Neurological Survey prior to Cardiac Surgery

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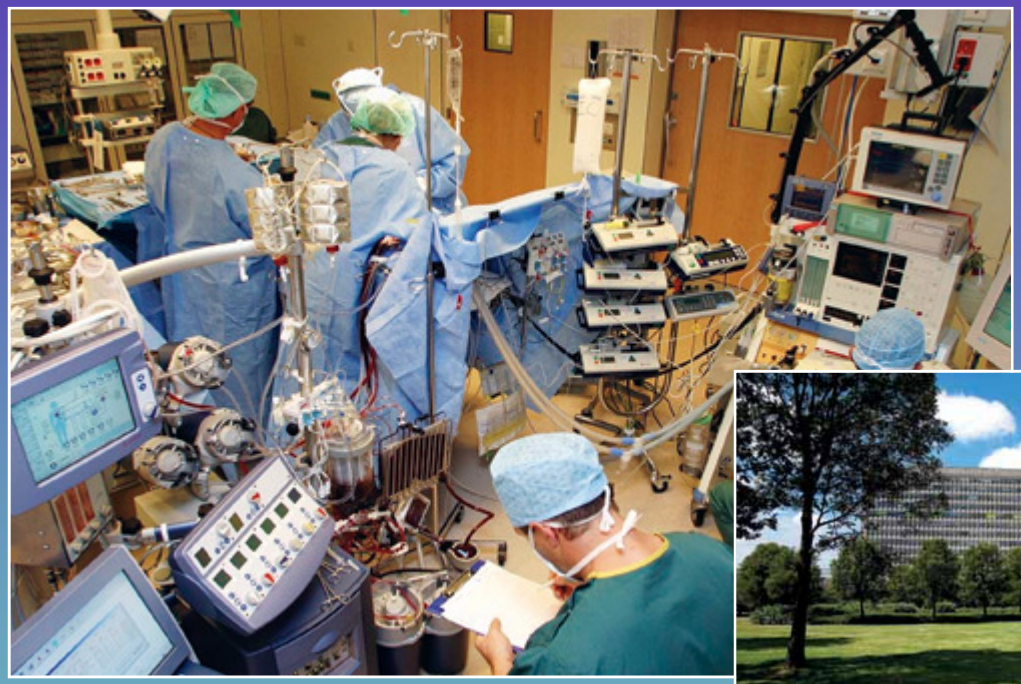
The Haga Teaching Hospitals,
The Hague, The Netherlands.

Lecture presented at the
CNE Thoraxchirurgie Symposium Utrecht
April 15th 2014
Organised by the NVHVV

HagaZiekenhuis van Den Haag

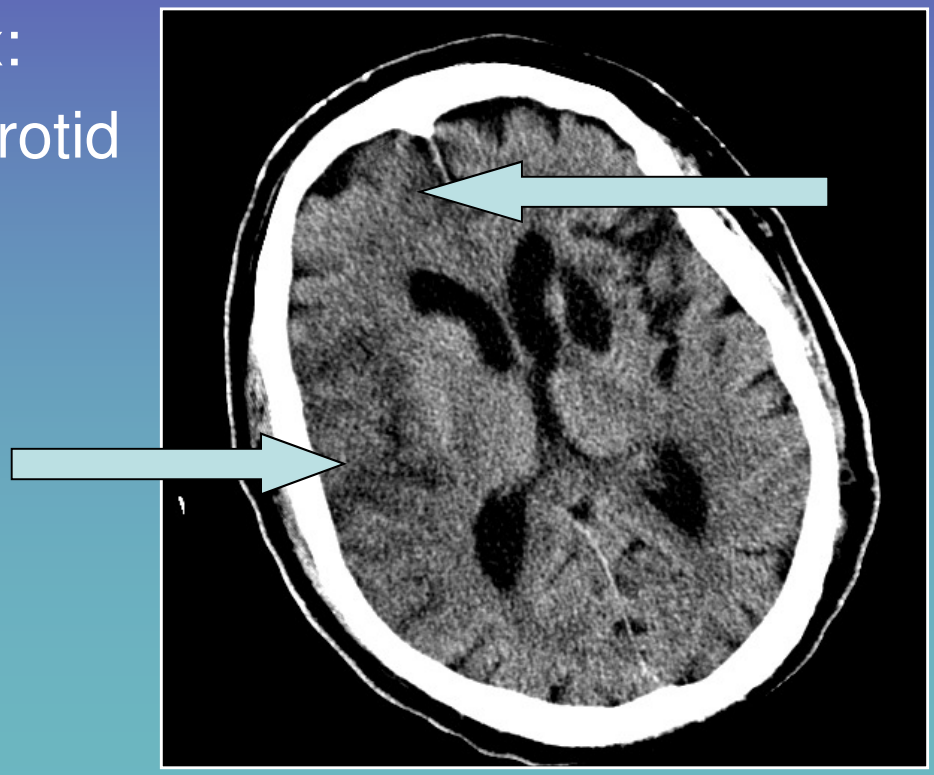
HAGA TEACHING HOSPITALS
The Hague The Netherlands.



Dept. of Neurology, Cardiosurgery, Anesthesiology,
Intensive Care and Clinical Neurophysiology
The Haga Teaching Hospitals, The Hague, The Netherlands.

An index IC patient with a post operative Delirium/Stroke

- Presurgery Stroke & Delirium risk score were low.
- Post surgery duplex: bilateral subtotal carotid artery stenosis
- Post surgery CT: ischemic lesion of right hemisphere
- Outcome: poor.



Conflict of interest

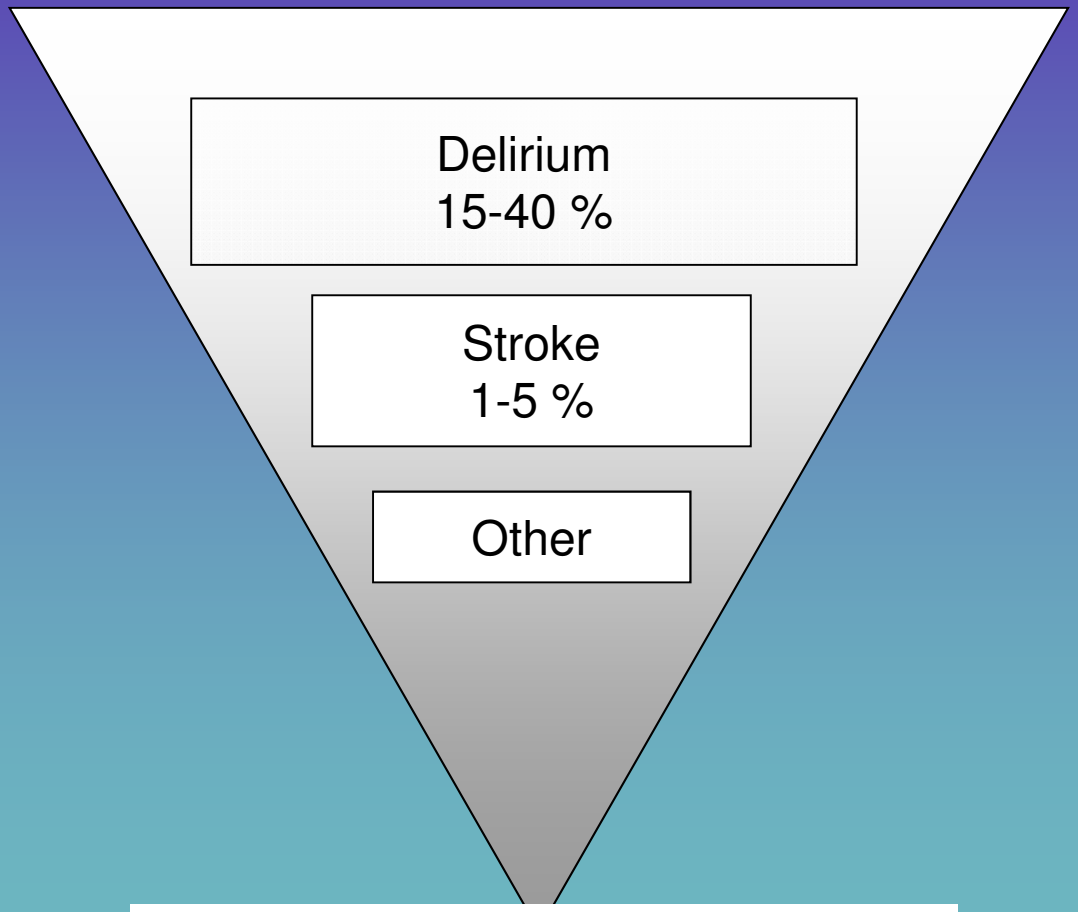
This lecture is supported by the
NVHVV

Keunen develops medical software for stroke prevention initiatives
which is distributed by third parties.

