SUPPLEMENTAL MATERIAL

Table S1. MOOSE Checklist for Meta-analyses of Observational Studies.

Item No	Recommendation	Page No.
	Reporting of background should include	
1	Problem definition	2
2	Hypothesis statement	2
3	Description of study outcome(s)	2
4	Type of exposure or intervention used	3
5	Type of study designs used	3
6	Study population	3
	Reporting of search strategy should include	
7	Qualifications of searchers (eg, librarians and investigators)	3
8	Search strategy, including time period included in the synthesis and key words	3
9	Effort to include all available studies, including contact with authors	3
10	Databases and registries searched	3
11	Search software used, name and version, including special features used (eg, explosion)	3
12	Use of hand searching (eg, reference lists of obtained articles)	3
13	List of citations located and those excluded, including justification	3
14	Method of addressing articles published in languages other than English	3
15	Method of handling abstracts and unpublished studies	3
16	Description of any contact with authors	3
	Reporting of methods should include	
17	Description of relevance or appropriateness of studies assembled for assessing the hypothesis to be tested	3
18	Rationale for the selection and coding of data (eg, sound clinical principles or convenience)	3
19	Documentation of how data were classified and coded (eg, multiple raters, blinding and interrater	3
20	Assessment of confounding (eg, comparability of cases and controls in studies where appropriate)	4

21	Assessment of study quality, including blinding of quality assessors, stratification or regression on possible predictors of study results	4
22	Assessment of heterogeneity	5
23	Description of statistical methods (eg, complete description of fixed or random effects models, justification of whether the chosen models account for predictors of study results, dose-response models, or cumulative meta-analysis) in sufficient detail to be replicated	4
24	Provision of appropriate tables and graphics	5
	Reporting of results should include	
25	Graphic summarizing individual study estimates and overall estimate	Figures
26	Table giving descriptive information for each study included	Tables
27	Results of sensitivity testing (eg, subgroup analysis)	6-7
28	Indication of statistical uncertainty of findings	6-7
29	Quantitative assessment of bias (eg, publication bias)	6-7
30	Justification for exclusion (eg, exclusion of non-English language citations)	6-7
31	Assessment of quality of included studies	6-7
	Reporting of conclusions should include	
32	Consideration of alternative explanations for observed results	8-11
33	Generalization of the conclusions (ie, appropriate for the data presented and within the domain of the literature review)	8-11
34	Guidelines for future research	8-11
35	Disclosure of funding source	12

From: Stroup DF, Berlin JA, Morton SC, for the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) Group. Meta-analysis of Observational Studies in Epidemiology. A Proposal for Reporting. JAMA. 2000;283:2008-2012.

Table S2. The Search Strategy for Ovid MEDLINE.

Ovid MEDLINE® (Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE® Daily and Ovid MEDLINE® - 1946 to Present)	
Line #	Search term (Searched on 04/11/2018)
1	(Intraoperative Complications/ or Postoperative Complications/) and exp Stroke/
2	((intraoperative or intra-operative or peroperative or per-operative or perioperative or peri-operative or early or postoperative or post-operative or post-surgical or postsurgical or delayed) adj4 (stroke or strokes or cerebrovascular accident* or cerebro vascular accident* or CVA or CVAs or apoplexy or apoplexia or brain vascular accident* or vascular brain accident* or acute cerebrovascular lesion or acute focal cerebral vasculopathy or brain blood flow disturbance or brain accident or brain attack or brain insult or brain insultus or brain ischaemic attack or brain ischemic attack or cerebral insult cerebral vascular accident or cerebral vascular insufficiency or cerebrovascular arrestor cerebrovascular failure or cerebrovascular injury or cerebrovascular insufficiency or cerebrovascular insult or ischaemic cerebral attack or ischaemic seizure or ischemic cerebral attack or ischemic seizure or brain infarction* or brain venous infarction* or cortical infarction or hemisphere infarct* or hemispheric infarct* or brain stem infarction* or brainstem infarction* or Claude Syndrome or Weber Syndrome or Millard-Gublar Syndrome or Top of the Basilar Syndrome or Benedict Syndrome or Foville Syndrome or cerebral infarct* or cerebrovascular infarct* or subcortical infarction* or posterior choroidal artery infarction* or anterior choroidal artery infarction* or lacunar syndrome* or lacunar infarct*)).tw.
3	1 or 2
4	Cardiac Surgical Procedures/

5	(cardiac surgery or cardiac surgical procedure* or heart surgery or heart valve surgery or heart surgical procedures* or cardiac operation* or heart operation* or cardiosurgery or myocardial resection).tw.
6	Coronary Artery Bypass/
7	(CABG or aortic coronary bypass or aorticocoronary anastomosis or Total arterial revascularization or total arterial revascularisation or Multiple arterial revascularization or multiple arterial revascularisation).tw.
8	((aortocoronary or aorta or coronary) adj2 (anastomosis or bypass or shunt or graft)).tw.
9	Coronary Artery Bypass, Off Pump/
10	Internal Mammary-Coronary Artery Anastomosis/
11	Myocardial Revascularization/
12	(cardiac muscle revascularisation or cardiac muscle revascularization or coronary revascularisation or coronary revascularization or heart muscle revascularisation or heart myocardium revascularisation or heart revascularisation or heart revascularization or internal mammary arterial anastomosis or internal mammary arterial implantation or internal mammary artery anastomosis or internal mammary artery graft or internal mammary artery implant or internal mammary artery implantation or internal mammary-coronary artery anastomosis or Coronary Internal Mammary Artery Anastomosis or myocardial revascularisation or myocardial revascularization or myocardium revascularisation or myocardium revascularization or transmyocardial laser revascularisation or transmyocardial laser revascularization or vineberg operation).tw.
13	(Aortic Valve Repair or Aortic Valve Replacement or aorta valve replacement or aorta valve transplantation or aortic valve transplantation or aortic valve xenotransplantation).tw.
14	Cardiac Valve Annuloplasty/

