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# OPEN SURGERY CONVENTIONAL: DISCREPANCY IN RESULTS (LIGHTS AND SHADOWS)

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# AORTIC ARCH SURGERY

- ⦿ *During the last decade, the patient outcome after thoracic aortic surgery has improved considerably.*
- ⦿ Surgery of the thoracic aorta is still associated with significant morbidity and mortality.
- ⦿ Neurological injuries remain the most feared complications.



# Antegrade Selective Cerebral Perfusion

## EDITORIALS

### CEREBRAL PROTECTION DURING AORTIC ARCH SURGERY\*

Randall B. Griepp, MD

In this issue of the *Journal*, Kozai and associates<sup>1</sup> report an outstanding series of patients with aortic arch operations, with an exceptionally low mortality and incidence of neurologic complications. This is the latest in a series of papers that have shown that aortic arch surgery, with an exceptionally low mortality and incidence of neurologic complications. This is the latest in a series of papers that have shown that aortic arch surgery, with an exceptionally low mortality and incidence of neurologic complications. This is the latest in a series of papers that have shown that aortic arch surgery, with an exceptionally low mortality and incidence of neurologic complications.

**Hypothermic circulatory arrest** is a technique to gain the aortic arch.<sup>1</sup>

\*For related article, see page 1067.  
From the Department of Thoracic and Cardiovascular Surgery, Harvard Medical School, Massachusetts General Hospital, Boston, MA.  
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0885-0666/02/0000-0000\$05.00  
DOI: 10.1097/00000000-200200000-00000

Presented at the Aortic Surgery Symposium VIII, May 2-3, 2002, New York, NY.  
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Address reprint requests to Dr. Kozai, First Department of Surgery, Hamamatsu University School of Medicine, 1-1-1 Handayama, Hamamatsu, Japan 431-8592; e-mail: kkozai@hamamatsu-u.ac.jp

a field essentially free of thrombi. Through inspection of distal anastomoses, the high incidence of neurologic complications with HCA led to the gradual recognition that the safety of HCA depends on very careful inspection of the field essentially free of thrombi. Through inspection of distal anastomoses, the high incidence of neurologic complications with HCA led to the gradual recognition that the safety of HCA depends on very careful inspection of the field essentially free of thrombi.

### Antegrade Cerebral Perfusion With Cold A 13-Year Experience

Jean Bachet, MD, David Guilmet, MD, Bertrand Goudot, MD, Gilles L Philippe Delentdecker, MD, Denis Brodaty, MD, and Claude Dubois, MD

**Background.** In 1986 we introduced the technique of antegrade selective perfusion of the brain with cold blood during surgery of the aortic arch.

**Methods.** Between January 1986 and December 2001, 330 patients underwent aortic arch repair using SCP. Operations were performed with the aid of hypothermic extracorporeal circulation, SCP, and systemic circulatory arrest in most cases. In all, 89 patients (27%) were operated on for acute aortic dissection, 77 (23%) for chronic aortic dissection, and 164 (50%) for degenerative aneurysm. Total arch replacement using a branched graft was performed in 284 patients (86%). Mean SCP time was 86.2 ± 28.5 minutes.

**Results.** The overall in-hospital mortality rate was 11.2% (falling to 3.2% in the 124 patients operated on between 1997 and 2001). Preoperative complications included shock in 30 (9%), chronic obstructive pulmonary disease (presence of chronic bronchitis, pulmonary emphysema or FEV<sub>1</sub> <70% in 29 (9%)), chronic renal dysfunction (creatinine level >3 mg/dL) in 36 (11%), with 8 requiring hemodialysis; cerebral infarct in 26 (8%), and coronary artery disease in 50 (15%). Aortic dissection-related complications included cardiac tamponade in 42 (13%), myocardial ischemia in 9 (3%), cerebral ischemia in 10 (3%), renal/mesenteric ischemia in 11 (3%), and leg ischemia in 11 (3%). Sixty patients (18%) had undergone a total of 68 previous cardiovascular procedures.

**Conclusions.** Selective cerebral perfusion is a reliable technique for cerebral protection and it facilitates complex and time-consuming total arch replacement.

Twenty-nine patients (16.9%) operative hospital course. There was no mortality in patients aged less than 60 years.

### Usefulness of Antegrade Selective Cerebral Perfusion During Aortic Arch Operations

Teruhisa Kazui, MD, Katsushi Yamashita, MD, Naoki Washihiro, MD, Abul Hasan Muhammad Bashir, MBE, and Kazuhiro Ohkura, MD

First Department of Surgery, Hamamatsu University School of Medicine, Hamamatsu, Japan

**Background.** To evaluate the safety and usefulness of antegrade selective cerebral perfusion (SCP) during arch aneurysm or aortic dissection operations.

**Methods.** Between January 1986 and December 2001, 330 patients underwent aortic arch repair using SCP. Operations were performed with the aid of hypothermic extracorporeal circulation, SCP, and systemic circulatory arrest in most cases. In all, 89 patients (27%) were operated on for acute aortic dissection, 77 (23%) for chronic aortic dissection, and 164 (50%) for degenerative aneurysm. Total arch replacement using a branched graft was performed in 284 patients (86%). Mean SCP time was 86.2 ± 28.5 minutes.

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**Conclusions.** Selective cerebral perfusion is a reliable technique for cerebral protection and it facilitates complex and time-consuming total arch replacement.

(Ann Thorac Surg 2002;74:1806-9)  
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It is well known that appropriate selection of cerebral protection methodology during aortic arch exclusion has a substantial influence on the surgical outcome of aortic arch aneurysm or dissection. Antegrade selective cerebral perfusion (SCP) has been the cerebral protection method of choice in our institute, particularly in cases of aortic arch disease requiring complicated and time-consuming aortic arch repair [1-3]. The aim of the present study was to evaluate the safety and usefulness of SCP during arch aneurysm or aortic dissection operations.

**Material and Methods**  
Three hundred and thirty patients underwent surgery for aortic arch disease using hypothermic cardiopulmonary bypass (CPB) and SCP between January 1986 and December 2001. The study patients ranged in age from 18 to 87 years with a mean of 62.9 ± 12.7. Two hundred and twenty (67%) of the patients were male and 110 (33%) were female. Eighty-nine patients (27%) were treated for acute aortic dissection, 77 (23%) for chronic dissection, and 164 (50%) for degenerative aneurysm. Ninety-nine (30%) patients underwent emergency operation within 24 hours of admission.

