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Surgical Site Infection in the General Surgery Department of the Commune I Reference Health Center of Bamako

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Abstract **Original Research Article**

***Objective*:** To study surgical site infections in the general surgery department of the CSRéf in Commune I of the Bamako district. ***Method*:** This was a 12-month prospective descriptive and analytical study from 1er June 2021 to 1er May 2022, including all patients operated on and hospitalised in the department. ***Results*:** During the study period, we recorded 80 cases of surgical site infection out of 442 patients included in the study, i.e. an overall total of 18.1%. The mean age of the patients was 32.24 years, with extremes ranging from 1 to 82 years. The rate of SSI was influenced by the surgical indication, the type of anaesthesia, the type of surgery according to the Altemeier classification, whether or not antibiotic prophylaxis and drainage were practised, and the length of postoperative hospitalisation. The majority of surgical site infections were diagnosed within the first 5-10 days postoperatively. Superficial infection was the most common (81%). E coli was the most common germ isolated from the site of infection at 49.15%. Most germs were sensitive to the combination of amoxicillin and clavulanic acid, imipenem and gentamicin.

Keywords: We recorded a total of 4 deaths, i.e. 0.9%, and the infection was not the direct cause of any deaths.

INTRODUCTION

Infection is a microbial process characterised by at least a local inflammatory response by the host to the presence of a germ in a usually sterile tissue or biological fluid [1].

An infection is said to be nosocomial (Greek nosos: disease; komein: to care for) if it develops in a patient who has been in hospital for at least 72 hours and was not present during the incubation period when the patient was admitted [1].

Surgical site infections (SSIs) are infections that occur at the incision, cavities or affected organs during surgery carried out within the previous 30 days, or within 12 months in the case of implants or prostheses [1].

Surgery is an essential therapeutic tool in the treatment of certain pathologies. An increasing number of diseases are being treated. Despite the mastery of surgical techniques, complications continue to arise, defined as any deviation from postoperative normality, in particular infectious complications [1, 2].

Post-operative infections are a public health problem. They cause an increase in morbidity, mortality, length of hospital stay and the cost of treating patients [3].

Statistics on the frequency of nosocomial infections rank surgical site infections second (11%) after urinary tract infections [4].

- The WHO estimates that an average of 240 million people undergo surgery each year worldwide, and that 9 million of them contract an infection during the procedure. Approximately one million patients die each year from these infections [5]. In developing countries, surgical site infection is one of the most common healthcare-associated infections. [6].
- In the USA and Europe, 2% of surgical procedures result in surgical site infection [7].

- In Senegal, West Africa, the incidence of surgical site infection was found to be 5.3% in 2003 [8].
- In Mali,
- ✓ DIARRA B reported a hospital frequency of SSI of 7.8% in a study carried out in 2011 on 374 patients operated on in the general surgery department of the Gabriel Touré University Hospital [8].
- ✓ CISSOKO B.-E. Reported in 2013 on 300 patients operated on, a frequency of SSI of 1.3% in the general surgery department of the CHU Gabriel Touré [9].

Diagnosis is easy in the case of wall abscesses, but difficult when the infection is deep. Treatment is difficult because it sometimes requires multiple surgical interventions, which usually lead to very poor results or dreadful after-effects [1].

The relevance of the subject, the problems posed by surgical site infections and the absence of such a study in the department prompted us to carry out this study.

METHODOLOGY

This was a prospective descriptive-analytical study conducted over a 12-month period from 1er June 2021 to 31 May 2022 in the general surgery department of the Commune I referral health centre in the Bamako district.

The study included all patients who underwent emergency or scheduled surgery, were hospitalised and presented with a surgical site infection. Data were entered and analysed using Microsoft Word 2016 and SPSS 21.0. Parameters were compared using the Chi2 statistical test with P significant < 0.05.

RESULTS

During our study period, 537 patients were operated on and hospitalised in the general surgery department. Of these, 442 met our inclusion criteria and 80 developed a surgical site infection, a frequency of 18.1%.

