Clinical experience showing arterial traumas of limbs and the neck for more than sixteen consecutive years of civil practice in Abidjan

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To share our experience regarding the treatment of limb and neck arterial traumas, we conducted a retrospective descriptive study using the medical records of patients who underwent surgical repair at the Abidjan Heart Institute between August 2005 and March 2022. The epidemiological, anatomo-clinical and therapeutic parameters were studied. 1073 patient records were collected. There were 108 females and 965 males. The average age of the patients was 28 years old. The circumstances of occurrence were dominated by assaults in 61.79% of cases. The anatomical lesions consisted of the arterial lateral wound in 48.09% of cases, the complete section of the artery in 29.08% of cases, the loss of arterial substance in 07.27% of cases, the arterial contusion in 04.38% of cases, the arteriovenous fistula in 02.61% of cases, and the false aneurysm in 08.57% of cases. The lesions were located on the upper limb arteries in 47.72% of cases, on the lower limb arteries in 39.05% of cases and on the neck in 13.23% of cases. Injurious agents included stabbing in 44.36% of cases, firearm in 19.29% of cases, traffic accident in 34.76% of cases, iatrogenic agents in 1.30% of cases and the fishbone in 3 cases (00.28%). Vascular repair had consisted of direct suture, patch closure, prosthetic or venous bypass, or flattening-graft. Traumatic arterial lesions are dominated by lateral wounds and complete sections. Their delay in therapeutic management is still too long due to the late arrival at the hospital and constitutes the major factor of poor prognosis. However, even unrecognized at the acute stage, certain arterial lesions can progress to chronicity, marked by arteriovenous fistula and false aneurysm.

Key words: Arteriovenous fistula, false aneurysm, flattening-graft, limbs and neck arterial traumas, prosthetic bypass.

INTRODUCTION

Arterial traumas results either in a contusion or in a solution of continuity of one or more coats of the arterial

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A right axillary swelling due to a right axillary artery false aneurysm. A: Axillary view showing scar from causative trauma (see red arrow). B: View over the right shoulder.

Figure 1. Right axillary swelling due to right axillary artery false aneurysm. A: Axillary view; showing scar from causative trauma (see red arrow). B: View over the right shoulder.

Source: Author

emergency that can jeopardize the functional prognosis of the limb or even the vital prognosis of the patient (Shireman et al., 2015; Li et al., 2014). Indeed, vascular lesions are a frequent cause of disability and mortality, which can represent 20 to 26% of deaths induced by trauma (Loh et al., 2011). Their clinical manifestations may be obvious but in some cases require more in-depth exploration using Döppler-Echography and/or angio-CT scans because if not recognized, the lesions can progress to chronicity with an anatomo-clinical expression dominated by arteriovenous fistulas and false aneurysms (Fokou and Teyang, 2021). Their treatment is generally surgical with numerous techniques and well codified indications (Fingerhut et al., 2002). The repair and reconstitution of vascular lesions are determined according to the type and site the lesion, the presence of concomitant lesions, the presence of collateral circulation in the extremities and the techniques and materials available (Li et al., 2014). While the epidemiological, anatomo-clinical and therapeutic characteristics of arterial traumas are relatively well known in North America and Europe, in sub-Saharan Africa these characteristics are still poorly understood due to the scarcity of related studies (Nason et al., 2001; Sampliner and Vlastou, 1997; Derbel et al., 2020). Indeed, arterial wounds are more and more frequent at the Abidjan Heart institute since the reopening of the Cardiovascular Surgery Department in August 2005 with a prevalence of 11% (Katché et al., 2016). Through the determination of the epidemiological profile of the patients, the study of the anatomo-pathological aspects of the various peripheral arterial lesions operated on, the determination of the delays in the management of the lesions, the identification of the different operating techniques and the evaluation of the operating results, this work aimed to make a factual observation of the management of peripheral arterial trauma and thus to reduce their mortality and amputation rates.