Preoperative complications included shock in 30 (9%), chronic obstructive pulmonary disease (presence of chronic bronchitis, pulmonary emphysema or FEV<sub>1</sub> <70% in 29 (9%)), chronic renal dysfunction (creatinine level >3 mg/dL) in 36 (11%), with 8 requiring hemodialysis; cerebral infarct in 26 (8%), and coronary artery disease in 50 (15%). Aortic dissection-related complications included cardiac tamponade in 42 (13%), myocardial ischemia in 9 (3%), cerebral ischemia in 10 (3%), renal/mesenteric ischemia in 11 (3%), and leg ischemia in 11 (3%). Sixty patients (18%) had undergone a total of 68 previous cardiovascular procedures.

Preoperative angiography or digital subtraction angiography and contrast computed tomography (CT) were performed in most patients undergoing elective procedures.

**Operative Technique**  
Operations were performed through a median sternotomy in 326 patients (99%) and through a median sternotomy and left anterior thoracotomy in 4 (1%) for extended descending aortic replacement (EDAR). As for the site of arterial cannulation for CPB, the ascending aorta, and the right axillary artery if necessary, were used in most of the recent cases. The details of hypothermic CPB and antegrade SCP have been described previously [1-3]. Briefly, when the patient was cooled by extracorporeal circula-

### Selective Antegrade Cerebral Perfusion Metabolic Deficit in Aortic Arch A Prospective Randomized Trial

D.K. Harrington, MB ChB MRCS, A.S. Walker, MSc, RG, R.M. Bracewell, PhD MRCP, T.H. Clifton-Brook, FRCA, MD, D. Pagano, MD, FRCS, FESC, FETCS, R.S. Bonser, FRCS

**Background.**—Aortic arch surgery has a high incidence of brain injury. This may be detected after hypothermic circulatory arrest (HCA). We hypothesized that antegrade selective cerebral perfusion (SCP) would attenuate this phenomenon.

**Methods and Results.**—In a prospective randomized trial, 42 adult patients were included to undergo HCA for aortic arch surgery. HCA occurred at a nasopharyngeal temperature of 15°C and SACP at a core temperature of 25°C with cerebral perfusion at 15°C. Paired arterial and jugular venous samples were taken before and after arrest. Continuous transcranial Doppler perfusion was recorded during the arrest. Mean arterial pressure was maintained at 60-70 mmHg. There was no change in cerebral perfusion at 12 minutes post-arrest.

**Conclusions.**—Antegrade selective cerebral perfusion during aortic arch surgery does not appear to attenuate the metabolic deficit observed after HCA.

**Prospective Comparative Study of Brain Protection in Total Aortic Arch Replacement: Deep Hypothermic Circulatory Arrest With Retrograde Cerebral Perfusion or Selective Antegrade Cerebral Perfusion**

Yutaka Okita, MD, Kenji Minatoya, MD, Osamu Tagusari, MD, Motomi Ando, MD, Kazuyuki Nagaotsuka, MD, and Soichiro Kitamura, MD

Department of Cardiac Surgery, University of Bologna, Bologna, Italy

**Background.** Various methods of cerebral protection have been used during aortic arch operations. Deep hypothermia with circulatory arrest is the most common technique but has a limited safe period for circulatory arrest. Selective cerebral perfusion has been introduced to prolong this safe period. We reviewed our experience with antegrade selective cerebral perfusion during surgical repair of the thoracic aorta.

**Methods.** Between November 1996 and December 1998, 57 consecutive patients were operated on for aortic arch aneurysm using selective cerebral perfusion. Forty-one were men (71.9%) and 16 were women. The mean age was 63.2 years. Thirty-seven patients had chronic aneurysms, and 20 had type A acute dissection. Preoperative, intraoperative, and postoperative factors were analyzed by univariate and multivariate analysis to identify predictors of early mortality and transient neurologic dysfunction.

**Results.** There were no preoperative predictors of mortality. The early mortality rate was 11.3% (6/53). The late mortality rate was 10.4% (5/48). The total mortality rate was 21.7% (11/50). The mean duration of SCP was 86.2 ± 28.5 minutes.

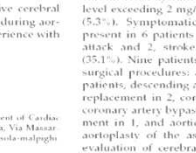
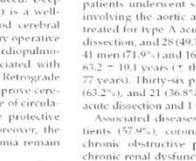
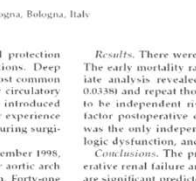
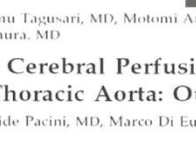
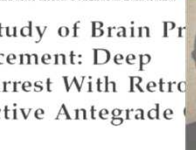
**Conclusions.** The present study confirmed that preoperative renal failure and repeat thoracotomy for bleeding are significant predictors of mortality in aortic arch operations using selective cerebral perfusion, and that cerebral perfusion time has no influence on the postoperative outcome. We believe that selective cerebral perfusion is an optimal technique of cerebral protection during operations on the aortic arch.

