

# *HOW TO TREAT THE ABERRANT RIGHT SUBCLAVIAN ARTERY AND ITS COMPLICATIONS?*

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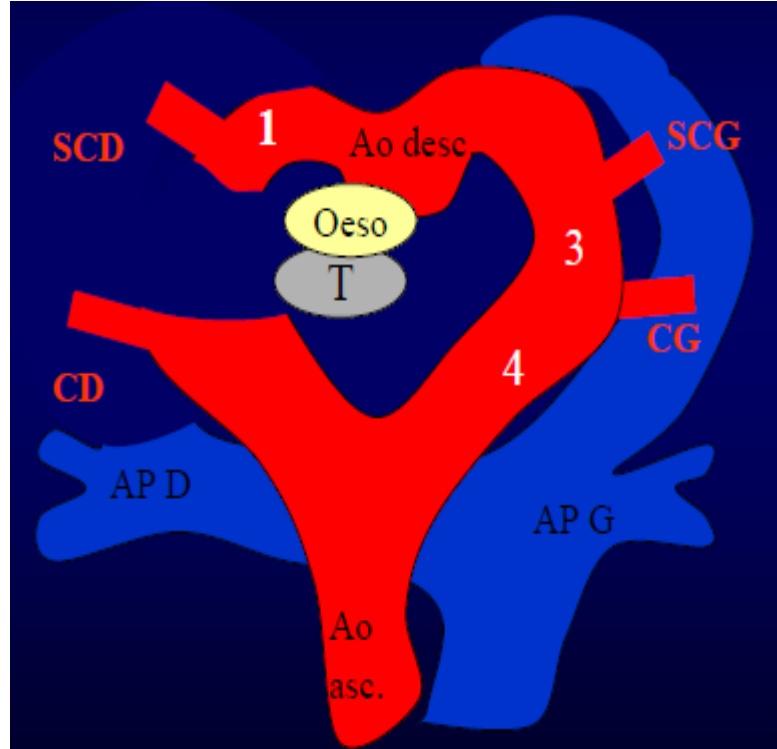
# Introduction

- Arteria Lusoria (trompeuse)= aberrant right subclavian artery (**ARSA**)
- The most common aortic arch anatomic anomalies
- Prevalence: 0.5–2.5% of the population\*
- Fisher\*\* was published 67 cases of aneurysms of ASA in 2005, with a 20% rupture and mortality rate
- Diversity of clinical manifestations

*\*P.O. Myers et al. / Annales de Cardiologie et d'Angéiologie 59 (2010) 147–154*

*\*\*FISHER R.G., WHIGHAM C.J., TRINH C. Diverticula of Kommerell and aberrant subclavian arteries complicated by aneurysms, Cardiovasc Intervent Radiol. 2005. vol. 28. n° 5. 553-560.*

# Embryology



*Embryologically, the aberrant right subclavian artery results from the interruption of the right arch between the right common carotid artery and right subclavian artery, This vessel arises as the last great vessel of the aortic arch, from the dorsal margin of the aorta, and steers towards the right arm, crossing the middle line of the body and usually passing behind the esophagus.*

# Anatomy

- This aberrant artery arise just distal to the left subclavian artery
- 80% of ARSA crosses between esophagus and vertebral column\*
- 15%\*: between trachea and esophagus
- 5% : anterior to trachea \*
- In 60% of cases, a diverticulum can be present at the origin of the aberrant right subclavian artery, residue from the right arch  
***Kommerell's diverticulum*\*\***

\*Levitt B, Richter JE. Dysphagia lusoria: A comprehensive review. Dis Esophagus 2007; 20: 455–460

\*\* Van Son JA, Konstantinov IE, Kommerell BF. Kommerell's diverticulum. Tex Heart Inst J 2002;29(2):109–12.

# Associated abnormalities

## **Other abnormalities of the aortic arch may be associated**

- Aortic coarctation
- Unusual position of the vertebral arteries \*
- Frequent association with cardiac abnormalities: septal defects
- A right thoracic duct
- A non-recurrent lower laryngeal nerve
- Bovine arch (30%) \* \*

\* Epstein DA. *Vasc Endovascular Surg* 2002;36(4):297–303.

\* \* Salomonowitz E. *AJR* 1984, vol. 142, n° 4, 673-679.

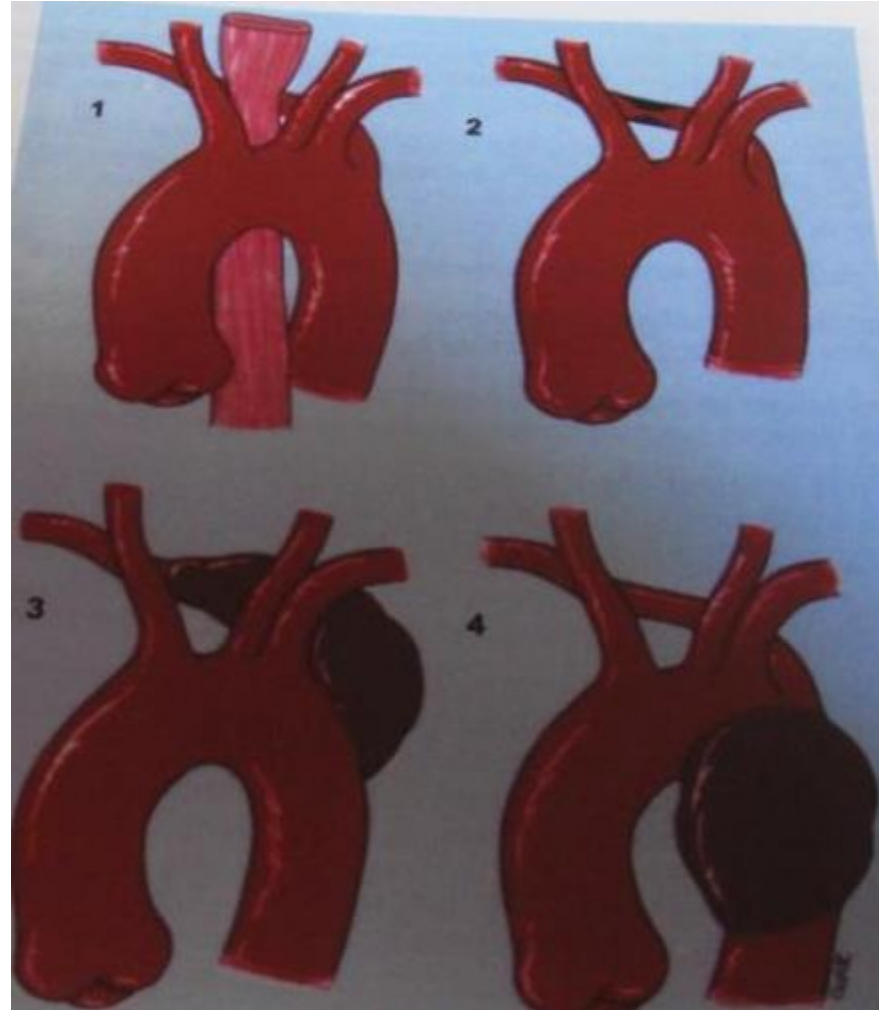
# Left ASA

A left ASA from a right aortic arch is much less frequent:  
1 case per 1000 \*

\* Freed K, Low VH. The aberrant subclavian artery. Am J Roentgenol 1997;168(2):481-4.

