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Arch Pathology: Surgery Is The Gold Standard

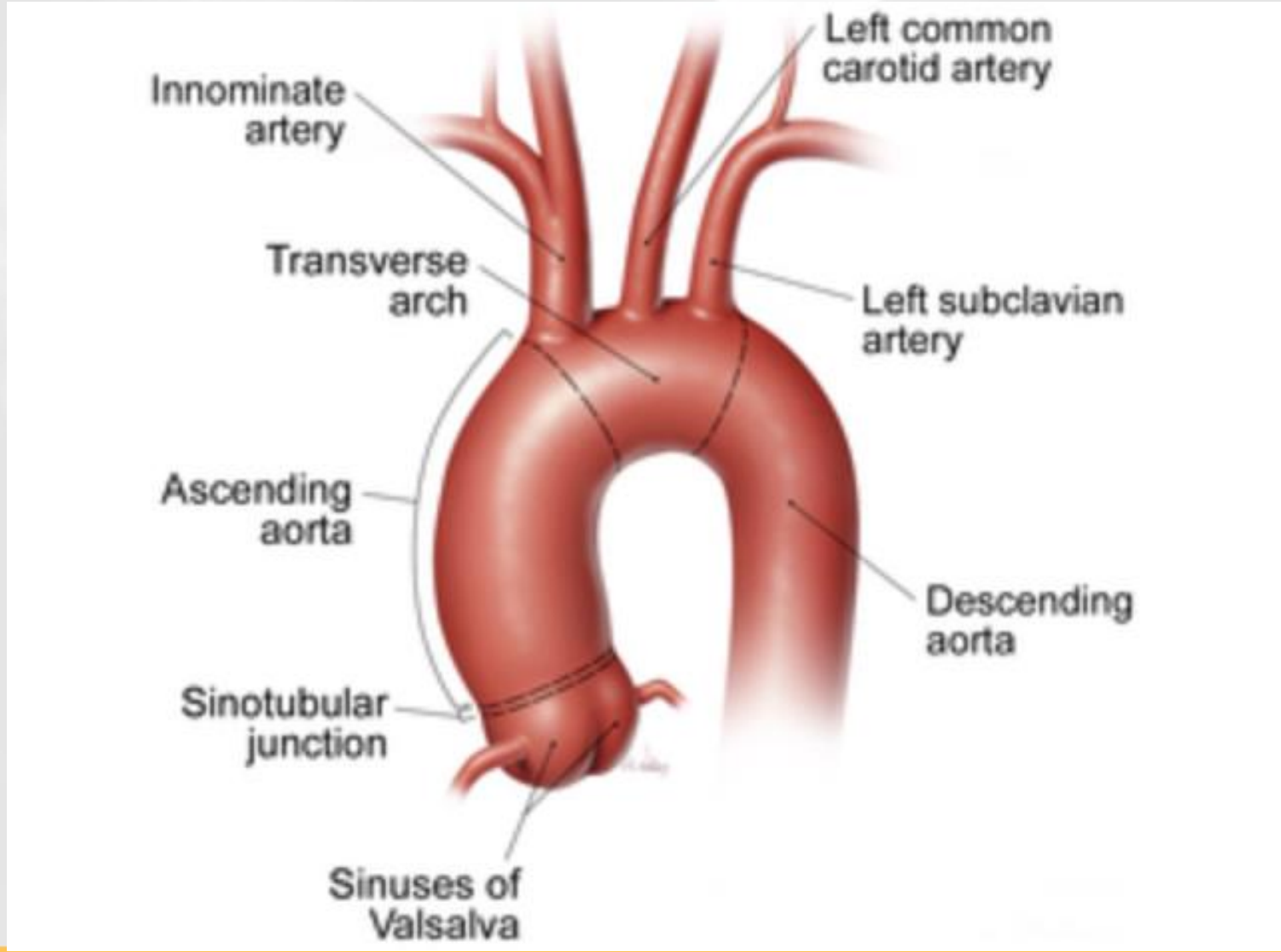
Introduction

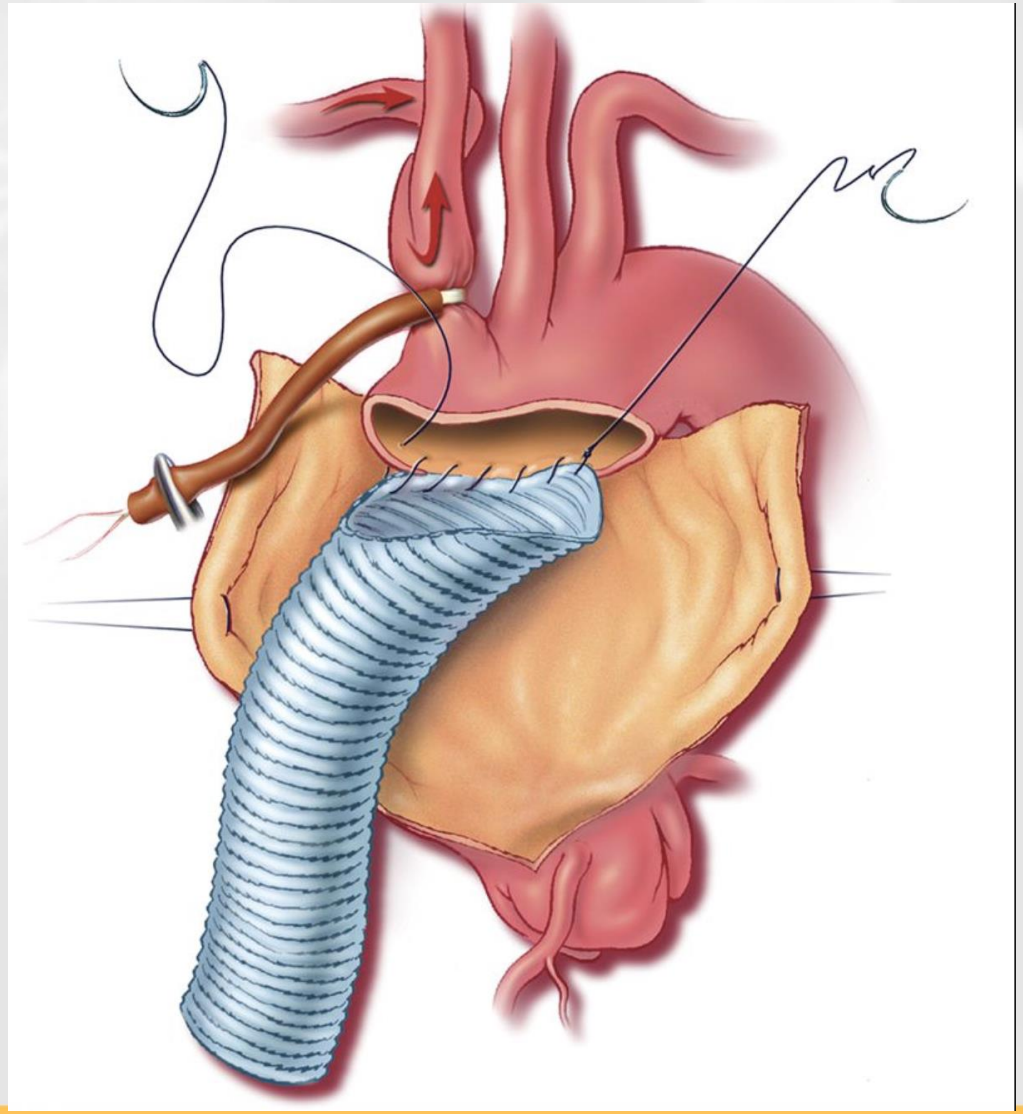
- Replacing the aortic arch can be one of the most daunting procedures in surgery
- Procedures on the arch seem to go against almost everything we have learnt about cardiac surgery
- The demanding task of aortic arch surgery is not something that early pioneers could have envisaged….

Introduction

- Yet, we have risen to overcome these and refine this procedure to its contemporary form.

- Complex arch replacement is now a standard practice in specialized centers, with acceptable survival and complication rates, as well as reasonable patient satisfaction and quality of life

