Scholars Journal of Medical Case Reports
Abbreviated Key Title: Sch J Med Case Rep
ISSN 2347-9507 (Print) | ISSN 2347-6559 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Surgery

Paraclinical, Therapeutic and Evolutive Profiles of Leg Injuries by Firearms in Kisangani in the Democratic Republic of the Congo (DRC)

Munsense Tshiyombo Wa Tshiaba Ralph Christophe[1,2,8], Kanyinda Ciamala Felly[1,5], Ngoy Safi Judith[2], Amini Kangali Urbain[1,3], Lukwamirwe Vahamwiti Aimé[6], Bwini Dianaben Asaph[1,7], Adipepe Bekale Flavien Luc[1,4], Tshimbila Kabangu Jean-Marie Vianey[1,4]

[1]University of Kisangani, Faculty of Medicine and Pharmacy, Department of Surgery, Democratic Republic of the Congo
[2]Military Hospital of the Third Defense Zone (HM3ZDef), Kisangani, Democratic Republic of the Congo
[3]Military Reference Health Center of the Lokosa Training Center, Kisangani, Democratic Republic of the Congo
[4]Professor of Surgery at the Faculty of Medicine and Pharmacy, University of Kisangani, Democratic Republic of the Congo
[5]Official University of Mbuji-Mayi, Mbuji-Mayi, Democratic Republic of the Congo
[6]Graben Catholic University of Butembo (UCG), Butembo, Democratic Republic of the Congo
[7]University of Kikwit, Kikwit, Democratic Republic of the Congo
[8]Military Health Corps of the Armed Forces of the Democratic Republic of the Congo

DOI: https://doi.org/10.36347/sjmcr.2025.v13i04.008 | **Received:** 27.02.2025 | **Accepted:** 04.04.2025 | **Published:** 08.04.2025

***Corresponding author:** Munsense Tshiyombo
University of Kisangani, Faculty of Medicine and Pharmacy, Department of Surgery, Democratic Republic of the Congo

Abstract **Original Research Article**

This article presents the paraclinical, therapeutic, and evolutive aspects of firearm leg injuries recorded in referral hospitals in the city of Kisangani, Democratic Republic of the Congo (DRC), over a period of 5 years. Firearm leg injuries are no longer the preserve of wars. Indeed, today, they are frequently found in civilian practice, affecting the most disadvantaged social classes, thus paying the heaviest price. They are responsible for a considerable financial burden for society, amounting to billions of dollars, in addition to the several disabilities of the locomotor system they cause. The objective of this work is to identify the paraclinical, therapeutic, and developmental aspects of traumatic firearm leg injuries in Kisangani. ***Methods*:** This was a retrospective study conducted in six referral hospitals in Kisangani. The sample consisted of 117 injured patients with documented firearm leg injuries. Our data collection technique was a document analysis of patient medical records. These data were entered using Excel 2013 and then imported into IBM SPSS version 20 for analysis. ***Results*:** From January 2019 to December 2023, we recorded 3572 trauma patients, including 308 patients with ballistic trauma, representing a hospital incidence of 8.62% of cases, and 117 cases of ballistic leg trauma, representing 37.99%. The prevalence was male (76%), representing a sex ratio of 3:1 in favor of males. The 22-32 age group was the most common, representing 49.57% of cases. The average age of our injured was 29.88 years with a standard deviation of 12.28 and extremes minimum 7 years and maximum 78 years. Pupils and students were the majority (29.06%). Most patients came from the Urban-rural commune of Lubunga. The majority of injured were of secondary education level (45%) and 45.30% had been injured on the street. The fight between law enforcement officers and the civilian population caused the largest number of injured (29.1%). The majority of injured were admitted within 6 hours of the trauma (73%). The most used means for evacuating the injured is transport by motorcycle (72.65%). Of this study, 88.03% performed the emergency hematology examinations requested, and the standard X-ray of two leg bones with two incidences, face and profile in 70.09%. It was the injured in category I who were most resuscitated in 51.3% and general anesthesia using ketamine was the most administered in 76.9%. The majority of the injured (62.39%) had received antitetanus serum on arrival followed by the tetanus vaccine. This study showed that group I antibiotics were most used in the injured in 36.75%. The majority of the injured had temporarily benefited from surgical debridement without primary suture of the wound followed by immobilization of the leg on a posterior plaster splint in 55.56%. The definitive treatment consisted of continuous transcalcaneal traction in 59.83%. And the majority of care was provided by general practitioners in 56.41%. The majority of fractures consolidated beyond 22 weeks in 59.42%. The most observed long-term complication was delayed consolidation in 35.04%. In their evolution, the majority of injured patients were cured without significant functional sequelae (42.74%). The majority of the injured (49.57%) had spent more than 4 months in the hospital, with an average stay of 54.38 days. ***Conclusion*:** Firearm leg injuries pose a serious public health problem in civilian practice, with medical personnel unfamiliar with military emergencies in developing countries due to their increasing frequency, their high cost of care, and the disabling complications they cause, in correlation with a severely deteriorating socioeconomic environment. Hence the importance of continuing training for all civilian medical personnel in ballistics.