1. Gender

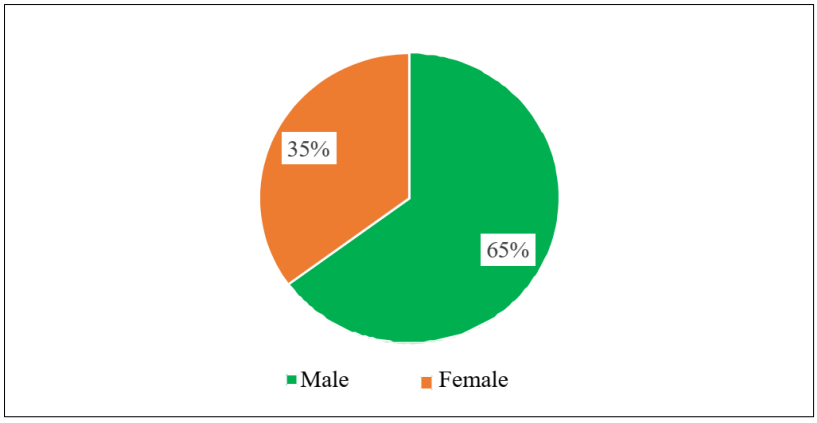

Figure 1: Breakdown of patients by sex.

Males predominated with a rate of 65%. The sex ratio (M/F) was 1.8.

2. Age:

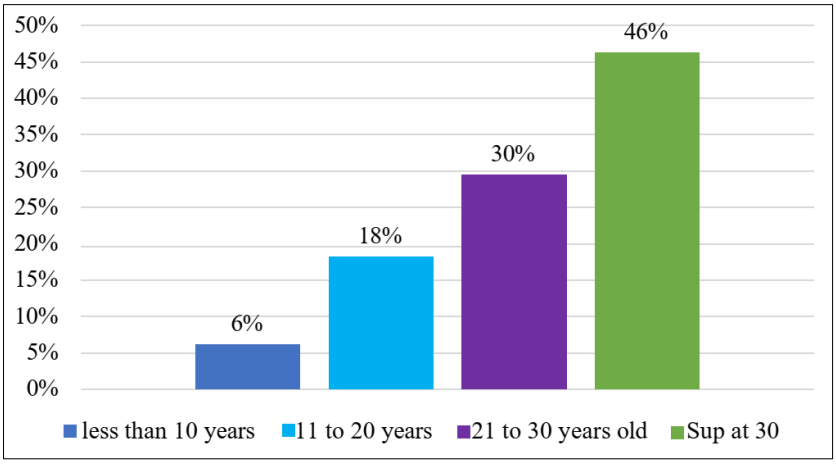

Figure 2: Breakdown of patients by age group

The most represented age group was over 30, with a rate of 46%. The average age was 32.24, with extremes ranging from 1 to 82.

3. Reason for Consultation

Table I: Breakdown of patients by reason for consultation

Reason for consultation	Workforce	Percentage
Abdominal pain	332	75,11
Inguinal swelling	61	13,80
Stopping materials and gases	16	3,63
Post caesarean section suppuration	3	0,68
Constipation and vomiting	2	0,45
Abdominal distension	2	0,45
Testicular pain	2	0,45
Acute retention of urine	4	0,90
Vomiting	3	0,68
Anal pain	3	0,68
Post CBV evisceration	2	0,45
Umbilical swelling	8	1,81
Scrotal swelling	2	0,45
postoperative parietal suppuration	1	0,23
Rectorrhagia	1	0,23
TOTAL	**442**	**100**

The most frequently reported reason for consultation was abdominal pain, with a rate of 75.11%.

4. Body Mass Index

Table II: Breakdown of patients by BMI

BMI	Workforce	Percentage
Not precise	93	21,04
16,5-18,5	19	4,31
18,5-25	291	65,83
25-30	39	8,82
Total	**442**	**100**

Body mass index was between 18.5 and 25 in 65.83% of patients.

5. The Karnofsky Index

Table III: Distribution of patients according to Karnofsky index

Karnofsky index	Workforce	Percentage (%)
100%	201	45,48
90%	114	25,79
80%	90	20,36
70%	24	5,43
60%	9	2,04
50%	2	0,45
40%	2	0,45
30-0%	0	0,00
TOTAL	442	100

Among our patients, 45.48% had a Karnofsky index of 100%.

6. Preoperative Preparation of the Patient

Table IV: Breakdown of patients according to skin preparation

Skin preparation	Workforce	Percentage
On the eve	115	26,0
On the operating table	308	69,7

Skin preparation	Workforce	Percentage
NO	19	4,3
Total	442	100

Skin preparation was mostly carried out on the operating table in 69.7% of patients.

