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Cardiac Wounds: A Seven-Case Series from the University Teaching Hospital of Bouaké, Côte d'Ivoire

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Abstract

Background and Objective: The Cardiovascular and Thoracic Surgery Unit of Bouaké University Teaching Hospital has limited technical resources. We report our experience with cardiac wounds, surgically and echocardiographically confirmed in patients with chest trauma over a 12-year period. **Methods:** Between October 2012 and December 2025, we conducted a descriptive cross-sectional study of consecutive patients admitted to the Emergency Department for penetrating thoracic wounds whose location and clinical, echocardiographic, and hemodynamic characteristics raised suspicion of cardiac injury. **Results:** There were 7 cardiac wounds in 6 men aged of 14, 28, 29, 30, 41, and 55 years old respectively, and one 30-year-old woman. The etiologies were iatrogenic (n = 1), traffic accidents (n = 3), and bladed weapons (n = 3). In the emergency setting, surgical approaches consisted of posterolateral thoracotomy (n = 2) and vertical median sternotomy (n = 4). Intraoperative findings included four cardiac ventricular wounds, one right ventricular crush injury, one iatrogenic right ventricular wound, and two stab wounds: one to the right ventricle and one to the left ventricle. There were two non-bleeding cardiac wounds, *i.e.*, one epicardial-pericardial wound and the other arrhythmogenic, associated with a contusion of the aortic isthmus. Cardiovascular procedures consisted of suturing the right ventricle (n = 3) and the left ventricle (n = 2) to a pericardial patch, pericardiorrhaphy (n = 1), and closure of the aortic isthmus (n = 1). The strategy of close observation was carried out in one case of a fibrillating non-bleeding cardiac wound. The postoperative follow-up was favorable in 6 patients. One immediate postoperative death occurred. **Conclusion:** Cardiac wounds should not be overlooked in our clinical practice. They

should be considered in the assessment of the type and location of injuries and in the differential diagnosis of thoracic trauma.

Keywords

Trauma, Thorax, Heart, Aorta, Follow-Up

1. Introduction

Chest trauma is considered severe when it affects the heart, the large vessels at the base of the heart, the lungs, and the ribs, thereby causing rib flaps, cardiorespiratory failure, and/or circulatory failure [1]. Thoracic wall injuries were not associated with clinical or anatomical characteristics or with the intraoperative findings in patients with polytrauma.

The resulting cardiac injuries are often complex in case of traffic accidents or gunshot wounds, although their clinical management is often limited to reanimation and chest drainage [2]. Given these increasingly severe and varied cardiac injuries, there is an ultimate interest in surgical indications, to the point where some authors assert that surgical exploration is mandatory in cases of cardiac wounds [2] [3].

Regarding our experience in cardiovascular surgery, we therefore present the etiology and pathogenesis, diagnostic strategy, and surgical management of cardiac wounds—performed on a beating heart—at our resource-limited setting.

2. Patients and Methods

Between October 2012 and December 2025, we conducted a cross-sectional, observational, and descriptive study of 7: consecutive patients who had sustained chest trauma resulting in heart wounds. Cardiac wounds, are defined as disruptions in continuity affecting all or part of the cardiac layers and/or the cardiac pedicle. The demographic, clinical, laboratory, surgical, and follow-up data for these patients were described. No statistical tests were performed. We described the variables based on the patients' medical records.

3. Observations

3.1. Case 1

Mr. KK, a 55-year-old married man and father of two children, an accountant and alcoholic, was evacuated on January 16, 2016, at 4:00 P.M. by the Bouaké Military Fire Department (GSPM) for multiple injuries sustained in a traffic accident. According to the trauma history, he was drunk and struck by a truck. Then, he was dragged under its wheels and he immediately lost consciousness.

He was admitted 4 hours later to the Surgical Emergency Department. The initial examination revealed Glasgow coma scale score of 12 without any sensory or motor deficits, a blood pressure of 110/85 mmHg, 120 beats per minute (bpm),

cold extremities, a central venous pressure of 41 cm H_2O, and 46 breaths per minute. The sternum was multi-indented and bulging, while cardiac auscultation revealed auscultatory silence.

The gastrointestinal examination revealed an abdominal pain syndrome. As a result, the diagnosis of multiple traumatism or polytrauma was made. It consisted of a head injury, abdominal trauma, and closed right-sided chest trauma involving a comminuted sternal fracture, multiple rib fractures, a pulmonary contusion, and a right hemothorax.