Keywords: Leg Injuries, Firearms, Paraclinical, Therapeutic.

INTRODUCTION

Firearm injuries are the result of the penetration of a projectile (bullet, pellet) or a metal fragment from the casing or contents of an explosive device (grenade, mine, shell, bomb) into the body. Due to their profession, military personnel are particularly concerned by the issue of firearm injuries [1, 2].

Firearm leg injuries are more frequently encountered in modern conflicts, even among military personnel equipped with fragmentation vests that leave their limbs exposed. These injuries are characterized by their hyperseptic nature [3]. They constitute a real public health problem in several countries, especially developing ones [4].

War surgery differs from peacetime surgery due to the context, the type of injuries (multiple wounding agents), and the treatments. As such, war surgery remains an emergency specialty [5].

In civilian practice, the availability of complementary exploration resources allows for the establishment of genuine diagnostic strategies and the adoption of a non-surgical approach to certain injuries. While there is a consensus on intraoperative resuscitation of the bleeding casualty, the preoperative strategy is not unequivocal. Leg injuries are the most common in wartime. Complex fractures pose difficult management problems. While hemorrhage is the leading cause of early death, infection is the second most common, starting as early as twenty-four hours. Prevention of this infection is crucial [5]. Firearm leg injuries most often occur in the context of multiple injuries (10-30% of cases), multiple limb screening, multiple aggression, multiple trauma or complex injuries [5].

They therefore frequently pose both a problem in terms of soft tissue treatment and fracture fixation; they affect functional prognosis, and life-threatening injuries can occur due to associated injuries [6, 7 and 8]. External fixation remains the method of choice in the treatment of open fractures of ballistic origin [4, 9 and 10].

The management of firearm trauma remains multidisciplinary, involving anesthesiologists, resuscitators, surgeons, radiologists, and paramedical staff. Firearm injuries of the legs represent a particular challenge for any surgeon in general, due to the potential simultaneous penetration of several compartments (soft tissue, bone tissue), the diagnosis of their involvement, and surgical management if necessary.

Data from the epidemiological surveillance of the armed forces from 2004 to 2010 show that the most common injuries were to the limbs, with 36.3% of leg injuries [11].

Within the French cohort during its military intervention in Afghanistan, the main anatomical region affected was also the limbs in 67.1%, including 42% of leg injuries. And a study conducted in Brussels in 2017 by FABECK L. et al., concluded that with regard to limb gunshot wounds; isolated leg wounds occupied second place with 20% of cases (after those of the thigh) and 36% concerned tibia fractures [12].

Djoubalo Traore, in his study conducted in Mali from 2012-2019, found that among the etiologies of leg fractures, those by firearms represented a significant frequency of 8.10% [13]. Also in Mali in 2022, leg injuries by firearms represented 15.9% [14]. In Madagascar, the leg injuries from firearms recorded in 2008 were not negligible and represented 18.51% of ballistic trauma [10].

Over the past three decades, our country, the Democratic Republic of Congo (DRC), has been and is the scene of conflicts of all kinds, resulting in the increased and uncontrolled use and circulation of firearms, with a resurgence in the number of victims; a situation that has not spared the various cities of the country.

Thus, in Bukavu, one of the cities in the east of the DRC in the grip of war; KIKOBIA et al., after their research conducted in 2012, found 28.3% of firearm fractures involving the leg bones [15]. And in Lubumbashi, studies conducted by ILUNGA et al., between 2018 and 2019 found 6.82% of leg bone fractures of ballistic origin [16]. The city of Kisangani is not spared, after having been the epicentre of the permanent armed clashes between the Ugandan and Rwandan armies, continues to experience the phenomenon of armed bandits resulting in daily victims. These constitute a particular group of civilians wounded by firearms outside of war; who are generally treated in the various large health structures of Kisangani.

