http://dx.doi.org/10.2106/JBJS.N.00315

MEDLINE Search Strategy

1. cell$ sav$.mp.
2. cell$ salvage.mp.
3. blood transfusion, autologous/
4. autotransfusion$.mp.
5. auto-transfusion$.mp.
6. blood salvage.mp.
7. autovac.mp.
8. solcotrans system.mp.
9. constavac.mp.
10. solcotrans.mp.
11. hemovac.mp.
12. BRAT.mp.
13. fresenius.mp.
14. consta vac.mp.
15. cell saver.mp.
16. dideco.mp.
17. electromedic.mp.
18. electromedics.mp.
19. gish biomedical.mp.
20. haemonetics.mp.
21. orth-evac.mp.
22. pleur-evac.mp.
23. sorenson.mp.
24. reinfusion system.mp.
25. sorin biomedical.mp.
26. or/1-25
27. exp blood transfusion/
28. exp hemorrhage/
29. exp anesthesia/
30. transfusion$.mp.
31. bleed$.mp.
32. blood loss$.mp.
33. hemorrhag$.mp.
34. haemorrhag$.mp.
35. or/27-34
36. 26 and 35
37. randomized controlled trial.pt.
38. controlled clinical trial.pt.
39. randomized controlled trials.sh.
40. random allocation.sh.
41. double blind method.sh.
42. single blind method.sh.
43. or/37-42
44. clinical trial.pt.
45. exp Clinical trials/
46. (clin$ adj25 trial$).ti,ab.
47. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
48. placebos.sh.
49. placebo$.ti,ab.
50. random$.ti,ab.
51. research design.sh.
52. or/44-51

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53. comparative study.sh.
54. exp Evaluation studies/
55. follow up studies.sh.
56. prospective studies.sh.
57. (control$ or prospectiv$ or volunteer$).ti,ab.
58. or/53-57
59. 43 or 52 or 58
60. 36 and 59
61. animal/ not human/
62. 60 not 6

http://dx.doi.org/10.2106/JBJS.N.00315

TABLE E-1 Characteristics and Risk-of Bias Assessment of Included Studies*

		Summary of Study Characteristics									Assessed Risk of Bias		
				Interventions		Transfusion Trigger			Treatment Policy in Control Group§	Tourniquet Control			
First Author	Year	Participants	Site†	Description	Timing‡	Yes/No	Hb Transfusion Threshold *(g/dL)*	Hb Subgroup *(g/dL)*			Random Sequence Generation	Allocation Concealment	Blinding
Abuzakuk[22]	2007	Patients undergoing primary cemented TKA	Knee	Intervention: autotransfusion (Bellovac ABT; Astra Tech autotransfusion system), n = 52. Control: standard suction drain, n = 52	Postop.	Yes	<9.0	>8.0	Suction	Yes	Low	Unclear	High
Adalberth[23]	1998	Patients undergoing primary TKA	Knee	Intervention: autotransfusion (Solcotrans; Solco Basle), n = 24. Control: no drain, n = 24	Postop.	Yes	<9.0	>8.0	No drain	Yes	High	High	High
Altinel[24]	2007	Patients undergoing bicompartmental or tricompartmental TKA	Knee	Intervention: autotransfusion (ConstaVac CBCII system; Stryker), n = 16. Control: standard care (2 drains for shed blood drainage), n = 16	Postop.	Yes	<9.0	>8.0	Suction	Yes	Unclear	Unclear	High
Amin[25]	2008	Patients undergoing TKA	Knee	Intervention: autotransfusion (Bellovac ABT autotransfusion system), n = 92. Control: standard vacuum drain, n = 86	Postop.	Yes	<8.0	≤8.0	Suction	Yes	High	High	High
Atay[40]	2010	Patients undergoing THA or TKA	Hip and knee	Intervention: autotransfusion (Transolog; Heim Medizintechnik), n = 17 (hip) and n = 20 (knee). Control: routine Hemovac drain, n = 19 (hip) and n = 21 (knee)	Postop.	Yes	<8.0, or Hct < 25% (i.e., Hb < 8.5 g/dL) and clinical symptoms of anemia	≤8.0	Suction	Yes	Unclear	Unclear	High
Ayers[12]	1995	Patients undergoing primary THA	Hip	Intervention: autotransfusion (Autovac postop. orthopaedic autotransfusion canister; Boehringer), n = 67. Control: closed suction drainage system, n = 89	Postop.	No		None	Suction	NA	High	High	High
Blatsoukas[26]	2010	Patients undergoing unilateral TKA	Knee	Intervention: 1. autotransfusion (Dideco Compact Advanced and ConstaVac CBCII), n = 92; 2. autotransfusion (ConstaVac CBCII), n = 71. Control: no drain, n = 85	Periop. or Postop.	Yes	9-10 (1 unit), 8-9 (2 units), or 7-8 (3 units)	>8.0	No drain	No	High	High	High
Cheng[27]	2005	Patients undergoing unilateral TKA	Knee	Intervention: autotransfusion (DONOR system; Van Straten Medical), n = 26. Control: no drain, n = 34	Postop.	Yes	<9.0	>8.0	No drain	No	Unclear	High	High

