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Axillary Vessels and Brachial Plexus Traumas in Abidjan: Lesional Aspects and Surgical Difficulties

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Abstract

Introduction-Objectives: Through the presentation of epidemiological, anatomo-clinical and surgical aspects, we report our experience in the management of traumatic axillary lesions. **Materials and Methods:** A descriptive retrospective study was based on the medical records of patients who suffered vascular axillary and/or brachial plexus trauma and who underwent surgical repair at the Abidjan Cardiology Institute from January 2008 to June 2022. Epidemiological, anatomo-clinical and surgical data were studied. **Results:** Thirty-four medical files belonging to 33 men and one woman, aged 32 on average, were collected. The circumstances of occurrence were dominated by the stab wound (n = 22). The combinations of injuries were as follows: associated involvement of the axillary artery and vein (n = 4); isolated involvement of axillary artery (n = 3); isolated involvement of the axillary vein (n = 2); associated involvement of the axillary artery and brachial plexus (n = 17); associated involvement of the axillary artery and vein and brachial plexus (n = 08). Anatomic lesions included acute arterial lesions (n = 29) and arteriovenous fistula (n = 1) and false aneurysms (n = 4). All patients were operated on under general anesthesia; vascular repair included direct suturing (n = 16), arterial and venous bypass using a long saphenous graft (n = 9), prosthetic arterial bypass (n = 5) and prosthetic flattening-graft (n = 4). Brachial plexus surgery consisted of an end-to-end anastomosis of each transected bundle in all cases (n = 25). The medium-term postoperative course was marked by success without functional sequelae in 88.24% of cases (n = 30)

and by the persistence of distal paralysis of the thoracic limb after 6 months in 05.88% (n = 2) of all patients, *i.e.*, 8% of patients who presented with brachial plexus injury. **Conclusion:** The concomitant surgical treatment of these axillary vascular and nerve lesions has given good results. However, if paralysis of the thoracic limb persists after 6 to 12 months, the patient should be referred to a specialist in brachial plexus surgery.

Keywords

Brachial Plexus Surgery, Distal Paralysis of the Thoracic Limb, False Aneurysms, Flattening-Prosthetic Graft, Traumatic Axillary Lesions

1. Introduction

The brachial plexus is formed by the anastomoses of the ventral branches of the last four cervical nerves (C5, C6, C7, C8) and the first thoracic nerve [1]. In its supraclavicular part, the brachial plexus crosses the cervical region where it travels in the inter-scalene space (between the anterior scalene and the middle scalene). Then it passes behind the clavicle to cross the axillary region (infra-clavicular part), between the small pectoral in front and the subscapularis behind, where it is related to the axillary artery. In its axillary course, the brachial plexus crosses the costoclavicular cleft accompanied by the subclavian and then axillary arterial axis [1] [2]. The three bundles of the brachial plexus anastomose around the axillary artery give the seven terminal branches intended for the thoracic limb ensuring its sensorimotor innervation [3]. These close relationships between the axillary vascular pedicle and the brachial plexus explain the frequency of associated vascular and nerve damage during trauma to the axillary region. These traumas can be direct, e.g., during the attack by a knife or firearm [4] [5] or indirect during a fracture of the upper extremity of the humerus [6] [7] [8].

Although rare, axillary vascular and nerve lesions are serious (hemorrhagic shock, gangrene, amputation) and require complex surgical repair. Through the presentation of lesional aspects and surgical difficulties, we share our experience in the management of traumatic lesions of the axillary vessels and the brachial plexus.

2. Materials and Method

This is a descriptive retrospective study based on the medical records of patients successively admitted to the Abidjan Heart Institute emergency and who suffered traumatic vascular and/or brachial plexus injuries (illustrated by **Figure 1**) and who underwent surgical repair from January 2008 to June 2022. The criteria for non-inclusion were represented by traumatic disarticulations of the thoracic limb and post-traumatic gangrenes that required immediate amputation. The parameters studied included: socio-demographic data, the circumstances of

