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Bacteriological Profile and Antimicrobial Susceptibility Pattern of Cervico-Facial Cellulitis at the Regional Teaching Hospital of Ouahigouya (Burkina Faso)

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Abstract

Context and Objective: Cervicofacial cellulitis is a lethal infection without treatment. The aim of this study is to establish the bacteriological and antimicrobial susceptibility profile of cervico-facial cellulitis at the Regional Teaching Hospital (RTH) of Ouahigouya, in order to guide practitioners in the development of effective probabilistic antibiotic therapy protocols. **Subjects and Methods:** This was a transversal descriptive study with prospective data collection from July 1 to December 31, 2021 at the RTH of Ouahigouya. All cases of suppurative cervicofacial cellulitis that had been the subject of pyoculture were retained. **Results:** A total of 63 patients were chosen including 41 men, with 40.91 years as the average age and the sex ratio was 1.86. In 90.48% of cases, the front door was dental. All patients took antibiotics before their admission. Pus culture was positive in 34/63 subjects (53.97%) and showed monomicrobial infection. The isolates were Gram-negative bacilli for 20.59% and Gram-positive cocci for 79.41%. These isolates were all resistant to certain beta-lactams (such as amoxicillin, amoxicillin + clavulanic acid). However, some isolates were susceptible to cefoxitin, ceftazidime and ceftriaxone. All isolates were sensitive to amikacin for aminoglycosides. As for macrolides, erythromycin had excellent activity (100%) against Gram-positive cocci. Indeed, some isolates were susceptible and others resistant to ciprofloxacin for quinolones. **Conclusion:** Bacteriological profile and antimicrobial susceptibility knowledge of cervicofacial cellulitis may propose an effective probabilistic antibiotic therapy protocol.

Keywords

Bacteriological Profile, Cervico-Facial Cellulitis, Ouahigouya

1. Introduction

Cervicofacial cellulitis is a neck and face fat tissue infection [1]. This disease is common in our developing country [2] [3] [4] [5]. Hospital frequency is from 20% to 33% in some African groups [2] [3]. It will be terrible and lethal if untreated. Fatality rate from 20% to 40% has been reported by some authors [4] [5]. Tooth decay remains the main cause [3] [6] [7]. Also, poor oral hygiene, use of nonsteroidal anti-inflammatory drugs (NSAIDs) monotherapy, diabetes, human immunodeficiency virus (HIV) infection, pregnancy, and general immunosuppression are relevant contributing factors [4] [7] [8]. Diagnosis of cervicofacial cellulitis is easy and is essentially based on the clinic. Then, microbiological diagnosis is based on pyoculture and/or blood culture. It is classically polymicrobial infection involving the aerobic, anaerobic and aero-anaerobic commensal flora of the oral cavity [9] [10] [11]. The treatment of cervicofacial cellulitis is a medical-surgical emergency, especially in our context where patients are seen for treatment [3] [4] [7]. In addition, pyoculture is negative generally and when it is positive, the results are not available soon. In such a situation, the life-threatening prognosis depends on the urgent initiation of effective probabilistic antibiotic therapy. A better bacteriological profile knowledge of cervicofacial cellulitis as well as bacteria susceptivity to antibiotics is one of their successful management guarantees. That is the purpose of this work. It will guide practitioners in the choice of first-line antibiotics for the management of cervicofacial cellulitis at the RTH of Ouahigouya.

2. Subjects and Methods

This is a descriptive cross-sectional study with prospective collection from July 1 to December 31, 2021. All suppurative cervicofacial cellulitis cases admitted to the maxillofacial surgery department at the RTH of Ouahigouya, which underwent pyoculture were included. The following variables were studied: epidemiological (age, sex, gateway), microbiological (receiving antibiotic before hospital admission, pus collection method, average time of pyoculture results availability, bacteria isolated, antibiotics tested, probabilistic antibiotic therapy protocol) and evolutive (number of declared cured patients). Information on the study variables (age, sex, gateway, antibiotic received before hospital admission) was collected by questionnaire based on a survey sheet for this purpose. The pus sample was taken from a patient, comfortably seated in a dental chair. After a complete clinical examination and identifying collection area, most often fluctuating, a rigorous asepsis of this area is performed using polyvidone-iodine. The pus puncture is then applied using a sterile, empty 10-milliliter syringe. At least five milli-

