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Epidemiological and Bacteriological Study of Surgical Site Infections at the El Hadji Ahmadou Sakhir Ndieguene Regional Hospital Center of Thies, Senegal

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ABSTRACT

Background: *Surgical site infections (SSI) are a common complication of surgical procedures. They are associated with an increase in the length of hospitalization, an increase in care costs, an increased use of surgical returns, as well as an increase in mortality. Their monitoring is thus a key element of prevention strategies.*

Methods: *This was a prospective study conducted over a period of seven (07) months, from January 1 to July 31, 2024. All patients operated on at the Thiès regional hospital center, in the general surgery, gynecology, neurosurgery and traumatology departments, who had post-operative suppuration, were included in the study.*

Results: *During the study period, 27 out of 1458 patients had postoperative suppuration, a frequency of 1.85%. The population studied included 18 women (67%) and 9 men (33%), corresponding to a sex ratio of 0.5. The average age of patients was 36.14 years. The average delay in infection was about 10 days, with the exception of the trauma department where a delay of 88 days was observed. In total, 27 bacterial strains were isolated, including 17 enterobacteria, 9 non-fermentary Gram-negative bacilli, and 1 Gram-positive cocci.*

Enterobacter spp. was the most frequently isolated species with seven cases (25.92%), followed by Acinetobacter baumannii with six cases. The broad-spectrum beta-lactamase phenotype was found in 11 cases. In addition, some imipenemasis profiles as well as a MRSA have also highlighted.

Conclusion: *Bacterial resistance is a phenomenon on the rise. It complicates therapeutic management and can compromise the life prognosis of patients, hence the need for rigorous monitoring of surgical site infections (SSI) and the implementation of effective strategies to control these infections.*

Keywords
Infection, Surgical site, Antibiotic, Resistance.

Introduction
Surgical site infections (SSI) belong to the group of care-associated infections and represent a major public health issue [1]. Each year, they endanger the lives of many patients, prolong the duration of hospitalization, lead to an increase in care costs, and may require surgical recovery [2].

In addition, an increase in these infections related to bacteria resistant to one or more antibiotics has been observed, making therapeutic management more complicated. In low-income countries, where data remain limited, about 11% of operated patients develop an infection during the perioperative period [1].

In Senegal, a study conducted in 2019 reported an incidence of 9.9% of infections from the surgical site at the Thiès regional hospital, thus highlighting the importance of continuous monitoring of these infections in order to evaluate the effectiveness of the prevention measures put in place [3].

In this context, the objective of our work was to conduct a recent study aimed at determining the frequency of post-surgical infections in the various departments of the Thiès hospital, to identify the bacteria involved and to analyze their antibiotic resistance profile.

Equipment and Methods

It was a prospective, descriptive and cross-sectional study, conducted over a seven-month period, from January 1, 2024 to July 31, 2024. It took place at the El Hadji Ahmadou Sakhir Ndiéguène Regional Hospital Center in Thiès, particularly in the gynecology, neurosurgery, general surgery and traumatology departments. The analyses were carried out at the National Public Health Laboratory of Thiès (NPHL). Following suspected surgical site infection (SSI), pus swabs were collected before treatment, under strict asepsis conditions.

In the laboratory, the samples were subjected to a macroscopic and microscopic examination, followed by culture on adapted media. Species identification was performed using conventional methods otherwise the Vitek or MALDI-TOF automated system was used.

The antibiotic sensibility testing was carried out by the standard method of dilution in a gelatinous medium or using the Vitek automated system with the CASFM 2024 standards.

For the *Enterobacteria,* the search for broad-spectrum beta-lactamase (ESBL) was based on a synergy test. For *Staphylococcus aureus*, the meticillin resistance phenotype (MRSA) was determined using a cefoxitin disc.

Results

Among the 1458 patients hospitalized and operated on in the various departments, 27 had postoperative suppuration, with a frequency of 1.85%. A female predominance was observed with 18 women (67%) versus 9 men (33%), corresponding to a sex ratio of 0.5.

