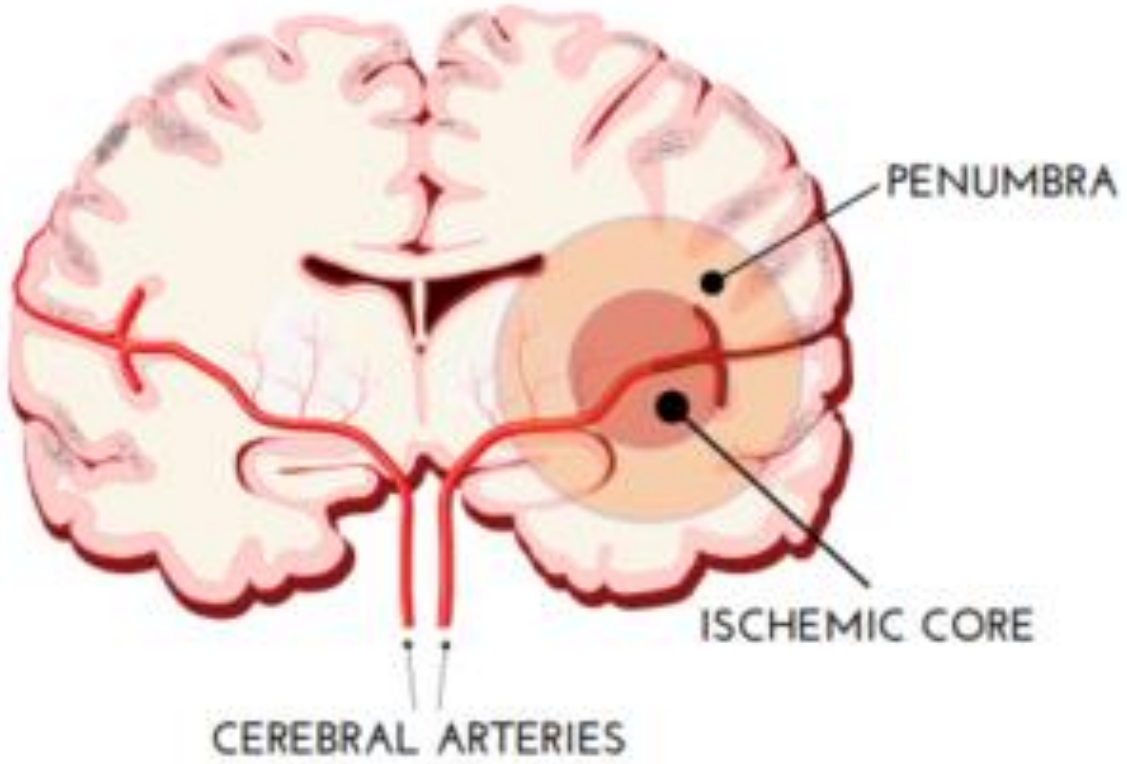
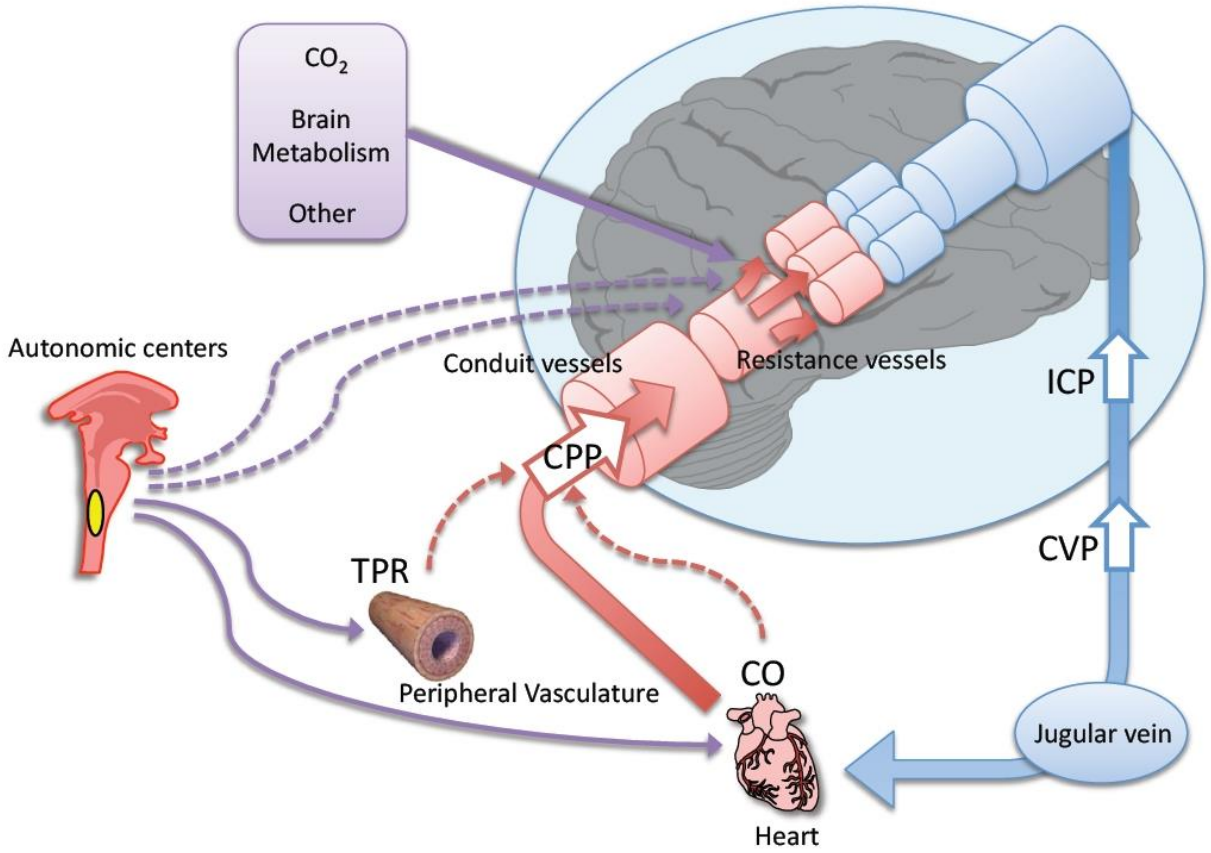
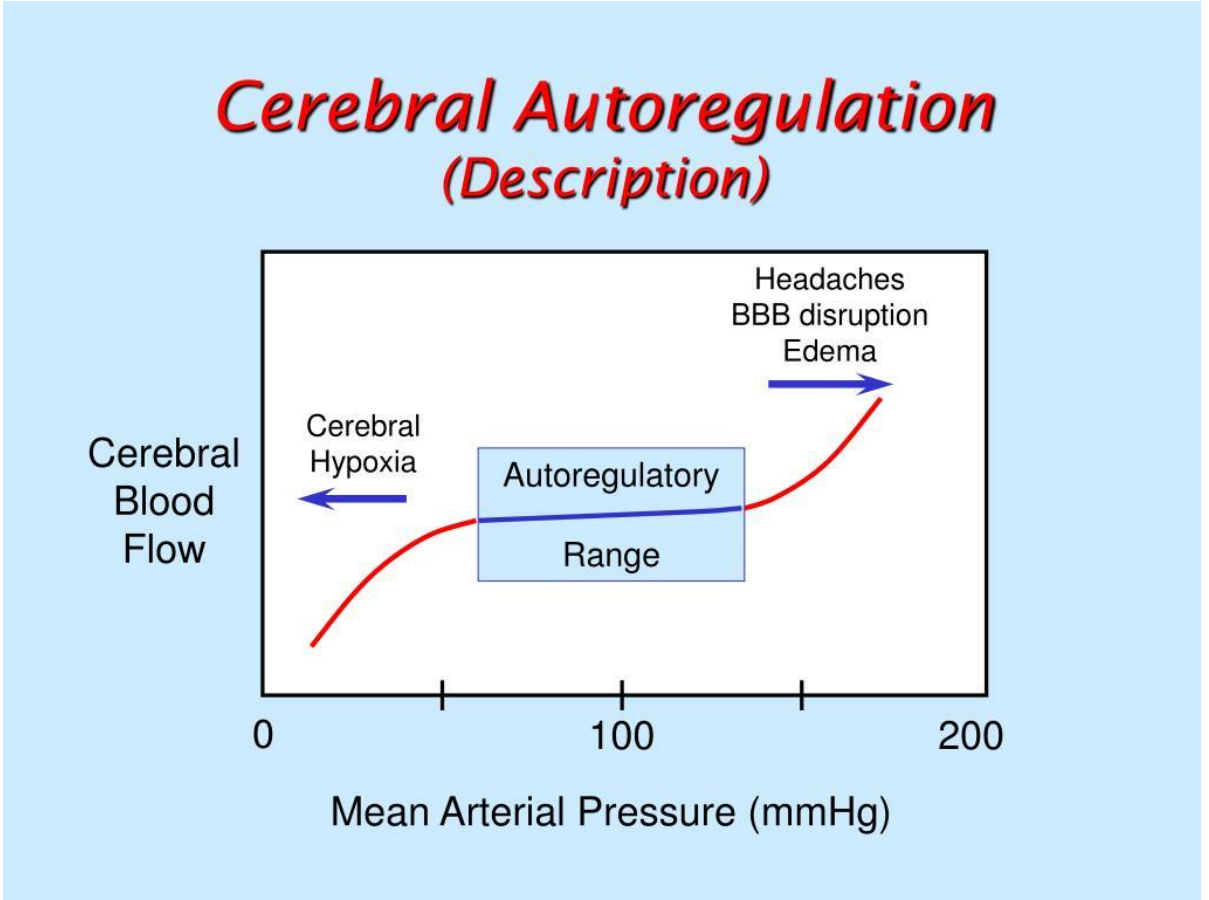
Stroke prior to cardiac and aortic surgery: When can we operate?

