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Antibioprophylaxis in the General Surgery Department of the Commune 1 Reference Health Center in the District of Bamako

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Abstract **Original Research Article**

The aim of our study was to investigate antibiotic prophylaxis in the general surgery department of the C I commune referral health centre. This was a 12-month prospective study from 01 February 2021 to 31 January 2022 on antibiotic prophylaxis in general surgery. 129 patients were selected according to our inclusion criteria (patients who had received ceftriaxone at the time of anaesthetic induction. Patients belonging to Altemeier class I (clean surgery) with an infectious risk of estimated at 2 by the NNISS score and Altemeier class II (contaminated clean surgery). The antibiotic used was ceftriaz (ceftriaxone). The dose was two (2) grams. A single dose was given at the time of anaesthetic induction. The intravenous route was used exclusively. Patients underwent constant clinical monitoring. We had four (4) cases of surgical site infection (3.1%). The average post-operative hospital stay was two (2) days. Analysis of our results enabled us to identify a number of infectious risk factors: type of surgery, ASA score, emergency, anaemia and blood glucose level. Among the germs isolated, *Escherichia coli* was the most frequent (50%).

Keywords: Antibiotic prophylaxis, infectious risk factors, surgery, surgical site, Mali.

INTRODUCTION

The surgeon's first concern is asepsis, which can be inadequate. Infection is a constant risk in surgery, and pathogenic bacteria are found in over 90% of surgical wounds during closure [1]. This is why the question of antibiotic prophylaxis support arises [1].

Antibiotic prophylaxis is the administration of antibiotics prior to potential bacterial contamination due to a high-risk situation during a surgical procedure [2]. It applies to certain so-called clean or clean contaminated surgeries [3]. The aim of antibiotic prophylaxis (ABP) in surgery is to prevent bacterial proliferation in order to reduce the risk of surgical site infection (SSI) [4]. Typically hospital- acquired post-operative infections rank third (20%) among nosocomial infections [5].

It increases the cost and length of hospital stay by a factor of between 1.5 and 2.5 depending on the type of operation [1].

Various studies have been carried out as part of the fight against surgical site infections, in which different frequencies have been noted:

- ✓ In Africa, in Niger, a frequency of 10.41% of surgical site infections was found in 2019 [6].
- ✓ In MALI
  - DIARRA. A, in 2018 reported on 650 patients operated on, a frequency of SSI of 8.46% was found in the general surgery department of the Bocar Sidy Sall hospital in Kati [7].
  - In 2017, a surgical site infection rate of 4.7% was found in "B" surgery at Point G Hospital (Mali) [8].
  - CISSOKO B.-E, in 2013, reported on 300 patients operated on, a frequency of SSI of 1.3% after antibiotic prophylaxis in the general surgery department of the Gabriel Toure University Hospital [9].
- ✓ In the USA and Europe, 2% of surgical procedures are complicated by a surgical site infection [2].

These various studies have led to better ideas on how to prevent these infections. This is why we have initiated this study on antibiotic prophylaxis, which is a useful, if not indispensable, adjunct, at least in certain surgical procedures.

Numerous studies have been carried out to make this antibiotic prophylaxis indisputable today:

- In 1957 Elek [10] showed that 10^2 *Staphylococcus aureus* were sufficient to cause a subcutaneous infection on a suture in guinea pigs, whereas 10^6 were needed to cause the same infection in the absence of a suture.
- In 1961 Burke [11] demonstrated that the efficacy of an antibiotic depended very much on the timing of its administration in relation to the surgical procedure.
- In 1957 Altemeier [12] set out the principles of rational antibiotic prophylaxis.
- In 1984 Vachon [13] set out the practical methodologies for antibiotic prophylaxis.
- In 1992 Classen [14] showed that in clean or contaminated clean surgery, whatever the associated risk factors, the incidence of postoperative infections was 3.8% when the antibiotic was administered 2 hours before the incision, and that this incidence increased when the antibiotic was administered more than 2 hours before the incision (4%) or after the incision (6%).

