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Bacteriological profile of cellulitis of dental origin and antimicrobial features of some antibiotic-based drugs used in Kinshasa city, Democratic Republic of the Congo

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Abstract
Cellulitis of dental origin (CDO) is frequently met in the developing countries. Knowledge of the main bacterial species involved and their antibiotic susceptibility profile provides an objective basis for probabilistic antibiotherapy. The objectives were to identify the germs responsible for CDOs and their sensitivities to antibiotics commonly used in Kinshasa city (DRC). A cross-sectional study of 40 cases of CDO collected in five hospitals in Kinshasa city during the period from June 15 to October 15, 2017. Informed consent of patients was obtained before inclusion. The bacteriological examinations concerned blood cultures and polycultures performed in cellulitis patients. Results revealed that of 79 patients with CDO, 50.6% and 44.3% respectively had blood culture and pyoculture. Only 65.7% of the polycultures carried out were positive. 27 germs were isolated from the three bacterial species: Gram-positive Cocci (77.8%), the most common of which was *S. aureus* (48.1%) followed by *S. viridans* **(**26.0%); Gram negative bacilli with the predominance of *Klebsiella pneumoniae* and *Pseudomonas aeroginosa* (7.4% each). The susceptibility of isolated germs towards antibiotics indicates 100% sensitivity to oxacillin, erytromycin and ciprofloxacin and 96.3% to augmentin. These results indicate that gram + cocci are more common during DOC. They were more sensitive to oxacillin, erythromycin, ciprofloxacin and augmentin. The above mentioned drugs may be used for first-line probiotic antibio-therapy. However, *S. aureus* and *S. viridans* displayed in this study a very low sensitivity towards tetracycline and bactrim and a loss of sensitivity towards the most used drug amoxicillin.

Keywords: *Cellulitis, positive gram bacteria,* Staphylococcus aureus, Streptococcus viridans, *antibiotic resistance*

1. Introduction
Cellulitis of Dental origin (CDO) is a common group of infections in developing countries with a variety of clinical features [1]. Their prognosis is generally excellent, but some forms of malignancy are life-threatening [1, 9]. The clinical importance of CDOs is often underestimated in the developing country where the peculiarity is to reach young and healthy adults, and sometimes lead them to resuscitation for simple tooth decay [1, 2]. They are generally evoked on clinical arguments but knowledge of the main bacterial species responsible for these cellulites and their susceptibility to antibiotics (AB) makes it possible to give an objective basis to probabilistic antibiotherapy [2, 3, 10, 12]. However, the bacterial ecology is in permanent evolution and the microbiological documentation is not always realized, generally in the developing country and in particular in the Democratic Republic of the Congo (DRC) where the data are rare. This knowledge of bacterial species makes it possible to reduce the emergence and diffusion of AB multi-resistant bacteria, which complicate the probabilistic management of CDO [2, 11]. The objectives of this study were to identify the germs responsible for CDOs and their sensitivities to antibiotics commonly used in Kinshasa.

2. Materials and Methods
The present study was conducted from June 15 to October 15, 2017, among patients who had visited the odontostomatology departments of five medical units in the city of Kinshasa.

They have been selected in a random manner. These Medical Centers are: Central Military Referral Hospital, Boyambi Hospital Center, Elonga Masina Center, CBCO/Bandalungwa Medical Center, and Kinshasa General Referral Hospital. A random sample was collected from patients with CDO who accepted to participate in the study. For children, the consent of the guardian or parents was obtained. The bacteriological examinations concerned hemocultures (serous and suppurative cellulites) and polycultures (collected cellulites) performed in patients with CDO during the study period.

2.1 Procedures for taking bacteriological examinations

- ***Blood culture***: Venous blood was collected at 10 ml for adults and 5 ml for children and inoculated into Bac/Alert aerobic flasks and incubated at 37 °C.
- ***Pyoculture***: The collection of pus was done with the empty sterile syringe ± 5 ml immediately recapped.

Samples of blood and pus were transported within minutes to the University hospital (CUK) bacteriology laboratory.

2.2 Laboratory assays

Detection of bacterial growth in the blood was done daily at best twice a day, by macroscopic visual inspection of the blood culture bottles for signs of positivity.