15	(Cardiac Valve Annuloplasty or Cardiac Valve Annuloplasties or Valvular Annuloplasties or Valvular Annuloplasty or Heart Valve Annuloplasty or Heart Valve Annuloplasties or Cardiac Valve Annulus Repair or Heart Valve Annulus Repair or Cardiac Valve Annular Repair or Heart Valve Annular Repair or Cardiac Valve Annular Reduction or Cardiac Valve Annulus Shortening or Cardiac Valve Annulus Reduction).tw.
16	Mitral Valve Annuloplasty/
17	(Mitral Valve Annuloplasties or Mitral Valve Annuloplasty or Mitral Annuloplasty Mitral Annuloplasties or Mitral Valve Annulus Repair or mitral valve surgery or mitral valve replacement or mitral valve repair).tw.
18	Heart Valve Prosthesis Implantation/
19	heart valve prosthesis implantation.tw.
20	or/4-19
21	3 and 20
22	limit 21 to English language

Table S3. Critical Appraisal of Included Studies Using the Newcastle-Ottawa Quality Assessment Scale for Cohort Studies.

Study/Year	Selection	Comparability	Outcome/Exposure	Total Score
Blossom 1992[1]	****	*	**	*******
Boivie 2005[2]	****	*	**	*******
Borger 2001[3]	****	*	**	*******
Bull 1993[4]	****	*	**	*******
Calafiore 2002[5]	****	**	**	********
Cao 2011[6]	****	*	*	******
Carrascal 2014[7]	****	**	**	********
Chen 2015[8]	****	*	**	*******
Doi 2010[9]	****	**	*	*******
Fessatidis 1991[10]	****	*	**	*******
Filsoufi.A 2008[11]	****	**	**	********
Filsoufi.B 2008[12]	****	**	**	********
Gaudino 1999[13]	****	*	**	*******
Goto 2003[14]	****	*	**	*******
Hedberg 2005[15]	****	*	*	******
Hedberg 2011[16]	****	**	**	********
Hedberg 2013[17]	****	**	*	*******
Hogue 1999[18]	****	**	**	********
Imasaka 2018[19]	****	**	*	*******
Karhausen 2017[20]	****	**	**	********
Karkouti 2005[21]	****	**	*	*******
Kinnunen 2015[22]	****	**	**	********
Lahtinen 2004[23]	****	*	**	*******
Lee 2011[24]	****	**	*	*******
Lisle 2008[25]	****	**	**	********
Martin 1982[26]	****	*	**	*******
Marui 2012[27]	****	**	**	********
Murdock 2003[28]	****	*	**	*******
Nishiyama 2009[29]	****	**	**	********

Peel 2004[30]	****	*	*	******
Ridderstolpe 2002[31]	****	**	**	********
Salazar 2001[32]	****	*	**	*******
Tarakji 2011[33]	****	**	**	********
Toumpoulis 2008[34]	****	**	**	********
Weinstein 2001[35]	****	*	*	******
Wijdicks 1996[36]	****	*	**	*******

Table S4. Stroke Definitions in the Included Studies.

• In 23 studies, early strokes were defined as strokes observed at awaking or extubation, while delayed strokes were defined as strokes occurring after a symptom-free interval after awaking or extubation.
• In 7 studies, early strokes were defined as strokes that occurred within 24 hours after cardiac surgery, while delayed strokes after 24 hours.
• In 2 studies, early were strokes occurring intraoperatively, while delayed were those occurring postoperatively
• In 1 early strokes were defined as stroke at recovering from anesthesia or within 12h, while delayed strokes were defined as strokes occurring after 12 hours
• In 1 study early strokes were strokes occurring by 1st POD, while delayed strokes were defined as strokes occurring between POD 2 and 30.
• In 1 study early strokes were strokes presenting on day 0, while delayed strokes were defined as strokes occurring afterwards
• In 1 study early strokes were strokes presenting within 3rd POD, while delayed strokes were defined as strokes occurring afterwards

POD, Post-operative day

Table S5. Demographics of the included studies.

Study/Year	Cohort	Age (Yr)	Females (%)	DM (%)	AF (%)	Carotid disease (%)	Prior Stroke (%)	Urgent/ Emergent (%)	PVD (%)	CKD (%)	Redo (%)	Type of Surgery (%)
Blossom 1992[1]	3428	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	CABG
Boivie 2005[2]	2641	66	27	NR	NR	NR	NR	NR	3	NR	NR	CABG 1882; Valve 195; CABG+Valve 200
Borger 2001[3]	6682	62	20	24	1	NR	8	17	14	3	8	CABG
Bull 1993[4]	245	NR	NR	21	6	11	12	NR	NR	NR	NR	CABG
Calafiore 2002[5]	4875	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	CABG
Cao 2011[6]	430	64	24	37	3	NR	100	NR	3	NR	NR	CABG
Carrascal 2014[7]	844	74	40	20	NR	NR	8	6	10	7	6	CABG 202; CABG+Valve 209; Valve 403; Aortic 32
Chen 2015[8]	1010	67	15	NR	NR	NR	NR	27	NR	NR	NR	CABG
Doi 2010[9]	611	68	22	46	NR	NR	NR	NR	NR	15	NR	CABG
Fessatidis 1991[10]	1487	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	CABG 943; Valve 496; Congenital 46
Filsoufi.A 2008[11]	2808	63	43	15	NR	NR	7	3	7	5	19	CABG+Valve 1529; Valve 1279
Filsoufi.B 2008[12]	2985	65	31	40	NR	NR	8	5	13	5	4	CABG
Gaudino 1999[13]	2987	60	44	18	NR	NR	11	NR	NR	NR	NR	CABG
Goto 2003[14]	463	70	31	35	NR	NR	17	NR	10	11	NR	CABG
Hedberg 2005[15]	2641	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	All Cardiac Surgery
Hedberg 2011[16]	9122	68	25	22	NR	NR	9	NR	NR	NR	5	CABG 8136; CABG+Valve 986

