1 year if a foreign body was implanted.[10,11] Data collection and analysis were performed by highly experienced nursing staff and epidemiologists in the preventive medicine service. The sources of information used were medical records, direct observation of each patient and consultations with doctors and nursing staff in each department studied.

Data analysis

The data collected were coded and entered into the database management software, dBASE III Plus. Descriptive statistics were calculated, along with the calculation of measures of central tendency and dispersion for continuous variables and frequencies for qualitative variables. The incidence measures recommended by the CDC were also calculated: cumulative incidence (CI) of patients with SSI (percentage of patients with surgical site infection), CI of surgical infection (percentage of operations with SSI) and incidence density or rate (ID) of surgical infections (number of SSI divided by the number of patients undergoing surgery per day).

These measures were also calculated for 5 particular procedures[9]: colorectal surgery, hip and knee replacement surgery, heart valve replacement and myocardial revascularisation. The incidence figures were calculated adjusting for the NNIS index in these procedures, as well as in each of the surgical units.

Calculation of the magnitude of the associations and their corresponding 95% confidence intervals were performed with the Epi Info software, version 6. The rest of the statistical analysis was performed with SPSS 12.0.

Results

Description of the study population

Of the 14 455 patients studied, 53.3% were male and 46.7% women. The average age in the adult population was 58.4 (19) years and 7.8 (4) years in the paediatric population. A total of 12 978 operations were performed for 12 428 patients undergoing surgery.

The mean hospital stay time in the surgical unit was 12.6 (12.3) days (median=9) for all patients, and 12.8 (12.6) days (median=9) for patients undergoing surgery. The average stay for patients who suffered SSI was 38.2 (26.2) days (median=31) compared to 11.9 (10.9) days (median=9) for those not infected. Information on variables related to surgery is summarised in Table 1.

Incidence of surgical site infections

There were 452 SSIs in 418 patients, which represented 29.1% of the total NI detected and 35.1% of infected patients. The overall AI rate was 3.4% (95% CI, 3.0-3.7) of patients operated on. The AI for SSI was 3.5% (95% CI, 3.2-3.8) of interventions. The ID was 0.28 per 100 patient/days. The AI for SSI for first surgery was 3.3% (95% CI, 3.0-3.6), while in reoperations it increased to 8.4% (95% CI, 6.0-10.7).

Table 1 – Variables related to surgery

	n	%
Major surgical procedures		
Musculoskeletal system (others)	2383	18.4
Urogenital system (others)	943	7.3
Hip joint replacement	863	6.7
Ear, nose, mouth and pharynx	771	5.9
Knee joint replacement	700	5.4
Ophthalmology	677	5.2
Spinal fusion	623	4.8
Herniorrhaphy	623	4.8
Colorectal surgery	603	4.6
Cholecystectomy	579	4.5
Heart valve replacement	509	3.9
Thoracic surgery (others)	329	2.5
Appendectomy	310	2.4
Other cardiac surgery	311	2.4
Myocardial revascularisation	201	1.5
Other procedures	2553	19.7
Type of approach		
Open	11 655	89.8
Endoscopy	1323	10.2
Type of anaesthesia		
General	8064	62.1
Local	4914	37.9
Type of intervention		
Scheduled	11 393	87.8
Urgent	1585	12.2

Table 1. *(Continued)*

	n	%
Length of the 1st intervention		
<60 min	2046	15.8
60-120 min	6131	47.2
121-180 min	2373	18.3
181-240 min	1170	9.0
>240 min	1258	9.7
ASA risk		
1	2595	20.0
2	5356	41.3
3	4471	34.4
4	556	4.3
Degree of contamination		
Clean	7870	60.6
Clean-contaminated	3162	24.4
Contaminated	931	7.2
Dirty	1015	7.8
NNIS		
0	5534	42.6
1	4993	38.5
2	2247	17.3
3	204	1.6
Infection prior to surgery		
Yes	1423	11.0
No	11 555	89.0
Patients undergoing two operations		
Yes	550	4.2
No	11 878	91.5
Medication up to 15 days before surgery		
Corticosteroids	1121	8.5
Immunosuppressants	119	0.9
Radiotherapy	46	0.3
Perioperative antimicrobial prophylaxis		
Yes	11 402	87.9
No	1576	12.1

% indicates percentage of the total number of interventions (12 978); ASA, American Society of Anaesthesiologists; n, number of interventions; NNIS, National Nosocomial Infection Surveillance.