PARINYA LEELAYANA, MD, RAMATHIBODI HOSPITAL

Stroke







CEREBRAL AUTOREGULATION

under normal physiologic condition

Many studies showed that …

Cerebral autoregulation become impaired after stroke.

Making penumbral tissue vulnerable to alteration

in blood pressure

Stroke
Volume 41, Issue 11, 1 November 2010, Pages 2697-2704
https://doi.org/10.1161/STROKEAHA.110.594168

COMMENTS AND OPINIONS

Cerebral Autoregulation in Stroke

A Review of Transcranial Doppler Studies

Marcel J.H. Aries, MD, Jan W. Elting, MD, PhD, Jacques De Keyser, MD, PhD, Berry P.H. Kremer, MD, PhD, and Patrick C.A.J. Vroomen, MD, PhD

- A meta-analysis review of 23 studies about stroke and autoregulation
- Progressive deterioration of cerebral autoregulation in the first 5 days after stroke and recovery over the next 3 months

Following an initial stroke, patients are at a significantly higher risk of a further stroke compared with the general population.

The highest risk of a recurrent event is within the first month.

Mohan, Keerthi M., et al. "Risk and cumulative risk of stroke recurrence: a systematic review and meta-analysis." *Stroke* 42.5 (2011): 1489-1494.

Incidence of spontaneous hemorrhagic transformation in all patients with stroke has been reported to range from 15-43%.

The rate of hemorrhagic conversion has been reported to increase by 7% when associated with anticoagulant.

Lyden PD, Zivin JA. Hemorrhagic transformation after cerebral ischemia: mechanisms and incidence; Cerebrovasc Brain Metab Rev. 1993;5:1-16.

Estol CJ, Pessin MS. Anticoagulation: is there still a role in atherothrombotic stroke? Stroke. 1990;21:820-4.

Early hemorrhagic transformation 9%

- AF
- Large anterior stroke
- Cardioembolic
- High NIHSS score
- Anticoagulant and antiplatelet

Early Hemorrhagic Transformation of Brain Infarction: Rate, Predictive Factors, and Influence on Clinical Outcome

Results of a Prospective Multicenter Study

Maurizio Paciaroni, MD; Giancarlo Agnelli, MD; Francesco Corea, MD, PhD; Walter Ageno, MD; Andrea Alberti, MD; Alessia Lanari, MD; Valeria Caso, MD, PhD; Sara Micheli, MD; Luca Bertolani, MD; Michele Venti, MD, PhD; Francesco Palmerini, MD; Sergio Biagini, MD; Giancarlo Comi, MD; Paolo Previdi, MD; Giorgio Silvestrelli, MD, PhD

Stroke. 2008

Cardiac and aortic surgery: risk of stroke

- Need to perform under cardiopulmonary bypass machine
- Need to use systemic heparin (high dose)
- Hypothermia and non-pulsatile flow affects cerebral autoregulation
- In complex open aortic surgery, deep hypothermia and circulatory arrest cause disruption of blood flow to brain
- Cardiac and aortic operation itself carry risk of stroke

- Altered cerebral blood flow during CPB
- Increased cognitive dysfunction with or without clinical stroke

Cardiopulmonary Bypass: Perioperative Cerebral Blood Flow and Postoperative Cognitive Deficit

Graham E. Venn, FRCS, Ramesh L. Patel, FRCS(Ed), and David J. Chambers, PhD

Cardiac Surgical Research, The Rayne Institute, and Department of Cardiothoracic Surgery, St. Thomas' Campus, Guy's and St. Thomas' Hospital NHS Trust, London, United Kingdom

Increased cerebral blood flow occurring during cardiopulmonary bypass as a result of changes in arterial carbon dioxide tension during acid-base regulation is thought to increase postoperative cognitive dysfunction. We studied 70 patients undergoing coronary artery bypass procedures who were randomized to two different acid-base protocols: pH-stat or alpha-stat regulation. Cerebral blood flow, cerebral blood flow velocity, and cerebral oxygen metabolism were measured before bypass, during bypass (hypothermic [28°C] and normothermic phases), and after bypass. Detailed cognitive tests were conducted before operation and 6 weeks after operation. During 28°C bypass, cerebral blood flow was significantly ($p < 0.05$) higher in the pH-stat group than in the alpha-stat group (41 ± 2 versus 24 ± 2 mL · 100 $g^{-1} \cdot min^{-1}$), and cerebral blood flow velocity was significantly increased in the pH-stat group and significantly decreased in the alpha-stat group (152% ± 10% versus 78% ± 7%). Cerebral extraction ratio of oxygen demonstrated a relatively greater disruption of autoregulation in the pH-stat group than in the alpha-stat group with relative hyperemia of 0.12 ± 0.02 versus 0.26 ± 0.03, respectively, during 28°C bypass. Using the criterion of deterioration in three or more neuropsychologic tests, a significantly higher proportion of patients in the pH-stat group fared less well than in the alpha-stat group (49% ± 17% versus 20% ± 13%). Patients in the alpha-stat group experienced less disruption of cerebral autoregulation during hypothermic cardiopulmonary bypass, and this was accompanied by a reduction in postoperative cognitive dysfunction.