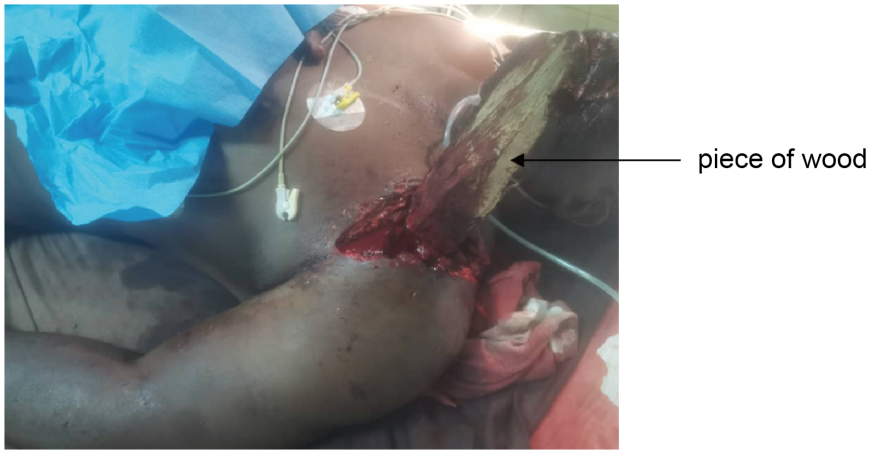

Figure 1. Left axillary wound due to a piece of wood.

occurrence, the vulnerating agents, the time taken for surgical management, the anatomical lesions, the surgical procedures, the early, medium and long-term results of the revascularization and nerve repair. The patients were reviewed in consultation at 1 month, 3 months and 6 months after the surgery. At each of these consultations, the patients undergo a clinical examination centered on the assessment of the humeral and radial pulses as well as the TINEL's sign in those who have a neurological deficit. Electromyography is performed at 6 months. From the register of operating reports which gives access to the patient's medical file number, the data were collected at the archives department on a survey sheet previously established. Data entry and analysis were performed by MICROSOFT WORD 2007 and INFINIX HOT 5 LITE software. The quantitative parameters were expressed in averages with their extremes and the qualitative parameters in numbers with their percentages.

3. Results

Thirty-four patient medical records were collected. There were 33 male patients and one female patient. The average age of the patients was 32 years (range 24 - 52 years).

The circumstances of occurrence are represented in **Table 1**.

Stabbing attacks were the main circumstances of occurrence. The case of work accident concerns a thoracic limb caught in the gears of a machine. Arterial lesions are as follows in **Table 2**.

The specification of the affected brachial plexus nerve bundles was not taken into account.

The combinations of lesions are grouped together in **Table 3**.

Axillary artery and brachial plexus associated involvement was the predominant damage combination (50%).

The delays in surgical management of acute arterial lesions (n = 29) were from 2 to 6 hours in 41.38% of cases, from more than 6 to 24 hours in 58.62% of cases. The mean time to management of False aneurysms or post-traumatic arteri-

ovenous fistulas (n = 5) was 4 months (range 2 - 13 months). Figure 2 illustrates a case of axillary vascular and nerve trauma.

The vascular repair techniques, after the section of the pectoralis major and pectoralis minor muscles, are grouped in Table 4.

The main surgical techniques for vascular repair were direct suturing (47.06%) followed by arterial and venous bypass (26.47%).

Brachial plexus surgery consisted of an end-to-end anastomosis of each severed nerve bundle in all cases of brachial plexus involvement (n = 25).

Table 1. Distribution of patients according the circumstances of occurrence.

Circumstances of Occurrence	Numbers	Percentage
Stabbing attacks	22	64.71
Traffic accidents	11	32.35
Work accident	1	2.94
Total	34	100

Table 2. Distribution of patients according the arterial lesions.

Arterial Lesions	Numbers	Percentage
Lateral wound of the axillary artery	10	29.41
Complete section of the axillary artery and vein	12	35.30
Complete section of the axillary vein	2	5.88
Loss of substance of the axillary artery	3	8.82
Contusion of the artery axillary	2	5.88
Arteriovenous fistula	1	2.94
False aneurysm	4	11.77
Total	34	100

Table 3. Combinations of vascular and nerve damage.

