Original Research Article

Bacteriological profile and antibiotic sensitivity of pus isolates in patients at Regional Hospital Center of Franceville in Gabon

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Abstract

Background: Bacterial resistance to antibiotics is a public health problem, it is a threat to the future. It compromises the effectiveness of antibiotic treatment and is constantly increasing worldwide. This work has been highlighted by the profile and sensitivity of pyogenic bacteria isolated at Franceville Regional Hospital Center. **Methods:**Effective antibiotic strategy, suppurations from the wounds of 530 patients were collected and analyzed. Biochemical identification of isolated bacterial strains was performed with Api 10s galleries and verified using Vitek-2 system. The Kirby-Bauer technic was used to perform the antibiogram. Five antibiotics were first tested in a simple way and then combined in pairs. **Results:**360 samples showed bacterial strains and 170 were sterile cultures. 360 microorganisms were isolated, of which 230 strains came from hospitalization surgery, 110 from minor surgery and 20 from medicine.The bacterial families identified are Enterobacteriaceae, Moraxellaceae, Pseudomonadaceae, Streptococcaceae and Xanthomonadaceae. Enterobacterizceae is the most common family with 64.69% and has revealed 7 genera *Citrobacter*, *Enterobacter*, *Escherichia*, *Klebsiella*, *Serratia*, *Yersinia* and *Proteus* 65% antibiotic sensitivity of simple antibiotics showed the best sensitivities with Ciprofloxacin and Ofloxacin a resistance rate 31.25%, 100% unlike Amoxicillin and Metronidazole. Ceftazidim was not very active on bacterial strains with a resistance rate of 93.75%. The interactions between antibiotics combined gave antagonistic, synergistic, indifferent and additive effects. The indifferent effect was much more observed (44 cases), in contrast to the additive effect which represented only 23 cases. The antagonic and synergistic effects were reported in 14 cases. Combined Amoxicillin and Metronidazole, Ceftazidim antibiotics showed good activity on bacterial strains, with good synergy and additive effect, or were not combined. **Conclusion:**The emergence of bacteria is major global problem multi-resistance. The rationalization of the prescription of antibiotics, especially Ofloxacin and Ciprofloxacin, and the optimization of bacteriological prescriptions are desirable in surgical services. However, rigor in dispensing pharmacies and the rational use of these antibiotics are essential to avoid the emergence of resistance phenomena.

Key words: Pyogenic bacteria, susceptibility, multi-resistance, combination of antibiotics,interaction.

Introduction

The widespread use of antibiotics after the Second World War was one of the most important advances of the twentieth century. Antibiotic treatments have increased more than 10 years, more than any other medical treatment [1, 2]. The discovery of antibiotics has been an extraordinary medical advance, which has

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improved the prognosis of infections caused by pathogenic bacteria [3, 4]. Bacteria have the ability to adapt to changes in their developmental environments of resistance mechanisms to protect themselves from attack [5]. In fact, resistance to antibiotics has rapidly developed and progressively evolved. Thus, the evaluation of antibiotics is threatened. Bacterial resistance is a global and growing phenomenon, with more resistance and antibiotics, associated with the analysis of therapeutic arsenal. This problem becomes a real threat [6, 7]. A survey conducted on the prevalence of infections by WHO in 2015 [8], reported that multi-resistant bacteria accounted for 77.79% of nosocomial infections, 44.45% of surgical site infections, 18.52% of respiratory system infections and 14.82% of urinary tract infections. The consequences are very numerous; an increase in the spread of these resistant bacteria causes a high rate of mortality and morbidity. These infections pose real economic problems because of the length of hospitalization, the expenses incurred by the biological explorations and the treatments requiring using the more expensive drugs. They threaten the prevention and effective treatment of pathologies [9, 10]. Nowadays, this real challenge requires special attention requiring specific measures, especially with people who are immuno-depressed with HIV, cancer and diabetes. These pathologies favor the appearance of bacterial germs whose knowledge of antibiotic sensitivity is essential to guide antibiotic therapy and improve the management of patients. Currently, antibiotic resistance kills 700,000 patients a year worldwide because antibiotics are becoming less effective. In Africa, there are some worrying data, major gaps in monitoring antibiotic resistance in a limited number of countries, and difficulties in assessing the true extent of the problem [8, 11]. Reinforcement by combination of antibiotics could give antibiotics a new efficacy without risk of resistance. This study aims to determine the bacteriological profile and antibiotic sensitivity of pus isolates in patients at Regional Hospital Center of Franceville in Gabon.

