

Characteristics, Management, and Outcomes of Tetanus Cases in a Referral Center in Senegal, between 2010 and 2017

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Abstract

Tetanus is an infection caused by *Clostridium tetani*. The disease has been described from the earliest medical literature. Despite this old knowledge, the existence of a vaccine, and the progress made in pathophysiology and treatment, tetanus remains a real public health problem, particularly in developing countries. Tetanus in children and adults is still a frequent cause of hospitalization in the Infectious and Tropical Diseases Department (SMIT) of the Fann National University Hospital (CHNU). We conducted this study with the main objective of carrying out a situational analysis of tetanus at SMIT from 2010 to 2017. We recorded 706 cases of tetanus in a total of 8123 hospitalized patients. The median age of the patients was 23 years [1 - 90 years]. The sex ratio (M/F) was 4/1. More than half (58.78%) came from suburban areas. The population was most frequently made up of students (24%) or manual workers (22.1%). At least one comorbidity was present in 107 patients (15.15%). The absence of a vaccination record was found in 99.56%. The main portal of entry was integumentary (83.3%), post-circumcision (5.7%) and otogenous (4%). Tetanus was generalized in 93.9% of cases. The main signs of tetanus found were trismus and dysphagia. Patients were most frequently classified as stage II (78.7%). Antibiotic therapy was based on metronidazole (51.41%). Anti-tetanus serotherapy was carried out by sub-occipital administration in 97.6%. Tracheostomy was performed in 48 patients. Complications occurred in 226 patients (32.01%). The main complications were respiratory (53.98%), infectious (45.13%) and cardiovascular (41.59%). The average delay in hospitalization was 3.6 ± 3.4 days. The mean length of hospital stay was

11.9 ± 8.2 days. The hospital case-lethality rate was 18.98%. Despite the decline in cases over the years in our country, tetanus remains a public health problem because of its prevalence, severity, and lethality.

Keywords

Tetanus, Management, Outcomes, Senegal

1. Introduction

Tetanus is an infection caused by *Clostridium tetani*. The disease has been described from the earliest medical literature. Despite this old knowledge, the existence of a vaccine whose effectiveness is beyond doubt, and the progress made in pathophysiology and treatment, tetanus remains a real public health problem, particularly in developing countries. In 2017, 12,476 cases of tetanus were reported by the WHO, including 2266 cases during the neonatal period [1]. In Senegal, a total of 251 cases of tetanus were reported in 2017, including 3 cases of neonatal tetanus. The expanded vaccination program (P.E.V.) implemented since 1981 led to certification of elimination of neonatal and maternal tetanus in 2012 [2]. However, tetanus in children and adults is still a frequent cause of hospitalization in the Infectious and Tropical Diseases Department (SMIT) of the Fann National University Hospital (CHNU), the national referral structure for the management of this disease. Unlike developed countries where tetanus is a disease of the elderly, in resource limited countries, it is mostly of interest in young people [3] [4]. Several studies have been carried out at SMIT to assess these different aspects of tetanus in Senegal. However, the most recent study on the subject dates back six years and focuses on complications [5].

It is in this context that we conducted this study with the main objective of carrying out a situational analysis of tetanus at SMIT from 2010 to 2017. The specific objectives were to describe characteristics, management, and evolution of these cases.

2. Methods

This was a retrospective, descriptive, cross-sectional study based on the records of patients hospitalized for tetanus at the Infectious and Tropical Diseases Department (SMIT) of Fann, from January 2010 to December 2017. We included any case of tetanus that occurred in person aged over 28 days of life, regardless of their sex and the circumstances of the disease. Newborns with a diagnosis of tetanus were not included in the study. The diagnosis of tetanus was clinical and was based on the epidemiological factors (presence of a portal of entry, absence of vaccination or notion of incomplete vaccination), clinical signs (presence of a trismus associated or not with dysphagia, contracture and/or paroxysms). No paraclinical arguments were necessary for confirmation. At admission, the cases were assessed for disease severity using the Mollaret system of classification and

the Dakar Scoring system, as follows: frust for stage I, or score 0 - 1; moderate (stage II, score 2 - 3); severe (stage III, score 4 - 6).