MATERIALS AND METHODS

This is a descriptive retrospective study that focused on the medical records of patients who suffered arterial trauma to the neck, upper limbs or lower limbs and who underwent surgery (Figures 1 and 2) at the Abidjan Heart institute from August 2005 to March 2022. The non-inclusion criteria were represented by cases of false aneurysm due to infection and isolated cases of venous wound. Associated trauma was not taken into account in this study. Data were collected and analysed using Epi-info 7, Microsoft word 2007 and Microsoft excel 2007 software and Infinix hot 5 live Camera.

The parameters studied included: the epidemiological data, the circumstances of occurrence, the injuring agents, the time before surgical management, the anatomical type and the location of lesions (thanks to ultrasound or angio-CT or intra operative findings), surgical procedures, successful revascularization, severity factors, morbidity and mortality.

RESULTS

1073 patient records were collected. There were 108 females and 965 males (sex ratio = 0.11). The average age of the patients was 28 years (range 4-62 years). The circumstances of occurrence were represented by Figure 3 with 03 cases of self-mutilations. The distribution of patients according to the trauma site is represented by Figure 4. Details of lesion topography are listed as follows: Neck: Carotid arteries (n=83), Thyroid arteries (n=42), occipital artery (n=5), vertebral arteries (n=12), Upper limbs: Subclavian artery (n=07), Axillary artery (n=27), Brachial artery (n=103), Radial artery (n=302), Ulnar artery (n=52), Radial and ulnar arteries (n=21), Lower limbs: External iliac artery (n=19), Common femoral artery (n=46), Superficial femoral artery (n=224), Popliteal
Figure 2. Surgical treatment of brachial artery contusion, A: Prosthetic bypass of the brachial artery after clearing; B: forearm lodges Aponeurotomy. Source: Author.

Figure 3. Distribution of patients according to the circumstances of occurrence. Source: Author.

Figure 4. Distribution of patients according to the trauma site. Source: Author.
Table 1. Distribution of patients according to injurious agents.

<table>
<thead>
<tr>
<th>Injurious agents</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stabbin</td>
<td>416</td>
<td>44.3</td>
</tr>
<tr>
<td>Fire arms</td>
<td>207</td>
<td>19.3</td>
</tr>
<tr>
<td>Velocity</td>
<td>373</td>
<td>34.8</td>
</tr>
<tr>
<td>Iatrogenic agents</td>
<td>14</td>
<td>1.3</td>
</tr>
<tr>
<td>Fish bone</td>
<td>3</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1073</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Author.

Table 2. Distribution of patients according to anatomical lesions.

<table>
<thead>
<tr>
<th>Lesions</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral arterial wounds</td>
<td>516</td>
<td>48.09</td>
</tr>
<tr>
<td>Complete arterial sections</td>
<td>312</td>
<td>29.08</td>
</tr>
<tr>
<td>Arterial wounds with loss of substance</td>
<td>78</td>
<td>7.27</td>
</tr>
<tr>
<td>Arterial contusions</td>
<td>47</td>
<td>4.38</td>
</tr>
<tr>
<td>Arteriovenous fistulas</td>
<td>28</td>
<td>2.68</td>
</tr>
<tr>
<td>False aneurysms</td>
<td>92</td>
<td>8.57</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1073</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Author.

artery (n=47), Leg arteries (n=83). The distribution of patients according to injuring agents is represented by Table 1.

The clinical manifestations were distributed as follows: hemorrhage externalized but contained by a compression bandage with or without signs of ischemia (n=953 (89.0%), beating swelling (n=92 (08.5%), thrill along the course of an artery (n=28 (02.5%).

The delays in surgical management of acute arterial lesions (n=953) were from 1.5 to 06 h in 13.96% of cases, from more than 06 to 24 h in 52.89% of cases, from more than 24 to 76 hours in 33.16% of cases. The average delay taken before treatment of false aneurysms or post-traumatic arteriovenous fistulas was 03 months (Range 7 days - 09 years). The distribution of patients according to anatomical lesions is represented by Table 2. Arterial injuries and their repairs are the following: "Lateral arterial wounds, n=516 (48.09%), and complete arterial sections, n=278 (25.91%), were all treated by direct suture, n=794 (74%) (Figure 5)."