(Ann Thorac Surg 2002;70:10-16)  
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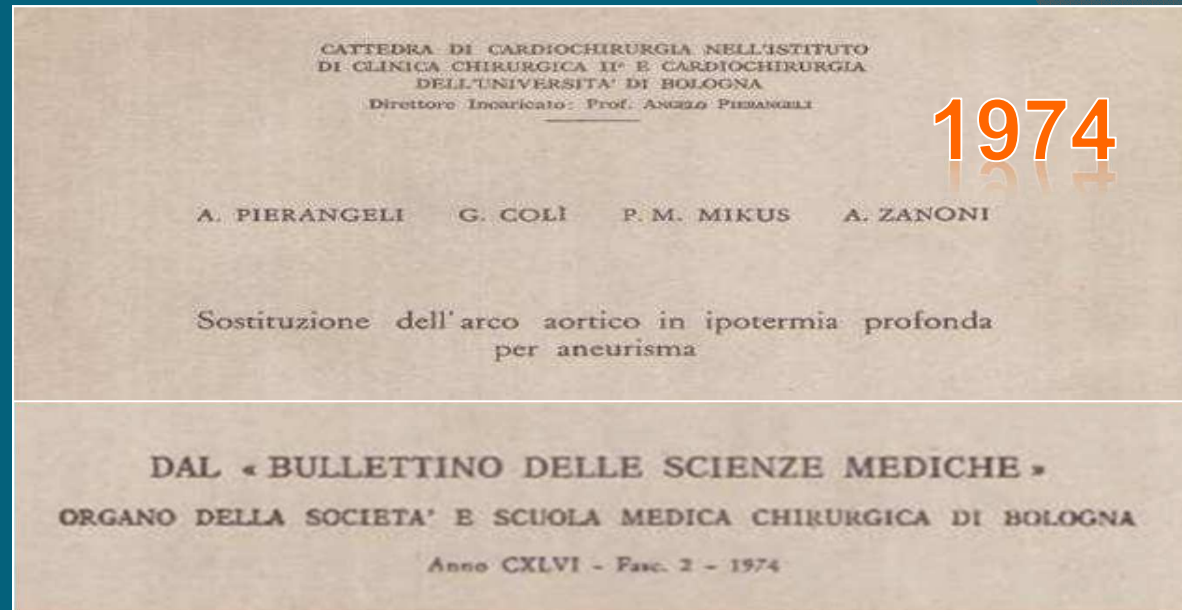
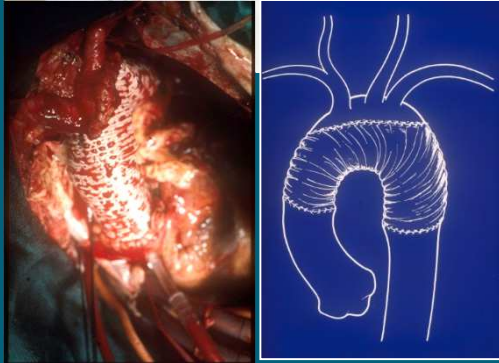
**Material and Methods**  
From November 1996 to December 1998, 57 consecutive patients underwent surgical treatment of aortic arch disease involving the aortic arch. Twenty patients (35.1%) were treated for type A acute dissection, 9 (15.8%) for chronic dissection, and 28 (49.1%) for true aneurysms. There were 41 men (71.9%) and 16 women (28.1%) with a mean age of 63.2 ± 10.4 years (± standard deviation) (range, 32 to 77 years). Thirty-six patients were operated on electively (63.2%), and 21 (36.8%) had emergency operation (20 for acute dissection and 1 for impending aneurysmal rupture).

Associated diseases included hypertension in 33 patients (57.9%), coronary artery disease in 12 (21.1%), chronic obstructive pulmonary disease in 11 (19.3%), chronic renal dysfunction (defined as a serum creatinine level exceeding 2 mg/dL) in 6 (10.5%), and diabetes in 3 (5.3%). Symptomatic cerebral vascular disease was present in 6 patients (10.5%); 4 had transient ischemic attack and 2, stroke. Twenty patients were smokers (35.1%). Nine patients (15.8%) had undergone previous surgical procedures: ascending aorta replacement in 2 patients, descending aorta replacement in 1, aortic valve replacement in 2, coronary artery bypass grafting in 2, coronary artery bypass grafting and aortic valve replacement in 1, and aortic valve replacement and tailoring aorticoplasty of the ascending aorta in 1. Preoperative evaluation of cerebral circulation was performed with

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# Deep Hypothermic Circulatory Arrest



## ADVANTAGES :

- SIMPLE TECHNIQUE
- NO CANNULATION
- NO SOPHISTICATED EQUIPMENT
- " BLOODLESS, OPEN " REPAIR

## DRAWBACKS :

- LONG COOLING TIME
- LONG REWARMING TIME
- LIMITED TIME OF ARCH EXCLUSION

GRIEPP RB., STINSON EB., HOLLINGSWORTH JF., BUEHLER D.  
*Prosthetic replacement of the aortic arch.*  
J Thorac Cardiovasc Surg 1975; 70: 1051-63



# Deep Hypothermic Circulatory Arrest

## Methods of cerebral protection in surgery of the thoracic aorta

*Davide Pacini<sup>†</sup>, Luca Di Marco and Roberto Di Bartolomeo*

**Table 1.** Early results with deep hypothermic circulatory arrest of current series of surgical repair of the thoracic aorta.

Author	Publication year	n	Hospital mortality (%)	PND rate (%)	TND rate (%)
Svensson	1993	656	10	5	2
Ergin	1997	171	17.16	6.37	19
Coselli	1997	204	16.9	6.5	NR
Coselli and LeMarie	1997	189	16.9	6.5	NR
Di Bartolomeo	1997	74	16.9	5.4	6.7
Grabenwöger	1997	86	19	12.9	NR
Ehrlich	1998	65	40	21%*	-
Augoustides	2005	110	8.2	8.1	10.9

- Incidence of TND ↑ after 25 min
- Incidence of CVA ↑ after 40 min
- Mortality ↑ after 60 mins

