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Original Research Article

Yeasts as a Potential Causes of Surgical Site Infections at the Sourô Sanou University Hospital Center of Bobo-Dioulasso, Burkina Faso

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Abstract: Fungal surgical site infections (SSIs) trend to increase in the recent decades. This study aimed at estimating the prevalence of fungal SSIs, and the time of occurrence of fungal SSIs at the Sourô Sanou University Hospital (SSUHC) in Burkina Faso. This study was carried out in two departments of the SSUHC. Samples of postoperative purulent secretions were collected from June to December 2019. Purulent secretions swabs at the surgical site were aseptically collected using sterile cotton swabs. Standard mycology, CHROMagar, agglutination latex test and immunological test were used to identify the different *Candida* species. A total of 39 postoperative patients were included in the study. The median age was 27 years and the majority of patients were women (74.4%). The probability of isolating fungal agents from the surgical site was 2.6% three days after surgery. This probability was 14.4% and 49.5% at one week and 12 days after the surgical intervention, respectively. A total of 8 (20.51%) fungal species, all belonging to the genus *Candida* were identified in the study. These species were *Candida albicans* (3), *Nakaseomyces glabrata* (2), *Candida tropicalis* (2) *and Pichia kudriavzevii* (1). This study showed that *Candida* spp. could be the cause of the occurrence of SSIs at the SSUHC in Burkina Faso. So, physician must integrate the fungal causes in the management of SSIs.

Keywords: Fungal surgical site infection, CHROMagar, Agglutination latex test, Enzymatic test, *Candida*, Bobo-Dioulasso, Burkina Faso.

INTRODUCTION

Surgical site infections (SSIs) are defined as infections occurring up to 30 days after surgery (or up to one year after surgery in patients receiving implants) and affecting either the incision or deep tissue at the operation site [1]. Despite recent advances in infection prevention efforts, SSIs remain a common cause of morbidity, mortality, and increased length of stay and cost amongst hospitalized patients [2]. In these patients, SSIs are the third most frequently reported infection and often account for 12-16% of all nosocomial infections [3]. SSIs although very often caused by bacteria [4], can also be caused by parasites, viruses and fungal agents. Fungi are rarely responsible of SSIs but could, in the case of a misdiagnosis, be fatal for the patient. In addition, the use of inappropriate treatment is a source of increased selection pressure for resistant strains especially to antibiotics. The burden of SSIs in low and middle-income countries (LMICs) like those in Sub-Saharan Africa is growing [5]. The data available on SSIs in these LMICs deal much more with the epidemiological aspects and risk factors of SSIs, much less on the microbiological profiles of these SSIs and almost not on the role of fungal agents in the occurrence of these infections [6-10]. This study aimed to assess the fungal agents in the microbiome of postoperative

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suppurative wounds at the Sourô Sanou University Hospital Center (SSUHC) in Burkina Faso.

1. MATERIALS AND METHODS

1.1. Study site and population

This study was carried out in the surgery and maternity departments of the SSUHC in Burkina Faso. Were included in this study, any patient who was hospitalized in the general surgery or maternity departments of the SSUHC and who presented post-operative suppuration occurring within 30 days after the surgical intervention and who had accepted to participate in this study. Any patient who received antifungal treatment in the last two weeks before surgery was not included.

1.2. Study duration and biological samples management (collection, transport and processing)

Samples of postoperative purulent secretions were collected from June to December 2019. For each patient with suppurative postoperative wound, purulent secretions swabs at the surgical site were aseptically collected using sterile cotton swabs (Heinz Herenz Hamburg, Germany). The specimens were immediately transported to microbiology laboratory using Stuart transport media (HiMedia, India). Gram staining was performed from direct specimen and the specimens were inoculated on Sabouraud's dextrose agar supplemented with 50 mg/mL chloramphenicol (SDA) (LIOFILCHEM®, Italy). Plates were aerobically incubated at 35°C for 24–48 hours.

1.3. Fungal identification

Standard mycological identification: Fungal positive cultures on SDA plates was preliminary identified as yeast based on the colony color (creamy to white) **[**11**]**.

Chromogenic *Candida* speciation media (CHROMagar™ Candida): Yeasts isolated from SDA were subculture on CHROMagar medium and incubated at 35°C for 24 hours. This medium is a selective and differential medium for the isolation of fungi. Because it has chromogenic substrates, colonies of *Candida albicans* (*C. albicans*), *Candida tropicalis* (*C. tropicalis*), *Pichia kudriavzevii* (*P. kudriavzevii*) and *Nakaseomyces glabrata* (*N. glabrata*) produce distinct colors there, thus making it possible to directly detect these yeast species on the isolation Petri dish [11-13]. The colonies of *C. albicans/C. dubliniensis* are light to medium green, those of *C. tropicalis* are greenish blue to metallic blue, and those of *P. kudriavzevii* are rose pink. The colonies of *N. glabrata* appear in white on the CHROMagar medium.