Schedule of presentation

- What are the major neurological complications after cardiac surgery?
- The Haga Braincare Strategy.
- Flowcharts and documentation of pre-operative neurological work-up of patients.
- Systematic assesment of perioperative neurological complications.

Neurological complications of CABG surgery



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The burden of Post Operative Delirium

Table 3: Comparison of baseline demographics and clinical parameters of patients included in 2009 and 2010 with and without POD

Factors	No POD ($n = 581$)	POD ($n = 61$)	*P*-value
Age	67.79 ± 9.8	75.31 ± 9.7	<0.001
Sex (male/female)	69.9%/30.1%	75.4%/24.6%	0.520
Type of surgery (CABG/CABG plus)	79.9%/20.1%	54.1%/45.9%	<0.001
Preoperative risk of POD	0.74 ± 1.3	1.92 ± 2.1	<0.001
Preoperative mRS	2.10 ± 0.369	2.20 ± 0.5	0.043
Mean length of ICU stay	1.65 ± 2.3	4.64 ± 6.0	<0.001
Mean length of hospital stay	6.56 ± 4.1	13.51 ± 14.1	<0.001
Stroke	0.9%	6.6%	<0.001
Postoperative mRS	2.52 ± 0.8	2.82 ± 0.9	0.002
Mortality	1.2%	1.6%	0.640

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Long term disability after POD

Optimised Anaesthesia to Reduce Post Operative Cognitive Decline (POCD) in Older Patients Undergoing Elective Surgery, a Randomised Controlled Trial

Clive Ballard[1]*, Emma Jones[1], Nathan Gauge[1], Dag Aarsland[2,3], Odd Bjarte Nilsen[3], Brian K. Saxby[4], David Lowery[5], Anne Corbett[6], Keith Wesnes[7], Eirini Katsaiti[1], James Arden[8], Derek Amaoko[8], Nicholas Prophet[8], Balaji Purushothaman[8], David Green[8]

1 Wolfson Centre for Age-Related Diseases, King's College London, London, United Kingdom, **2** Department of Neurobiology, Ward and Society, Karolinska Institute, Stockholm, Sweden, Norway, **3** Faculty of Science and Technology, Stavanger University Hospital, Stavanger, Norway, **4** Institute of Ageing and Health, University of Newcastle, Newcastle, United Kingdom, **5** Research Department of Primary Care and Population Health, University College London, London, United Kingdom, **6** Research Directorate, Alzheimer's Society (UK), London, United Kingdom, Anaesthetics, King's College Hospital, London, United Kingdom

Discussion

The cohort study confirms that there is a significant increased frequency of cognitive impairment in people over the age of 60 undergoing major non-cardiac surgery, and highlights that a greater level of cognitive impairment is still evident after 52 weeks in comparison to age-matched controls. These results emphasise the clinical importance of POCD and its long term impact on cognition in this patient group.

doi:10.1371/journal.pone.0037410.t004

Delirium

- Definition: DSM-IV criteria
  - Fluctuation in attention and/or conciousness
  - Altered awareness
- Diagnosis:
  - Bedside testing
    - DOS score (25 items), CAM, MDAS (10 items).
  - Extended Neuropsychological testing
    - Delirium symptom interview (107 items)

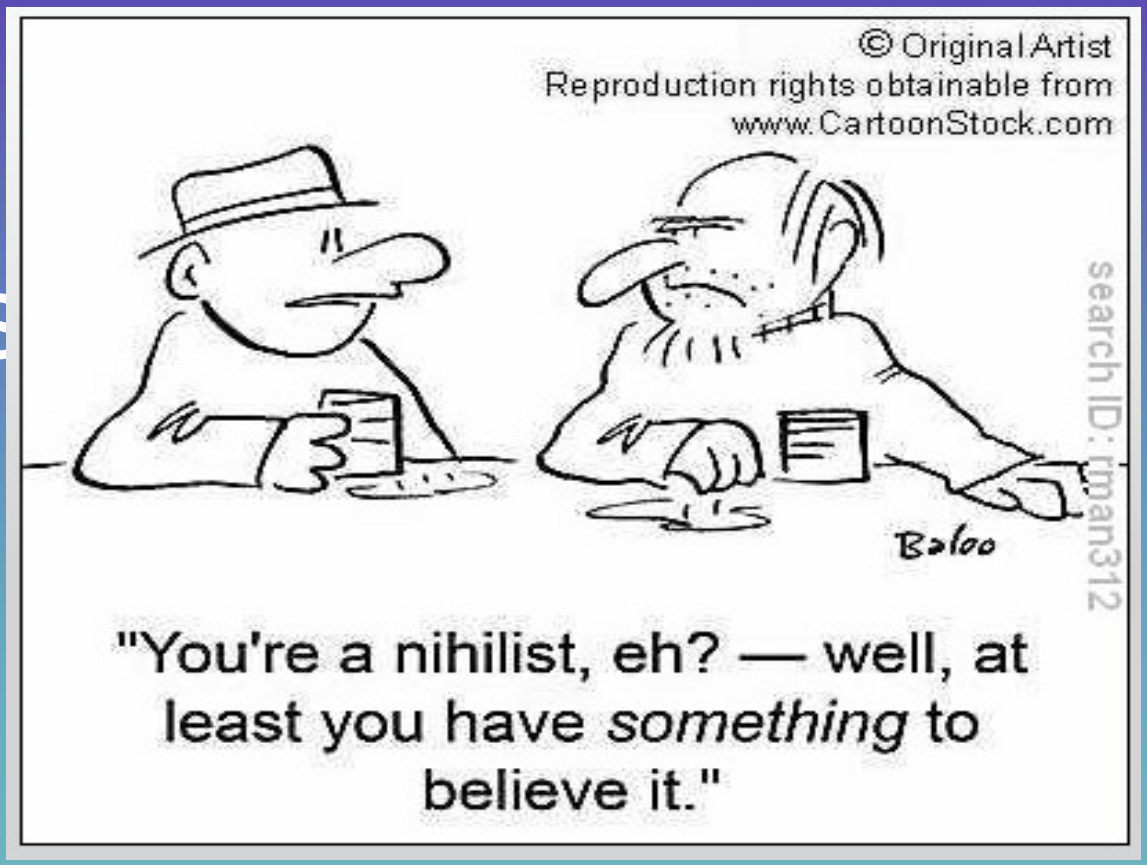
Adamis D, et al. Delirium scales: a review of current evidence. Ment Health 2010;14:543–55.

Risk factors for post CABG delirium

- pre-existing mild cognitive impairement
- a history of dementia and/or delirium
- age > 75 yrs.
- use of opiates, tranquilizers, narcotics ect.
- > 4 drinks of alcohol each day.
- low pre-operative cerebral saturation

Pre-operative Delirium Outcome Scores
can reliably predict patients who will experience
a post-operative delirium after major surgery

Ris se


© Original Artist
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www.CartoonStock.com
search ID: tman312
Baloo
"You're a nihilist, eh? — well, at least you have *something* to believe it."

Paradigma Shift

The concept of the post surgery ‘ischemic delirium’

Cerebral Oxygen Desaturation Predicts Cognitive Decline and Longer Hospital Stay After Cardiac Surgery

James P. Slater, MD, Theresa Guarino, RN, Jessica Stack, BS, Kateki Vinod, BA, Rami T. Bustami, PhD, John M. Br… Christopher J. Magovern, MD, Tho… Grant V.S. Parr, MD

Departments of Cardiac Surgery, Cardiac Research, Health, Office of Grants and Research, Biostatistics, Group, Parsippany, New Jersey

Monitoring Brain Oxygen Saturation During Coronary Bypass Surgery: A Randomized, Prospective Study

John M. Murkin, MD, FRCPC*

BACKGROUND: Cerebral deoxygenation is associated with various adverse systemic outcomes. We hypothesized, by using the brain as an index organ, that interven- …ion would have systemic benefits in cardiac …ery bypass patients were randomized to either …gen saturation (rSO_2) monitoring with active …rotocol (intervention, n = 100), or underwent … = 100). Predefined clinical outcomes were …n the control group demonstrated prolonged … longer duration in the intensive care unit (P = …here was no difference in overall incidence of …ntly more control patients had major organ …ilation >48 h, stroke, myocardial infarction, …rvention group patients (P = 0.048). Patients … or mortality had lower baseline and mean …d longer lengths of stay in the intensive care …n, than patients without such complications. …verse correlation between intraoperative rSO_2 …pitalization in patients requiring ≥10 days …$_2$ in coronary artery bypass patients avoids … is associated with significantly fewer inci-