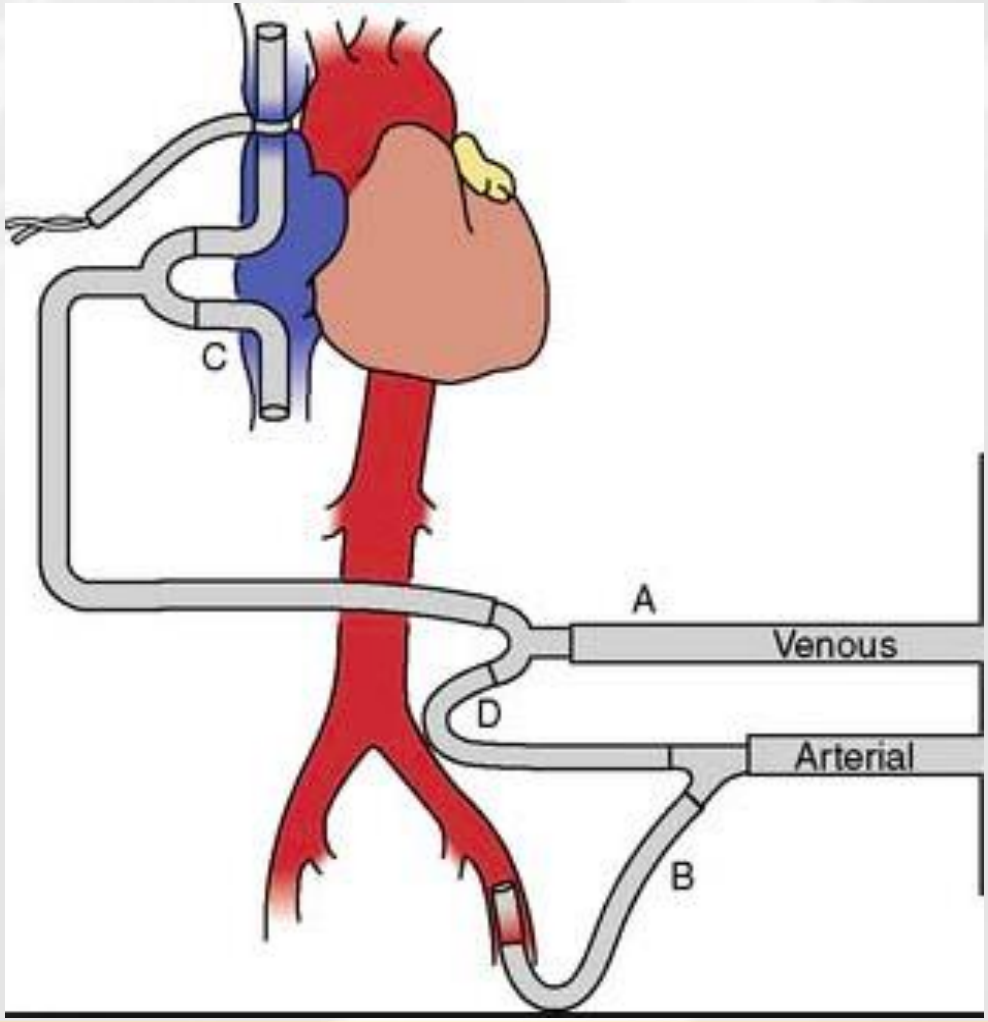

Innominate artery
Left common carotid artery
Transverse arch
Left subclavian artery
Ascending aorta
Descending aorta
Sinotubular junction
Sinuses of Valsalva

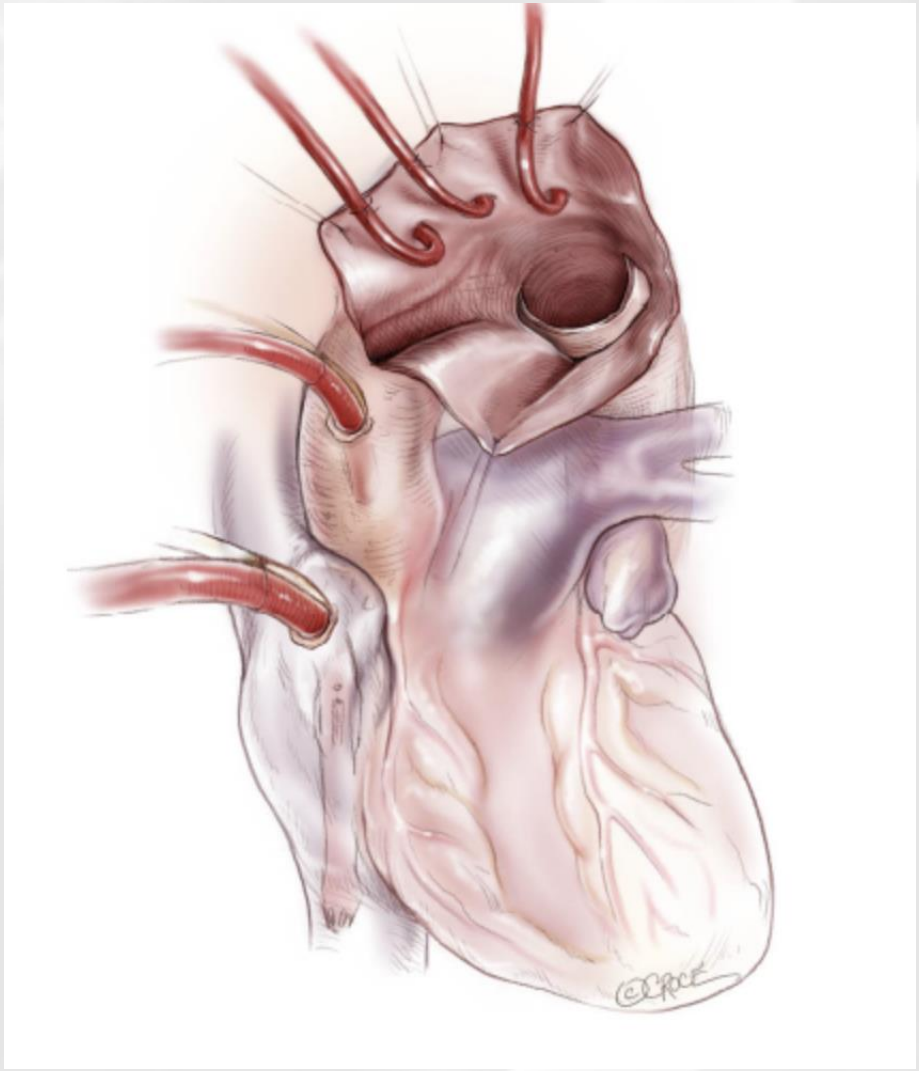


Cerebral Protection

- The optimal selection of cerebral protection strategies is of critical in aortic arch surgery.

- A fundamental component of this has been deep hypothermic circulatory arrest (DHCA), which has in been supplemented by retrograde cerebral perfusion (RCP) and then selective antegrade cerebral perfusion (SACP)