Based on this study, we aimed to identify the strategies implemented by surgical and intensive care teams in terms of paraclinical and therapeutic management, in order to propose coherent decision trees adapted to the organization of care in hospitals in the city of Kisangani.

This leads us to ask the following questions:

- What are the paraclinical methods and strategies for managing firearm leg injuries in Kisangani, and what are the modalities of their evolution after treatment?

We therefore set the following objectives:

General Objective: To identify strategies for improving the management of firearm leg injuries in civilian practice in Kisangani.

Specific Objectives:

To analyze the paraclinical and therapeutic methods applied in the management of these injuries; To establish the progression of firearm leg injuries in Kisangani; Implement a decision logarithm for the management of leg injuries caused by firearms.

PATIENTS AND METHODOLOGY

Our study was multicenter and was conducted successively in the Surgery Department of the University Clinics of Kisangani (CUKIS), in the General Surgery Departments of the General Referral Hospitals of MAKISO/KISANGANI, LUBUNGA, and KABONDO, the Military Referral Hospital of the Third Defense Zone of Kisangani (HM3ZDef), and the Military Referral Health Center of the LOKOSA Training Center. We collected 308 patients with firearm trauma of any kind admitted to these departments, including 117 with firearm leg injuries, thus constituting our sample.

This was a retrospective, descriptive and cross-sectional study carried out over a period of five years (January 1, 2019 to December 31, 2023). With an exhaustive sample (consisting of all patients with ballistic leg trauma during this study period). The minimum sample size was calculated by the SCHWATZ formula: $N= t^2.p(1-p)/M^2$ where N= Sample size, t= 95% confidence interval (standard value of 1.96), M= 5% margin of error (standard value 0.05), p= Estimated prevalence of leg wounds by firearms in BAMAKO which is 8.10% according to a study conducted by DJOUBALO Traoré [13]. This prevalence was chosen because the study of this author had been conducted under conditions similar to ours. That is, Bamako is a city plagued by terrorism and armed banditry. Therefore, the minimum sample size calculated was 112 patients.

Our study included all trauma patients with isolated or associated firearm leg injuries, admitted, treated, and followed up in the aforementioned hospitals, and those with complete records including anamnestic and clinical data defining a firearm leg injury. Not all patients admitted during the study period for ballistic trauma without firearm leg injuries and with incomplete medical records were included in this study.

Our data collection technique was a document analysis. Data were collected from patient medical records, consultation records, surgical reports, anesthesiologist reports, and hospitalization reports from the wards.

Each patient had a file containing all administrative, clinical, diagnostic, and therapeutic data. The information collected was entered on individual survey forms. Given the retrospective nature of the study, we did not conduct a patient review for evaluation. Data entry and analysis were performed using IBM SPSS version 20 software.

Word processing and spreadsheets were created using Microsoft Word 2017 and Excel 2017, respectively. We calculated the frequency, mean, and standard deviation.

RESULTS

1. Paraclinical Aspects

Table I shows that 88.03% of patients underwent the emergency hematology tests (hemoglobin, hematocrit, blood type, and Rh factor). Regarding imaging tests, the majority of the injured had performed standard X-rays of two leg bones with two views, frontal and lateral, with 82 cases, or 70.09% (Table I).

2. Therapeutic Aspects

Table II shows that Category I injured patients were the most resuscitated, with 60 cases, or 51.3%, and general anesthesia using ketamine was the most commonly administered, with 90 cases, or 76.9%.

The majority of the injured, with 73 cases, or 62.39%, had received antitetanus serum upon arrival, followed by tetanus vaccination (Table III). This study showed that group I antibiotics were the most commonly used in the injured population, accounting for 36.75% of the cases (Table IV).

The majority of the injured population received temporary surgical debridement without primary suture of the wound, followed by immobilization of the leg in a posterior cast in 65 cases, or 55.56% (Table V).

Table VI shows that the most commonly used definitive treatment consisted of continuous transcalcaneal traction, with 70 cases, or 59.83%.

The majority of care was provided by general practitioners, with 66 cases, or 56.41% (Table VII).
The majority of fractures healed after 22 weeks, with 41 cases, or 59.42% (Table VIII).

3. Progression Aspects

Table IX shows that the most observed long-term complication was delayed union, with 41 cases, or 35.04%.

Over the course of their progression, the majority of injured patients recovered without significant functional sequelae, with 50 cases, or 42.74% (Table X).