While the macroscopic examination of pus makes it possible to appreciate the aspect of the sample, the color, the consistency.

Then, fresh slide-slide examination, smear for Gram stain, replication on appropriate culture media, and incubation at 37 °C for 48-78 hours were performed.

The identification of bacteria was based on the study of morphological, cultural, biochemical and antigenic traits. The sensitivity study of different strains isolated towards antibiotics was carried out by the method of diffusion in Mueller-Hinton agar medium (method of disks impregnated with antibiotics *in vitro* according to Kirby Bauer, recommended by the World Health Organization, WHO) [11, 13]. The data collection was done from an archived register during the study period. Using a survey card, the following parameters of interest were used: age, sex, medical training, the isolated germ and the susceptibility of germs to antibiotics were collected.

2.3 Data analysis

The Excel 2013 and SPSS 21.0 software packages were used for analyzing the data.

3. Results & Discussion

The table 1gives the performance profile of blood culture and pyoculture.

Table 1: Performance profile of blood culture and pyoculture

Biological examination	Blood culture N = 79 (%)	Pyoculture N = 79 (%)
Not done (missing)	20(25,3)	23(29,1)
Rejected	19(24,1)	21(26,6)
Executed	40 (50,6)	35(44,3)
Negative	40(100,0)	12(34,3)
Positive	0	23(65,7)

The results of the table 1 revealed that out of 79 patients with dental cellulitis, 40 (50.6%) and 35 (44.3%) respectively performed blood culture and pyoculture. All blood cultures were negative; however, 65.7% of the polycultures were positive.

The figure 1 gives the profile of isolated germs during DOC.

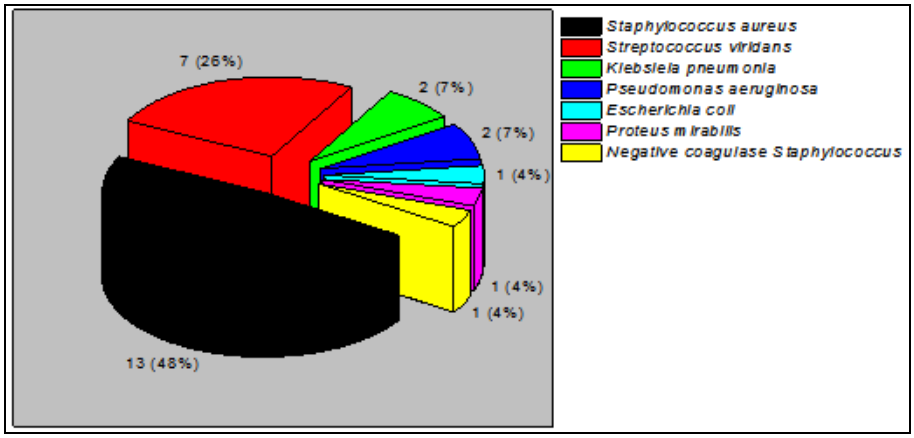

Fig 1: Profile of isolated germs during CDO

The figure 1 shows that 27 organisms were isolated from pyocultures, of which *Staphylococcus aureus* and *Streptococcus viridans* were the most frequently isolated bacteria with 48.1% and 26.0% respectively. Thus this s*et al*one accounted for 74.1%. As revealed by the figure 2, these germs belong to the following three bacterial species: Gram Positive Cocci: *Staphylococcus aureus*, *Streptococcus viridans* and Negative *Staphylococcus* Coagulase (77.8%), Gram Negative Bacilli (Enterobacteria): *Escherichia coli*, *Klebsiela pneumoniae*, *Proteus mirabilis* (14, 8%) and Gram Negative Bacilli (non enterobacteria): *Pseudomonas aeruginosa* (7.4%).

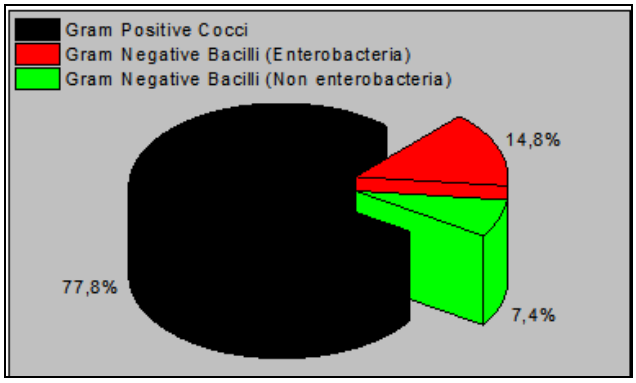

Fig 2: Category of bacterial species isolated

The table 1 gives the antibiotic susceptibility profile of isolated germs.