The units with the highest numbers of CI were maxillofacial, digestive and cardiovascular surgery. However, when adjusted for stay by the ID, urology (0.56) and paediatric surgery (0.42) were the services with the highest number of infections. On the other hand, neurosurgery and ophthalmology had very low levels in all the parameters studied (Table 2).

As the risk rate for surgical infections increased so did the overall number of cumulative incidence in SSI, the NNIS index, with values of 1.1 for patients with NNIS=0, up to 16.6 in patients with NNIS=3. Digestive surgery, urology and trauma were the units with the highest number of SSI per 100 patients at high risk (cumulative incidence=30%, 22.7% and 19.2%, respectively). Jaw, thoracic and plastic surgery as well as neurosurgery only had one patient in this group, without any infections occurring in the surgery, whereas otolaryngology, ophthalmology and paediatric surgery did not have any high-risk patients (Table 3).

In the 5 priority procedures (Table 4), colorectal surgery had the greatest cumulative incidence of SSI (10%) and ID (0.57), followed by myocardial revascularisation, hip replacement, heart valve surgery and knee replacement. Except for myocardial revascularisation, in all procedures there was an increase in AI in accordance with how far the NNIS index increased.

Isolated micro-organisms

A microbial culture was requested in 73.9% of cases, with 68.6% of the SSI being identified. General surgery and otolaryngology requested less cultures, while trauma, thoracic, paediatric, plastic and cardiovascular surgery identified the infection in over 75% of cases (Table 5).

The most frequently isolated micro-organisms (Table 6) were gram-positive cocci, which accounted for 53.4% of the

Table 2 – Cumulative incidence and incidence rates of surgical site infections in surgical units

Unit	Patients operated upon	Number of interventions	Patient-days	Patients with SSI				SSI				SSI/100 patient-days	
				No.	(%)	CI*	95% CI	No.	(%)	CI#	95% CI	No.	ID
Maxillofacial Surgery	342	366	5571	19	(21.1)	5.6	3.1-8.0	22	(18.2)	6.0	3.6-8.4	22	0.39
Gastrointestinal surgery	796	831	12 543	42	(35.7)	5.3	3.7-6.8	44	(34.1)	5.3	3.8-6.8	44	0.35
Cardiovascular	1255	1334	19 554	64	(10.9)	5.1	3.9-6.3	68	(10.3)	5.1	3.9-6.3	68	0.35
General Surgery	2316	2409	28 273	98	(39.8)	4.2	3.4-5.1	104	(38.5)	4.3	3.5-5.1	104	0.37
Urology	909	937	7098	36	(13.9)	4.0	2.7-5.2	40	(12.5)	4.3	3.0-5.6	40	0.56
Thoracic Surgery	338	361	4180	11	(18.2)	3.3	1.4-5.1	11	(18.2)	3.0	1.3-4.8	11	0.26
Traumatology	3294	3404	44 153	98	(13.3)	3.0	2.4-3.6	107	(15.0)	3.1	2.6-3.7	107	0.24
Paediatric Surgery	738	764	5282	20	(5.0)	2.7	1.5-3.9	22	(4.5)	2.9	1.7-4.1	22	0.42
Plastic Surgery	551	622	8683	15	(0.0)	2.7	1.4-4.1	18	(0.0)	2.9	1.6-4.2	18	0.21
Otorhinolaryngology	650	661	5387	10	(0.0)	1.5	0.6-2.5	11	(0.0)	1.7	0.7-2.6	11	0.20
Neurosurgery	592	617	14 080	4	(75.0)	0.7	0.0-1.3	4	(75.0)	0.6	0.0-1.3	4	0.03
Ophthalmology	647	672	4538	1	(0.0)	0.2	0.0-0.5	1	(0.0)	0.1	−0.1-0.4	1	0.02
Total	**12 428**	**12 978**	**159 342**	**418**	**(21.3)**	**3.4**	**3.0-3.7**	**452**	**(20.6)**	**3.5**	**3.2-3.8**	**452**	**0.28**

(%) indicates infection rate of organ/space with respect to total surgical infections in this category; 95% CI, 95% confidence interval; CI*, cumulative incidence of patients with SSI per 100 patients operated upon; CI#, cumulative incidence of SSI per 100 operations; ID, incidence density of infections per 100 patients under surgery per day; No., number of cases; SSI, surgical site infections.