7. Number of People in the Block

Table V: Breakdown of patients by number of people in the operating theatre

Number of people	Workforce	Percentage
3-5	172	38,9
6-8	270	61,1
Total	**442**	**100**

We noticed 6 to 8 people in the operating theatre in 61.1% of cases.

8. Type of Anaesthesia

Table VI: Breakdown of patients by type of anaesthesia

Type of anaesthesia	Workforce	Percentage
AG without IOT	117	26,5
AG with IOT	69	15,6
Local	7	1,6
Loco-regional	249	56,3
Total	442	100

General anaesthesia with IOT was used in 15.6% of patients.

9. Type of Surgery

Table VII Distribution of patients according to the Altemeier classification

Type of surgery	Workforce	Percentage
Clean surgery	248	56,1
Contaminated clean surgery	71	16,0
Contaminated surgery	94	21,3
Dirty surgery	29	6,6
Total	442	100

Clean surgery was used in 56.1% of patients.

10. Operator level

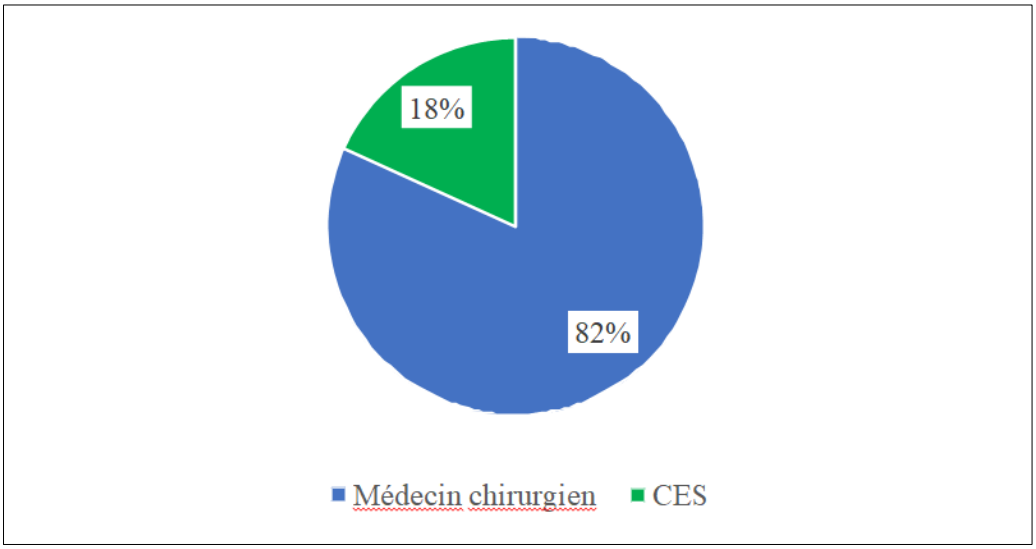

Figure 3: Breakdown of patients by operator

In our study, 82% of operations were carried out by surgeons.

11. Antibiotic Prophylaxis

Table VIII: Distribution of patients according to antibiotic prophylaxis

Antibiotic prophylaxis	Workforce	Percentage
Yes	332	75,1
No	110	24,9
Total	**442**	**100**

In our study, antibiotic prophylaxis was applied to 75.1% of patients.

12. NNISS Score

Table IX: Distribution of patients according to NNISS Score

NNISS score	Workforce	Percentage
0	263	59,5
1	150	34,0
2	24	5,4
3	5	1,1
Total	442	100

The NNISS 0 score was the most common, accounting for 59.5% of cases.

13. Prevalence of SSI

a. Surgical site Infection

Table X: Breakdown of patients by surgical site infection

Surgical site infection	Workforce	Percentage
Yes	80	18,1
No	362	81,9
Total	**442**	**100**

The surgical site was infected in 18.1% of cases.

b. ISO Headquarters :

Table XI: Distribution of patients by site of surgical site infection

Site of surgical site infection	Workforce	Percentage
Superficial	65	81
Deep	8	10
Espace	7	9
Total	80	100

The majority of postoperative infections (81%) were superficial.