Hedberg 2013[17]	10809	NR	28	20	4	NR	9	NR	9	NR	5	All But Aortic 98,5%; Aortic 1.5%
Hogue 1999[18]	2972	68	36	28	NR	32	7	NR	NR	NR	NR	CABG (88.4); CABG/valve (15.0); Valve (26.6)
Imasaka 2018[19]	1134	NR	39	31	16	14	14	NR	NR	7	4	CABG 378; CABG+Valve 151; Valve 480; Aortic 43; Other 82
Karhausen 2017[20]	6130	NR	28	38	NR	NR	10	NR	NR	6	2	CABG
Karkouti 2005[21]	10949	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	All Cardiac Surgery
Kinnunen 2015[22]	1314	66	21	29	11	NR	4	56	12	NR	1	CABG
Lahtinen 2004[23]	2630	NR	33	31	10	NR	36	1	NR	NR	NR	CABG
Lee 2011[24]	1367	63	26	44	4	NR	9	NR	2	7	NR	CABG
Lisle 2008[25]	7201	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	All Cardiac Surgery
Martin 1982[26]	253	54	83	5	8	NR	6	NR	7	NR	NR	CABG
Marui 2012[27]	2446	67	28	47	6	11	21	6	NR	39	NR	CABG
Murdock 2003[28]	2104	60	50	46	6	NR	22	NR	30	NR	NR	CABG 1798, Valve 135, CABG+Valve 151, Other 20
Nishiyama 2009[29]	2516	67	28	46	6	NR	22	6	20	17	0	CABG
Peel 2004[30]	10573	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	CABG
Ridderstolpe 2002[31]	3282	66	27	14	NR	NR	8	3	7	NR	0	CABG 2290, CABG+Valve 275, Valve 570, Aortic 60, Other 87
Salazar 2001[32]	5971	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	CABG 3,974; Valve 828; CABG/valve 463;

												CABG/CEA 52; CABG/Other 76; Aortic 310; Transplant 94; Other 174
Tarakji 2011[33]	45432	68	21	23	2	NR	6	3	16	3	19	CABG
Toumpoulis 2008[34]	4140	64	31	35	NR	6	7	70	NR	3	NR	CABG
Weinstein 2001[35]	2217	71	35	33	19	NR	NR	NR	6	NR	NR	CABG
Wijdicks 1996[36]	8270	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	CABG

DM, diabetes mellitus; CKD, chronic kidney disease; PVD, peripheral vascular disease; CABG, coronary artery bypass graft; CEA, carotid endarterectomy; NR, not reported.

Table S6. Summary of the outcomes (fixed effect model).

Outcomes	No. of Studies	Proportion [Confidence interval]	Heterogeneity (I^2 , P-value)	Perioperative stroke vs No stoke ¶	Early vs delayed stroke difference ¶
FIXED EFFECT MODEL					
Pooled rate of perioperative stroke	36	2.15% [2.08; 2.22]	94.1%, P<0.0001	----	----
Pooled rate of early stroke	36	1.25% [1.19; 1.30]	94.7%, P<0.0001	----	<0.0001
Pooled rate of delayed stroke	36	1.08% [1.03; 1.14]	91.5%, P<0.0001	----	<0.0001
Pooled rate of operative mortality in the whole group	20	3.39% [3.28; 3.50]	96.9%, P<0.0001	----	----
Pooled rate of operative mortality for patients with perioperative stroke	22	20.76% [19.12; 22.49]	58.8%, P=0.0003	<0.0001	----
Pooled rate of operative mortality for patients without stroke	16	3.19% [3.08; 3.31]	96.9%, P<0.0001	<0.0001	----
Pooled rate of operative mortality for patients with early stroke	12	25.97% [21.80; 30.62]	84.2%, P<0.0001	----	0.0049
Pooled rate of operative mortality for patients with late stroke	13	17.85% [14.57; 21.67]	20.1%, P=0.2407	----	0.0049
Incidence rate of late mortality in the all group	5	5.78% [5.71; 5.84]	99.3%, P<0.0001	----	----
Incidence rate of late mortality in patients with perioperative stroke	5	8.44% [7.83; 9.10]	84.8%, P< 0.0001	<0.0001	----
Incidence rate of late mortality in patients without stroke	8	5.37% [5.32; 5.43]	99.7%, P=0	<0.0001	----
Incidence rate of late mortality in patients with early stroke	5	8.64% [7.49; 9.95]	87.6%, P< 0.0001	----	0.3738
Incidence rate of late mortality in patients with delayed stroke	5	7.73% [6.34; 9.43]	71.2%, P=0.008	----	0.3738

¶ P value for subgroup difference

Table S7. Meta-Regression for Early and Delayed Stroke (Restricted maximum likelihood model). By getting exponential of Beta (exp Beta):

- 1%↑ in prior stroke history→↑ absolute risk of peri-operative stroke by 1.01%, P=0.001
- 1%↑ in on-pump →↑ absolute risk of early stroke by 1.00%, P=0.006
- 1%↑ in in off-pump →↓absolute risk of early stroke by 0.99%, P=0.012
- 1%↑ in in prior stroke history →↑ absolute risk of delayed stroke by 1.02%, P<0.001)