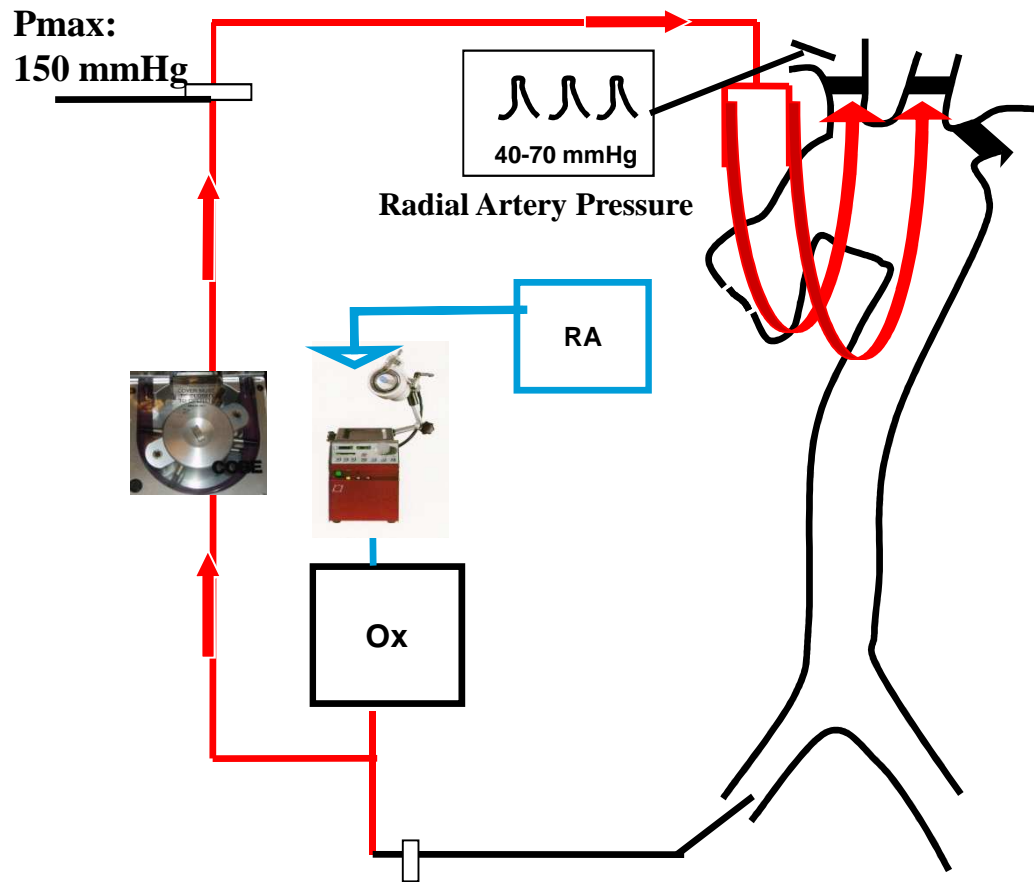
\*Overall neurological dysfunction

NR: Not reported; PND: Permanent neurological dysfunction; TND: Temporary neurological dysfunction.



**Bologna, November 1996.**  
**The first case of ASCP with the Kazui technique**

**Selective Cerebral Perfusion:**  
**10 ml/Kg/min**



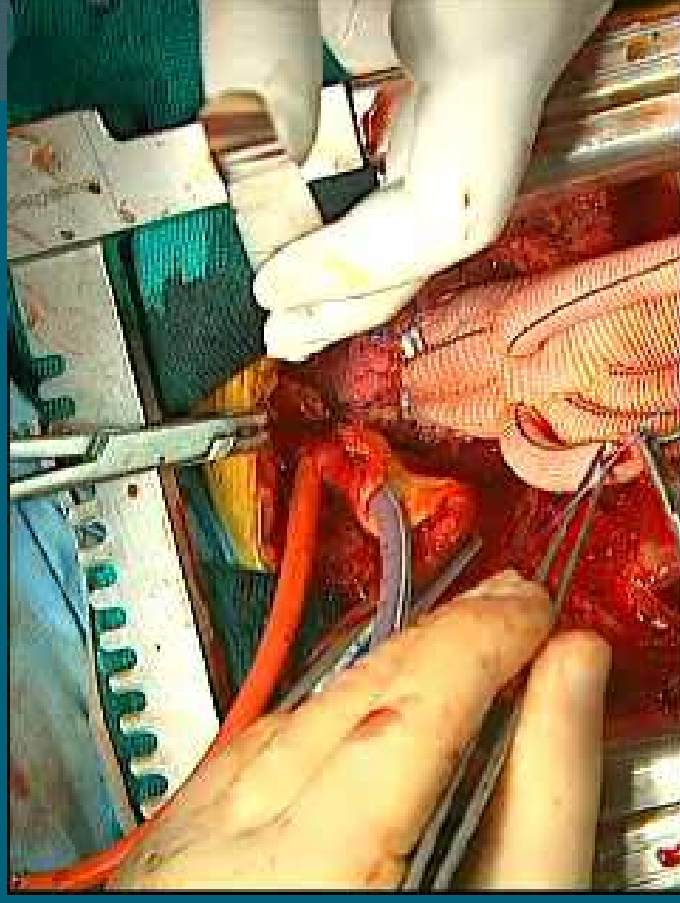
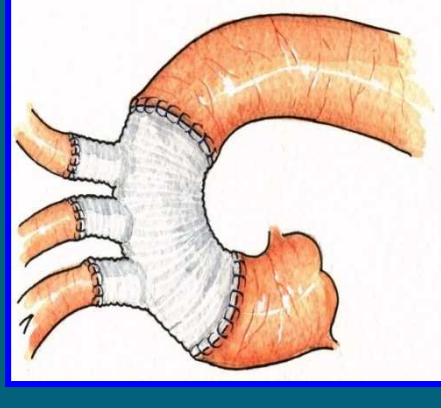
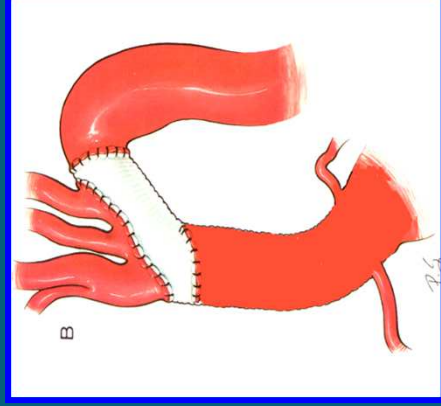
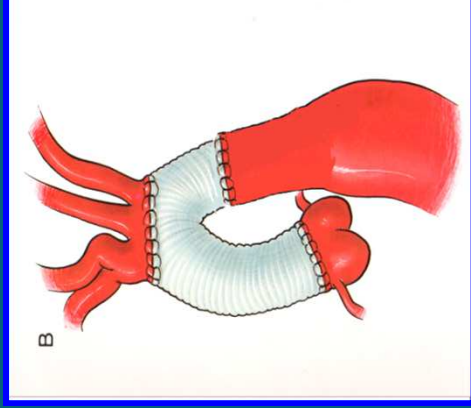
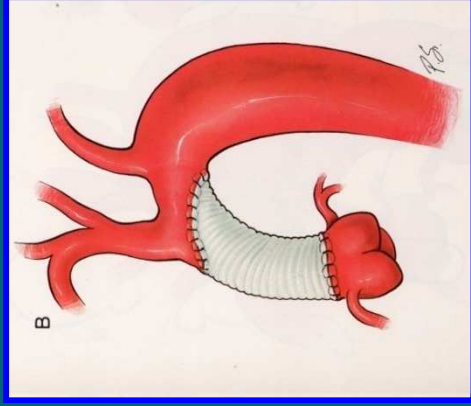
**Nasopharyngeal T. 26 ° C**

