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Adresse du Rédacteur en Chef / Adress of Editor-in-Chief
Prof. François ONDO N'DONG Fondation Jeanne Ebori
B.P 306 Libreville Gabon
Email : ondondong@yahoo.fr

Adresse du Rédacteur en chef-délégué / Addresse of Assistant Editor-in-Chief
Prof. Martin AGHAJI Dept of Surgery UNTH Enugu Nigeria
Email: maghaji@infoweb.abs.net

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An English summary and a French summary not exceeding 250 words accompany the manuscript. This summary must be stru ctured in the following way, for original work : objectives, methods, results and conclusions. For the clinical facts and the technical notes, the summary should not excced 100 words. 3 to 5 English and French key words must appear under the summaries.

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ANNALES 1er SEMESTRE 2018/ ANNALS 1st SEMESTER 2018

ANNALES AFRICAINES DE CHIRURGIE THORACIQUE ET CARDIO-VASCULAIRE/ AFRICAN ANNALS OF THORACIC AND CARDIO-VASCULAR SURGERY

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CHIRURGIE CARDIAQUE / CARDIAC SURGERY

SURGERY OF CARDIAC MYXOMA IN SUB-SAHARAN PATIENTS

R. ATIPO-GALLOYE[A,b], S.H.MOUMPALA[a], B.N.TSEYI OSSERE[a], G OKIEMY[a], R AJJAJA[c], R SAYAH[c], Y CHEIKHAOUI[c]

(a): General Surgery Department, University Teaching Hospital Brazzaville, Congo
(b): MARIEN NGOUABI University, Faculty of Medical Sciences, Brazzaville, Congo
(c): International University Teaching Hospital Cheikh Zaid, Rabat, Morocco

Correspondence: R. ATIPO-GALLOYE, MD
Senior Lecturer, Consultant, Faculty of Medical Sciences
University Teaching Hospital Brazzaville
General Surgery Department, University Teaching Hospital
Brazzaville, Congo.

Abstract

Objectives: Myxomas are the most common form of benign cardiac tumors. We present here a successful surgical treatment. The aim of this study was to present surgical cardiac cares of congolese patients abroad. **Methods and results:** Between 2011 and 2019, twelve patients were operated in our service for cardiac myxoma. There were 8 left atrium myxoma and 4 in right atrium. Mean age was 38 ± 4.5 years, and sex-ratio 0.7. In four cases, myxomas were findings at echocardiography, and the remain 8 patients had different symptoms: palpitations, syncopa, asthenia, angina. The diagnosis of myxoma has been well established by trans-thoracic echocardiography. Myxoma acess varies according to the site of implantation in our serie, no hospital mortality after surgery was noted **Conclusion:** Myxomas is considered to be rare, and remain an emergency with low operative risk, even in developing countries.

Keywords: Myxoma, cardiac surgery

Résumé:

Objectifs : Les myxomes représentent la principale tumeur bénigne cardiaque. Nous rapportons ici, la prise en charge chirurgicale des patients congolais à l'étranger par manque de plateau sur place. **Patients/méthodes** : Entre Juin 2011 et Décembre 2019, douze patients congolais (Brazzaville), ont été opérés à l'hôpital universitaire international Cheikh Zaid de Rabat, Maroc, pour un myxome cardiaque. **Résultats** : L'age moyen était de 38 ± 4.5 ans, avec un sex-ratio à 0.7. Le délai minimum entre le diagnostic et la prise en charge était de 2 ans. Tous ces patients étaient de bas niveau socio-économique. Sur les 12, 8 myxomes étaient localisés dans l'oreillette gauche. Huit patients étaient symptomatiques, chez les quatre autre, l'échocardiographie a été capital pour le diagnostic. La voie de Sondergaard a été principalement utilisée comme voie d'accés, avec dans quatre cas, des gestes complémentaires tels que : Plastie de

Devega, annuloplastie mitrale. Les suites opératoires ont été simples dans tous les cas.

Conclusion : Bien que, les myxomes représentent des tumeurs bénignes, leur localisation intracardiaque constitue un argument pour une prise en charge chirurgicale immédiate. Cela, permettrait d'éviter la survenue des complications.

Mots clés : Myxome, Chirurgie cardiaque

Introduction

Cardiac myxoma is one of the most encountered cardiac tumors. This tumor embryogically results of proliferation of cardiac stem-cells under endocarde lawer, especially in left atrial cavity. Most myxoma are located in the left atrium (75-80%), arising from interatrial septum at the border of the fossa ovalis. But, they can also originate by descending order of frequency from the right atrium, ventricles, vena cave, pulmonary trunk and aorta[1].In some cases, cardiac myxomas are associated with others lesions, such as; spotty skin pigmentation, endocrine overeactivity. Some authors, have called these complex association syndromes of Carney[2].Traditionally, surgical resection of atrial myxomas is accomplished via a sternotomy incision with the patient on cardiopulmonary bypass (CPB). Reports in recent literature indicate that robotic-assited resection of atrial myxomas is being performed, but this approach is still uncommon[3]. Among several complications, thromboembolic events remain a redoutable one, for potential pulmonary embolization, if right cavities location, coronary embolization, but especially cerebral with a risk of ischemic cerebrovascular event. Once a cardiac myxoma is diagnosed, surgical excision should be performed without delay, because of the risk of thromboembolic events[4].

In most developing countries, where facilities with surgical cardiovascular department are absent, patients with congenital or acquired cardiovascular diseases have poor prognosis. Myxomas, with the potential evolution to heart congestion, or thromboembolic events which may lead to death, and represent one of acquired heart diseases emergency. We report a series of congolese patients operated on Rabat, Morocco.

Patients/Methods

We carried out a retrospective study, from June 2011 to December 2019, at surgical cardiovascular department of the International Teaching Hospital Cheikh Zaid. All patients were from Republic of Congo, operated on cardiac myxoma during the study period have been included. Preoperative records were clinical data, trans thoracic echocardiography. Trans thoracic echocardiography revealed in all cases, the presence of interatrial mass (Picture 1). All patients beneficiated of classic biological exams for open heart surgery. In three cases, coronary angiogram has been requested before surgery, because patients were male, age more than 50 years, with existence of cardiovascular risk factors. All coronary angiogram was normal. Two female patients, have a history of benign chest tumor.

After providing written consent, patients have been operated under CPB, in normothermia, after performing median sternotomy. CPB was established between aortic, and two venous cannulas. Myocardial protection was antegrade cold blood cardioplegia in aortic root. In the case of isolate left atrial mass, Syndergaard incision has been the principal landmark for mass exploration. When, cardiac mass was located in right atrium cavity; right atriotomy incision has been selected. In near all case, the macroscopic feature was, a lobulated mass with an irregular surface and polypoid areas (Pictures 2, 3). Pathology revealed, an optical microscopic of myxoid stroma with stellate cells, without necrosis, mitotic activity, atypia or pleomorphism (Picture 4). Variables analyzed were: sociodemographic, clinical, echocardiographic, therapeutic data and evolution. Excel windows ten has been used for data treatment. Qualitative data were represented in percentages, and quantitative data in mean ± standard deviation.

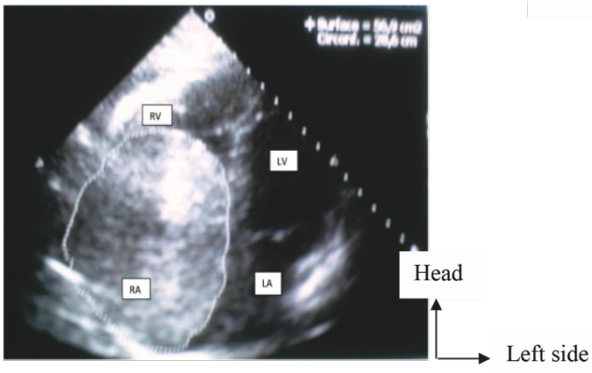

Image 1 : Four chambers view showing Right atrial myxoma

Image 2 : A lobulated mass with an irregular surface,polypoid areas

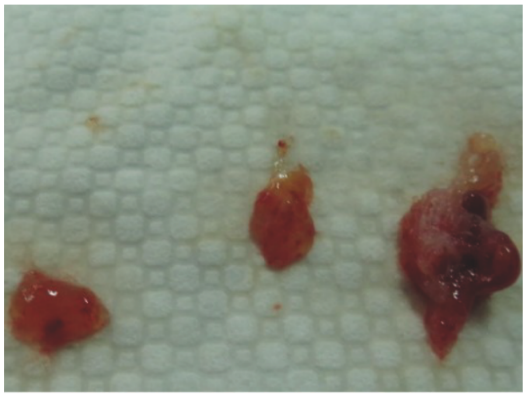

Image 3 : Sesile myxomas

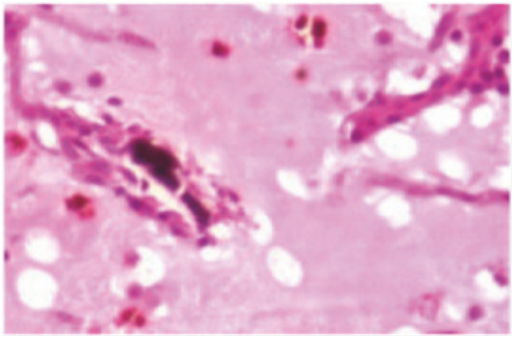

Image 4 : An optical microscopic view Of myxoid stroma with stellate cells without necrosis.

