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INFECTIONS RELATED TO CARE IN THE VISCERAL SURGERY DEPARTMENT OF THE "CENTRE NATIONAL HOSPITALIER ET UNIVERSITAIRE HUBERT-KOUTOUKOU MAGA" (CNHU-HKM) OF COTONOU (BENIN)

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ABSTRACT

Objective: The aim of this study was to determine the bacteriological profile of nosocomial post-operative infections in visceral surgery at the CNHU-HKM in Cotonou. **Patients and Method:** The methodology used consisted in isolating and identifying the bacterial species present, firstly on 50 pus samples taken from post-operative patients whose wounds had festered and secondly in the hospital environment and on the care equipment. **Results:** At the end of this study, the different bacterial species found in the suppurations were: Staphylococcus aureus (36%), Enterobacter aerogenes (26%), Enterobacter gergoviae (12%), Escherichia coli (8%), Klebsiella oxytoca (4%), Citrobacter diversus (4%), Shigella flexneri (4%) and in the hospital environment, the same germs were found apart from the last three (K. oxytoca, C. diversus and S. flexneri). **Conclusion:** Whether from wounds or samples from the hospital environment, most of the germs isolated are multi-resistant to the antibiotics tested.

Keywords: Nosocomial infections, postoperative infection, suppurated wounds, bacteria.

INTRODUCTION

An infection is said to be nosocomial if it appears following hospitalization or care in a hospital environment [1] and is at the forefront of adverse events related to care [2]. Despite the progress made in public health and hospital care, these infections continue to occur in some hospital patients and can affect medical staff. Among the plurality of factors that contribute to this are the inadequacy of infection control precautions, the increasing variety of interventions and invasive procedures that can pave the way for infections without overlooking the vulnerability of certain patients to infections (immunocompromised patients, lengthy surgical procedures, patients with several serious pathologies, polytrauma patients in intensive care). [3]The nosocomial infection does not prejudge the endogenous or exogenous origin of the responsible germ, nor the avoidable nature of this infection [1]. However, thanks to medical progress, some countries have developed a prevention policy. Thus, the overall prevalence of nosocomial infections in the USA is estimated at between 3 and 5% increase of up to 9.2% in intensive care units [4], in France 20% in intensive care units [5], and Africa, not to be outdone, has the highest prevalence (25%) [6]. It is to study these infections that we proposed to evaluate the bacteriological profile of nosocomial post-operative infections in visceral surgery at the CNHU-HKM in Cotonou.

PATIENTS AND METHOD

The study was conducted over a period of six months from August 2017 to January 2018 in departments A and B of the visceral surgery of the CNHU-HKM of Cotonou and in the bacteriology laboratory of "SPACE-LABM" located in Cadjehoun.

Patient collection

Fifty (50) pus samples were taken from 50 patients who had undergone abdominal surgery and whose wounds had healed regardless of sex or age. Samples were taken with 2 sterile swabs at the patient's bedside in the morning before the day's dressing: one for direct examination and the other for culture.

Samples from the hospital environment

The samples taken here concerned, the hospital ward (the trolleys, trays, dressing clamps, hospital beds and air in the hospital wards); the operating theatre: air in the operating theatre, clamps, drums, floor and operating field. The environmental sampling was carried out by leaving open for a few minutes the petri dishes containing the different culture media used in the fields concerning the study. The tins were then transported to the laboratory and incubated in the oven at 37°C. They were observed 24 hours later to see if any culture was present. The removal of dressing trolleys, trays and clamps, from the beds, floor, operating field, and drums was carried out using sterile swabs.

Handling in the bacteriology laboratory

For each pus sample, the methodology used was that reserved for any bacteriological examination including macros copy, microscopy including direct examination, gram staining and depending on the germ found, the choice of culture media was made, followed by inoculation and incubation at 37oC for 24 hours. For any positive

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culture, a control examination was made for the identification of bacterial species whether pus or hospital environment. For gram negative bacilli, we searched for oxidize and then inoculated the rapid rack consisting of urea-indole broth, peptone water, Hajna kligler agar, Mannitol-Mobility, Simmons Citrate; as well as Vauges Proskauer (VP), Nitrate Reductase, ONPG test, Urea-Indole Revelation and Tryptophan Deaminase (TDA). For gram-positive cocci, we looked for catalase, free coagulase, Dnase. Then we performed an antibiogram of each of the isolated germs in order to test their sensitivity to known antibiotics. The sensitivity or resistance of the bacterium was assessed by measuring the diameter of the growth inhibition zone around the disc.

RESULTS

Prevalence of operative wound suppuration

Over the period of our study, 400 patients underwent visceral surgery and 100 or 25% had postoperative suppuration. Of the latter, we recorded 4% negative culture.