A cranial and thoracic CT scan confirmed the diagnosis. An abdominal ultrasound revealed a liver contusion with moderate hemoperitoneum. A right-sided chest drainage was urgently performed in Intensive Unit Care. A subsequent laparotomy confirmed the liver contusion with moderate hemoperitoneum and revealed the contusion of the right colic angle.

Then, a peritoneal irrigation was performed. Given the worsening signs of cardiogenic shock and the onset of desaturation of 88%, we carried out, five hours after the cardiac trauma, a vertical median sternotomy and a pericardiotomy under general anesthesia, which showed a right ventricle rupture, as shown in Figure 1(a), Figure 1(b).

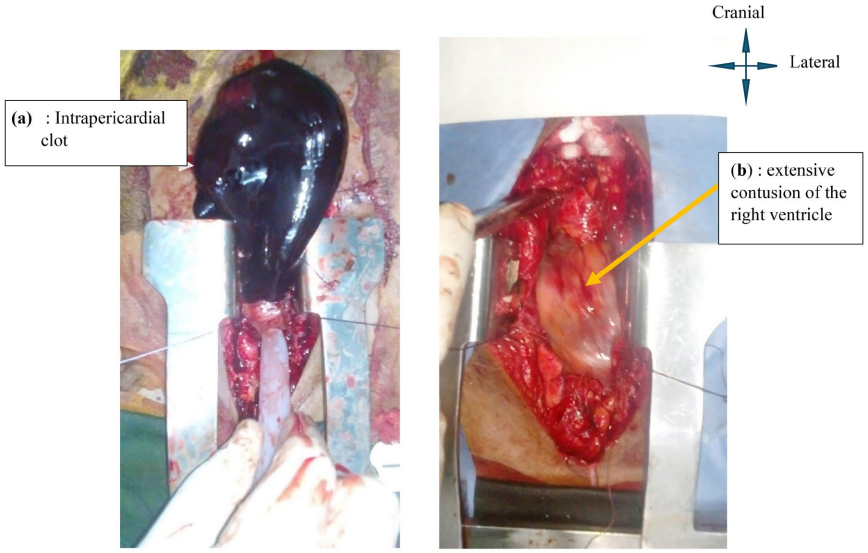


Figure 1. (a) (b): Intraoperative view showing a right ventricular rupture following chest trauma.

The procedures performed included a right ventricular suture to a pericardial splint, sternal osteosynthesis, and pericardial debridement. He died because of a massive pulmonary embolism.

3.2. Case 2

Ms. AD, a 30-year-old household wife, was evacuated from Odienné on February 12, 2018, for a moderate pleural effusion. According to her medical history, she initially presented a dry cough, mid-chest pain, and gradually developing breath

shortness due to infection. Prior to her admission, she received traditional treatment along with 2 grams of acetaminophen per day during three weeks without success. Because of the New York Heart Association (NYHA) Class 3 dyspnea, and moderate pericardial effusion, she was referred to us by her cardiologist for adequate care management.

The initial examination displayed that the patient was calm and alert and presented NYHA Class 2 dyspnea and minimal redness conjunctiva. She had a regular pulse of 126 bpm, a blood pressure of 110/90 mmHg, an arterial oxygen saturation of 96%, a respiratory rate of 36 breaths per minute, and a central venous pressure of 26 cm H_2O. The cardiac auscultation displayed muffled heart sounds and a pericardial rub. The electrocardiogram findings were diffuse repolarization abnormalities and microvoltage in the inferolateral leads. The anteroposterior chest X-ray findings were a global cardiomegaly with a cardiothoracic index of 0.67.

The Doppler echocardiogram revealed a moderate pericardial effusion with anterior and posterior pericardial separation of 16 and 25 mm, respectively. Intrapericardial fibrin deposits were predominant at the heart apex. The fine-needle pericardial aspiration identified 50 ml of uncoagulable bloody fluid, which favored a heart injury, confirmed by the echocardiogram findings. The echocardiogram revealed thrombus as a linear parietal hypoechogenicity in the right ventricle. The patient underwent urgent surgical treatment three hours after the cardiac trauma. We performed a vertical median sternotomy, followed by a pericardotomy which showed a punctate iatrogenic lesion in the right ventricle. We sutured the lesion using a pericardial patch as a splint. The postoperative follow-up was favorable.