Table 3 – Cumulative incidence of surgical site infections according to NNIS risk index

Unit	NNIS 0				NNIS 1				NNIS 2				NNIS 3			
	No.#	No.	CI	95% CI	No.#	No.	CI	95% CI	No.#	No.	CI	95% CI	No.#	No.	CI	95% CI
General Surgery	737	8	1.1	0.3-1.8	992	46	4.6	3.3-5.9	567	34	6.0	4.0-8.0	113	16	14.2	7.7-20.6
Gastrointestinal surgery	360	5	1.4	0.2-2.6	312	18	5.8	3.2-8.4	139	15	10.8	5.6-15.9	20	6	30.0	9.9-50.1
Maxillofacial Surgery	141	3	2.1	0.0-4.5	156	8	5.1	1.7-8.6	68	11	16.2	7.4-24.9	1	0	0	–
Thoracic Surgery	162	3	1.9	0.0-3.9	142	5	3.5	0.5-6.6	56	3	5.4	0.0-11.3	1	0	0	–
Cardiovascular Surgery	152	1	0.7	0.0-1.9	389	11	2.8	1.2-4.5	773	54	7.0	5.2-8.8	20	2	10.0	0.0-23.1
Plastic Surgery	285	4	1.4	0.0-2.8	293	7	2.4	0.6-4.1	43	7	16.3	5.2-27.3	1	0	0	–
Neurosurgery	386	2	0.5	0.0-1.2	191	1	0.5	0.0-1.5	39	1	2.6	0.0-7.5	1	0	0	–
Urology	372	4	1.1	0.0-2.1	426	14	3.3	1.6-5.0	117	17	14.5	8.1-20.9	22	5	22.7	5.2-40.2
Traumatology	1626	19	1.2	0.6-1.7	1429	55	3.8	2.9-4.8	323	28	8.7	5.6-11.7	26	5	19.2	4.1-34.4
Otolaryngology	472	7	1.5	0.4-2.6	173	2	1.2	0.0-2.7	16	2	12.5	0.0-28.7	0	0	–	–
Ophthalmology	282	0	0	–	337	1	0.3	0.0-0.9	53	0	0	–	0	0	–	–
Paediatric Surgery	550	7	1.1	0.3-2.2	157	10	6.4	2.5-10.2	57	5	8.8	1.4-16.1	0	0	–	–
Total	**5525**	**63**	**1.1**	**0.9–1.4**	**4997**	**178**	**3.6**	**3.0-4.1**	**2251**	**177**	**7.9**	**6.8-9.0**	**205**	**34**	**16.6**	**11.5-21.7**

95% CI indicates confidence interval at 95%; CI, cumulative incidence of surgical site infections per 100 interventions; NNIS, National Nosocomial Infection Surveillance; No., number of surgical site infections; No.#, number of interventions.

Table 4 – Cumulative incidence of surgical site infections according to NNIS index in procedures prioritised by the Servicio Andaluz de Salud (Andalusian Health Service)

Procedure	NNIS 0				NNIS 1				NNIS 2-3				Total		
	No.#	No.	CI	95% CI	No.#	No.	CI	95% CI	No.#	No.	CI	95% CI	CI	95% CI	ID
Knee replacement	314	2	0.6	0.0-1.5	292	3	1.0	0.0-2.2	94	1	1.1	0.0-3.1	0.9	0.2-1.5	0.09
Hip replacement	320	1	0.3	0.0-0.9	453	21	4.6	2.7-6.6	90	13	14.4	7.2-21.7	4.1	2.7-5.4	0.28
Colorectal surgery	6	0	0	–	223	21	9.4	5.6-13.3	374	39	10.4	7.3-13.5	10.0	7.6-12.3	0.57
Heart valve	4	0	0	–	49	1	2.0	0.0-6.0	456	11	2.4	1.0-3.8	2.4	1.0–3.7	0.16
Cardiac revascularisation	0	0	–	–	10	1	10.0	0.0-28.6	191	17	8.9	4.9-12.9	9.0	5.0-12.9	0.52
Total	**644**	**3**	**0.5**	**0.0-1.0**	**1027**	**47**	**4.6**	**3.3-5.9**	**1205**	**81**	**6.7**	**5.3-8.1**	**4.6**	**3.8-5.4**	**0.32**

95% CI indicates confidence interval at 95%; CI, cumulative incidence of surgical site infections per 100 interventions; ID, incidence density per 100 patient-days; NNIS: National Nosocomial Infection Surveillance; No., number of surgical site infections; No.#, number of interventions.

isolates. S. *Aureus* was the predominate infection in this group, with 62.5% being resistant to methicillin (MRSA).