## ARSA COMPLICATIONS

1. Esophageal compression: 3 cases
2. Stenosis (atherosclerosis, traumatic, inflammatory) : 2 cases
3. Aneurysm: 1 case
4. Aneurysm of the thoracic aorta close to ARSA: 2 cases



# Complications of ARSA ANEURYSM

- Tracheal compression
- Venous compression
- Arterial embolism on the upper limb

## Rupture

**Pleural cavity, mediastinum, œsophagus, lung**

**More than 36% mortality \***

Series:8 patients

January 2006 to December 2019

## **Demographic characteristics**

Patient	Sex	Age (ys)	Medical History	Symptoms	Diagnostic	Pathology	Procedure
1	F	23	NO	critical ischemia of the right upper limb	.Duplex ultrasound .CT .Arteriography	Length stenosis of post vertebral subclavian artery	Open repair
2	F	35	NO	Dysphagia	CT Endoscopy	ARSA with compression of esophagus	Open repair
3	F	32	NO	Dysphagia	CT Esophagogram	ARSA with compression of esophagus	Open repair
4	F	26	NO	Dysphagia	CT Endoscopy	ARSA with compression of esophagus	Open repair
5	F	55	Hypertension	Upper Extremity Claudication	Duplex ultrasound .CT	Occlusion of ARSA	Open repair
6	M	55	Hypertension  Former smoker,	Acute chest pain	CT	Aneurysm of the descending aorta measuring 64/60 mm ,with a dissection beginning at the ARSA, Extension of dissection to the supra and infra-renal aorta with a normal diameter	Endovascular (Multilayer Stent, MFM: 40/150).
7	M	50	Hypertension under tri therapy.  Obesity (125Kg).  Current Smoker	Chest pain + pain and paresthesia in the right upper limb beginning since 15 days.	CT	Aneurysm of the kommerell's diverticulum (diameter=70mm) next to the ostium of the arteria lusoria which is dissected, extension of the dissection to the axillary artery	Hybrid procedure (thoracic endograft TEVAR+ revascularization)
8	M	59	Hypertension.  Aortic Dissection type A, operated in emergency 04 years ago, benefited prosthesis replacement of the arch above the coronary .	Acute chest pain + Dyspnea	CT	Aneurysm with a retrograde dissection of the proximal descending thoracic aorta of 60 mm diameter associated with the ARSA,	Hybrid procedure (thoracic Endograft TEVAR + revascularization)

# RESULTS

- **Symptomatic ARSA(n=5):**open surgery

ligation of the ASA at its ostium at the aortic arch, associated with

1.carotid-subclavian bypass using saphenous vein graft (n=2)

2.prosthetic graft (n= 02)

3.subclavian-carotid transposition(n=02)

Takayasu disease was positive in 01 patient on histo-pathology

- **ARSA associated with aneurysm (n = 3):Hybrid surgery (n=2) and endovascular(n=1)**

# results

- Good outcomes: 7 patients
- Minor dysphagia: 1 patient
- Type II endoleak: 1 patient without increasing aneurysm diameter.

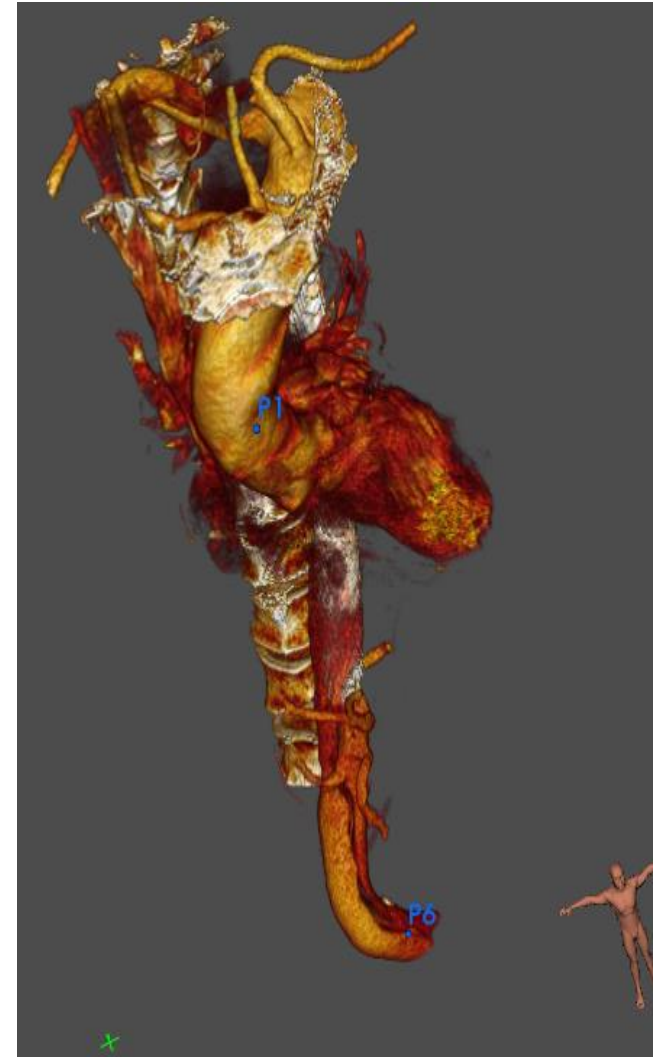
Angiographie :23-year-old female patient, with critical upper limb ischemia.