Data were collected from the Medical Information Unit database. A standardized form was used for data collection and included sociodemographic data (age, sex, geographical origin, occupation, vaccination status), clinical data (clinical form, incubation and invasion duration, trismus, dysphagia, tonic paroxysms, tonic-clonic paroxysms), therapeutic data (antibiotics, trimming, serotherapy), prognostic and evolutionary data (overall evolution, complications, length of hospitalization, classification by Mollaret stage, classification by Dakar score). The data were entered using Microsoft Excel and processed by using Epidata software 3.1, Stata/SE version 12.1. Quantitative variables were described through their mean, standard deviation, median and extremes. However, the qualitative variables were described by their relative frequencies.

3. Results

3.1. Epidemiological Data

We recorded 706 cases of tetanus in a total of 8123 hospitalized patients, a hospital frequency of 87 cases per 1000 hospitalized patients or 11 cases per 1000 patient-years. **Figure 1** shows the annual distribution of tetanus cases diagnosed. Our study population was predominantly male (79.7%), with a sex ratio (M/F) of 4/1. The median age of the patients was 23 years [1 - 90 years]. The distribution according to age showed that tetanus was more common in the age groups [1 - 15 years] and [15 - 25 years], representing 37.11% and 11% respectively (**Figure 2**). Most of the study population (58.78%) came from suburban areas and 22.23% from the urban areas. Marital status was recorded for 518 patients. Single patients were predominant (280 cases, 54.05%), followed by married (199 cases, 38.41%). The population comprised mainly of students (24%) or manual workers (22.1%). Regarding to school level, most of patients (63.59%) were uneducated, patients with university level accounted for 2.2%. Information on previous

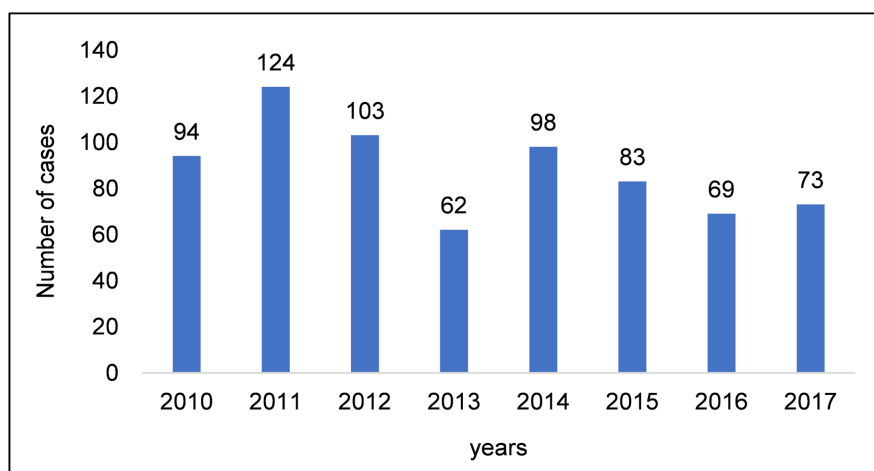


Figure 1. Annual distribution of tetanus cases diagnosed at SMIT Fann from 2010 to 2017 (n = 706).