**Additional Monitoring:**

- $S_{jv} O_2$
- NIRS
- TCD



# Conventional Open Surgery of the Aortic Arch



# Selective antegrade cerebral perfusion and mild (28°C-30°C) systemic hypothermic circulatory arrest for aortic arch replacement: Results from 1002 patients

Andreas Zierer, MD,<sup>a</sup> Ali El-Sayed Ahmad, MD,<sup>a</sup> Nestoras Papadopoulos, MD,<sup>a</sup> Anton Moritz, MD,<sup>a</sup> Anno Diegeler, MD,<sup>b</sup> and Paul P. Urbanski, MD<sup>b</sup>

**Objectives:** The use of selective antegrade cerebral perfusion (ACP) makes deep hypothermia nonessential for aortic arch replacement. Consequently, a growing tendency to increase the body temperature during circulatory arrest with ACP has recently been reported from various institutions. However, very little is known about the clinical effect of different modes of ACP (unilateral vs bilateral) on neurologic morbidity. Also, the safe limits of this approach for spinal chord and visceral organ protection are yet to be defined.

**Methods:** Between January 2000 and January 2011, 1002 consecutive patients underwent aortic arch repair during ACP (unilateral, 673; bilateral, 329) with mild systemic hypothermia (30°C ± 2°C; range, 26°-34°C) at 2 centers in Germany. The mean patient age was 62 ± 14 years, 663 patients (66%) were men, and 347 patients (35%) had acute type A dissection. Hemiarch replacement was performed in 684 patients (68%), and 318 (32%) underwent total arch replacement.

**Results:** The cardiopulmonary bypass time accounted for 158 ± 56 minutes and the myocardial ischemic time, 101 ± 41 minutes. Isolated ACP was performed for 36 ± 19 minutes (range, 9-135). We observed new postoperative permanent neurologic deficits in 28 patients (3%); stroke in 25 and paraplegia in 3) and transient neurologic deficits in 42 patients (4%). All 3 cases of paraplegia occurred in patients with acute type A dissection and a broad range of ACP times (24, 41, and 127 minutes). A trend was seen toward a reduced permanent neurologic deficit rate after unilateral ACP ( $P = .06$ ), but no difference was seen in the occurrence of transient neurologic deficits ( $P = .6$ ). Overall, the early mortality rate was 5% (n = 52). Temporary dialysis was necessary primarily after surgery in 38 patients (4%). When corrected for the unequal distribution of type A dissection, neurologic morbidity, early mortality, and the need for temporary dialysis were independent of the duration of ACP and were not affected by unilateral versus bilateral ACP.

**Conclusions:** Current data suggest that ACP and mild systemic hypothermic circulatory arrest can be safely applied to complex aortic arch surgery even in a subgroup of patients with up to 90 minutes of ACP. Unilateral ACP offers at least equal brain and visceral organ protection as bilateral ACP and might be advantageous in that it reduces the incidence of embolism arising from surgical manipulation on the arch vessels. (J Thorac Cardiovasc Surg 2012;144:1042-50)



# Policlinico S.Orsola-Malpighi University of Bologna

*From November 1996 to December 2014*

**795** patients underwent thoracic aorta surgery

**Hospital Mortality 95 pts (11.9%)**

Preoperative characteristics	N. (%)
<i>Hyperthension</i>	502 (63.1)
<i>CAD</i>	96 (12.1)
<i>COPD</i>	34 (4.3)
<i>Preop-renal insuff.</i>	39 (4.9)
<i>Smoking</i>	260 (32.7)
<i>Urgent/Emergent</i>	302 (38.0)

Extent of aortic replacement	N (%)
<i>Ascending + aortic arch</i>	279 (35.1)
<i>Ascending aorta/hemiarch</i>	330 (41.5)
<i>Aortic arch</i>	178 (22.4)
<i>Classic ET</i>	61 (7.7)
<i>Frozen ET</i>	164 (20.6)



# Visceral organ protection in aortic arch surgery: safety of moderate hypothermia<sup>†</sup>

Davide Pacini<sup>a,\*</sup>, Antonio Pantaleo<sup>a</sup>, Luca Di Marco<sup>a</sup>, Alessandro Leone<sup>a</sup>, Giuseppe Barberio<sup>a</sup>,  
Giacomo Murana<sup>a</sup>, Sebastiano Castrovinci<sup>a</sup>, Sandra Sottili<sup>b</sup> and Roberto Di Bartolomeo<sup>a</sup>

## Abstract

**OBJECTIVES:** Although antegrade selective cerebral perfusion (ASCP) provides good brain protection during aortic arch surgery, the issue of distal organ protection during circulatory arrest remains to be clarified. The aim of the study was to retrospectively evaluate the outcome of aortic arch surgery using ASCP at different temperatures, focusing on visceral functions (VFs).

**METHODS:** Three hundred and thirty-four patients underwent elective aortic arch surgery using ASCP from November 1996 to March 2011. Those patients were divided into two groups by comparing pre-operative and postoperative outcomes. Univariate and multivariate analysis were performed.

**Overall 30-day mortality 4.6% (14/304 pts)**

**RESULTS:** Three hundred and four patients represent the cohort of the study. Deeper systemic hypothermia ( $\leq 25^{\circ}\text{C}$ ) (Group A) was used in 194 patients (63.8%) and moderate hypothermia ( $>25^{\circ}\text{C}$ ) (Group B) in 110 patients (36.2%). The 30-day mortality rate was 3.6% in Group B and 5.2% in Group A ( $P = \text{NS}$ ). Permanent neurological deficits occurred in 4 (3.6%) and in 14 patients (7.2%) of Group A and Group B, respectively ( $P = \text{NS}$ ). Postoperative renal insufficiency requiring dialysis occurred in 6 patients (5.4%) in Group A and in 15 patients (7.7%) in Group B, the differences were not statistically significant. Biochemical markers of VFs increased in the postoperative period without differences between groups. At the multivariate analysis, cardiopulmonary bypass time  $>180$  min (odds ratio (OR) = 2.16) was the only significant risk factor for renal dysfunction with or without liver dysfunction, while cardiopulmonary bypass time longer than 180 min (OR = 2.28) and hypothermia higher than  $25^{\circ}\text{C}$  (OR = 0.54) were found to be independently related to liver dysfunction.