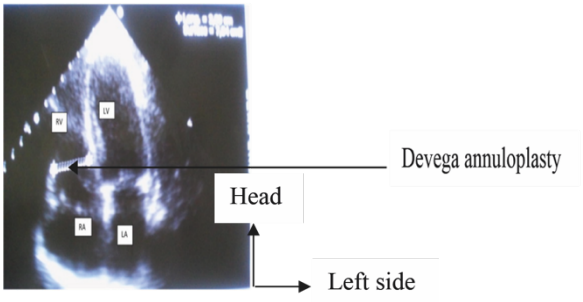

Image 5 : Postoperative view, after removing myxoma, with presence of Devega annuloplasty.

Results

I. Socio-demographic data

Twelve patients have been included. Mean age was 38± 4.5 years (extremes,32 to 58 years). The sex-ratio was 0.7.

II. Pre-operative data

Among twelve patients, eight (66.6%) were symptomatic. Asthenia was the principle symptom for consultation; table I summarized recorded clinical data.

Symptoms	No. of Patients	%
Asthenia	6	50
Angina	4	33
Syncopa	2	17
Palpitations	4	33
Fever	3	25

Table I: Preoperative symptoms

C-Reactive Protein were high in all patients, and ten patients were anemic. Two (%) patients had transient ischemic cerebral vascular accident one year before. Three patients had at physical exam, symptoms of mitral stenosis. At TTE, eight patients have myxoma located in left atrium and four in right atrium.

III. Surgical data

Mean time of CPB was 49 ± 2.5 min (range, 35-65 min), and the mean cross clamp time was 24 ± 1.5 min (range,20-34 min).

a) Cardiac access

Table II, summarized cardiac access to myxoma per-operatively.

Cardiac access	No. of Patients	%
Biatrial*	2	17
Left atriotomy**	8	66
Right atriotomy	2	17

Table II: Surgical approaches
*Guiraudon access
**Sondergaard access

b) Associated procedures

In other cases, associated techniques were used.

Associated gestures	No. of Patients	%
Devega annuloplasty	2	17
Mitral annuloplasty	1	8
Mitral valve replacement	1	8
None	8	67

Table III: Associated Procedures

c) Post-operative data

Mean of follow-up was 36 ± 2.5 months (range,28 to 60 months) Trans-thoracic echocardiography revealed no residual cavity tumor. There had mild mitral regurgitation in one patient, whom concomitantly has a mitral annuloplasty. There had no tricuspid regurgitation, in two patients with Devega annuloplasty, picture 5. There is no postoperative arrhythmias.

Discussion

Primary cardiac neoplasms are rare, and their indicence in autopsy reviews vary between 0.0017 and 0.19%, less than 5% of all cardiac tumors[5]. Among benign cardiac tumors, myxomas represent about 50%. Histologically, myxomas derived from mesenchymatous, pluripotents cells under endocarde. Majority of myxomas are located in left atrium in 75-80%, right atrium about 18%; and rarely in ventricles, vena cava, pulonary trunk and aorta[6,7]. Physical signs or symptoms, may be varied. More often, mean age of patients affected by myxomas is 50 years, with range 15 -80 years, and female predominance. Manifestation may be sporadic, or myxomas might result in association of others abnormalies such as; spotty skin pigmentation, endocrine overeactivity, which may define Carney's syndrome[2]. Genetic analysis are necessary to confirm Carney syndrome diagnosis. In our series, we have two patients with extracardiac abnormalies, these refer to clinical manifestations of this syndrome. We did not realize genetic analysis; because of high cost of these tests, and our patients have low socio-economic conditions. Clinical manifestations vary according to the site of implantation. If the tumor is located in right cavities; superior and inferior vena cava syndromes may be present. Pulmonary edema might complicate left cardiac cavities myxomas. Constitutional symptoms can consist of fever, weight loss, and malaise, with associated laboratory abnormalities of anemia, elevated c-reactive protein, and increase gamma globulin[8]. The constitutional symptoms have been correlated with increased levels of plasma IL-6[8]. Cardiac symptoms include dyspnea, palpitations, syncope, angina, and fatigue. Typical symptoms of mitral stenosis result from pulmonary hypertension. Once, the diagnosis has been confirmed, principal risks are represented by thromboembolic events, congestion symptoms, and potential evolution in certain cases to valvular stenosis. Thromboembolic events may be central ischemic cerebro-vascular, or peripheral ischemic complication in our conditions, with limited access to surgical treatment of cardiovascular diseases, most often, patients, at least have one of these complications. Our reality is that, time between diagnosis and surgical treatment may last at least two years. Because, patients are poor, and wait for aid by health public system. Trans-thoracic echocardiography (TTE) remains the gold standard for cardiac myxomas. Esophageal echocardiographic is more accurate than TEE[9]. To avoid these complications, surgical approach represents the cornerstone of therapeutic attitude. Usually, surgical excision is lead under CPB, in normothermia, and with myocardial

protection. About surgical approach for cardiac incision, there is no consensus among different surgical cardiac teams around the world. Some authors, advise that the choice of cardiac incision may be in correlation with myxoma site of implantation, or also existence of other cardiac abnormalities[10-12]. In our series, in every case of isolated left atrial myxoma, we prioritize left atriotomy Sondegaard access. If we need to evaluate right atrium either for myxoma excision, or tricuspid reparation, we opt for biatrial incision (Guiraudon access); and in the case that only the right atrium is concerned, we used simple right atriotomy. In most cases, surgical results are excellent[13.14]. Evene if, in the literature, some authors report cases of recurrence. However, currently it is thought that the major factor in recurrence is the genetic predisposition to multiple and recurrent tumors, and the removal of the septum is no longer thought to be absolutely mandatory[15]. The current risk of recurrence in sporadic myxoma cases is between 2% to 5%[16]. The mean follow-uo in our serie was short, but we do not identify any case of recurrence among our patients.

Conclusion

Cardiac myxomas are characterized by clinical polymorphism. Echocardiography remains the cornerstone for the diagnosis. It is a benign tumor. Thus, surgical treatment is mandatory to ameliore the patient prognosis, with less peri-operative morbidity and mortality. Our governement might change their policy, to promote local development of surgical cardiovascular facilities for helping populations with very low cost of cardiac surgery at low cost.

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CHIRURGIE CARDIAQUE / CARDIAC SURGERY

SURGICAL TREATMENT OF AORTIC COARCTATION IN ADULTS

R ATIPO-GALLOYE[A, B], S.H MOUMPALA[A], B.N TSEYI OSSERE[A], G OKIEMY[A], R AJJAJA[C], R SAYAH[C], Y CHEIKHAOUI[C]

(a) : General Surgery Department, University Teaching Hospital Brazzaville, Congo
(b): MARIEN NGOUABI University, Faculty of Medical Sciences, Brazzaville, Congo
(c): International University Teaching Hospital Cheikh Zaid, Rabat, Morocco

Correspondence: R. ATIPO-GALLOYE, MD
Senior Lecturer, Consultant, Faculty of Medical Sciences
University Teaching Hospital Brazzaville
General Surgery Department, University Teaching Hospital Brazzaville, Congo.