liters of pus was aspirated, and the syringe was immediately recapped. The samples were then sent immediately (within 15 minutes) to the microbiology laboratory at the RTH of Ouahigouya to be processed according to the procedures relating to the cytobacteriological examination of pus and cytopunctures [12]. The main stages of this culture at the RTH of Ouahigouya can be summarised as follows. Firstly, macroscopic examination of the sample to assess its appearance, consistency, colour and odour. Secondly, fresh microscopic examination between slide and coverslip to assess the presence of leukocytes and red blood cells but also the morphology of any isolates. Thirdly, culture on agar media (CLED (cystine lactose electrolyte deficient), BHIB (brain heart infusion broth) incubated at 37˚C in an oven; GC + PVX (chocolate agar + polyvitex) incubated at 37˚C under a bell for 18 to 24 hours) and finally bacterial identification based on morphological and biochemical characteristics on an Api 20E gallery. The Mueller-Hinton agar susceptibility test of isolated strains was performed using antibiotic discs according to the antibiogram committee of French Society of Microbiology (CA-SFM) [13]. The data collected were entered and processed using a microcomputer with Word 2016 and Epi-info software version 7.2.1.0. Patients' anonymity and the confidentiality of collected information have been saved. Hospital's general manager authorized this study to be conducted.

3. Results

A total of 63 patients were collected, including 41 men and 22 women, with a sex ratio of 1.86. The average age was 40.91 years with extremes of seven and 91 years. Three causes were blamed: tooth decay (90.48%), periodontitis (6.35%) and tonsillitis (3.17%). All patients took antibiotic therapy before admitting at the regional teaching hospital (RTH) of Ouahigouya. These were penicillin (42.86%), ceftriaxone (23.81%), amoxicillin (22.22%) and amoxicillin + clavulanic acid (11.11%). Pyoculture was positive for 34 patients (53.97%). The average duration to pyoculture results availability at the laboratory was 6.5 days with extremes of three and 14 days. The isolates identified included *Klebsiella pneumoniae* (6/34), *Staphyloccocus aureus* and *saprophyticus* (5/34) (**Table 1**). All isolates were resistant to amoxicillin and amoxicillin + clavulanic acid (**Table 2** and **Table 3**). However, cefoxitin showed excellent activity (100%) against *Staphylococcus Aureus*, *Streptococcus sp*, and no activity against *Staphylococcus Saprophyticus* for Gram-positive cocci (GPC) (**Table 4**). For Gram-negative bacilli (GNB), cefoxitine, ceftazidime and ceftriaxone showed excellent activity (100%) against all GNBs except *Bunkholderia cepacia*, *Entrerococcus cloacae* and *Entrerococcus sp*, against which their activity was none (**Table 5**). Imipenem had excellent activity (100%) against all GNBs (**Table 5**).

For aminoglycosides, all isolates (GPC and GNB) were sensitive to amikacin (**Table 2** and **Table 3**). It was the same for gentamicin, except *Enterococcus sp* and *Escherichia coli* (**Table 2** and **Table 3**). Erythromycin showed excellent activity (100%) against GPC (**Table 2**). For quinolones, all isolates were tested susceptible to ciprofloxacin. In the GPCs, ciprofloxacin showed excellent activity

Table 1. Distribution of isolated bacteria by morphology and Gram.

Isolated bacteria	Numbers	Frequency (%)
Gram-positive cocci	**7**	**20.59**
Staphylococcus aureus	4	11.76
Staphylococcus saprophyticus	1	2.94
Streptococcus sp	2	5.88
Gram-negative bacilli	**27**	**79.41**
Aeromonas hydrophilia	1	2.94
Burkholderia cepacia	1	2.94
Citrobacter braakii	1	2.94
Enterococcus cloacae	1	2.94
Enterococcus sp	1	2.94
Escherichia coli	2	5.88
Klebsiella pneumoniae	6	17.65
Pasteurella pneumotropica	4	11.76
Pseudomonas aeruginosa	4	11.76
Pseudomonas luteola	1	2.94
Salmonella arizonae	1	2.94
Salmonella sp	3	8.82
Stenotrophomonas maltophilia	1	2.94

Table 2. GPCs suceptibility to Penicillin G (Peni G), Amoxicillin (Amoxi), Amoxicillin + Clavulanic Acid (CA), Erythromycin (Erythro), Gentamicin (Genta), and Amikacin.