**CONCLUSIONS:** Our results confirmed that ASCP with moderate hypothermia at  $26^{\circ}\text{C}$  is a safe method for brain protection. Moreover, during circulatory arrest, moderate hypothermia also offers good protection of visceral organs and it should be preferred for limited periods ( $<60$  min) of visceral ischaemia because it may reduce the systemic inflammatory response and the reperfusion organ injury.

**Keywords:** Hypothermia • Aortic aneurysm • Aortic arch repair • Cerebral protection • Visceral protection

# Antegrade selective cerebral perfusion and moderate hypothermia in aortic arch surgery: clinical outcomes in elderly patients<sup>†</sup>

Davide Pacini<sup>a</sup>, Luca Di Marco<sup>a</sup>, Alessandro Leone<sup>a</sup>, Roberto Di Bartolomeo<sup>a</sup>, Gottfried Sodeck<sup>b</sup>,  
Lars Englberger<sup>c</sup>, Thierry Carrel<sup>c</sup> and Martin Czerny<sup>c,\*</sup>

## Abstract

**OBJECTIVES:** To evaluate the outcome in elderly patients ( $\geq 75$  years) undergoing elective aortic arch surgery with the aid of selective antegrade cerebral perfusion (SACP) and moderate hypothermic circulatory arrest (HCA).

**METHODS:** A series of 95 patients  $\geq 75$  years (median age 77 years, median EuroSCORE 28) undergoing elective aortic arch surgery with SACP and moderate HCA were analysed with regard to clinical outcome. Risk factors for serious adverse events (mortality, neurological injury) were determined.

**RESULTS:** Sixty-three patients (66%) underwent ascending aorta and hemiarch replacement, whereas 32 patients (34%) underwent ascending aorta and total arch replacement. Isolated arch replacement was rare. Additionally, 27% of patients underwent aortic valve replacement and 26% underwent root replacement. In-hospital mortality was 7%. Permanent neurological deficits occurred in 5%, transient neurological deficits occurred in 2%. Median SACP time was 24 min. Univariate analysis revealed femoral cannulation site (OR: 3.4; CI: 1.25–9.22,  $P = 0.016$ ) as well as HCA  $\geq 40$  min (OR: 4.21; CI: 1.83–12.58,  $P = 0.001$ ) as predictors of serious adverse events (mortality, neurological injury).

**CONCLUSIONS:** Summarizing, elective aortic arch surgery in elderly patients using SACP and moderate HCA provides excellent results regarding mortality and postoperative neurological outcome. Prolonged HCA time and femoral cannulation were the only predictors of serious adverse events (mortality, neurological injury).

**Keywords:** Aortic arch surgery • Elderly • Hypothermic circulatory arrest • Selective antegrade cerebral perfusion



# Conventional Open Surgery of the Aortic Arch

## Contemporary open aortic arch repair with selective cerebral perfusion in the era of endovascular aortic repair

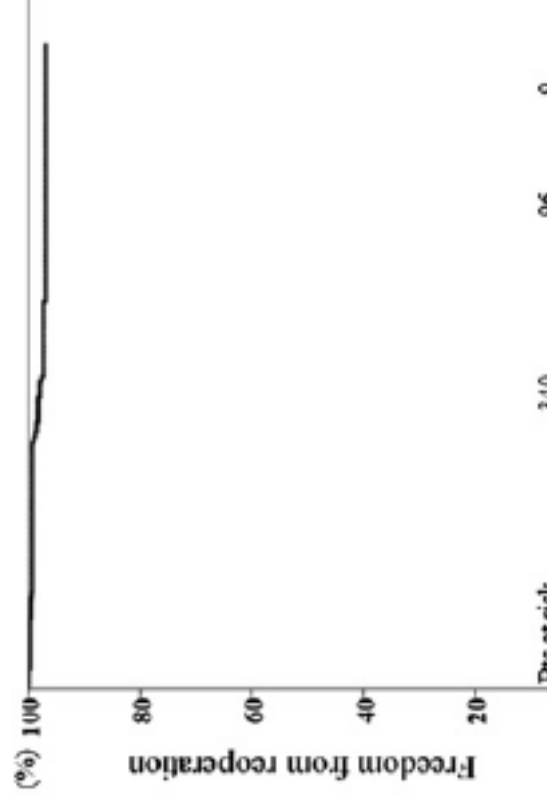
Yutaka Iba, MD,<sup>a</sup> Kenji Minatoya, MD, PhD,<sup>a</sup> Hitoshi Matsuda, MD, PhD,<sup>a</sup> Hiroaki Sasaki, MD, PhD,<sup>a</sup> Hiroshi Tanaka, MD, PhD,<sup>a</sup> Junjiro Kobayashi, MD, PhD,<sup>a</sup> and Hitoshi Ogino, MD, PhD<sup>b</sup>

**Objective:** With the recent advance of endovascular aortic repair, the role of open aortic arch repair should be reassessed. We reviewed our experience with open aortic arch repair with selective cerebral perfusion by way of the axillary artery with de-

**Methods:** From 2001 to 2011, 1007 patients (male 703, female 304) underwent open aortic arch repair with selective cerebral perfusion through the right axillary artery (mean age 67 years, range 25-92 years). Of the 1007 patients, 52% (524) were operated on for acute aortic dissection, 28% (282) for aortic aneurysm, and 20% (201) for aortic arch atherosclerosis.

**Results:** The early mortality was 4.7% for all patients. The independent predictors of in-hospital mortality were acute aortic dissection (OR 1.5, 95% CI 1.1-2.0), chronic kidney disease (OR 1.5, 95% CI 1.1-2.0), and concomitant neurologic dysfunction (OR 1.5, 95% CI 1.1-2.0). The cumulative survival at 5 years was 80.0%. The cumulative survival from reoperation related to the initial arch repair was 95.0%.