I. METHODOLOGY

1. Type and period of study:

This was a prospective descriptive analytical study conducted over a 12-month period from 1er February 2021 to 31 January 2022.

2. Study framework:

This work was carried out in the general surgery department of the Commune I reference health centre (CSRéf CI) in the Bamako district.

3. Sampling:

The sample size was calculated using the following formula:

$N=4 (P.Q) / I^2$

P= Frequency of SSI obtained previously Q=1-P
I= Risk of error
4= a constant approximately $E^2 = (1.9)^2$
A previous study on ISO 2018 found an SSI rate of 8.46%. So P=0.0846 and I=0.05
The minimum sample size was therefore 124 patients.

Inclusion criteria: Our study included:

- The patients operated on in the general surgery department who had received ceftriaxone at the time of anaesthetic induction.
- Patients belonging to Altemeier class I (clean surgery) with an infectious risk estimated at 2 by the NNISS score.
- The patients belong to Altemeier class II (contaminated clean surgery).

II. RESULTS

1. Frequency:

During our study period, 524 patients were operated on and hospitalised in the general surgery department, 129 of whom met our inclusion criteria and 4 of whom developed a surgical site infection, a frequency of 3.1%.

1.2 Gender:

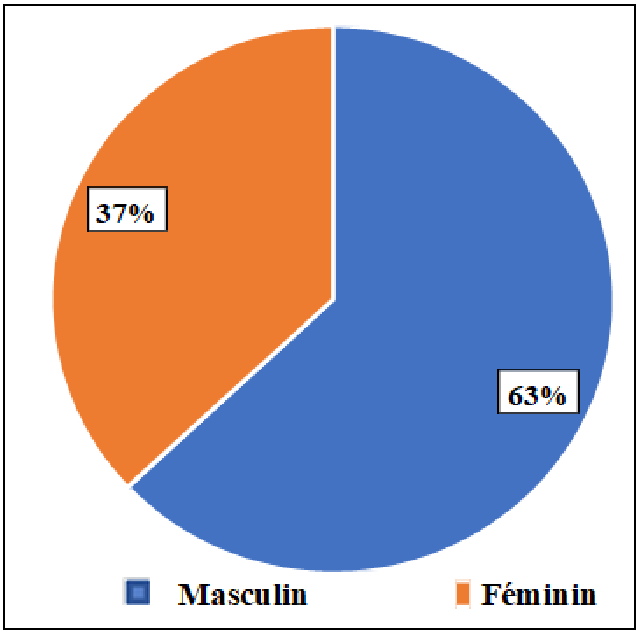

Figure 1: Male patients predominated, accounting for 63% of cases. The sex ratio was 1.7

1.3. Age:

Table I: Breakdown of patients by age group

Age range	Workforce	Percentage
2- 20 years	24	18,6
21-40 years old	44	34,1
41-60 years old	42	32,6
61-84 years old	19	14,7
Total	**129**	**100**

The 20-40 age group accounted for 34.1% of cases. The mean age was 39.56 ± 19.1 years, with extremes of 2 and 84 years.

1.4. Recruitment method:

Table II: Breakdown of patients by recruitment method

Recruitment mode	Workforce	Percentage
Emergency	48	37,2
Normal consultation	81	62,8
Total	**129**	**100**

Emergencies accounted for 37.2% of cases.

1.5 Body mass index (BMI):

Table III: Distribution of patients according to BMI

BMI	Workforce	Percentage
<16	1	0,8
16,5-18,5	16	12,4
18,5-25	77	59,7
25-30	23	17,8
30-35	9	7
35-40	3	2 ,3
Total	**442**	**100**