Schoen *et al. Critical Care* 2011, **15**:R218
http://ccforum.com/content/15/5/R218

CRITICAL CARE

RESEARCH Open Access

Preoperative regional cerebral oxygen saturation is a predictor of postoperative delirium in on-pump cardiac surgery patients: a prospective observational trial

Julika Schoen, Joscha Meyerrose, Hauke Paarmann, Matthias Heringlake*, Michael Hueppe and Klaus-Ulrich Berger

Risk Factors for post CABG strokes

- Age > 65 yrs
- Carotid bruits
- History of a Stroke or TIA
- Bilateral carotid artery occlusions/subtotal stenosis
- smoking
- Peri-operative manipulation/cannulation of the cardiovascular systems
- Peri-operative atrial fibrillation

Post operative stroke are generally difficult to predictor prior to surgery because most of these strokes are embolic in nature

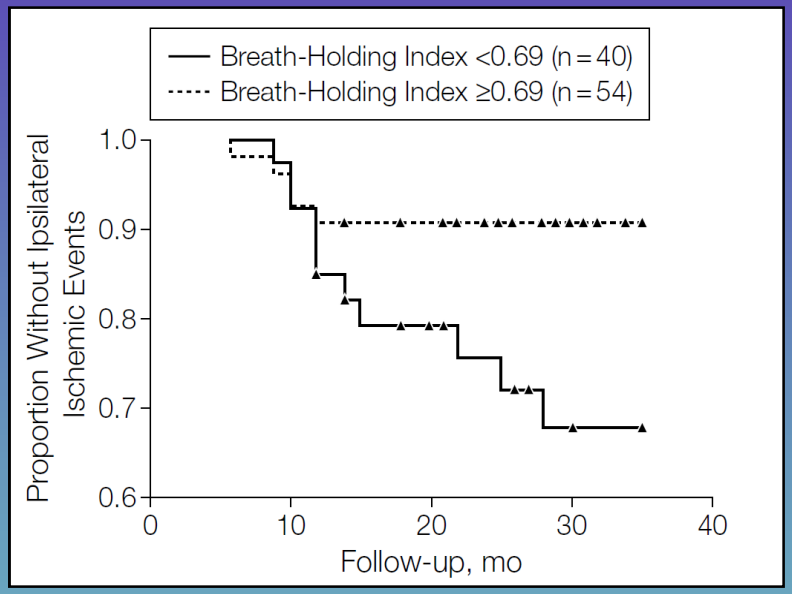
.

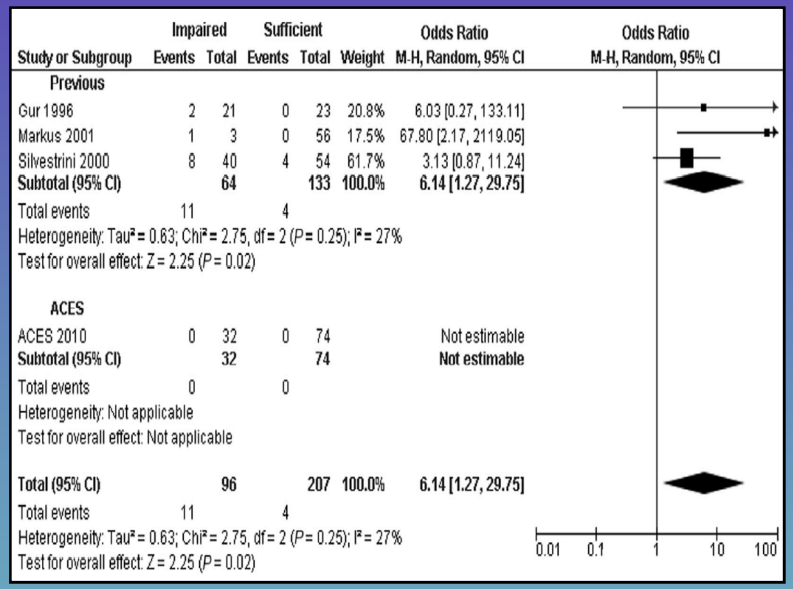
Hemodynamic Stroke Incidence
(results Cardiac Surgery 2009-2011*)

- No CA stenoses
  - N= 165 **1.4 %**
- Asympt. unilateral CA (70 %-100 %) **5.7 %**
  - N = 35 (2/35)
- Asympt. bilateral CA (70-100%) **9.1 %**
  - N =11 (1/11)

•Data of 211 patients who underwent a duplex or CTA exam prior to surgery

Poor collaterals and Stroke Risk in high grade carotid artery stenosis





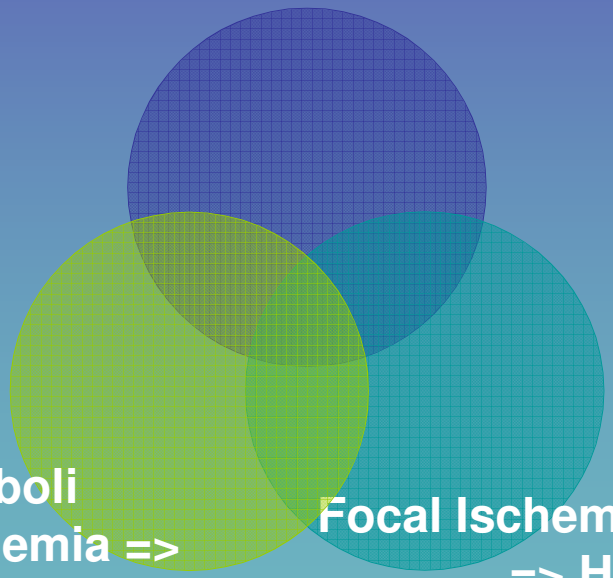
Study or Subgroup	Impaired Events	Impaired Total	Sufficient Events	Sufficient Total	Weight	Odds Ratio M-H, Random, 95% CI
Previous						
Gur 1996	2	21	0	23	20.8%	6.03 [0.27, 133.11]
Markus 2001	1	3	0	56	17.5%	67.80 [2.17, 2119.05]
Silvestrini 2000	8	40	4	54	61.7%	3.13 [0.87, 11.24]
Subtotal (95% CI)		**64**		**133**	**100.0%**	**6.14 [1.27, 29.75]**
Total events	11		4			
Heterogeneity: Tau² = 0.63; Chi² = 2.75, df = 2 (P = 0.25); I² = 27%						
Test for overall effect: Z = 2.25 (P = 0.02)						
ACES						
ACES 2010	0	32	0	74		Not estimable
Subtotal (95% CI)		**32**		**74**		**Not estimable**
Total events	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						
Total (95% CI)		**96**		**207**	**100.0%**	**6.14 [1.27, 29.75]**
Total events	11		4			
Heterogeneity: Tau² = 0.63; Chi² = 2.75, df = 2 (P = 0.25); I² = 27%						
Test for overall effect: Z = 2.25 (P = 0.02)						

Silvestrini M, et al. Impaired cerebral vasoreactivity And risk of stroke in patients with asymptomatic carotid artery stenosis. JAMA 2000;283:2122-7

King A, et al. Does impaired cerebrovascular reactivity predict stroke risk in asymptomatic carotid stenosis? A prospective substudy of the ACES. Stroke 2011;42:1550-5

Ischemia
is the final common path of neuronal damage after CABG

Global ischemic hypoperfusion =>
Delirium



Air and/or solid emboli
induced multifocal ischemia =>
Embolic strokes

Focal Ischemia distal to an occluded ICA
=> Hemodynamic Stroke

Pivotal Questions

‘If ischemia is the central cause of neurological complications after cardiac surgery why don’t we:

a. pro-actively identify high risk patients prior to surgery and try to restore abnormal hemodynamics?