3.3. Case n˚3

Mr. KKA, a 41-year-old farmer residing in Béoumi, was carried by the Bouaké GSPM to the Surgical Emergency Department of the University Teaching Hospital of Bouake on March 7, 2022, for a chest injury after a traffic accident. According to the patient's trauma history, he was riding his bicycle on the side of the road when he was struck violently by the rear of a tank transporter. He felt a sharp pain in the left hemithorax and heard a rib cracking. Then, he suffered from progressively worsening dyspnea, reaching NYHA Class 2. The patient's initial examination revealed a contusion of the anterolateral thoracic wall at the level of the 7th, 8th, and 9th ribs, between the left anterior and posterior axillary lines.

This detached thoracic parietal segment measured 120 mm × 60 mm, corresponding to a left anterolateral costal flap. The patient was agitated and alert, with a pulse of 110 bpm, a blood pressure of 130/70 mmHg, and an arterial oxygen saturation of 97%, a respiratory rate of 48 breaths per minute, and a central venous pressure of 22 cm H_2O. Cardiac sounds were regular with no additional murmurs. Examination of the pleuropulmonary system showed a costal flap involving the 7th, 8th, and 9th left anterolateral costal arches and signs of fluid-filled pleural effusion. The digestive system was normal. The chest X-ray confirmed the left anter-

olateral costal flap and moderate hemothorax. The electrocardiogram showed complete arrhythmia due to atrial fibrillation. The echocardiography with cardiac Doppler results were a minimal hemopericardium and pericardial separation of 7 mm from anterior side and 10 mm from posterior side. Upon admission to the hospital one hour after sustaining chest trauma, a decision was made to proceed with surgery. Immediately, patient underwent an anterolateral thoracotomy under general anesthesia. The surgical procedure highlighted a pericardial wound, moderate left hemothorax, minimal hemopericardium, cardiac contusion, left ventricular congestion, and contusion of the aortic isthmus. As a result, we performed the aspiration of the hemothorax and hemopericardium and treated the aortic isthmus. The surgical procedures are illustrated in Figure 2. The postoperative follow-up was satisfactory.

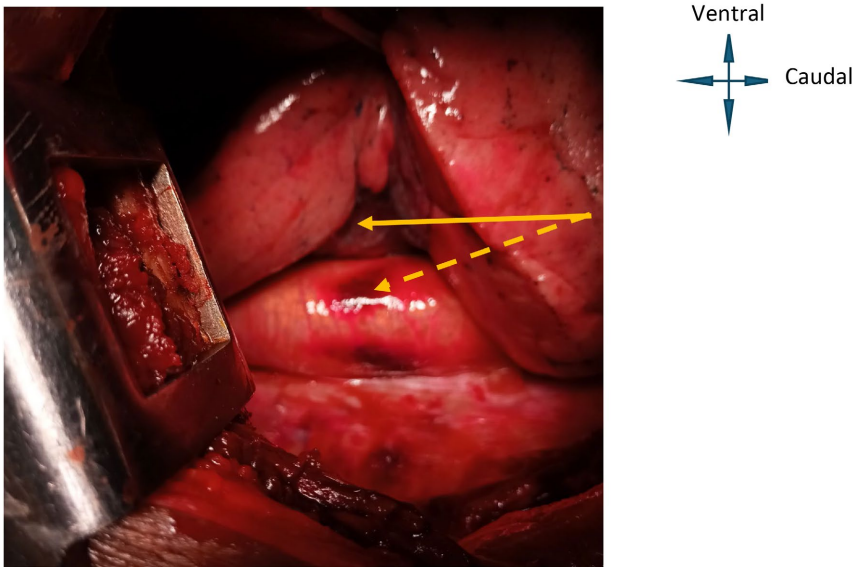


Figure 2. Posterolateral thoracotomy showing aortic and pericardial contusions with moderate hemothorax and minimal hemopericardium.