Combinations of Lesions	Numbers	Percentage
Associated involvement of the Axillaryartery and axillary vein	4	11.77
Isolated involvement of the Axillaryartery	3	8.82
Isolated involvement of the Axillaryvein	2	5.88
Associated involvement of the axillary artery and brachial plexus	17	50.00
Associated involvement of the axillary artery, axillary vein and brachial plexus	8	23.53
Total	34	100

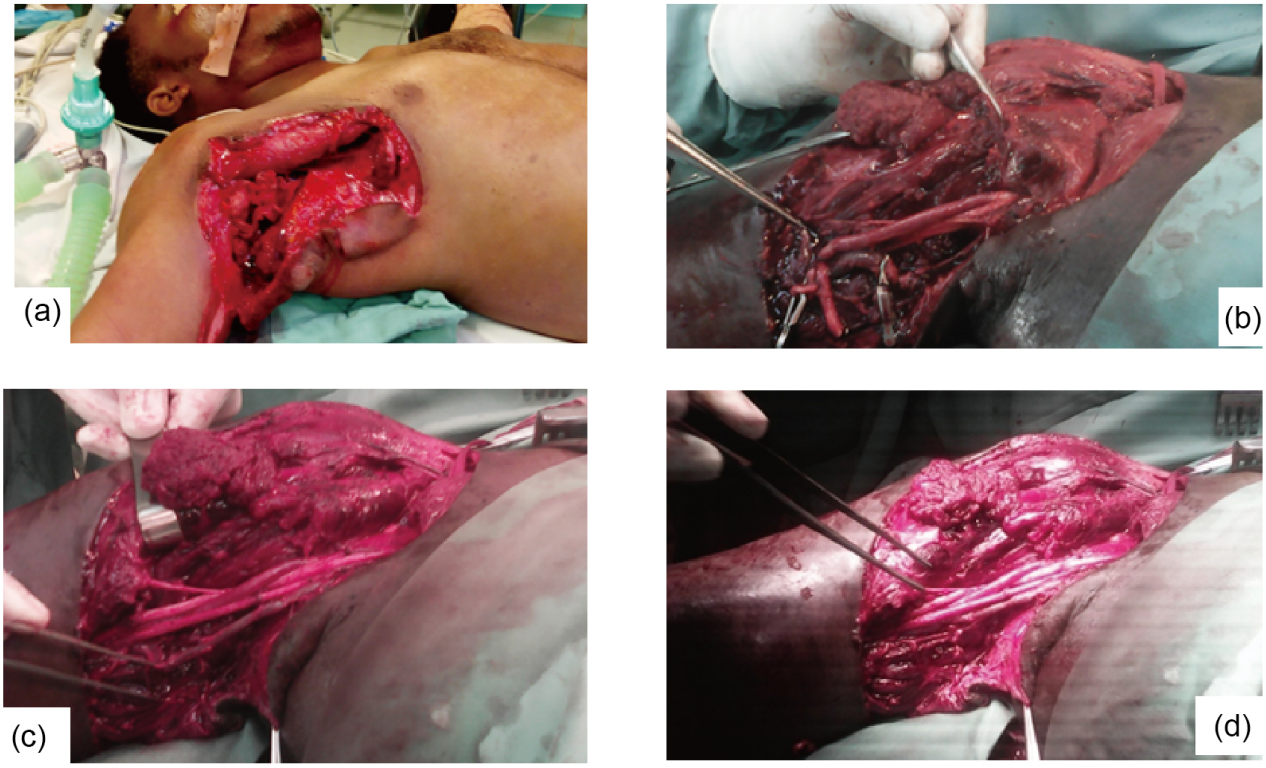

Figure 2. Right axillary traumatic injury. (a) Preoperative picture; (b) Control of vessels and brachial plexus bundles; (c) Start of vascular and nerve repairs; (d) End of vascular and nerve repairs.

Table 4. Types of vascular repairs according to lesions.

Repairs vascular / vascular Lesions	Direct suture	Prosthetic arterial bypass	Arterial and venous bypass by internal saphenous graft	Flattening-prosthetic graft	Total vascular lesions
Lateral wound of the axillary artery	n = 10 (29.41%)				N = 10 (29.41%)
Complete axillary artery and vein section	n = 3 (8.83%)		n = 9 (26.47%)		N = 12 (35.30%)
Axillary vein Complete section	n = 2 (5.88%)				N = 2 (5.88%)
Arteriovenous fistula	n = 1 (2.94%)				N = 1 (2.94%)
Axillary artery defect		n = 3 (8.82%)			N = 3 (8.82%)
Axillary artery Contusion		n = 2 (5.88%)			N = 2 (5.88%)
False aneurysm				n = 4 (11.77%)	N = 4 (11.77%)
Total vascular repairs	N = 16 (47.06%)	N = 5 (14.7%)	N = 9 (26.47%)	N = 4 (11.77%)	N = 34 (100%)

The early surgical results were marked, on the one hand by a failure of the re-vascularization with an amputation of the arm in 2.94% of the cases (n = 1) and on the other hand, by a partial muscular necrosis at the level of the forearm in 2.94% of cases (n = 1) having undergone secondary excision with major sequelae

to the thoracic limb. The medium-term postoperative course was marked by the persistence of distal paralysis of the thoracic limb after 6 months in 5.88% (n = 2) of all patients, *i.e.*, 8% of patients who presented with an attack of the brachial plexus. Surgical results at 12 months were marked by success without functional sequelae in 88.24% of cases (n = 30).