The majority of injured patients, with 58 cases, or 49.57%, had spent more than 4 months in the hospital, with an average stay of 54.38 days (Table XI).

Table I: Distribution of patients according to the hematological tests performed.

Paraclinic	Frequency	Percentage
Hematology (Hb, Hct, GS et Rh)		
Yes	103	88,03
No	14	11,97
X-ray (Front and profil)		
Yes	82	70,09
NO	35	29,91
Total	117	100

Hb: Hemoglobin, Hct: Hematocrit, GS and Rh: Blood group and Rhesus factor.

Table II: Distribution of injured according to the resuscitation and anesthesia received.

Drugs	Frequency	Percentage
Resuscitation		
Catégory I(*)	60	51,3
Catégory II(**)	25	21,4
Catégory III(***)	15	12,8
Catégory IV(****)	17	14,5
Type of anesthesia used		
Ketamine	90	76,9
Lidocaine	24	20,5
Spinal anesthesia	3	2,6
Total	117	100
(*): Transfusion, infusion, antibiotic, analgesic and/or venotropic (**): Infusion, antibiotic, analgesic (***): Antibiotics alone (****): Without resuscitation.		

Table III: Distribution of injured persons according to the administration of tetanus serum and/or vaccine.

Prophylaxis	Frequency	Percentage
TS(*) alone	43	36,75
TS and TV (**)	73	62,39
Neither TS or TV	1	0,85
Total	117	100

(*): Tetanus serum, (**): Tetanus Vaccine.

Table IV: Distribution of Injured Patients by Antibiotic Treatment.

Antibiotic Therapy	Frequency	Percentage
Group I(*)	43	36,75
Group II(**)	42	35,90
Group III(***)	20	17,09
Group IV (****)	12	10,26
Total	117	100
(*): Ampicillin, Gentamycin, Metronidazole (**): Ceftriaxone, Metronidazole (****): Without antibiotic therapy.		

Table V: Distribution of wounded according to provisional procedures performed

Provisional procedure	Frequency	Percentage
Debridement with primary wound suture	20	17,09
Debridement without primary wound suture and posterior plaster splint	65	55,56
Simple dressing without immobilization	14	11,97
Debridement + projectile removal	15	12,82
Surgical amputation	3	2,56
Total	117	100

Table VI: Distribution of Injuries by Final Procedure Performed

Final procedure	Frequency	Percentage
Transcalcaneal Traction	70	59,83
Traction then Cast	15	12,82
Bone Curettage	1	0,85
External Fixator	6	5,13
Simple Dressing	4	3,42
Cross-Pedal Cast	17	14,53
None	4	3,42
Total	117	100

Table VII: Distribution of Injuries by Healthcare Provider

Providers	Frequency	Percentage
General Practitioner	66	56,4
Specialist Assistant	46	39,3
Surgical Specialist	2	1,7
Nurse	3	2,6
Total	117	100

Table VIII: Distribution of Injuries by the time taken for fractures to heal (N=69)

Time (Weeks)	Frequency	Percentage
12-16	20	17,09
17-21	8	6,84
More than 22	41	59,42
Total	69	100

Table IX: Distribution of Injured Patients by Complications

Complications	Frequency	Percentage
EARLY		
Hemorrhage accompanied by anemia	34	29,06
B. MEDIUM OR LONG TERM		
Wound Suppuration	20	17,09
Amputation	3	2,56
Gangrene	3	2,56
External popliteal sciatica	2	1,71
Delayed Union	41	35,04
Osteitis	1	0,85
None	13	11,11
Total	117	100

Table X: Distribution of injured patients by outcome

Outcome	Frequency	Percentage
Recovered with limp	26	22,22
Recovered without sequelae	50	42,74
Escaped	18	10,17
Lost to follow-up	21	17,95
Death	2	1,71
Total	117	100

Table XI: Distribution of patients by hospital stay

Stay (Months)	Frequency	Percentage
1-2	19	16,24
3-4	40	22,60
More than 5	58	49,57
Total	117	100

