

Supplemental Digital Content 1

Search Strategies

Ovid Medline from inception to present (1946 to 31 December 2016), searched on 31 December 2016

Term #	Purpose	Term	Hits
1	Population Terms	exp General Surgery/ or exp Thoracic Surgery/ or exp Perioperative Care/ or exp Coronary Artery Bypass/ or exp Cardiac Surgical Procedures/ or exp Cardiopulmonary Bypass/	404642
2		((orthop?ed* or hip or femur or knee or ankle or toe or shoulder or elbow or hand or wrist or finger* or digit* or fracture or neck or spine) adj2 (surg* or operat* or resect* or repair or arthro* or fixation or pinning)).mp.	189163
3		((neurosurg* or surg* or operative) adj2 patient*) or laparo* or colectomy or thorascopic or kidney transplant* or renal transplant* or liver transplant* or hepatic transplant* or flap reconstruct* or cystectomy or prostatectomy or nephrectomy or gastrectomy or esophagectomy or thyroidectomy or cholecystectomy or hysterectomy).mp.	684041
4		((thorac* or lung* or pulmon* or cardiac or heart or mediastinal or general or abdo* or intraperiton* or intra-periton* or intraabdominal or intra-abdominal or bowel or colon* or gastrointestinal or colorectal or vasc* or pancrea* or liver or hepat* or transplant* or kidney or renal or aneurysm or aortic or plastic or reconstruct* or otorhinolaryng* or thyroid or ear* or nose* or nasal or throat or traum* or neurosurg* or brain or tumor or tumour or cancer or onco* or neoplasm or graft or urol* or gyn?e* or breast* or bariatric or schedule* or plan* or elective or emergen* or urgent or high or high-risk or high risk or moderate or moderate-risk or moderate risk or intermediate or intermediate-risk or intermediate risk or low or low-risk or low risk or major or minor) adj2 (surg* or operat* or resect*)).mp.	684798

5	Goal-directed Therapy (Intervention) Terms	(cardiac output or cardiac index or pressure varia* or pulse waveform or pressure waveform or stroke volume or stroke index or variability index or swan-ganz or swan ganz or pulmonary artery catheter* or pulmonary-artery catheter* or PA catheter* or central venous pressure or CVP or ?esophageal Doppler or trans?esophageal doppler or oxygen delivery or O2 delivery or oxygen extraction or O2 extraction or oxygen consumption or O2 consumption or DO2 or VO2 or pulse contour or pulse-contour or arterial waveform or arterial wave or arterial-wave or pulse wave or pulse-wave or pressure wave or pressure-wave or echocardiograph* or central venous oxygen or mixed venous oxygen or ScVO2 or svo2 or intrathoracic blood index or intra-thoracic blood index or end diastolic volume or EDV or GEDVI or end-diastolic volume).mp. or exp Hemodynamics/ or exp Cardiac Output/	953915
6		(((h?emodynamic* or cardiac or fluid* or perioperative or peri-operative or pre-operative or preoperative or post-operative or postoperative or intraoperative or intra-operative) adj2 optimi#ation) or (((goal-directed or goal directed or h?emodynamic*) adj2 (therapy or fluid or administration or guidance or guided or treatment or protocol or strategy or monitoring or target*)) or (supranormal adj2 (oxygen or delivery or value* or cardiac)) or output-guided or volume-guided or variability-guided or fluid strategy or fluid management or fluid administration or h?emodynamic monitor* or flotracs or masimo or lidco or vigileo or cardioQ or cardio-Q or pulsion or pulsioflex or picco or piccoplus or picco-plus or piccotmplus or nico or lidcorapid or lidco-rapid or lidcotmrapid or lidcoplus or lidco-plus or lidcotmplus or proaq or datex or ohmeda or datex-ohmeda or deltex or hemosonic or bioZ or physioflow or lithium dilution)).mp.	13722
7	Trial Design Terms	(animal\$ not (human\$ and animal\$)).sh,hw.	4792153
8		(book or conference paper or editorial or letter or review).pt. not exp randomized controlled trial/	3878565