c. Isolated Germ

Table XII: Breakdown of patients by germ responsible for infection

Germ responsible for the infection	Workforce	Percentage
Impaired PNN	21	26,25
Candida albicans	1	1,25
Enterobacterspp	1	1,25
Escherichia coli	29	36,25
Klebsiella pneumoniae	1	1,25
Pseudomonas aeruginosa	1	1,25
Salmonella typhi	13	16,25
Staphylococcus aureus	13	16,25
Total	80	100

Bacteriological examination was carried out in all our patients, with altered neutrophils (PNN) detected in 26.25% of cases and Escherichia coli being the germ responsible for 36.25% of infections.

d. Antibiotic Susceptibility Testing

Table XIII: Breakdown of patients by type of antibiotic susceptibility test performed

Antibiogram	Workforce	Percentage (%)
YES	59	73,75
NO	21	26,25
Total	80	100

Antibiotic susceptibility testing was not performed in 26.25% of our patients.

e. Appropriate Postoperative Antibiotic Therapy

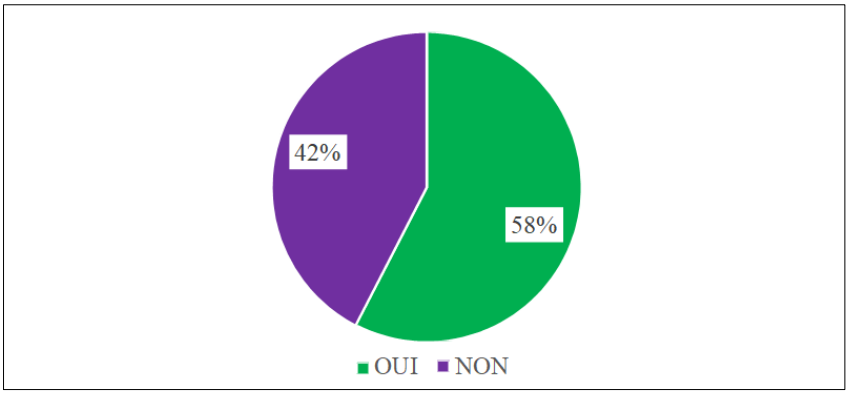

Figure 4: Distribution of patients according to postoperative antibiotic therapy

In our study, postoperative antibiotic therapy was given to all our patients and was adapted to the antibiogram in 58% of patients.

f. Molecule(S) used in Antibiotic Therapy

Table XIV: Breakdown of patients by antibiotic used

Antibiotic(s)	**Workforce**	**Percentage**
Amoxicillin + Ac clavulanique	19	14,4
Amoxicillin+Ac clavulanique, Metronidazole	7	5,3
Ceftriaxone	7	5,3
Ciprofloxacin, Metronidazole	4	3,0
Ciprofloxacin	2	1,5
Erythromycin	1	0,8
Fosfomycin	1	0,8
Furandatine	2	1,5
Gentamicin	2	1,5
Imipenem	7	5,3
Levofloxacin	1	,8
Metronidale, Ceftriaxone	7	5,3
Metronidale, Ceftriaxone, Gentamicin	18	13,6

Amoxicillin + clavulanic acid was used in 14.4% of cases.

g. ISO Processing

Table XV: Breakdown of patients by type of treatment received

Type of complications	**Workforce**	**Percentage**
Dressing + ATB	57	71
Takeover	8	10
Secondary suture	15	19
Total	**80**	**100**

Dressing and antibiotic therapy were carried out in 71% of our patients.

h. Evolution

Table XVI: Distribution of patients according to outcome

Evolution	Workforce	Percentage
Healing	438	99,1
Deaths	4	0,9
Total	**442**	**100**

In our study, 99.1% of patients were cured and there were 4 cases of death.

14. Analytical and Statistical Study of ISO

a. Gender and ISO:

Table XVII: Relationship between gender and surgical site infection Gender Surgical site infection Total

	YES		NO		
Male		56		231	287
Female		24		131	155
Total		80		**362**	**442**

P=0.137 ddl=1

There was no statistically significant relationship between gender and surgical site infection.

b. Karnofsky and ISO score

Table XVIII: Relationship between Karnofsky score and SSI

	▪	▪	▪	▪	▪	▪	▪	▪
Karnofsky index / ISO	**100**	**90**	**80**	**70**	**60**	**50**	**40-0**	**TOTAL**
YES	11	13	35	18	3	0	0	80
NO	90	18	148	101	3	1	1	362
TOTAL	101	31	183	119	6	1	1	442
P=0,072								