Materials and Methods

The study was carried out at Amissa Bongo Regional Hospital Center (CHRAB) in Franceville, Haut-Ogooue province, particularly in the departments of hospital surgery, minor surgery, medicine and resuscitation, which is the place where the biological results of patients are recorded. The study was conducted in August 2016 to February 2019 and focused on bacteria isolated from suppurations from wounds of patients in different departments of CHRAB. The protocol was reviewed and approved by National Committee on Ethics for Research (CNER) of Gabon (No. 009 March 10, 20013) and Scientific Committee of Faculty of Sciences of University of Sciences and Technology of Masuku (USTM) Gabon.

Study population

Patients were informed that participation is completely voluntary, and written consent was obtained from each participant before being subjected to the questionnaire and after discussing the objective with the participants. No names were recorded on the questionnaires. Adequate training of data collectors took place to ensure protection of confidentiality, and all questionnaires were kept safe. Patient information included demographic information (names, age and sex), general clinical data on admission pathologies and clinical history. A total of 530 patients were participated in this study.

Inclusion and exclusion criteria

The study population included inpatients and non-hospitalized patients who routinely dressed in hospital, minor surgery, medicine and intensive care units. A sample for the cytobacteriological examination of pus is made. The exclusion criteria were patients who preferred to do their examinations in another laboratory and those who refused to participate in this study.

Collection, conservation and transport

The method consisted of removing suppurations from simple wounds and surgical wounds after cleaning around the wound by previously identified sterile swabbing. Collection and bacteriological analysis were performed according to the site of infection and commensal flora. The samples were sent to the bacteriology laboratory accompanied by analysis reports and to Laboratory of Research in Biochemistry in Faculty of Sciences in Department of Chemistry-Biochemistry at USTM. Two swabs were used per patient, one for direct microscopic examination, and the other for petri dish seeding for pure culture isolation, and then Gram staining was performed to determine Gram-positive bacteria (BGP) or Gram-negative bacteria (BGN) for the identification of the germ. The smell, appearance and color of the pus were noted for macroscopic examination

Culture of bacterial strains

The suppurations harvested were streaked by progressive depletion on Petri dishes according to the different agar media including EMB, for the isolation of enterobacteria and Gram-negative bacilli. Chapman medium was used for the isolation of staphylococci and blood agar for non-demanding bacteria. The culture was done anaerobically using GEN box CO_2 for EMB then Chapman and aerobically for blood agar. The seeded culture media were put in an oven at 37ºC for a period of 18-24 hours. The different bacterial strains that grew on the different agar media after 24 hours of culture were removed and subjected to biochemical tests.

Catalase and oxidase assays were performed to guide the identification of Gram-positive and Gram-negative bacteria [12].

Isolation and identification

Bacteria were isolated at Regional Hospital Center Amissa Bongo (CHRAB) in Franceville from clinical specimens like pus collected from adult inpatient, mainly the inpatient in therapeutic failure without distinction of sexes. Pus strains were searched for MDR strains including: Methicillin-resistant *Staphylococcus aureus* (MRSA), Methicillin-resistant coagulase-negative *Staphylococcus* (MRSCN), enteric bacterium (*Klebsiella pneumonia*) resistant to 3rd generation cephalosporins (carrier of a cephalosporinase or broad-spectrum beta-lactamase), Ticarcillin-resistant *Pseudomonas aeruginosa* or Imipenem-resistant *Acinetobacter baumanii*. The presence of *Enterobacterium* (*Klebsiella pneumonia*) resistant to third generation Cephalosporins and a Ticarcillin resistant *Pseudomonas aeruginosa* was sought. Each sample was grown on a specific medium and incubated.