Abstract:

Objectives: Surgical treatment of aortic coarctation in adults may be feasible. Limited studies have reported the surgical outcomes of coarctation repair in this particular population. The aim of this retrospective study was to determine the impact of coarctation surgical repair on arterial blood pressure in adults more than 18 years of age. **Methods:** We retrospectively reviewed all patients who underwent operation between 2011 and 2019 in our adult cardiovascular surgery department. Only patient with isolated aortic coarctation without complex congenital heart diseases were operate. All patients were operating by left posterolateral thoracotomy. **Results:** The mean age was 27.33 ± 5.9 years, and 9 patients (%) were asymptomatic. Reconstruction of aortic coarctation with end-to-end anastomosis was performed in majority in majority of patients (73.33%). There was no in-hospital mortality. Two patients were lost for follow-up. In remain 13 patients, the mean postoperative systolic blood pressure was 122.00 ± 13.86 mm Hg versus 168.33 ± 19.45 mm Hg (t=8.48, p=0.000), and mean gradient was 7.87 ± 5.93 mm Hg. Nine patients were normotensive; among then, 5 were normotensive without any antihypertensive drugs at last follow-up. **Conclusion:** Patients with native adult aortic coarctation have low in-hospital morbidity when treated with an open surgical reconstruction. However, long term surveillance is mandatory to identify patients with potential systemic hypertension.

Keywords: Coarctation of aorta, surgery, adults.

Résumé

Objectifs : Le traitement chirurgical de la coarctation de l'aorte est possible chez l'adulte. Il existe peu d'articles sur la chirurgie de la coarctation dans cette classe. L'objectif de cette étude était d'évaluer l'impact de la chirurgie sur l'évolution de l'hypertension artérielle. **Patients/Méthodes** : Il s'est agi d'une étude rétrospective, réalisée dans le service de chirurgie cardiovasculaire de l'hôpital universitaire international Cheikh Zaid de Rabat. Tout patient opéré pour coarctation de l'aorte, et ayant un âge d'au moins 18 ans a été inclus. Tout cas de cardiopathie complexe a été exclus. **Résultats** : L'âge moyen était de 27.33 ± 5.9 ans, neuf patients (%) étaient asymptomatiques. L'approche thérapeutique end-to-end a été la plus utilisée avec 73.33%. Il n'y a pas eu de mortalité hospitalière. Deux patients étaient perdus de vue, parmi les treize restants ; la pression artérielle systolique post opératoire était de 122.00 ± 13.86 mm Hg Vs 168.33 ± 19.45 mm Hg (t=8.48, p=0.000), et le gradient était de 7.87 ± 5.93 mm Hg. Neuf patients étaient devenus normotensifs, parmi eux, cinq ne prenaient aucun médicament anti-hypertensif au dernier contrôle. **Conclusion** : Les patients adultes avec coarctation aortique native peuvent être traités chirurgicalement avec une mortalité et morbidité faible. Cependant, la surveillance à long terme est nécessaire pour le suivi de l'impact de la chirurgie sur l'hypertension artérielle.

Mot clés : Coarctation, aorte, chirurgie, adulte.

Introduction

Since the first surgical repair of aortic coarctation by Crafoord and Nylin in 1945 Surgical techniques have evolved, aiming to reduce early and late mortality as well as minimise long-term sequelae such as re-coarctation and late aneurysm[1]. Many questions remain unanswered about benefits of coarctation repair in adults. Unrepaired aortic coarctation results in high morbidity and mortality from hypertension and associated problems including myocardial infarction, heart failure, aortic rupture, infective endocarditis, coronary disease and inracranial hemorrhage[2,3]. Usually, when patients are younger than 10 years at operation, the survival probability is highest. Several reports indicated poor resolution on hypertension postoperatively in older patients[4.5]. Some authors, suggest that the best age for coarctation repair is approximately 1.5 years [6]. Meanwhile, few data suggest that, surgical repair even in adluts, is safe and improve systemic hypertension[7].The purpose of this study, was to evaluate the fate of hypertension after surgical repair of aortic coarctation in adults.

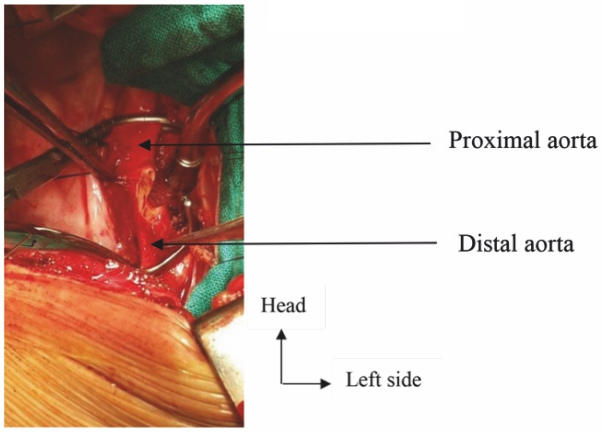
Patients and Methods

We carried out a retrospective study, between 2009 and 2012, 15 adults (≥ 18-years old) underwent repair of aortic coarctation, at cardiovascular surgical department of International Teaching Hospital Cheikh Zaid at Rabat. Patients presenting to this service above age 18 years, with simple aortic coarctation (defined as having no associated congenital heart disease (CHD) except bicuspid aortic valve, persistent ductus arteriosus) were included. Five patients

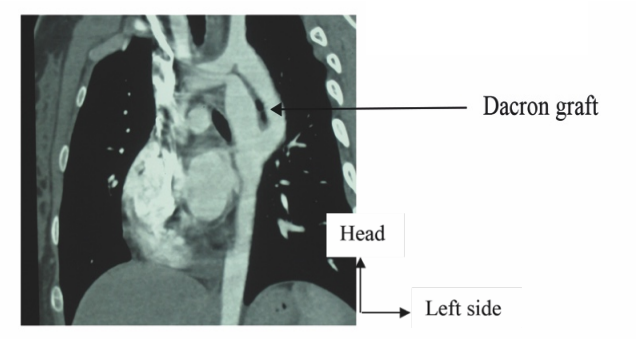
with aortic coarctation in conjunction with other complex CHD were excluded. There included double-inlet RV in 1 patient, Eisenmenger's syndrome due to unrepaired VSD in 1 patient, subaortic stenosis in 2 patients, and Shone's complexe in 1 patient. Preoperative symptoms are summarized in table I. Six patients (%) presented with at least one symptom. For the other 9 patients, the diagnosis made by physical examination was prompted by the discovery of high blood pressure. Clinical findings were a systolic murmur in 2 patients, and femoral pulses were absent in 10 patients. Preoperative and postoperative blood pressure measurements were obtained simultaneously in the left and right arms and lower limbs. In accordance with guidelines established by Joint National Committee, criteria for hypertension, systolic arterial hypertension was defined as follows: mild if systolic blood pressure ranged between 140 and 159 mmHg ; moderate, 160 to 179 mmHg ; severe, 180 to 210 mmHg ; and very severe ≥ 210 mmHg. According to those criteria, and at preoperative evaluation, 4 patients had moderate, 9 had severe, and 2 patients had very severe hypertension. The patients were divided into groups according to the number of antihypertensive drugs taken before surgery and at the time of the last follow up. The drugs included diuretics, beta blockers, vasodilators, calcium channel blockers, angiotensin-converting enzyme inhibitors and angiotensin II receptors inhibitors. Left ventricular hypertrophy was found on electrocardiogram in all patients, rib notching was present in 13 patients, and a dilated mammary artery was found in 2 patients. Two patients had a bicuspid aortic valve with no regurgitation. Coarctation repair was carried out through left thoracotomy. End to end anastomosis was the principal surgical approach in 11 patients (picture 1), resection with interposition of a Dacron tube graft (size 22) in 2 patients, patch aortoplasty with Dacron in 1 patient, and in one case we realized an extra-anatomic shunt; the coarctation was bypassed by a Dacron tube graft between the ascending and descending aortas (picture 2). All 15 patients presented a systemic hypertension. Variables analyzed were sociodemographic, clinical, echocardiographic, therapeutic data and evolution. Data are presented as the mean ± standard déviation, Systolic gradient across the coarctation before and after repair were compaired using a paired *t* test. A value of *p* less than 0.05 was considered significant.

Symptoms	N° of Patients	%
Vertigo	5	33
Asthenia	4	27
Palpitations	4	27
Syncope	2	13
Claudication	3	20
Angina pectoris	1	7

Table I: Preoperative symptoms in 6 patients*
*Nine patients (60%) were asymptomatic.



Picture 1: Operative view of End to End Anastomosis



Picture 2: Sagital view, postoperative result of a proximal and descending aorta bypass.

Results

1) Socio-demographic data

Mean age was 27,33 ± 5.49 years (extremes, 18-36 years). Median was 27, the value of Q1 was 23, and Q3 was 32. Sex-ratio was 2. Table II, illustrates repartition of patients by age and sex.