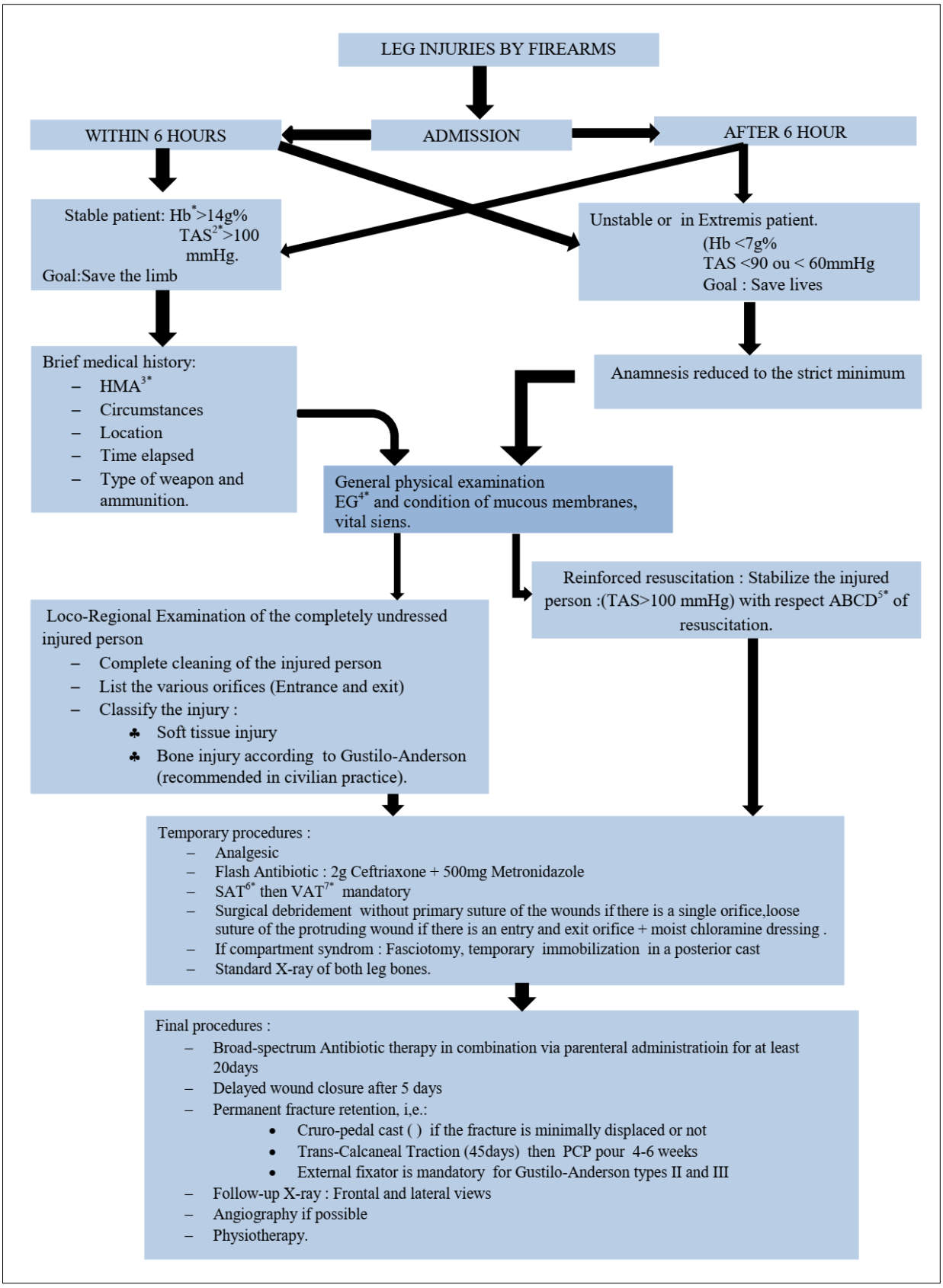

Figure 1: Logarithm of treatment for a firearm leg injury.

Hemoglobin,[2]: Systolic blood pressure,[3*]: History of present illness,[4*]: General condition,[5*] : ABCD resuscicitation,[6*] : Antitetanus serum,[7*]: Tetanus vaccine.

DISCUSSIONS

It should be noted that for this chapter, the sociodemographic, ballistic, pathological, and clinical aspects were the subject of another previously published article and therefore will not be included in this discussion.

1. PARACLINICAL ASPECTS

✓ Paraclinical Examinations

Table I shows that 88.03% of patients underwent the requested emergency hematology tests. The majority of injured patients had standard X-rays of two leg bones with two views, anteroposterior and lateral, with 82 cases, or 70.09%.

According to BRUNER, Bone injuries suspected on clinical examination should be reduced and stabilized as soon as possible. X-rays in two orthogonal views should be performed, regardless of hemodynamic stability, to demonstrate a fracture and the presence of a metallic foreign body [17]. This is consistent with literature data that require an X-ray for all gunshot wounds, even if there is no exit orifice.