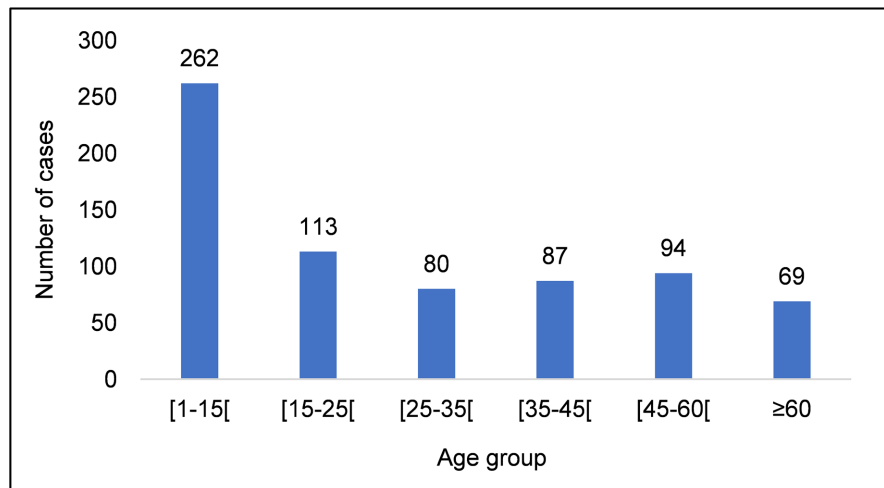


Figure 2. Distribution of tetanus patients hospitalized at SMIT de Fann from 2010 to 2017, by age group, (n = 706).

tetanus vaccination was obtained from 683 patients. Almost all patients (99.6%) did not have a vaccination record. No booster vaccination had been carried out in 87% of patients. A portal of entry was found in 672 cases (95.2%). **Table 1** summarizes the epidemiological characteristics of our patients.

3.2. Clinical Data

One hundred and seven patients (15.15%) presented at least one comorbidity. The main comorbidities were hypertension (33.6%), diabetes (18.7%), chronic otitis (18.7%) and asthma (15%). The main portal of entry was integumentary (560 cases, 83.3%). This was a recent wound in 390 cases (69.6%) and the lesion was located on the lower limbs in 362 cases (64.6%). Others main portals of entry were post-circumcision (5.7%) and otogenous (4%) as shown in **Table 2**. Tetanus was generalized in 93.9% of cases. The median duration of the incubation phase was 8 days [2 - 90 days]. The average invasion phase was 2.2 ± 2.1 days. The main signs of tetanus found were trismus (99.29%) and dysphagia (90.50%). Paroxysms were present in 500 patients (70.82%) which were predominantly tonic paroxysms (83.6%). A temperature $\geq 38.4^\circ\text{C}$ was noted in 70 patients (9.91%) and a pulse ≥ 120 beats/minute in 36 cases (**Table 3**). The stage was not specified for 11 patients and for those who were staged, (78.7% of cases) they were mostly classified as stage II according to the Dakar scoring system (**Figure 3**).

3.3. Therapeutic and Evolutionary Data

Trimming of the portal of entry (with hydrogen peroxide and antiseptic) was performed in 566 patients (84.7%). Antibiotic therapy was based on metronidazole in over half of cases (363 cases, 51.41%) and penicillin G in 283 cases (40.2%). Amoxicillin was used in 39 cases (5.5%). Anti-tetanus serotherapy was carried out in 702 patients (99.4%). It was given via sub-occipital route in 97.6%. All patients had received treatment for contractures. The drugs used for muscle

relaxant were diazepam and phenobarbital in combination (68%), followed by diazepam alone (31%). Tracheostomy was performed in 48 patients (6.79%).

During hospitalization, 226 patients (32.01%) had at least one complication. The main complications were respiratory (53.98%), infectious (45.13%) and cardiovascular (41.59%) as shown in **Table 4**.

The average delay in hospitalization was 3.6 ± 3.4 days. The mean length of hospital stay was 11.9 ± 8.2 days. One hundred and forty-eight cases (79.03%) recovered fully. Fourteen patients (1.98%) were transferred to intensive care unit.

Table 1. Distribution of tetanus patients hospitalized at SMIT de Fann from 2010 to 2017, according to epidemiological characteristics.