(Ann Thorac Surg 1995;59:1331–5)

Operative mortality

- Early stroke: 28.8%
- Delayed stroke: 17.9%
- No stroke: 2.4%
- (P<0.001)

Early Versus Delayed Stroke After Cardiac Surgery: A Systematic Review and Meta-Analysis

Mario Gaudino, MD; Mohammed Rahouma, MD; Michele Di Mauro, MD; Bobby Yanagawa, MD, PhD; Ahmed Abouarab, MD; Michelle Demetres, MLIS; Antonino Di Franco, MD; Mohammed J. Arisha, MD; Dina A. Ibrahim, MD; Massimo Baudo, MD; Leonard N. Girardi, MD; Stephen Fremes, MD, PhD

Background—Although it is traditionally regarded as a single entity, perioperative stroke comprises 2 separate phenomena (early/intraoperative and delayed/postoperative stroke). We aimed to systematically evaluate incidence, risk factors, and clinical outcome of early and delayed stroke after cardiac surgery.

Methods and Results—A systematic review (MEDLINE, EMBASE, Cochrane Library) was performed to identify all articles reporting early (on awakening from anesthesia) and delayed (after normal awakening from anesthesia) stroke after cardiac surgery. End points were pooled event rates of stroke and operative mortality and incident rate of late mortality. Thirty-six articles were included (174 969 patients). The pooled event rate for early stroke was 0.98% (95% CI 0.79% to 1.23%) and was 0.93% for delayed stoke (95% CI 0.77% to 1.11%; P=0.68). The pooled event rate of operative mortality was 28.8% (95% CI 17.6% to 43.4%) for early and 17.9% (95% CI 14.0% to 22.7%) for delayed stroke, compared with 2.4% (95% CI 1.9% to 3.1%) for patients without stroke (P<0.001 for early versus delayed, and for perioperative stroke, early stroke, and delayed stroke versus no stroke). At a mean follow-up of 8.25 years, the incident rate of late mortality was 11.7% (95% CI 7.5% to 18.3%) for early and 9.4% (95% CI 5.9% to 14.9%) for delayed stroke, compared with 3.4% (95% CI 2.4% to 4.8%) in patients with no stroke. Meta-regression demonstrated that off-pump was inversely associated with early stroke (β=−0.009, P=0.01), whereas previous stroke (β=0.02, P<0.001) was associated with delayed stroke.

Conclusions—Early and delayed stroke after cardiac surgery have different risk factors and impacts on operative mortality as well as on long-term survival. **(*J Am Heart Assoc*. 2019;8:e012447. DOI: 10.1161/JAHA.119.012447.)**

Stroke occurred in 10.3% of patients

Hospital mortality

- Stroke group: 21%
- No stroke: 2.7%

Impact of Surgical Stroke on the Early and Late Outcomes After Thoracic Aortic Operations

Noritaka Okada, MD, Hideki Oshima, MD, PhD, Yuji Narita, MD, PhD, Tomonobu Abe, MD, PhD, Yoshimori Araki, MD, PhD, Masato Mutsuga, MD, PhD, Kazuro L. Fujimoto, MD, PhD, Yoshiyuki Tokuda, MD, PhD, and Akihiko Usui, MD, PhD

Department of Cardiac Surgery, Nagoya University Graduate School of Medicine, Nagoya, Japan

Background. Thoracic aortic operations still remain associated with substantial risks of death and neurologic injury. This study investigated the impact of surgical stroke on the early and late outcomes, focusing on the physical status and quality of life (QOL).

Methods. From 1986 to 2008, 500 patients (aged 63 ± 13 years) underwent open thoracic aortic repair for root and ascending (31%), arch (39%), extended arch (10%), and descending and thoracoabdominal (19%) aneurysms. Brain protection consisted of retrograde cerebral perfusion (52%), antegrade cerebral perfusion (29%), and simple deep hypothermic circulatory arrest (19%). Surgical stroke was defined as a neurologic deficit persisting more than 72 hours after the operation. QOL was assessed with the Short-Form 36 Health Survey Questionnaire 5.9 ± 4.2 years after the operation.

Results. Stroke occurred in 10.3% of patients. Hospital mortality was 21% in the stroke group and 2.7% in the nonstroke group ($p < 0.001$). At hospital discharge, 76% of survivors in the stroke group had permanent neurologic deficits (PNDs), with sustained tracheostomy in 39%, tube feeding in 46%, and gastrostomy in 14%, and 89% required transfer to other facilities. PND was an independent risk factor for late death (hazard ratio, 2.29; 95% confidence interval, 1.04 to 4.62; $p = 0.041$) in a multivariate analysis. The physical component of the QOL score was worse in the PND group (51% vs 100%; $p = 0.039$), whereas the mental component was similar in both groups (14% vs 14%).

Conclusions. Surgical stroke is associated with high hospital mortality and PNDs that decrease late survival and the physical component score of the QOL survey.

(Ann Thorac Surg 2015;99:2017–23)

Prospective analysis of 1000 patients

71 patients with Hx of stroke matched with 142 patients in control group

Table 3. Postoperative Course

Outcome	Study Patients (n = 71)	Control Patients (n = 142)	*p* Value
Time to awaken (h)	12.6 ± 10.9	3.5 ± 2.1	<0.001
Time to extubate (h)	29.5 ± 29.3	9.1 ± 5.2	<0.001
Reintubation	7/71 (9.9%)	2/142 (1.4%)	<0.01
Confusion	26/71 (36.6%)	7/142 (4.9%)	<0.001
Focal deficit	31/71 (43.7%)	2/142 (1.4%)	<0.001
ICU stay (days)	4.3 ± 2.7	1.5 ± 0.8	<0.001
Hospital mortality	5/71 (7.0%)	1/142 (0.7%)	<0.01
Hospital stay (days)	14.1 ± 8.4	6 ± 2.1	<0.001

ICU = intensive care unit.

Neurologic Injury in Cardiac Surgical Patients With a History of Stroke

J. Mark Redmond, MD, Peter S. Greene, MD, Maura A. Goldsborough, RN, Duke E. Cameron, MD, R. Scott Stuart, MD, Marc S. Sussman, MD, Levi Watkins, Jr, MD, John C. Laschinger, MD, Guy M. McKhann, MD, Michael V. Johnston, MD, and William A. Baumgartner, MD

Division of Cardiac Surgery, Johns Hopkins Medical Institutions, Baltimore, Maryland

Background. Controversy still exists as to whether patients with previous stroke are at increased risk for neurologic complications after heart operations.

Methods. We performed a prospective analysis of 1,000 consecutive patients undergoing cardiac operations requiring cardiopulmonary bypass, without hypothermic circulatory arrest. Of the 1,000 patients, 71 had previously documented stroke (study group); 2 control patients with no history of stroke were selected for each of these patients (control group, n = 142). There were no significant differences between the study and control patients with respect to established risk factors for neurologic complications.