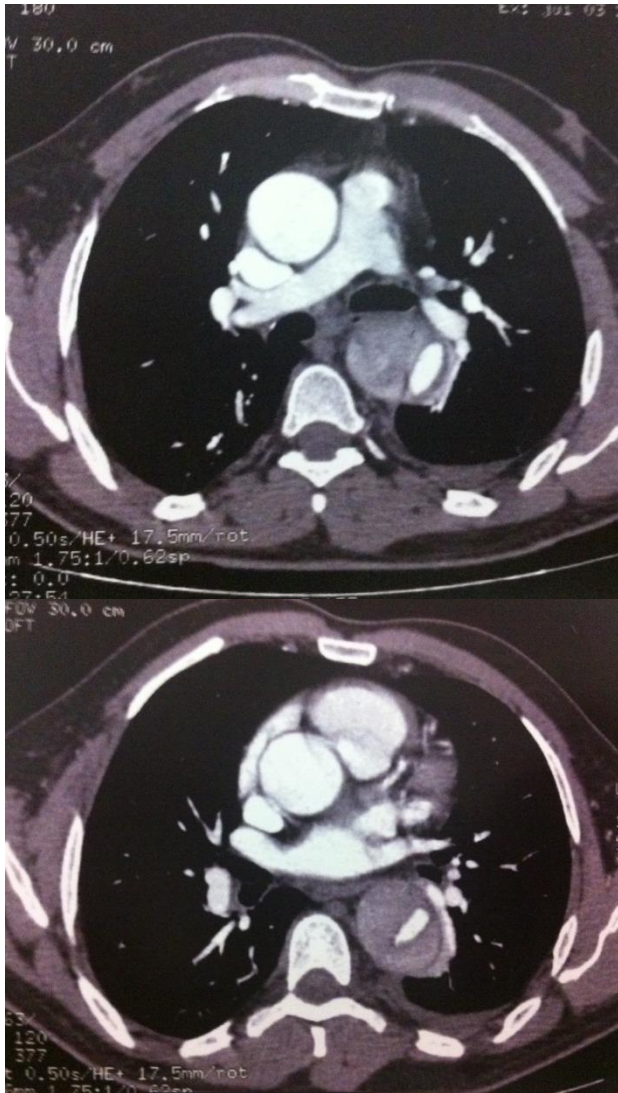
40-year-old female patient with dysphagia  
Ligation of ARSA + subclavian transposition.  
CT scan :axial and coronal view



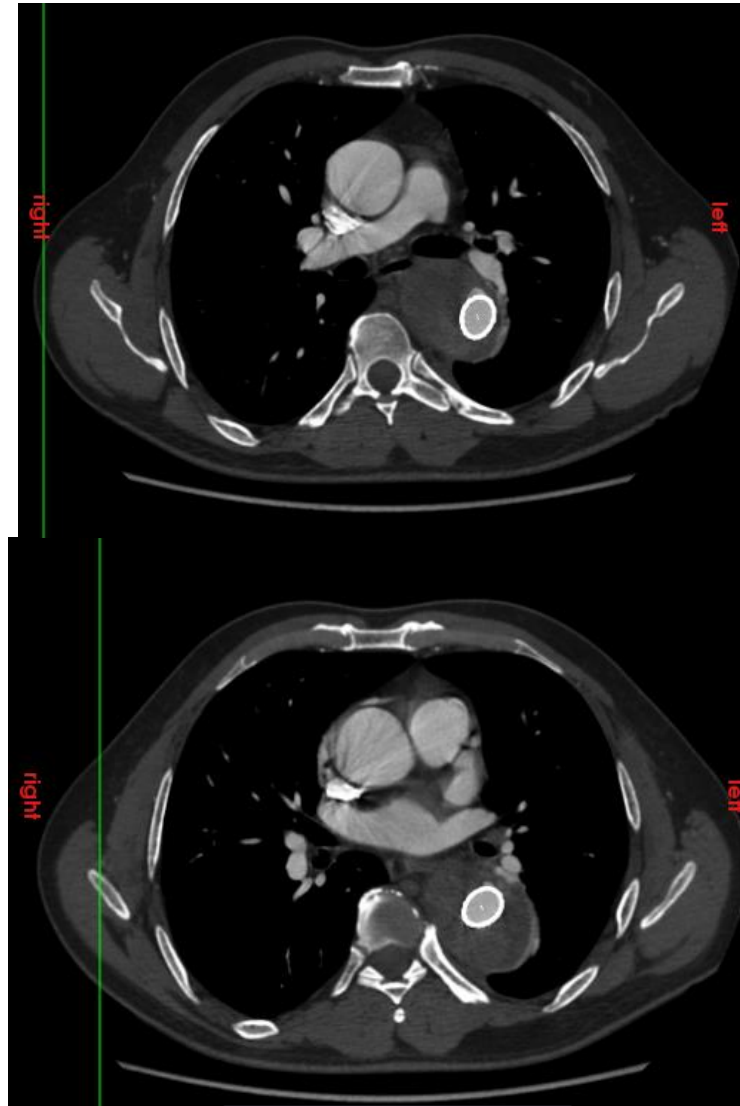
*CT Scan* : *Isthmus aorta aneurysm 64/60 mm with a dissection beginning at the level of the ARSA*