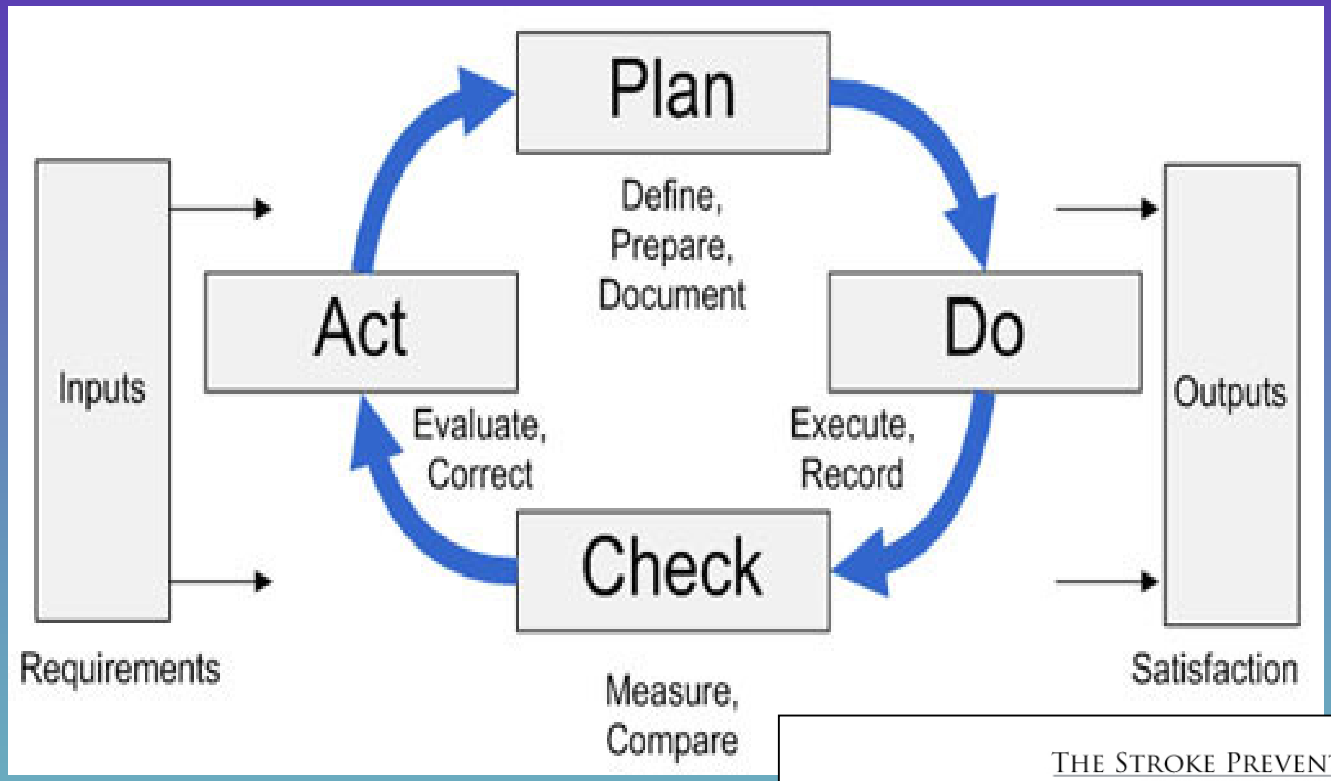
and why don’t we

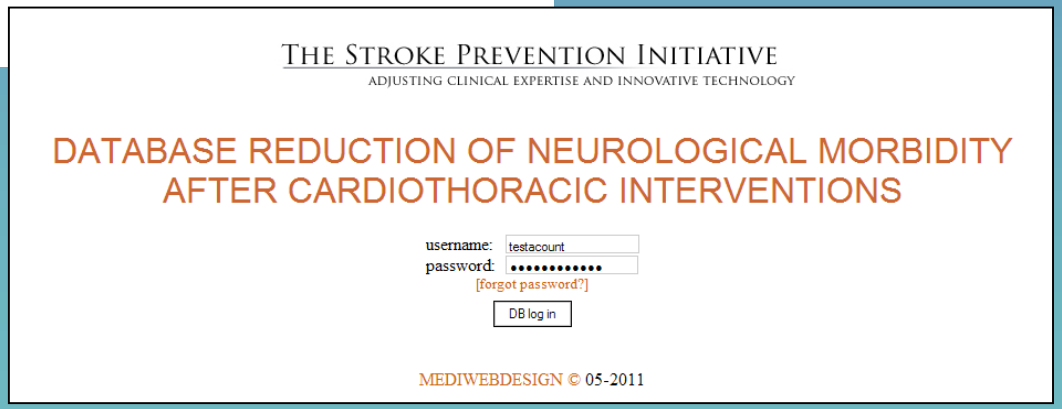
b. closely monitor cerebral oxygination peri-operatively?’

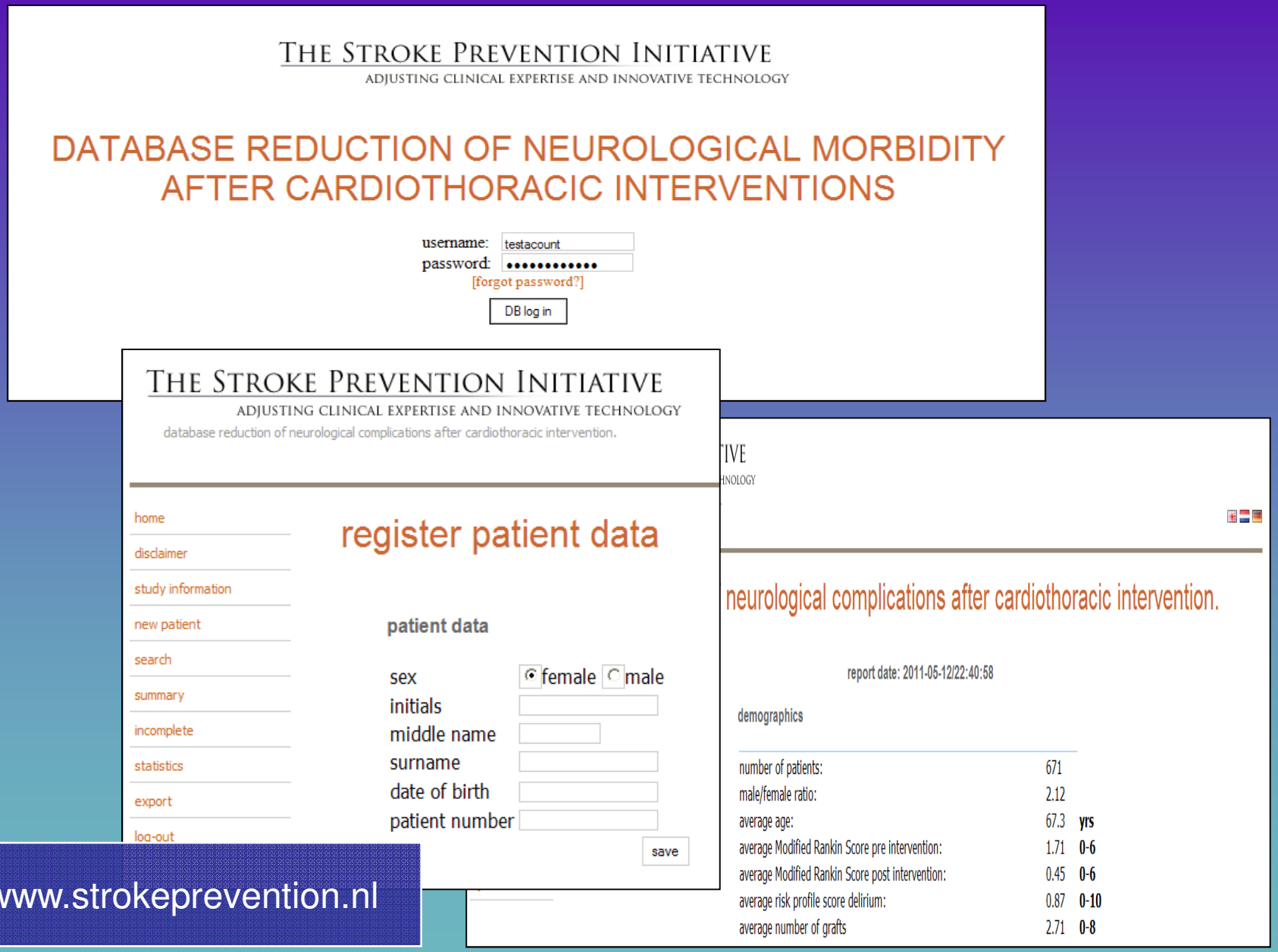
The Haga Braincare Strategy - mission statement -

- A joint initiative of the cardiovascular surgeons, neurologist and cardio anaesthesiologist to reduce the burden of ischemic neurological complications after CABG
- The Strategy is an integral part of the regular work-up of every patients scheduled for CABG
- The Haga Braincare Strategy includes a quality control model for on-line monitoring of neurological complications after cardiac surgery.

Quality management







www.strokeprevention.nl

Haga Brain Care Strategy
- vision -

- Every patients should be evaluate about the adequacy of cerebral hemodymains by TCD, and if this is not possible they should duplex CTA
- Every patients with uni- or bilatteral CAS should be carefully monitoried by bilateral cerebral oximetry
- Every patient with preoperative poor hemodynamics in combined with high grade ICA should be underwent revascular procedures (selective angioplasthy)

The Haga Braincare Strategy - technology aspects -

- pre-operative evaluation of cerebral hemodynamics with transcranial Doppler (TCD) in the front-end of the vascular work-up.
- Per-operative cerebral oximetry.
- Post-operative cerebral oximetry.