9		(random sampl\$ or random digit\$ or random effect\$ or random survey or random regression).ti,ab. not exp randomized controlled trial/	72717
10		exp randomized controlled trial/ or (random\$ or placebo\$ or single blind\$ or double blind\$ or triple blind\$).ti,ab.	1211614
11		10 not (9 or 8 or 7)	914406
12		1 or 2 or 3 or 4	1617796
13		5 and 6	6828
14		13 and 12 and 11	373

Embase from inception to present (1947 to 30 December 2016), searched on 31 December 2016

Term #	Purpose	Term	Hits
1	Population Terms	exp surgery/ or exp perioperative period/ or exp postoperative care/	4551125
2		((orthop?ed* or hip or femur or knee or ankle or toe or shoulder or elbow or hand or wrist or finger* or digit* or fracture or neck or spine) adj2 (surg* or operat* or resect* or repair or arthro* or fixation or pinning)).mp.	232336
3		((neurosurg* or surg* or operative) adj2 patient*) or laparo* or colectomy or thorascopic or kidney transplant* or renal transplant* or liver transplant* or hepatic transplant* or flap reconstruct* or cystectomy or prostatectomy or nephrectomy or gastrectomy or esophagectomy or thyroidectomy or cholecystectomy or hysterectomy).mp.	965790

4		<p>((thorac* or lung* or pulmon* or cardiac or heart or mediastinal or general or abdo* or intraperiton* or intra-periton* or intraabdominal or intra-abdominal or bowel or colon* or gastrointestinal or colorectal or vasc* or pancrea* or liver or hepat* or transplant* or kidney or renal or aneurysm or aortic or plastic or reconstruct* or otorhinolaryng* or thyroid or ear* or nose* or nasal or throat or traum* or neurosurg* or brain or tumor or tumour or cancer or onco* or neoplasm or graft or urol* or gyn?e* or breast* or bariatric or schedule* or plan* or elective or emergen* or urgent or high or high-risk or high risk or moderate or moderate-risk or moderate risk or intermediate or intermediate-risk or intermediate risk or low or low-risk or low risk or major or minor) adj2 (surg* or operat* or resect*)).mp.</p>	1080631
5	<p>Goal-directed Therapy (Intervention) Terms</p>	<p>(cardiac output or cardiac index or pressure varia* or pulse waveform or pressure waveform or stroke volume or stroke index or variability index or swan-ganz or swan ganz or pulmonary artery catheter* or pulmonary-artery catheter* or PA catheter* or central venous pressure or CVP or ?esophageal Doppler or trans?esophageal doppler or oxygen delivery or O2 delivery or oxygen extraction or O2 extraction or oxygen consumption or O2 consumption or DO2 or VO2 or pulse contour or pulse-contour or arterial waveform or arterial wave or arterial-wave or pulse wave or pulse-wave or pressure wave or pressure-wave or echocardiograph* or central venous oxygen or mixed venous oxygen or ScVO2 or svo2 or intrathoracic blood index or intra-thoracic blood index or end diastolic volume or EDV or GEDVI or end-diastolic volume).mp. or exp hemodynamics/ or exp heart hemodynamics/ or exp cardiopulmonary hemodynamics/ or exp coronary hemodynamics/</p>	1337229