*Procedure: Multilayer Stent , MFM: 40/150 mm*



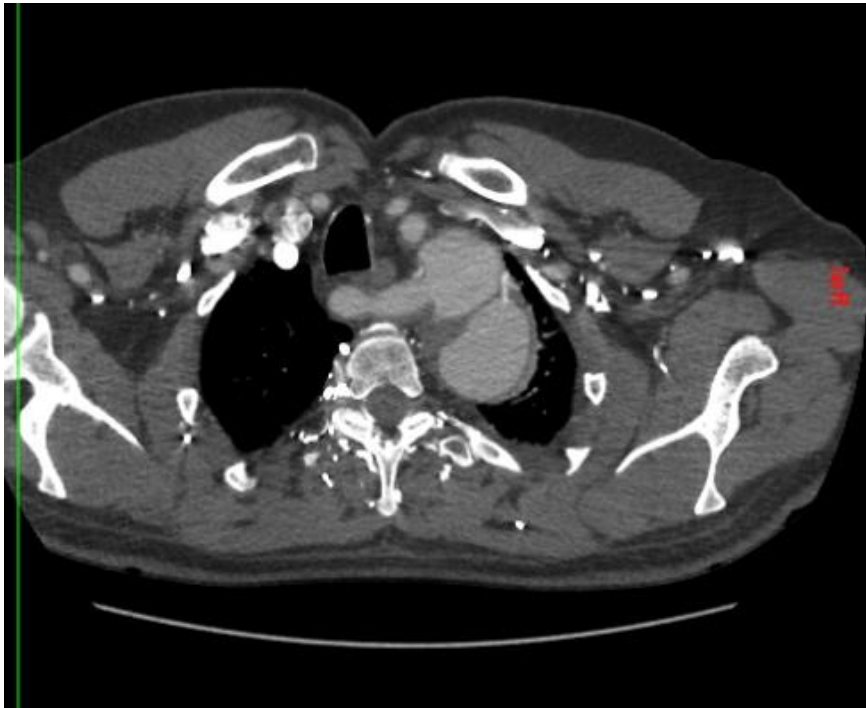
Before



3 years after

**CT Scan: Thoracic aneurysm 60 mm diameter associated with ARSA**

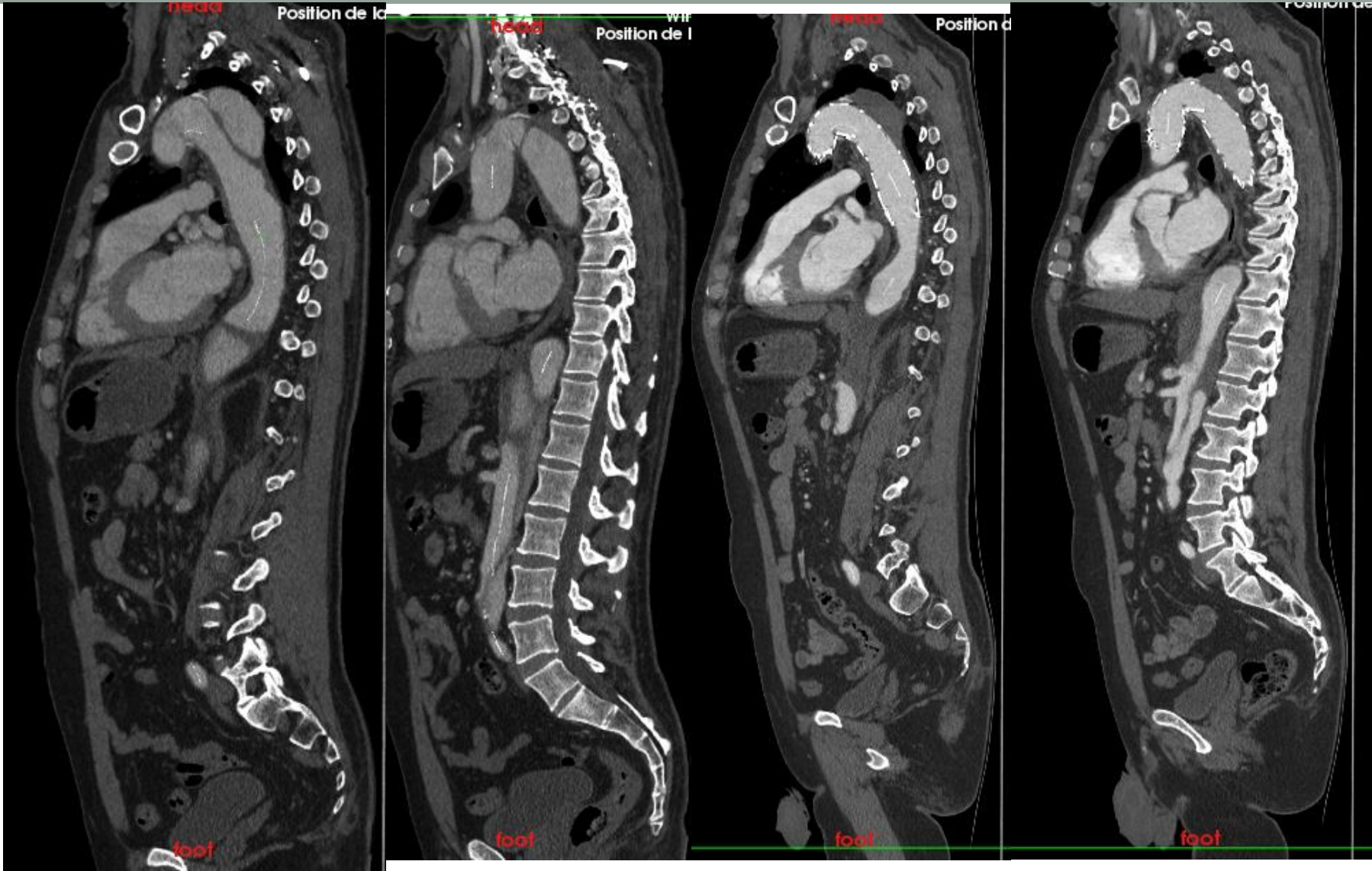
**Procedure: Hybrid surgery: stent-graft "Zenith COOK" covering the ostium of the left SCA and the infundibulum of the ARSA +reimplantation of the ARSA on right common carotid artery**