2. THERAPEUTIC ASPECTS

The management of a patient injured by a gunshot begins, as for all trauma patients, following the ATLS protocol [17, 18, and 19]. One of the most important points is a complete examination of the patient, looking for all existing wounds [20]. Because gunshot wounds are frequently multiple, as in a quarter of the cases in our series. For stable patients, the history can be more detailed, including, among other things, the type of weapon used, the shooting distance, and the number of shots heard, in order to guide the clinician in assessing the number and extent of internal injuries [21].

As a reminder, a handgun can cause considerable damage despite the low velocity of its projectile, depending on the shooting distance and the loss of velocity of the projectile in flight.

✓ Resuscitation and Anesthesia

Table II shows that Category I casualties were the most frequently resuscitated, with 60 cases, or 51.3%, and that general anesthesia using ketamine was the most commonly administered, with 90 cases, or 76.9%.

This is likely due to the fact that firearm leg injuries most often occur in a context of multiple trauma, requiring medical personnel to urgently stabilize the casualty's hemodynamic status and then administer general anesthesia for the remainder of the care.

✓ Tetanus Prophylaxis

The majority of the injured, with 73 cases or 62.39%, had received antitetanus serum followed by tetanus vaccination. Tetanus prophylaxis should be administered to all patients who are unvaccinated or whose vaccination status is unknown [18-20].

This is likely due to the strict adherence of the city's hospitals to tetanus prevention.

✓ Antibiotic Therapy for at Least 20 Days and Analgesia

This study showed that group I antibiotics were the most commonly used in the injured, accounting for 36.75% of the patients (Table IV). Analgesia consisted mainly of paracetamol, ibuprofen, and tramadol.

Antibiotic therapy recommended for ballistic trauma remains controversial. It is essential for high-energy trauma with extensive tissue damage [22, 23], for intra-articular locations, extensively contaminated wounds and fractures, regardless of the transmitted energy [24]. A first-generation cephalosporin is recommended for at least 48 hours intravenously, combined with penicillin in cases of obvious contamination or gentamicin [23], if the lesions are extensive [22]. For low-energy trauma without fracture, antibiotic therapy does not appear to be essential [17-22]. Certain risk factors such as delayed wound management or inadequate care, a wound larger than 2 cm, obvious contamination, poor patient compliance, diabetes or vascular lesions, may require antibiotic therapy, preferably broad-spectrum, either intravenous or per os [17].

✓ Temporary Surgical Treatment

The majority of injured patients underwent temporary surgical debridement without primary wound closure followed by leg immobilization in a posterior cast in 65 cases, or 55.56%.

The two pillars of anti-infective treatment are high-quality debridement and antibiotic therapy [23]. High-energy trauma, with or without fracture, requires extensive debridement of bone fragments and devitalized soft tissue, as well as foreign bodies, with copious lavage with saline [20, 22, 25 and 26].

An exception may be made for low-energy wounds, small in extent, distant from joints, without fracture or obvious contamination, which can be treated with minimal debridement and irrigation [17-22]. Primary closure is not recommended in both cases to allow natural wound drainage [17-25]. Our therapeutic approach in this study could be explained by the significant infectious risk of firearm wounds which are always considered contaminated and the commitment of orthopedic surgeons.

✓ **Definitive Surgical Treatment**

Table VI shows that the most commonly used definitive treatment consisted of continuous transcalcaneal traction, with 70 cases, or 59.83%.

External fixation is the preferred method of osteosynthesis in cases of open fractures of long bones. It is also used in cases of comminuted fractures associated with extensively destroyed soft tissue (high energy transfer from a hunting weapon, large-caliber pistol) [19-27].

Prophylactic fasciotomy is also indicated to prevent compartment syndrome [18-22].

Low-energy trauma from low-velocity projectiles (small-caliber pistols) presents less extensive lesions and is commonly treated as closed fractures, depending on their stability [17-23], without systematic fasciotomy [17-28]. Stable non-comminuted fractures can be treated conservatively [19-22].

For unstable fractures with small wounds, in a civilian environment less contaminated than a battlefield [19-23], primary fixation by intramedullary nail is also valid [20-26].

✓ **Healthcare Providers**

The majority of care was provided by general practitioners, with 66 cases, or 56.41% (Table VII).