Results. Compared with controls, study patients took longer to awaken (12.6 ± 10.9 versus 3.5 ± 2.1 hours; $p < 0.001$) and longer to extubate (29.5 ± 29.3 versus 9.1 ± 5.2 hours; $p < 0.001$), and had a greater incidence of reintubation (7 of 71, 9.9% versus 2 of 142, 1.4%; $p < 0.01$) and postoperative confusion (26 of 71, 36.6% versus 7 of 142, 4.9%; $p < 0.001$). There was a higher incidence of focal neurologic deficit among study patients (31 of 71, 43.7% versus 2 of 142, 1.4%; $p < 0.001$). These deficits included new stroke (6 of 71, 8.5%) as well as the reappearance of previous deficits (19 of 71, 26.8%) or worsening of previous deficits (6 of 71, 8.5%), without new abnormalities on head computed tomography or magnetic resonance imaging. Study patients with neurologic deficit had longer cardiopulmonary bypass times than did study patients without deficit (146 ± 48.5 versus 110 ± 43.3 minutes; $p < 0.001$). The 30-day mortality rate was greater in study patients than in controls (5 of 71, 7% versus 1 of 142, 0.7%; $p < 0.02$), with four deaths among the 6 study patients with a new stroke (66.7%).

Conclusion. This analysis identifies a group of patients at high risk for neurologic sequelae and confirms the vulnerability of the previously injured brain to cardiopulmonary bypass, as evidenced by reappearance or exacerbation of focal deficits in such patients.

(Ann Thorac Surg 1996;61:42–7)

So…

Cardiac and aortic surgery should be delayed in all patients with stroke

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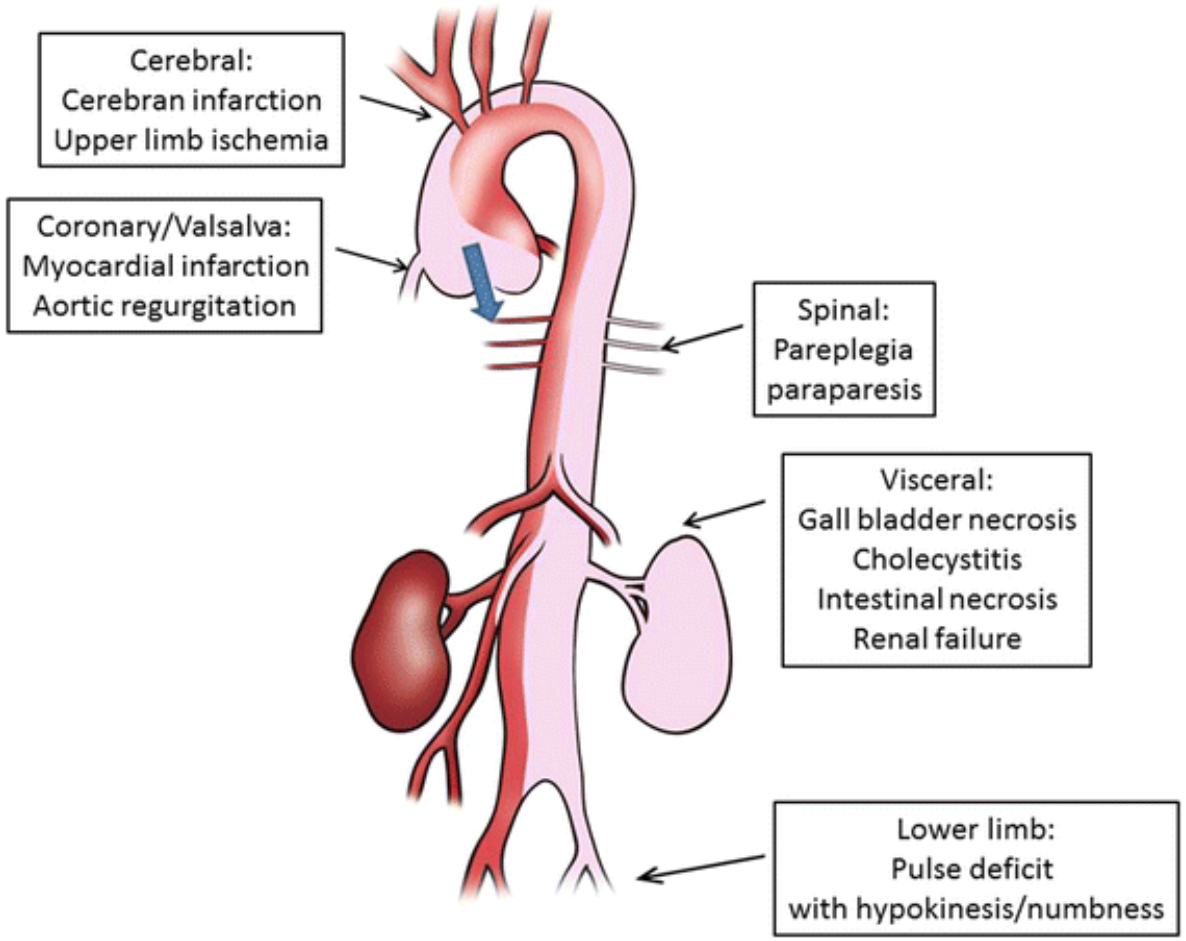
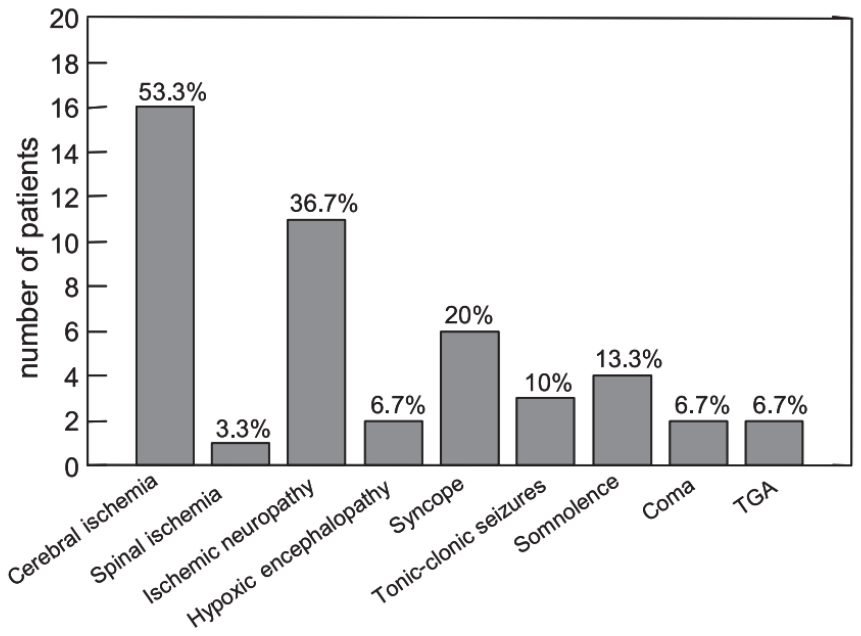
EXCEPT STROKE FROM ACUTE AORTIC DISSECTION