All isolates were identified to the species level using standard methods such as API 20E gallery or API 10S strips, various Slidex kit and verified using the Vitek-2 system (BioMérieux, France) according to the manufacturer's instructions. Sensibility of all isolates were determined using reference BioMerieux ATB test strips (ATB UR EU (08), ATB G, ATB-Staph, and ATB-Strep; (BioMérieux, France) and Vitek 2 compact automaton. Resistance to both Penicillin G and Oxacillin indicated a Methicillin-resistant-like profile [13, 14]. All tests were done following manufacturer's instructions.

Antibacterial activity

Bacterial strains

The antibacterial screening of some antibiotics alone and their combinations were tested against a panel of multi-resistant bacteria, including eight strains of clinical isolates obtained from patients in therapeutic failure in Regional Hospital Center Amissa Bongo (CHRAB) in Franceville, Gabon. These strains were tested to different antibiotics such as Amoxicillin (AMX), Ceftazidim (CAZ), Metronidazol (MTZ), Ofloxacin (OFL) and Ciprofloxacin (CIP).

Preparation of antibiotics used for antibacterial activity

Antibiotic powders of Amoxicillin (AMX), Ciprofloxacin (CIP), Ceftazidim(CAZ), Metronidazole (MTZ) and Ofloxacin (OFL) were used. Each antibiotic was individually combined. The combinations used are AMX+CAZ, AMX+OFL, AMX+MTZ, AMX+CIP, CAZ+OFL, CAZ+MTZ, CAZ+CIP, OFL+MTZ, OFL+CIP and MTZ+CIP. For antibacterial screening, stock antibiotic solutions were prepared (50 mg/mL) alone and combinations.

Antibacterial screening

The antibacterial screening of antibiotics alone and combination was carried out using by agar well diffusion method [6, 12, 14]. The bacteria grown in nutrient broth at 37°C for 18 h were standardized using normal saline to turbidity of 0.5 Mac Farland standards (10^8CFU/mL). Petri dishes (90 mm in diameter) were prepared with 15 mL of a base layer of Müeller-Hinton gelose medium and the test bacteria were inoculated on nutrient agar plates and spread uniformly using a sterile glass spreader. Six millimeter of sterile paper discs (Whatman No. 3) soaked with 20 µL of the antibiotics dilution or combinations (50 mg/mL) were placed on agar in 15 mm of Petri dishes periphery. The Petri dishes were incubated aerobically at 37°C for 18 h. The effect of antibiotic alone and combination was reflected by the appearance around disc with a transparent circular zone corresponding to the absence of growth. The diameter of inhibition zone was measured in mm. All tests were performed in triplicate and antibacterial activity was expressed as the mean of Diameters of Inhibition Zone (DIZ) produced. The percentage improvement in the activity of antibiotics was calculated on the combinations having a synergetic effect according to EL-Zawahry et *al*.[15] and Sima et *al*.[16].

Statistical analysis

Experimental results were expressed as mean ± standard deviation. All measurements were replicated three times.

Results and Discussion

Results

During the study period, a total of 360 samples from Hospital Surgery, Small Surgery, Medicine and Resuscitation were analyzed (Figure 1). 230 patients were recruited in hospitalization surgery department, ie 63.9%, 110 patients for minor surgery, 30.5% and 20 patients in medicine (5.5%). The sample taken in the intensive care unit showed, after seeding and incubation, a sterile culture. The results show that the study population consisted of 58.3% men (aged 40-50 years) and 41.7% women (Aged 30-40 years) with a sex ratio W/M of 0.71.

Macroscopic examination

The appearance, color and consistency of the specimens received in a syringe or in a sterile container have been carefully examined. The color of the pus was usually yellow. Some pus was yellow-green to red-brown. A red color that is usually due to a mixture with blood or hemoglobin. The colored pus in blue-green (pyocyanin or the elaborated pyoverdine), is due to the presence of

Pseudomonas aeruginosa. For consistency, the pus was thick, viscous, elastic, mixed or unmixed with blood, fluid, serous or sero-hematic. It was homogeneous or granular.