2) Surgical procedures

The End to end anastomosis was the most frequent surgical procedure practice surgical intervention (73.33%). Table II.

Type of surgery	M		F		Total	
	n	%	n	%	n	%
End to end Anastomosis	7	70,00	4	80,00	11	73,33
Dacron graft interposition	2	20,00	0	0,00	2	13,33
Subclavian flap aortoplasty	0	0,00	1	20,00	1	6,67
Subclavian-aortic bypass	1	10,00	0	0,00	1	6,67
Total	10	100	5	100	15	100

Table II: Repartition of patients according to type of surgery and sex.

3) Hypertension

All patients were hypertensive before surgery. Systolic blood pressure in patients ranged from 140 to 200 mm Hg, with a mean of 168.33 ± 19.43 mm Hg. Mean diastolic blood pressure was 90 ± 12.5 mm Hg (range, 65 to 135 mm Hg). Hypertension was severe in 6 patients, moderate in 4, and mild in 5. The peak systolic gradient across the coarctation in 12 patients 64.93 ± 19.74 mm Hg (Range 38 to 120 mm Hg); the gradient across the coarctation segment could not be assessed in the other 3 patients who had very little forward flow in the aorta. Most patients (11/15, 67%) were on a regimen of at least one antihypertensive drug (figure 2).

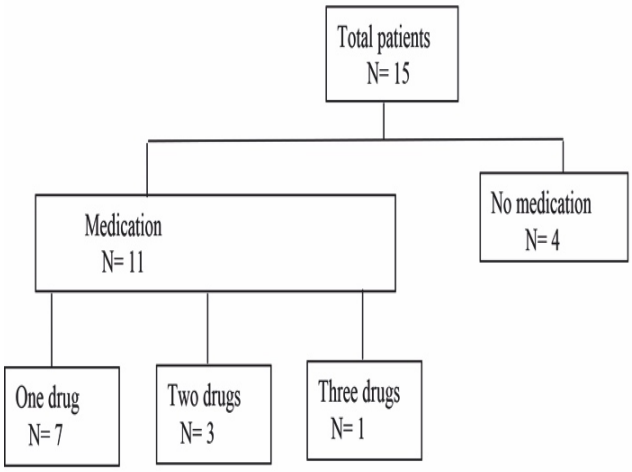


Figure 2: Preoperative anti-hypertensive medication.

Patients were followed up after coarctation repair for 5 to 27 months (mean, 13.73 ± 7.95 months). There was no death. Of all patients with pre-operative hypertension, two were lost to follow-up, remain 9 patients were normotensive (systolic blood pressure < 140 mm Hg) at the most recent follow-up. Mean systolic blood pressure after

the correction in the 13 hypertensive patients who were followed up completely was 122.00 ± 13.86 mm Hg (Range:100-150 mm Hg); compared to the pre-operative value, difference was significant (T=8.48, P=0.000). Mean sistolic blood pressure (65 ± 9.5 mm Hg) was also significantly reduced (T=5.9, P=0.000). Post-operative gradient across the repaired segment was trivial (≤ 10 mm Hg) in 8 patients, mild (≤ 20 mm Hg) in 4 patients, and moderate (> 20 mm Hg) in one patient. Mean post-operative gradient across the repaired segment was 7.87 ± 5.93 mm Hg. Table III, summarizes peri-operative evolution of pressures and gradients.

Variables	Mean	SD	T	P	IC95%
Pressures					
Pre-operative	168,33	19,43			
Post-operative	122,00	13,86			
Paired T test : Pre-operative-Postoperative	46,33	21,17	8,48	0,000	[34,61 ;58,06]
Gradients					
Pre-operative	64,93	19,74			
Post-operative	7,87	5,93			
Paired T test : Pre-operative-Post-operative	57,06	20,58	5,9	0,000	[45,67 ;68,46]

Table III: Comparison between pre-operative and Post-operative pressive gradient.
T : Student Test ; SD: Standard deviation

Five (55%) patients were taking no medication at the last follow-up. Two of the 4 other patients required only a single agent, one required two drugs, and one three drugs. Figure 3 showed post-operative hypertensive status and medication.

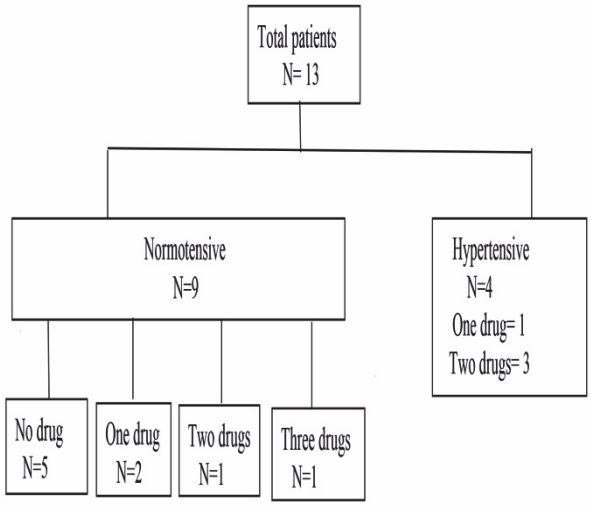


Figure 3: Post-operative anti-hypertensive medication

3) Associated anomalies

A bicuspid aortic valve was associated with the coarctation in 2 patients and their valves were functional with no significant gradient at first examination. A moderate enlargement of the internal mammary arteries in 2 patients.

Discussion

The natural history of the coarctation has been well documented by Campell[2], who demonstrated that 50% of untreated patients were dead by the age of 30 years, 75% at 46 years, and 90% at 58 years. Comparing these data with normal life expectancy tables, we observed that there was a high increase in mortality during the third to fifth decades of life. Age at the time of initial repair of coarctation is the most important predictor of late

hypertension[8,9]. For this reason, there has been some reluctance to refer older adults for coarctation repair, and it has been suggested that patients with repaired coarctation of the aorta, may be "fixed but no cured"[10]. Presbitero and al, whose postoperative follow-up ranged from 15 to 30 years, reported improved life expectancy after surgery[11].In our series, end to end anastomosis remained the cornerstone of aortic coarctation. A graft interposition was used whenever adequate resection of the narrowed segment resulted in too great discrepancy to permit direct suture of the aorta. In one case, we used a bypass between proximal and distal aortas. Certains surgical difficulties may be noted during aortic coarctation repair in adults, such as; thickness of the aortic wall, severe calcifications, difficulties in aortic arch mobilization, and large collateral arteries with aneurysmal dilatation. In these cases, a prothesis should be used to avoid traction on aortic ends. In some cases, bypass grafting between the proximal aorta and the distal aorta should be the procedure of choice. Aris and al, performed operations on 8 patients over 51 years using this technique and achieved good results[12]. This procedure requires less aortic dissection, can be peformed with a partially occluding clamp, and does not compromise the spinal cord vascularization. Persistent hypertension or hypertension recurring or developing after coarctation repair is the most important factor of morbidity and mortality associated with advancing age in patients. Some series, found that the younger the age the operation was performed the greater the postoperative reduction in blood pressure[13-15]. Also, late hypertension was more common when the operation was delayed until the age of 20 years.In our study, all patients had systolic preoperative hypertension. Of these, two were lost to follow-up and 9 (69%) were normotensive at the recent follow-up. The mean systolic blood pressure was significantly less than the preoperative value. This result is in agreement with Y and al, that found hypertensive patients had significantly improved systolic blood pressure postoperatively, and the majority were normotensive[16,17]. The mean post-operative gradient across the repaired segment was significantly reduced. Another finding was that 5 (38%) patients were taking no medication at the last follow-up. Persistent hypertension after aortic coarctation repair is multifactorial[18-20]. In adults, these factors include; anatomic aortic alterations, functional and structural wall alterations of thoracic peripheral vessels, poor compliance of arterial tree, endocrine factors, and altered renin-angiotensin system[21]. After repair, patients have an increased sympathetic discharge at peak exercise leading to increased peripheral resistances.

Conclusion

Thus, with small number of patients, the results of this study confirm that surgical repair of aortic coarctation in patients older than 18 years of age reduces systolic hypertension. However, we think in the future realize study in large cohort, and appreciate the incidence of ischemic heart disease and also major cardiovascular and cerebro-vascular events (MACCE).