Epidemiological data	Frequency (n)	Percentage (%)
Sex (n = 706)		
Male	563	79.75
Female	143	20.25
Geographic origin (n = 706)		
Suburban	415	58.78
Urban	157	22.23
Rural	134	18.98
Occupation (n = 479)		
Students	115	24.00
Manual workers	106	22.12
Traders	44	9.18
Farmers	27	5.63
Unemployed	12	2.50
Manager	9	1.87
others employs	166	34.65
Vaccination status (n = 683)		
Vaccination record not available	680	99.56
Vaccination record available	3	0.44
No Booster vaccination	595	87.11
School level (n = 706)		
None	449	63.59
Primary	167	23.79
Secondary	75	10.62
University	16	2.26

Table 2. Distribution of tetanus patients hospitalized at SMIT de Fann from 2010 to 2017, by type of portal of entry (n = 672).

Type of entry point	Frequency (n)	Percentage (%)
Integumentary	560	83.3
Post-circumcision	38	5.7
Otogenic	27	4.0
Surgical	13	1.9
Dental	13	1.9
Open fracture	8	1.2
Intramuscular	7	1,0
Burns	5	0.7
Post abortum	1	0.1
Total	672	100

Table 3. Distribution of patients with tetanus hospitalized at SMIT de Fann from 2010 to 2017, by clinical signs on admission (n = 706).

Clinical signs	Frequency (n)	Percentage (%)
Incubation < 7 days	181	25.64
Incubation ≥ 7 days	525	74.36
Invasion < 48 hours	319	45.19
Invasion ≥ 48 hours	387	54.81
Trismus	701	99.29
Dysphagia	639	90.50
Tonic paroxysms	418	59.20
Tonic-clonic paroxysms	82	11.61
Temperature ≥ 38.4°C	70	9.90
Pulse ≥120/min	36	5.10

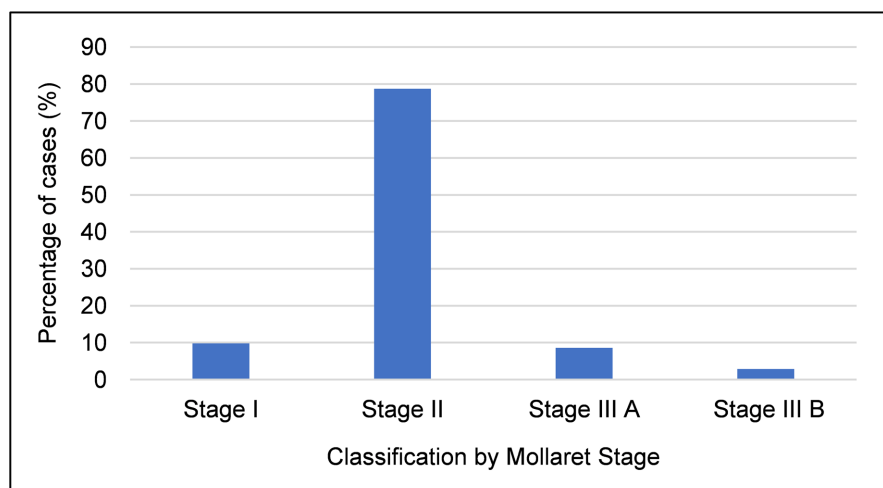
**Figure 3.** Distribution of tetanus cases hospitalized at SMIT de Fann from 2010 to 2017, by stage (n = 706).

Table 4. Distribution of tetanus cases at SMIT, from 2010 to 2017 according to the nature of complications.

Complications	Frequency (n)	Percentage (%)
Respiratory (n = 122)		
Laryngeal spasm	66	54.10
Thoracic Blockage	42	34.42
Tracheotomy	4	3.28
Other	10	8.20
Infectious (n = 102)		
Urinary infections	58	56.87
Bacteremia	19	18.63
Pulmonary infections	11	10.79
Others	14	13.72
Cardiovascular (n = 94)		
Cardiac arrest	84	89.36
Thromboembolique disease	7	7.44
Rhythm disorder	1	1.07
Other	2	2.13
Iatrogenic (n = 16)		
Hypersensitivity to sedatives	13	81.3
Hypersensitivity to antibiotics	2	12.5
Anti tetanus serum related	1	6.3
Metabolic (n = 14)		
Dehydration	7	50.00
Under-nutrition	2	14.29
Renal failure	2	14.29
Others	3	21.42
Pressure sores (n = 21)		