Stroke from malperfusion





Neurological Symptoms in Type A Aortic Dissections

Charly Gaul, MD; Wenke Dietrich, MD; Ivar Friedrich, MD;
Joachim Sirch, MD; Frank J. Erbguth, MD

- 102 type A AOD patients
- Initial neurologic symptoms 29%
- 2/3 of patients with neurologic symptoms have chest pain vs 94% in patients without neurologic symptoms

TABLE 3. Initial Neurological Symptoms in the Present Study in Comparison With Literature

	Present Study	Blanco et al[3]	Alvarez et al[2]	Meszaros et al[5]	Fann et al[24]	IRAD[6]
No. of included patients	102 with type A dissection	24 with type I dissection	90 with type A dissection	75 with type A or B dissection	174 with type A dissection	289 with type A dissection
Neurological Symptoms	30 (29.4%)	6 (25%)	21 (23%)	30 (40%)	*	17%
Ischemic stroke	16 (15.7%)	2 (8.3%)	12 (13.3%)	24 (32%)	17 (6%)	(6.1%)
Spinal cord ischemia	1 (1%)	1 (4.2%)	8 (8.9%)	2 (2.7%)	(5%)	*
Ischemic neuropathy	11 (10.8%)	1 (4.2%)	5 (5.6%)	4 (5.3%)	*	*
Hypoxic encephalopathy	2 (2%)	2 (8.3%)	*	*	*	*
Syncope	6 (5.9%)	*	3 (3.3%)	*	*	(12.7%)

*No data available.
N (%) presented.

- Postoperative neurologic complications 47.5%
- Mortality rate is higher in patients with preoperative stroke but not significant
- Preoperative hypotension seems to be a predisposing factor toward perioperative stroke but not significant

Acute type A aortic dissection complicated by stroke: Can immediate repair be performed safely?

Anthony L. Estrera, MD,[a] Zsolt Garami, MD,[b] Charles C. Miller, PhD,[a] Eyal E. Porat, MD,[a] Paul E. Achouh, MD,[a] Jayesh Dhareshwar, MD,[a] Riad Meada, MD,[a] Ali Azizzadeh, MD,[a] and Hazim J. Safi, MD[a]

- 151 type A AOD patients
- Preoperative stroke in 16 patients (Rt hemispheric 81%)
- Aortic repair under profound hypothermic circulatory arrest and RCP
- Overall hospital mortality 18.8% (3/16)
- 100% mortality (2/2) in patients who did not undergo surgery (devastated coma and aortic rupture)
- Among patients undergoing surgery, regarding neurological status 14% completely recovery, 43% improve, 43% remained the same and worsened in none
- 80% of patients underwent surgical repair within 10 hr. had improvement in neurological status

27 **patients with coma** (defined as GCS < 11 on arrival at the hospital; mean GCS = 6.5)

21 immidiate repair in 5 hr

6 initial manage medically (3 convert to Sx-delay group)

Hospital mortality was 14% in the immediate group and 67% in the delayed group

Full recovery of consciousness was achieved in 86% of patients in the immediate group and in 17% in the delayed group

Neurological Outcomes After Immediate Aortic Repair for Acute Type A Aortic Dissection Complicated by Coma

Takuro Tsukube, MD, PhD; Taro Hayashi, MD; Toshihiro Kawahira, MD, PhD; Tomonori Haraguchi, MD, PhD; Ritsu Matsukawa, MD, PhD; Shuichi Kozawa, MD, PhD; Kyoichi Ogawa, MD, PhD; Yutaka Okita, MD, PhD

Background—Management of acute type A aortic dissection (AADA) complicated by coma remains controversial. We analyzed our experience in managing AADA complicated by coma to determine the relationship of duration of preoperative coma to postoperative neurological recovery.

Methods and Results—Between September 2003 and October 2010, 181 patients with AADA were treated, including 27 presenting with coma (Glasgow Coma Scale <11) on arrival. Twenty-one patients were repaired immediately (immediate group); time from onset of symptoms to operating room was <5 hours. For brain protection, deep hypothermia with antegrade cerebral perfusion was used, and postoperative therapeutic hypothermia with magnesium treatment was performed. Six patients initially were managed medically, and 3 of them were followed by eventual repair because time from onset was >5 hours (delayed group). The preoperative National Institutes of Health Stroke Scale score was 31.4±6.6 in the immediate group and 28.3±9.5 in the delayed group. Hospital mortality was 14% in the immediate group and 67% in the delayed group. Full recovery of consciousness was achieved in 86% of patients in the immediate group and in 17% in the delayed group. In immediate group, the postoperative National Institutes of Health Stroke Scale score significantly improved to 6.4±8.4, cumulative survival rate was 71.8% in 3 years, and independence in daily activities was achieved in 52% (11/21).

Conclusions—Aortic repair, if performed immediately from the onset of symptoms, showed satisfactory recovery of consciousness and neurological function in patients with AADA complicated by coma. In this patient population, immediate aortic repair is warranted. **(*Circulation*. 2011;124[suppl 1]:S163–S167.)**

Ischemic vs Hemorrhagic stroke

- 556 patients with IE complicated by ischemic stroke
- 198 underwent valve replacement Sx post stroke
  - 29.3% early surgical treatment (1-7 days)
  - 70.7% late surgical treatment (>7 days after stroke)
- No significant difference in in-hospital mortality rates and death after 1-year follow-up

Influence of the Timing of Cardiac Surgery on the Outcome of Patients With Infective Endocarditis and Stroke

Bruno Barsic,[1] Stuart Dickerman,[2] Vladimir Krajinovic,[1] Paul Pappas,[3] Javier Altclas,[4] Giampiero Carosi,[5] José H. Casabé,[6] Vivian H. Chu,[3] Francois Delahaye,[7] Jameela Edathodu,[8] Claudio Querido Fortes,[9] Lars Olaison,[10] Ana Pangercic,[11] Mukesh Patel,[12] Igor Rudez,[13] Syahidah Syed Tamin,[14] Josip Vincelj,[13] Arnold S. Bayer,[15] and Andrew Wang[3]; for the International Collaboration on Endocarditis–Prospective Cohort Study (ICE-PCS) Investigators[a]

[1]Hospital for Infectious Diseases, School of Medicine, Zagreb, Croatia; [2]New York University School of Medicine, New York; [3]Duke University Medical Center, Duke Clinical Research Institute, Durham, North Carolina; [4]Barcelona Centre for International Health Research, Spain; [5]University of Brescia, Italy; [6]Fundación Favaloro, Buenos Aires, Argentina; [7]Hopital Louis Pradel, Lyon, France; [8]Faisal Hospital and Research Centre, Riyadh, Saudi Arabia; [9]Clementino Fraga Filho Hospital, Rio de Janeiro, Brazil; [10]Sahlgrenska University Hospital, Göteborg, Sweden; [11]University Hospital Centre Sestre Milosrdnice, Zagreb, Croatia; [12]University of Alabama at Birmingham, Birmingham Veterans Affairs Medical Center; [13]Dubrava University Hospital, Zagreb, Croatia; [14]Institut Jantung Negara, Kuala Lumpur, Malaysia; and [15]Geffen School of Medicine at the University of California, Los Angeles

Clinical Infectious Diseases 2013;

No apparent survival benefit in delaying otherwise indicated valvular surgery in IE patients after ischemic stroke.