4. Discussion

Male and young age predominance was also found by Johnson *et al.* [9] and Dieng *et al.* [10]. This predominance can be attributed to the higher level of activity or mobility of the male subject in general, which exposes him to various traumas. The circumstances of occurrence in our study were dominated by stabbing attacks. While HYRE *et al.* [11] in a study on the aggressive management of vascular lesions of the thoracic outlet found a predominance of gunshot wounds in 54.29% of cases. Indeed the easy access to bladed weapons in Côte d'Ivoire could explain their predominance in terms of vulnerating agents. In addition, during certain traumas, axillary vascular and nerve damage can be indirect. That is the consequence of the upper extremity humerus fractures. These fractures are frequent in daily practice in orthopaedics-traumatology and represent approximately 5% of all fractures [12]. Paradoxically, the vasculo-nervous complications associated with these fractures are infrequent [13]. This explains their non-observation in our series. Direct associated vascular and nervous damage, during trauma to the axillary region, is frequent. Johnson *et al.* [9] and Degiannis *et al.* [14] respectively found in their series an association of axillary, subclavicular and brachial plexus lesions in 32.2% of patients and an association of axillary artery and brachial plexus lesions in 34.37% of patients. However, isolated vascular damage during axillary trauma is not so rare. Indeed Graham *et al.* [15] found isolated lesions of the axillary vein in 21.50% of patients, isolated lesions of the axillary artery in 47% of patients and associated lesions of the axillary vein and artery in 30.80% of patients. The predominance of arterial and/or venous acute lesions is also found by McKinley *et al.* [16] who, in a series on the management of lesions of the proximal axillary and subclavian artery, also found predominance of arteriovenous lesions but at a lower proportion of 50%. There are several methods available for the repair of vascular damage. They range from innovative endovascular methods such as that used by Chander *et al.* [17] for the repair of bilateral traumatic rupture of the axillary artery, to conventional surgical methods. These methods were dominated, in our series, by direct suture and prosthetic or vein bypasses. These results were comparable to those of Askoy *et al.* [18] who found a predominance of autologous vein graft interposition in 42% of patients followed by end-to-end anastomoses in 26.3% of patients. Hyre *et al.* [11] found no complications related to vascular repairs. Askoy *et al.* [18] found a failure of arterial reconstruction in 2.6% of cases during the perioperative period. Our results are less good and could be explained by the long delay before treatment. As for the results of nerve repair, they are variable and

multifactorial. Indeed McCready *et al.* [19] in a study on subclavian and axillary vascular trauma, found an improvement in neurological dysfunction in 6 patients, *i.e.*, 50% of patients who underwent neurological repair after nerve section. On the other hand, Johnson *et al.* [9] found no improvement in neurological status during a mean follow-up of 7.2 months. Our relatively good neurological results are due to the fact that most of the lesions were caused by stabbing, resulting in clean-edged wounds that were relatively easy to repair surgically.

5. Conclusion

Axillary vascular injuries are most often associated with brachial plexus injuries. Their diagnosis is easy in case of exteriorized hemorrhage and/or signs of ischemia and/or paralysis of the thoracic limb. Their surgical treatment, which must include vascular and nerve repairs at the same time, gives good results. However, if paralysis of the thoracic limb persists after 6 to 12 months, the patient should be referred to a specialist in brachial plexus surgery. Moreover, even unrecognized at the acute stage, certain axillary arterial lesions can progress to chronicity, marked by arteriovenous fistulas and false aneurysms.

6. Limits of the Study

The retrospective nature and the small size of the population studied constitute the main limitations of our study. Moreover, the lack of specification of the affected brachial plexus bundles is also to be included in the account of the limits of this study.

Conflict of Interests

The authors have no conflicts of interest to disclose.

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