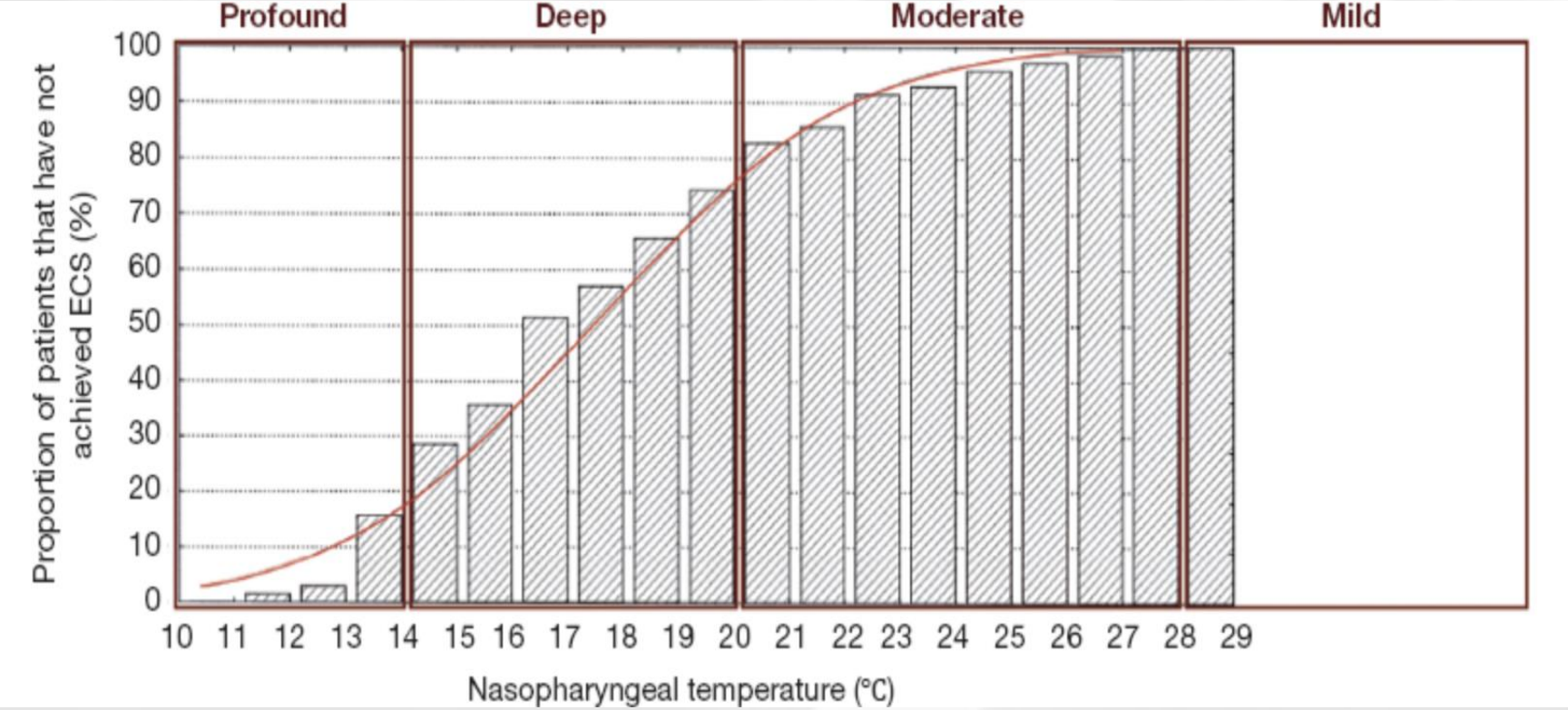

C
A
Venous
D
Arterial
B

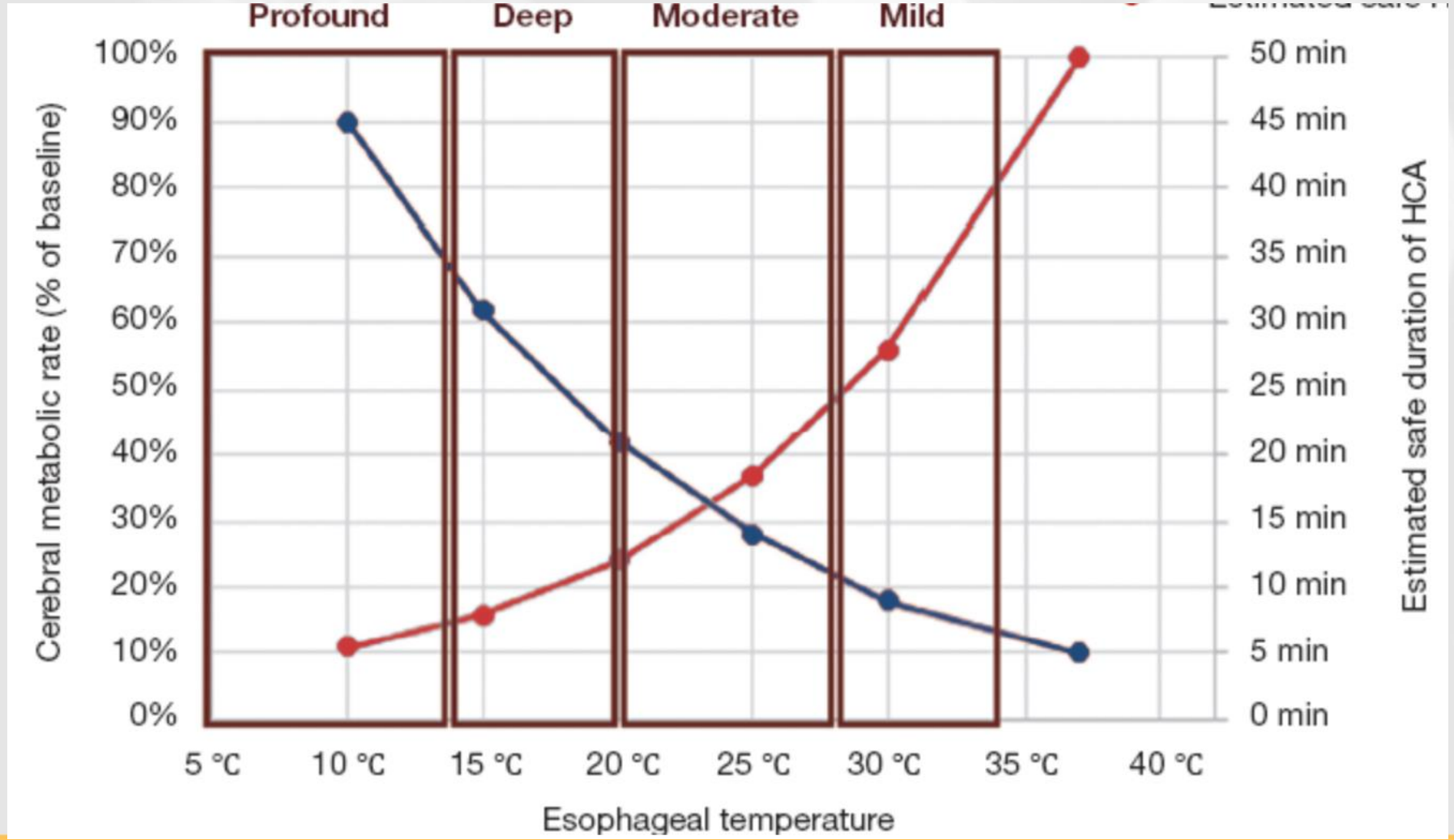


Hypothermia in Aortic Arch Surgery

Table 1 Expert consensus on classifications of hypothermia in circulatory arrest during aortic arch surgery

Category	Nasopharyngeal temperature
Profound hypothermia	≤14 ℃
Deep hypothermia	14.1-20 ℃
Moderate hypothermia	20.1-28 ℃
Mild hypothermia	28.1-34 ℃


Profound
Deep
Moderate
Mild
Proportion of patients that have not achieved ECS (%)
0
10
20
30
40
50
60
70
80
90
100
10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
Nasopharyngeal temperature (°C)


Profound
Deep
Moderate
Mild
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Cerebral metabolic rate (% of baseline)
50 min
45 min
40 min
35 min
30 min
25 min
20 min
15 min
10 min
5 min
0 min
Estimated safe duration of HCA
5 °C
10 °C
15 °C
20 °C
25 °C
30 °C
35 °C
40 °C
Esophageal temperature

Open aortic arch reconstruction

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A retrospective analysis of data from all patients admitted to the University of Michigan Hospitals from 1993 to 2009 who underwent aortic arch replacement via a median sternotomy was performed (n=721). Details of the operative technique have been described in our previous work (5).

Open aortic arch reconstruction

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- Early mortality was seen in 36 patients (5.0%)
- By multivariate analysis, older age, lower ejection, prolonged cardiopulmonary bypass and hypothermic circulatory arrest time were independently associated with early mortality.