Bacteriological profiles

Table 1 shows the distribution of bacteria identified by family, genus and Gram stain. A total of 530 samples were analyzed with 360 positive cultures and 170 sterile cultures. The bacterial families Enterobacteriaceae, Moraxellaceae, Pseudomonadaceae, Streptococcaceae and Xanthomonadaceae have been identified. The most represented family was that of Enterobactericeae (more than 64.69% of isolates) with the genus *Escherichia* (17.65%).

The more representative Enterobacteriaceae presented seven genera namely *Citrobacter, Enterobacter, Escherichia, Klebsiella, Serratia*and *Yersinia*, followed by Staphylococcaceae with a frequency of 11.76%. The other four families each had a single genus of 5.88%: *Acinetobacter*, *Pseudomonas*, *Stenotrophomonas* and *Streptococcus*.

14 Gram-negative bacteria strains and 3 Gram-positive strains were identified and isolated from suppurations from patients' wounds at Amissa Bongo Regional Hospital Center (CHRAB). For Gram-negative bacteria, the species isolated were *Escherichia coli* (n=2), *Enterobacter aerogenesa* (n=2), *Enterobacter cloacae, Yersinia enterolitica, Citrobacterkoseri, Proteus penneri, Klebsiellaoxytoca, Klebsiella pneumonia* ssp*pneumoniae, Serratiaodorifera, Stenotrophomonas maltophilia, Pseudomonas* spp and *Acinetobacter baumanii*.

On the other hand, for Gram-positive bacteria, *Staphylococcus aureus* and *Streptococcus* spp are the two main strains isolated. The main bacterial species isolated were *Escherichia coli*, *Staphylococcus aureus* and *Enterobacter aerogenesa*.

Sensitivity to antibiotics

The resistance of the most frequently isolated bacteria to the suppurations of patients' wounds has been studied with the most prescribed antibiotics and their combination.

Inhibition zone diameter of antibiotics and combination

The antibacterial activity of the antibiotics as a function of zone inhibition diameter (DZI) is interpreted as follows: DZI < 8 mm: non-sensitive or resistance; 8 mm ≤ DZI ≤ 14 mm: sensitive; 15 mm≤ DZI ≤ 19 mm: very sensitive; DZI ≥20 mm: extremely sensitive [17].

Antimicrobial susceptibility

The results of susceptibility tests with simple antibiotics yielded antibacterial activity on isolated microbial strains (Table 2).Of all the antibiotics tested, Amoxicillin and Metronidazole showed no activity on all isolated bacteria with a very high resistance rate of 100%. Ceftazidim has rarely been active, with an antibiotic resistance rate of 93.75%. Only Ciprofloxacin and Ofloxacin showed fairly good antibacterial activity on isolated strains with a resistance rate of less than 31.25% (Figure 2).

Also some isolated bacteria such as: *Citrobacterkoseri, E coli* and *Streptococcus*, were resistant to all antibiotics tested. *Acinetobacter baumanii, Yersinia enterolitica, Staphylococcus aureus, Klebsiella oxytoca, Serratiaodorifera, Stenotrophomonas maltophilia, Pseudomonas* spp and *Staphylococcus aureus* were only susceptible to Ciprofloxacin and Ofloxacin.

Enterobacteraerogenesa showed resistance to the majority of antibiotics tested, only Ciprofloxacin showed good activity on this strain.