continued

TABLE E-1 (*continued*)

		Summary of Study Characteristics											
						Transfusion Trigger					Assessed Risk of Bias		
				Interventions					Treatment Policy in Control Group§				
First Author	Year	Participants	Site†	Description	Timing‡	Yes/No	Hb Transfusion Threshold *(g/dL)*	Hb Subgroup *(g/dL)*		Tourniquet Control	Random Sequence Generation	Allocation Concealment	Blinding
Cheung[4]	2010	Patients undergoing primary THA	Hip	Intervention: autotransfusion (Bellovac ABT autotransfusion system), n = 53. Control: no drain, n = 48	Postop.	No		None	No drain	NA	Low	Unclear	High
Cip[5]	2012	Patients undergoing TKA	Knee	Intervention: autotransfusion (OrthoPAT; Haemonetics), n = 70. Control: no autotransfusion system, n = 70	Periop.	Yes	<8.0, or signs of anemia or tachycardia	>8.0	Suction	No	Low	Low	High
Dramis[28]	2006	Patients undergoing primary unilateral TKA	Knee	Intervention: autotransfusion (CellTrans system; Summit Medical), n = 32. Control: standard vacuum drain, n = 17	Postop.	Yes	<9.0, or clinical symptoms of anemia	>8.0	Suction	Yes	Unclear	Unclear	High
Dutton[29]	2012	Patients undergoing TKA	Knee	Intervention: autotransfusion (Bellovac ABT autotransfusion system), n = 23. Control: no drain, n = 25)	Postop.	No		None	No drain	Yes	Low	Low	Unclear
Ekbäck[13]	1995	Patients undergoing THA	Hip	Intervention: Autotransfusion (Haemonetics Cell Saver 4, Althin model AT 1000, or Shiley STAT), n = 15. Control: no autotransfusion, n = 15	Periop.	Yes	EVF < 27% (i.e., Hb < 9.2 g/dL)	>8.0	Suction	NA	Unclear	Unclear	High
Elawad[14]	1991	Patients undergoing primary THA	Hip	Intervention: autotransfusion (Electromedics Autotrans AT-100) autotransfusion system), n = 20. Control: no drain, n = 20	Intraop.	Yes	<8.5	>8.0	No drain	NA	Unclear	High	High
Gannon[45]	1991	Patients undergoing THA or TKA	Not able to split	Intervention: autotransfusion (Solcotrans), n = 124. Control: standard suction canister, n = 115	Postop.	Yes	<9.0, or by internist on basis of patient's medical condition	>8.0	Suction	Yes	Low	Unclear	High
Healy[46]	1994	Patients undergoing THA, TKA, or spinal fusion	Not able to split	Intervention: autotransfusion (Deknatel Ortho-Evac system or Solcotrans), n = 75. Control: standard wound drainage system, n = 43	Postop.	No		None	Suction	Unknown	Unclear	Unclear	High
Heddle[30]	1992	Patients undergoing elective TKA	Knee	Intervention: autotransfusion (Solcotrans), n = 39. Control: standard care (drained blood collected by a DAVOL [Bard] suction unit and discarded), n = 40	Postop.	Yes	8.0-8.9 (1 unit), 7.0-7.9 (2 units), 6.0-6.9 (3 units), or 5.0-5.9 (4 units)	≤8.0	Suction	Yes	Unclear	Unclear	High