Before



After 6 months

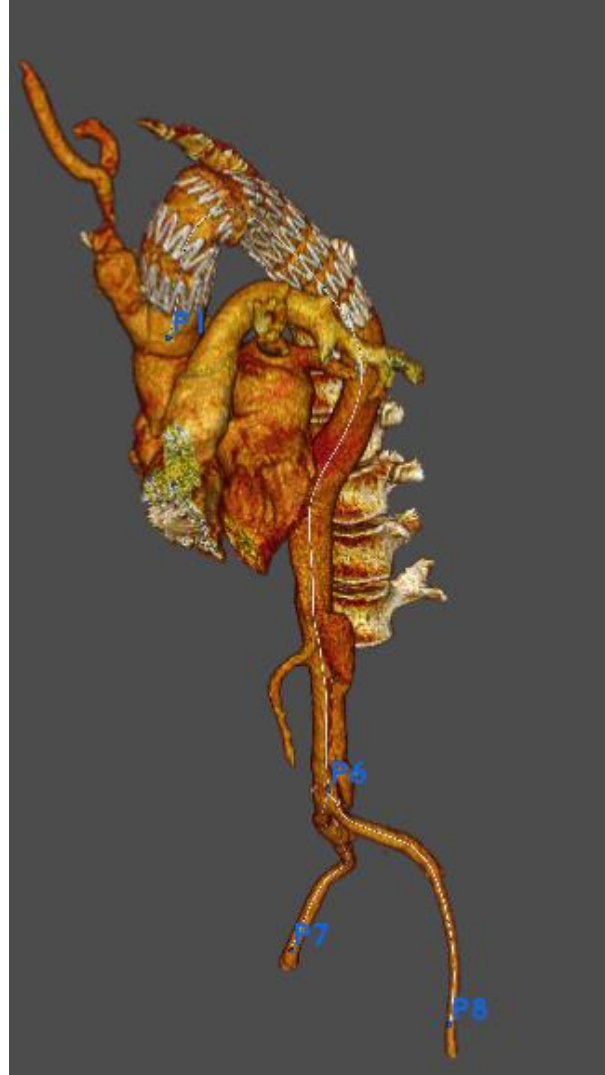


Before

After 6 months

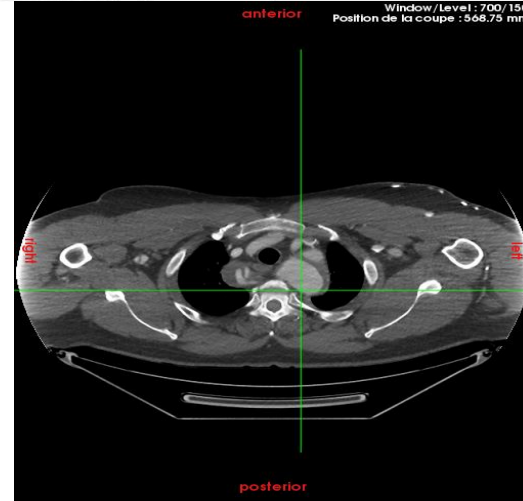
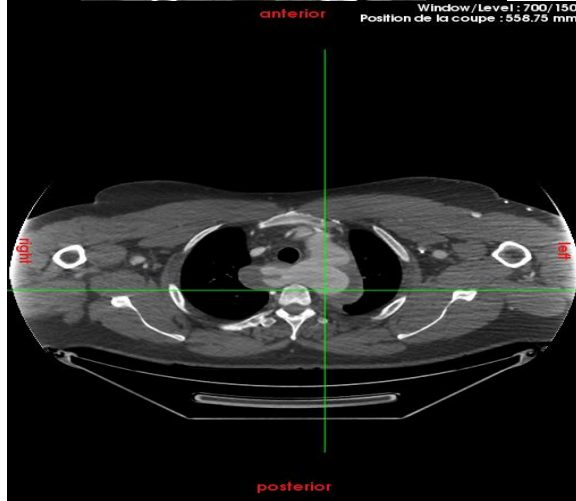
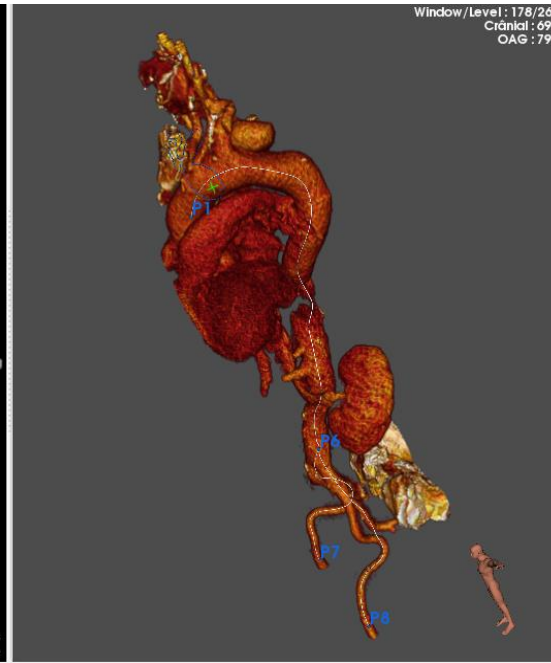


Before



At 2 years

**CT Scan: Dissecting aneurysm of the Kommerell's diverticulum (diameter=70mm) extension of the dissection to axillary artery,**



**CT Scan: Dissecting aneurysm of the Kommerell's diverticulum (diameter=70mm) extension of the dissection to axillary artery**