Antibiotiques testés Isolats	Péni-G		Amoxi		Amoxi + AC		Erythro		Genta		Amikacin	
	R	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**
Staphylococcus Aureus	100%	0%	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%
Streptococcus sp	100%	0%	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%
Staphylococcus Saprophyticus	100%	0%	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%

R: Resistant; **S**: Sensitive.

Table 3. GNBs susceptibility to amoxicillin (amoxi), amoxicillin + clavulanic acid (CA), gentamicin (Genta), amikacin, and ciprofloxacin.

Antibiotiques testés Isolats	Amoxi		Amoxi + AC		Gentamicin		Amikacin		Ciprofloxacin	
	R	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**
Aeromoas hydrophilia	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%
Bunkholderia cepacia	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%
Citrobacter braakii	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%

Continued

Entrerococcus cloacae	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%
Entrerococcus sp	100%	0%	100%	0%	100%	0%	0%	100%	100%	0%
Escherichia coli	100%	0%	100%	0%	100%	0%	0%	100%	50%	50%
Klebsiella pneumoniae	100%	0%	100%	0%	0%	100%	0%	100%	66.67%	33.33%
Pasteurella pneumotropica	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%
Pseudomonas aeruginosa	100%	0%	100%	0%	0%	100%	0%	100%	100%	0%
Pseudomonas luteola	100%	0%	100%	0%	0%	100%	0%	100%	100%	0%
Salmonella arizonae	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%
Salmonella sp	100%	0%	100%	0%	0%	100%	0%	100%	33.33%	66.67%
Stenotrophomonas maltophilia	100%	0%	100%	0%	0%	100%	0%	100%	0%	100%

R: Resistant; **S**: Sensitive.

Table 4. GPCs suceptibility to ciprofloxacin, cefoxitin, and cotrimoxazole.

Antibiotiques testés Isolats	Ciprofloxacin		Cefoxitin		Cotrimoxazole	
	R	**S**	**R**	**S**	**R**	**S**
Staphylococcus Aureus	50%	50%	0%	100%	50%	50%
Streptococcus sp	0%	100%	0%	100%	0%	100%
Staphylococcus Saprophyticus	100%	0%	100%	0%	100%	0%

R: Resistant; **S**: Sensitive.

Table 5. GNBs susceptibility to cefoxitin, ceftriaxone, ceftazidine, imipenem and cotrimoxazole.

Antibiotiques testés Isolats	Cefoxitin		Ceftriaxone		Ceftazidine		Imipenem		Cotrimoxaole	
	R	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**
Aeromoas hydrophilia	0%	100%	0%	100%	0%	100%	0%	100%	100%	0%
Bunkholderia cepacia	100%	0%	100%	0%	100%	0%	0%	100%	100%	0%
Citrobacter braakii	0%	100%	0%	100%	0%	100%	0%	100%	100%	0%
Entrerococcus cloacae	100%	0%	100%	0%	100%	0%	0%	100%	100%	0%
Entrerococcus sp	100%	0%	100%	0%	100%	0%	0%	100%	100%	0%
Escherichia coli	0%	100%	0%	100%	0%	100%	0%	100%	100%	0%
Klebsiella pneumoniae	0%	100%	0%	100%	0%	100%	0%	100%	66.67%	33.33%
Pasteurella pneumotropica	0%	100%	0%	100%	0%	100%	0%	100%	100%	0%
Pseudomonas aeruginosa	0%	100%	0%	100%	0%	100%	0%	100%	100%	0%
Pseudomonas luteola	0%	100%	0%	100%	0%	100%	0%	100%	100%	0%
Salmonella arizonae	0%	100%	0%	100%	0%	100%	0%	100%	100%	0%
Salmonella sp	0%	100%	0%	100%	0%	100%	0%	100%	33.33%	66.67%
Stenotrophomonas maltophilia	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%

NB: **R**: Resistant; **S**: Sensitive.