4. Discussion

Tetanus is a major public health problem in developing countries, where the disease still affects all age groups. Despite the existence of an effective, and completely safe vaccine, morbidity and mortality remain high. During our study period, 706 cases were recorded in the department, representing an incidence of 87 cases per 1000 hospitalized patients. There has been a steady decline in the hospital incidence of tetanus over the years. No case of neonatal tetanus was found in our study. Previous studies carried out in the same department, had found an incidence of 181 cases per 1000 hospitalized patients between 1990 and 1996 [6]. This reduction could be attributed to the improvement in the quality of care in

the department, which is the reference center, as well as the development of strategies to combat the disease such as Expanded Vaccination Program (EVP) and the vaccination of pregnant women. However, there is still work to be done.

The median age of our patients was 23 years [1 - 90 years]. Most of patients were under 15 years old, and 16% were between 15 and 25 years old. This feature of tetanus in children and young people in the department has not changed over the years, as concluded in a similar study in the department [7]. The same observations have been made in African sub-regions [8] [9]. These results can be explained by the fact that young people are more likely to suffer trauma (leading to wounds), because of their activities, and their vaccination is almost incomplete. On the other hand, elderly subjects (≥ 60 years) represented 10% of the population studied, in contrast with studies in developed countries, where tetanus is more prevalent in older people due to loss of their acquired immunity.

Males predominated, with a sex ratio of 4:1. This is not a new finding, as it has already been demonstrated in other series [7] [8] [10] [11]. This male predominance could be related to the increased risk of trauma in male patients in their professional and especially recreational activities. Furthermore, women have more opportunity to access tetanus immunization, particularly at their routine antenatal visits during pregnancy. This highlights the need for more men to receive tetanus vaccination booster shots [12].

Nearly half of our patients were students or manual workers. Similar data have been found in other studies [7] [13] [14]. These results are related to the many injuries associated with work equipment among manual workers and craftsmen. The patients were mainly from suburban areas, as described by various authors [7] [13] [14]. The high proportion of cases in suburban areas is thought to be linked to overcrowding, unfavorable socio-economic conditions with poor access to healthcare, precariousness and the existence of poor environmental hygiene and living conditions.

Tetanus booster vaccination appears to be non-existent in studies [15] [16]. Our study is no exception to this rule. Vaccination coverage was very inadequate in our series. In fact, almost all the patients did not have a vaccination record and had not received any tetanus booster dose. The same observation was made in Lagos [8]. This lack of tetanus booster vaccination could be linked to a lack of information, a lack of schooling, but also a lack of financial resources in most cases.

The main portal of entry was integumentary [7] [9] [13] [17]. Our study came to the same conclusions. The second portal of entry was circumcision. In Senegal, child circumcision is a rite of passage, both culturally and religiously. In our country, this procedure is carried out by surgeons, but mainly by nurses, sometimes even at home [18]. The often-dubious aseptic conditions in which it is performed appear to be the cause. The otogenous portal was the third most common. This portal of entry is not uncommon in tetanus [7] [19] [20]. This calls for better ENT examination of patients, and appropriate treatment of otitis.

Surgical, dental, and intramuscular portal of entry were significantly minimal in our study. This can be explained by improved surgical care procedures, with greater compliance with sero-vaccination for the surgical portal, and improved oral hygiene for the dental portal. As for the intramuscular portal of entry, this is due to the discontinuation of intramuscular injections of quinine, which were the main method of inoculation in this type of tetanus.

Occult or untraced routes of entry accounted for 4.8% of tetanus cases, a much lower proportion than that reported by Seydi *et al.* [7].