The average age of patients was 36.14 years, with a predominance of the age group (23-27) years, representing 33% of cases.

The average delay in post-operative infection varied according to the department: it was 7.2 days in gynecology, 8.66 days in general surgery, 10.6 days in neurosurgery and 88 days in traumatology. Of the 27 cases of SSI, 16 came from the gynecology department (59.25%), 6 from neurosurgery (22.22%), 3 from visceral surgery (11.11%) and 2 from traumatology (7.40%).

The average duration of the procedures was 38.5 min in gynecology and 117.5 min in neurosurgery. She was not informed for general surgery and traumatology services.

A total of 23 samples could be analyzed, 4 having been lost during handling. Among them, 22 crops were positive and only one negative, a yield of 95.65%. There were 18 monomicrobial and 4 polymicrobial cultures. One polymicrobial culture had 3 germs while the other three had two, thus allowing the identification of 27 bacterial strains in total.

Of these twenty-seven (27) isolated strains, 17 were *Enterobacteria*, 9 were non-fermented Gram-negative bacilli, and 1 Gram-positive cocci. *Enterobacter spp* was the majority species with 7 cases or 25.92% followed by *Acinetobacter baumannii* with 6 cases or 22.22% and *Escherichia coli* with 4 cases or 14.81%.

Table 1: Different isolated germs

Germs	Number of Germs	Percentage
Enterobacter spp	7	25,92 %
Acinetobacter Baumannii	6	22,22 %
Escherichia coli	4	14,81 %
Pseudomonas aeruginosa	3	11,11 %
Klebsiella pneumoniae	2	7,40 %
Providencia stuartii	2	7,40 %
Proteus mirabilis	1	3,70 %
Proteus vulgaris	1	3,70 %
Staphylococcus aureus	1	3,70 %
Total	27	100 %

Table 2: Distribution of species according to service.

Species	Gynecology	Neurochirurgy	General surgery	Traumatology	Total
Acinetobacter baumannii	**4**	**1**	**-**	**1**	**6**
Enterobacter spp	**5**	**1**	**1**	**-**	**7**
Escherichia coli	**3**	**-**	**1**	**-**	**4**
Klebsiella pneumoniae	**2**	**-**	**-**	**-**	**2**
Proteus mirabilis	**-**	**-**	**1**	**-**	**1**
Proteus vulgaris	**1**	**-**	**-**	**-**	**1**
Providencia stuartii	**1**	**-**	**-**	**1**	**2**
Pseudomonas aeruginosa	**2**	**1**	**-**	**-**	**3**
Staphylococcus aureus	**-**	**1**	**-**	**-**	**1**
					27

Table 3: Resistance of *enterobacteria to antibiotics.*

	***E.coli* (4)**	***Enterobacter spp* (7)**	***Klebsiella pneumoniae* (2)**	***Providencia stuartii* (2)**	***Proteus mirabilis* (1)**	***Proteus vulgaris* (1)**
Amox- Ac. Clav	2(2)	2(2)	2(2)	NT	0(1)	1(1)
Ampicillin	2(2)	2(2)	1(1)	1(1)	1(1)	NT
Ticarcillin	4(4)	6 (7)	2(2)	1(1)	1(1)	1(1)
Ticar Ac. Clav	3(3)	6 (6)	NT	2(2)	NT	NT
Piperacillin	2(2)	6 (6)	1(1)	1(2)	NT	1(1)
Piperacillin- Tazo	1(1)	5(6)	1(2)	1(2)	1(1)	0(1)
Ceftazidime	3(4)	5(6)	2(2)	1(1)	0(1)	NT
Cefepime	1(2)	5(6)	1(1)	NT	NT	NT
Cefotaxime	3(3)	2(3)	NT	1(1)	0(1)	NT
Cefuroxime	2(2)	2(2)	1(1)	1(1)	NT	NT
Aztréoname	0(2)	4(5)	NT	0(2)	NT	NT
Imipénème	2(3)	3(6)	0(2)	1(1)	NT	NT
Méropénème	1(3)	3(5)	2(2)	1(2)	NT	NT
Amikacin	0(4)	1(7)	1(2)	0(2)	0(1)	NT
Gentamicin	1(4)	4(7)	1(2)	1(1)	0(1)	0(1)
Tobramycin	1(4)	4(7)	1(2)	1(1)	0(1)	0(1)
Ciprofloxacin	1(4)	5(7)	2(2)	2(2)	NT	0(1)
Lévofloxacin	1(3)	3(4)	0(1)	1(1)	NT	0(1)
Ofloxacin	NT	NT	NT	NT	0(1)	0(1)
Colistin	0(2)	0(6)	NT	1(1)	NT	NT
Fosfomycin	NT	NT	NT	NT	NT	1(1)

