Bacteriological Profile Of Surgical Site Infection In Orthopedic Surgery About 142 Cases

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Abstract: .Surgical site infection in orthopedic surgery is a serious complication with serious consequences. Economic, social and psychological cost is very high. Its treatment is long and difficult; it requires perfect knowledge of the pathophysiology of bone infection and causative organism in order to optimize treatment. We conducted a retrospective study of 142 cases of deep surgical site infection. All of these infections have had a profound sampling done in the operating room. A study of antibiotic susceptibility was performed.The average age of our patients was 52.08 years with a sex ratio of 1.15 (H / F). We identified 85 post- traumatic infections (59.9%), 42 prosthetic joint infections (29.6%), 7 following orthopaedic surgery (4.9%), 6 following a tumour surgery (4.2 %) and 2 after an arthroscopic instrument (1.4%). Infections were monobacteriennes in 76.8% of cases, polybacteriennes in 16.2 % of cases and negative levy in 7 % of cases. Germs found were 56.3% for Gram positive Gram negative 36.7 %. Hundred and sixty germs were identified. There was a predominance of Staphylococcus aureus (33.1 %) and coagulase negative Staphylococcus (CNS) (16.9 %). A study of the distribution of seeds by surgery was performed, and a study of their sensitivity to antibiotics has established memoranda of antibiotics. The prescription of antibiotics is a deliberate act that must be the fruit of a collective collaboration between surgeon, bacteriologist and infectious diseases.

Keywords: infection; operative site ; bacteriology ; orthopedic surgery

INTRODUCTION

The surgical site infection (ISO) is an uncommon complication in orthopedic surgery. This is a serious complication that can compromise the function and sometimes vital patient prognosis. Its management is multidisciplinary and requires close collaboration between the surgeon , biologist and infectious disease . Indeed, if the quality of surgical debridement is crucial, effective antibiotic therapy is an essential supplement for treatment. Unfortunately, this antibiotic still suffers from several shortcomings related to lack of knowledge of the pathophysiological basis of bone infection and the absence of well-established protocols . This often leads to an incorrect prescription. The irrational use of antibiotics is not only ineffective but also dangerous. It causes persistent infection and promotes the emergence of bacterial strains more resistant to severe environmental consequences. Through a series of patients operated on for surgical site infection in orthopedic environment, we proposed a retrospective study of aspects of the management of osteo - articular infection that is bacteriological diagnosis. This work is motivated by our ongoing effort to improve the quality of our management of postoperative infections, it is intended to be informative, the critical and constructive basis for a new better job. The aim of this work is:

- Develop the bacteriological profile of ISO in an orthopaedic ward.
- Discuss the steps of the bacteriological diagnosis of ISO.
- Propose antibiotic protocols adapted to germs observed.

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MATERIALS AND METHODS

This is a retrospective study in the “Septic" service about patients hospitalized for a surgical site infection. The collection of records was made from notebooks intake "Septic" service, specifications operative reports and archives of biology laboratory. ISO is defined by the Center of Disease Control and Preventions (CDC) in Atlanta in the United States (1,2,3) as: "Any infection that was not present or incubating at admission occurring within 30 postoperative days in case of intervention without bone or in postoperative year if an osteosynthesis was performed. According to this definition, there are 3 levels of infection:

- Infection of the surface portion of the incision;
- Infection of the deep portion of the incision;
- Infection of the organ or area concerned with the surgical site.