6		((h?emodynamic* or cardiac or fluid* or perioperative or peri-operative or pre-operative or preoperative or post-operative or postoperative or intraoperative or intra-operative) adj2 optimi#ation) or ((goal-directed or goal directed or h?emodynamic*) adj2 (therapy or fluid or administration or guidance or guided or treatment or protocol or strategy or monitoring or target*)) or (supranormal adj2 (oxygen or delivery or value* or cardiac)) or output-guided or volume-guided or variability-guided or fluid strategy or fluid management or fluid administration or h?emodynamic monitor* or flotrac or masimo or lidco or vigileo or cardioQ or cardio-Q or pulsion or pulsiotflex or picco or piccoplus or picco-plus or piccotmplus or nico or lidcorapid or lidco-rapid or lidcotmrapid or lidcoplus or lidco-plus or lidcotmplus or proaq or datex or ohmeda or datex-ohmeda or deltex or hemosonic or bioZ or physioflow or lithium dilution)).mp.	32638
7	Trial Design Terms	(animal\$ not (human\$ and animal\$)).sh,hw.	4073137
8		(book or conference paper or editorial or letter or review).pt. not (exp randomized controlled trial/ or exp controlled clinical trial/)	4475496
9		(random sampl\$ or random digit\$ or random effect\$ or random survey or random regression).ti,ab. not (exp randomized controlled trial/ or exp controlled clinical trial/)	77381
10		exp randomized controlled trial/ or exp controlled clinical trial/ or (random\$ or placebo\$ or single blind\$ or double blind\$ or triple blind\$).ti,ab.	1519133
11		10 not (9 or 8 or 7)	1238413
12		1 or 2 or 3 or 4	4767109
13		5 and 6	18386
14		13 and 12 and 11	1345

Cochrane Library searched up to "Issue 11 of 12, November 2016" on 31 December 2016

Term #	Term	Final Hits
1	MeSH descriptor: [Specialties, Surgical] explode all trees	227
2	MeSH descriptor: [Anesthesia] explode all trees	
3	MeSH descriptor: [Anesthesiology] explode all trees	

4	((orthop?ed* or hip or femur or knee or ankle or toe or shoulder or elbow or hand or wrist or finger* or digit* or fracture or neck or spine) ADJ2 (surg* or operat* or resect* or repair or arthro* or fixation or pinning))	
5	(((neurosurg* or surg* or operative) adj2 patient*) or laparo* or colectomy or thorascopic or kidney transplant* or renal transplant* or liver transplant* or hepatic transplant*)	
6	((thorac* or lung* or pulmon* or cardiac or heart or mediastinal or general or abdo* or intraperiton* or intra-periton* or intraabdominal or intra-abdominal or bowel or colon* or gastrointestinal or colorectal or vasc* or pancrea* or liver or hepat* or transplant* or kidney or renal or aneurysm or aortic or plastic or reconstruct* or otorhinolaryng* or thyroid or ear* or nose* or nasal or throat or traum* or neurosurg* or brain or tumor or tumour or cancer or onco* or neoplasm or graft or urol* or gyn?e* or breast* or bariatric or schedule* or plan* or elective or emergen* or urgent or high or high-risk or high risk or moderate or moderate-risk or moderate risk or intermediate or intermediate-risk or intermediate risk or low or low-risk or low risk or major or minor) adj2 (surg* or operat* or resect*))	
7	cardiac output or cardiac index or pressure varia* or pulse waveform or pressure waveform or stroke volume or stroke index or variability index or swan-ganz or swan ganz or pulmonary artery catheter* or pulmonary-artery catheter* or PA catheter* or central venous pressure or CVP or ?esophageal Doppler or trans?esophageal doppler or oxygen delivery or O2 delivery or oxygen extraction or O2 extraction or oxygen consumption or O2 consumption or DO2 or VO2 or pulse contour or pulse-contour or arterial waveform or arterial wave or arterial-wave or pulse wave or pulse-wave or pressure wave or pressure-wave or echocardiograph* or central venous oxygen or mixed venous oxygen or ScVO2 or svo2 or intrathoracic blood index or intra-thoracic blood index or end diastolic volume or EDV or GEDVI or end-diastolic volume	
8	MeSH descriptor: [Cardiac Output] explode all trees	