Among the gram-negative organisms were *Enterobacteriaceae* (30% of isolates), with *Escherichia coli* causing 11.9% of infections. The gram-negative micro-organism with the highest proportion of multidrug resistance was *Acinetobacter* (27.8% of the *Acinetobacter* total).

Discussion

It is difficult to interpret the results, as well as to make comparisons between countries, cities, hospitals and even between units of the same hospital due to the large differences in the calculation of the indicators of hospital infection, added to the complexity of the epidemiology of SSI. To achieve methodological consistency, and control the multiple confounding factors that might explain the apparent differences found between hospitals, the idea in Andalusia is to unify these care quality indicators in a single surveillance and control plan.[9]

Similarly, there are many countries that have developed NI surveillance plans which allow comparison between participating hospitals.[2,4-7] Each of these studies establishes particular methodological criteria to be considered for the correct interpretation of such comparisons.

Firstly, there are differences in the observation periods used. In this study, surveillance was limited to the patient's hospital stay. Therefore, slight infections that developed after discharge were not included in the incidence figures calculated. However, infections occurring within 30 days of the intervention (1 year for a prosthesis) and which required hospitalisation were included, the same as in the VICONOS system,[7] the European project,[6] and the American system.[5] This may have led to an inadequate assessment of the true frequency measurements, given that slight infections occurring after being discharged were not considered. Although the magnitude of the problem of NI after discharge has been described in various Publications,[1,14] it is difficult to establish the best surveillance method, since the resources needed to monitor the system could make it inefficient. For example, Huenger et al[15] showed that the active surveillance of sending questionnaires to patients undergoing hip and knee surgery may not be necessary, since any infections that develop would force those affected to return to hospital.

In addition, hospital stay varies widely depending on factors such as type of surgery or age of patients, so some patients are monitored for longer. This is why ID is considered as one of the most realistic frequency measurements, partly because it avoids the observation bias caused by differences in the length of hospital stay and monitoring.

The overall cumulative incidence figure for SSI in this study (3.5%) was similar to those published by the SSISS (3%)[4] and the HELICS-SSI project (2.9%).[6] However, they are slightly lower than those found in Holland,[2] with overall incidence figures of 4.3% between 1996 and 1999. The incidence was also lower than that found in a 1994 study in the same hospital,[16] where 5 SSI per 100 surgical procedures were found, which

Table 5 – Cultures requested from patients with surgical site infection by surgical units

	Surgical site infections	Cultures requested		Result			Cultures not requested	
		No.	%	Positive	(%*)	Negative	No.	%
General surgery	104	58	55.8	56	(53.8)	2	46	44.2
Gastrointestinal surgery	44	34	77.3	31	(70.4)	3	10	22.7
Maxillofacial Surgery	22	16	72.7	14	(63.6)	2	6	27.3
Thoracic surgery	11	10	90.9	9	(81.8)	1	1	9.1
Cardiovascular Surgery	68	56	82.4	52	(76.5)	4	12	17.6
Plastic Surgery	18	14	77.8	14	(77.8)	0	4	22.2
Neurosurgery	4	3	75.0	2	(50.0)	1	1	25.0
Urology	40	26	65.0	23	(57.5)	3	14	35.0
Traumatology	107	97	90.7	90	(84.1)	7	10	9.3
Otolaryngology	11	1	9.1	1	(9.1)	0	10	90.9
Ophthalmology	1	1	100	0	(0.0)	1	0	0.0
Paediatric Surgery	22	18	81.8	18	(81.8)	0	4	18.2
Total	**452**	**334**	**73.9**	**310**	**(68.6)**	**24**	**118**	**26.1**

%* indicates infections identified in total surgical site infections in each unit; No.: number of cases.