1.3.1. Immunological and enzymatic tests

The immunological and enzymatic tests were used to confirm the identification of the species made with CHROMagar medium. All these tests were performed in accordance with the manufacturer's instructions.

Immunological test: these tests are based on the principle of agglutination of latex particles sensitized by a specific monoclonal antibody against *C. albicans*/*C. dubliniensis* (BICRO-ALBICANS FUMOUZE®), *C. dubliniensis* (BICRO-DUBLI FUMOUZE®) or *P. kudriavzevii* (KRUSEI-COLOR FUMOUZE®). The appearance of red agglutinates is considered to be a positive reaction, and the absence of agglutination is considered to be negative for the species concerned

Enzymatic tests: the GLABRATA R.T.T. FUMOUZE® is based on the ability of *N. glabrata* to hydrolyze trehalose but not maltose. It requires an inoculum of only four to six colonies, and the results are available within 20 min. The positive reaction results in the appearance of an orange color only in the appropriate cup (cup T).

1.4. Sample size determination and Statistical analysis

We want to estimate the proportion (or prevalence) of fungal SSIs in inpatient hospitalized at the SSUHC after performing a surgical intervention. An estimate of the unknown prevalence of fungal SSIs in this population is 0.026 [14]. We would like to be 95% certain that our estimate is within 5% of the true proportion of the population that is positive to fungal SSIs. Under these assumptions, the minimum sample size was estimated at 39. Data were collected using paper questionnaire and then entered and verified with Microsoft Excel 2016 and analyzed with R software (R Core Team (2019), Vienna, Austria). Descriptive statistical analysis was used to summarize the data into median with their range (minimal and maximal) and proportion. Kaplan Meier analysis was used to determine the time of occurrence of fungal SSIs.

2. RESULTS

2.1. Socio-demographic characteristics

A total of 39 postoperative patients meeting the all eligibility criteria were included in this study. The table I summarizes the socio-demographic characteristics. The median age of the patients was 27 years. The majority of patients were women (74.4%) and 53.8% of these patients were housewives. A slight majority (56.4%) of patients lived outside the city of Bobo-Dioulasso.

Table I: Socio-demographic characteristics

Variables		**Values**
Age in year, median (min, max)		27 (13, 47)
Sex n (%)	Male	10 (25.6)
	Female	29 (74.4)
Profession n (%)	Student	4 (10.3)
	Housewife	21 (53.8)
	Informal sector[1]	14 (35.9)
Residence n (%)	Bobo-Dioulasso	17 (43.6)
	Others city	22 (56.4)

[1] Informal sector: Laundress, Farmer, Trader, Builder

2.2. Clinical characteristics

Of the 39 patients, 64.1% were referred to the SSUHC by other health centers and 56.4% were hospitalized in the maternity department. The median duration of the intervention was 49 minutes. The median time of occurrence of SSI among those who experienced a SSI was 7 days. The main reasons for the surgery were acute peritonitis (28.21%) and acute fetal distress (23.08%). Table II summarizes the clinical characteristics of the patients.

Table II: Clinical characteristics of patients

Variables			**Values**
Mode of admission n (%)	Consultation at the SSUHC		14 (35.9)
	Referred		25 (64.1)
Medical department n (%)	General surgery		17 (43.6)
	Maternity		22 (56.4)
Duration of surgery (minutes**)** median (min, max)			49 (30, 149)
Postoperative suppuration time (days) median (min, max)			7 (3, 22)
Surgical diagnosis n (%)	**General surgery (Laparotomy, amputation)**	Acute peritonitis	11 (28.21)
		Postoperative wound	2 (5.13)
		Gangrene of the lower limb	2 (5.13)
		Others[1]	2 (5.13)
		Subtotal 1	**17 (43.59)**
	Cesarean	Acute fetal distress	9 (23.08)
		Feto-pelvic disproportion	3 (7.69)
		Obstructive presentation	2 (5.13)
		Pre-eclampsia	2 (5.13)
		Others[2]	6 (15.38)
		Subtotal 2	**22 (56.41)**
	Total		**100**

[1]: appendicitis and inguinal hernia; [2]: severe infectious syndrome, decompensated diabetes, sickle cell crisis, decompensated anemia

2.3. Microbiology findings

2.3.1. Gram staining

Of the 39 samples analyzed by Gram staining, 16 (41.02%) were positive with respectively 7 for gram positive cocci (GPC), 6 for gram negative bacilli (GNB), 1 for gram positive bacilli (GPB) and 2 polybacterials (GNB and GPC).

2.3.2. Fungal Examinations

A total of 8 (20.51%) fungal species, all belonging to the genus *Candida*, were identified in the study. These species were *C. albilcans* (3), *N. glabrata* (2), *C. tropicalis* (2) and *P. kudriavzevii* (1). Two mixed infections GNB and *N. glabrata*, and GNB and *C. tropicalis* were identified. Data analysis showed that 50% (4/8) of fungal agents were isolated in the general surgery department and the remained 50% (4/8) from the maternity department.