9	<p>(((h?emodynamic* or cardiac or fluid* or perioperative or peri-operative or pre-operative or preoperative or post-operative or postoperative or intraoperative or intra-operative) adj2 optimi?ation) or (((goal-directed or goal directed or h?emodynamic*) adj2 (therapy or fluid or administration or guidance or guided or treatment or protocol or strategy or monitoring or target*)) or (supranormal adj2 (oxygen or delivery or value* or cardiac)) or output-guided or volume-guided or variability-guided or fluid strategy or fluid management or fluid administration or h?emodynamic monitor* or flotracs or masimo or lidco or vigileo or cardioQ or cardio-Q or pulsion or pulsioflex or picco or piccoplus or piccoplus or piccotmplus or nico or lidcorapid or lidco-rapid or lidcotmrapid or lidcoplus or lidco-plus or lidcotmplus or proaq or datex or ohmeda or datex-ohmeda or deltex or hemosonic or bioZ or physioflow or lithium dilution))</p>	
10	#1 or #2 or #3 or #4 or #5 or #6	
11	#7 or #8	
12	#10 and #11 and #9	

Supplemental Digital Content 2: Table of Excluded Studies

Study	Year	Reason for exclusion	Full citation
Minkovich	2012	No clinically relevant outcomes	Minkovich L, McCluskey S, Djaiani G, Goldstein D, Gilbert R: Goal directed fluid therapy in surgery for head and neck cancers. Canadian Journal of Anesthesia 2012; 59(1):S143
Picard	2016	No clinically relevant outcomes	Picard J, Bedague D, Bouzat P, Ollinet C, Albaladejo P, Bosson JL, Payen JF: Oesophageal Doppler to optimize intraoperative haemodynamics during prone position. A randomized controlled trial. Anaesthesia Critical Care & Pain Medicine 2016; 35(4):255-60
Carstens	2012	No clinically relevant outcomes	Carstens A, Gerstung S, Renner J, Bein B: Goal directed therapy using PulsioFlex monitoring in general surgery. European Journal of Anaesthesiology 2012; 29(1):45
Sundaram	2016	No clinically relevant outcomes	Sundaram SC, Salins SR, Kumar AN, Korula G: Intra-Operative Fluid Management in Adult Neurosurgical Patients Undergoing Intracranial Tumour Surgery: Randomised Control Trial Comparing Pulse Pressure Variance (PPV) and Central Venous Pressure (CVP). Journal of Clinical and Diagnostic Research 2016; 10(5):UC01-UC05
Wilmin	2009	Duplicate conference presentation of included article	Wilmin S, Dierick A, De Hert S, Van der Linden P: Optimization of oxygen delivery in vascular surgery with Flotrac System, a prospective double blind randomized study. European Journal of Anaesthesiology 2009; 26(1):38
Yassen	2012	Duplicate conference presentation of included article	Yassen K, El Sharkawy O, Ibraheem AE, Refaat E, Mahdy W, Fayed N: Transesophageal doppler

			as a haemodynamic monitor during and after liver resection for cirrhotic patients. An observational study. <i>European Journal of Anaesthesiology</i> 2012; 29(1):36-7
Yu	2015	No clinically relevant outcomes	Yu Y, Dong J, Xu Z, Shen H, Zheng J: Pleth variability index-directed fluid management in abdominal surgery under combined general and epidural anesthesia. <i>Journal of clinical monitoring and computing</i> 2015; 29(1):47-52
Joyce	1990	Wrong intervention	Joyce WP, Provan JL, Ameli FM, McEwan MP, Jelenich S, Jones DP: The role of central haemodynamic monitoring in abdominal aortic surgery. A prospective randomised study. <i>European journal of vascular surgery</i> 1990; 4(6):633-6