continued

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TABLE E-1 (*continued*)

		Summary of Study Characteristics									Assessed Risk of Bias		
				Interventions		Transfusion Trigger			Treatment Policy in Control Group§	Tourniquet Control			
First Author	Year	Participants	Site†	Description	Timing‡	Yes/No	Hb Transfusion Threshold *(g/dL)*	Hb Subgroup *(g/dL)*			Random Sequence Generation	Allocation Concealment	Blinding
Horstmann[15]	2012	Patients undergoing THA	Hip	Intervention: autotransfusion (Bellovac ABT autotransfusion system), n = 50. Control: no drainage, n = 50	Postop.	Yes	<6.4, <8.0, or <9.6, dependent on ASA classification	≤8.0	No drain	NA	Unclear	Low	Low
Kirkos[31]	2006	Patients undergoing TKA	Knee	Intervention: autotransfusion, n = 78. Control: standard vacuum drain, n = 77	Postop.	Yes	<10.0	>8.0	Suction	Yes	High	Unclear	High
Koopman-van Gemert[47]	1993	Patients undergoing THA or dorsal lumbosacral spinal fusion	Not able to split	Intervention: autotransfusion (Haemonetics HaemoLite 2 system), n = 29. Control: no autotransfusion, n = 30	Periop.	Yes	Hct < 30% (i.e., Hb < 10.2 g/dL)	>8.0	Suction	NA	Unclear	High	High
Lorentz[16]	1991	Patients undergoing THA	Hip	Intervention: Autotransfusion, n = 16. Control: standard care, n = 15	Periop.	Yes	<9.0 (operating room, ICU) or <10.0 (general ward)	>8.0	Unknown	NA	Unclear	Unclear	High
Mah[32]	1995	Patients undergoing elective primary TKA	Knee	Intervention: autotransfusion (Electromedics BT-795), n = 44. Control: standard care, n = 55	Postop.	Yes	<10.0	>8.0	Active	Yes	Low	Unclear	High
Majkowski[33]	1991	Patients undergoing primary unilateral TKA	Knee	Intervention: autotransfusion (Solcotrans), n = 20. Control: 3 standard standard suction drains	Postop.	Yes	<9.5, or if indicated hemodynamically	>8.0	Suction	Yes	Unclear	Unclear	High
Mauerhan[48]	1993	Patients undergoing elective primary THA or TKA	Not able to split	Intervention: autotransfusion (CBC ConstaVac), n = 57. Control: standard postop. collection system, n = 54	Postop.	No		None	Suction	Yes	Low	Unclear	High
Menges[17]	1992	Patients undergoing THA and preoperative plasmapheresis	Hip	Intervention: autotransfusion (Autotrans BT-795 P, Dideco system), n = 14. Control: no autotransfusion, n = 12. (Both groups also received crystalloids and colloids)	Postop.	Yes	<9.0, or Hct < 28% (i.e., Hb < 9.5 g/dL)	>8.0	Active	NA	Unclear	Unclear	High
Moonen[41]	2007	Patients undergoing primary TKA or THA	Hip and knee	Intervention: autotransfusion (Bellovac ABT autotransfusion system), n = 35 (hip) and n = 45 (knee). Control: regular postop. low-vacuum drainage, n = 48 (hip) and n = 32 (knee)	Postop.	Yes	<8.1, <8.9, or <9.7, dependent on ASA classification	≤8.0	Suction	Yes	Low	High	High

continued

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TABLE E-1 (*continued*)