Susceptibility with combinations of antibiotics

The results of the antibiotics in combination as a function of inhibition zone diameter (DZI) were interpreted as Resistant: R (DZI_{A+B} < 8 mm), Antagonism: An (DZI_{A+B} < DZI_A and DZI_B), Indifference: I ($DZI_A \leq DZI_{A+B} \leq DZI_B$), Synergy: S ($DZI_A \leq DZI_B \leq DZI_{A+B}$), Addition: Ad ($DZI_{A+B}$> DZI_B and DZI_A). The susceptibility tests with combinations of antibiotics showed the diameters of inhibitions on the microbial strains isolated from the suppurations of the wounds (Table 3). Interactions with two antibiotics combined showed activity on wound suppuration isolates. The antibiotic combinations observed showed different interactions on the microbial strains isolated from the suppurations of the wounds. The results of the activity of the 10 antibiotic combinations on the isolated strains show that all the different types of interactions have been obtained, in particular the synergistic, indifferent and antagonistic effect. However, the additive effect has been observed only in certain combinations of antibiotics (AMX+OFL, CAZ+MTZ, CIP+OFL, OFL+MTZ). The interactions between antibiotics combined gave antagonistic, synergistic, indifferent and additive effects. The indifferent effect was much more observed (44 cases), in contrast to the additive effect which represented only 23 cases. The antagonic and synergistic effects were reported in 14 cases. The highly observed number of cases of the antagonistic effect can be explained by the fact that, in general, a combination of bactericidal and bacteriostatic antibiotics will be antagonistic as well as the combination of two active antibiotics such as Ciprofloxacin and Ofloxacin. *Citrobacterkoseri* and *E. coli* were resistants to the all antibiotic combinations.

Discussion

A total of 530 samples were analyzed with 360 positive cultures and 170 sterile cultures. Hospitalization (230 strains) followed by Surgery (110) and Medicine (20)

with values, of 63.9%, 30.5% and 5.5%, respectively (Figure 1). Surgical site infections (SSI) were a real public health problem in Africa with an incidence ranging from 6.8% to 26% [18]. In 2018, where 78.5% of the bacterial strains were proven by surgery department contamination of the surgical site often occurs more often, either from the patient present before the incision, or from personnel, or from antiseptic solutions or contaminated instruments [19]. Men predominance was summer (58.3%). Male dominance has also been reported in studies in Ouagadougou-Burkina Faso and Brazzaville-Congo [20, 21]. This male predominance could be explained by the fact that men are more exposed to the risks of postoperative infections such as road accidents and road or construction sites.

Bacteriological profile

Enterobacteriaceae, Moraxellaceae, Pseudomonadaceae, Streptococcaceae and Xanthomonadaceae were the identified bacterial families. More than 64.69% of the isolates were Enterobactericeae with the predominant *Escherichia* genus (17.65% Enterobacteriaceae). These results are in line with those of Bassolé (2012)with more than 55% of Enterobactericeae and the *Escherichia* genus with a majority of 53.64% [21]. The more representative Enterobacteriaceae presented seven genera namely *Citrobacter, Enterobacter, Escherichia, Klebsiella, Serratia* and *Yersinia*, followed by Staphylococcaceae with a frequency of 11.76%. *Acinetobacter, Pseudomonas, Stenotrophomonas*and *Streptococcus* each represent 5.88% with a single genus. Seventeen bacterial species were identified and isolated from suppurations from patients' wounds at Amissa Bongo Regional Hospital Center (CHRAB), representing 82.34% Gram-negative and 17.64% Gram-positive.

Escherichia coli (n=2), *Enterobacter aerogenesa, Enterobactercloacae,Yersiniaenterolitica,Citrobacterkoseri,Proteuspenneri,Klebsielapneumonias*sp*pneumoniae ,Serratiaodorifera, Stenotrophomonas maltophilia, Pseudomonas* spp and *Acinetobacter baumanii* are bacterial species isolated from Gram-negative.

In contrast, for Gram-positive bacteria, *Staphylococcus aureus* (n=2) and *Streptococcu*s spp are the two main isolated species.

The main bacterial strains isolated were *Escherichia coli* and *Staphylococcus aureus*. These results are consistent with those of Coulibaly in Bobo-Dioulasso (Burkina Faso)[22], Jadranka et *al*., in Serbia[23], and finally the study of Masahico et *al*., in Japan [24] who also found a predominance of *Staphylococcus aureus* [25]. This predominance of *Staphylococcus aureus* confirms the literature data [25, 26].