NB: NT = Untested Antibiotics.

Table 4: Resistance of non-fermenting bacteria to antibiotics.

	***Acinetobacter baumannii* (6)**	***Pseudomonas aeruginosa* (3)**
Amox- Ac. Clav	NT	NT
Ampicillin	1(1)	NT
Ticarcillin	6(6)	1(1)
Ticar Ac. Clav	1(1)	1(2)
Piperacillin	3(3)	0(2)
Piperacillin-Tazo	4(6)	1(3)
Ceftazidime	3(3)	NT
Cefepime	3(3)	0(2)
Cefotaxime	2(2)	NT
Cefuroxime	NT	NT
Aztreonam	1(1)	0(2)
Imipénème	2(6)	1(2)
Méropénème	NT	NT
Ertapénème	3(3)	1(1)
Amikacin	0(3)	0(2)
Gentamicin	2(5)	0(3)
Tobramycin	1(5)	0(3)
Ciprofloxacin	3(4)	0(2)
Lévofloxacin	1(1)	0(1)
Ofloxacin	NT	NT
Colistin	NT	NT
Fosfomycin	1(1)	NT

Table 5*:* Resistance of *Staphylococcus aureus* to antibiotics.

	***Staphylococcus aureus* (1)**
Gentamicin	0(1)
Moxifloxacin	0(1)
Benzylpénicillin	1(1)
Oxacillin	1(1)
Erythromycin	0(1)
Clindamycin	0(1)
Tétracyclin	1(1)
Tigécyclin	0(1)
Linézolide	0(1)
Vancomycin	1(1)
Quinupristin-Dalfopristin	0(1)
Trimethoprime-Sulfamethoxazole	0(1)
Nitrofurane	0(1)

Table 6: Résistance profile of *enterobacteria.*

Germs	BLSE	Low-level Pénicillinase and céphalosporinase	High-level natural Céphalosporinase	High-level Céphalosporinase + BLSE	Low-level Pénicillinase	Total
E.coli	3	1	-	-	-	4
Enterobacter *spp*	5	-	1	1	-	7
Proteus mirabilis	-	-	-	-	1	1
Proteus vulgaris	1	-	-	-	-	1
Providentia *stuartii*	2	-	-	-	-	2
Total	11	1	1	1	1	

The tables show the resistances of *enterobacteria*, non-fermentary bacteria, *Staphylococcus aureus* against the antibiotics tested (Tables 3 to 5); As well as their respective resistance profiles (Tables 6 to 8).

In gynecology, a predominance of *Enterobacter spp* (5 souches), suivi de *Acinetobacter baumanii* (4 souches), in the other services, no species dominated, the different species being distributed as follows:

Table 7: Résistance profile of *Pseudomonas aeruginosa*.

Germ	Imipenemase	Cephalosporinase inductible naturelle	Total
P.aeruginosa	1	2	3

Table 8: Résistance profile of *Staphylococcus aureus*.