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- Stroke was identified in 34 patients (4.7%).
- By multivariate analysis, independent predictors of stroke included history of COPD, procedure for type A dissection, prolonged HCA time, resection into proximal descending aorta and occurrence of permanent postoperative dialysis

Open Aortic Arch Repair

- In high-volume centers and in patients at low risk, surgical techniques such as complete open repair of the aortic arch or the hybrid (frozen) elephant trunk have been associated with a mortality rate of up to 9% and a stroke rate of 4% to 12%
- However, conventional surgical techniques for managing the aortic arch are invasive and frequently associated with a significant systemic inflammatory response syndrome and related complications.

Interactive CardioVascular and Thoracic Surgery 15 (2012) 63–68
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Outcomes following redo sternotomy for aortic surgery

William B. Keeling[a], Bradley G. Leshnower[b], Vinod H. Thourani[b], Patrick S. Kilgo[b] and Edward P. Chen[b,*]

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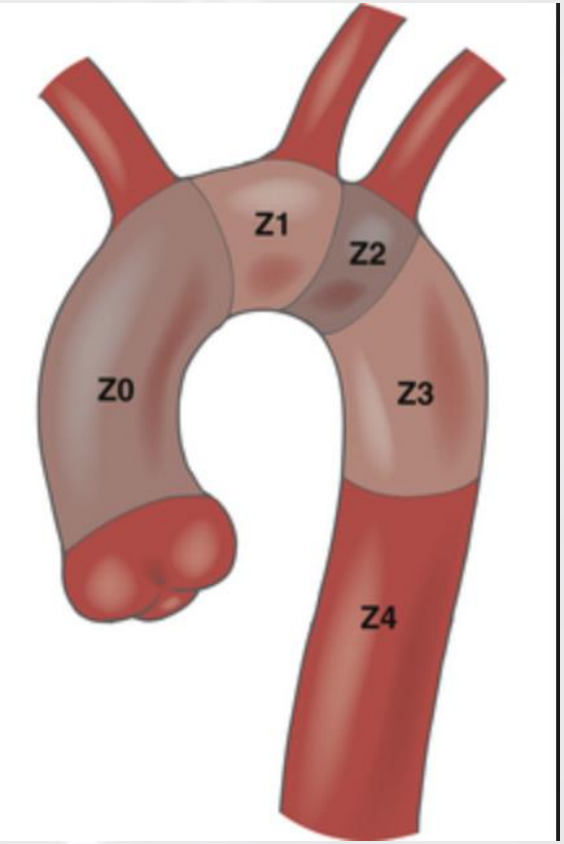
- Reoperative cardiac surgery is a higher risk of both morbidity and mortality, and this fact holds true for reoperative aortic surgery.
- Aortic surgery following a prior sternotomy for cardiac surgery with an in-hospital mortality rate of 11.5%
- Low stroke rate at 3.3% despite nearly 21% of patients having experienced a preoperative CVA