Body mass index was between 18.5 and 25 in 59.7% of patient

1.6. Diagnosis:

Table IV: Breakdown of patients by diagnosis

Diagnosis	Workforce	Percentage
Appendicitis	23	17,8
Inguinal hernia	15	11,6
Umbilical hernia	10	7,7
Eventration	10	7,7
Hernia of the white line	9	6,9
Hydrocele	8	6,2
Uterine fibroma	8	6,2
Adenofibroma of the breast	6	4,7
Cryptorchidism	6	4,7
Lipoma	6	4,7
Goitre	6	4,7
Ovarian cyst	4	3,1
Uterine prolapse	4	3,1
Cord cyst	3	2,3
Thyreoglossal cyst	3	2,3
Giant cell tumour of the foot	3	2,3
Cystocele	2	1,6
Adenocarcinoma of the ovary	1	0,8
Grade I fibromyxoma of the thigh	1	0,8
Mature teratoma of the reshaped ovary	1	0,8
Total	**129**	**100**

1.7. Preoperative preparation of the patient:

Table V: Breakdown of patients according to skin preparation

Skin preparation	Workforce	Percentage
On the eve	75	58,1
On the operating table	35	27,1
NO	19	14,8
Total	**129**	**100**

In 58.1% of patients, skin preparation was carried out the day before the operation.

1.8. Type of surgery:

Table VI: Breakdown of patients according to the Altemeier classification

Types	Workforce	Percentage
Class I	83	64,3
Class II	46	35,7
Total	**129**	**100**

Classes III and IV were excluded from our study.

1.9. A.SA score:

Table VII: Distribution of patients according to A.S.A. score

Score A.S. A	Workforce	Percentage
A.S.A I	89	69,0
A.S.A II	38	29,5
A.S.A III	2	1,5
Total	**129**	**100**

We did not receive patients with ASA score = IV and V

1.10. NNISS score:

Table VIII: Distribution of patients according to NNISS score

NNISS score	Workforce	Percentage
0	71	55,0
1	53	41,1
2	5	3,9
Total	**129**	**100**

NNISS = National Nosocomial Surveillance System. NNISS =0 the risk of infection is 1.5
NNISS =1 the risk of infection is 2.6 NNISS = 2 the risk of infection is 6.8
We did not receive any patients with a score of 3 The NNISS score was determined in all our patients.

1.11. Length of postoperative hospital stay:

Table IX: Breakdown of patients by length of hospital stay

Length of hospital stay	Workforce	Percentage
≤ 1 day	36	27,8
2-4 days	74	57,4
>4 days	19	14,8
Total	**129**	**100**

The mean was 2 days; standard deviation = 1.30; with extremes = 1 day and 7 days**.**

1.12. Type of anaesthesia:

Table X: Breakdown of patients by type of anaesthesia

Type of anaesthesia	Workforce	Percentage
AG without IOT	33	25,6
AG with IOT	24	18,6
Local	7	5,4
Loco-regional	65	50,4
Total	**129**	**100**

General anaesthesia with IOT was used in 18.6% of patients.

1.13. Operator level:

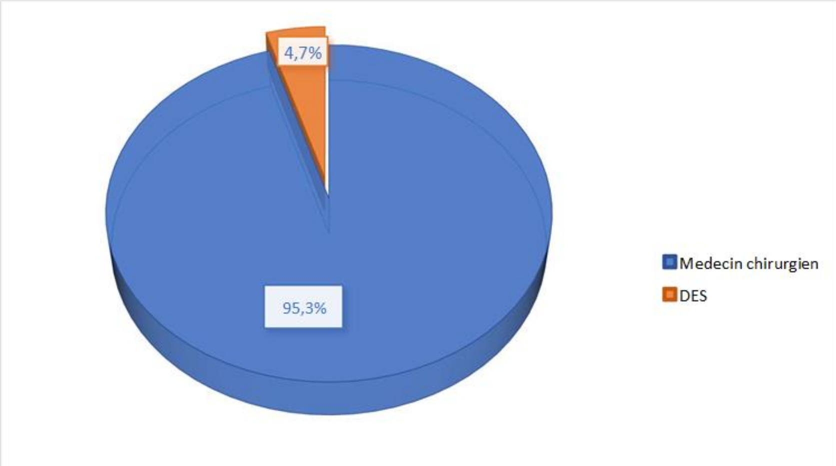

Figure II: Breakdown of patients by operator

Surgeons operated on 95.3% of patients.