Germs	Resistance profile	Total
Staphyloccus aureus	SARM	1

Discussion

Our study involved 1458 hospitalized and operated patients, among whom 27 had postoperative suppuration, a frequency of 1.85%. The sex ratio was 0.5 and the average age was 36.14 years. Among the cases of ISO, 26 were superficial and only one case was deep. Our results are comparable to those reported by Fouedjio et al. in Yaoundé in 2021, which found a rate of 1.81% [4]. On the other hand, Abdoulaye O et al. in Niamey in 2018 observed a slightly higher rate of 2.47%, while Lizon et al. reported an average prevalence of 4.9% in Nice in 2017 [5,6]; Wade Thomas et al. found an even higher incidence of 9.9% in the same hospital in 2019 (CHR Thies) [3]. In our series, 59.25% of ISOs were observed in gynecology, which is partly explained by the higher proportion of patients in this department. The occurrence of SSI is multifactorial, involving patient-related factors (age, comorbidities, immunosuppression), factors related to the surgical procedure and especially factors related to the hospital environment such as hygiene, constitute a major challenge in developing countries [7]. Conversely, countries such as France and the United States have much lower rates thanks to efficient surveillance systems: 0.4% in the United States between 2009 and 2010 and 0.93% in France in 2011 [8]. In France, this surveillance has been done since the creation of the RAISIN (National Alert and Surveillance of Nosocomial Infections) in partnership with Santé Publique France, which has made it possible to standardize the surveillance of these ISOs at the national level [9].

The average time to occur in SSI was generally within the first 15 days in gynecology, general surgery and neurosurgery, while in traumatology it reached 88 days, due to the installation of prosthetic equipment.

These results agree with those of Monte and Neto in Brazil in 2010 in a public university hospital, they note the appearance of SSI in the first 15 days after the intervention [10]. Conversely, Diallo and Mohamed Brehima in Kayes in 2023 reported a shorter average delay of 4 days [11]. It should be noted that the infection usually manifests 1-2 weeks after the intervention except in the case of infection with ultra virulent germs or when foreign (prosthetic) material is installed where the infection appears later even after several years [12].

The average duration of intervention is between 38.5 minutes for gynecology and 1 hour 57 minutes for neurosurgery. In the study by Diallo and Mohamed Brehima in 2023, the occurrence of SSI was linked to the duration of the intervention [11]. Indeed, a long duration of intervention influences the occurrence of an operating site infection because the longer the intervention, the more the patient is exposed to the risk of infection. We can cite in several studies the risk factors related to the intervention: a duration of the intervention beyond the 75th average percentile of the specific intervention [13] as well as an emergency intervention, dirty surgery in the Altemeier classification and an absent antibiotic prophylaxis [9].

Regarding strains, the culture was positive in 95.65% of cases and the infection was superficial in 26 out of 27 cases, i.e. 96.29%. In the series of Wade Thomas and al. at the Regional Hospital of Thiès in 2019 the culture was positive in 89.6% of cases [3]. Bacteriologically, a total of 27 bacteria were isolated.

Enterobacter was the dominant species, then come *Acinetobacter baumannii* then *Escherichia coli*. The germs that are mostly found in surgical site infections are *Enterobacteria* with *Escherichia coli* at the top of the list [3,11,14-17] then come the Gram-positive cocci with Staphylococcus aureus [5,18,19]. Hami Ismael found a majority of *Klebsielles* at the CHU le Dantec in Dakar in 2017 [20]. This disparity can be explained by the fact that the germs found mostly come from the endogenous bacterial flora which differs according to the operative area, and therefore according to the service. Indeed, the majority of contaminations are via the patient's endogenous flora. This difference can also be due to the bacterial ecology of each hospital.