Endovascular Aortic Arch Repair



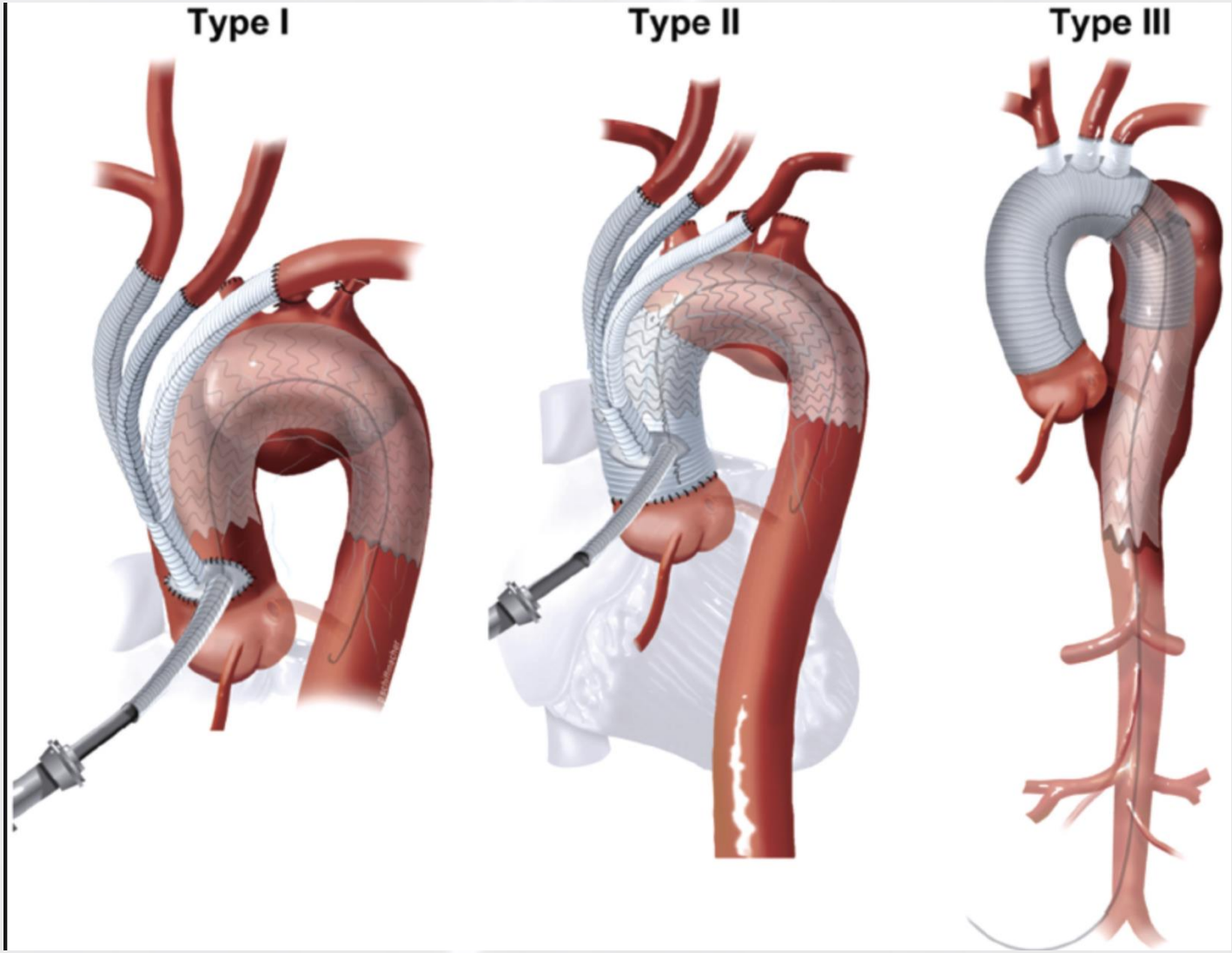
Five-year results of thoracic endovascular aortic repair with the Zenith TX2