We selected for this study as infections of the last level. We're immediately excluded haematogenous osteoarticular infections such as osteomyelitis and septic arthritis and all other non- surgical infections. All surgical indications were included in this study: trauma response set called ... Whether tumour surgery on the bone or soft tissues, with or without hardware implementation. Only the results of the samples taken deep puncture or surgical unit were considered. Pots collection and transport arrangements were unclear due to lack of well-defined protocols. The isolation of bacteria was done on enriched media: blood agar, chocolate and PolyViteX enrichment broth heart brain (BCC) agar. The incubation was carried out aerobically, under 5 % CO2 and at 37 ° C. Anaerobic In general, the seeds are isolated 24 to 48 hours, otherwise the incubation is continued for 10 to 14 days. The identification of the organism was carried out according to the usual characters namely bacteriological techniques: morphological, cultural and biochemical. Commercial galleries were used: 10 Api Api 20 Staph Api Api Stepto ... The study of the action of antibiotics on different colonies and identification were performed on each sample, as recommended by the Committee on the susceptibility of the French Society of Microbiology (4). When susceptibility testing is performed, the activity of antibiotics has been interpreted by the bacteriologist .

Was not selected for this study that documented results, whether positive with mandatory susceptibility in this case, or negative. All data were entered into an SPSS computer software with a statistical study. A cross-tabulation was conducted between germs, the type of surgery and antibiotic sensitivity. The chi-square test was used to determine statistically significant associations. These have been defined with a value of $p<0.05$.

RESULTS

The average age of our patients was 52.08 years, ranging from 16 to 88 years. A slight male predominance was noted with a sex ratio of 1.15. The infection has complicated the treatment of a fracture in 85 patients (59.9 %), a prosthetic joint in 42 patients (29.6%), an act performed during diagnosis or treatment malignancy in 6 patients, making a tibial osteotomy in 6 cases, an arthroscopic ACL reconstruction in 2 cases and Scarf osteotomy in 1 case. In this series, there's been the implementation of 136 orthopaedic materials: 46 plate osteosynthesis , 42 prostheses (29 total knee prostheses and 13 total hip), 17 intramedullary nails, 11 cephalic prosthesis, 8 external fixators, 6 pin and 6 screws (Fig1).

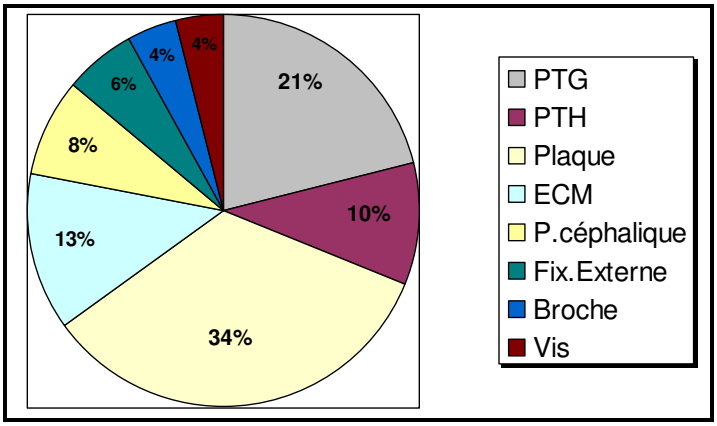

Fig1: infection rates from orthopaedic hardware.

Hundred and sixty germs were isolated from 132 patients. We observed 109 single germ infections, 23 polymicrobial infections and 10 infections levy negative. Gram-positive Cocci (CG+) were the most common microorganisms in infections monobacteriennes. The combination of both Gram-negative bacilli (BGN) was the most frequent in polybacteriennes infections (Table1).

Table1: Distribution of germs depending on the type of infection.

	Morphology	Number	Rate %	Total %
Monobacteriennes infections	CG+ BGN	69 40	48,6 28,2	76,8
Polybacteriennes infections	BGN BGN CG+ CG+ BGN CG+	11 3 9	7,8 2,1 6,3	16,2

Once two, the infection was caused by a Staphylococcus. It was at 33.1 % of cases Staphylococcus aureus (SA) and in 16.9 % of cases of Staphylococcus coagulase negative (SCN). Enterobacteria constituted the second most common family with 20.3 % of cases. Other organisms were Pseudomonas aeruginosa in 14.1 % of cases and Streptococcus in 6.3 % of cases (Fig2).