Perioperative Stroke	Beta ±SD (P-value)	Exp (Beta)
Age (years)	0.0041±0.0265, P=0.8774	1.004
Female (%)	0.0071±0.0076, P=0.3527	1.007
Diabetes (%)	0.0015±0.0080, P=0.8470	1.002
AF (%)	-0.0111±0.0246, P=0.6530	0.989
Carotid disease (%)	-0.0220 0.0144, P=0.1271	0.978
Prior stroke (%)	**0.0129±0.0040, P=0.0014**	**1.013**
Urgent or Emergent Procedure (%)	0.0043±0.0041, P=0.2957	1.004
On-pump (%)	0.0017±0.0025, P=0.4927	1.002
Off-pump (%)	-0.0014±0.0028, P=0.6152	0.999
Single clamp (%)	0.0034±0.0055, P=0.5385	1.003
Multiple clamp (%)	-0.0034±0.0055, P=0.5385	0.997
Asc Aorta atheroma or calcification (%)	0.0017±0.0065, P=0.7927	1.002
Use of circulatory arrest (%)	NA (no enough study)	NA
CPB time (in minutes)	0.0007±0.0030, P=0.8220	1.001
Aortic clamp time (in minutes)	0.0002±0.0038, P=0.9522	1.000
Early Stroke	**Beta ±SD (P-value)**	**Exp (Beta)**
Age (years)	0.0158±0.0318, P=0.6202	1.016
Female (%)	0.0074±0.0102, P=0.4687	1.007
Diabetes (%)	-0.0178±0.0097, P= 0.0678	0.982
AF (%)	-0.0153±0.0240, P=0.5256	0.985
Carotid disease (%)	-0.0473±0.0252, P=0.0600	0.954
Prior stroke (%)	-0.0046±0.0072, P=0.5244	0.995
Urgent or Emergent Procedure (%)	0.0056±0.0074, P=0.4508	1.006
On-pump (%)	**0.0091±0.0034, P=0.0064**	**1.009**

Off-pump (%)	-0.0097±0.0038, P=0.0115	0.990
Single clamp (%)	0.0012 0.0087, P=0.8874	1.001
Multiple clamp (%)	-0.0012±0.0087, P=0.8874	0.999
Asc Aorta atheroma or calcification (%)	0.0005±0.0115, P=0.9634	1.001
Use of circulatory arrest (%)	NA (no enough studies)	NA
CPB time (in minutes)	-0.0030±0.0047, P=0.5267	0.997
Aortic clamp time (in minutes)	-0.0035±0.0059, P=0.5600	0.997
Delayed Stroke	**Beta ±SD (P-value)**	**Exp (Beta)**
Age (years)	0.0108 0.0420, P=0.7982	1.011
Female (%)	0.0087±0.0115, P=0.4502	1.009
Diabetes (%)	0.0233±0.0120, P=0.0523	1.024
AF (%)	0.0193±0.0465, P=0.6782	1.019
Carotid disease (%)	0.0059±0.0091, P=0.5185	1.006
Prior stroke (%)	0.0224±0.0056, P<.0001	1.023
Urgent or Emergent Procedure (%)	0.0005±0.0077, P=0.9510	1.001
On-pump (%)	-0.0057±0.0036, P=0.1166	0.994
Off-pump (%)	0.0062±0.0039, P=0.1103	1.006
Single clamp (%)	0.0041±0.0091, P=0.6511	1.004
Multiple clamp (%)	-0.0041±0.0091, P=0.6511	0.996
Asc Aorta atheroma or calcification (%)	0.0010±0.0045, P=0.8213	1.001
Use of circulatory arrest (%)	NA (no enough studies)	NA
CPB time (in minutes)	0.0065±0.0050, P=0.1943	1.007
Aortic clamp time (in minutes)	0.0062±0.0064, P=0.3356	1.006

AF, Atrial Fibrillation; Asc, ascending; CPB, cardiopulmonary bypass; NA, not applies.

Figure S1. PRISMA flowchart.