(100%) against *Streptococcus sp*, 50% activity against *Staphylococcus aureus* and no activity against *Staphylococcus saprophyticus*. For GNBs, ciprofloxacin showed excellent activity (100%) against *Aeromoas hydrophilia*, *Bunkholderia cepacia*, *Citrobacter braakii*, *Entrerococcus cloacae*, *Pasteurella pneumotropica*, *Salmonella arizonae and Stenotrophomonas maltophilia* and from 0% to 66.67% against other GNBs (Table 3 and Table 4). Two probabilistic antibiotic therapy protocols were done after admitting at the RTH of Ouahigouya.: there were ceftriaxone + metronidazole for all hospitalized patients and amoxicillin + clavulanic acid for outpatients. These protocols have been adapted to antibiotic susceptibility testing according to the clinical cellulitis. All patients were cured after this treatment.

4. Discussion

The challenge in our context is determining the most effective probabilistic antibiotic therapy, given the diversity of isolates, their varying susceptibility to antibiotics, the impossibility of isolating anaerobic isolates, and some cultures negativity. Then, our study limits were pre-hospital antibiotic therapy and lack of culture to all possible isolates, particularly anaerobic isolates. Nevertheless, this study provided insight into the most common isolates and their susceptibility to antibiotics.

On one hand, 53.97% of patients pyoculture was positive, *i.e.* just over half of the patients. Some authors reported significantly higher positivity rates ranging from 65% to 93% [14] [15] [16] [17]. On the other hand, Itiere [7] and Togo *et al.* [18] reported 6% and 33.3% positive pyocultures, respectively. The low positivity of pyocultures in this series may be due to pre-hospital antibiotic therapy. In fact, all of the patients had received an antibiotic before being admitted to hospital. In addition, inadequacies in the sampling, conveying or seeding technique could be blamed because of the modest technical platforms. Although cervicofacial cellulitis is considered polymicrobial by the oral flora abundance, pyocultures were monomicrobial in this series [9] [10] [11]. Agoda *et al.* [16] also reported monomicrobial infection. Lack of specific culture for anaerobic bacteria in our context would justify this situation. Indeed, no anaerobic bacteria were tested for this study. Also, a polymicrobial infection can be difficult to provide a culture environment that is equally suitable for all the bacteria involved. In addition, inadequate transport conditions and/or late inoculation of samples contribute to the decapitation of some germs, thus making them undetectable [19]. For morphotype, the isolated germs belonged to both, such as GNB (79.41%) and GPC (20.59%). Both appear to be most frequently isolated during cervicofacial cellulitis in the literature [14] [15] [16]. For the dominant morphotype, opposite to the data from this study, GPCs appear to be predominant in the literature, regardless of the number of morphotypes isolated [10] [11] [14] [17]. The study by Bissa *et al.* [15] also, corroborated the present by reporting 57.2% of GNB. *Staphylococcus* was the most common germ of GPC in the series. Other authors have made the same observation [14] [16]. However, streptococcus is

the most frequently encountered among GPCs, during cervicofacial cellulitis according to the literature [3] [9] [10] [11] [20]. For GNBs, *Klebsiella pneumoniae* (6/27), *Pasteurella pneumotropica* (4/27) and *Pseudomonas aeruginosa* (4/27) were the top three isolates. According to Agoda *et al.* [16], it is *Escherichia coli* (6/20), *Enterobacteria* (6/20) and *Klebsiella pneumoniae* (4/20). Zegbeh *et al.* [3] reported *Escherichia coli* (25/32) and *Pseudomonas aeruginosa* (7/32). Unlike GPCs where *Streptococcus* and *Staphylococcus* are the first bacteria, the predominance of Gram-negative bacteria varies from study to study.