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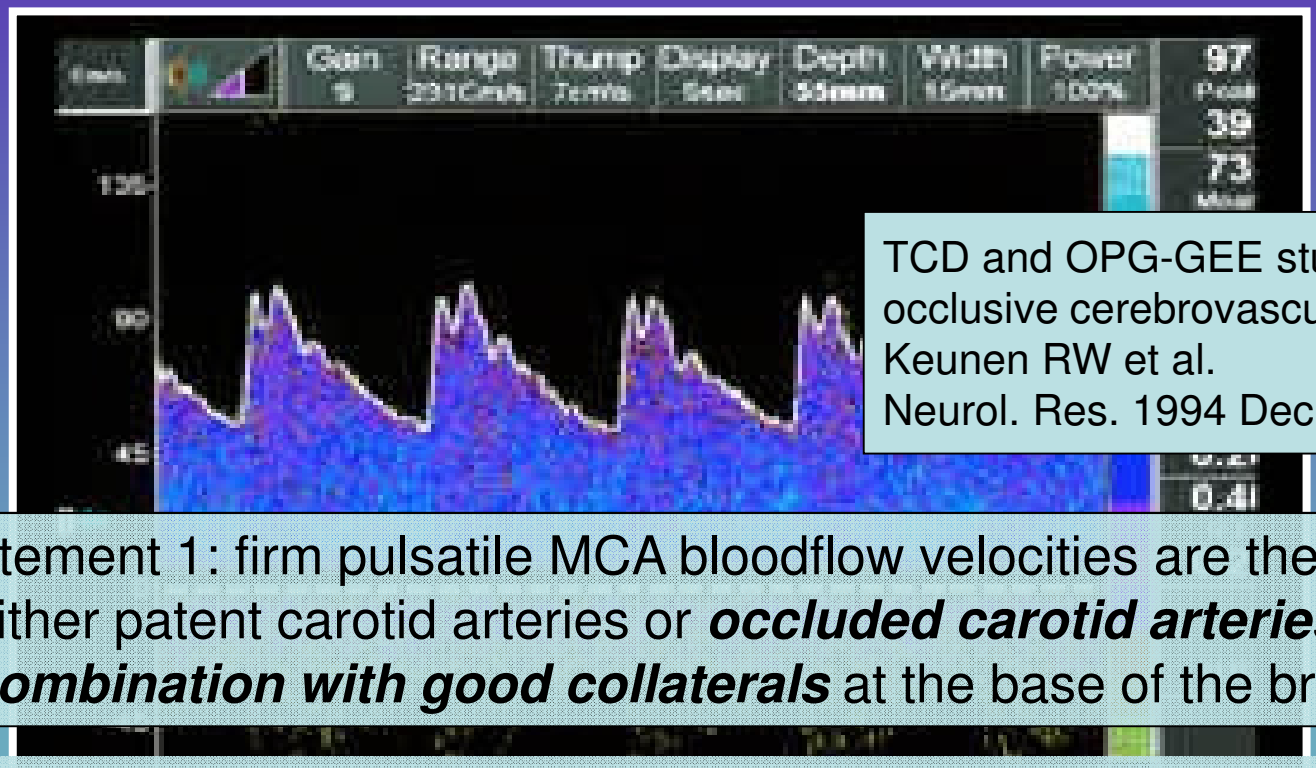
The importance of normal MCA bloodflow velocities

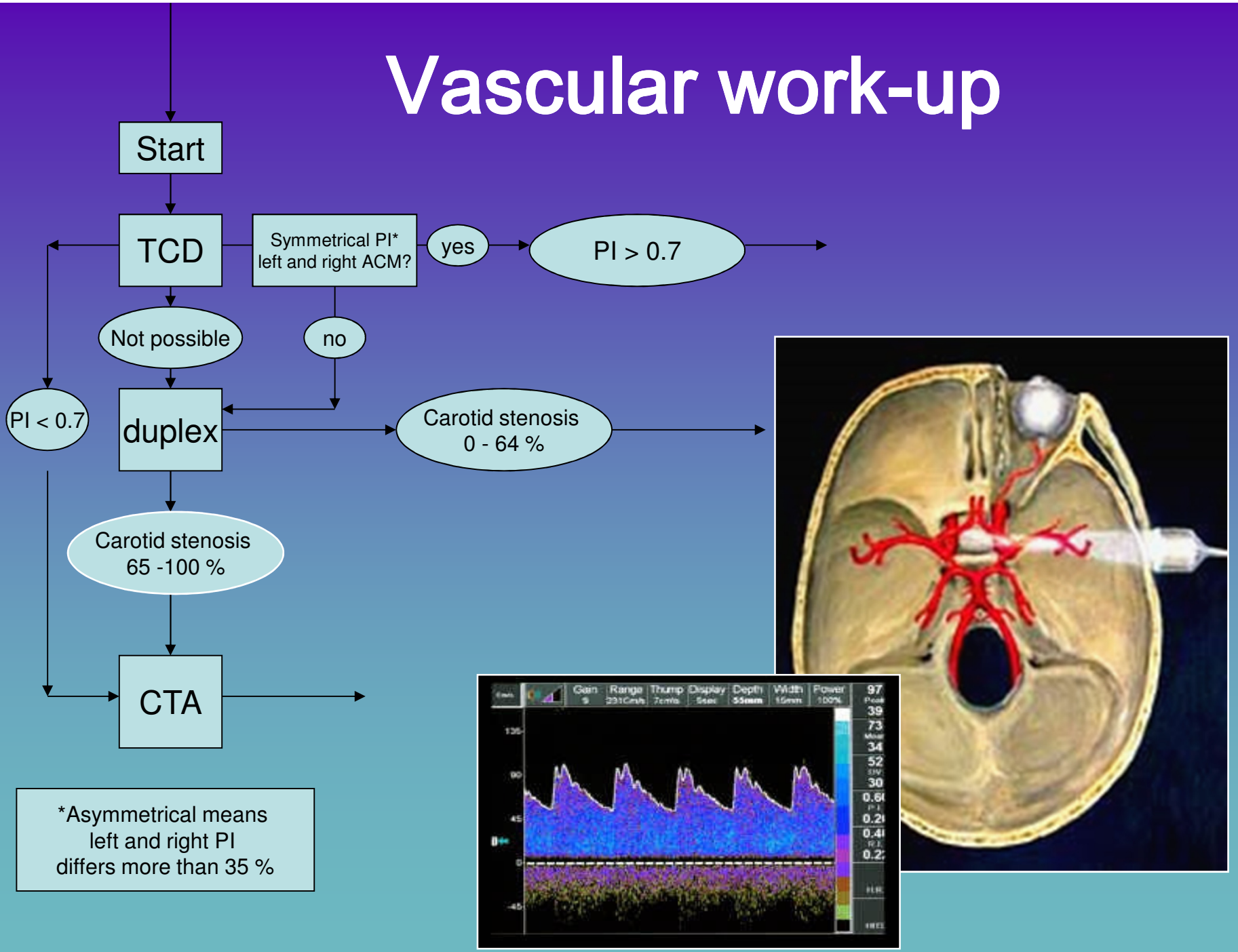


TCD and OPG-GEE studies in occlusive cerebrovascular disease
Keunen RW et al.
Neurol. Res. 1994 Dec16(6): 413-6

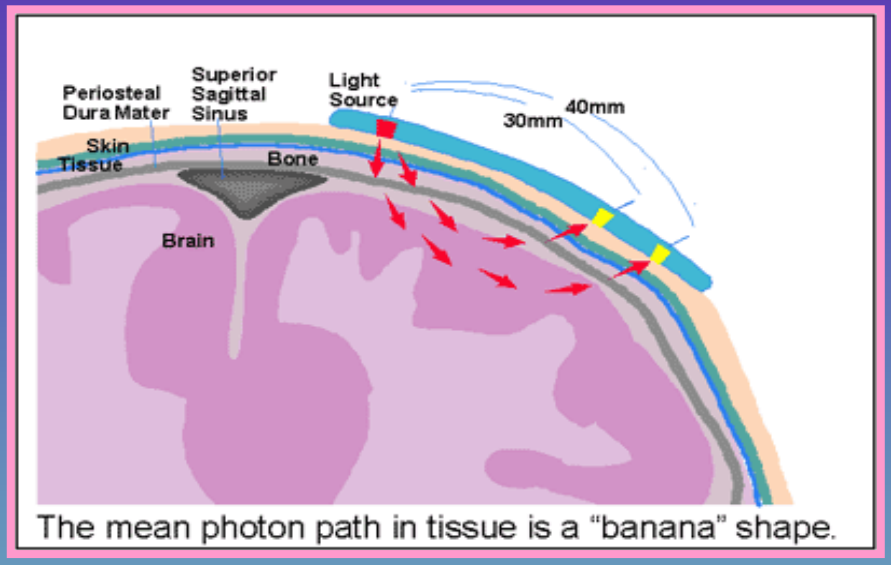
Statement 1: firm pulsatile MCA bloodflow velocities are the result of either patent carotid arteries or ***occluded carotid arteries in combination with good collaterals*** at the base of the brain.