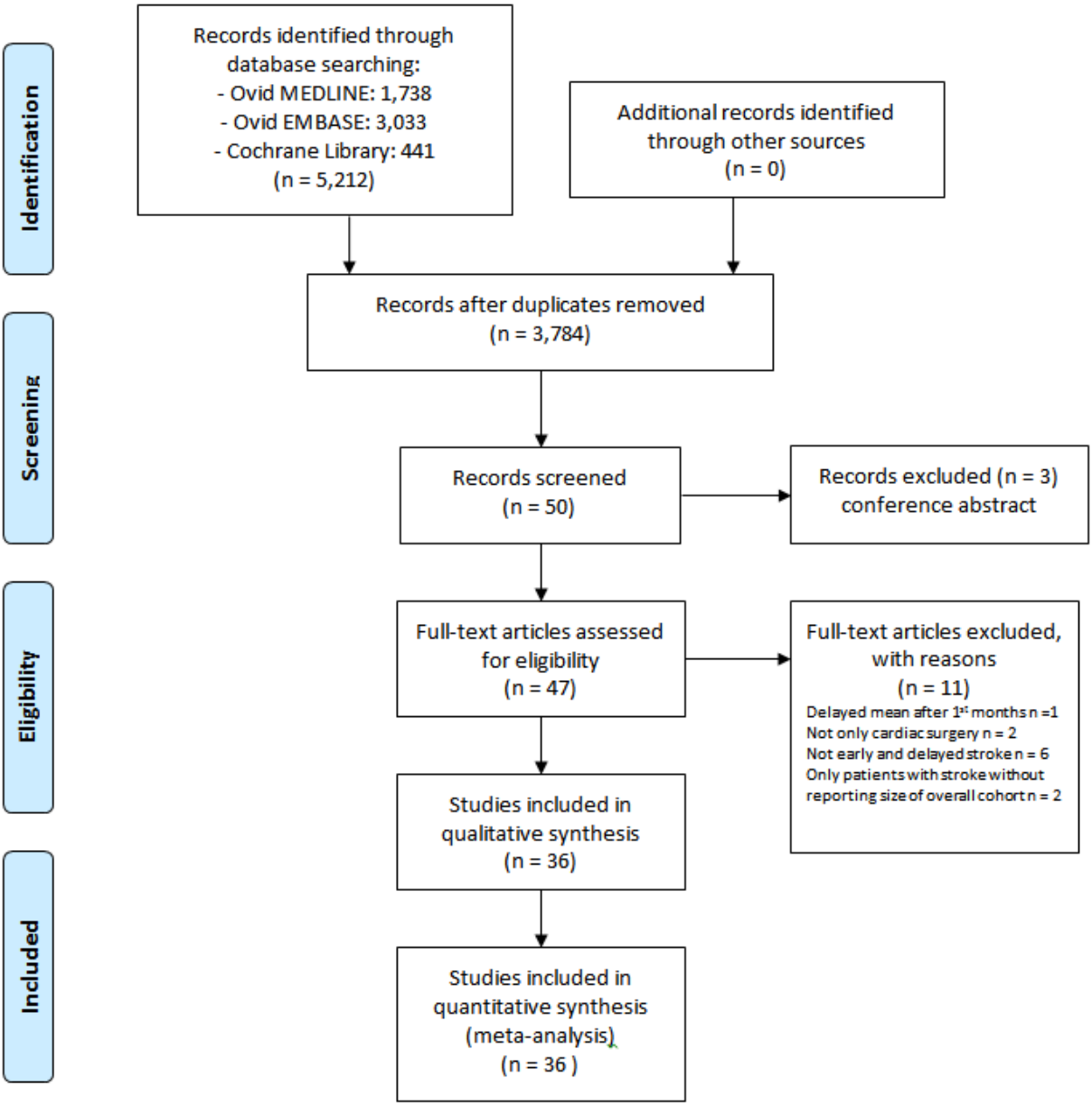


Figure S2. Pooled event rate for perioperative stroke.

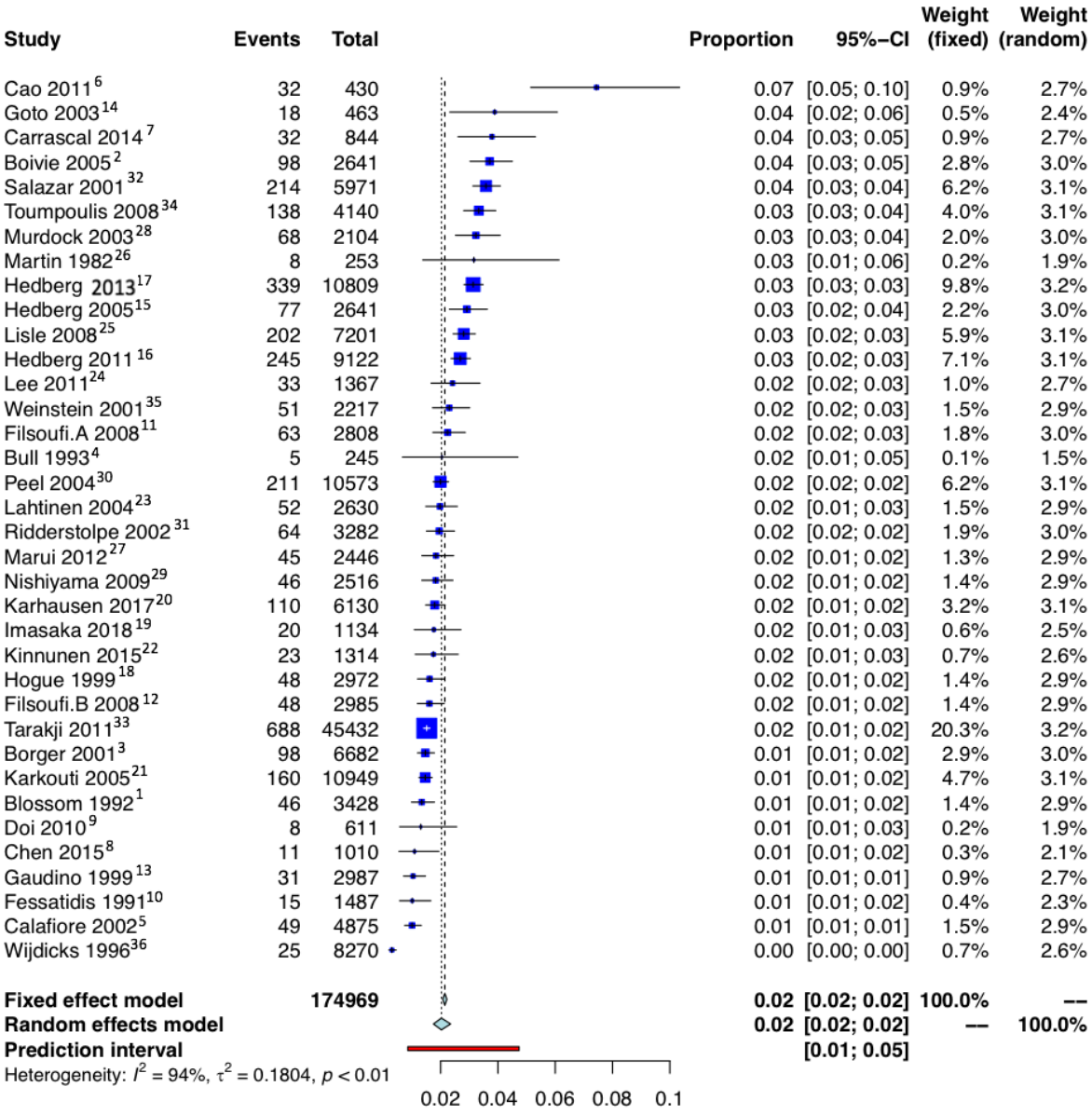
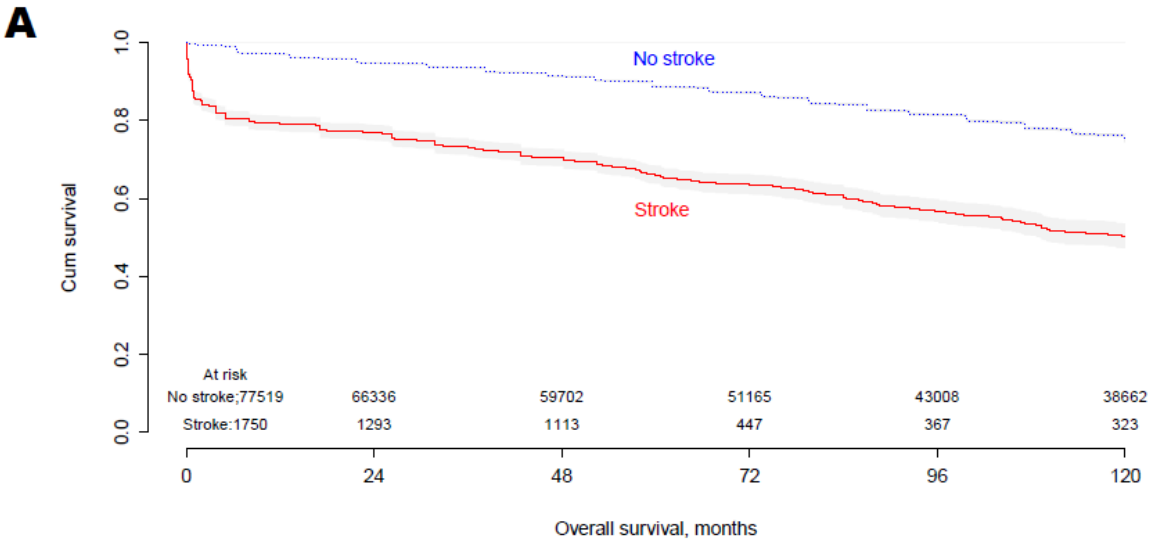