In our series, tetanus manifested itself in the generalized form described by many authors [7] [11]. Localized tetanus is not uncommon in the literature [21] [22], in our study it accounted for 6.1% of cases, a higher proportion than previously described in the same department by Soumaré *et al.* [21] and Seydi *et al.* [7].

Incubation period and duration of invasion were comparable to those found by some authors [19] [23]. It has been established that shorter the incubation and invasion periods, the more severe the tetanus. As such, incubation and invasion are prognostic classification factors in Dakar. All the classic signs of tetanus, such as trismus, contractures, and paroxysms, were present on admission. Their distribution was almost identical to that found by other authors [7] [24]. The presence of all these classic clinical signs of tetanus at the time of admission may be linked to the long clinical course of patients before their arrival at the referral department. This explains why less than half of patients were hospitalized within 48 hours of the onset of clinical symptoms.

The use of antiseptic and hydrogen peroxide was the most common. This combination acts on both the spores and the vegetative form of *Clostridium tetani*. Similarly, during treatment, antibiotic therapy was based more on metronidazole than on amoxicillin and penicillin G. This was due to the unavailability of injectable amoxicillin and the discontinuation of penicillin G in our country. In addition, metronidazole appears to be more effective than penicillin G, which has a GABA antagonist effect and may exacerbate symptoms [25]. In the department, intrathecal injection of 250 IU of tetanus immunoglobulin is preferred and has been for many years [26]. The lower doses used in our department would limit serotherapy accidents. Intrathecal heterologous tetanus serum is much more widely used in Senegal and Ivory Coast because of its superiority and lower cost [27], whereas in other countries the high-dose intramuscular route is preferred [11] [28]. None of the patients had been placed on assisted ventilation and tracheotomy was performed in 48 patients because of laryngeal spasm or thoracic blockage.

Sedative treatment was mainly based on a combination of diazepam and phenobarbital, which would control contractures due to their GABA agonist action. At present, there is no consensual treatment, particularly for neuromuscular blockade. Curariform drugs or intrathecal baclofen may be used; however, in the absence of an intensive care unit, they are not used in our department.

On admission, Mollaret stage II predominated, as previously described in other studies [7]. The average length of hospital stay was less than previously recorded in the same department [7], in Ivory Coast [29], Congo [9] and Mali [17].

Complications occurred in at least a third of cases, which is much higher than previous data [7]. These complications were mainly respiratory and infectious, as described in the literature [7]. They can be life-threatening in the short term, especially in the first 48 hours. Thoracic blockage and glottic spasm, with the risk of sudden death from anoxia, remain the worst fears of practitioners. They can occur at any time, but especially during the phase of generalization of contractures with the onset of paroxysms. Tracheostomy remains the treatment of choice to prevent these respiratory accidents. Episodes of desaturation, may also occur during tonic-clonic paroxysms, leading to cardiac arrests.

The case fatality rate was 18.98%. Previously, in the same department Seydi et al reported a lethality rate of 22% [7]. In the sub-region, most studies showed a lethality rate between 31 and 82% [7] [9] [11] [14] [17].

The main risk factors for death in the ward were advanced age, at least stage II tetanus, Dakar score ≥ 3 and the presence of complications, particularly cardiovascular [12] [13]. In addition to these factors, other factors have also been identified in studies. These include a short incubation and invasion period, presentation in the form of generalized tetanus, absence of post-exposure prophylaxis, the presence of an intramuscular or integumentary portal of entry and the APACHE II score [8] [9] [11] [30] [31]. Our study should be completed to identify factors predictive of death.

5. Constraints

We were faced with several difficulties related to the retrospective nature of this work:

- inadequate archiving for the years 2010 to 2015, which resulted in a few files not being found;
- the lack of information for certain variables.