**Conclusions:** Conventional open arch repair yielded satisfactory outcomes and should remain the standard therapy, with good long-term durability in all but high-risk patients. (J Thorac Cardiovasc Surg 2013;145:S72-7)



## High risk patient:

**Associated comorbidity:**

- Pulmonary insufficiency (FEV1<40-50%)
- Cardiac dysfunction (EF<30%)
- Chronic renal insufficiency

**Very old age**

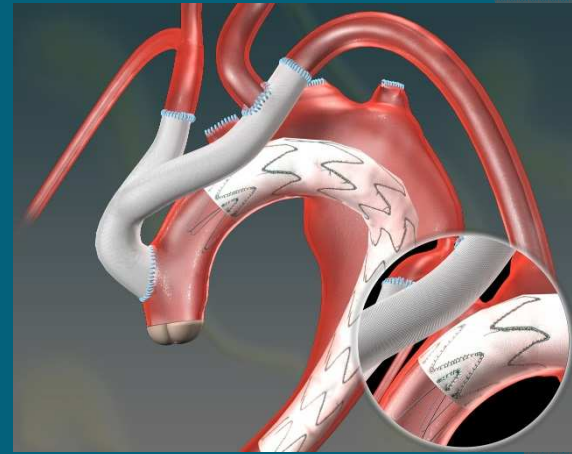
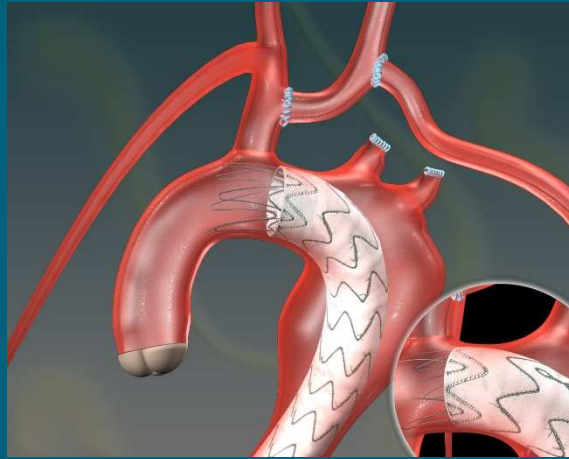
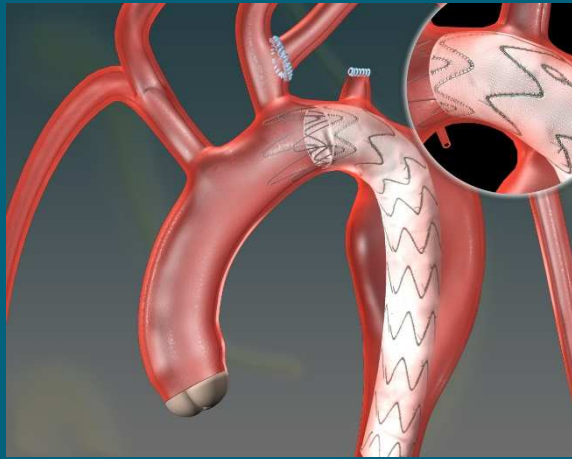


CPB and HCA

### **„potential drawbacks“**

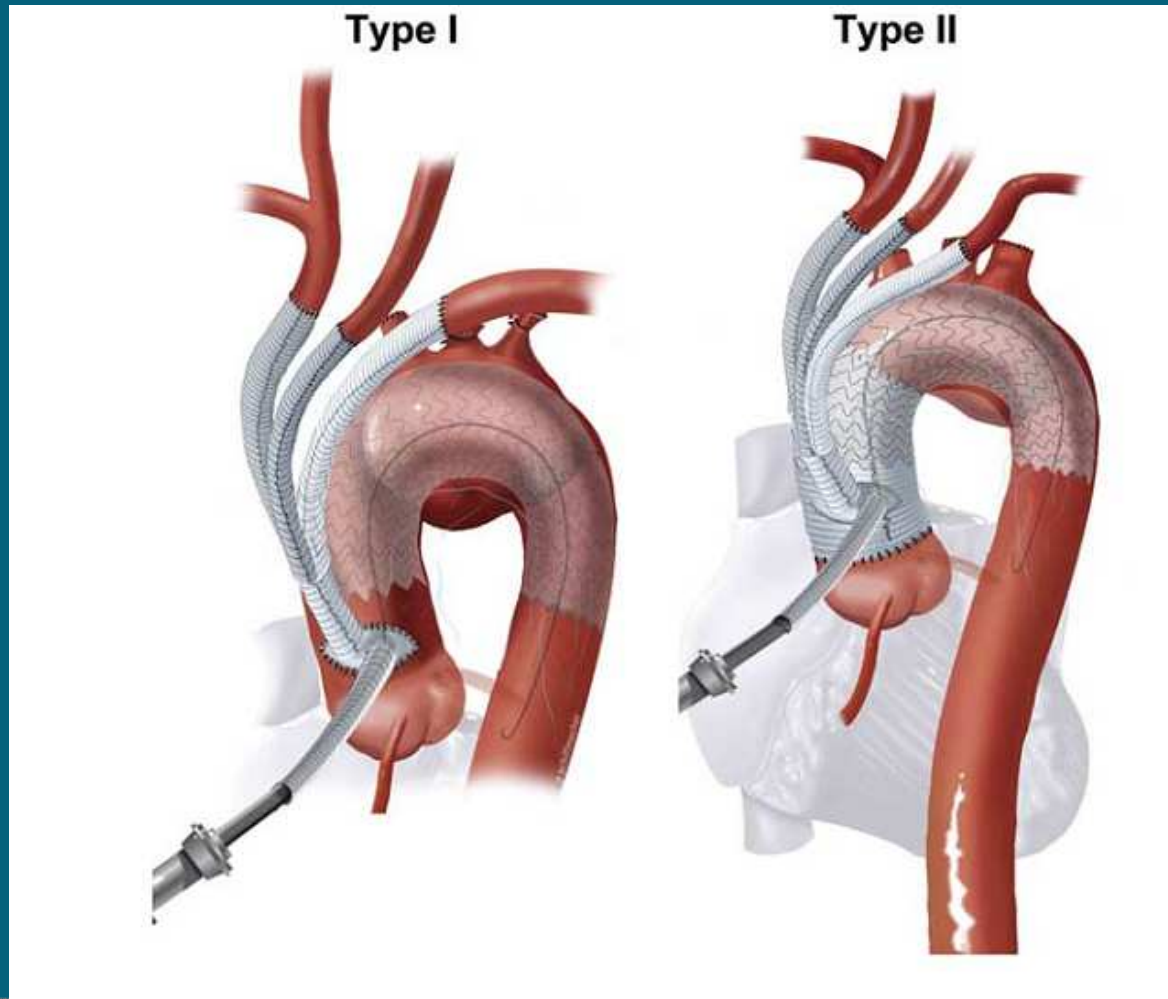
- brain injury
- bleeding complications
- complement activation
- SIRS
- infection
- long rehabilitation