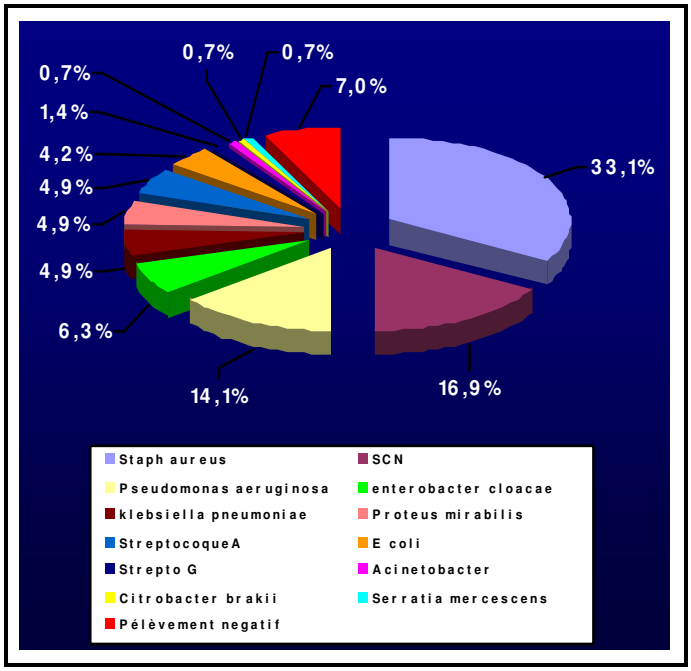

Fig2: Nature germs causing the infection site procedure.

The study of the bacterial flora depending on the type of surgery showed the following results:

- The first organism causing infection trauma was: Staphylococcus aureus (41.2 % of cases), followed by Pseudomonas aeruginosa (17.6%).
- The SCN were the first germs in infections on prostheses with: a rate of 26.6 % of cases (p=0.09).
- The gram-negative bacilli (BGN) were more frequent in post infection traumatic in series with an overall rate of 41.2 % of (p = 0.12)
- Streptococci were more frequent in prosthetic infections that in the overall series with a rate of 14.3 % of cases (Table2).

Table2: Nature of germs according to the type of intervention

	TRAUMA	JOINT PROSTHESIS	GLOBAL SERIES	P
SA	41,2%	19,0%	33,1%	0,001
SCN	10,6%	26,2%	16,9%	0,001
enterobacteria	23,6%	19,1%	20,3%	0,09
Pseudomonas aeruginosa	17,6%	7,1%	14,1%	0,12
streptococci	1,2%	14,3%	6,3%	0,09
other	2,4%	2,4%	2,1%	

The study of antibiotic susceptibility showed the following results:

- Rate staphylococci methicillin-R was 26.7%.
- SCN were more resistant to methicillin as SA with a rate 45.8% against 17%. This difference was significant.
- The SCN were also more resistant than SA for all families' antibiotics without exception significantly. This resistance more important of SCN is even more alarming that two strains isolated SCN resistant to vancomycin (Fig.3).

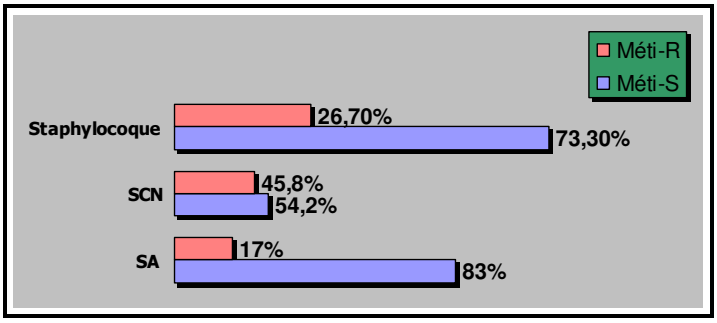

Fig3: Distribution of the staphylococcus according to its sensibility in the méticilline.