Multicenter cohort of 1345 episodes of left-sided IE

340 neurological complication

- 192 ischemic stroke
- 86 encephalitis
- 60 hemorrhage
- 2 abscess

Moderate to severe ischemic stroke and brain hemorrhage were found to have a significant negative impact on the outcome of infective endocarditis

Neurological Complications of Infective Endocarditis

Risk Factors, Outcome, and Impact of Cardiac Surgery: A Multicenter Observational Study

Emilio García-Cabrera, MSc; Nuria Fernández-Hidalgo, MD; Benito Almirante, MD, PhD; Radka Ivanova-Georgieva, MD, PhD; Mariam Noureddine, MD; Antonio Plata, MD; Jose M. Lomas, MD; Juan Gálvez-Acebal, MD, PhD; Carmen Hidalgo-Tenorio, MD, PhD; Josefa Ruíz-Morales, MD; Francisco J. Martínez-Marcos, MD, PhD; Jose M. Reguera, MD; Javier de la Torre-Lima, MD, PhD; Arístides de Alarcón González, MD, PhD; on behalf of the Group for the Study of Cardiovascular Infections of the Andalusian Society of Infectious Diseases (SAEI) and the Spanish Network for Research in Infectious Diseases (REIPI)

***Circulation*. 2013;127:2272-2284.**

The risk of postoperative bleeding appears to be low in cases with:

- small ischemic strokes - when surgery is performed immediately
- moderate-severe cases - when the intervention takes place after 2 weeks

In hemorrhagic stroke, postpone valve replacement for ≥4 weeks**

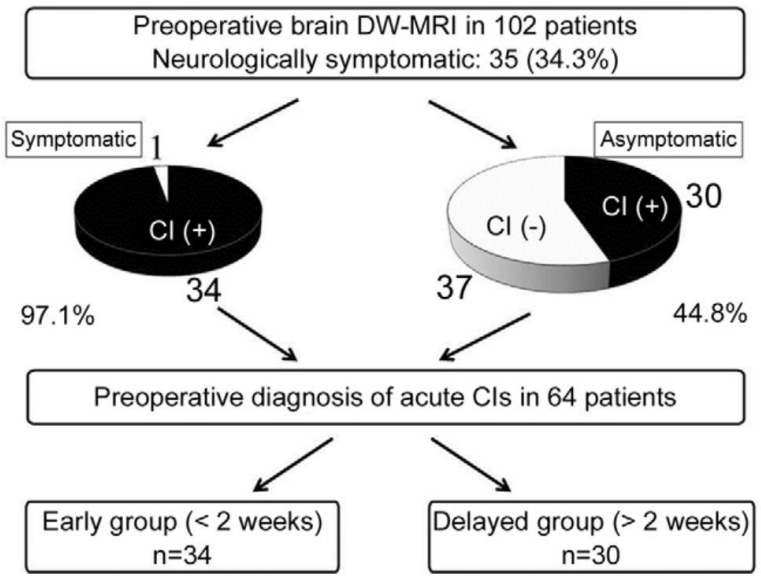


Fig 2. Relationships between preoperative cerebral infarction (CI) symptoms and prevalence of acute CI. (DW-MRI = diffusion-weighted magnetic resonance imaging.)

Impact of Early Surgical Treatment on Postoperative Neurologic Outcome for Active Infective Endocarditis Complicated by Cerebral Infarction

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Departments of Cardiovascular Surgery and Neurology, Osaka University Graduate School of Medicine, Osaka, Japan

Background. The optimal timing of surgical intervention for infective endocarditis (IE) with cerebrovascular complications remains controversial because the risk of perioperative intracranial hemorrhage is still unclear. The aim of this study was to investigate the prevalence of acute cerebral infarction (CI) in patients with IE and its hemorrhagic risk after valve operations.

Methods. We retrospectively evaluated 102 consecutive patients (35 with neurologic symptoms; 67 without neurologic symptoms) who underwent diffusion-weighted magnetic resonance imaging (DW-MRI) before valve operations for left-sided active IE between 2005 and 2010. The prevalence of acute CI and its postoperative neurologic outcome were evaluated.

Results. Acute CI was detected preoperatively in 64 of 102 (62.7%) patients. Of the 64 patients with acute CI, 34 underwent surgical treatment within 14 days after diagnosis of CI (early group), whereas the other 30 patients underwent operation after more than 14 days (delayed group). Postoperative CI deterioration was confirmed in 1 patient in each group. Furthermore, in 43 of the patients with acute CI who were followed with postoperative neuroimaging, hemorrhagic transformation was confirmed in only 1 patient in the delayed group. However new ectopic intracranial hemorrhage was confirmed in 2 patients in the early group and 3 patients in the delayed group.

Conclusions. The risk of postoperative hemorrhagic transformation of preoperative acute CI was low, even in patients who underwent early operation. Our data suggested that there is no benefit for delaying surgical treatment beyond 2 weeks to prevent hemorrhagic transformation in patients with CI. However ectopic intracranial hemorrhage sometimes occurs regardless of the timing of surgical treatment.

(Ann Thorac Surg 2012;94:489–96)

Risk for recurrent intracranial hemorrhage increases 5-fold when warfarin is resumed

Risk of recurrent bleeding with resumed warfarin is higher than is the risk of ischemic events without anticoagulation

Resumption of warfarin can therefore be delayed by more than 1 month after the index event

Optimal period for resumption of anticoagulation seems to occur between week 10 and week 30

Optimal Timing of Resumption of Warfarin After Intracranial Hemorrhage

Ammar Majeed, MD; Yang-Ki Kim, MD; Robin S. Roberts, PhD;
Margareta Holmström, MD, PhD; Sam Schulman, MD, PhD

Background and Purpose—The optimum timing of resumption of anticoagulation after warfarin-related intracranial hemorrhage in patients with indication for continued anticoagulation is uncertain. We performed a large retrospective cohort study to obtain more precise risk estimates.

Methods—We reviewed charts of 2869 consecutive patients with objectively verified intracranial hemorrhage over 6 years at 3 tertiary centers. We calculated the daily risk of intracranial hemorrhage or ischemic stroke with and without resumption of warfarin; we focused on patients who survived the first week and had cardiac indication for anticoagulation or previous stroke. Using a Cox model, we estimated rates for these 2 adverse events in relation to different time points of resumed anticoagulation. The combined risk of either a new intracranial hemorrhage or an ischemic stroke was calculated for a range of warfarin resumption times.

Results—We identified warfarin-associated intracranial hemorrhage in 234 patients (8.2%), of whom 177 patients (76%) survived the first week and had follow-up information available; the median follow-up time was 69 weeks (interquartile range [IQR] 19–144). Fifty-nine patients resumed warfarin after a median of 5.6 weeks (IQR 2.6–17). The hazard ratio for recurrent intracranial hemorrhage with resumption of warfarin was 5.6 (95% CI, 1.8–17.2), and for ischemic stroke it was 0.11 (95% CI, 0.014–0.89). The combined risk of recurrent intracranial hemorrhage or ischemic stroke reached a nadir if warfarin was resumed after approximately 10 to 30 weeks.