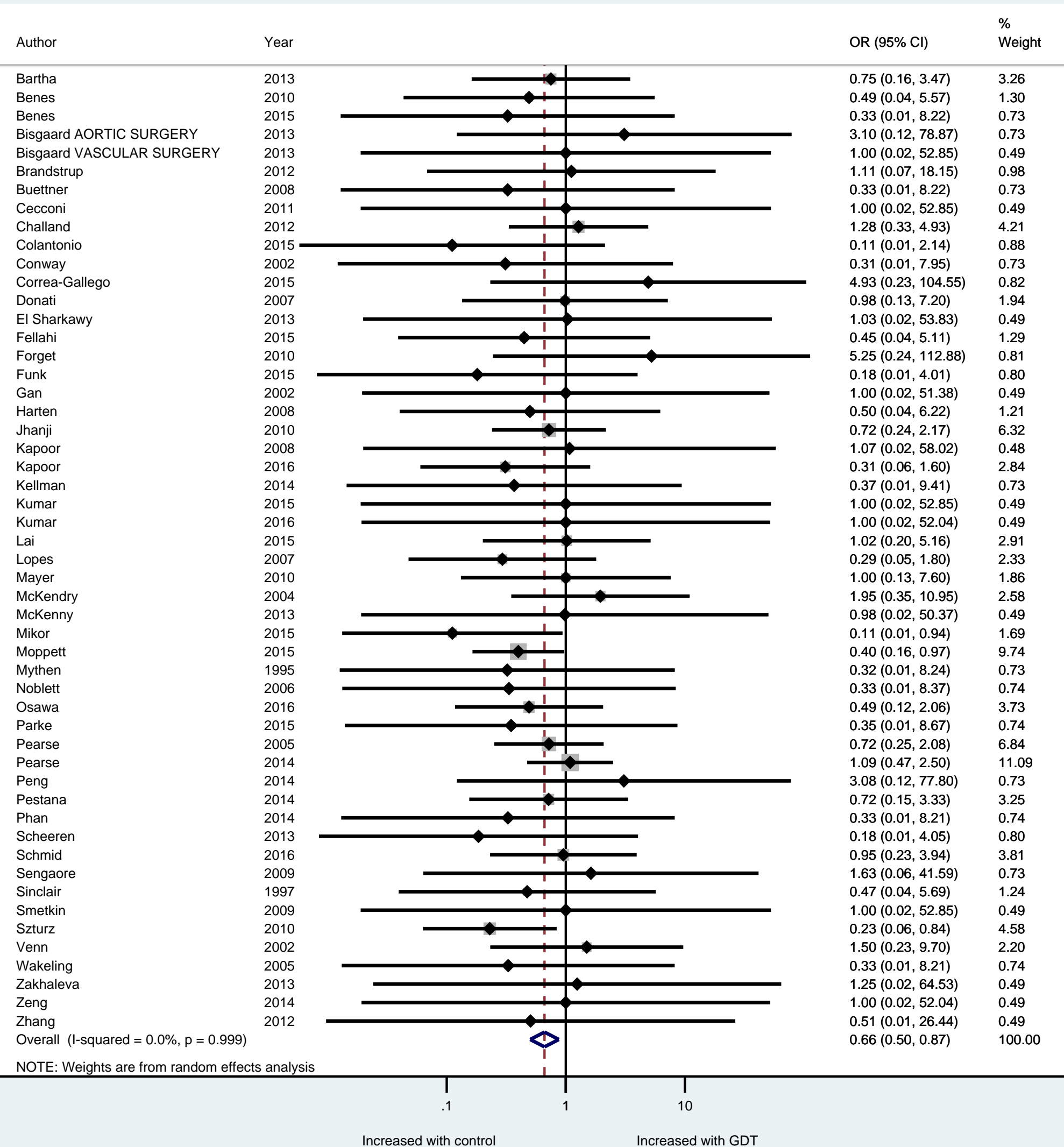
Caption: The table lists the studies that were excluded during full text review, along with the reason for exclusion.