Statement 2: patients with firm pulsatile MCA bloodflow velocities will therefore ***be able to resist per-operative hypoxic/ischemic events much better than patients with a reduced cerebral flow pulsatility.***

Vascular work-up



Peri-operative oximetry



The mean photon path in tissue is a "banana" shape.

Monitoring Brain Oxygen Saturation During Coronary Bypass Surgery: A Randomized, Prospective Study

John M. Murkin, MD, FRCPC*
Ivan Iglesias, MD*
Andrew Cleland, RRT‡

BACKGROUND: Cerebral deoxygenation is associated with various adverse systemic
ized, by using the brain as an index organ, that interven-
al oxygenation would have systemic benefits in cardiac

coronary artery bypass patients were randomized to either
regional oxygen saturation (rSO_2) monitoring with active
ntervention protocol (intervention, n = 100), or underwent
g (control, n = 100). Predefined clinical outcomes were
bserver.
re patients in the control group demonstrated prolonged
= 0.014) and longer duration in the intensive care unit (P =
0.029) versus intervention patients. There was no difference in overall incidence of
adverse complications, but significantly more control patients had major organ
morbidity or mortality (death, ventilation >48 h, stroke, myocardial infarction,

Cerebral oximetry is used from the induction of anaesthesia until the patient is awake and hemodynamically stable at the recovery or ICU.


Marotta
Benny & Luisa Marotta
& Family
Coppa
Chiodo

Haga Braincare Strategy
- initial evaluation -

- Study Design: retrospective follow-up study
- Data-management: electronical CRF developed by Mediweb Design.
- Delirium established by the Delirium Observation Screening Scale
- Cerebral Oximetry by INVOS 5100; COVIDIEN, Boulder, CO, USA
- TCD by2-MHz pulsed bidirectional TCD, Delica 9-series, Delicate Manufacturer, Shenzhen, China.

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Results Haga Brain Care Strategy

Retrospective Follow-up Study

Table 1: Comparison of baseline demographics and preoperative clinical parameters of patients included in 2009 and 2010

Factors	2009 ($n = 233$)	2010 ($n = 409$)	*P*-value
Age	68.21 ± 10.1	68.68 ± 10.0	0.568
Sex (male/female)	74.2%/25.8%	68.2%/31.8%	0.128
Type of surgery (CABG/CABG plus)	80.3%/19.7%	75.8%/24.2%	0.229
Preoperative delirium risk score	0.71 ± 1.3	0.94 ± 1.5	0.055
Preoperative mRS	2.08 ± 0.3	2.13 ± 0.4	0.094
TCD examination	9.0%	64.1%	
Cerebral oximetry (NIRS)	1.7%	49.1%	
HBCS (TCD + NIRS)	1.7%	34.0%	
Duplex examination	13.3%	13.0%	

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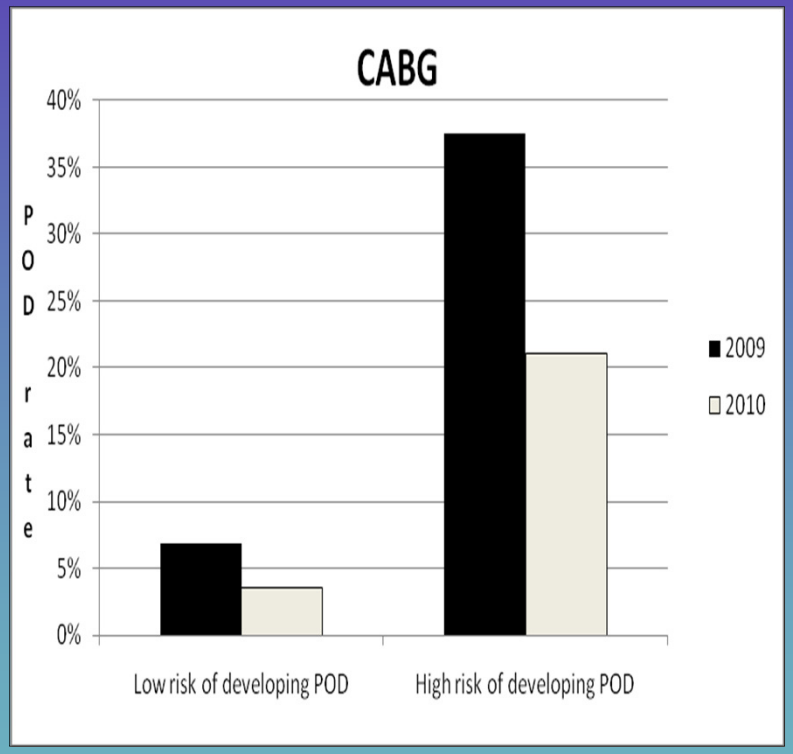
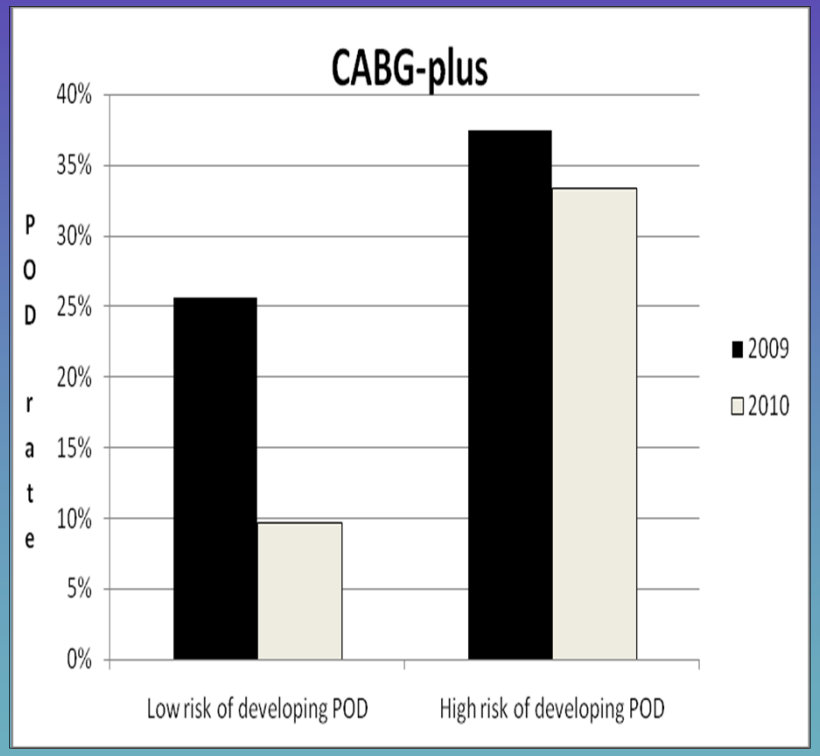
Incidence Post operative Delirium 2009 versus 2010





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Results

Table 2: Comparison of postoperative clinical parameters of patients included in 2009 and 2010

Factors	2009 (n = 233)	2010 (n = 409)	P-value
Length of ICU stay			
Mean	2.11 ± 3.0	1.83 ± 2.9	0.228
1 day	70.0%	79.2%	
>1 day	30.0%	20.8%	0.011
Mean length of hospital stay	7.15 ± 6.3	7.27 ± 6.1	0.441
Neurological complications			
POD	13.3%	7.3%	0.019
Stroke	1.3%	1.5%	1.000
Postoperative mRS	2.52 ± 0.7	2.56 ± 0.8	0.537
Mortality	1.3%	1.2%	1.000