Figure S3. Reconstructed Kaplan-Meier survival curves from derived individual patient data (IPD) for A) No stroke versus perioperative stroke and B) No stroke versus early and delayed stroke. Solid/dotted line represents aggregation of all available Kaplan-Meier curves with 95% CI.



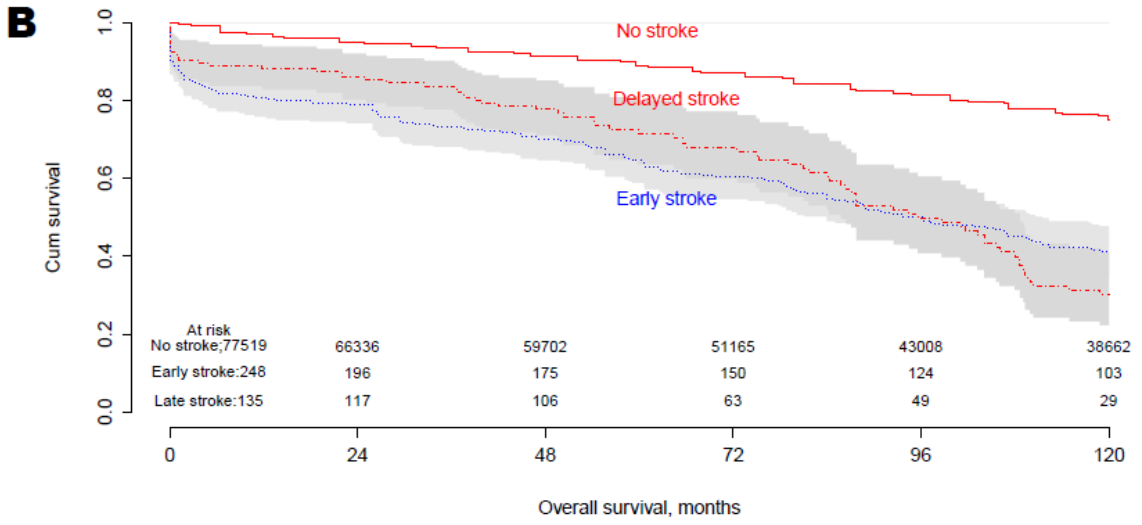
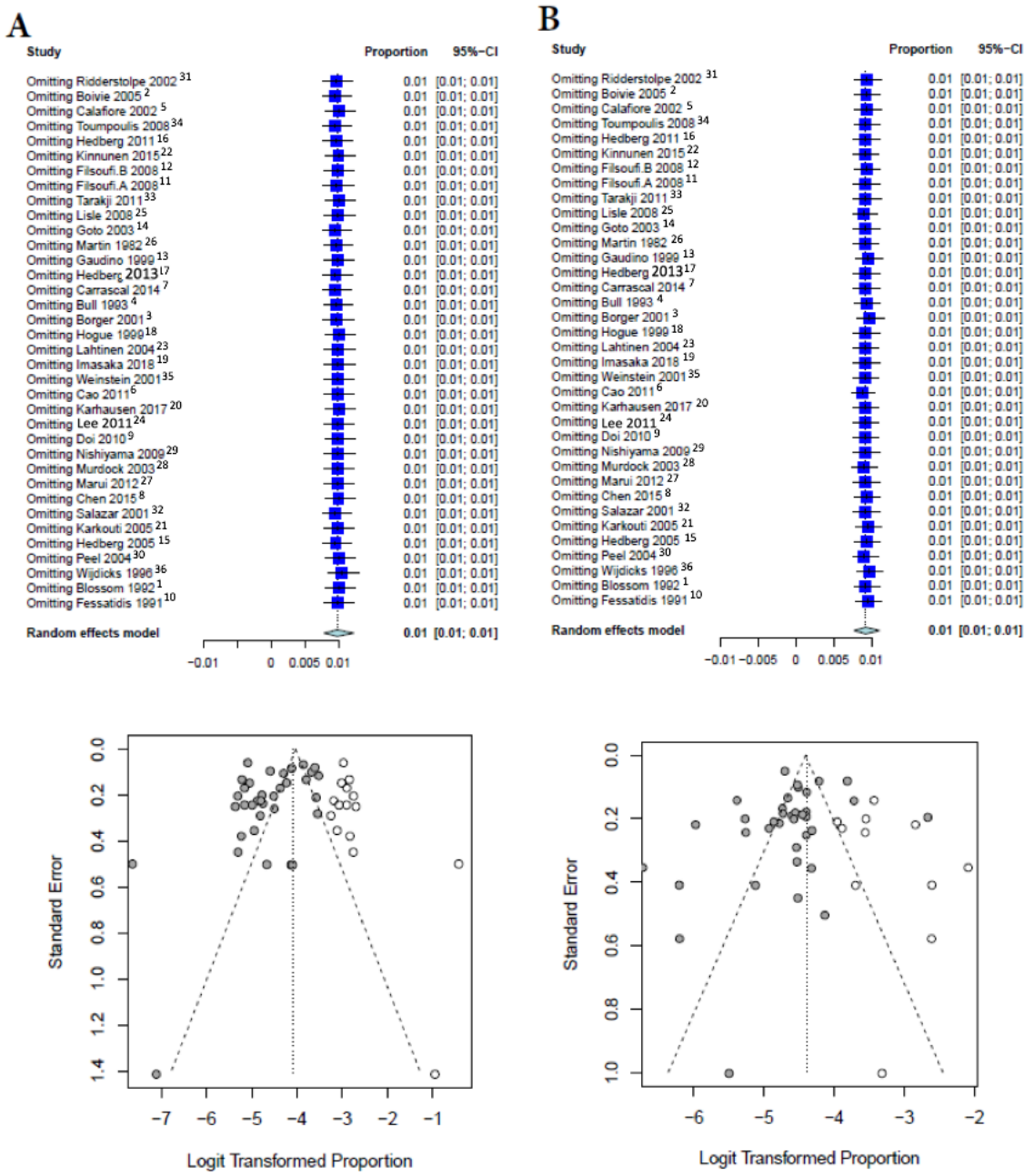