All isolates (GPC and GNB) in the series were resistant to the usual beta-lactams amoxicillin and amoxicillin + clavulanic acid. However, cefoxitin showed excellent activity (100%) against *Staphylococus aureus* and *Streptococcus sp*. In addition, it had no activity against *Staphylococcus saprophyticus*. Ceftazidime and ceftriaxone, each had excellent activity (100%) against GNBs except *Burkholderia cepacia*, *Enterococcus cloacae and Enterococcus sp*, which activity was non-existent. Opposite to our study, Shakya *et al.* [20], Paul *et al.* [14] reported 100% and 96.30% activity of amoxicillin + clavulanic acid against isolates, respectively. However, the activity of amoxicillin was low (45.80%) against isolates, according to the study by Paul *et al.* [14]. For cefotaxime, the suceptibity of aerobic isolates were 91.18% according to Shakya *et al.* [20]. For Fating *et al.* [9], this resistance was 20% to amoxicillin and amoxicillin + clavulanic acid and 5% to ceftriaxone. Bacterial resistance to beta-lactams, first-line antibiotics for the treatment of cervicofacial cellulitis, varies from study to study. Self-medication and over-prescribing would justify the high bacterial resistance to beta-lactams in our study. Indeed, amoxicillin, amoxicillin + clavulanic acid and ceftriaxone are available and dispensed by poorly qualified health team and lack of any biological assessment, particularly in primary health centers. In addition, these molecules are freely available in pharmacies that promote self-medication. Carbapenems, which are better protected by their prescription only dispensing and their high cost, were not subject to bacterial resistance in the present series.

For aminoglycosides, amikacin had excellent activity (100%) against all isolates in the series. However, two isolates (*Enterococcus sp* and *Escherichia coli*) were resistant to gentamicin. Paul *et al.* [14], Fating *et al.* [9] reported resistance of 36.8% and 15% of isolates to amikacin, respectively. For gentamicin, in addition, Fating *et al.* [9], Paul *et al.* [14] reported suceptivity of 100% and 95.50% of isolates, respectively. For macrolides, all GPCs were sensitive to erythromycin. Paul *et al.* [14], also reported 100% susceptibility of all isolates to erythromycin. For Fating *et al.* [9], only aerobic isolates had a 95.50% suceptivity to erythromycin because of their significant activity on isolates. Macrolides and aminoglycosides could be therapeutic alternative to beta-lactams, also amoxicillin and amoxicillin + clavulanic acid.

For quinolones, ciprofloxacin had excellent activity (100%) against *Streptococcus sp* and low activity (50%) against *Staphylococcus aureus*. Ciprofloxacin activity was absent against *Staphylococcus saprophyticus* as well as the major GNBs isolated. Then, Paul *et al.* [14] reported excellent (100%) activity of ci-

profloxacin against all isolates tested. Shakya *et al.* [20] also reported significant activity (90.77% to 96.08%) of ciprofloxacin against aerobic and anaerobic isolates. The over-prescribing of ciprofloxacin in our context could explain its low activity against some isolates. Indeed, ciprofloxacin is available and handled by low-skilled health team, especially in primary health centers.

All patients in the series were cured despite antibiotic therapy that was not always appropriate because of late availability of pyoculture results (average duration 6.5 days). This cure is based on three hypotheses such as the discrepancy between "*in vitro*" and "*in vivo*" resistance to mixed infections, the effect of etiologic treatment combined with surgical drainage and pathogen complex inactivation in mixed interdependent and synergistic infections where one species is susceptible to penicillin [21]. However, new probabilistic antibiotic protocols excluding amoxicillin and amoxicillin + clavulanic acid are needed.

5. Conclusion

Bacteriological profile and antimicrobial susceptibility study of cervicofacial cellulitis shows no activity of amoxicillin and amoxicillin + clavulanic acid. It gradually extends to ceftriaxone for some bacteria. However, beta-lactams were previously considered as first-line antibiotics in the treatment of cervicofacial cellulitis in our context. Significant activity of some antibiotics such as amikacin, erythromycin, and gentamicin was noted against all isolates. So, these readaptation data need probabilistic antibiotic therapy protocols for the effective management of cervicofacial cellulitis at the RTH of Ouahigouya. In the end, an evaluation of these new protocols should be effective.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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