2.4. Time of occurrence of fungal SSIs

Figure 1 presents the average time of occurrence of fungal SSIs with the number of postoperative days in the x-axis and in the y-axis the probability of the occurrence of fungal infection. The probability of isolating fungal agents from the surgical site was 2.6% three days after surgery. This probability was 14.4% and 49.5% at one week and 12 days after the surgical intervention, respectively.

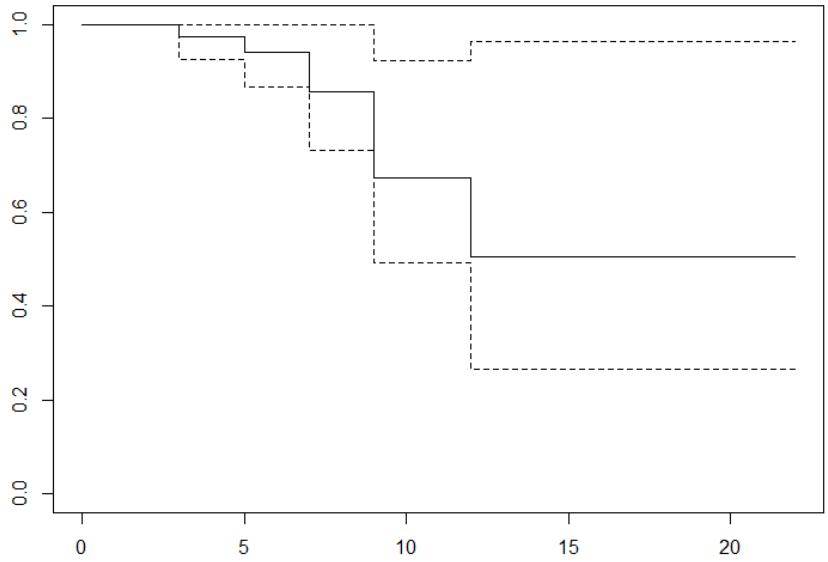

Figure 1: Average time of occurrence of fungal SSIs

3. DISCUSSION

The burden of fungal SSIs in sub-Saharan Africa remains largely unexplored although the number of SSIs in this part of the world is constantly increasing [5]. SSIs remain a common cause of morbidity and mortality amongst hospitalized patients [2]. This present study showed that fungal agents belonging to the genus *Candida* could cause SSIs. Data analysis showed that over 74% of the study population were women. This is explained by the inclusion of the maternity department in the departments eligible for this study. Indeed, taking into account only the department of general surgery, the male sex mainly represented with 58.82%. These data also showed that more than half (56.41%) of SSIs at the SSUHC occurred after cesarean section and 50% of fungal agents were isolated from cesarean patients. It estimated that 21.1% or 29.7 million births occurred through caesarean section in 2015, representing almost a doubling since 2000 (12.1%) [15]. The trend towards an increase in cesarean sections also implies an increase in cases of fungal SSIs. So, it is imperative to review the indications for cesarean section in different countries in order to prevent the exposure of cesarean patients to these potentially fatal infections. All of the fungal agents identified in this study belonged only to the genus *Candida*. These data are in accordance with those reported by Kaya et *al.* [14]. The occurrence of fungal infections being possible from the third postoperative day, strategies such as strict compliance with hygiene measures or even antifungal prophylaxis should be initiated, especially in immunocompromised patients. This antifungal prophylaxis although potentially important to control fungal infection is not recommended by Eggimann P. and Pittet D [16]. For these authors, despite the fact that a significant proportion of postoperative patients are colonized, only a minority develops invasive candidiasis. In addition, this antifungal prophylaxis could also promote the selection of resistant isolates. However, because clinical signs of serious infection appear late, Eggimann P. and Pittet D recognize the difficulty in rapidly diagnosing serious fungal infections [16]. Misdiagnosis of a surgical site infection due to fungal agents could cause delayed surgical healing or even a fatal outcome [17]. Finally, in this study two mixed infections (GNB and *Candida*) were identified. The wound environment may promote multispecies biofilm formation between bacteria and fungi with implications for pathogenicity, treatment, and outcomes [18]. One of the limitations of this study was the difficulty in discriminating between a simple colonization of postoperative wound by *Candida* and a real *Candida* SSI.

CONCLUSION

This study showed that *Candida* spp. could be the cause of the occurrence of SSIs at the SSUHC in Burkina Faso. Given these data, a mycological examination should be routinely performed in the case of SSI. These routine microbiological tests should also include antifungal susceptibility testing for better management of fungal SSIs. Fungal nosocomial SSIs can be of endogenous or exogenous cause. So, studies should be conducted to determine the part attributable to each route in the occurrence of these infections.

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Conflict of Interest: No conflict of interest.

AUTHORS' CONTRIBUTIONS

JZ, SB and IWY designed the study. AK did sample collections. AK and NG did laboratory work. JZ, IWY and TR participate in data analysis. JZ and IWY wrote the manuscript. All authors revised the final version of manuscript. All authors read and approved the final manuscript.

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