Thus, in most studies, isolated organisms are dominated by staphylococci, unlike Bassole studies, where *Escherichia coli* were the majority specie [21]. This difference in results could be explained by the nature of microbial ecology.

Antibacterial activity

Sensitivity of simple antibiotics

These results of antibacterial activity show that fluoroquinolones are effective and have remarkable diffusion: easy to use, good tolerance profile, excellent bioavailability, broad antibacterial spectrum [27]. Indeed, fluoroquinolones inhibit the functioning of two bacterial topoisomerase enzymes, DNA gyrase and topoisomerase IV. Fluoroquinolones, by binding to the DNA-topoisomerase complex, lead to the immobilization of enzymes by causing bacteriostasis and cause double-strand breaks in DNA, activating the SOS system and producing a "poison" effect responsible for the properties bactericides of fluoroquinolones. The susceptibility results of simple antibiotics show that the best antimicrobial activities were obtained by Ciprofloxacin and Ofloxacinwith resistance rates of 31.25%, unlike Amoxicillin and Metronidazol, where strains showed a very high resistance rate of 100%. These studies are in agreement with those of Eyang on bacteria isolated at University Hospital Center of Libreville (CHUL), having a very high resistance rate of 100% to Amoxicillin [28]. The results are similar to those of Bassole et *al*. that showed a fairly good sensitivity to Ciprofloxacin (64.95%). Amoxicillin and Ceftazidim belong to β-lactam family. The resistance observed with Amoxicillin and Ceftazidim, which are third-generation cephalosporins (C3G), can be explained by the fact that most ESBLs are found in Enterobacteriaceae family [21].The main strains are *E. coli* and *Klebsiella* more rarely *Serratia, Citrobacter, Enterobacter, Proteus, Pseudomonas* and *Acinetobacter* [29]. These bacteria produce broad-spectrum β-lactamases secreted naturally or following the acquisition of resistance. These are enzymes that give rise to resistance to the majority of β-lactams. They are secreted outside the cell to degrade the antibiotic before it can act. Total resistance was observed to Metronidazole (100%) commonly called Flagyl, initially known as an active pest on amides and *Trichomonas*. This antibiotic was then shown to have excellent action on most bacteria. Significant consumption in Gabon of this antibiotic may be at the origin of the high rate of resistance[30, 31]. Indeed, the improper capture alters the microbiome and helps to increase resistance genes. In addition, unnecessary use of an antibiotic has a double negative effect for an individual by promoting colonization by resistant bacteria and therefore a risk of a subsequent infection difficult to treat [32, 33].

Interaction of two combined antibiotics

Resistance to antibiotics predominated with 46 cases, followed by indifferent effect (44 cases) and additive effect (23 cases), respectively. Interactions between combined antibiotics gave 14 cases of antagonistic and synergistic effects. The antibiotics Ciprofloxacin and Ofloxacin gave synergistic activities on *Acinetobacter baumanii*, *Yersinia enterolitica*, *Streptococcus spp* and *Enterobacter aerogenes*. The combinations (OFL + CAZ, CIP + MTZ, OFL + MTZ and CAZ + MTZ) gave synergistic effects on *Proteus penneri*. The combination (OFL + MTZ) gave antagonistic action on *Acinetobacterbaumanii*, *Staphilococcus aureus* and *Enterobacter cloacae*. The combinations (AMX + CIP and CAZ + CIP) gave antogonistic effects on *Stenotrophomonasmaltophilia* and *Enterobacter cloacae*. Combined antibiotics Ceftazidim, amoxicillin and Ofloxacin (AMX + CAZ, CAZ + OFL) showed quite good antimicrobial activity with an additive effect on *Yersinia enterolitica* and *Enterobacter aerogenes*. The combinations AMX + CIP, AMX + OFL, AMX + MTZ and CAZ + CIP gave antogonistic properties on *Pseudomonas*spp and *Streptococcus* spp. These combination have an indifferent effect on *Proteus penneri, Klebsiellaoxytoca Klebsiella oxytoca* and *Serratiaodorifera*. The combinations AMX+CAZ, AMX+MTZ and CAZ+MTZ, showed good antibacterial activity, with a synergistic effect in different interactions of the combined antibiotics; twice as much property for simple antibiotics. These results are similar to those of Ondo et *al*. and Obame et *al*. [34, 35]. *Citrobacterkoseri*, *E. coli* and *Klebsiella pneumonia*ssp *pneumonia* have been resistant to antibiotics tested in a simple and also combined way.