Conclusion—The optimal timing for resumption of warfarin therapy appears to be between 10 and 30 weeks after warfarin-related intracranial hemorrhage. **(*Stroke*. 2010;41:2860-2866.)**

European Heart Journal (2015) **36**, 3075–3123
doi:10.1093/eurheartj/ehv319

2015 ESC Guidelines for the management of infective endocarditis

The Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC)

Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM)

Following intracranial haemorrhage, surgery should generally be postponed for ≥1 month	**IIa**	**B**	264–266
After a stroke, surgery indicated for HF, uncontrolled infection, abscess, or persistent high embolic risk should be considered without any delay as long as coma is absent and the presence of cerebral haemorrhage has been excluded by cranial CT or MRI	**IIa**	**B**	9,263

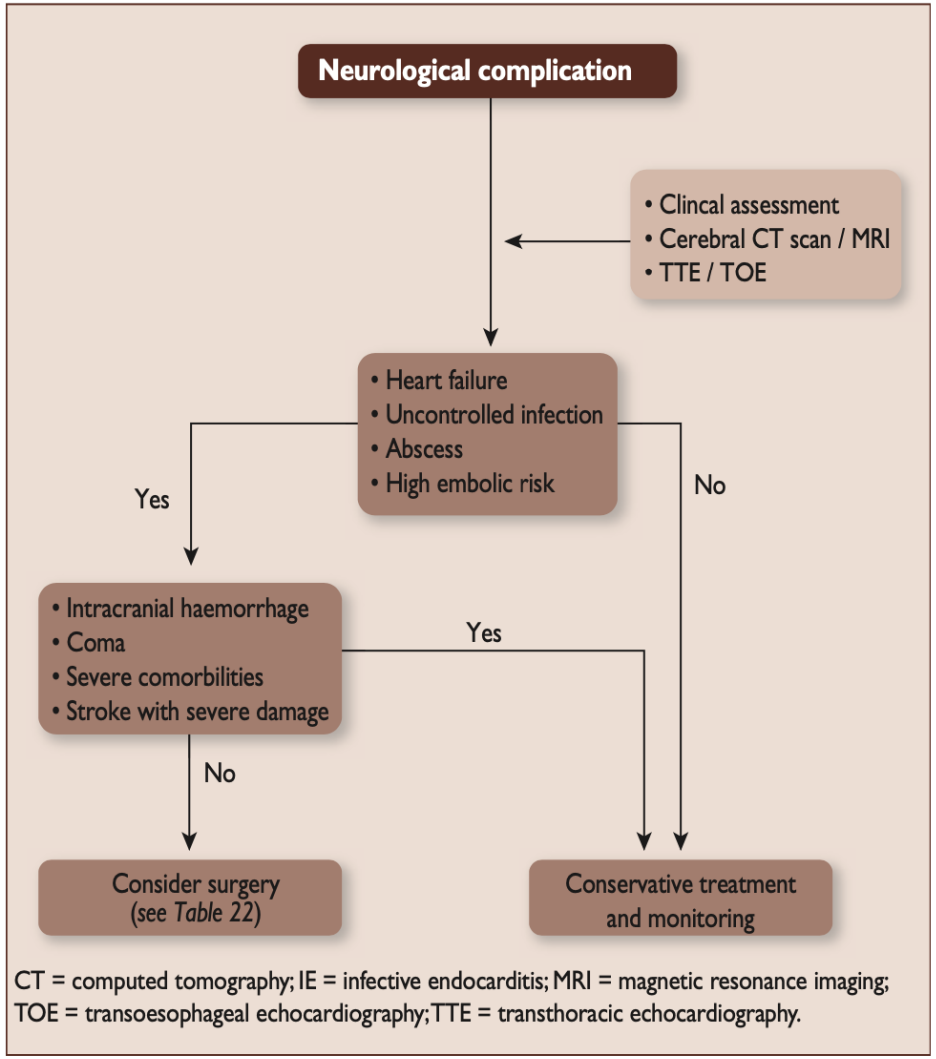


Figure 4 Therapeutic strategies for patients with infective endocarditis and neurological complications.

- 14,030 patients with aortic stenosis underwent SAVR
- 616 patients with prior stroke
- 13,414 patients without prior stroke
- Risk of ischemic stroke and MACE increased in patients with stroke less than 3 months prior to surgery

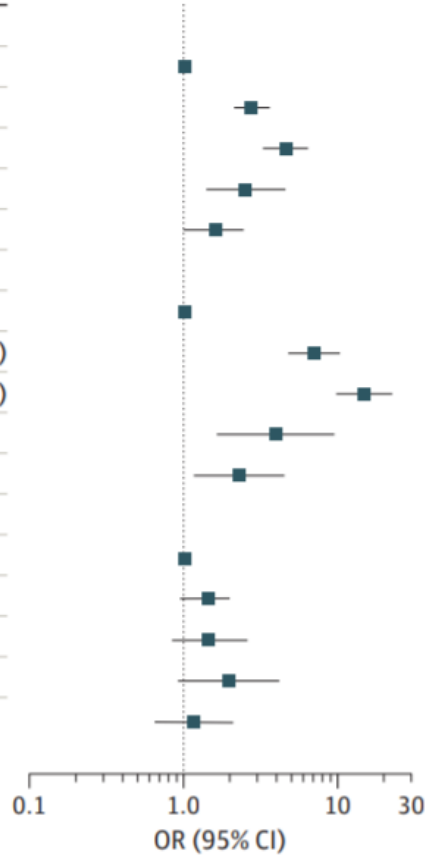
JAMA Cardiology | Original Investigation

Association of Timing of Aortic Valve Replacement Surgery After Stroke With Risk of Recurrent Stroke and Mortality

Charlotte Andreasen, MD; Mads Emil Jørgensen, MD; Gunnar H. Gislason, MD, PhD; Andreas Martinsson, MD; Robert D. Sanders, MD; Jawdat Abdulla, MD, PhD; Per Føge Jensen, MD, PhD; Christian Torp-Pedersen, MD, DSc; Lars Køber, MD, DSc; Charlotte Andersson, MD, PhD

Figure 1. Crude Events and Adjusted Odds Ratios (ORs) for 30-Day Major Adverse Cardiovascular Events (MACE), Ischemic Stroke, and All-Cause Mortality Stratified in 4 Groups

Outcome	No. of Events	No. of Patients (%)	OR (95% CI)
30-d MACE			
No prior stroke	768	13414 (5.7)	1 [Reference]
Prior stroke at any time	97	616 (15.7)	2.75 (2.12-3.58)
Stroke <3 mo prior	53	227 (23.3)	4.57 (3.24-6.44)
Stroke 3-<12 mo prior	15	106 (14.2)	2.51 (1.40-4.50)
Stroke ≥12 mo prior	29	283 (10.2)	1.58 (1.03-2.41)
30-d Ischemic stroke			
No prior stroke	164	13414 (1.2)	1 [Reference]
Prior stroke at any time	57	616 (9.3)	6.96 (4.77-10.16)
Stroke <3 mo prior	40	227 (17.6)	14.69 (9.69-22.27)
Stroke 3-<12 mo prior	6	106 (5.7)	3.96 (1.63-9.59)
Stroke ≥12 mo prior	11	283 (3.9)	2.29 (1.16-4.51)
30-d All-cause mortality			
No prior stroke	522	13414 (3.9)	1 [Reference]
Prior stroke at any time	37	616 (6.0)	1.39 (0.95-2.02)
Stroke <3 mo prior	15	227 (6.6)	1.45 (0.83-2.54)
Stroke 3-<12 mo prior	8	106 (7.5)	1.94 (0.91-4.16)
Stroke ≥12 mo prior	14	283 (4.9)	1.16 (0.65-2.07)