The *E. coli* strains that we isolated were mostly resistant to antibiotics used routinely and even to imipenem, there are 2 resistances to amoxicillin-clavulanic acid or 50% as well as resistance to cephalosporins. Bouza E in his multicenter study also had 50% resistance to penicillin A [21]. However, 3 out of 4 were sensitive to aminosides and quinolones. Unlike Abdoulaye O et al. who had obtained significant resistance to these two families of antibiotics in Niamey, namely 62% to gentamycin, 78% to amikacin, 74% to nalidixic acid, 69% to ofloxacin etc[5]. On the other hand, in Benin Adrien H. et al. had similar results to ours, with 100% resistance to amoxicillin-clavulanic acid for Escherichia coli in 2016, as well as Wade Thomas and al at the Thiès Regional Hospital in 2019 [3,14].

For *Enterobacter spp* and *Pseudomonas aeruginosa*, resistance is noted for most antibiotics including Imipenem; With an Imipenemase profile among *Pseudomonas*. Results comparable to those of Hami Ismaël in 2016 who had resistance to the majority of antibiotics tested for *E. coli* and *Pseudomonas aeruginosa* [20]. *Klebsiella pneumoniae* was 100% sensitive to imipenem, a result similar to that of Abdoulaye O et al. as well as literature data, despite its multi-resistance to other antibiotics tested [5]. As for *Acinetobacter baumannii*, 2 out of 6 were resistant to imipenem, while half were sensitive to aminosides. Also in our series, *Proteus mirabilis* was sensitive to amoxicillin-clavulanic acid, ceftazidime, cefotaxime and aminosides. Unlike the results of Adrien H et al. who had no strain of *Proteus* sensitive to these antibiotics [14]. Our strain of *Staphylococcus aureus* had shown resistance to the following antibiotics: Penicillin G, oxacillin, tetracycline and vancomycin. In 2010 Diarra BB obtained 100% resistance to penicillin G [16]. The Staphylococcal that we had isolated was a SARM, which represents a real public health problem because of its easy transmission from one person to another in hospital environments, its resistance to many antibiotics making treatment difficult and costly and it also causes serious infections especially in immunocompromised subjects. Regarding resistance phenotypes, we observed eleven "breaded-spectrum beta-lactamase" phenotypes, or 40% of isolated species. The prevalence of BLSE in the study of WADE and al was 73.3% of BLSE in 2019 [3]. Several other studies were conducted in sub–Saharan Africa to determine the prevalence of BLSE-producing *Enterobacteria* in various populations in various places, carrying ranged from 22.4% to 78% [22]. The misuse of broad-spectrum antibiotics is a major factor in the emergence and spread of beta-lactam-resistant bacteria [23]. This has multiple consequences, namely infections that are more difficult to treat requiring the use of expensive antibiotics, which will increase expenses without counting the loss of human life. The phenomenon of resistance is gaining momentum and is becoming a global problem, especially favored by a socio-economic context and unfavorable hospital hygiene.

Compared to the evolution, it was favorable in 100% of the cases because we did not record any deaths.

Conclusion

Infections of the surgical site remain common and constitute a major public health problem, aggravated by the increase in bacterial resistance. They have a significant impact on morbidity, length of hospitalization and care costs.

Their prevention is based on strict compliance with asepsis measures, adapted antibiotic prophylaxis and improved hospital hygiene. The implementation of continuous monitoring and the proper use of antibiotics are essential to reduce their incidence and limit resistance.

Early management, guided by local bacteriological data, improves the prognosis of patients.

References

1. HPCi. Surgical site infection (SSI) surveillance [Internet]. 2022.
2. https://www.who.int/fr/news/item/03-11-2016-who-recommends-29-ways-to-stop-surgical-infections-and-avoid-superbugs
3. Rokhaya D, Niang NC, Wade TMM, et al. Surgical Site Infections in General Surgery at the Regional Hospital of Thies (Senegal): Epidemiological, Bacteriological Aspects and Risk Factors. Microbiol Infect Dis. 2021; 5: 1-6.
4. Fouedjio JH, Mbongo JA, Kamdem TA, et al. Factors

associated with surgical site infections after cesarean section in Yaoundé. Health Sci Dis. 2021; 22: 1-6.