Complete arterial sections n=34 (3.17%) and Arterial wounds with Loss of substance n=78 (07.27%) were treated by arterial bypass n=112 (10.44%) either with a vein graft n=13 (1.21%) and either with a prosthetic graft n=99 (9.23%).

Arterial contusions leading to thrombosis n=47 (4.38%) benefited from desobstruction using a Fogarty probe either associated with a bypass with venous graft n=41 (3.82%) taken from the great saphenous vein or the basilar and either associated to a bypass with prosthetic graft n=6 (0.56%) (Figure 3).

Aponeurotomy was associated with arterial repair in patients suffering from an acute injury and operated on more than 6 h after the trauma (n=820 (76.42%)).

Arteriovenous fistulas cases n=28 (2.61%) were treated by resection of the fistula associated with a synthetic patch for arterial closure n=22 (2.05%) or by radial arterial ligation n=6 (0.56%).

False aneurysms cases n=92 (8.57%) were treated by flattening-prosthetic graft (Figure 6) n=54 (5.03%), or by flattening-vein graft n=13(1.21%) or by flattening with closure of the collar by direct suture n=24 (2.23%) or by synthetic patch n=1(0.09%).

Surgical results

**False aneurysms and Arteriovenous fistulas surgical results**

All cases of false aneurysms and arteriovenous fistulas presented a good postoperative result (n=120). Acute arterial lesions (n=953) surgical results are the following: Eleven cases n=11 (1.15%) of postoperative deaths due to ischemia-reperfusion syndrome n=8, uncontrollable
hemorrhage n=1 and septic shock n=2. Surgical repair was unsuccessful, marked by major amputations n=76 (7.97%) as follows: arm amputation n=3, forearm amputation n=4, thigh amputation n=42, leg amputation n=27. According to the delays in surgical management major amputation percentages are represented by Table 3.

Revascularization resulted in partial muscle necrosis and/or minor amputations (toes) in 5.56% of cases (n=53). Surgical repairs of acute arterial lesions were
successful without any functional sequelae in 85.31% of cases (n=813).

DISCUSSION

Epidemiological aspects

The male predominance and the young age of the patients were also described by Derbel et al. (2020), Magee et al. (1996) and Baghi et al. (2015) who found respectively an average age of 27 years with 97.62% of men, an average age of 26 years with 66% of men and an average age of 21-30 years with 98.86% of men. In all these series, the majority of the population was male, young and active. The circumstances of occurrence and the injuring agents in our series were similar to those of the series by Naouali et al. (2013) and Banga et al. (2022), where stabbings accounted represent respectively 78 and 65.38% of cases. On the other hand, in the series of D’Alessio et al. (2020) and Magee et al. (1996), traffic accidents appeared in the foreground with 48.1 and 45%, respectively. Indeed, since the end of the 1990s, new forms of violence have accompanied the transformation of Ivorian society with the birth of new bands such as Children in conflict with the law, commonly called “microbes”, who, under the effect of alcohol or narcotics, engage in fights and group assaults with easily accessible edged weapons. That might explain our numbers. In addition, studies carried out in certain countries in the context of war show that firearms were mainly incriminated. Indeed, Guraya (2004) and Ibrahim et al. (2019) respectively found gunshot wounds in 54.30 and 90% of cases. Among the less incriminated vulnerating agents in our series, there was an exceptional and unusual agent, the fishbone, which was previously described in a study at the Abidjan Heart Institute (Kirioua-Kamenan et al., 2015).