Take home message

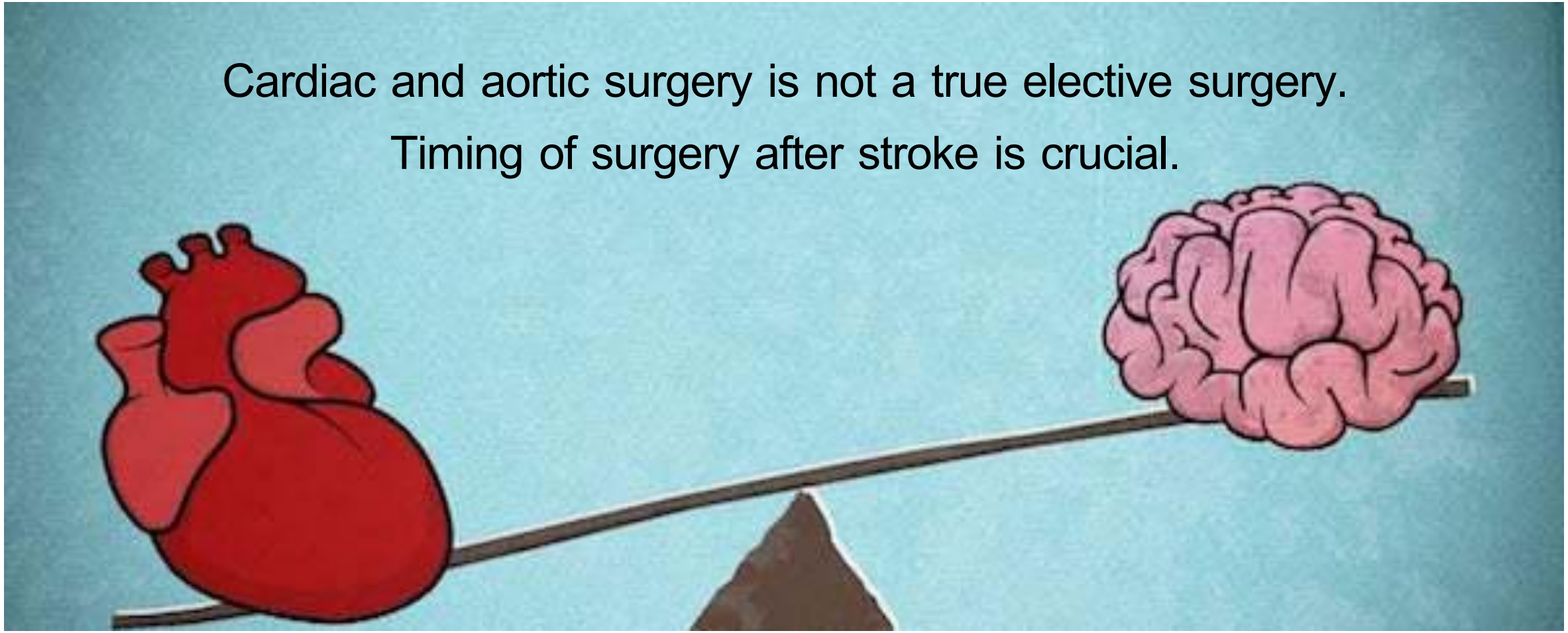
- In hemorrhagic stroke – delayed Sx for at least 4 weeks
- In ischemic stroke

  AOD typeA - surgery as soon as possible, unless coma > 5 hours

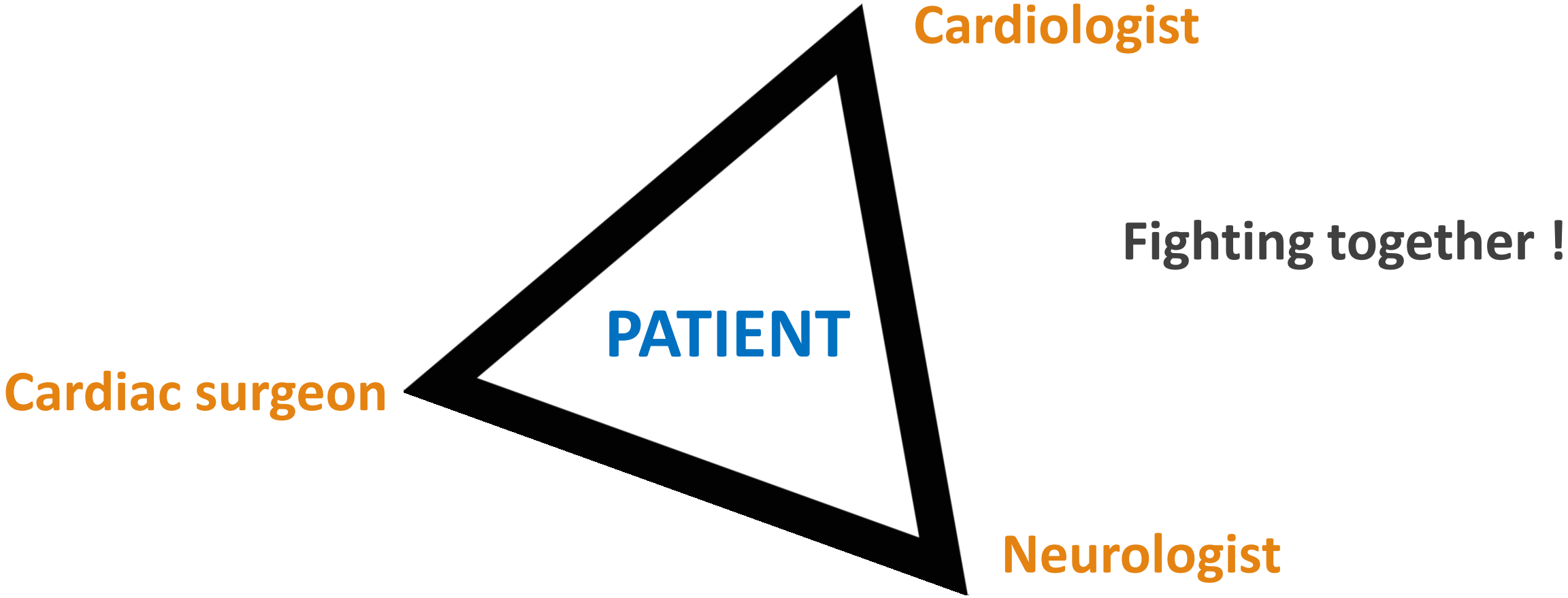
  Cases with minor brain injury - if urgency, go on surgery

  Moderate damage – wait and imaging to confirm no hemorrhagic transformation

  Elective surgery - wait 3 months or more



The risk-benefit assessment between recurrent stroke in early cardiac surgery and occurrence of the cardiac event in non-operative management needed to be considered



Fighting together !

The risk-benefit assessment between recurrent stroke in early cardiac surgery and occurrence of the cardiac event in non-operative management needed to be considered

Thank you for your attention