		Summary of Study Characteristics											
				Interventions		Transfusion Trigger			Treatment Policy in Control Group§		Assessed Risk of Bias		
First Author	Year	Participants	Site†	Description	Timing‡	Yes/No	Hb Transfusion Threshold *(g/dL)*	Hb Subgroup *(g/dL)*		Tourniquet Control	Random Sequence Generation	Allocation Concealment	Blinding
Newman[34]	1997	Patients undergoing unilateral TKA	Knee	Intervention: autotransfusion (Dideco 797 transfusion system), n = 35. Control: standard Hemovac suction drain (Zimmer), n = 35	Postop.	No		None	Suction	Yes	Low	Unclear	High
Riou[49]	1994	Patients undergoing elective, non-emergency spinal surgery	Other orthopaedic	Intervention: autotransfusion (Solcotrans), n = 25. Control: postop. drained blood collected into Solcotrans Orthopedic Plus system but salvaged blood was not considered for reinfusion, n = 25	Postop.	Yes	Hct < 25% (i.e., Hb < 8.5 g/dL)	>8.0	Suction	NA	Low	Unclear	Low
Ritter[42]	1994	Patients undergoing primary THA or TKA	Hip and knee	Intervention: autotransfusion (Solcotrans), n = 78 (hip) and n = 137 (knee). Control: no drainage system, n = 62 (hip) and n = 138 (knee)	Postop.	Yes	<9.0	>8.0	No drain	Yes	Unclear	Unclear	High
Rollo[18]	1995	Patient undergoing primary THA	Hip	Intervention: 1. autotransfusion (Haemonetics), n = 35; 2. autotransfusion (Solcotrans), n = 40. Control: no drain, n = 38	Periop. or Postop.	No	Based on clinical condition of patient; absolute Hb or Hct values were not considered in isolation	None	Active	NA	Unclear	High	High
Rosencher[35]	1994	Patients undergoing TKA	Knee	Intervention: autotransfusion (Ortho-Evac system or Solcotrans), n = 20. Control: no drain, n = 10	Postop.	Yes	Hct < 30% (i.e., Hb <10.2 g/dL)	>8.0	No drain	Yes	Unclear	Unclear	High
Sait[36]	1999	Patients undergoing TKA	Knee	Intervention: autotransfusion, n = 60. Control: standard care without autotransfusion, n = 60	Postop.	No		None	Suction	Yes	Unclear	Unclear	High
Shenolikar[37]	1997	Patients undergoing TKA	Knee	Intervention: autotransfusion (Haemonetics Cell Saver 3), n = 50. Control: no drain, n = 50	Postop.	Yes	<9.0	>8.0	No drain	Yes	Low	Unclear	High
Simpson[50]	1994	Patients undergoing elective primary THA or TKA	Not able to split	Intervention: autotransfusion (Solcotrans), n = 12. Control: closed suction drain, n = 12	Postop.	Yes	<10, or Hct < 30% (i.e., Hb < 10.2 g/dL)	>8.0	Suction	Unknown	Unclear	Unclear	High

continued

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TABLE E-1 (*continued*)