Anatomo-clinical aspects

Exterior bleeding was the main clinical presentation in this series. Kakar (2012), Djoussouf (2022) and Banga et al. (2022) also found hemorrhage at the top of the clinical presentations. On the other hand, in the series of Naouli (2013) and Leclerc et al. (2018), it was rather ischemia that predominated. The predominant involvement of the upper limbs was observed in the series of Özmen et al. (2020) with 62.3%, Naouali (2013) with 65% and Randimbinirina et al. (2018) with 62%. But the lower limbs were the most affected in the series of Fokou and Teyang (2021) and Leclerc et al. (2018) in respectively 70.6 and 83.3% of cases. In their cervical localization, the predominant involvement of the carotid artery was noted. In the series by Randimbinirina et al. (2018), the carotid artery was also the most affected. Regarding the upper limbs, the predominant involvement of the radial artery was found by Özmen et al. (2020), Randimbinirina et al. (2018) and Banga et al. (2022). Concerning the lower limbs, our series found a predominant involvement of the superficial femoral artery. Fokou and Teyang (2021), Randimbinirina et al. (2018) and Özmen et al. (2020) also found predominantly superficial femoral artery involvement, whereas Baghi et al. (2015), Ibrahim et al. (2019) and Leclerc et al. (2018) found predominantly popliteal artery involvement. The predominant anatomical lesions in our series were lateral wounds followed by complete sections. This is consistent with the results of Randimbinirina et al. (2018). However, a previous study carried out at the Abidjan Heart Institute (Katché et al., 2016) had found more cases of false aneurysms 44.3%. This is due to the fact that the proportion of patients who presented to Abidjan Heart Institute emergency services in the acute phase has become more important since it’s reopening in August 2005 after a 06-year closure.

Therapeutic aspects

The time to surgical management of acute lesions was greater than 6 h for the majority of patients in our series. In the series by Mpira et al. (2021), 75% of patients were treated after 6 h. This delay could be explained by geographic remoteness or isolation and sometimes by the ignorance of the degree of vascular lesions gravity in the centers of first contact. For chronic vascular lesions, the time to diagnosis of false aneurysms or post-traumatic arteriovenous fistulas in our series ranged from 7 days to 9 years with an average of 3 months. In the

<table>
<thead>
<tr>
<th>Delays in surgical management (H)</th>
<th>Numbers of patient</th>
<th>% of patient</th>
<th>Numbers of major amputations</th>
<th>% of major amputations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5-6</td>
<td>133</td>
<td>13.96</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>6-24</td>
<td>504</td>
<td>52.89</td>
<td>71</td>
<td>7.45</td>
</tr>
<tr>
<td>24-76</td>
<td>316</td>
<td>33.16</td>
<td>4</td>
<td>0.42</td>
</tr>
<tr>
<td>Total</td>
<td>953</td>
<td>100</td>
<td>76</td>
<td>7.97</td>
</tr>
</tbody>
</table>

Source: Author.

Table 3. Distribution of major amputations according to the delays in surgical management.
series by Fokou and Teyang (2021), the time interval between injury and presentation to hospital was 3 weeks to 15 years with an average of 3 months. The often painless nature and the lack of financial means could explain the delay in consultation. Since the type of vascular repair depends on several factors, direct suturing was the most frequently encountered technique in our study. It was also found in the series by Jaha et al. (2012) at 58.3%, by Özmen et al. (2020) at 75.3% and by Franz et al. (2009) at 46.7%. On the other hand, venous bypass was the predominant surgical technique in the series by Banga et al. (2022) at 50%, from Derbel et al. (2020) at 52% and Heis et al. (2008) at 44%. In terms of postoperative results, the revascularization success rate in our series is close to that of Aduful and Hodasi (2007) 84.60%, of Kakar (2012) 84.90%, but is lower than that of Derbel et al. (2020) 96.80% and Franz et al. (2009) 96%. This difference could be due to our more developed technical and logistical platform than ours. The mortality rate in our series was close to that of Özmen et al. (2020 and Chong et al. (2014) which had rates of 1.1 and 3% respectively. On the other hand, Ibrahim et al. (2019), Heis et al. (2008) and Kakar (2012) had higher mortality rates of 7.8, 7 and 9.6% respectively. Their high rates could be explained by the context of frequent armed conflicts in these regions with ballistic trauma.

Conclusion

Traumatic arterial injuries are dominated by lateral wounds and complete cuts. The delay in the therapeutic management is still too long due to the late arrival at the hospital and constitutes the major factor of poor prognosis.

However, even unrecognized at the acute stage, some lesions can progress to chronicity marked by arteriovenous fistulas or by false aneurysms which are easily diagnosed, as soon as the patient consults a doctor, and whose surgical treatment gives good results.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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