Conclusion

Infections are the leading cause of hospitalization and one of the major causes of formidable complications ranging from gangrene to limb amputation. The study focused on frequently identified and isolated bacteria from the suppurations of wounds of patients in different departments of Regional Hospital Center showed a high frequency of pyogenic infections in both surgical departments. The samples of pus analyzed allowed identifying responsible bacteria with a predominance of *Escherichia coli*, *Enterobacteraerogenes* and *Staphylococcus aureus.* The sensitivity of the bacteria to the antibiotics tested showed a high level of resistance to Aminopenicillins, but good sensitivity was observed with Ciprofloxacin and Ofloxacin. In addition, a high prevalence of multidrug-resistant bacteria was noted. The emergence of multidrug-resistant bacteria is a public health problem. In the absence of new antibacterial agents, this may lead to dead ends. The rationalization of the prescription of antibiotics, especially Ofloxacin and Ciprofloxacin, and the optimization of bacteriological prescriptions are desirable in surgical services. However, rigor in dispensing pharmacies and the rational use of these antibiotics are essential to avoid the emergence of resistance phenomena.

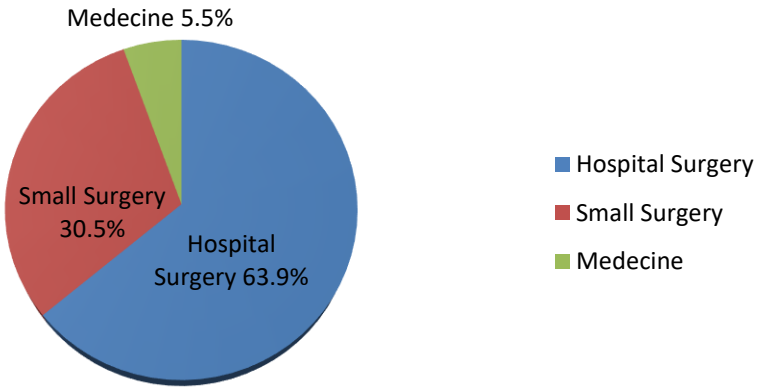

Fig 1: Distribution of strains by different services

Table 1: Families, genera, species and Gram strain of bacteria isolated from wound suppuration

Families	Genera	Species	Gram
	Citrobacter	*Citrobacterkoseri*	-
	Yersinia	*Yersinia enterolitica*	-
Enterobacteriaceae	*Enterobacter*	*Enterobacteraerogenesa* (n=2)	-
		Enterobactercloacae	-
	Escherichia	*E coli* (n=2)	-
	Proteus	*Proteuspenneri*	-
	Klebsiella	*Klebsiellaoxytoca*	-
		Klebsiellapneumonia ssp *pneumoniae*	-
	Serratia	*Serratiaodorifera*	-
Xanthomonadaceae	*Stenotrophomonas*	*Stenotrophomonasmaltophilia*	-
Pseudomonadaceae	*Pseudomonas*	*Pseudomonas* spp	-
Moraxellaceae	*Acinetobacter*	*Acinetobacterbaumanii*	-
Staphylococcaceae	*Staphylococcus*	*Staphylococcus aureus* (n=2)	+
Streptococcaceae	*Streptococcus*	*Streptococcus* spp	+