Supplemental Digital Content 3 - Risk of bias assessment

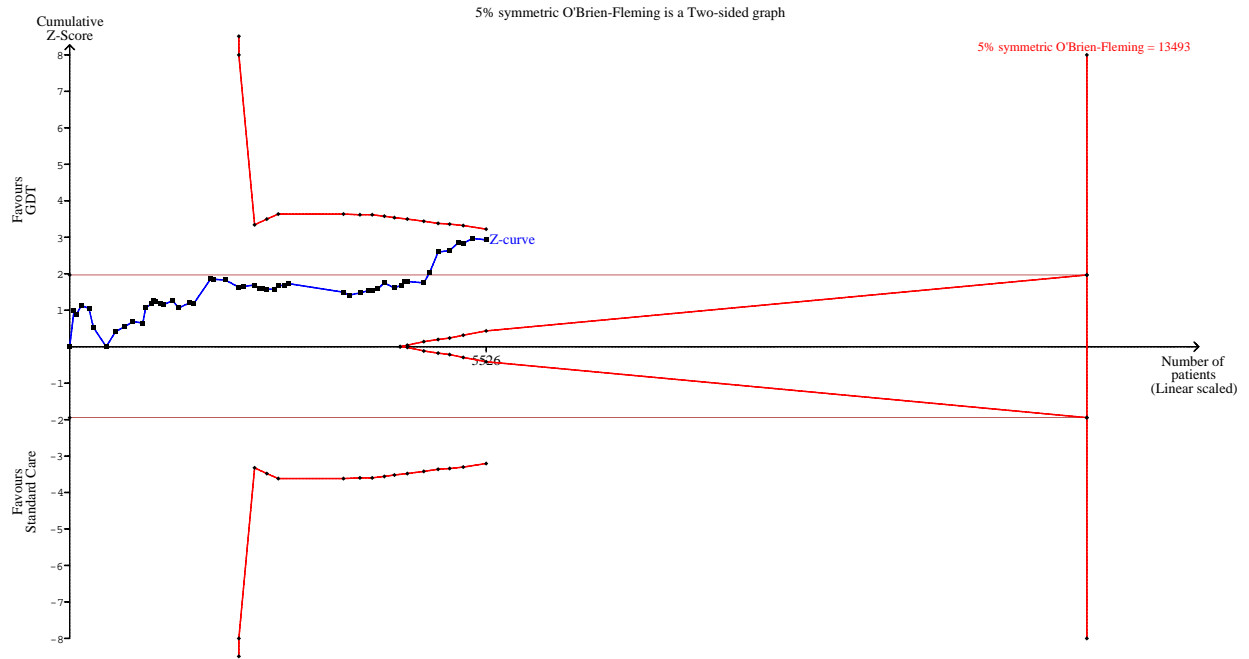
	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective Reporting Bias (reporting bias)	Other Bias
Ackland 2015	+	+	+	+	+	+	-
Bartha 2013	+	+	-	-	+	+	+
Ben Romdhane 2014	?	?	?	?	?	?	?
Bender 1997	?	?	-	?	+	+	+
Benes 2010	+	+	-	+	+	+	-
Benes 2015	+	+	-	+	+	+	-
Berlauk 1991	+	?	-	?	+	+	-
Bisgaard (Aortic surgery) 2013	+	?	-	+	+	+	-
Bisgaard (Vascular surgery) 2013	+	?	-	+	+	-	-
Bonazzi 2002	+	+	-	?	+	+	+
Boyd 1993	?	?	-	?	+	+	+
Brandstrup 2012	+	+	-	?	+	+	-
Broch 2016	?	?	-	?	+	+	-
Buettner 2008	+	?	-	?	+	+	-
Bundgaard-Nielsen 2013	+	+	?	?	+	+	+
Calvo Vecino 2014	?	?	?	?	?	?	?
Cecconi 2011	+	?	-	?	+	-	-
Challand 2012	+	+	+	+	+	+	-
Colantonio 2015	+	+	-	+	+	+	+
Conway 2002	?	?	-	?	+	-	+
Cordero-Rochet 2014	?	?	?	?	?	?	?
Correa-Gallego 2015	?	?	-	?	+	-	+
Donati 2007	+	+	-	?	+	+	+
El Sharkawy 2013	+	?	-	?	?	-	-
Fellahi 2015	+	?	-	+	+	+	+
Forget 2010	?	?	-	+	+	+	-
Funk 2015	+	?	-	+	+	+	+
Gan 2002	+	?	-	+	+	?	-
Gerent 2015	?	?	?	?	?	?	?
Goepfert 2013	+	?	-	+	+	+	-
Han 2016	?	?	-	?	+	?	+
Hand 2015	+	?	-	?	+	?	-
Harten 2008	+	+	-	?	+	+	-