3.4. Case n˚4

A 30-year-old man, named Mr. Al, was admitted to the Surgical Emergency Department at Bouaké University Teaching Hospital for chest trauma after a traffic accident on May 12, 2023, at 4:00 P.M. According to his medical history, the patient fell from his motorcycle, and his chest struck the steering wheel. He immediately experienced severe chest pain, inspiratory dyspnea, and palpitations. The initial physical examination revealed an agitated patient with NYHA Class 2 dyspnea. He had flushed conjunctiva, 122 bpm, 145/80 mmHg of blood pressure, 95% of arterial oxygen saturation, 40 breaths per minute, and 28 cm H_2O of central venous pressure. The precordial examination revealed an oval-shaped contusion of 4 cm in diameter located at the left breast region, at the intersection of the midclavicular vertical line and the horizontal line at the 4th left intercostal space. The cardiac auscultation findings were irregular, rapid, and intense heart sounds

without any pericardial friction rub. The other systems—pleuropulmonary, gastrointestinal, and musculoskeletal—were normal. The electrocardiogram showed complete arrhythmia due to atrial fibrillation. The chest X-ray displayed a cardiomegaly with a cardiothoracic ratio of 0.51, and the doppler echocardiogram highlighted a pericardial detachment and segmental dyskinesia of the right midventricle. The diagnosis of a dry heart wound associated with atrial fibrillation was confirmed ten hours later. Because of the absence of cardiac scintigraphy and magnetic resonance imaging, we completed the follow-up of patient: strict bed rest, medical treatment of analgesics (200 mg/day of tramadol via syringe pump and 1 g of injectable acetaminophen every 6 hours), 50 mg/day of nebivolol, 1.25 mg/day of perindopril, and 6.000 IU of enoxaparin twice subcutaneous daily. During the patient's evolution, cardioversion and a reduction in pain were observed on Day 4 of hospitalization. On Day 7, the patient was discharged with a treatment of nebivolol 50 mg/day, perindopril 1.25 mg/day, and aspirin 100 mg/day. The 18-month follow-up was satisfactory.

3.5. Case n˚5

Mr. NP, a 29-year-old single man who worked from dawn, was admitted at the University Teaching Hospital on June 2, 2023, at 6:30 A.M. for a chest injury resulting from a stabbing. During a scuffle intended to steal his cell phone, he was stabbed in the precordial region just below the left nipple. This resulted in sharp precordial pain, exertional dyspnea, and dizziness. He was rescued by pedestrians, who immediately took him to the Surgical Emergency Department at Bouaké University Teaching Hospital for treatment of a chest wound.

The initial examination showed that the patient was agitated and conscious with NYHA Class 2 dyspnea and minimal red conjunctiva. He had a regular pulse at 94 beats per minute, a blood pressure of 120/90 mmHg, an arterial oxygen saturation of 97%, a respiratory rate of 32 breaths per minute, a central venous pressure of 24 cm H_2O. The entry wound was a linear non-bleeding incision of 20 mm long, located in the left parasternal region at the 5^{th} intercostal space, 60 mm from the mid-sternal vertical line (**Figure 3**). The cardiac auscultation displaced regular heart sounds without any additional murmurs.

The examinations of the pleuropulmonary and digestive systems were normal.

The chest X-ray was normal. The electrocardiogram revealed nonspecific and diffuse repolarization abnormalities. The echocardiography with cardiac doppler showed a 7-mm anterior pericardial detachment. The complete blood count result was normochromic normocytic anemia with a hemoglobin value of 7.8 g/dL. Four hours after the assault and 30 minutes after hospital admission, surgical exploration of the chest was indicated due to suspected cardiac injury. Indeed, pericardotomy was completed through vertical median sternotomy under general anesthesia with cardiorespiratory and vascular monitoring. We found a 3-mm-diameter wound of the right ventricular, located at 10 mm from medial to the middle third of the anterior interventricular artery. The wound was sutured with two "U"-

shaped stitches on an autologous pericardial patch (Figure 4).