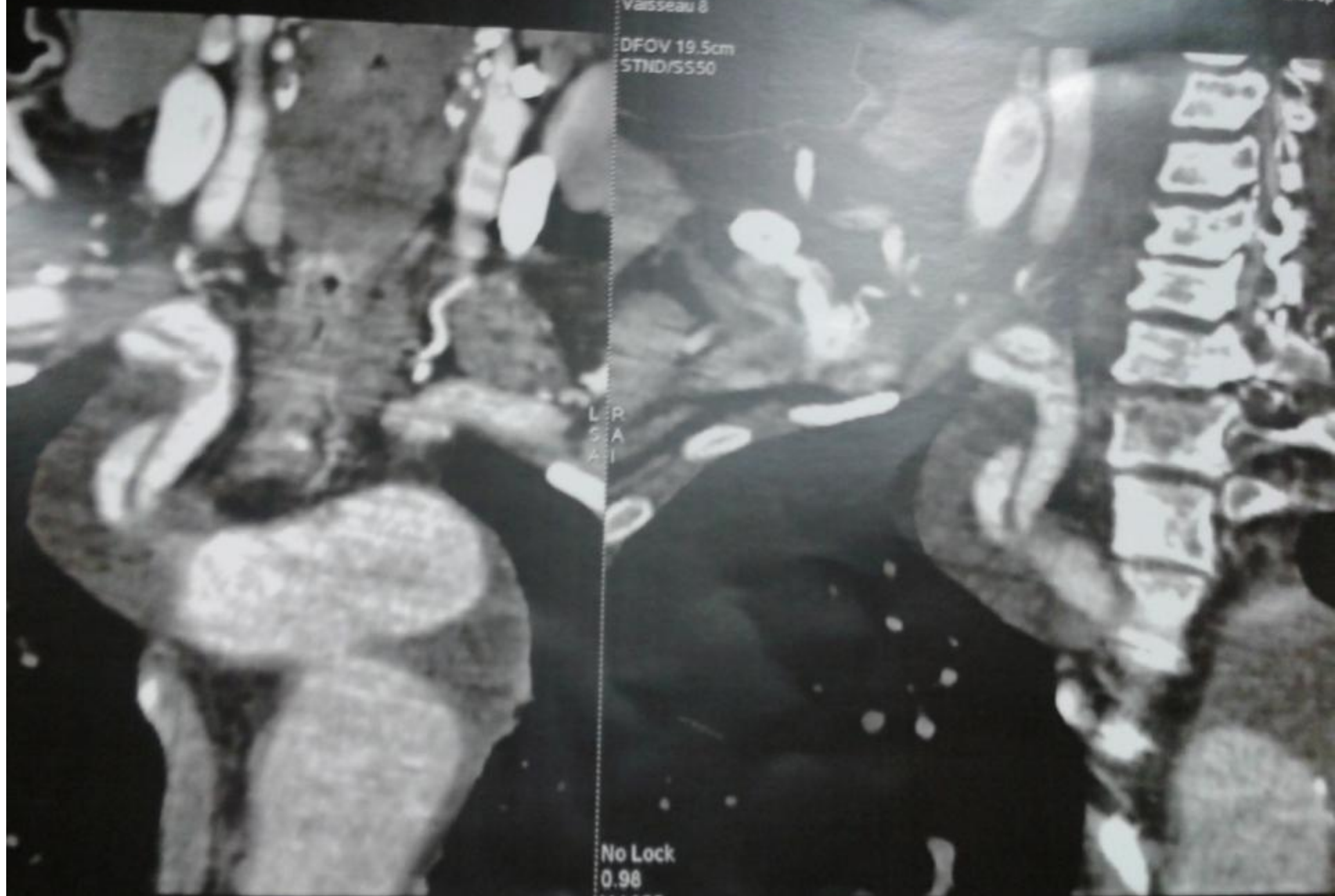


48  
Ex:Sep 07 2014 Se:2

A: 19.3 (coi)  
Vaisseau 8

Ex:Sep

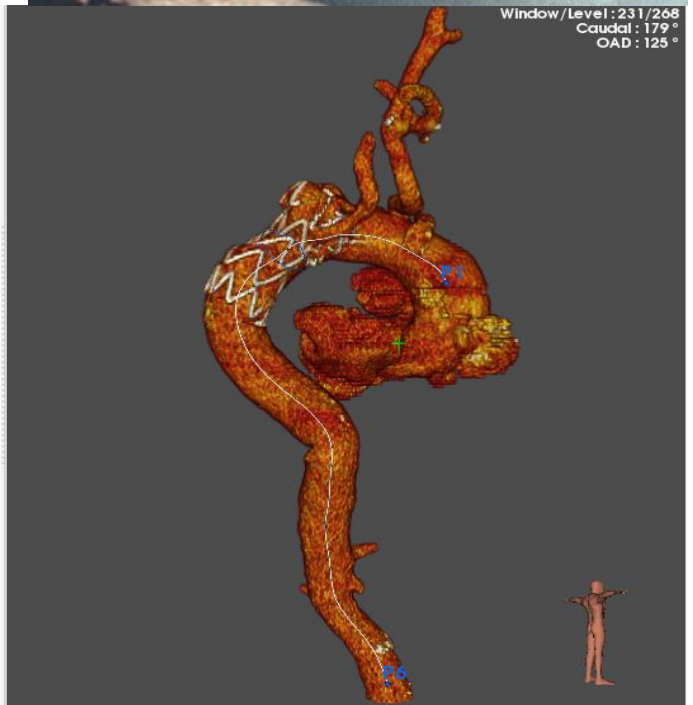
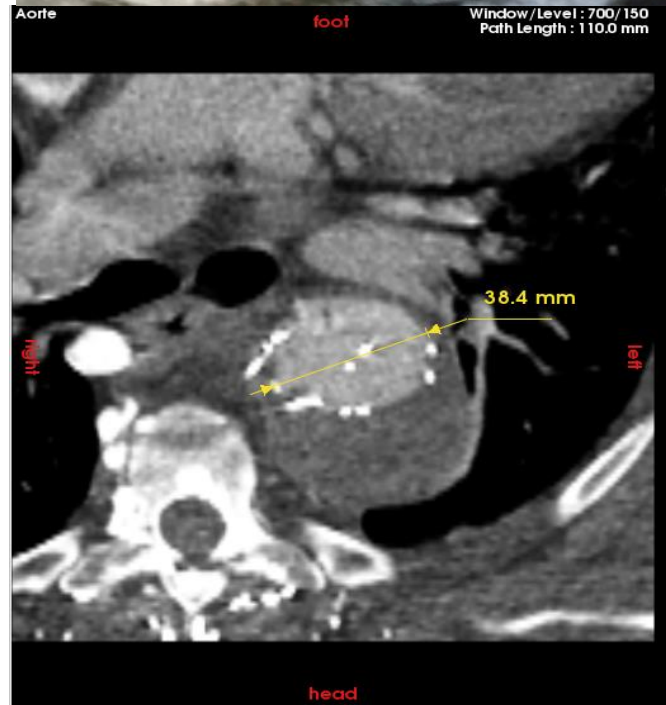
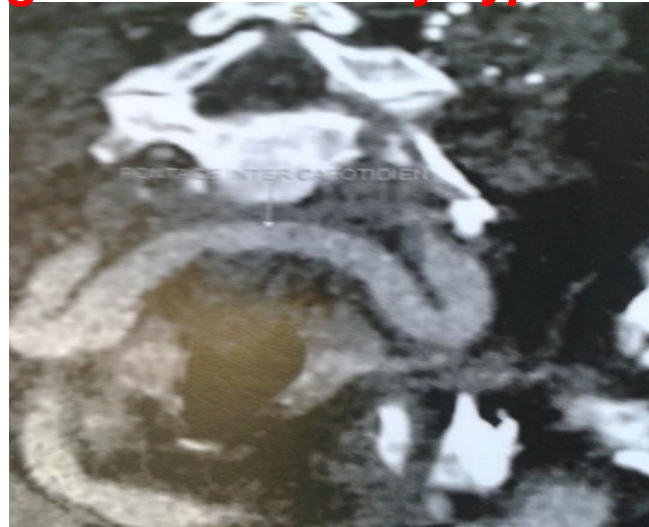
DFOV 19.5cm  
STND/SS50



L  
S  
A  
I

No Lock  
0.98  
KV 120  
mA Mod

**Procedure: Stent-graft "Valiant Medtronic '44x150 mm' + inter-carotid bypass+ Ligation of the ARSA behind the esophagus and right Carotid-axillary bypass CT scan after 2 years**



# ***DISCUSSION***

-ARSA most commonly cause no symptoms

-Symptoms related to aneurysmal or occlusive atherosclerotic lesion, inflammatory or traumatic lesions. More manifestations and aneurysmal degeneration of the origin of ARSA

-Symptoms of compression of the trachea resulting in dyspnea (18.7%), retrosternal pain (17.0%), coughing (7.6%), or more commonly the esophagus (71.2%),

# *Discussion*

Angio Ctscan or Angio MRI

- Finds this anomaly when it is asymptomatic while these explorations were requested for thoracic or mediastinal diseases
- Systematically in case of symptoms:
  - ischemia of the upper limb
  - signs of compression(dysphagia ...)
  - Aneurysm

**The degree of compression exerted on adjacent mediastinal organs, and concomitant vascular anomalies can be easily visualized in angioCT scan**

# Discussion

- **Conservative treatment of the aneurysm of an ARSA is associated with high mortality and morbidity because there are 44-57% risks for progression to rupture or fistula**
- *The mortality rate of conventional surgical repair of an aneurysm linked to ARSA has a range between 18% and 33%,\**
- *Endovascular treatment and hybrid approach are amongst other therapeutic options*

\*,Kieffer E, Bahnini A, Koskas F (1994) Aberrant subclavian artery: surgical treatment in thirty-three adult patients. J Vasc Surg. 19:100– 109

# *TREATMENT*

- No surgical indication for ARSA asymptomatic
- **Operative indications**
  - dysphagia
  - ischemia of the upper limb
  - signs of ischemia in the vertebrobasilar territory
  - symptomatic or non-symptomatic aneurysm when diameter is more than 4 cm

# *Non aneurysmal ARSA*

## *Open surgery*

- Surgical treatment of no-aneurysmal ARSA is conducted either after cervicotomy or left thoracotomy
- The sternotomy is only indicated to treat associated cardiac lesions.