Table 6 – Micro-organisms isolated in the surgical site infection

	Total	%	%#
Number of micro-organisms	**446**	**100.0**	–
Gram-positive cocci	238	53.4	–
Staphylococcus aureus	27	6.1	6.0
MRSA	45	10.1	10.0
Coagulase-negative *Staphylococcus*	70	15.7	15.5
Other *staphylococcus*	21	4.7	4.4
Enterococcus spp.	61	13.7	12.8
Streptococcus spp.	14	3.1	3.1
Gram-positive bacilli	9	2.0	–
Gram-negative bacilli, enterobacteriaceae	134	30.0	–
Citrobacter spp.	7	1.6	1.6
Enterobacter spp.	28	6.2	5.3
Escherichia coli	54	12.1	11.9
Morganella morgagni	7	1.6	1.6
Klebsiella spp.	11	2.5	2.2
Proteus spp.	15	3.4	3.3
Serratia spp.	6	1.3	1.3
Others	6	1.3	1.3
Non-enterobacteriaceae gram-negative bacilli	58	13.0	–
Acinetobacter spp.	18	4.1	4.0
Pseudomona aeruginosa	32	7.2	6.9
Other *pseudomona*	1	0.2	0.2
Stenotrophomonas maltophilia	2	0.4	0.4
Haemophylus haemolyticus	1	0.2	0.2
Other non-enterobacteriaceae gram-negative bacilli	4	0.9	0.9
Others	7	1.6	–

% indicates number of isolates in relation to total microbiological isolates; %#, proportion of surgical site infections in which the organism was isolated; MRSA, resistant to methicillin.

resulted in a decrease of 30% in this period of time. This drop occurred in the same way in ID, which went from 0.41 to 0.28 SSIs per 100 patient-days.

During the period of time that passed between these studies performed in our hospital, the characteristics of the study population remained stable for most of the variables (degree of infection in the surgery, urgent or scheduled surgery, previous infection). There were also no changes in the NI surveillance definitions or protocols used, which may explain the drop in these indicators. By contrast, there were changes in the intensity of infection surveillance, as well as in improvements in the information provided annually by the preventive medicine service to the surgical area practitioners, regarding the characteristics of SSI and the evolution of incidence measurements over the years. Therefore, these results may reflect a growing awareness in the implementation of hospital infection control measures worked on from the results obtained from that study.

When the incidence distribution over different surgical units was analysed, we observed that there were differences in the weighting for each depending on whether an adjustment was made for hospital stay or not. The maxillofacial surgery unit had the highest number of infections and infected patients per 100 admissions, which cannot be explained by a higher risk index among patients, since most of them had a NNIS less than 2. However, it ranked third in the ID rates after urology and paediatric surgery. This result reflects the slower speed with which infection occurs in this unit.

Gastrointestinal surgery, cardiovascular, general surgery and urology had the next highest frequency of infection, with overall CI infection figures above 4%. On the other hand, ophthalmology, neurosurgery and ENT had the lowest figures for all parameters studied. This last unit deserves a special mention, as it had the highest AI for SSI and ID in 1994 (14.3% and 1.2/100 patient-days).[16]

Comparing the results obtained from priority procedures with the main surveillance plans with similar characteristics, AI in colorectal surgery (10%) was similar to that described in England (9,2%)[4] and in the HELICS-SSI project (8,8%),[6] as well as those obtained from 14 regional SAS hospitals (unpublished data), and lower than that reported by VICONOS[7] when stratified by risk groups. Also, indicators in cardiac valvular surgery and knee replacement were similar to those recorded by the systems that provided these data.[5,7]

However, in cardiac revascularisation surgery and hip replacements, the figures were higher than those published. In the first case, infections in the NNIS group equal to 1 were markedly higher (CI=10%) than in other published data, which ranged from 3.5[5,6] and 3.8%.[4] This might be explained by the small size of the denominator (10 patients). The VICONOS system[7] published similar figures in patients with risks 1 and 2-3. In hip replacement, the higher incidence was particularly notable in the NNIS risk group 2-3, where the figures were somewhat higher than those achieved by the VICONOS system[7] and markedly higher than the American system.[5] However, among patients with low risk (50% of operations), our figures were lower than both systems.

In terms of epidemiology, the number of infections with etiological identification was higher (68.6%), especially when compared with the 40% found in the HELICS-SSI project of 2004.[6] The departments with higher incidences requested cultures in more than 72% of cases. This was interpreted as an indicator of good care quality, since the identification of the SSI not only contributes to a better antibiotic prescription but knowledge of the flora commonly present in the department's infections also provides a better empirical choice of prescription while waiting for the antibiogram results. As in the 1994 study in our centre,[16] gram-positive cocci were the most common microorganisms isolated in the cultures requested in the SSISS[4] and the HELICS-SSI studies.[6] The important role of MRSA is worth noting, where representation in this hospital was similar to the 64% obtained in the England.[4]

The development of surveillance plans maintained in our hospital over the years has highlighted the progress achieved in both targeted treatment and the prevention of surgical infection, based undoubtedly on the collaboration and work of personnel responsible for both health care and the prevention of infection.