Distribution of germs isolated from surgical wounds

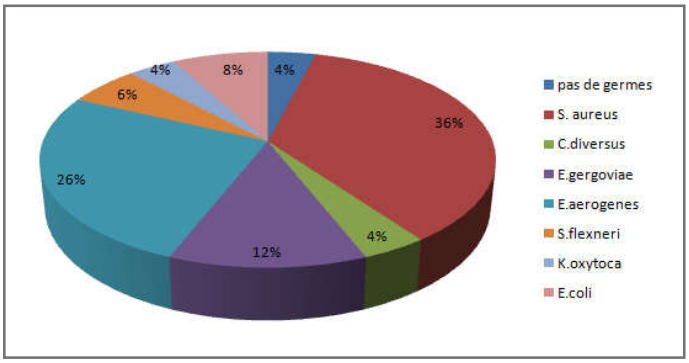

Figure 1. Distribution of germs isolated from surgical wounds

7 bacterial species of which the most frequent are Staphylococcus aureus 36%, Enterobacter aerogenes 26% and Enterobacter gergoviae 12%. 4% of the patients sampled had a negative culture.

Distribution of isolated germs in the hospital environment

Table I. Distribution of isolated germs in the inanimate environment and on work materials

		Bacillus gram -	Cocci gram +
Environment	Resuscitation air	Enterobacter gergoviae	
	Air Hospital rooms	Enterobacter gergoviae	Staphylococcus aureus
	Air Treatment room	Enterobacter gergoviae	
	Operating theatre air	Enterobacter gergoviae	
	Hospital bed		
	Block bed		
	Resuscitation bed		
	Surgical field		
Materials	Dressing forceps	Enterobacter gergoviae	
	Block clamps	Enterobacter gergoviae	Staphylococcus aureus
	Treatment drum	Enterobacter aerogenes	
	Block drum	Escherichia coli	
	Floor of the block		

This result reveals a predominance of gram-negative bacilli including Enterobacter gergoviae 46.16% followed by Staphylococcus aureus 38.47%.

Behavior of germs isolated from suppurated wounds and the hospital environment with regard to antibiotics

This result reveals that for all strains of S.aureus isolated from suppurated wounds or in the environment, there is a total sensitivity (100%) to Amikacin (AK) and Netilmicin (NET). In contrast, total resistance to Penicillin (P), Amoxicillin (AM), Doxycycline (DOX) and Spiramycin (SP) has been observed.

Table 2. Comparative effect of antibiotics on isolated Staphylococcus aureus in postoperative wound suppurations and in the hospital environment.

ATB	Staphylococcus aureus					
	Wound healing			Hospital environment		
	Sensitive	Intermediary	Resistant	Sensitive	Intermediary	Resistant
AK	100%	0%	0%	100%	0%	0%
OFX	40%	30%	30%	40%	30%	30%
NET	100%	0%	0%	100%	0%	0%
P	0%	0%	100%	0%	0%	100%
AM	0%	0%	100%	0%	0%	100%
NOR	0%	20%	80%	0%	20%	80%
DOX	0%	0%	100%	50%	0%	50%
CXC	0%	10%	90%	0%	10%	90%
VM	0%	5%	95%	0%	5%	95%
SP	0%	0%	100%	0%	0%	100%
MZ	0%	0%	100%	0%	0%	100%
0X	0%	20%	80%	0%	20%	80%
FLC	0%	30%	70%	0%	30%	70%
AMC	30%	0%	70%	30%	0%	70%

Cases of Enterobacter aerogenes

The examination of this table shows a total sensitivity to Amikacin on both sides and a sensitivity of half to Gentamicin and Netilmicin for this germ isolated from suppurated wounds while for the same molecules we observe a total sensitivity compared to the germ found in the inanimate hospital environment.

Case of Enterobacter gergoviae

We observe here, a total sensitivity to Amikacin, Tobramicin and Netromicin for this germ on both sides, except for a decrease of half of the sensitivity to Gentamicin for this same germ isolated in the wound suppuration, whereas it is totally sensitive in the samples taken from the inanimate environment of the hospital.

Case of Escherichia coli

The analysis of this table shows that Escherichia coli isolated in suppurated wounds is highly sensitive to Amikacin 100%, Netromicin 100%, Erythromycin 100%, and a little less to Gentamicin 60% and Augmentin 50%. However, in the inanimate environment, total sensitivity was only observed for Amikacin; Erythromycin and Augmentin are totally resistant to it.