- Escherichia coli and Proteus mirabilis have kept a good sensitivity to all antibiotics, particularly Quinolone.
- The Klebsiella pneumoniae was the most resistant germ, with production Beta- lactamase broad spectrum in all cases and resistance to Quinolones in 71.4 % of cases (Table3).

Table3: The sensibility of the entérobactéries main clauses in antibiotics (%). (S: sensitive, R: resisting).

	Escherichia coli		Enterobacter cloacae		Klebsiella pneumoniae		Proteus mirabilis	
	S	**R**	**S**	**R**	**S**	**R**	**S**	**R**
Amoxicillin	54	**46**	0	**100**	0	**100**	17	**83**
C3G	83	**17**	59	**41**	28	**72**	83	**17**
Aminosides	92	**8**	100	**0**	28	**72**	75	**25**
Quinolones	90	**10**	92	**8**	36	**64**	83	**17**
Tétracyclin	83	**17**	59	**41**	28	**72**	0	**100**
Fosfomycin	100	**0**	100	**0**	100	**0**	100	**0**
Tiénam	100		100	**0**	100	**0**	100	**0**

- Streptococci were susceptible to 3rd generation Cephalosporins (C3G) and Rifampicin in nearly 90 % of cases (Table4).

Table4: The sensibility of Streptococci in various antibiotics (%).

	Oxacillin	**C3G**	**Aminosides**	**Macrolides**	**Quinolones**	**Tétracyclin**	**Fucidic acid**	**Rifampicin**	**Imipénem**
Sensible (%)	**89**	**87,5**	**11,1**	**44,4**	**22,2**	**22,2**	**67**	**89**	**100**
Résistant (%)	**11**	**12,5**	**88,9**	**55,6**	**77,8**	**77,8**	**33**	**11**	**0**

- The rate sensitivity of P. aeruginosa to quinolones was 76 % (Table5).

Table5: The sensibility of Pseudomonas in various antibiotics (%).

	Amoxicillin	Céfotaxime	Céftazidine	Gentamycin	Amikacin	Tétracycline	Quinolones	Fosfomycin	Tiénam
Sensible (%)	0	0	90	62	81	0	76	71	86
Résistant (%)	100	100	10	50	31,6	100	24	29	14

DISCUSSION

Very few studies in the literature have specifically studied bacteriological ISO, especially in orthopedic surgery. It is usually either a special study of prosthetic joint infections or investigation epidemiological research on nosocomial infections. Our work fits among the studies that provide a broad idea about the bacteriological profile of the ISO any indication confused. However, the lack of control population did not identify risk factors for surgical site infection. The bacterial flora isolated in our series showed some particularities. This series showed that the bacterial flora of the ISO observed were roughly comparable to that reported in the literature (Table 6).

Table6: Nature of germs in the infection of the operating site.

	Lecuire et al. [2]	Dumaine et al [5]	Our series
S A	35%	58,1%	33,1%
SCN	27%	22,1%	16,9%
P. aeruginosa	3%	15,1%	14,1%
Streptococci	7%	4,6%	6,3%
enterobacteria	16%	34,9%	22,4%

The rate of SA Meti -R was not very high. Indeed, 83% of SA infections are germs methicillin-S. However, this rate is an average over a period of 10 years. The analysis of the evolution of this rate over time was against us realize its regular progression. The methicillin resistance is not the same for the two families of staphylococci. Indeed, among the SA, only 17% of the strains were methicillin -R, while the rate of SCN Meti -R was 45.8 % (p 0.05) (Table 7).

Table7: Distribution of Staph according to its sensibility in Methicillin.