Table 2: Sensitivity of antibiotics

Bacteria	AMX	CAZ	CIP	MTZ	OFL
Citrobacterkoseri	R	R	R	R	R
Acinetobacterbaumanii	R	R	S	R	S
Yersinia enterolitica	R	R	S	R	S
Enterobacteraerogenes	R	R	R	R	S
Staphylococcus aureus	R	R	S	R	S
Proteuspenneri	R	R	S	R	R
Klebsiellaoxytoca	R	R	S	R	S
Serratiaodorifera	R	R	S	R	S
Sténotrophomonasmaltophilia	R	R	S	R	S
Enterobactercloacae	R	R	R	R	R
E coli	R	R	R	R	R
Pseudomonas spp	R	R	S	R	S
*Streptococcus*spp	R	R	R	R	R
klebsiellapneumoniassppneumoniae	R	S	S	R	S
Staphylococcus aureus	R	R	S	R	S

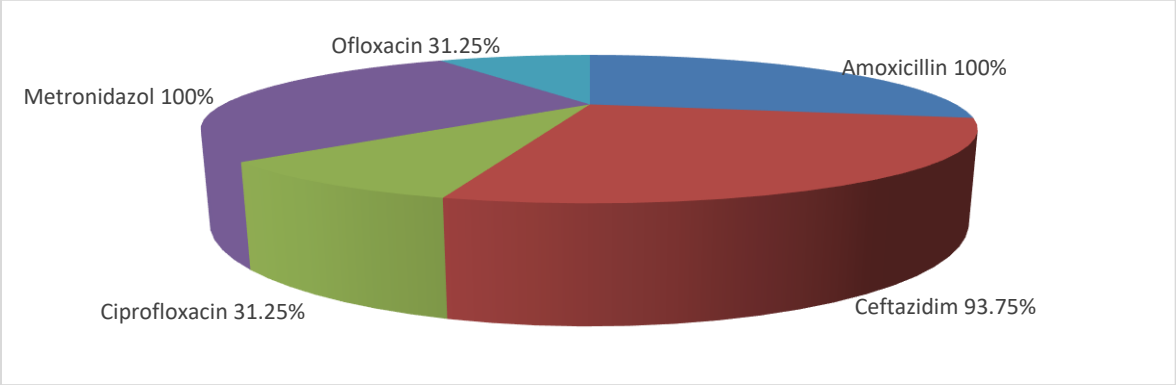

Fig 2: Frequency of resistance of isolated strains.

Table 3: Interaction of antibiotics combination against clinical isolates.

Bacteria	Standard antibiotic in combinations									
	CAZ +MTZ	CAZ+ OFL	CIP+ MTZ	CIP+OFL	OFL+ MTZ	AMX+CAZ	AMX+CIP	AMX+ OFL	AMX+ MTZ	CAZ+CIP
Citrobacterkoseri	R	R	R	R	R	R	R	R	R	R
Acinetobacterbaumanii	S	In	Ad	S	An	Ad	In	In	Ad	Ad
Yersinia enterolitica	S	Ad	In	S	In	Ad	In	In	S	In
Enterobacteraerogenes	Ad	Ad	In	S	Ad	Ad	In	Ad	In	In
Staphilococcus aureus	R	An	An	R	An	R	R	In	An	R
Proteuspenneri	In	S	S	An	S	S	In	In	In	In
Klebsiellaoxytoca	R	In	In	R	In	R	In	In	In	In
Serratiaodorifera	R	In	S	R	In	R	In	In	In	In
Stenotrophomonasmaltophilia	An	In	In	An	In	R	An	An	An	An
Enterobactercloacae	R	In	In	R	An	R	An	R	In	An
E coli	R	R	R	R	R	R	R	R	R	R
Pseudomonas spp	Ad	In	In	In	In	R	Ad	Ad	Ad	Ad
*Streptococcus*spp	S	An	Ad	S	Ad	Ad	Ad	Ad	Ad	Ad
*Klebsiellapneumoniass*ppneumoniae	R	R	R	R	R	Ad	R	R	S	R
Staphylococcus aureus	R	In	In	R	In	R	R	Ind	S	R

Resistant: R (DZIA+B ≤8 mm), Antagonism: An (DZIA+B < DZIA andDZIB), Indifference: I (DZIA ≤ DZIA+B ≤ DZIB), Synergy: S (DZIA ≤ DZIB ≤ DZIA+B), Addition: Ad (DZIA+B > DZIB and D

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