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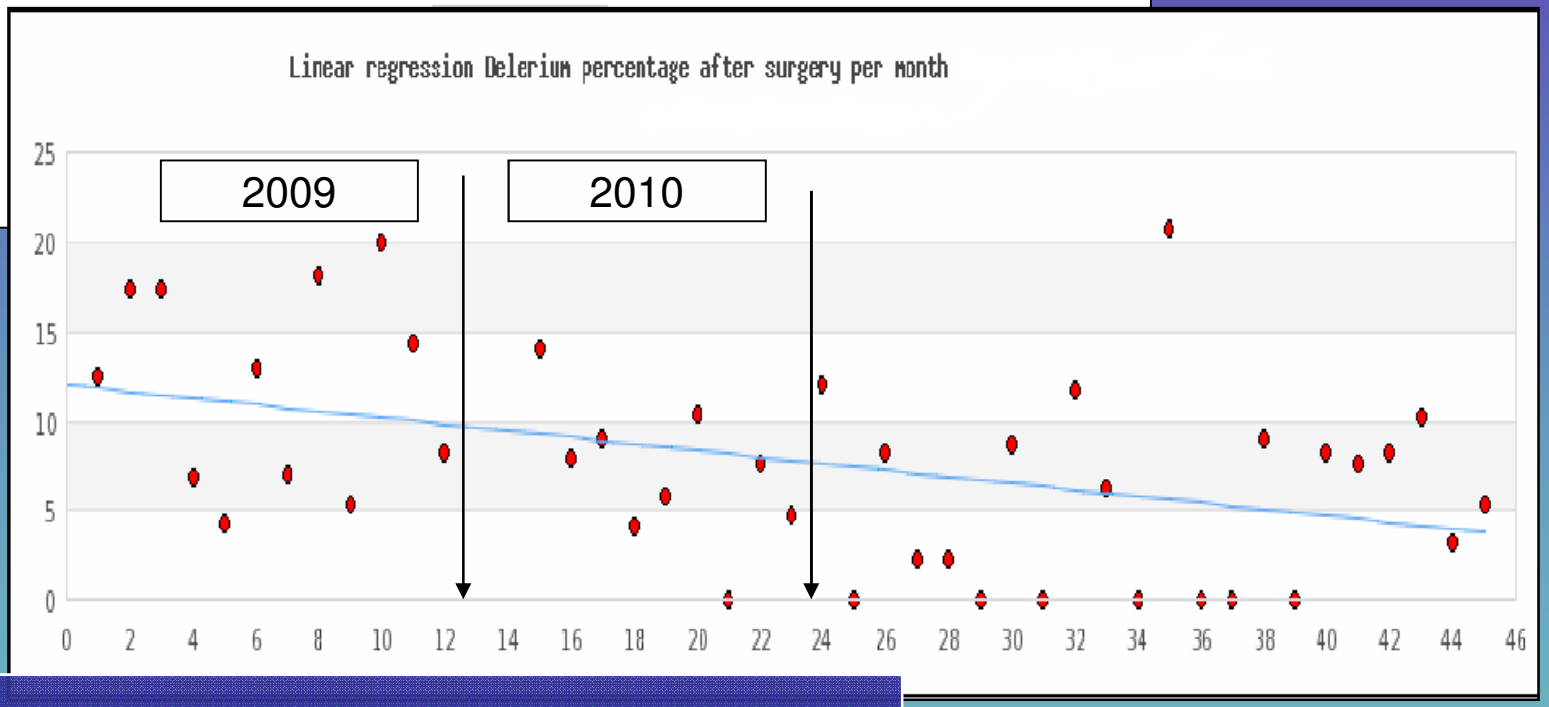
THE STROKE PREVENTION INITIATIVE

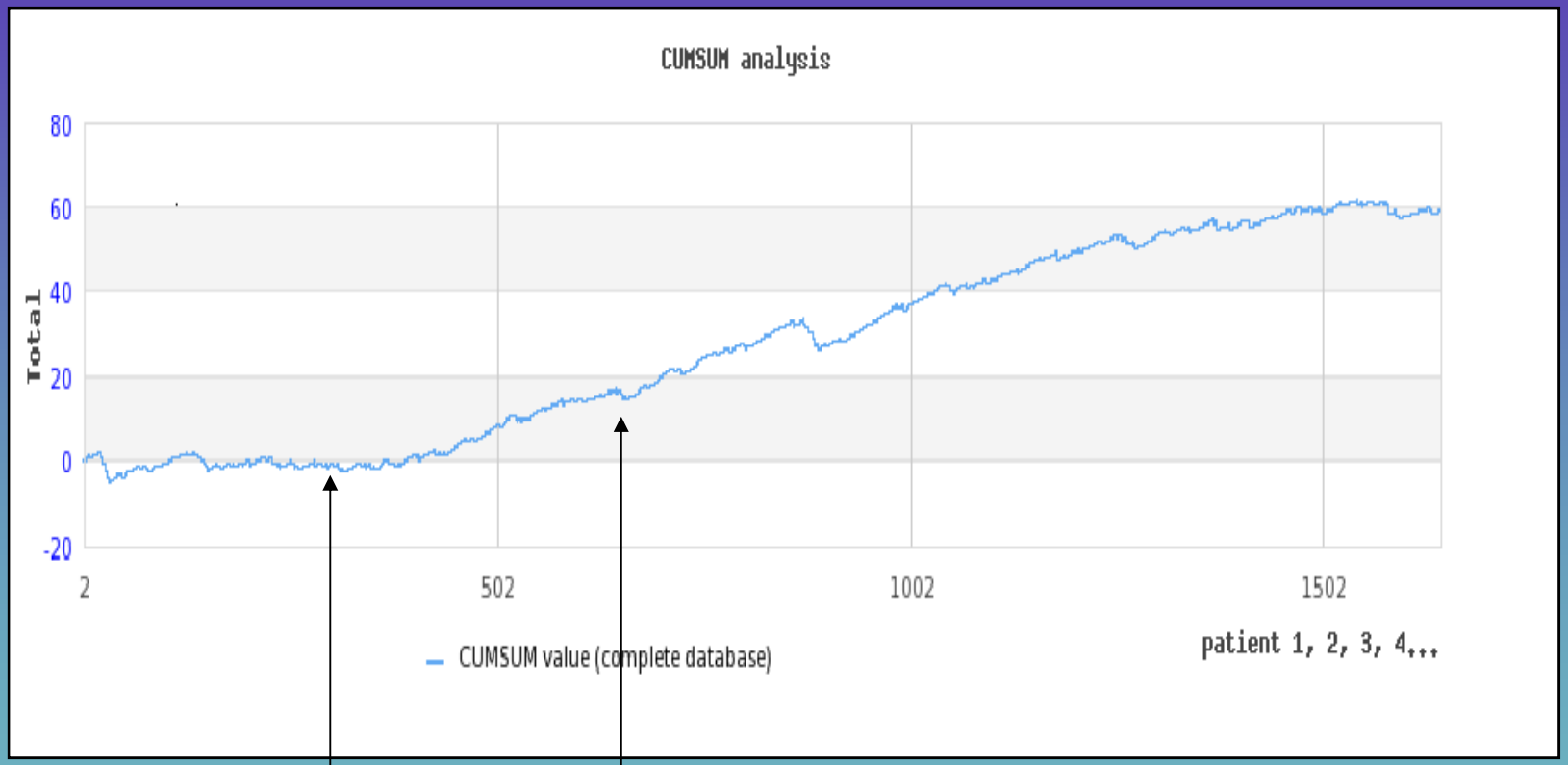
ADJUSTING CLINICAL EXPERTISE AND INNOVATIVE TECHNOLOGY

DATABASE REDUCTION OF NEUROLOGICAL MORBIDITY AFTER CARDIOTHORACIC INTERVENTIONS



The advantage of using an electronic CRF is that we use this online database after the study for continuous quality control (www.strokeprevention.nl)

CUM SUM Analysis



2009 | 2010 | Delirium prevented 2010-2013: n=68

The burden of neurological complications after CABG surgery in the early days '2006-2009'