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CHIRURGIE VASSCULAIRE / VASCULAR SURGERY

FALSE TRAUMATIC ANEURYSM OF THE LEFT RADIAL ARTERY IN A TEENAGER

R. ATIPO-GALLOYE[ab], S.H MOUMPALA[a], B.N TSEYI OSSERE[a], G OKIEMY[a].

(a): General Surgery Department, University Teaching Hospital Brazzaville, Congo

(b): MARIEN NGOUABI University, Faculty of Medical Sciences, Brazzaville, Congo

Correspondence: R. ATIPO-GALLOYE, MD
Senior Lecturer, Consultant, Faculty of Medical Sciences
University Teaching Hospital Brazzaville
General Surgery Department, University Teaching Hospital
Brazzaville, Congo.

Abstract

A 17-year-old man sustained a minor penetrating injury to his left foreman, resulting in false aneurysm formation. It is a generally rare unrecognized pathology. Complications are serious: embolism and thrombosis of interdigital arteries. The diagnosis is based on the presence a pulsatile mass, with finger dysesthesia. It is confirmed by duplex Doppler. Surgical treatment was successful

Keywords: False, aneurysm, radial artery, surgery.

Résumé :

Les anévrysmes des artères de la main sont le plus souvent d'origine traumatique. Il s'agit d'une pathologie assez rare, aux conséquences parfois graves, car se compliquant de thrombose ou d'embolie distale au niveau des artères interdigitales. Le diagnostic est suspecté devant une masse pulsatile, sensible, associée à des dysesthésies des doigts. La confirmation est apportée par l'échographie doppler.

Nous rapportons le cas d'un adolescent présentant un faux anévrisme de l'artère radiale post traumatique traité chirurgicalement.

Mots clés : Faux, anévrisme, artère radiale, chirurgie.

Introduction

A false aneurysm is defined as extravasation of blood with hematoma formation outside the lumen of an artery, which is contained by the surrounding tissue and continues to communicate with the vessel.

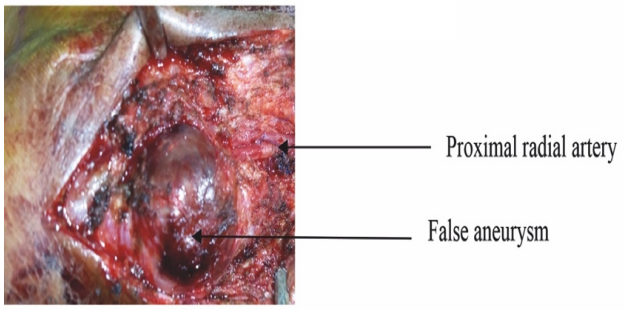
Penetrating trauma is the most common cause and increasingly this is iatrogenic secondary to the increase number of endovascular procedures[1,2]. We report a case of false traumatic aneurysm of left radial artery in a teenager patient, successfully treated by open surgery.

Case report

A 17-year-old man, who cut his left wrist with a nail, presented to the Emergency department 28 days later, with a painful lump on the site of trauma. Physical examination revealed a pulsatile mass on the lateral region of his left wrist. There was no neurological deficit and Allen's test demonstrated that both the radial and ulnar arteries were patent and that the palmer arch was intact.

Duplex ultrasonography confirmed the diagnosis of a false radial artery aneurysm, which measured 2 mm of great diameter (Picture 1). Given its size with local pressure effects on the skin and spontaneous risk of breaking, we decided to intervene, after writing consent of the patient. A requirement to reduce the tension on the skin to prevent subsequent pressure necrosis, made surgery the most appropriate option in this case. After skin incision, we note a voluminous false aneurysm (Picture 2). We performed an exclusion of the false aneurysm from the native radial artery, and direct suture with 3-0 polypropylene. under loco-regional anesthesia by brachial plexus blocked. At one month follow up, he was asymptomatic with no post-operative complications.

Picture 1: Doppler view of false neurysm.



Picture 2: Pre-operative view of false radial artery aneurysm after dissection.

Discussion

False and true radial artery aneurysm in teenager are less frequent. Most of time, trauma is the predominant etiology. Diagnosis is evoked in the presence of complications. As Radial nerve injury by compression, with hypoesthesia at thenar eminence. Other potential complications are distal embolization, which might lead to possible ischemia of the extremities.

In our case, we had radial artery damage by direct trauma. Clinical presentation showed a pulsatile mass, without neurological deficit. False radial aneurysms in teenager are less frequent, as reported by some authors[3]. Exceptional cases of false traumatic axillary artery aneurysms had been reported[4]. In most cases, direct trauma, lead to neither complete arterial section, or incomplete arterial lesion. A pulsatile mass and direct trauma notion, are sufficient to evoke false aneurysm even when complications are absent. Confirmation of the diagnosis has been realized by duplex ultrasonography. In our institution, arteriography has not been realized. Once diagnosis has been done, surgery is urgent. Several therapeutic approach might be used, such as: conventionnal surgical approach, catheterization, or

embolization with coils. Our department, has only one therapeutic option, surgical approach. We realize false aneurysm exclusion by direct suture of a tear between the radial artery and the aneurysm hull. Therapeutic attitude is controversial. Some authors, defend surgical approach with systematic revascularization, to prevent thromboembolic events in one hand. Revascularization by end to end, saphenous vein graft interposition is feasible with good results[6]. Therapeutic abstention may be possible, in asymptomatic and patients with small aneurysm[7]. In the presence of painful mass, with difficulty to work or practice sport, or existence of neurologic symptoms; aneurysm excision is mandatory[8,9]. If contra-lateral artery is dominant, and collateral vessels well developed, simple ligation of injury artery may be indicated[10]. Others therapeutic technics might be used, for example interventional approach[11]. Komorowska et al[12], reported their results about intraarterial thrombin injection under duplex ultrasonography.

Conclusion

Diagnosis of false radial aneurysm in a teenager, might be evoked when specific symptoms are presents, in the context of penetrant trauma in history. Duplex ultrasonography, is essential for the diagnosis. Surgical revascularization remains the landmark for the treatment to prevent complications.

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CHIRURGIE THORACIQUE / THORACIC SURGERY

CLOSED PLEURAL DRAINAGE AFTER CHEST TRAUMA AT BOUAKE TEACHING HOSPITAL, BOUAKE, COTE D'IVOIRE

MENEAS GC [1, 2], ABRO S [1], YANGNI-ANGATE KH [1].

1- Department of Cardio-vascular and Thoracic Diseases, and Anatomy Unit, Bouake Teaching Hospital, Bouake, Cote d'Ivoire
2- Abidjan Heart Institute, Abidjan, Cote d'Ivoire

Correspondence: Koffi Herve Yangni-Angate, Chairman
Department of Cardio-Vascular and Thoracic Disease and Anatomy Unit,
Bouake Teaching Hospital, Bouake, Cote d'Ivoire.

Introduction: Pleural drainage is the most common surgical procedure performed in thoracic surgery. It has become the care standard for the management of pleural effusion. The aim of this study was to report our experience on pleural drainage at Bouake Teaching Hospital,Bouake Cote d'Ivoire. **Patients and Methods:** This is a retrospective study from January 2010 to September 2017 of 90 pleural drainage performed in 81 men and 9 women. Mean age was 35.14 years (range: 9 months-83 years). The procedure, indications and results of pleural drainage were analyzed. **Results:** Among 115 chest trauma received, 90 (78,26%) needed closed pleural drainages Traumatic hemopneumothorax was the most frequent indication of closed pleural drainage (n=67; 93.05%) and we used the British Society of Thorax (BTS) procedure to perform all closed pleural drainage. Eleven failures (15.27%) of closed pleural drainage required a thoracotomy. There was no hospital mortality and overall morbidity rate was 1.21%. The drain was removed after 6.14 days (range 3-17 days). **Conclusion:** Traumatic hemopneumothorax remains the first indication of pleural drainage with good results and low failure rate.

Keywords: Pleural drainage, Thoracic surgery, Chest trauma.

Introduction

Pleural drainage consists of evacuating, by a chest tube, the pleural effusion[1]. It is the most commonly performed surgical procedure in thoracic surgery[2]. The first description of a closed tube was done in 1867 by Hewett[3]. After the second world war, it has become the standard of care for management of chest trauma[4]. The aim of this study was to report our experience on pleural drainage at Bouake Teaching Hospital, Bouake, Cote d'Ivoire.

Patients and methods

This is a retrospective study from January 2010 to September 2017. We reviewed 90 pleural drainages performed in 81 men and 9 women. Mean age was 35.14 years (range: 9 months-83 years). Procedure, indications and results of pleural drainage were analyzed.