Cases of Klebsiella oxytoca and Citrobacter diversus

Analysis of the table below shows that these germs are sensitive to Amikacin, Tobramicin, Gentamicin and Amoxicillin + Clavulanic Acid

Cases of Shigella flexneri

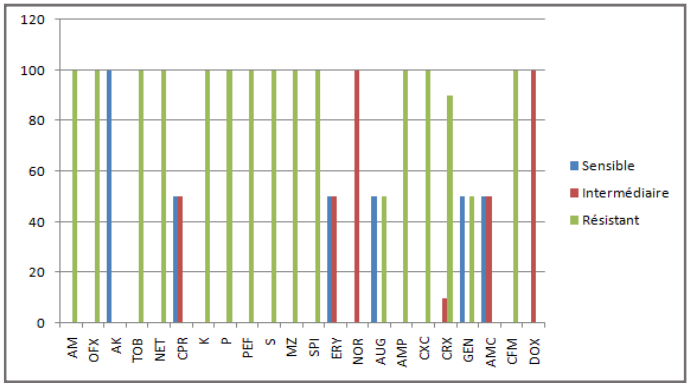

Figure 2. Effect of antibiotics used on Shigella flexneri isolated in suppurated wounds

Table 3. Comparative effect of antibiotics on *Enterobacter aerogenes* Isolated in post-operative wound suppurations and in the hospital environment

ATB	Enterobacter aerogenes					
	Wound healing			Hospital environment		
	Sensitive	Intermediary	Resistant	Sensitive	Intermediary	Resistant
AM,AMP,P	0%	0%	100%	0%	0%	100%
AMC,CFM, CFX,AUG	0%	0%	100%	0%	0%	100%
OFX,CPR, PEF,NOR	0%	0%	100%	0%	0%	100%
K,S,SPI, ERY,TOB	0%	0%	100%	0%	0%	100%
AK	100%	0%	0%	100%	0%	0%
NET,GEN	50%	0%	50%	100%	0%	0%
MZ	0%	0%	100%	0%	0%	100%
CXC	0%	0%	100%	0%	0%	100%
DOX	0%	100%	0%	0%	100%	0%

Table 4. Comparative effect of antibiotics on isolated Enterobacter gergoviae in postoperative wound suppurations and in the hospital environment

ATB	Enterobacter gergoviae					
	Wound healing			Hospital environment		
	Sensitive	Intermediate	Resistant	Sensitive	Intermediate	Resistant
AM,AMP,P	0%	0%	100%	0%	0%	100%
AMC,CFM,	0%	0%	100%	0%	0%	100%
CFX,AUG,CXC	0%	0%	100%	0%	0%	100%
OFX,CPR,	0%	0%	100%	0%	0%	100%
PEF,NOR	100%	0%	0%	0%	0%	0%
K,S,SPI,ERY, TOB	100%	0%	0%	100%	0%	0%
AK,NET, GEN	50%	0%	50%	100%	0%	0%
MZ	0%	0%	100%	100%	0%	0%
CXC	0%	0%	100%	0%	0%	100%
DOX	0%	100%	0%	0%	100%	0%

Table 4: Comparative effect of antibiotics on *Escherichia coli* isolated in postoperative wound suppurations and in the hospital environment

ATB	Enterobacter gergoviae					
	Wound healing			Hospital environment		
	Sensitive	Intermediate	Resistant	Sensitive	Intermediate	Resistant
AM,AMP,P,	0%	0%	100%	0%	0%	100%
CFM,CXC	0%	0%	100%	0%	0%	100%
CRX, OFX,PEF,	0%	0%	100%	0%	0%	100%
K,S,T,SPI, MZ,	0%	0%	100%	0%	0%	100%
AK	100%	0%	0%	100%	0%	0%
NET	100%	0%	0%	50%	0%	50%
GEN	60%	20	20%	50%	0%	50%
CPR	0%	10%	90%	0%	0%	100%
NOR	0%	100%	0%	0%	0%	100%
ERY	100%	0%	0%	0%	0%	100%
AMC	40%	20%	40%	50%	50%	0%
AUG	50%	0%	50%	0%	0%	100%
DOX	0%	100%	0%	0%	100%	0%

Table 4: Sensitivity of *Klebsiella oxytoca* and *Citrobacter diversus* in the suppuration of post-operative wounds

Antibiotics	*Klebsiella oxytoca*			*Citrobacter diversus*		
	Sensitive	Intermediary	Resistant	Sensitive	Intermediary	Resistant
AM						
OFX						
AK						
TOB						
NET						
CPR						
K						
P						
PEF						
S						
Mz						
SPI						
ERY						
NOR						
AUG						
AMP						
CXC						
CRX						
GEN						
AMC						
CFM						
DOX						

Analysis of this figure reveals a sensitivity of 100% to Amikacin and 50% to Ciprofloxacin, Erythromycin, Augmentin and Amoxicillin plus Clavulanic Acid.