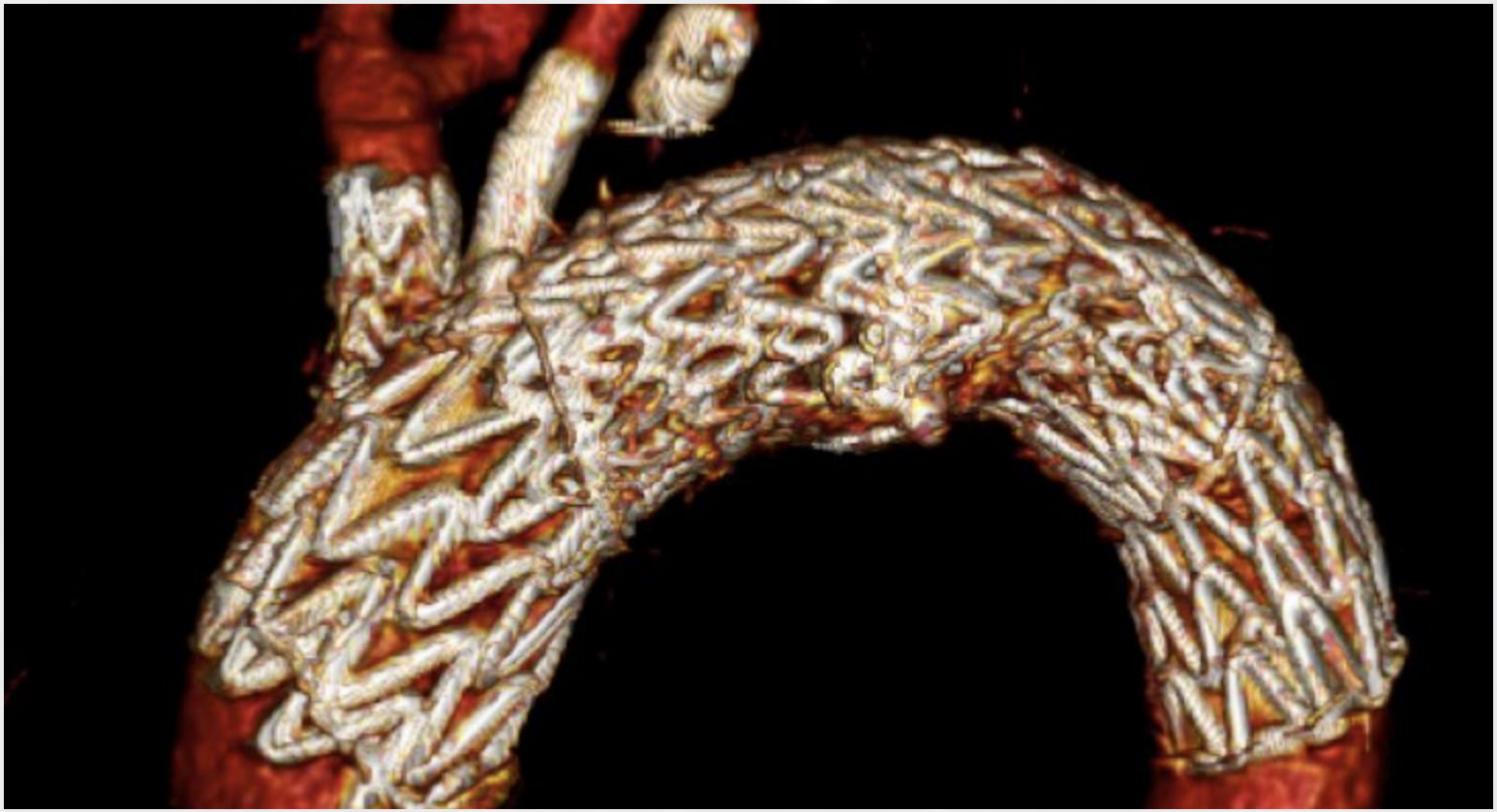
Jon S. Matsumura, MD[a], Germano Melissano, MD[b], Richard P. Cambria, MD[c], Michael D. Dake, MD[d], Shraddha Mehta, PhD[e], Lars G. Svensson, MD[f], Randy D. Moore, MD[g], for the

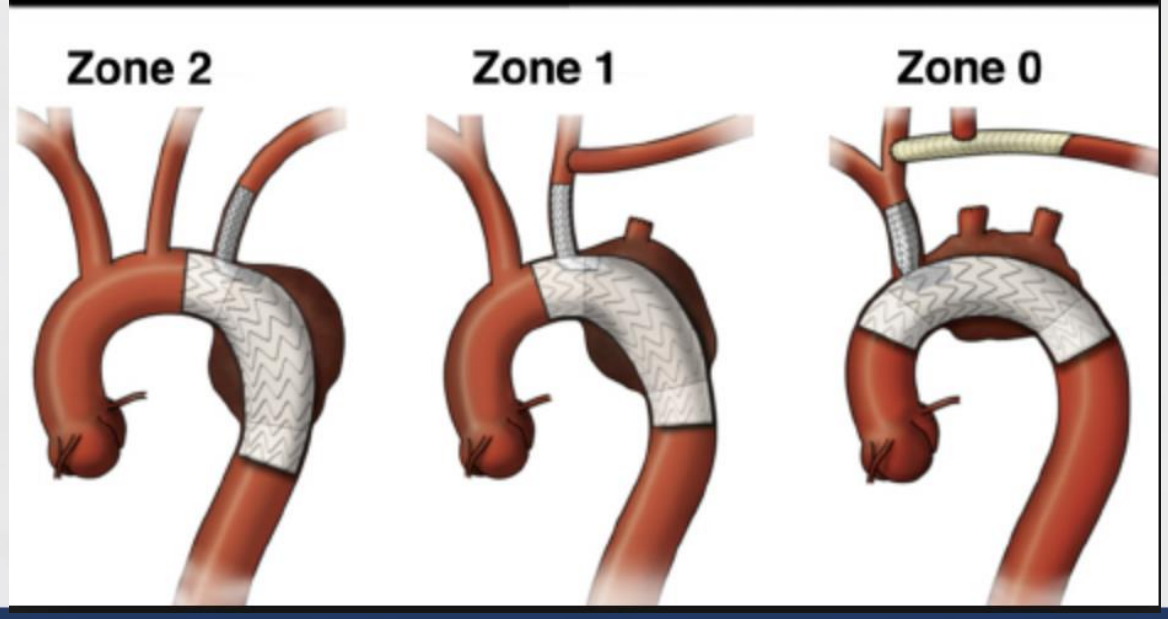
- Over the past 10 years, thoracic endovascular aneurysm repair (TEVAR) has prevailed as the treatment of choice for pathologies of the descending aorta and aortic arch up to zone 2.
- The superiority of TEVAR in comparison to open repair in reducing perioperative and long-term severe morbidity has been demonstrated in a prospective comparative study.