Results

Procedures

Equipment

Before commencing the procedure, we have listed and obtained all the equipment required to insert a chest tube. The necessary equipment was: sterile gloves and gown, skin antiseptic solution, e.g. iodine, sterile drapes, gauze swabs, syringes and needles (21–25 gauge), local anaesthetic, e.g. lignocaine (lidocaine) 2%, scalpel and blade, suture (e.g. “1” silk), instrument for blunt dissection (e.g. curved clamp), chest tube, connecting tubing, closed drainage system (including sterile water if underwater seal being used), dressing.

Patient consent

Prior to commencing chest tube insertion, the procedure, we explained fully to the patient and consent recorded

Patient position

The patient was lied on the bed, slightly rotated, with the arm on the side of the lesion behind the patient’s head to expose the axillary area.

Site of chest tube insertion

We inserted the chest tube in the mid axillary line, through the “safe triangle” of British Thoracic Society (BTS) [5] illustrated in **Figure 1**. This is the triangle bordered by the anterior border of the latissimus dorsi, the lateral border of the pectoralis major muscle, a line superior to the horizontal level of the nipple, and an apex below the axilla. Before insertion the chest tube, we aspirated air or fluid with a needle at the time of anaesthesia to confirm the site of drain insertion

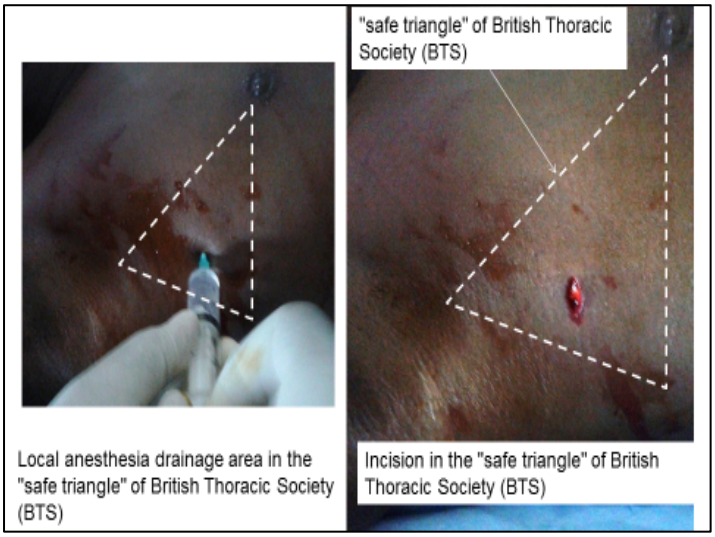

Figure 1: Picture to illustrate the "safe triangle"

Chest tube size

We used 24-28 F chest tube in pneumothoraces and 24-28 F chest tube in the case of acute haemothorax.

Aseptic technique

• We employed during chest tube insertion, rigorous Aseptic measures and prophylactic antibiotics to avoid infection complications.

Anaesthesia

• We infiltrated ocal anaesthetic prior to insertion the drain **(Figue 1).**

Figure 2: Wound dressing after chest tube inserted

Figure 3: Picture of the patient doing the pulmonary re-expansion physiotherapy session

Insertion of chest tube

Incision

Once the anaesthetic has taken effect a skin incision is made. After a skin incision whose diameter is similar to the diameter of the tube being inserted. The incision was made just above and parallel to a rib.

Blunt dissection

We performed Chest drain insertion without substantial force by blunt dissection through the chest wall and into the pleural space before chest tube insertion.

Chest tube position

Any chest tube intrathoracic position confirmed on radiographic was considered satisfactory.

Chest tube security

We inserted two sutures: the first to assist later closure of the wound after drain removal and the second, a stay suture, to secure the drain. Using non-absorbable (e.g. “1” silk).

Management of drainage system

Closed system drainage

In all cases the chest tube was connected to a suction pump. In all cases, the dressing is done **(Figure 2)** and the chest tube was connected to a suction pump **(Figure 3)**.

Suction

In all cases we performed a non-continuous suction via the underwater seal at a level of 25 cm H2O.

Removal of the chest tube

The drain was removed once: 1) a reduction in the daily output of the drain less than 1-2 ml / kg / day for 48 to 72 hours, 2) a lack of bubbling or spontaneous, neither at the cough nor after a test of clamping of the drain 3) Pulmonary re-expansion is achieved with the return of the lung to the wall at the standard chest X-Ray. Re-expansion pulmonary physiotherapy was systématic in all patients **(Figure 4)**.

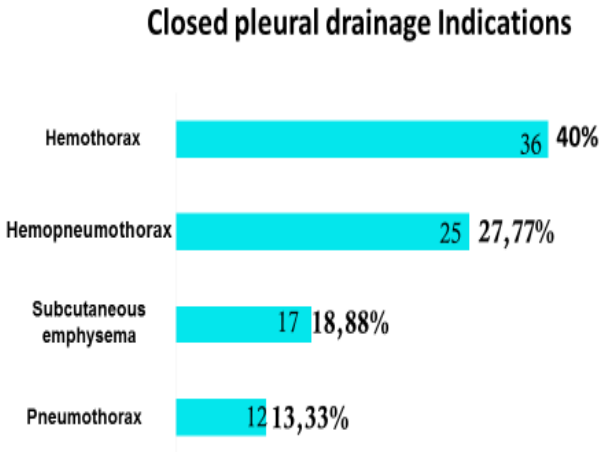

Figure 4: liste of closed pleural drainage indications

Indications

Figure 4 lists the closed pleural drainage indications. The main indications were Hemothorax (n=36; 40%), Hemopneumo-thorax (n=25; 27,77%), Subcutaneous emphysema (n=17; 18,88%), Pneumothorax (n=12; 13,33%),

Post-drainage results

Immediate Results

Immediate results were good (n=76; **84,44%**) with 4 failures cases 4,44which required a thoracotomy. There no hospital mortality. Drainage average length was **6.14 days** (range 3-17 days).

Discussion

Indications in pleural traumatic effusions

Hemothorax

According to an Eastern Association for the Surgery of Trauma guidelines[12] From the Department of Surgery in Wake Forest University in USA in 2011, pleural drainage by chest tube is the primary mode of treatment for hemothorax. large-bore chest tubes, usually 36 F to 42 F, is the traditional means used to achieve adequate drainage in adults. However, surgeons debate how large a hemothorax can be safely observed. Eastern Association for the Surgery of Trauma guidelines suggest tube thoracostomy (TT) be considered for all traumatic hemothoraces. However, previous research has suggested that some traumatic hemothoraces may be observed safely. Demetri L et Al[13], in 2018 in USA have conducted a study to determine the safety of selective observation for traumatic hemothorax and to identify predictors of failed observation.

They found that (66%) of traumatic hemothorax were successfully observed and according to the result, four independent predictors of failed observation were identified: older age, fewer ventilation-free days, large hemothorax ie ≥300 cc based on chest computed tomography (CT) scan measurements, concurrent pneumothorax. We think that the debate remains open. Otherwise, Eastern Association for the Surgery of Trauma guidelines[12] suggest that Persistent retained hemothorax, seen on plain films, after placement of a thoracostomy tube should be treated with early VATS, not a second chest tube (Level 1).

Pneumothorax

There is a paucity of literature regarding the traumatic pneumothorax optimal management, including the role of conservative treatment[14]. Current guidance by the American College of Surgeons Advanced Trauma Life Support[15] advises chest tube placement for any traumatic pneumothorax and it suggests that asymptomatic pneumothoraxes can be managed with observation and aspiration at the treating physician's discretion. Eastern Association for the Surgery of Trauma guidelines defined Occult pneumothorax as a pneumothorax that is seen on chest CT but not on plain films. It suggests that occult pneumothorax may be observed in a stable patient regardless of positive pressure ventilation (Level 3). Walker et al. In 2017in England, treated 46% of traumatic pneumothorax initially

conservatively. They found that 90% did not require subsequent chest tube insertion. Only the presence of a large hemothorax was associated with an increased likelihood of failure of conservative management. Here too, we think that the debate remains open. Otherwise, Eastern Association for the Surgery of Trauma guidelines[12] suggest that a chest drain is required in patients receiving either general anesthesia or positive pressure ventilation (PPV) to avoid a life-threatening pneumothorax.

Presumptive antibiotics and chest tube insertion

Do presumptive antibiotics reduce the incidence of empyema or pneumonia in TT for traumatic hemopneumothorax?