1.14. Post-operative care:
Morbidity and mortality:

Table XI: Distribution of patients according to surgical site infection

Post-operation	Workforce	Percentage
Not infected	125	96,9
Infected	4	3,1
Total	**129**	**100**

Complications included 4 cases of SSI and no deaths.

Isolated germs:

Table XII: Breakdown of germs found by bacteriology

Germ	Workforce	Percentage
Escherichia coli	2	50
Proteus mirabilis	1	25
Staphylococcus Aureus	1	25
Total	**4**	**100**

E. coli accounted for 50.0% of the germs found.

Antibiogram:

Table XIII: Distribution of germs according to antibiotic sensitivity Antibiotics

Amoxicillin + Ac. Clav. Ampicillin
Imipenem Ceftriaxone Gentamycin Amikacin Ciprofloxacin Levofloxacin Azithromycin
Nitrofurantoine Chloramphenicol Nitrofurantoine
The germs found were sensitive to these antibiotics.

Type of surgery and ISO:

Table XIV: Distribution of infected patients according to Altemeier class

Altemeier class	ISO		Workforce
	No	Yes	
Class I	69	0(0)	69
Class II	56	4(6,7)	60
Total	**125**	**4 (3,1)**	**129**

Chi2=4.747 ddl=1 p=0.029. There was a statistically significant relationship between Altemeier class and surgical site infection.

III. DISCUSSION

Table XV: Frequency of SSI according to authors

Authors	Study framework	ISO rate
Hami I, Senegal, 2017 [25]	n=141	15,6%
Mekhail NA *et al*., USA, 2011 [26]	n=707	2,5%
Muhlemann, Switzerland, 2007 [27]	n=520	3,2%
Cissoko B. -E, Mali, 2013 [9]	n=300	1,3%
Ouologuem H. -O, Mali, 2010 [28]	n=353	12,2%
Our study	**n=129**	**3,1%**

3.2. Risk factors for O. S. I.:

3.2.1. Age:

Our mean age of 67 years for infected patients is different from the mean age of 38.7 years for uninfected patients, which is still higher than that reported by other authors [29, 30]. Some authors believe that SSI frequently occurs at the extremes of life [19, 31].

3.2.2. Gender:

We found no association between SSI and gender (with P = 0.145). Some authors do not consider gender to be a factor influencing the occurrence of SSI [20, 29, 32].

On the other hand, others consider the amount of subcutaneous fat in women as a factor that can influence the occurrence of surgical site infection [33, 34]. SSI was more frequent in women than in men in our study.

3.2.3. Duration of the intervention:

It is generally accepted that the rate of OSI is influenced by the duration of the operation [17, 24], although others have found that there is no link between the duration of the operation and infection [20, 21].

In our series, the duration of the operation was considered to be a risk factor for infection. The average operating time for non-infected patients was 96.5 min, compared with 123 min for infected patients.

3. 3. Types of surgery:

Table XVI: Frequency of iso according to Altemeier class by authors

Authors	Number of cases	Altemeier class I iso rate (%)	Altemeier class II iso rate (%)
German S, France [35]	474	0	0,8
CDC Atlanta, USA [21].	-	<1	<7
Dembélé D, Mali (CHU G.T) [36]	300	0	2, 3
Diarra B. -B, Mali (CHU G T) [37]	374	1,6	4,6
Coulibaly A, Mali (CHU P.G) [15]	270	7,2	12,6
Our study 2022	129	0	6,7

3.4. The N.N.I.S.S score

Table XVII: Distribution of O.S.I. rate according to N.N.I.S.S. score by authors.

Authors	Iso rate in %	Iso rate in %	Iso rate in %	Iso rate in %
	NNISS=0	**NNISS=1**	**NNISS=2**	**NNISS=3**
German S, France [35]	1	1,9	5,8	-
Dembélé D, Mali [36]	0,9	1,7	15,8	-
CDC Atlanta, USA [21]	1,5	2,6	6,8	13,0
Ouologuem H. O. Mali [28]	-	4,6	38	100
Our study	**1,4**	**3,8**	**20**	-

We note an increase in the rate of I.S. O in relation to the score of N.N.I.S. S in all series.