	S Méti-R	SA Méti-R	SCN Méti-R
Dumaine et al [5]	23,2 %	16%	42%
Lecuire et al. [2]	34%	28%	42,5%
Our series	26,7 %	17%	45,8%

We are currently witnessing an increase in infections SNA. This germ is considered saprophytic skin is becoming increasingly responsible for real infections in orthopaedic surgery and this has been the development of prosthetic surgery. Indeed, it is the most common type of this germ of surgery. Increased rates of SA methicillin-R, isolation of two SCN strains resistant to Vancomycin and frequency of secreting beta-lactamase Klebsiellas broad spectrum may have serious ecological consequences and should prompt us to reconsider our close policy on hospital hygiene and especially our way of prescription antibiotics. If the SA is the most common germ in bone infections all confused surgery (33.1 % of cases in our series), the SCN is the most common joint prosthesis infections (6,7) case. In our series, the SCN was present in 16.9 % of the overall series and in 26.2 % of cases of prosthetic joint infections ($p<0.001$). Murdoch et al. (8) followed 44 patients with a joint prosthesis having presented Staphylococcus aureus bacteremia. During this monitoring, the infection rate was 34 %. The knee is most often the subject of bacterial transplantation as the hip. The risk of secondary bacteremia is an invasive procedure variable: (colonoscopy: 4%, cystoscopy: 19%, dental gesture: 40-91 %) (9,10). In our series, the streptococcus was isolated in 14.3% of prosthetic infections ($p = 0.09$) . This is for the character of secondary infections (Table 8).

Table8: Germs responsible for infections on artificial joint

	Tsukayama 1996 [12]	Tsukayama 1999 [13]	Desplaces 2002 [11]	Lecuire 2003 [2]	Our series
SA	22	35	25	35	19
SCN	38	38	23	27	26,2
Streptococci	13,5	22	9	7	14,3
Entéro bacteria	11	2	6	13	19,1
P. aeruginosa	3	1	2	3	7,1
P. acnes	8	-	16	-	0
Cocci G+	74	95	74	72	59,5
BGN	14	3	10	16	28,6
sterile samples	-	-	3	16	11,9

(%).

The rate of negative samples in infections on prostheses was among the highest. This is probably due to fastidious organisms, non-target. This is especially true when one realizes that the acnes Proprionibacterium germ increasingly responsible for infections on prostheses in real world literature was not observed in our series. In our series, specialized culture medium is not done in a systematic way but must be motivated by a request from the surgeon. This may explain the fact that we did not isolate anaerobes, normal saprophytes of the skin (ex: Proprionibacterium acnes) but are increasingly responsible for infection prosthetic 8% of the number of germs in Tsukayama (12), 16 % in series Desplaces (11) and 2.3% in the range of Dumaine (5). Before embarking on a memorandum of long and costly antibiotics, it is essential to remember that this antibiotic is only adjuvant to surgery and it is unrealistic to think that it can replace a gesture of cleaning insufficient. We based on the protocols proposed by Desplaces (14,15), we face the bacteriological results of our study to identify associations that seem most appropriate to the bacterial flora observed.

1 Infections Staphylococcal methicillin-S:
We recommend a combination of a Quinolone or Fusidic acid, Rifampicin. The advantage of these associations is the ability to prescribe oral and limit the duration of hospitalization. These associations showed in vitro efficacy in 90-100% of cases of infection SA, a bit less for infections SCN.

initial antibiotic 4 to 6 weeks	**oral relay 3 to 6 months**
Oxacillin i.v cefazolin cefotaxime ceftriaxone Pefloxacin i.v. or oral Ofloxacin i.v Fusidic acid i.v. or oral	**(forget oral oxacillin)** **+ + +** **pefloxacin** **ofloxacin** **fusidic acid**
Association	
Essential with: Gentamicin (maximum 3 weeks) fosfomycin Rifampicin i.v	If possible: rifampicin

2 Infections Staphylococcal methicillin-R:
These seeds were susceptible to Rifampicin and Quinolones in 50% of cases. In other cases, the combination of Vancomycin with Fosfomycin provides in vitro efficacy in 82% of cases

initial antibiotic 4 to 6 weeks	**oral relay 3 to 6 months**
Pefloxacin S and S Rifampicin (50% of cases)	
Pefloxacin and Rifampicin	Pefloxacin and Rifampicin
Pefloxacin R and R Rifampicin	
Vancomycin and fosfomycin (82% sensitivity) Fusidic acid and fosfomycin inches (56% sensitivity)	 fusidic acid