1. There is insufficient published evidence to support any recommendation either for or against the use of presumptive antibiotics to reduce the incidence of empyema or pneumonia in TT for traumatic hemopneumothorax.

Most authors have used the estimated volume of 500 mL, the amount needed tobe seen on plain X-ray, as the entry point into studies looking at evacuation of retained hemothorax. It is unknown whether complications of retained hemothorax including empyema and fibrothorax could be decreased by a more aggressive approach. After tube thoracostomy is performed, a repeat chest radiograph should always be obtained. This helps identify chest tube position, helps determine completeness of the hemothorax evacuation, and may reveal other intrathoracic pathology previously obscured by the hemothorax. The presence of retained hemothorax on postplacement CXR has been shown to be an independent predictor of the development of an empyema in 33% of patients. If drainage is incomplete as visualized on the postthoracostomy chest radiograph, placement of a second drainage tube should be discouraged. In a prospective randomized trial, Meyer et al[17]. showed that patients who had retained hemothorax on plain films 72 hours after initial chest tube output benefited from early VATS instead of a second chest tube. Patients undergoing VATS had significantly shorter duration of chest tube drainage, fewer days in the hospital after the procedure, and lower hospital costs than putting in a second chest tube. In addition, 10 of the 24 patients who underwent a second chest tube required surgical intervention later in their hospital stay.

Procedures

British Thoracic Society (BTS) has published guidelines[5,6]concerning chest tubes insertion training, indications, procedures. BTS has recommended the “Triange of safety” (*Figure 1*) as the site for insertion for intercostal drain. Some surgeons propose an alternative site. Thus, Kuhajda [7], in Serbia, in 2014 affirmed that for evacuation of an apical pneumothorax apical access can be used through the first intercostals space in scapular line without trocar anteriorly, due to large subclavian vessels. For him, this access is quite comfortable for the patient and easy to handle but it requires experienced thoracic surgeons to perform. in addition, it is accepted that in loculated pleural collection, the

position of insertion will be dictated by the site of the locule as determined by imaging[5]. There are three techniques to place a chest tube. The standard technique employs blunt dissection to access the pleural space. The Seldinger technique uses serial dilatation over a guide wire and third technique is by using trocar[7]

Suction system

Since the last years, the necessity of the succion in pleural drainage is controversial question. Some authors showed that applying suction to chest tubes should be avoided. Because in trauma and postoperative patients, suction has been shown not to improve pneumothorax resolution times or chest drain duration[8,9] and, in some cases, may potentially be detrimental.[10,11]. However, there is no evidence to recommend or discourage the use of suction in chest tube drainage[6].

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CHIRURGIE THORACIQUE / THORACIC SURGERY

MINIMALLY INVASIVE THORACIC SURGERY IN COTE D'IVOIRE: ADVOCACY FOR A REAL START

MENEAS GC [1, 2], ABRO S [1], YANGNI-ANGATE KH [1].

3- Department of Cardio-vascular and Thoracic Diseases, and Anatomy Unit, Bouake Teaching Hospital, Bouake,Cote d'Ivoire
4- Abidjan Heart Institute, Abidjan, Cote d'Ivoire

Correspondence: Koffi Herve Yangni-Angate
Department of Cardio-Vascular and Thoracic Disease and Anatomy Unit,
Bouake Teaching Hospital, Bouake, Cote d'Ivoire.

Abstract:

Purpose: Minimally invasive thoracic surgery has been adopted by some thoracic surgeons as the preferred approach over thoracotomy. However, this surgical approach remains a myth in some thoracic surgery centers in developing countries. In this study, we point out the thoracic surgical approaches we performed in general thoracic surgery and results.

Material and Methods: This is a retrospective study conducted from January 2005 to June 2015 on 341 patients operated for a general thoracic disease. Mean age was 32.73 years (range: 2 months - 88 years). **Results:** Most of patients (n=321; 94.13%) were operated through a classic postero-lateral thoracotomy. Immediate post-operative pain required opioids administration in 84.39% of cases. Average length of hospitalization and healing were respectively 9.43 days (range: 2-50 days) and 18.30 days (range: 1-56 days). **Conclusion**: To improve hospital stay length and patient comfort, minimally invasive thoracic surgery may be an alternative to conventional thoracic surgery. However, in our low-income country, this surgical option will require a good strategy for patient selection, a use of chest conventional instruments, and little consumables.

Keywords: Surgical Approach, Thorax, Minimally Invasive Procedures.

Introduction

In recent years, minimally invasive procedures have gained acceptance in thoracic surgery over standard thoracotomy.Minimally invasive chest approach involve direct thora-coscopy, video-assisted thoracospic surgery, video-assisted thoracic surgery, video-assisted in conventional surgery, minimally invasive cardiac surgery assisted by video-assisted thorascopic surgery, approaches for diagnostic biopsies (the "traditional" mediastinoscopy; video mediastinoscopy) and Robotics[1,2]. However, this thoracic approach requires a specific technical and ancillary material that limits diffusion in developing countries. In Côte d'Ivoire, some minimal gestures of pleural surgery are performed by standard thoracotomy, often dilapidated approach. It therefore seemed necessary to us to conduct this study to present indications and postoperative results of chest surgical approach performed.

Material and methods

This is a retrospective study from January 1998 to June 2015 performed at Abidjan Heart Institute and at Cardio-vascular and Chest Diseases Department of the University Hospital of Bouake, on 341 chest-operated patients. The average age was 32.73 (range 2 months - 88 years). The post-operative pain was treated according to two different protocols depending on the ladder of the WHO analgesic activity scale[3]
Protocol 1 begins with the WHO analgesic ladder III (ladder 3) i.e. intravenously injected morphine by syringe pump at a dose of 0.3 mg·kg-1·d-^{1} from D0-D3 postoperative then nefopam by slow intravenous injection at a dose of 20 mg x 4. D^{-1} associated with paracetamol intravenously at a dose of 1g x 4.d^{-1} from post-operative D4-D6; then an oral treatment with paracetamol associated with codeine (500/30mg) at a dose of 1capsule x 3.d^{-1} or by tramadol 50 mg at a dose of 1 capsule x 2/day, from D6 to discharge. **Protocol 2** begins with the WHO analgesic ladder II (ladder 2) i.e. neoplasm by slow intravenous injection at a dose of 20 mg x 4. D^{-1} associated with intravenously injected paracetamol at a dose of 1g x 4.d^{-1} from postoperative D0-D4; then an oral treatment with paracetamol associated with codeine (500/30 mg) at a dose of x 1capsule 3.d^{-1} or 50 mg of tramadol at a dosage of 1 capsule 2 x/d, from D4 to the exit. No epidural analgesia or intercostal nerve block was used. Chest tubes were set in continuous aspiration to -25 mmHg except in case of pneumonectomy. We study the chest surgical approaches performed, their indications, postoperative results regarding intensity of post-operative pain, assessed by analgesic protocol used, length of stay, time of healing and the appearance of the post-operative scar.

Results

In non-cardiac thoracic surgery, 321 (94.13%) postero-lateral thoracotomies, 15 (4.39%) vertical median sternotomies (1.46%) and 5 (1.46%) minimally invasive approaches such as Chamberlain anterior mediastinotomy, mediastinoscopy were performed. The postero-lateral thoracotomy was prescribed for the surgical treatment of 121 (35.48%) pleural diseases, 133 (39.00%) diseases, 19 (5.57%) mediastinal disorders, 34 (9.97%) parietal diseases, and 14 (4.10%) other non-cardiac chest diseases. Conventional vertical median sternotomy was prescribed for the surgical treatment of 7 (2.05%) mediastinal disorders and 8 (2.34%) parietal conditions. The Chamberlain mediastinotomy (n = 2; 0.58%), and mediastinoscopy (n = 3; 0.87%) were prescribed to performed mediastinal tumor biopsies. The intensity of post-operative pain after the vertical median sternotomy and posterolateral thoracotomy (n = 687; 84.39%) was sharp and required the administration of morphine by injection (WHO analgesic ladder 3), while minimally invasive approaches such as Chamberlain anterior mediastinotomy, media-stinoscopy were less painful and required the administration of tramadol by injection (analgesic WHO ladder 2) (**Table I**). The hospital stay was 5.25 days (4-7 days) for vertical median sternotomy, 13.68 days (3-31 days) for postero-lateral thoracotomy, and 3.5 days (2-4 days) for minimally

invasive approaches such as Chamberlain anterior mediastinotomy, mediastinoscopy (**Table I**). The Indications and postoperative results depending on the type of surgical procedure performed (**Table II**). Healing time was 22.25 days (17-30 days) for vertical median sternotomies, 27.69 days (13-60 days) for posterolateral thoracotomies, with a highly visible and unsightly scar while it was 7.5 days (6-10 days) for minimally invasive approaches such as Chamberlain anterior mediastinotomy, mediastinoscopy with a less visible and anesthetic scar.