There was no statistically significant relationship between the Karnofsky score and surgical site infection.

c. ASA and ISO

Table XIX: Relationship between ASA score and SSI

Surgical	**site**	**American Society of Anesthesists**			**Total**
infection		Score 1	Score 2	Score 3	
YES	0	65	14	1	80
NO	1	41	8	2	52
Total	1	106	22	3	132

P=0,461

There was no statistically significant relationship between ASA score and surgical site infection.

d. BMI and ISO

Table XX: Relationship between BMI and surgical site infection BMI Surgical site infection Total

		YES		NO	
Not specified	0		93		93
16,5-18,5	8		11		19
18,5-25	67		224		291
25-30	5		34		39
Total	80		362		442

P=0,000ddl=3

There was a statistically significant relationship between body mass index and surgical site infection.

e. NNISS and ISO score

Table XXI: Relationship between NNISS score and surgical site infection NNISS score surgical site infection Total

	YES	NO	
0	38	225	263
1	29	121	150
2	13	24	24
3	0	5	5
Total	**80**	**362**	**442**

P=0.318 ddl=3

There was no statistically significant relationship between NNISS score and surgical site infection.

f. Relationship between the Altémeier classification and ISO

Table XXII: Relationship between Altémeier classification and ISO

Type of surgery					
Clean surgery Contaminat ed Contaminate d Dirty surgery					
Clean surgery					
Surgical infection	**site**	**surgery**		**Total**	
YES	22	22	19	17	80
NO	25	5	11	10	51
Total	47	27	30	27	131

P=0,031

There was a statistically significant relationship between the type of surgery according to the Altémeier classification and the occurrence of surgical site infection.

g. Relationship between type of anaesthesia and SSI

Table XXIII: Relationship between type of anaesthesia and SSI

Type of Anaesthesia							**Total**
Surgical infection	**site**	**AG without IOT**	**AG IOT**	**with**	**Local**	**Loco-regional**	
YES		10	44		3	23	80
NO		6	15		4	26	51
Total		16	59		7	49	131

P=0,022

There was a statistically significant relationship between the type of anaesthesia and the occurrence of surgical site infection.

DISCUSSION

1. Frequency

The results of this study can also be discussed with the data in the literature on SSIs, since according to a meta-analysis in sub-Saharan Africa, the incidence of SSIs varied from 6.8% to 26%, with a predominance in general surgery of 19.1% [10]. Out of 537 patients operated on and hospitalised in our department during the course of our study, 442 were included according to the above-mentioned criteria, 80 of whom developed a surgical site infection, i.e. a frequency of 18.1%.

Authors and date	**Study framework**	**ISO rate**
Mekhail NA *et al*., 2011[11].	USA n=707	2,5% P=0,000032
Ouédraogo AS *et al*. 2011[12]	Burkina Faso n=681	23,8% P=0,02356
Hami I, 2017[4]	Senegal n=141	15,6% P=0,0001
Tembely D, 2009[13]	Mali n=100	27,4% P=0,04366
Koné S, 2017[14]	Mali n=265	9% P=0,0001
Our study, 2023	Mali n=442	18,1%

Our frequency of 18.1% is close to that of Hami I in Senegal [4].

It is clearly lower than those of these authors [12 and 13] but higher than the frequencies found by authors [11 and 14]. This difference can be explained by the precarious state of the technical facilities in the operating theatre, the conditions of hospitalisation and the state of the equipment used for post-operative care.

2. Surgical Indication

Digestive pathologies accounted for 70.6% of cases (p=0.000). Similar data have been reported by authors [15; 7; 12and 5].

These data could be explained by the high frequency of digestive pathologies and the number of microbial agents present in these organs.

3. Type of Anaesthetic

General anaesthesia with IOT was used in 44 infected patients (55%). In the literature some authors consider the type of anaesthesia as a factor influencing the occurrence of SSI [5]. Our SSI rate was negatively influenced by the type of anaesthesia with p=0.022.

This could be explained by the fact that hypoxia increases the risk of infection and the invasive and traumatic nature of IOT.

4. Type of Surgery According to the Altemeier Classification

In our study, an increase in the rate of infection according to Altemeier class was observed in classes II and III, which represented 16% and 21.3% respectively, with p=0.031. The same observation has been made by authors [10; 15; 14 and 5].