6. Conclusion

Tetanus is a serious disease, but can be prevented by vaccination. In our country, most of cases occur in children and adolescents. Despite the decline in cases over the years, tetanus remains a public health problem because of its prevalence, severity, and lethality. The eradication of juvenile and adult tetanus requires its inclusion in the integrated disease surveillance and response system, and greater adherence by the population to the Expanded Vaccination Program (EVP), with particular emphasis on booster vaccinations.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Standardized Form

1.1. Socio-Demographic Data

- 1) Year of admission: _____
- 2) Record patient number _____
- 3) Age: _____
- 4) Sex: Female Male
- 5) Geographic Origin: Urban Suburban Rural
- 6) Marital status: Married Single Widowed
 Divorced Unspecified
- 7) Occupation: Manager Manuel workers Farmers
 Trader Student Other
- 8) School level: Primary Secondary University
 None
- 9) Length of hospitalization (days): _____

1.2. Epidemiological Data

- 1) Vaccination record: available not available
- 2) Anti-tetanus vaccine: yes no
- 3) Number of anti-tetanus vaccine: 0 1 2 3
- 4) Entry point: found not found
- 5) Integumentary: yes no
- 6) Dental: yes no
- 7) Open fracture: yes no
- 8) Intramuscular: yes no
- 9) Post abortum: yes no
- 10) Surgical yes no
- 11) Burn yes no
- 12) Post circumcision: yes no
- 13) Other point of entry: _____

1.3. Clinical Data

- 1) Comorbidity: yes no
- 2) Type of comorbidity: Diabetes Hypertension Obesity
 Other
- 3) Tetanus form: generalized localized
- 4) Duration of incubation (days): _____
- 5) Duration of invasion (days): _____
- 6) Trismus: yes no
- 7) Dysphagia: yes no
- 8) Temperature (°C): _____
- 9) Pulse (bat/min): _____
- 10) Paroxysms: yes no
- 11) Type of paroxysms: Tonics Tonic-clonics

1.4. Therapeutic Data

- | | | |
|---|--------------|---------------------------------------|
| 1) Contracture treatment: | yes | no |
| 2) Type of contracture treatment: | Diazepam | Phenobarbital
others |
| 3) Trimming of entry point: | yes | no |
| 4) Product of trimming: | Dakin | Eau oxygénée
Dakin et eau oxygénée |
| 5) Antibiotic therapy: | Pénicillin G | Métronidazole
Amoxicilline other |
| 6) Anti-tetanus vaccine: | yes | no |
| 7) Anti-tetanus serum: | yes | no |
| 8) Anti-tetanus serum dose (International unity): | _____ | |
| 9) Tracheotomy: | yes | no |

1.5. Prognostic Data

- | | | | | | | |
|--------------------|-------------|----------|-------------|---|---|---|
| 1) Mollaret Stage: | Stage I | Stage II | Stage III A | | | |
| | Stage III B | | | | | |
| 2) Dakar Score: | 1 | 2 | 3 | 4 | 5 | 6 |

1.6. Evolutionary Data

- | | | | | |
|---|-------------------------------|------------------|---------------|---------------------------------|
| | Recovery | Transfer | Death | |
| 1) Complications: | | | yes | no |
| 2) Respiratory complications: | | | yes | no |
| • Type of respiratory complications: | | | | |
| | laryngeal spasm | thoracic | Blockage | tracheotomy related. |
| 3) Cardiovascular complications: | | | yes | no |
| • Type of cardiovascular complications: | | | | |
| | cardiac arrest | rythme disorders | | thromboembolique disease |
| | others | | | |
| 4) Infectious complications: | | | yes | no |
| • Type of infectious complications: | | | | |
| | Urinary | Pulmonary | bacteremia | others |
| 5) Metabolic: | | yes | no | |
| • Type of metabolic complications: | | | | |
| | Dehydration | undernutrition | Renal failure | others |
| 6) Pressure sores: | yes | | no | |
| 7) Iatrogenic: | yes | | no | |
| • Type of iatrogenic complications: | | | | |
| | Hypersensitivity to sedatives | | | Hypersensitivity to antibiotics |
| | Anti tetanus serum related. | | | |