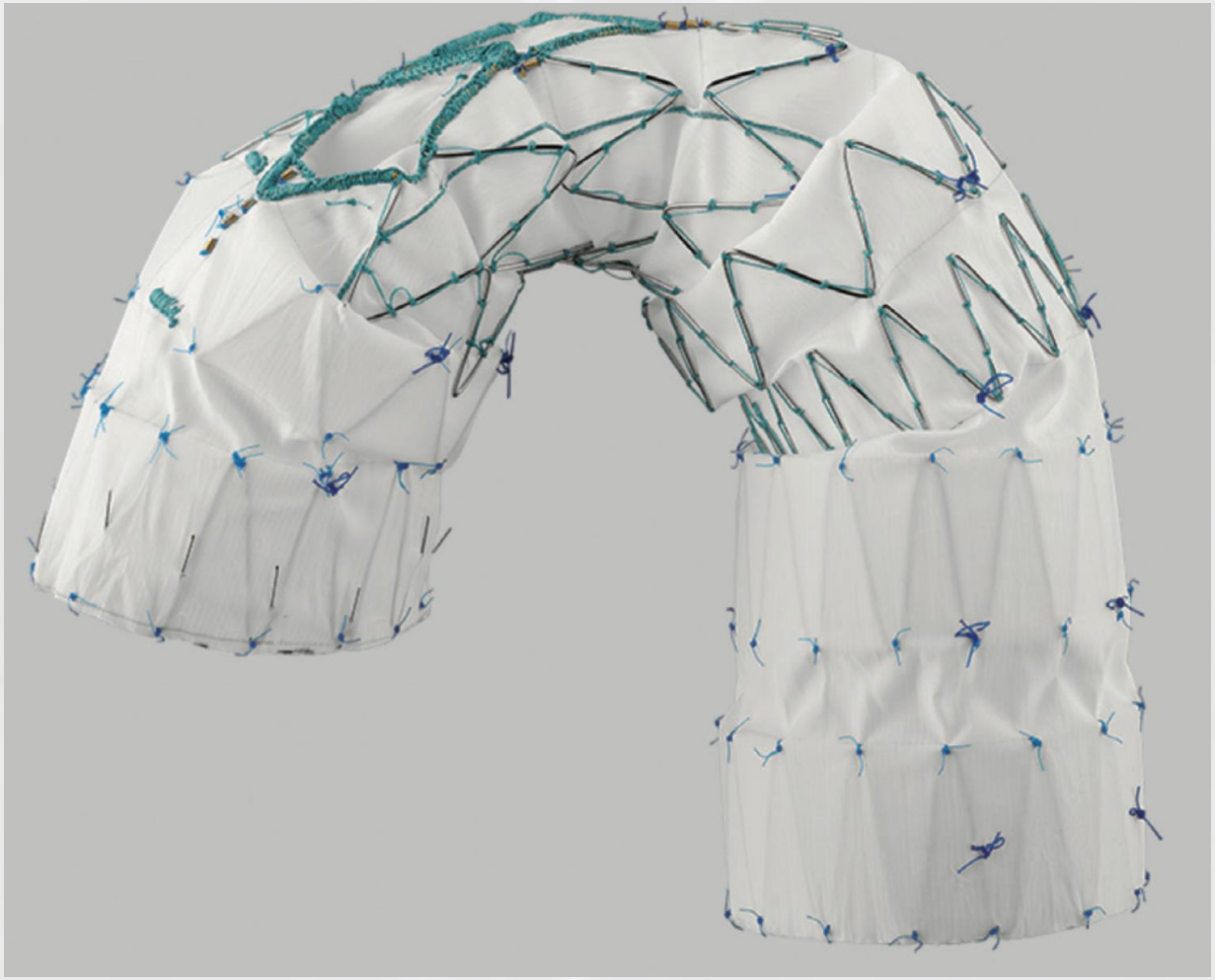
Endovascular Aortic Arch Repair

- ENDOVASCULAR HYBRID TECHNIQUES
- CHIMNEY PROCEDURES
- IN SITU FENESTRATED AORTIC ARCH ENDOGRAFTS
- CUSTOM-MADE FENESTRATED AND BRANCHED STENT GRAFTS


Type I
Type II
Type III




Zone 2
Zone 1
Zone 0



Technical Challenges of Endovascular Aortic Arch Repair

- The special hemodynamic and anatomic characteristics of the aortic arch make manipulation in this region challenging.
- The supra-aortic branches perfuse the brain, which has a low ischemic tolerance.
- Inaccuracy of stent graft placement can have fatal consequences for the patient and increase the risk of endoleaks and stroke.

Technical Challenges of Endovascular Aortic Arch Repair

- Aortic arch is wide, angulated, pulsatile, and is further away from the typical access vessels, the femoral arteries.
- Presence of plaque and thrombus in the aortic arch (ie, “shaggy aorta”) increases the risk for brain embolism

Conclusion

- Today, open surgery is considered the gold standard in treating the ascending aorta and the aortic arch
- Hybrid interventions can be a good alternative to open surgery in high-risk patients.
- The future of fenestrated and branched TEVAR in the aortic arch is promising and represents a potential future option for more patients with aortic arch disease