5. Antibiotic Prophylaxis

Antibiotic prophylaxis is considered to be a factor influencing the occurrence of SSI in our series (p=0.059), as it was not applied in 66.25% of our infected patients. The negative influence of the absence of antibiotic prophylaxis on the occurrence of SSI can be explained by the predominance of clean surgery cases.

6. How ISO is Diagnosed

- The time to onset of surgical site infection was between 5-10 days in 52.5% of cases. DIARRA B B, in Mali in 2011 reported similar data GUETARNIN, in Algeria in 2014 reported an overall time to onset of SSI of 9.7+/-15 days this difference could be explained by the way the patients were monitored.
- Pus discharge was reported in 50.8% of patients, and postoperative infection was located in the superficial part in the majority of cases, approximately 49.2% of cases. Bacteriological examination was carried out in all our patients, and altered PNN were detected in 26.25% of cases.

7. Sensitive Germs

During our study period, the culture was mono-microbial in 93.10% of cases and poly-microbial in 6.9% of cases. HAMI I, in 2019, in Senegal, found 14 cases of mono-microbial infections and 8 cases of poly-microbial infections.

The germs most frequently encountered were Escherichia coli (49.15%), Staphylococcus aureus and Salmonella typhi (22.03% each). This predominance of E.coli followed by Staphylococcus aureus has been reported by several authors [10-16].

In the study conducted by HAMI I in Senegal in 2019, Escherichia coli came second after Klebsiella pneumoniae. However, Staphylococcus aureus and Pseudomonas aeruginosa are each the leading cause of SSI in many studies [12].

8. Susceptibility of Identified Germs to Antibiotics

Escherichia coli, the species most frequently isolated, was sensitive to the combination of amoxicillin and clavulanic acid in 11 cases, to imipenem in 7 cases, and to ciprofloxacin in 4 cases. Staphylococcus aureus was sensitive to imipenem and nitrofurantoin. Salmonella typhi was sensitive to metronidazole, gentamicin and ceftriaxone.

Escherichia coli and Staphylococcus aureus were resistant to the drugs frequently used in the department (Ceftriaxone, metronidazole, gentamicin).

DIARRA BB, in Mali in 2011 found the same germs listed in the literature. Escherichia coli was 67% resistant to quinolones (Ciprofloxacin); 13% to aminoglycosides (Gentamycin); and 13% resistant to cephalosporins (Ceftriaxone).

Salmonella typhi showed resistance to most antibiotics, including imipenem in some cases. Similar data was reported by TRAORE S, in Mali in 2017.

In their studies [4-15], the authors observed a high level of resistance in enterobacteria to amoxicillin (100%), cotrimoxazole (100%), the combination of amoxicillin and clavulanic acid (95.5%) and ceftriaxone (84.4%), which are the antibiotics of choice commonly used pre-, intra- and post-operatively.

These antibiotics are the most commonly used in our context as part of probabilistic antibiotic therapy. These resistances could be explained by the over-frequent use of these antibiotics in therapy and also the practice of self- medication, which is at the origin of a selection pressure of resistant mutants within our hospital.

Staphylococcus is the most widespread germ on the skin surface, and summary emergency disinfection does not eliminate the maximum number of germs on the skin. In addition, intraoperative intestinal procedures encourage infections with enterobacteria such as Escherichia Coli.

The high prevalence of Enterobacteriaceae may be explained by the higher frequency of digestive pathologies. As for polybial cultures, these can probably

be linked to a lack of asepsis at some point during the operation, post-operative care or the sampling itself. Data on the antibiotic sensitivity of isolated S. aureus show almost total resistance to penicillin G.

9. Evolution

In our study, 96.25% of our patients recovered, 67.5% by dressing, 18.75% by secondary suture and 10% by revision, with a p=0.000. Mortality was 3.64%. The patients died as a result of complications related to the pathologies for which they had been hospitalised or operated on. Comparable data were found in the series by DIARRA A *et al*., in Mali in 2020. However, the authors [14-5], found respective mortality rates of 16.7% and 10.3%.

CONCLUSION

Surgical site infection is a microbial process characterised by at least a local inflammatory response of the host to the presence of a germ in a normally sterile tissue or biological fluid.

Diagnosis is easy in the case of wall abscesses, but difficult when the infection is deep.

At the end of the study, we believe that the overall rate of SSI is very high, hence the need to focus on preventive measures.

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