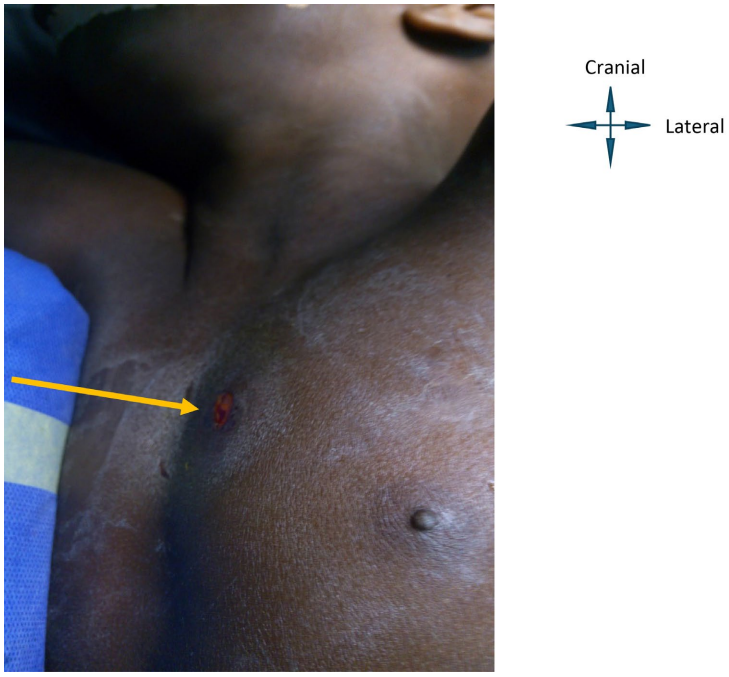


Figure 3. Cutaneous entry wound from a stab injury.

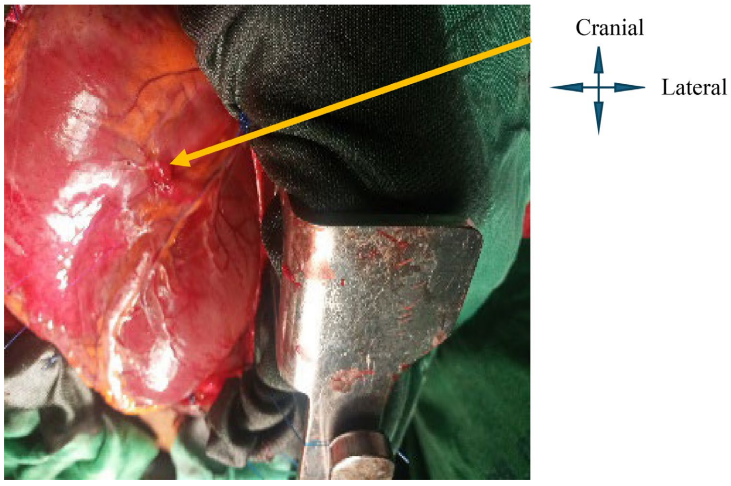


Figure 4. Surgical repair of the right ventricular wound.

The pericardial cavity was irrigated with isotonic saline and drained prior to parietal closure. The postoperative follow-up was favorable.

3.6. Case n°6

Mr GF, a 14-year-old student residing in Kounahiri, was admitted at the University Teaching Hospital on September 17, 2025, for a knife chest injury. The patient's medical history revealed that he was stabbed on the left edge of the sternum during a game. This injury resulted in external bleeding of 250 ml, severe pain,

and exertional dyspnea without any loss of consciousness. The patient's initial examination displayed a linear and horizontal wound measuring 20 mm. It was in the 4th left intercostal space of the left parasternal region. The patient was agitated and alert with 120 BPM, 140/80 mmHg of blood pressure, 95% of arterial oxygen saturation, 46 breaths per minute, and 26 cm of water of central venous pressure. The heart sounds were rapid and regular with minimal pericardial friction. Examinations of the pleuropulmonary and digestive systems were normal. The chest X-ray showed the enlargement of the middle mediastinum. The electrocardiogram results were an inferolateral microvoltage and ventricular premature beats. Echocardiography with cardiac Doppler revealed a pericardial tear, an 11-mm pericardial effusion in the posterior region, and a 7-mm pericardial detachment in the anterior region. Three and half hours later, an anterolateral thoracotomy was performed under general anesthesia, and a 25-mm-long epicardial-pericardial wound was observed.

Our treatment procedures consisted of suturing the parietal wound from within the thoracic cavity, aspirating the hemopericardium, and carrying out a pericardiorrhaphy using 4/0 non-absorbable suture (**Figure 5**). The postoperative follow-up was favorable.