		Summary of Study Characteristics											
						Transfusion Trigger					Assessed Risk of Bias		
				Interventions									
First Author	Year	Participants	Site†	Description	Timing‡	Yes/No	Hb Transfusion Threshold *(g/dL)*	Hb Subgroup *(g/dL)*	Treatment Policy in Control Group§	Tourniquet Control	Random Sequence Generation	Allocation Concealment	Blinding
Slagis[44]	1991	Patients undergoing THA or TKA	Hip and knee	Intervention: autotransfusion (Haemolite Cell Saver), n = 24 (hip) and n = 27 (knee). Control: Hemovac standard drainage system, n = 26 (hip) and n = 25 (knee)	Postop.	No		None	Active	No	Unclear	Unclear	High
Smith[19]	2007	Patients undergoing THA	Hip	Intervention: autotransfusion (ABTrans autologous re-transfusion system; Surgical Innovations), n = 76. Control: 2 standard Medinorm vacuum drains, n = 82	Postop.	Yes	<8.0, or 2 units if 8.0-10.0 and patient symptomatic	≤8.0	Suction	NA	Low	High	High
So-Osman[43]	2006	Patients undergoing primary or revision THA or TKA	Hip and knee	Intervention: autotransfusion (DONOR [Van Straten] or Bellovac ABT autotransfusion system), n = 35 (hip) and n = 12 (knee). Control: standard closed suction wound drainage, n = 11 (hip) and n = 11 (knee)	Postop.	No		None	Suction	Yes	Low	High	High
So-Osman[6]	2014	Patients undergoing primary or revision THA or TKA	Hip and knee	Intervention: 1. autotransfusion (OrthoPAT), n = 412 (hip); 2. autotransfusion (DONOR or Bellovac ABT autotransfusion system), n = 419 (hip) and n = 436 (knee). Control: low-vacuum wound drain, n = 419 (hip) and n = 417 (knee)	Periop. or Postop.	Yes	<6.4 for age < 60 yr and normal risk, <8.1 for age ≥ 60 yr and normal risk, and <9.6 g/dL for high risk	≤8.0	Suction	Yes	Low	Low	High
Thomas[38]	2001	Patients undergoing TKA	Knee	Intervention: autotransfusion (Haemonetics Cell Saver 5), n = 115. Control: all drained blood was discarded, n = 116	Postop.	Yes	<9.0	>8.0	Suction	Yes	Unclear	Unclear	High
Thomassen[20]	2012	Patients undergoing primary or revision THA	Hip	Intervention: autotransfusion (Sangvia Blood Management System; Astra Tech), n = 106. Control: regular postop. low-vacuum drain, n = 110	Periop.	Yes	<8.5, or clinical symptoms of anemia	>8.0	Suction	NA	Low	Low	Low

continued

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TABLE E-1 (*continued*)

		Summary of Study Characteristics											
						Transfusion Trigger					Assessed Risk of Bias		
				Interventions									
First Author	Year	Participants	Site†	Description	Timing‡	Yes/ No	Hb Transfusion Threshold *(g/dL)*	Hb Subgroup *(g/dL)*	Treatment Policy in Control Group§	Tourniquet Control	Random Sequence Generation	Allocation Concealment	Blinding
Tripković[21]	2008	Patient undergoing primary THA	Hip	Intervention: autotransfusion (BIODREN system; B.E.R. C.O.), n= 30. Control: no autotransfusion, n = 30	Postop.	Yes	<10, or Hct < 30% (i.e., Hb < 10.2 g/dL)	>8.0	Active	NA	Unclear	Unclear	High
Zacharapoulos[39]	2007	Patients undergoing unilateral TKA	Knee	Intervention: autotransfusion (Gish Orthofuser system), n = 30. Control: standard wound suction drainage system, n = 30	Postop.	Yes	<9.0	>8.0	Suction	Yes	Unclear	Unclear	High
Zhang[51]	2008	Patients undergoing orthopaedic procedures	Not able to split	Intervention: autotransfusion (Haemonetics Cell Saver 5 system), n = 20. Control: standard care, n = 20	Intraop.	No		None	Suction	NA	Unclear	Unclear	High

*Hct = hematocrit, NA = not applicable, ICU = intensive care unit, EVF = erythrocyte volume fraction, and ASA = American Society of Anesthesiologists. †Hip, knee, hip and knee, or not able to split. ‡Periop. = both intraoperative and postoperative. §Suction = standard suction or vacuum drain in control group, and active = active treatment in control group compared with cell salvage plus active treatment in experimental group.