For the 0 score, we found no statistically significant difference. between our results and those of [21, 35, 36].

Our rate is statistically lower than that of Ouologuem H. O. [28] who did not undergo antibiotic prophylaxis.

For score II, our rate of I.S. O is statistically higher than that of German S [35]. The N.N.I.S.S. score is multifactorial and therefore difficult to compare, but it is a better indicator of infectious risk than the Altemeier classification alone.

3.5. Blood sugar levels:

We did not record any cases of SSI in diabetics in our study. As ISO is multifactorial, it would be difficult to explain this difference.

In all series, hyperglycaemia has been recognised as a risk factor for SSI [20, 38, 39]. Diabetes increases the rate of SSI because of the complications it causes. These include vaso-occlusive disorders, immunological failure and neutrophil dysfunction [16, 40].

3.6. Anemia and ISO:

- We noted anaemia as a factor influencing the occurrence of SSI.
- The rate of SSI is statistically higher in anaemic patients than in those with normal haemoglobin levels.
- As other authors [18, 19] have suggested, anaemia is a significant risk factor for SSI.

3.7. Emergency:

The rate of SSI in patients undergoing emergency surgery was different from those of patients operated on in the cold block.

This could be linked to the emergency context where the patient is not sufficiently prepared before the operation [19, 46].

In the literature [19], emergency care is recognised as a risk factor for O.S.I. where it is difficult to put the patient in optimal physiological conditions before the operation.

3.8. Germs

Escherichia colis was the most frequently isolated (50% in our series) as in other series at 42.9% [36] and [41].

For others, *Staphylococcus aureus* is the germ most frequently found on the site. operation [22,42].

In Europe [43], the USA [44] and Africa [45], *Escherichia coli, Staphylococcus aureus, Proteus mirabilis, Pseudomonas aeruginosa, Klebsiella pneumoniae* have been the problem germs in our hospitals.

3.9. Susceptibility of germs to antibiotics:

a - Betalactam sensitivity:

Ampicillin:

- All the germs isolated were resistant to ampicillin.
- *Staphylococcus aureus* was 50% sensitive.

Combination of amoxicillin and clavulanic acid:

The germs isolated were sensitive to the combination of amoxicillin and clavulanic acid at rates ranging from 90 to 100%. This result is similar to those of other authors [36, 23, 41].

Cephalosporins:

- They are expensive.
- The germs were generally very sensitive to cephalosporins.

b - Aminoside sensitivity:

They are used exclusively parenterally. All the germs isolated were sensitive to aminoglycosides; sensitivity varied between 50 and 100%.

The high sensitivity of hospital germs to aminoglycosides has been reported by Sarr [22] and Dembélé D [36]. They were 100% sensitive to staphylococcus.

c - Tetracycline sensitivity:

The germs were resistant to tetracyclines at a rate of around 100%, as in other studies [41].

d - Quinolone sensitivity:

Fluoroquinolones were highly sensitive to the germs found. Ciprofloxacin was almost sensitive to all germs.

3.10. Consequence of SSI on the length of post-operative hospitalisation:

The post-operative hospital stay of our infected patients was significantly increased ($p = 0.000$).

This prolongation was 7 days, i.e. 2 times more than in the non-infected patients. Dembélé D [36] found a prolongation of 15 days.

According to Brun Buisson [19], SSI increases the length of post-operative hospitalisation by 5 to 15 days.

IV. CONCLUSION

Antibiotic prophylaxis is the administration of antibiotics prior to potential bacterial contamination as a result of a high-risk situation during surgery. The aim of antibiotic prophylaxis in surgery is to prevent bacterial proliferation in order to reduce the risk of surgical site infection (SSI). Infection control is not simply a question of antibiotic prophylaxis. Improving and observing hygiene and asepsis measures are essential for reducing the rate of SSI.

Conflict of interest: The authors declare no conflict of interest.

Authors' Contributions: All the authors contributed to the writing of this manuscript and also read and approved the final version of this manuscript.

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