Approaches	Postoperative pain treatment	Hospital stay length : days Average (extreme)	Postoperative disorders (%)	Cicatrization duration (days)
Vertical median sternotomy N=15	Morphine (48h) + tramadol +/- nefopam (5 days)	5.25 (4-7)	0	22.25 (17-30)
Posterolateral thoracotomy N=321	Morphine (48h) + tramadol +/- nefopam (5 days)	13.68 (3-31)	6.3	27.69 (13-60)
Others (mediastinoscopy, chamberlain mediastinotomy) n=5	Tramadol +/- nefopam (48h)	3.5 (2-4)	0	7.5 (6-10)

Table I: Post-operative results according to chest approach

indications	Hospital stay length : days Average (extreme)	Postoperative pain treatment	Postoperative disorders (%)	Cicatrization duration (days)
POSTEROLATERAL THORACOTOMY				
Empyemectomy / pleurectomy	10.04 (5-31)	Morphine (48H) + Tramadol +/- Nefopam (5 days)	6.3	27.69 (13-60)
Mechanic and chemical pleurodesis	9.57 (4-15)			
Pneumonectomy/Lobectomy	11.5 (6-30)			
Bullectomy	7			
Bronchotomy	6.6 (6-8)			
Tumoral biopsy	3.5 (3-5)			
Tumorectomy	7.66 (7-8)			
Diaphragmatic repair	8.5 (4-17)			
Exploratory Thoracotomy for Post traumatic hemothorax	7.66 (3-14)			
STERNOTOMY				
Tumorectomy	7.66 (7-8)	Morphine (48H) + Tramadol +/- Nefopam (5 days)	0	13.50 (7-20)
OTHERS Mediastinoscopy/ Mediastinotomy				
Mediastinal Tumor biopsy	2	Tramadol +/- Nefopam (24 H)	0	7 (6-10)

Table II: Indications and post-operative results in general thoracic surgery

Discussion

Non-cardiac thoracic surgery in Cote d'Ivoire is carried out mainly through traditional surgical approaches. Minimally invasive thoracic surgical approaches are almost non-existent. This situation is contrary to that of the developed countries where the minimally invasive thoracic surgery and minimally invasive cardiac surgery have been growing for over 15 years[4]**.** The minimally invasive approach is almost nonexistent in our practice because of the lack of suitable equipment and training of the surgical team while according to several authors[5-29] the minimally invasive thoracic surgery remains the technique choice to surgically treat almost all pleuro-pulmonary and mediastinal diseases. However, according to Joshua Neto et al[30] in 2014 in Brazil and Thomas Kirby[18] in 1995 in the USA, regardless of the type of surgery, the minimally invasive approaches are used in two forms. On the one hand, in a direct form

or by mini-thoracotomies or by the technique by muscular savings and on the other hand, in an indirect form with the video-assisted performed safely. Intensity and duration of post-operative pains are less important in chest minimally invasive approach versus conventional thoracic approach. So, Santambrogio[25] in 1995 in Italy, administered 106 mg of ketorolac versus 143 mg, Ayed[26] in 2000 in Kuwait, used Demerol 75 mg (45-150) versus 150 mg (40-300) and Abdala[23] in 2001 in Spain administered painkillers for 38 hours versus 77 hours. As for Kuhlman[31] in 1999 in France, asserted that given the various backgrounds of pain after thoracic surgery, it is rare that a single technique, even the most sophisticated, brings about a total control of painful manifestations and namely shoulder pains. Also, regardless of the choice of a postoperative local analgesia technique, the association with a parenteral supplement administered on demand should be prescribed systematically. According to Joshi[32] in England in 2013, the Video-Assisted Thoracic Surgery reduces the length of hospital stay. The brevity of hospital stay for minimally invasive thoracic approach versus conventional chest approach was also dealt with by other authors namely Santambrogio[25] in 1995 in Italy, Ayed[26] in 2000 in Kuwait, Abdala[35] in 2001, in Spain. They respectively found it for pulmonary segmentectomy, an average length of 4.6 *versus* 7.8 days; 3 *versus* 5 days; 5.3 *versus* 7.5 days. Other authors like Ayed[19] in 2000 in Kuwait, Waller[21] in 1994 in England and Gebhard[22] in 1996 in Germany, found hospital stay length as follows in order: 6.5 versus 10.7 days, 4 versus 5 days and 5 versus 7 days for the surgical treatment of pneumothorax (with talc) by video-assisted Thoracic surgery versus thoracotomy. S for Thomas Kirby[18] in 1995 in the USA, it is 7.1 *versus* 8.3 days for pulmonary lobectomy by video-assisted thoracic surgery versus thoracotomy. Considering these results in literature, the average hospital stay is 9.43 days (range 2-50 days) in our practice remains excessive. The hospital stay in our study was comparable to the length of hospital stay found by other authors for conventional chest approaches while it was too long compared to the minimally invasive approaches with the same authors. Regarding the rate of wound infections to abscesses type of the wound found in 7.6% of cases, our results were comparable to those of Grossi[33] in 1999 who reports an incidence of 5.7% for conventional sternotomy versus 0.9% for the mini-thoracotomy. Regarding the cost of minimally invasive approaches, it remains questionable. Actually, according to Swanson Sj[34] in the USA, hospital costs of conventional thoracotomy for lobectomy ($ 21,016) are higher than those of Video-assisted Thoracic Surgery ($ 20,316) for the same intervention (p = 0.027). These results tally with the findings of Casali[35] in 2009, in England, who indicated that the overall cost of Video-assisted Thoracic Surgery for a lobectomy was lower (8023 € ± 565) compared to the cost of a lobectomy at (8178 € ± 167) (P = 0.0002) by conventional thoracotomy; and that, due to the reduction in the duration of the patient's postoperative stay in intensive care for Video-assisted Thoracic surgery. The author concludes that the video-assisted Thoracic Surgery for a lobectomy is cheaper than lobectomy by conventional approach; and the increased costs of surgical procedure due to consumables is

offset by a shorter hospital stay. Rodriguez E[36] drew the same conclusion in September 2014, in the USA. He found out that the aortic valve replacement by right anterior minimally invasive approach is less expensive than that achieved by conventional median sternotomy ($ 38,769 versus $ 42,656; p <0.01). In our developing countries, this practice of minimally invasive chest approach is possible as it has already been carried out in South Africa[37], Turkey[38] and Brazil[39], but unlike Western countries, in developing countries like ours, the video-assisted Thoracic Surgery is more expensive than the conventional thoracotomy approach because of consumables cost[38,40]. Thus, the practice of these minimally invasive approaches in our developing countries will require a good strategy for patient selection according to defined prescriptions, the use and modification of chest conventional instruments, the moderate use of consumables[40,41]. However, to start this minimally invasive thoracic approach in our developing countries, the Brazilian model of Cardiac Surgery could be encouraged because it provides direct minimally invasive thoracic without video-assistance and gives satisfactory results[39]. In non-Thoracic Cardiac Surgery, the thoracotomy with Muscular Saving[18] could be recommended because it gives encouraging results. Moreover, as argued by **Frank Edwin**[40], in 2011, in Ghana; the development of Cardio-Thoracic Surgery seems closely parallel to the country's economic development and patients' ability to honor the cost of this surgery. In our developing countries, health insurance will apparently be the essential condition for the development of Cardio-Thoracic Surgery in general, and Minimally invasive Cardio-Thoracic Surgery in particular. According to V Joshi[32] in England in 2013, the Video-Assisted Thoracic Surgery has a similar recurrence rate with that of the conventional thoracotomy; it reduces the risk of intraoperative bleeding.

Conclusion

To improve hospital-stay length and patient comfort, minimally invasive thoracic surgery may be an alternative to conventional thoracic surgery. However, in our low-income country, this surgical option will require this requires not only a good strategy for patient selection, a use of chest conventional instruments, and a use of little consumables, but also a health insurance.

Conflicts of interest: The authors did not report any conflict of interest in connection with the writing of this scientific article.

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