DISCUSSION

Our discussion will focus on the prevalence of germs found in surgical wounds, the frequency of germs found and the behavior of these germs with regard to the antibiotics tested. Over the duration of our study, the prevalence of 25% of the postoperative wounds we obtained is an expression of the low level of hospital hygiene at the CNHU-HKM in Cotonou. It is respectively higher than the 12.7% observed by AGUEMON O. in 1994 [6] in the same department and the 18.9% observed by MEERS et al. in Great Britain [7] in 1980. On the other hand, the prevalence we recorded is lower than that reported by MAKOUTODE [8] in 1991 in BENIN, i.e. 33%. Of the frequency of species most often isolated from surgical wounds, the 1994 AGUEMON O. study revealed *Escherichia coli* 33.3%, *Staphylococcus aureus* 25.4%, *Proteus mirabilis* 15.8% *and Pseudomonas aeruginosa* 9.5% [6]. This frequency is similar to that of other authors such as LEIGH [9], WEMAMBU [10] in 1981 and MAKOUTODE [8] in 1991, who found *Staphylococcus aureus, Escherichia coli, Proteus mirabilis and Pseudomonas aeruginosa in* descending order. Thus our study places Staphylococcus aureus at the head of the list, followed by *Enterobacter aerogenes, Enterobacter gergoviae and Escherichia coli*. Although the distribution of germs isolated from these wounds is not identical from one author to another, it would be interesting to point out that the same germs are found everywhere incriminated. The same germs were isolated from samples taken from the inanimate hospital environment and from the care materials used for dressing the patients (see Table 1), which means that the operating room environment is already polluted before the operations. *Citrobacter diversus* and *Shigella flexneri* were also identified in the wounds in proportions of 4 and 6%. In relation to the behavior of the various isolated germs, we have observed the same resistance and sensitivity in *Staphylococcus aureus* species, whether in wounds or in the hospital environment: 100% resistance to Penicillin, 80% to Oxacillin and 100% sensitivity to Amikacin and Netromicin. AGUEMON in 1994 obtained the same sensitivity to Netromicine and almost the same resistance to Penicillin 75%, compared to the result obtained by WEMAMBU in 1981 in Nigeria 97%, it is important to underline the increase in Penicillin resistance in the visceral surgery departments of the CNHU-HKM in Cotonou from 1994 to 2018. The prevalence of *Staphylococcus aureus resistance to* oxacillin being 80% is higher than that reported by AGUEMON in 1994. This resistance in 24 years is very much increased and is becoming worrying, leading us to suppose that there is a plasmid of the *Staphylococcus aureus* OXA 'R' strains and that its germs also have a tendency to multi-resistance. *Escherichia coli*, isolated from wounds, is completely sensitive to Amikacin, Netromicin and Erythromycin. Gentamicin and Augmentin have an acceptable sensitivity of 60% and 50%. On the other hand, against Kanamycin, Norfloxacin, Ampicillin and Chloramphenicol, on both sides we have obtained complete resistance. If we compare this profile with other work, we could conclude that the resistance of these germs to these antibiotics could be explained by their overuse; aggravated by the probable presence of plasmids and other elements that code for the bacterium's resistance to antibiotics. These structural elements of certain bacteria, which code for antibiotic resistance genes that can be passed on from generation to generation, are worth studying. The multi-resistance of the germs encountered leads us to envisage research work on plasmids, transposons and integrons with a view not only to confirm the existence of these elements which code for the bacteria's resistance to antibiotics, but also to certify the origin of this multi-resistance in the bacterial strains studied. For the species *Enterobacter aerogenes* and *Enterobacter gergoviae*, *Citrobacter diversus*, *Klebsiella oxytoca* and *Shigella flexneri* we have also obtained total sensitivity to Amikacin. However, the resistance to Amoxicillin plus Clavulanic Acid of the first two should be highlighted. These gram-negative bacilli, whether isolated from wounds or from the environment, showed an increased resistance to Ampicillin plus Penicillin and Kanamycin, a result that is found in the one found by AGUEMON in 1994.

CONCLUSION

At the end of this study we conclude that the prevalence of postoperative wound suppurations is 25%, which indicates an increase in the rate of nosocomial infections and forces all the social and health personnel to strictly respect the rules of hygiene and asepsis at all levels (operating theatre, sterilization room, hospitalization room). Seven bacterial species have been found in the suppuration of operating wounds *(Staphylococcus aureus, Enterobacter aerogenes, Enterobacter gergoviae, Escherichia coli, Klebsiella oxytoca, Citrobacter diversus, Shigella flexneri)* and with the exception of the last 3, the same germs have been isolated in the inanimate hospital environment and on work equipment. The multi-resistance of these germs calls for a more conscientious use of antibiotics, a reconsideration of the fight against infection of operating wounds and other hospital infections, which is indeed a necessity, while thinking about the rehabilitation of the operating theatre in order to provide surgeons with rooms that meet international standards.

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