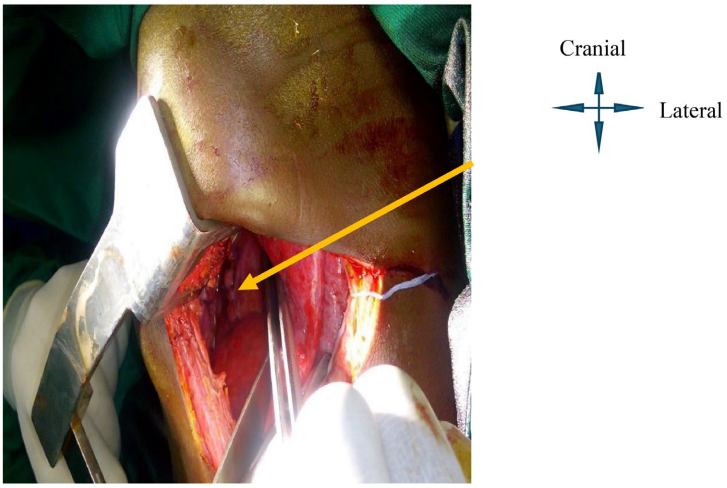


Figure 5. Cardiorrhaphy and pericardiorrhaphy via thoracotomy.

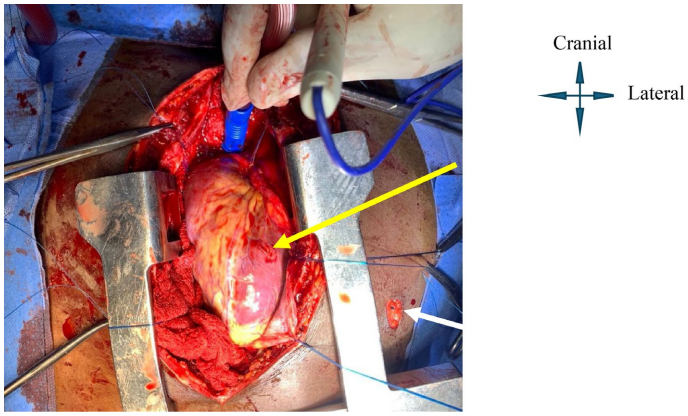
3.7. Case n°7

Mr. OP, a 28-year-old single man with no children, was brought to the Surgical Emergency Department at Bouaké University Teaching Hospital by his parents on September 22, 2025, at 8:00 A.M, for a stabbing. According to the trauma history, the patient was stabbed in the precordium during a scuffle. This resulted in sharp chest pain and breath shortness.

During the initial examination, the patient was alert and agitated. He had NYHA Class 2 dyspnea, reddened conjunctiva, 110/78 mmHg of blood pressure, 110 bpm, 95% of arterial oxygen saturation, 42 breaths per minute, and 36 cm H_2O of central venous pressure.

The entry wound was a 3-cm deep linear wound from which bright red blood was oozing without any blood clots (Figure 6(a)). The amount of blood had been reduced by prolonged compression for 15 minutes prior to admission. The left parasternal wound was located on the mid-clavicular vertical line intersecting the horizontal line passing through the third left intercostal space.

(a)



(b)

Figure 6. (a): Stab wound entry site with minimal hemorrhage; (b) Linear left ventricular laceration caused by a sharp-edged weapon.

The heart sounds were regular, rapid, and intense with pericardial friction. The other systems, pleuropulmonary, gastrointestinal, and musculoskeletal, were normal. Based on this clinical examination, a cardiac injury was suspected and needed further surgical investigations.

As a result, two hours from admission, a vertical median sternotomy and a pericardotomy were done, and 650 ml of coagulable blood was aspirated under general anesthesia.

The heart was dislocated using a surgical field and placed posteriorly. A 20-mm linear wound in the left mid-ventricle with minimal bleeding was found. The treatment protocol of the injury consisted of suturing the left ventricular myocardial wound with No. 5/0 polypropylene suture over a pericardial patch (**Figure 6(b)**). After through irrigation of the pericardial cavity, the sternum was closed on two drains, one intrapericardial and the other retrosternal.

The postoperative follow-up was favorable.

4. Discussion

Cardiac wounds rank among the most common chest trauma due to their poor prognosis, their severity [2], and their rarity [4]. Only 11% - 25% of patients with cardiac injuries were admitted alive at the hospital [4] [5]. Daniel *et al.* [4] have demonstrated that the cardiac injuries represent less than 2% of all thoracic injuries treated in hospitals. This incidence has increased in Bouaké, where we have been working since the military-political crisis in Côte d'Ivoire.