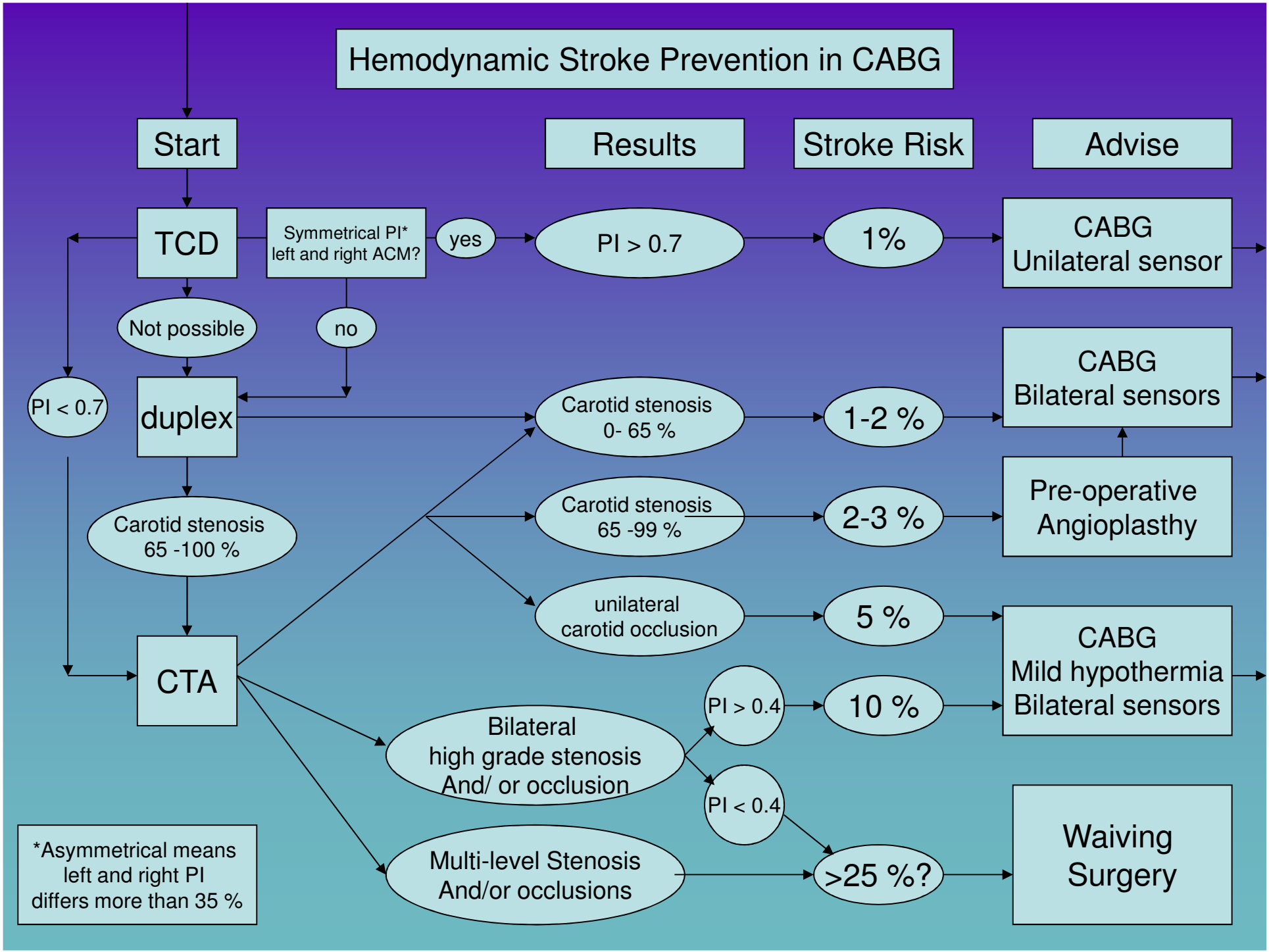
- Stroke Rate 1.7 %[1]
  - Stroke Severity rate (NIHSS >10) 59 %
  - Mortality Stroke 27 %
  - Hemodynamical Strokes Rate 18 %
- Delirium 12 %[2]
- Mortality rate 2.0 %[3]

Ref. 1. retrospective data 2006/7 Sonderen van A, et al. Cerebrovasc. Dis. 2011 31(suppl 1): 57
2. prospective follow-up data 2009 Palmbergen et.al.
3. prospective follow-up data Mirador & NICE databases HagaZiekenhuis

Stroke epidemiology
results CABG 2008-2011 (2006/7)

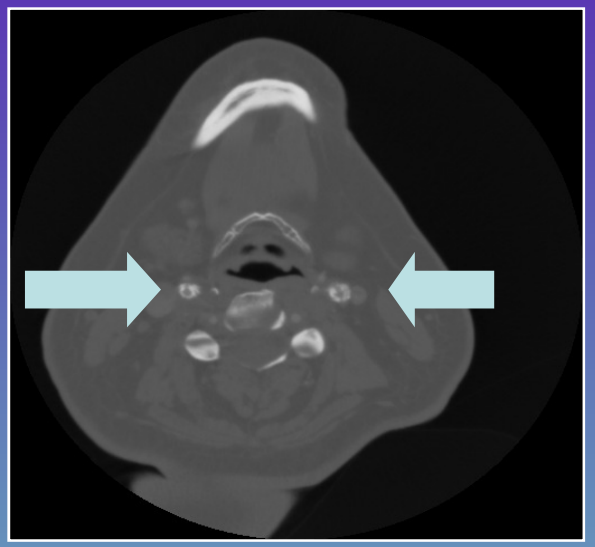
- Overall Stroke Rate 1.4 % (1.7 %)
  - Stroke Severity rate (NIHSS >10) 15 % (59 %)
  - Mortality Stroke 4 % (27 %)
  - Hemodynamical Strokes Rate 4 % (18 %)

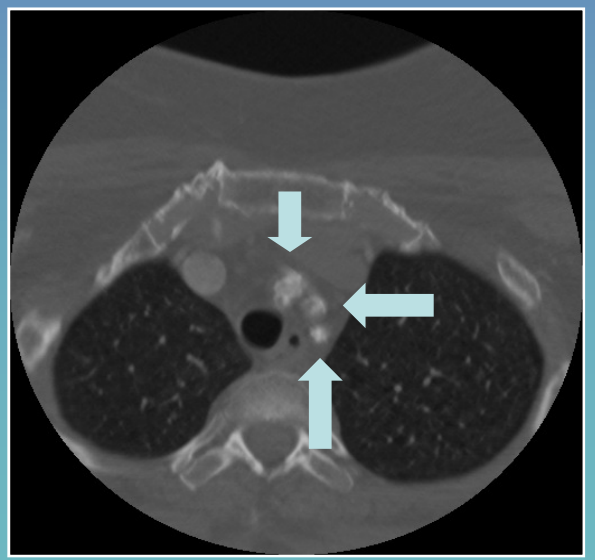

TD


Hemodynamic Stroke Prevention in CABG
Start
Results
Stroke Risk
Advise
TCD
Symmetrical PI* left and right ACM?
yes
PI > 0.7
1%
CABG Unilateral sensor
Not possible
no
PI < 0.7
duplex
Carotid stenosis 0- 65 %
1-2 %
CABG Bilateral sensors
Carotid stenosis 65 -100 %
Carotid stenosis 65 -99 %
2-3 %
Pre-operative Angioplasthy
unilateral carotid occlusion
5 %
CTA
CABG Mild hypothermia Bilateral sensors
PI > 0.4
10 %
Bilateral high grade stenosis And/ or occlusion
PI < 0.4
Multi-level Stenosis And/or occlusions
>25 %?
Waiving Surgery
*Asymmetrical means left and right PI differs more than 35 %

Index Patient refused for CABG

- Pre-operative analysis
  - Female 52 yrs, AP, dyspneu d'effort, paroxymal vertigo, *no carotid bruits, no history of strokes.*
  - TCD: reduced pulsatility in both middle cerebral arteries with reduced bloodflow velocities.
  - Duplex: bilateral high grade internal carotid artery stenosis.
  - CTA: occlusion both anonyma & left subclavian artery with subtotal stenosis of origo of left common carotid artery.
  - Advice: do not perfom cardiac surgery in this patient because she will experience a stroke during the induction of anaesthesia even before the cardiac surgeon has opened the chest.





Summary

- Ischemia is an important causative factor of the neurological burden after CABG surgery.
- The Haga Braincare Strategy has been introduced to counterbalance perioperative cerebral ischemia.
- In this retrospective follow-up study the HBCS reduces the ischemic neurological complications in CABG patients.

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ADJUSTING CLINICAL EXPERTISE AND INNOVATIVE TECHNOLOGY

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Clinical Resources and Innovative Software for Stroke Prevention

The Stroke Prevention Initiative exists to inform neurologists, cardiovascular surgeons and others about the strategies and software that have been developed at the Haga Teach
Hague/The Netherlands) to re
Stroke patients and to reduce
and post-operative delirium ra
software includes electronical
allows on-line follow-up of the
includes a new embolus detec
embolus detection on every t
of the CRF's and EDS are avai

Electronic CRF's are available

a. NIRS technology following
b. Embolus detection in TIA a

Contact

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The Netherlands

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doi:10.1093/icvts/ivs317

ORIGINAL ARTICLE

CARDIAC GENERAL

Improved perioperative neurological monitoring of coronary artery bypass graft patients reduces the incidence of postoperative delirium: the Haga Brain Care Strategy

Wijnand A.C. Palmbergen[a], Agnes van Sonderen[a], Ali M. Keyhan-Falsafi[b], Ruud W.M. Keunen[a,*] and Ron Wolterbeek[c]

www.strokeprevention.nl