Figure S4. Leave-one-out analysis (top) and funnel plot (bottom) for incidence of A) early stroke and B) delayed stroke.



List of the included studies

1. Blossom GB, Fietsam R, Bassett JS, Glover JL, Bendick PJ. Characteristics of cerebrovascular accidents after coronary artery bypass grafting. *Am Surg*. 1992;58:584–589; discussion 589.

2. Boivie P, Edström C, Engström KG. Side differences in cerebrovascular accidents after cardiac surgery: a statistical analysis of neurologic symptoms and possible implications for anatomic mechanisms of aortic particle embolization. *J Thorac Cardiovasc Surg*. 2005;129:591–598.

3. Borger MA, Ivanov J, Weisel RD, Rao V, Peniston CM. Stroke during coronary bypass surgery: principal role of cerebral macroemboli. *Eur J Cardio-Thorac Surg*. 2001;19:627–632.

4. Bull DA, Neumayer LA, Hunter GC, Keksz J, Sethi GK, McIntyre KE, Bernhard VM. Risk factors for stroke in patients undergoing coronary artery bypass grafting. *Cardiovasc Surg*. 1993;1:182–185.

5. Calafiore AM, Di Mauro M, Teodori G, Di Giammarco G, Cirmeni S, Contini M, Iacò AL, Pano M. Impact of aortic manipulation on incidence of cerebrovascular accidents after surgical myocardial revascularization. *Ann Thorac Surg*. 2002;73:1387–1393.

6. Cao L, Li Q, Bi Q, Yu Q-J. Risk factors for recurrent stroke after coronary artery bypass grafting. *J Cardiothorac Surg*. 2011;6:157.

7. Carrascal Y, Guerrero AL, Blanco M, Valenzuela H, Pareja P, Laguna G. Postoperative stroke related to cardiac surgery in octogenarians. *Interact Cardiovasc Thorac Surg*. 2014;18:596–601.

8. Chen J-W, Lin C-H, Hsu R-B. Mechanisms of early and delayed stroke after systematic off-pump coronary artery bypass. *J Formos Med Assoc*. 2015;114:988–994.

9. Doi K, Yaku H. Importance of cerebral artery risk evaluation before off-pump coronary artery bypass grafting to avoid perioperative stroke. *Eur J Cardio-Thorac Surg*. 2010;38:568–572.

10. Fessatidis I, Prapas S, Hevas A, Didilis V, Alotzeilat A, Missias G, Asteri T, Spyrou P. Prevention of perioperative neurological dysfunction. A six year perspective of cardiac surgery. *J Cardiovasc Surg (Torino)*. 1991;32:570–574.

11. Filsoufi F, Rahmanian PB, Castillo JG, Bronster D, Adams DH. Incidence, topography, predictors and long-term survival after stroke in patients undergoing coronary artery bypass grafting. *Ann Thorac Surg*. 2008;85:862–870.

12. Filsoufi F, Rahmanian PB, Castillo JG, Bronster D, Adams DH. Incidence, imaging analysis, and early and late outcomes of stroke after cardiac valve operation. *Am J Cardiol*. 2008;101:1472–1478.

13. Gaudino M, Martinelli L, Di Lella G, Glieca F, Marano P, Schiavello R, Possati G. Superior extension of intraoperative brain damage in case of normothermic systemic perfusion during coronary artery bypass operations. *J Thorac Cardiovasc Surg*. 1999;118:432–437.

14. Goto T, Baba T, Matsuyama K, Honma K, Ura M, Koshiji T. Aortic atherosclerosis and postoperative neurological dysfunction in elderly coronary surgical patients. *Ann Thorac Surg*. 2003;75:1912–1918.