This is likely due to the rigor observed in the management of these injuries and the fact that all of the hospitals attended by the injured are secondary hospitals, and therefore run primarily by general practitioners.

✓ **Fracture Healing Time**

The majority of fractures healed after 22 weeks, with 41 cases, or 59.42%.

This is likely explained by a delayed healing observed in the progression of these fractures.

3. EVOLUTIVE ASPECTS

✓ **Complications**

This table shows that the most observed long-term complication is delayed healing, with 41 cases, or 35.04%.

This is likely explained by the use of less effective restraints for these complex (communicative) fractures.

✓ **Outcome**

The majority of the injured patients recovered without functional sequelae, with 50 cases, or 42.74%.

This could be explained by careful debridement, good reduction with cast retention, and good patient follow-up.

✓ **Stay**

The majority of the injured patients, with 58 cases, or 49.57%, had spent more than 4 months in the hospital.

This could be linked not only to the observed delay in bone healing but also to the precarious socioeconomic conditions of these trauma patients, preventing them from meeting their financial obligations to the hospitals.

CONCLUSION

Gunshot injuries to the legs pose a public health problem and constitute a daily and alarming concern in the Democratic Republic of Congo and other developing countries. They represent a significant reason for emergency trauma surgery visits in hospitals in rebel-occupied Congolese cities, given their increasing frequency and potential severity.

Their initial care is essential. It must be multidisciplinary, involving medical, surgical, and radiological teams with maximum resources. Conservative treatment plays a key role in therapeutic management. The technical platform must be comprehensive and permanently accessible to teams dedicated to emergency management. The ultrasound-CT combination is of great value in the assessment of injuries. In cases of limited resources, the receiving team must decide on a rescue intervention to ensure the secondary transfer of the patient in the best conditions to centers equipped and prepared to receive these trauma patients for definitive treatment. In our context, the difficulties of optimal care are often linked to transfer conditions related to insecurity, which are not always up to date and at the limit of care resources.

Funding: This is a self-funded study.

Conflict of Interest: The authors declare no conflict of interest regarding the writing of this article.

BIBLIOGRAPHY

1. Daghfous A., Bouzaïdi K., Abdelkefi M., Rebai S., Zoghlemi A., Mbarek M., Rezgui L., Marhoul. Apport De L'imagerie Dans La Prise En Charge Initiale Des Traumatismes Balistiques; Journal De Radiologie Diagnostique Et Interventionnelle ; Volume 96, 2015.
2. Haus-Cheymola R, Bouguerra C, Mayorga E, Nivoixb P, Pratc N, Verreta C, .Durona S, Mayeta A, Meynarda J-B, Pommier De Santib V, Decamb C, Ponsd F, Migliania R. Blessures Par Arme A Feu Et Engins Explosifs Dans Les Armées. Résultats De La Surveillance Epidémiologique De 2004 A 2008, 2010
3. Gunepin Mc François-Xavier : Traumatismes Des Membres Et Des Parties Molles, Conduite A Tenir Devant Une Plaie Des Parties Molles, Ecole Du Val-De-Grace, Clermont, France, 2010