# DEBRANCHING



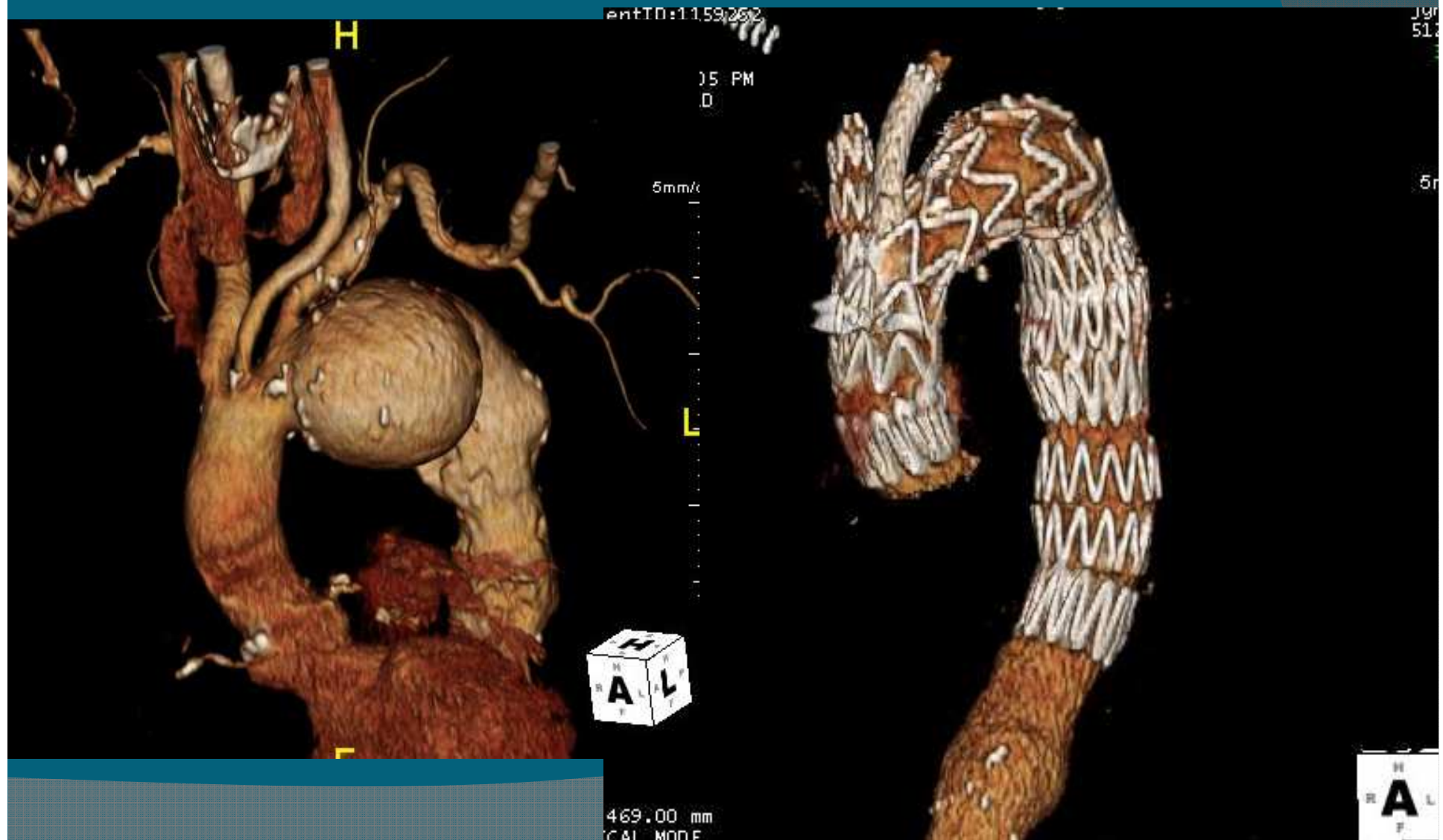


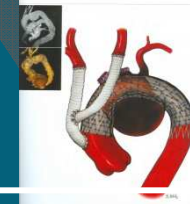
# DEBRANCHING



# Total EndoVascular Arch Procedure !!

Courtesy of Cherrie Abraham, MD, Montreal, Canada





# Meta Review of Zone 0 LZ Hybrids

Study	Year	N	Periop Mortality	Periop Stroke	Paraplegia/Sp. Ischemia	Zone 0 Hybrids only?
Milewski et al	2010	27	10%	5%	10%	No- only 19
Wiegang et al	2009	16	15%	4%	0%	Yes
Chan et al	2008	7	0%	0%	0%	No- only 5
Hughes et al	2008	7	14%	0%	0%	Yes
Chen et al	2008	6	0%	0%	0%	Yes
Melissano et al	2007	26	14.3%	14.3%	0%	No- only 14
Czerny et al	2007	27	4-7%*	0%	0%	No- only 14
Bergeron et al	2006	25	8-13%*	12-20%*	4-6%*	No- only 15
Saleh et al	2006	15	0%	0%	0%	Yes
Carrel et al	2006	6	0%	0%	0%	No- only 5

\* Percentages inaccurate, as outcomes in zone 0 are not addressed separately in original paper!



# CONCLUSIONS

- **Conventional open surgery still represents the gold standard in aortic arch surgery providing good and stable results**
- **Open surgery in high risk patients (very old, severe comorbidity) has unsatisfactory results**
- **Hybrid treatment has been introduced to improve outcomes**

*University of Bologna*

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***THANK  
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