One of the distinctive features of this study is the prevalence of stabbings.

Beyond the classic causes of cardiac wounds due to gunshot wounds, as described by Daniel *et al.* [4] and Carrasquilla *et al.* [6], these injuries are increasingly caused by traffic accidents and stabbings [2] [7]. The left precordial location of the entry wounds reflects the violence and the intent to inflict a fatal blow on the victim.

As a result, their clinical and anatomical characteristics vary, ranging from "dry" heart injuries—in which the patient is hemodynamically stable—to "white" injuries, in which the patient is in hemorrhagic shock, a condition that can sometimes be fatal. This latter clinical aspect is rarely seen in a hospital setting [5]. The intermediate characteristic of the "blue" patient—in whom tamponade is common and the pericardial cavity is sometimes filled with clotted blood—is what keeps our patients in the hospital.

These various mechanisms explain the reasons for the prolonged duration of clinical management of patients in our underserved community. These mild to moderate forms of hemopericardium corroborate with the literature data [2; 5; 8], whose 30% were predominant in the right ventricle [8].

No diagnostic tests should delay the treatment if a cardiac injury is suspected.

However, all authors acknowledge the diagnostic effectiveness of echocardiography with doppler, making it the test of choice in cardiology [3]. It confirms the diagnosis by highlighting the pericardial effusion, the segmental myocardial dyskinesia, and the cardiac laceration. Its unavailability does not hinder surgical management in most of our patients.

The echocardiography with doppler is available in our working setting, but it was not performed on all our patients. Furthermore, the surgical approaches for these various injuries vary depending on the etiology and the location of the chest wound. Thus, a thoracotomy was carried out within 2 patients.

Boddaert *et al.* have reported that thoracotomy is the surgical approach of

choice in 10% of cases of chest trauma involving cardiac injury [9]. In contrast, Degiannis *et al*. [10] and Wall Jr. *et al*. [11] have reported that the sternotomy is the only approach. Although this approach provides good access to the heart, it is used in only 67% of cases in our study (n = 4).

Regardless of the surgical approach used, no intracardiac lesions were repaired in our study. Objectively, a cardiorrhaphy was performed in 6 patients, as recommended by El Kouache *et al*. [2]. Consequently, the patient must be carefully monitored during the follow-up to prevent any myocardial and/or atrioventricular insufficiency and aneurysms [12].

Most authors recommend repairing cardiac lesions under cardiopulmonary bypass unless other options are readily available [4] [13]. This highlights the limitations of our technical capabilities. The cases presented and operated one appear to be minor, with a stable thoracic condition, compared to those reported in the literature data [8] [12]-[14]. In our study, the postoperative mortality rate was 14.29% (1/7), which is similar to that of Avaro *et al*. (15.5%) [1].

In contrast, Degiannis *et al*. [10] have reported 8% lower mortality rate when the tamponade is stable. The postoperative evolution of these cardiac wounds appears to correlate with their etiologies, given the outcome of the watch-and-wait approach adopted for a case of a dry cardiac wound in our study. this approach differs from that of Robert *et al*. [15], who recommend surgery for any cardiac wound—whether ballistic or not—regardless of its anatomic and clinical presentation.

5. Conclusions

Our study demonstrated the association between closed or open chest trauma and mild-to-moderate cardiac injuries caused by stab wounds and traffic accidents. This association should not be overlooked in our clinical practice. These cardiac injuries can affect all myocardial structures and the cardiac pedicle, with a wide range of clinical and anatomical characteristics that may result in a thoracotomy or exploratory sternotomy.

These surgical approaches help not only to confirm the diagnosis of a cardiac wound in a resource-limited setting but also to achieve a satisfactory postoperative outcome.

Author Contributions

Ayegnon K.G., Lead surgeon, Author of the article; patient manager and writer of article, Abro K.S.; Article conception; Binaté A. The following authors contributed to the patient's care and to the review process, and provided methodological suggestions aimed at improving the quality of the article. N'guessan K.I., Edi A.A. Meneas G.C., Diby K.F., Gnaba L.A., Ouattara P.E.C., Adoubi K.A., Methodology, syntactic revision, quality, proofreading of the article.

Conflicts of Interest

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

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