Table 2: Antibiotic susceptibility profile of isolated germs

Antibiotics	N	Sensitive N (%)	Resistance N (%)	Intermediate N (%)
Oxacillin	12	12(100,0)	0	0
Erythromycin	20	20(100,0)	0	0
Ciprofloxacin	26	26(100,0)	0	0
Augmentin	27	26(96,3)	1(3,7)	0
Gentamicin	24	23(95,8)	1(4,2)	0
Lincocin	19	17(89,5)	0	2(10,5)
Ceftriaxone	9	8(88,9)	1(11,1)	0
Clindamycin	11	8(72,7)	0	3(27,3)
Amikacin	19	12(63,2)	7(36,8)	0
Amoxicillin	24	11(45,8)	5(20,8)	8(33,3)
Ampicillin	22	7(31,8)	14(63,6	1(4,5)
Tetracyclin	18	4(22,2)	13(72,2)	1(5,6)
Bactrim	20	4(20,0)	14(70,0)	2(10,0)

The susceptibility of antibiotics to dental cellulitis shown in this table indicates a sensitivity of 100% for oxacillin, Erythromycin and ciprofloxacin, 96.3% for the increase, and 95.8% for gentamycin, 89.5% for lincocin, 88.9% for Ceftriaxone.

Data on the profile of antibiotic sensitivity of the most occurring germs are given in table 3.

Table 3: Profile of antibiotic sensitivity of *Staphylococcus aureus* and *Streptococcus viridans*

	S. aureus				***S. viridans***			
Antibiotics	**n**	**S N (%)**	**R N (%)**	**I N (%)**	**n**	**S N (%)**	**R N (%)**	**I N (%)**
amoxicillin	13	6(46,2)	1(7,7)	6(46,2)	5	5(100,0)	0	0
Augmentin	13	13(100,0)	0	0	7	7(100,0)	0	0
Ampicillin	11	0	10(90,9)	1(9,1)	6	6(100,0)	0	0
Gentamicin	11	11(100,0)	0	0	6	6(100,0)	0	0
Erythromycin	13	13(100,0)	0	0	1	1(100,0)	0	0
Clindamycin	3	3(100,0)	0	0	1	1(100,0)	0	0
Tetracyclin	7	0	7(100,0)	0	5	4(80,0)	1(20,0)	0
Bactrim	13	3(23,1)	9(69,3)	1(7,7)	4	0	3(75,0)	1(25,0)
Oxacillin	12	12(100,0)	0	0	-	-	-	-
Lincocin	12	12(100,0)	0	0	1	1(100,0)	0	0
Ciprofloxacin		13(100,0)	0	0	7	7(100,0)	0	0
Ceftriaxone	1	1(100,0)	0	0	2	2(100,0)	0	0

The results of the table 3 indicate that the most common isolated germ *S. aureus* is more sensitive (100% sensitivity) to augmentin, gentamycin, erythromycin, clindamycin, oxacillin, lincocin, ciprofloxacin, ceftriaxone but 100% resistance was noted for tetracycline. While *S. viridans* displayed 100% sensitivity towards amoxicillin, augmentin, ampicillin, gentamycin, erythromycin, clindamycin, lincocin, ciprofloxacin and ceftriaxone.

The present study revealed that among 79 patients suffering from dental cellulitis, 40 (50.6%) and 35 (44.3%) respectively performed blood culture and pyoculture. This rate of achievement of pyoculture is much lower than that of Badiane in Dakar (Senegal, West Africa) which represented 76.36% [12]. This is because almost half of our patients had not done bacteriological examinations (49.4% for blood culture and 55.7% for pyoculture). These patients either refused to participate in the study after explanations or they disappeared during the samples. Most of them had estimated that the 10 ml blood sample was a lot, and refused to do the pyoculture. For the missing patients, we found no explanation for this because they were absent from the call for the samples.