5. Abdoulaye O, Amadou MLH, Amadou O, et al. Epidemiological and bacteriological aspects of surgical site infections in surgical departments at the National Hospital of Niamey. Pan Afr Med J. 2018; 31: 1-7.
6. Lizon J, Marchand B, Jay N, et al. Detection of surgical site infections by data mining: contribution of medical data from hospital information systems to the performance of a detection model. Rev Epidemiol Sante Publique. 2017; 65: 12.
7. World Health Organization. Global guidelines for the prevention of surgical site infection [Internet]. Geneva: WHO. 2016.
8. Birgand G. Surgical site infections: innovative approaches to diagnosis and prevention [thesis]. Paris: Pierre and Marie Curie University. 2014; 213.
9. Public Health France. Surveillance of surgical site infections in French healthcare facilities: 2017 results [Internet]. Saint-Maurice: Public Health France. 2019.
10. Monte MCCD, Neto AMP. Postdischarge surveillance following cesarean section: the incidence of surgical site infection and associated factors. Am J Infect Control. 2010; 38: 467-472.
11. Diallo MB. Surgical site infections in the general surgery department of Fousseyni Daou Hospital in Kayes [thesis]. Bamako: University of Sciences, Techniques and Technologies of Bamako. 2023; 104.
12. Mangram AJ, Horan TC, Pearson ML, et al. Guideline for prevention of surgical site infection, 1999. Infect Control Hosp Epidemiol. 1999; 20: 250-278.
13. Culver DH, Horan TC, Gaynes RP, et al. Surgical wound infection rates by wound class, operative procedure, and patient risk index. Am J Med. 1991; 91: 152-157.
14. Adrien HM, Fany H, Alexandre AS, et al. Bacteriological aspects of surgical site infections at the Borgou Departmental Hospital Center in Parakou (Benin). Eur Sci J. 2016; 12: 353-363.
15. Diallo K. Surgical site infections among women undergoing cesarean section in the gynecologyobstetrics department of the Reference Health Center of Commune VI, Bamako District [thesis]. Bamako: University of Sciences, Techniques and Technologies of Bamako. 2023; 108.
16. Diarra BB. Surgical site infections in the general surgery department of Gabriel Touré University Hospital Center [thesis]. Bamako: University of Bamako. 2012; 112.
17. Doutchi M, Adamou H, Yahaya ML, et al. Surgical site infections at the National Hospital of Zinder, Niger: epidemiological and bacteriological aspects. Eur Sci J. 2020; 16: 576-584.
18. Benedetto C, Bruno A, Bernasconi E. Surgical site infection: risk factors, prevention, diagnosis and treatment. Rev Med Suisse. 2013; 9: 1832-1839.
19. Idé G, Wahab MA, Hama Y, et al. Surgical site infection in clean orthopedictrauma surgery at CNHU-HKM of Cotonou. Health Sci Dis. 2018; 19: 1-6.
20. Hami I. Surgical site infections in abdominal surgery: epidemiological, clinical, bacteriological and therapeutic aspects [thesis]. Dakar: Cheikh Anta Diop University. 2017; 128.
21. Bouza E, San Juan R, Muñoz P, et al. Co-operative Group of the European Study Group on Nosocomial Infections. A European perspective on nosocomial urinary tract infections II: report on incidence, clinical characteristics and outcome (ESGNI-004 study). Clin Microbiol Infect. 2001; 7: 532-542.
22. Ngah JE, Bénet T, Djibrilla Y. Incidence of surgical site infections in Ngaoundéré, sub-Saharan Africa: a systematic review and meta-analysis. Pan Afr Med J. 2016; 24: 171.
23. Vora S, Auckenthaler R. What does "extended-spectrum beta-lactamases" mean in clinical practice?. Rev Med Suisse. 2009; 5: 1991-1994.