Hughes 2013	?	?	?	?	?	?	?
Jammer 2015	?	?	?	+	+	+	-
Jerez Gomez-Coronado 2001	?	?	?	?	+	+	?
Jhanji 2010	+	+	-	+	+	+	-
Kapoor 2016	+	?	-	?	+	?	+
Kapoor 2008	+	?	-	?	+	+	+
Kellman 2014	?	?	?	?	?	?	?
Khambalia 2015	?	?	?	?	?	?	?
Kulkarni 2012	?	?	?	?	?	?	?
Kumar 2015	+	?	-	?	+	+	+
Kumar 2016	?	?	-	?	+	+	+
Lai 2015	+	+	+	+	+	+	+
Lopes 2007	+	?	-	+	+	+	-
Martini 2009	?	?	?	?	?	?	?
Mayer 2010	+	?	-	+	+	+	-
McKendry 2004	+	+	-	?	+	+	-
McKenny 2010	+	+	-	+	+	+	+
Mikor 2015	+	?	-	?	+	+	-
Moppett 2015	+	+	-	+	+	+	+
Munoz 2012	?	?	?	?	?	?	?
Mythen 1995	+	?	-	-	+	?	+
Noblett 2006	?	?	?	?	+	+	+
Osawa 2016	+	+	-	+	+	+	-
Oubaha 2009	?	?	?	?	?	?	?
Park 2016	?	?	?	?	?	?	?
Parke 2015	+	+	-	-	+	+	?
Pearse 2005	+	+	+	+	+	+	-
Pearse 2014	+	+	?	+	+	+	-
Peng 2014	+	?	?	?	+	+	+
Pestana 2014	+	+	-	?	-	+	?
Phan 2014	+	+	?	+	+	+	+
Pillai 2011	?	?	+	?	+	+	+
Polonen 2000	+	?	-	-	+	+	+
Ramsingh 2013	+	?	-	?	+	-	-
Salzwedel 2013	+	+	-	-	+	+	-
Sandham 2003	+	+	-	+	+	+	+
Scheeren 2013	+	?	-	+	+	-	-
Schmid 2016	+	?	-	?	+	+	+
Schultz 1985	?	?	?	?	+	?	+
Senagore 2009	+	?	?	?	+	+	-
Shoemaker 1988	+	+	-	-	?	+	+

Sinclair 1997	+	?	-	?	+	+	+
Smetkin 2009	?	?	-	?	+	+	+
Srinivasa 2014	+	?	-	+	+	+	+
Szturz 2010	?	?	?	?	?	?	?
Tolstova 2010	?	?	?	?	?	?	?
Valentine 1998	+	?	-	-	+	+	+
Van Dellen 2013	+	?	?	?	?	?	?
Van Der Linden 2010	+	?	-	?	+	+	+
Vanakas 2012	?	?	?	?	?	?	?
Venn 2002	+	+	-	?	+	+	+
Wakeling 2005	+	+	-	?	+	+	-
Wilson 1999	+	+	-	?	+	+	-
Yassen 2012	+	?	-	?	+	+	+
Zakhaleva 2013	+	?	-	-	-	+	-
Zeng 2014	?	?	-	+	+	+	+
Zhang (Abdominal surgery) 2012	+	?	-	?	+	+	+
Zhang 2013	+	?	-	?	+	+	+
Zhang (Neurosurgery) 2012	?	?	?	?	?	?	?
Zheng 2013	+	?	-	+	+	+	+
Zheng 2016	+	?	?	?	+	+	?
Ziegler 1997	?	?	-	?	+	+	+



Supplemental Digital Content 5 - Trial sequential analysis



Supplemental Digital Content 6