Conflict of interest

The authors affirm they have no conflicts of interest.

Acknowledgements

We would like to thank Pilar Ayora, María Dolores Ríos, Leonor Jiménez, Concepción Castilla, Araceli Alcaide and María Dolores González for their vital work in gathering information; Marina Rodríguez for her computing work; Rafaela Cuadrado for coordinating with the rest of the staff in the Preventive Medicine Department; the Microbiology Service of the Hospital Universitario Reina Sofia for their contribution to the etiological identification of infections. We would also like to thank all the health care staff who make up the surgical units in this hospital for their cooperation. They were essential for the development of the surveillance of surgical infections carried out by the Preventive Medicine Department.

REFERENCES

1. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR; The Hospital Infection Control Practice Advisory Committee. Guideline for prevention of surgical site infection. Infect Control Hosp Epidemiol. 1999;20:250-78.
2. Geubbels EL, Nagelkerke NJ, Mintjes-De-Groot AJ, Vandenbroucke-Grauls CM, Grobbee DE, De Boer AS. Reduced risk of surgical site infections through surveillance in a network. Int J Qual Health Care. 2006;18:127-33.
3. Haley RW, Culver DH, White JW, Morgan WM, Emori TG, Munn VP, et al. The efficacy of infection surveillance control programs in preventing nosocomial infections in US hospitals. Am J Epidemiol. 1985;121:182-205.
4. Health Protection Agency. Surveillance of surgical site infection in England: October 1997-September 2005. London: Health Protection Agency; 2006.
5. National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 through June 2004, issued October 2004. Am J Infect Control. 2004;32:470-85.
6. Hospital in Europe Link for Infection Control through Surveillance (HELICS). Surveillance of Surgical Site Infections Statistical Report 2004 [internet]. Brussels: Comisión Europea. Dirección General de Sanidad y Protección del Consumidor; March 2006. [accessed 2/5/2007]. Available from: http://helics.univ-lyon1.fr/documents/HELICS-SSI%20Stat%20Report%202004%20Final%20Version%20180406.pdf
7. Jodrá VM, Díaz-Agero C, Sainz de los Terreros L, Saa CM, Dacosta D. Results of the Spanish national nosocomial infection surveillance network (VICONOS) for surgery patients from January 1997 through December 2003. Am J Infect Control. 2006;34:134-41.
8. Ministerio de Sanidad y Política Social. Plan de Calidad para el Sistema Nacional de Salud [internet]. Madrid: Ministerio de

Sanidad y Política Social; 2006. [accessed 2/5/2007]. Available from: http://www.msc.es/organizacion/sns/planCalidadSNS
9. Dirección General de Asistencia Sanitaria, Subdirección de Programas y Desarrollo, Subdirección de Servicio de Protocolos Asistenciales. Plan de vigilancia y control de las infecciones nosocomiales en los hospitales del Servicio Andaluz de Salud. Edita: Servicio Andaluz de Salud. Consejería de Salud; 2002.
10. Ganer JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections, 1988. Am J Infect Control. 1988;16:128-40.
11. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definition of surgical wound infections. Infect Control Hosp Epidemiol. 1992;13:606-8.
12. Sociedad Española de Medicina Preventiva, Salud Pública e Higiene. Proyecto EPINE 1990-1999. Evolución de la prevalencia de las infecciones nosocomiales en hospitales españoles. Grupo de Trabajo EPINE. Vaque J, Rosselló J, editors. Madrid: 2001.
13. Owens W, Felts J, Spitznagel E. ASA physical status classifications: a study of consistency of ratings. Anesthesiology. 1978;49:239-44.
14. Oliveira AC, Lima EDRP, Lima AP. Post-discharge surgical site infection surveillance in hospital in Brazil. The American Journal of Surgery. 2007;193:266-8.
15. Huenger F, Schmachtenberg A, Haefner H, Zolldann D, Nowicki K, Wirtz DC, et al. Evaluation of postdischarge surveillance of surgical site infection alter total hip and knee arthroplasty. Am J Infect Control. 2005;33:455-62.
16. Pelayo A, Díaz C, Martínez D, Fernández R, Masa J, De Irala J, et al. Infección nosocomial en Servicios Quirúrgicos. Medicina Preventiva. 1998;4:8-14.