# Non aneurysmal ARSA

## Endovascular treatment

Numerous articles have been published on the hybrid treatment of ARSA: occlusion of the proximal segment of ARSA:

-aortic stent graft covering the origin of ARSA \*

**-Occluder (Amplatzer) inserted to the origin of ARSA\*\***

Second stage:transposition or carotid-subclavian bypass

\* Attmann T, Brandt M, Muller-Hulsbeck S, Cremer J. Two-stage surgical and endovascular treatment of an aneurysmal aberrant right subclavian(Lusoria) artery. *Eur J Cardiothorac Surg* 2005;27(6):1125–7.

\*\*Hoppe H, Hohenwarter EJ, Kaufman JA, Petersen B. Percutaneous treatment of aberrant right subclavian artery aneurysm with use of the Amplatzer septal occluder. *J Vasc Interv Radiol* 2006;17(5):889–94.

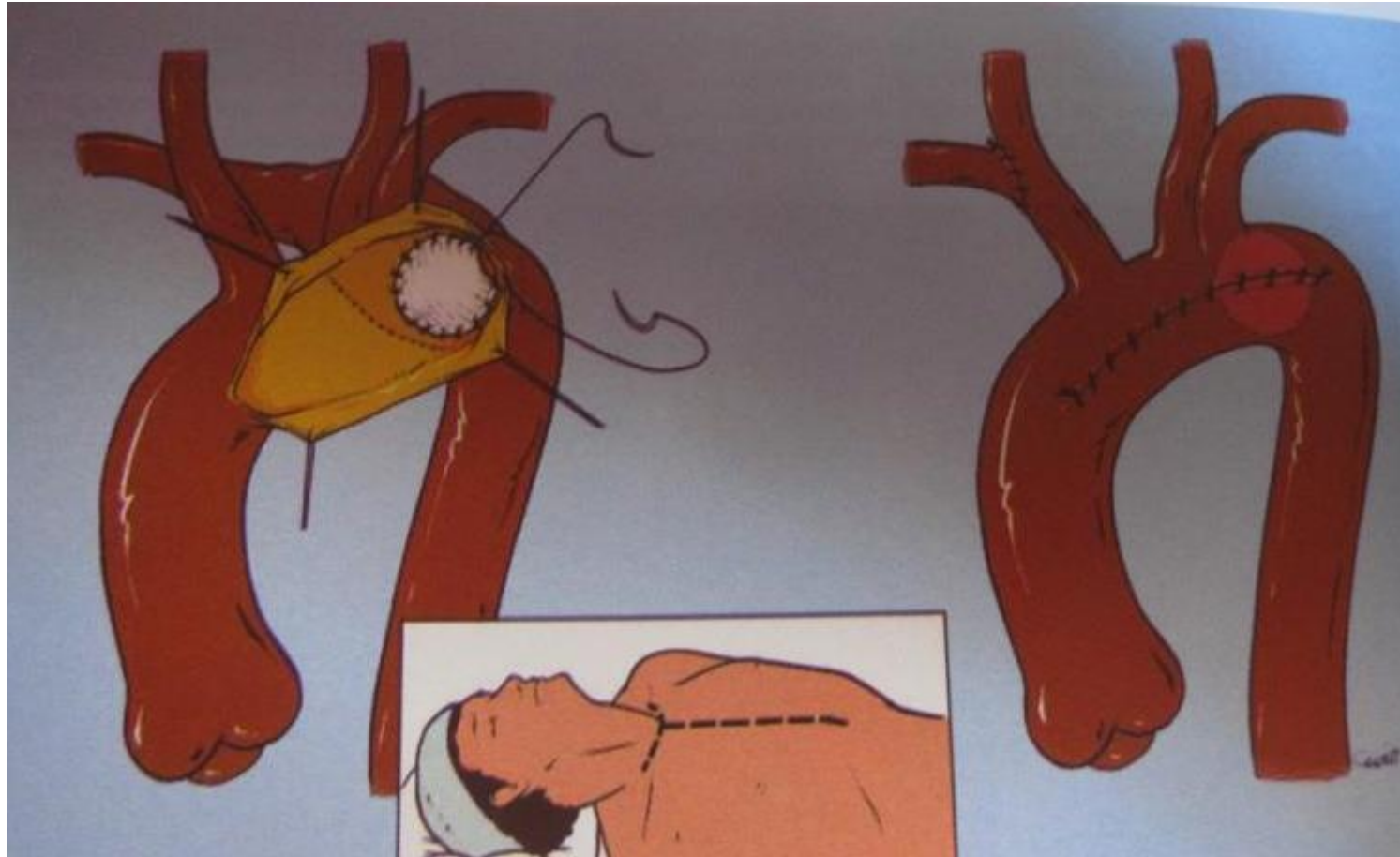
# ***Surgical treatment of aneurysm linked to ARSA***

Thoracotomy, sternotomy

Closure of the aneurysmal collar by trans-aortic prosthetic patch and subclavio-right carotid transposition

# Surgical Treatment of aneurysm linked to ARSA

Sternotomy, ECC and closure of the aneurysmal collar by trans-aortic approach



## ***Surgical treatment of aneurysm linked to ARSA***

- An ECC should be used in case of aortic arch pathology
- Repair of the distal aortic arch requires a partial ECC with moderate hypothermia, rarely with a deep hypothermia with circulatory arrest

# *Endovascular Procedure*

- *The development of endovascular techniques has expanded the arsenal therapeutic of complicated ARSA*
- *In 1998, Davidian et al,\* published the first case of aneurysmal ARSA treated by endovascular approach*
- *Lacroix et al.\*\* claimed that hybrid treatment for aneurysmal ARSA patients was feasible, safe, and effective.*