15. Hedberg M, Boivie P, Edström C, Engström KG. Cerebrovascular accidents after cardiac surgery: an analysis of CT scans in relation to clinical symptoms. *Scand Cardiovasc J*. 2005;39:299–305.

16. Hedberg M, Boivie P, Engström KG. Early and delayed stroke after coronary surgery - an analysis of risk factors and the impact on short- and long-term survival. *Eur J Cardio-Thorac Surg*. 2011;40:379–387.

17. Hedberg M, Engström KG. Stroke after cardiac surgery--hemispheric distribution and survival. *Scand Cardiovasc J*. 2013;47:136–144.

18. Hogue CW, Murphy SF, Schechtman KB, Dávila-Román VG. Risk factors for early or delayed stroke after cardiac surgery. *Circulation*. 1999;100:642–647.

19. Imasaka K-I, Tayama E, Morita S, Tomita Y. Neurological outcome and efficacy of intensive craniocervical screening for elective cardiac surgery. *Interact Cardiovasc Thorac Surg*. 2018;26:216–223.

20. Karhausen JA, Smeltz AM, Akushevich I, Cooter M, Podgoreanu MV, Stafford-Smith M, Martinelli SM, Fontes ML, Kertai MD. Platelet Counts and Postoperative Stroke After Coronary Artery Bypass Grafting Surgery. *Anesth Analg*. 2017;125:1129–1139.

21. Karkouti K, Djaiani G, Borger MA, Beattie WS, Fedorko L, Wijeysundera D, Ivanov J, Karski J. Low hematocrit during cardiopulmonary bypass is associated with increased risk of perioperative stroke in cardiac surgery. *Ann Thorac Surg*. 2005;80:1381–1387.

22. Kinnunen E-M, Juvonen T, Biancari F. Use of Blood Products and Diseased Ascending Aorta Are Determinants of Stroke After Off-Pump Coronary Artery Bypass Grafting. *J Cardiothorac Vasc Anesth*. 2015;29:1180–1186.

23. Lahtinen J, Biancari F, Salmela E, Mosorin M, Satta J, Rainio P, Rimpiläinen J, Lepojärvi M, Juvonen T. Postoperative atrial fibrillation is a major cause of stroke after on-pump coronary artery bypass surgery. *Ann Thorac Surg*. 2004;77:1241–1244.

24. Lee E-J, Choi K-H, Ryu J-S, Jeon S-B, Lee S-W, Park S-W, Park S-J, Lee J-W, Choo S-J, Chung C-H, Jung S-H, Kang D-W, Kim JS, Kwon SU. Stroke risk after coronary artery bypass graft surgery and extent of cerebral artery atherosclerosis. *J Am Coll Cardiol*. 2011;57:1811–1818.

25. Lisle TC, Barrett KM, Gazoni LM, Swenson BR, Scott CD, Kazemi A, Kern JA, Peeler BB, Kron IL, Johnston KC. Timing of stroke after cardiopulmonary bypass determines mortality. *Ann Thorac Surg*. 2008;85:1556–1562; discussion 1562-1563.

26. Martin WR, Hashimoto SA. Stroke in coronary bypass surgery. *Can J Neurol Sci*. 1982;9:21–26.

27. Marui A, Kimura T, Tanaka S, Okabayashi H, Komiya T, Furukawa Y, Kita T, Sakata R, CREDO-Kyoto Investigators. Comparison of frequency of postoperative stroke in off-pump coronary artery bypass grafting versus on-pump coronary artery bypass grafting versus percutaneous coronary intervention. *Am J Cardiol*. 2012;110:1773–1778.

28. Murdock DK, Rengel LR, Schlund A, Olson KJ, Kaliebe JW, Johnkoski JA, Riveron FA. Stroke and atrial fibrillation following cardiac surgery. *WMJ*. 2003;102:26–30.

29. Nishiyama K, Horiguchi M, Shizuta S, Doi T, Ehara N, Tanuguchi R, Haruna Y, Nakagawa Y, Furukawa Y, Fukushima M, Kita T, Kimura T. Temporal pattern of strokes after on-pump and off-pump coronary artery bypass graft surgery. *Ann Thorac Surg*. 2009;87:1839–1844.

30. Peel GK, Stamou SC, Dullum MKC, Hill PC, Jablonski KA, Bafi AS, Boyce SW, Petro KR, Corso PJ. Chronologic distribution of stroke after minimally invasive versus conventional coronary artery bypass. *J Am Coll Cardiol*. 2004;43:752–756.

31. Ridderstolpe L, Ahlgren E, Gill H, Rutberg H. Risk factor analysis of early and delayed cerebral complications after cardiac surgery. *J Cardiothorac Vasc Anesth*. 2002;16:278–285.

32. Salazar JD, Wityk RJ, Grega MA, Borowicz LM, Doty JR, Petrofski JA, Baumgartner WA. Stroke after cardiac surgery: short- and long-term outcomes. *Ann Thorac Surg*. 2001;72:1195–1201; discussion 1201-1202.

33. Tarakji KG, Sabik JF, Bhudia SK, Batizy LH, Blackstone EH. Temporal onset, risk factors, and outcomes associated with stroke after coronary artery bypass grafting. *JAMA*. 2011;305:381–390.

34. Toumpoulis IK, Anagnostopoulos CE, Chamogeorgakis TP, Angouras DC, Kariou MA, Swistel DG, Rokkas CK. Impact of early and delayed stroke on in-hospital and long-term mortality after isolated coronary artery bypass grafting. *Am J Cardiol*. 2008;102:411–417.

35. Weinstein GS. Left hemispheric strokes in coronary surgery: implications for end-hole aortic cannulas. *Ann Thorac Surg*. 2001;71:128–132.

36. Wijdicks EF, Jack CR. Coronary artery bypass grafting-associated ischemic stroke. A clinical and neuroradiological study. *J Neuroimaging*. 1996;6:20–22.