With regard to the results of the bacteriological examinations, it appears that all the blood cultures were negative 100%; in contrast, 77.1% of the polycultures were positive.

The high rate of negative blood cultures observed in our study could be explained by antibiotic use by patients before consultation and bacteriological sampling. This was one of the drawbacks of self-medication, and also that sampling was performed in the absence of the hyperthermia period which would also give negative results [11]. The rate of positive cultures observed in our study is higher than those of Badiane [12].

We isolated 27 germs belonging to three bacterial species: Gram-positive cocci: 21 strains, Gram-negative bacilli (enterobacteria): 4 strains and Gram-negative bacillus (non-enterobacteria): 2 strains. According to Larosa *et al*., the isolated causative organisms are part of the saprophytic flora present in the oral cavity; they can be found in the blood and often in the pus taken by syringe puncture [14]. It is made up of numerous bacteria in which gram-positive cocci are the most frequently isolated as bacterial reservoir [14]. The predominance of Gram-positive cocci was also reported by Badiane in Dakar (Senegal) [12], Chechomkammogne in Cocody (Côte d'Ivoire) [11], Kouame in Treichville (Côte d'Ivoire) [15] and diomande in Abidjan (Côte d'Ivoire) [16]. The present study confirms this predominance of Gram-positive Cocci with 77.8% versus 22.2% Gram-negative bacilli. The most frequently isolated organisms in this study were *S. aureus* (48.1%) and *S. viridans* (26.0%), which together accounted for 74.1% of isolated organisms.

These results seem to contradict the works of Kouame [15], Laroque [17], Fofana [18] and Benzarti [3], which had found a predominance of streptococci. These results provide comforting evidence in the literature that streptococci are the

predominant causative organisms in CDO [15, 17, 19, 20]. For this reason, most authors recommend first-line targeted streptococcal probabilistic antibiotic therapy [5, 6, 19, 20]. On the other hand, Chechomkammogne [11] and Badiane [12] had found the predominance of *Staphylococcus*.

Comparing these results with ours, we find that staphylococci become more and more important in the bacterial flora of CDO. According to these results, we believe that in the context of first-line probiotic ant biotherapy of CDO, antibiotic therapy would be targeted both staphylococci and streptococci.

This work revealed a decreased sensitivity of amoxicillin (45.8%) and ampicillin (31.8%), and also highlights tetracycline and Bactrim as antibiotics with a small sensitivity with respectively (22%) and (20%). The decrease in the sensitivity of these antibiotics is explained by their uncontrolled use establishing thus a relationship between anarchic antibiotic consumption and antibiotic resistance [21-23]. This bacterial resistance to commonly used AB is responsible for 700,000 deaths a year in the world [24]. This is why the prescription of AB must be rational in order to reduce and prevent this mortality. Amoxicillin is considered as a molecule of choice in the treatment of cellulitis [43], although, we found in this study that this AB displayed low sensitivity (46.2%) towards *Staphylococcus aureus* while tetracycline exhibited a resistance of 100% towards *Staphylococcus aureus.* Bactrim displayed resistance of 96.3% and 75% respectively towards *Staphylococcus aureus* and *Streptococcus viridans*. These antibiotics will not be used in the first-line probabilistic antibiotherapy of CDO in our ecological environment.

4. Conclusions

The aim of this cross sectional study on bacteriological profile of acute CDO and antibiotic pattern in Kinshasa was to identity pathogenic bacteria responsible and to evaluate their sensitivity to common used antibiotics. Results revealed the isolation of 27 pathogenic bacteria belonging to Positive-gram Cocci, Negative-Gram bacilli (enterobacteria and non-enterobacteria), with predominance of *Staphylococcus aureus* followed by *Streptococcus viridans*. The susceptibility of the isolated bacteria highlights the following antibiotics as being highly effective during CDO: oxacillin, erythromycin, ciprofloxacin, augmentin, gentamycin, lincocin, ceftriaxone and clindamycin. However, *S. aureus* and *S. viridans* displayed in this study a very low sensitivity towards tetracycline and bactrim and a loss of sensitivity towards the most used drug amoxicillin. Thus these drugs cannot be prescribed in the first-line probabilistic antibiotherapy of CDO in our ecological environment.

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