4. Diallo S, Tambassi Si, Sangare As, Traore T, Arachtane O, Bore B, Bagaysogo Dk Et Al. : Prise En Charge Des Traumatismes Balistiques Des Membres A L'hôpital Régional De Gao Au Mali, Health Sci. Dis: Vol 24 (06) June 2023.Pp 62-66
5. Rigal Mcs S. : Lésions Par Explosion De Mines Antipersonnel, Cachirmex - Module 2/2 - Juin 2010
6. Jacques Barsotti, Jean Cancel, Christian Robert, Guide Pratique De Traumatologie, Elsevier Masson, 2010.
7. P. Thoreux, T. Begue, A.-C. Masquelet : Fractures Fermées De Jambe De L'adulte.Emc, Appareil Locomoteur,14-086-A-10-2007 :P2, 3, 4, 5
8. Court-Brown Cm, Bugler Ke, Clement Nd, Duckworth Ad, Mcqueen Mm. The Epidemiology of Open Fractures in Adults. A 15-Year Review. Injury. 2012 Jun; 43(6):891-7]
9. Rigal S. : Chirurgie Militaire Et Blessés Des Membres : Service De Chirurgie Orthopédique Et Traumatologique, Ia Percy, 101 Avenue Henri Barbusse, 92141 Clamart Cedex, Médecine Et Armées. 2008.
10. Randriambololona Ra, Rabemazava A, Razafimahatratra R, Solofomalala Gd : Les Plaies Par Balle Vues Au Centre Hospitalier Universitaire De Fianarantsoa, Service D'orthopédie Traumatologie Chu De Fianarantsoa, Madagascar, 2007-2008
11. Rigal S., Mathieu L. : Damage control orthopédique de guerre des lésions des membres. Réflexions sur l'expérience du service de santé des armées français, Journal Européen des Urgences et de Réanimation, March 2021, Pages 46-55
12. Fabeck L., Hock N.,Goffin J.,Ngatchou W. : notions de balistique et prise en charge des plaies par balle au niveau des membres,Rev Med Brux,Bruxelles,2017 ;38 :474-81
13. Djoubalo traoré : Fractures ouvertes de jambe à l'hopital Somine Dolo de Mopti, Bibliosante.ml, Bamako, 2019.
14. Moussa A K, Bagayoko T B, Touré L, Diallo M, Traoré M B, Kanikomo D, Django D M. : Lesions De L'appareil Locomoteur Par Agressions Physiques Au Centre Hospitalier Universitaire Gabriel Toure,Jcsm,Bamako, 2022
15. Kikobya Sambili D., Kabinda Maotelas J. ,Munyanga Mukungo : Profil épidémiologique et facteurs associés aux complications des fractures ouvertes des membres par arme à feu. A propos de 184 cas admis à l'hôpital militaire régional de Bukavu, du 1er janvier au 31 décembre 2012, en République Démocratique du Congo, Revue internationale des services de santé des forces armées ; Vol 89/2, 2015
16. Manix Ilunga Banza, Igor Mujinga Wa Mujinga, Dimitri Kanayanda Nafatalewa, Trésor Kibangula Kasanga, Augustin Kibonge Mukakala, Serge Ngoie Yumba, Emmy Manda Kisimba, Mylord Kambu Ngoma And Danny Ndua Kapend : Fracture ouvertes des os de la jambe : Profil épidémiologique, clinique et thérapeutique aux cliniques universitaires de Lubumbashi. De Janvier 2018 à Decembre 2020, IJAR 2022; 8(8): 274-282
17. Bruner D, Gustafson CG, Visintainer C. Ballistic injuries in the emergency department. Emerg Med Pract.2011;13(12):1-30
18. Russell R, Clasper J, Jenner B, Hodgetts TJ, Mahoney PF. Ballistic injury. BMJ. 2014; 348:g1143
19. Clasper J. The interaction of projectiles with tissues and the management of sballistic fractures. J R Army Med Corps. 2001;147(1): 52-61.)
20. Versier G, Ollat D. Blessures es membres et du rachis par projectiles. EMC - Rhumatologie-Orthopédie 2005;2(3):262-75 , Volgas DA, Stannard JP, Alonso JE. Current orthopaedic treatment of ballistic injuries. Injury. 2005;36(3):380
21. Van Waes, O.J.F., Van Lieshout, E.M.M., Hogendoorn, W., Halm, J.A. and Vermeulen, J. (2013) Treatment of Penetrating Trauma of the Extremities: Ten Years' Experience at a Dutch Level 1 Trauma Center. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 14, Article 2.
22. Lichte P, Oberbeck R, Binnebösel M, Wildenauer R, Pape H-C, Kobbe P. A civilian perspective on ballistic trauma and gunshot injuries. Scand J Trauma Resusc Emerg Med. 2010;17:18-35,
23. Seng VS, Masquelet AC. Management of civilian ballistic fractures. Orthop Traumatol Surg Res. 2013;99(8):953-8.)
24. Simpson BM, Wilson RH, Grant RE. Antibiotic therapy in gunshot wound injuries. Clin Orthop Relat Res. 2003;(408):82-5.
25. Volgas DA, Stannard JP, Alonso JE. Current orthopaedic treatment of ballistic injuries. Injury. 2005;36(3):380-6.
26. Hollmann MW, Horowitz M. Femoral fractures secondary to low velocity missiles: treatment with delayed intramedullary fixation. J Orthop Trauma. 1990;4(1):64 9.
27. Hildebrand F, Giannoudis P, Kretteck C, Pape HC. Damage control: extremities. Injury. 2004;35(7):678-89.
28. Franz RW, Shah KJ, Halaharvi D, Franz ET, Hartman JF, Wright ML. A 5-years review of management of lower extremity arterial injuries at an urban level I trauma center. J Vasc Surg. 2011;53 (6):1604-10.)