3 Infections streptococci or enterococci:
The combination of Amoxicillin or C3G Rifampicin offers sensitivity in 87% of cases

initial antibiotic 4 to 6 weeks	**Relais oral 3 à 6 mois**
Iv amoxicillin or C3G associated with rifampicin iv	Amoxicillin

4 Osteoarticular Infections to Enterobacterie:
These seeds were sensitive to Quinolones in 88% of cases. In this case, monotherapy is quite possible because there is no risk of mutation. In case of multi resistors (beta-lactamase producing extended spectrum), Imipenem was effective in 90-100% of cases.

initial antibiotic 4 to 6 weeks	**Relais oral 3 à 6 mois**
Nalidixic acid S (little risk of mutations)	
Can monotherapy Quinolone p.o or C3G (88% sensitivity) Or combination therapy with: Aminoglycoside or fosfomycin	Pefloxacin or ciprofloxacin or ofloxacin
Nalidixic acid but fluoroquinolones R S (1st level of mutation)	
essential association Fluoroquinolones with C3G or Gentamycin or Fosfomycin	Pefloxacin or ciprofloxacin or ofloxacin
Multidrug-resistant (ESBL) * (12.6% of germs)	
Imipenem (90 to 100% sensitivity) fosfomycin or associated with Amikacin	No oral relay prolonged infusion

Beta lactamase extended spectrum

5 Infections Pseudomonas aeruginosa:
If sensitivity to Quinolones(68%), we recommend a combination of a Quinolone with an Aminoglycoside or Fosfomycin. Otherwise, the combination of an Aminoglycoside to Imipenem or Fosfomycin gives sensitivity in two cases only.

initial antibiotic 4 to 6 weeks	oral relay 3 to 6 months
P. aeruginosa sensitive to fluoroquinolones (68%)	
Never monotherapy for risk transfer - Quinolone high dose: Oral pefloxacin or oral ciprofloxacin. Together with two other antibiotics: ceftazidime (15% S) and Amikacin (65% S) or fosfomycin (100% S)	pefloxacin ciprofloxacin
P. aeruginosa resistant to fluoroquinolones (32% of cases)	
- Imipenem (66% S) Associated if possible with two other antibiotics: - Amikacin (50% S) or - Fosfomycin (50% S)	

6 Anaerobic infections:
For completeness and although anaerobic were not observed in our series, we include these therapeutic proposals prepared by Desplaces (10).

initial antibiotic 4 to 6 weeks	oral relay 3 to 6 months
Anaerobic Gram-positive	
-Amoxicillin i.v - Augmentin i.v - Céfacidal i.v - Clindamycin i.v associated - Rfampicin	- Amoxicillin - Augmentin - Cephalexin - Clindamycin associated - Rfampicin
Anaerobic Gram-negative	
- Augmentin i.v - Metronidazole i.v Related to: - Rifampicin	- Augmentin - Metronidazole Related to: - Rifampicin

7 Infections negative sample:
a. Post-traumatic infection: The most likely germs are either SA or Pseudomonas aeruginosa. We recommend in this case the combination of a Quinolone with an Aminoglycoside or Fosfomycin.
b. Infection in joint replacement: there must target both the CG+ (especially SCN) and Enterobacteriae. It is recommended in this case a combination of a Quinolone Rifampicin +/- Vancomycin depending on the context.

CONCLUSION

It is necessary to recall at the end of this work that the prescription of antibiotics is not a solitary act, but the result of a multidisciplinary collaboration involving: The orthopaedic surgeons used to treat infections; bacteriologists; the infectious disease doctors, both the balance sheet for the monitoring and surveillance of antibiotic treatment. These conditions cannot be met in specialized centres where you can find all these skills. Finally, we cannot overemphasize the fact that it is the surgeon who is the first forensic responsible for postoperative infection. It would be unfortunate to see divest from this painful problem.

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