\*Davidian M, Kee ST, Kato N, et al. Aneurysm of an aberrant right subclavian artery: treatment with PTFE covered stent-graft. J Vasc Surg 1998;28(2):335-9,

\*\*Lacroix V, Astarci P, Philippe D, et al. Endovascular treatment of an aneurysmal aberrant right subclavian artery. J Endovasc Ther. 2003;10:190-194

# *Treatment of aneurysms linked to ARSA*

- *Hybrid approach : ARSA is occluded distal to the aneurysm combined with a covered stent in the aorta on both sides of the origin of this aneurysm.[1,2]*
- *« Chimney » :aortic endoprosthesis graft+ covered stent-graft in LCC and LSCA+ right carotid-subclavian bypass [3]*

1, Lee CY, Moraca RJ, Benckart DH, Bailey SH, Magovern Jr GJ, Muluk S. Thoracic endovascular aortic repair of an aberrant right subclavian artery: technique and long-term outcome. J Card Surg. 2010;25:390–3.

2, Bosma J, van Swijndregt AD, Vahl AC. Hybrid treatment of a ruptured diverticulum of Kommerell. J Endovasc Ther. 2010;17(6):762–6

3, Schwein A, Georg Y, Ohana M, Delay C, Lejay A, Thaveau F, Chakfe N, Title: Treatment of aneurysmal aberrant right subclavian artery with triple-barrel stentgraft, Annals of Vascular Surgery (2015), doi: 10.1016/j.avsg.2014.10.035.

# *Treatment of aneurysms linked to ARSA*

Several endovascular techniques are described in the literature

- fenestrated aortic covered stents
- branched grafts
  - anatomical unsuitability for standard endovascular interventions
  - High cost

**Therapeutic choice depends on the availability of the devices, the quality of the technical platform as well as the experience of the surgical team.**

## ***Aortic Dissection type B and aneurysm associated with an ARSA and Kommerell's diverticulum***

- *Few cases of ARSA with Kommerell's diverticulum and dissecting aortic aneurysm have been reported*
- *We reported 2 cases with good results for a follow up of over 2 years*



## ***Left ASA associated to a right-sided aortic arch***

*Aortic dissection involving a right-sided aortic arch and associated with a Kommerell diverticulum of a left ASA is very rare: about 40 cases reported in the literature. \**

*A case has been reported of right-sided aortic arch and aortic dissection type B involving a left ASA with Kommerell diverticulum treated by an aortic endoprosthesis and embolization of the origin of the left ASA \**

\*Tanaka K, Yoshitaka H, Chikazawa G, Sakaguchi T, Totsugawa T, Tamura K. Hybrid repair of right aortic arch aneurysm with a Kommerell's diverticulum. *Asian Cardiovasc Thorac Ann.* 2014;22: 725-7

\*\*He H, Yao K, Nie WP, Wang Z, Liang Q, Shu C, *Endovascular treatment for acute type B aortic dissection involving a right-sided aortic arch and Kommerell's diverticulum: A case report and review of the literature, Annals of Vascular Surgery* (2015), doi: 10.1016/j.avsg.2014.12.028.

## ***Conclusion***

***Fully endovascular therapy or hybrid therapy would certainly be the treatment of choice for complicated or aneurysmal ARSA or aortic diseases related to ARSA***

*Thank you for  
your attention*



- The median age of the patients was 41.87 years (range 23- 59 years old). Five women and three men were included. Reported symptoms included dysphagia (n=3), dyspnea (n=1), acute chest pain (n =3), critical ischemia of right upper limb (n=2), three patients had thoraco abdominal aneurysm associated with ASA, a median diameter of 64.66mm (range 60 -70mm), whose one patient had an aneurysm of the Kommerell's diverticulum (diameter=70mm) next to the ostium of the arteria lusoria which is dissected and with an extension of the dissection to the axillary artery, and dissection of ASA in 2 patients(n=2).
- All patients were evaluated by computed tomography angiography (CTA) to visualize the anatomy and to assess the location of the aberrant artery and its lesions, the size of the aorta, cerebral perfusion and to look for other abnormalities

- *Our cases confirm the Feasibility ,Safety and Durability of the Endovasclar therapy.*

# Discussion

- *There is no indication to operate a non-aneurysmal and asymptomatic arteria lusoria*
- *The indication depends on patient's status, anatomical relationship to neighbouring organs, characteristics of the lesion within the ARSA, and complaints of the patient.*

- According to Kieffer: **type 1**: implies dysphagia caused by a non-aneurysmal aberrant subclavian artery; **type 2** includes ischemic symptoms caused by occlusive disease of a non-aneurysmal aberrant artery; **type 3** is an aneurysm (with or without symptoms) of the aberrant artery; **type 4** includes aberrant subclavian artery arising from a diseased (usually aneurysmal) thoracic aorta with or without aberrant subclavian aneurysm. [15]
- More recently, Yang et al, [23] in a literature review on aberrant subclavian arteries, updated the classification with the addition of a fifth group including iatrogenic injuries and by dividing **group 4** into two subgroups: **4a** is aberrant subclavian from aneurysmal thoracic aorta, and **4b** is aortic dissection originating from an ASA. There is common agreement that aneurysmal aberrant subclavian disease carries higher risks.

- either by deploying an occluder (Amplatzer) to the origin of ASA then transposition or carotid subclavian bypass
- Nevertheless, the risk of these hybrid techniques is the persistence of dysphagia secondary to compression by the plug positioned in the arterial segment which covers the esophagus. [31, 23] Furthermore, there is a potential risk for a subclavian esophageal fistula, with its often fatal consequences [32].

- open surgical repair should be considered in young patients, in patients with connective tissue disease, and in patients with failed endovascular repair. The authors recommend reconstruction of the blood flow to the upper extremity in order to maintain the arm's viability and, more importantly, to maintain the spinal and vertebrobasilar circulation

# Endovascular treatment of aneurysms linked to ARSA

- There is a progressive decrease in the size of the ARSA aneurysm after its endovascular exclusion, between 4% \* and 50% \*\* relative to the original size

\*Hoppe H, Hohenwarter EJ, Kaufman JA, Petersen B. Percutaneous treatment of aberrant right subclavian artery aneurysm with use of the Amplatzer septal occluder. *J Vasc Interv Radiol* 2006;17(5):889–94.

\*\*Corral JS, Zuniga CG, Sanchez JB, et al. Treatment of aberrant right subclavian artery aneurysm with endovascular exclusion and adjunctive surgical bypass. *J Vasc Interv Radiol* 2003;14(6):789–92.