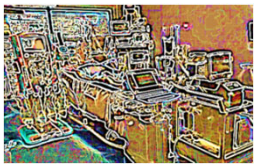
RÉCUPÉRATION SANGUINE PEROPÉRATOIRE

Spécificités en chirurgie cardio-vasculaire

Prof. Alexandre OUATTARA M.D Ph.D
Service d'anesthésie-réanimation cardiovasculaire,
INSERM, UMR 1034 Biologie des maladies cardiovasculaires
CHU Bordeaux



université de BORDEAUX — Inserm — CHU BDX ANESTHÉSIE-RÉANIMATION CARDIOVASCULAIRE

Halvorsen S et al. Blood Transfus 2024; 22:122-9

Extract from the 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery - Patient Blood Management

Recommendations	Class[a]	Level[b]
In patients undergoing surgery with expected blood loss of ≥500 mL, use of washed cell salvage is recommended.	I	A
It is recommended to use point-of-care diagnostics for guidance of blood component therapy, when available.	I	A

Mertes PM et al. Anaesth Crit Care Pain Med 2022;41:101059

Guidelines

Guidelines on enhanced recovery after cardiac surgery under cardiopulmonary bypass or off-pump[☆,☆☆]

R5.2 — It is probably recommended to use an intraoperative cell saver to limit red blood cell transfusion in cardiac surgery. GRADE 2+ (STRONG AGREEMENT)

PRINCIPES (TRAITEMENT SÉQUENTIEL)

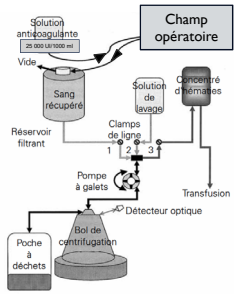
Système aspiratif (vide autonome ou mural) – 150-200 mmHg permettant d'aspirer sang épanché (cristalloïdes) dans collecteur rigide ouvert (2500-3600 ml) avec filtration (40-200 µm)

Dilution continue du sang recueilli par cristalloïdes à une débit de 100 à 150 ml/min (cristalloïdes héparinés)

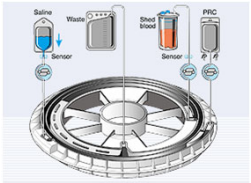
Concentration par centrifugation (2500-5600 trm) des éléments figurés dans bol (70-225 ml)

Lavage 500-800 ml/min (cristalloïdes 1000 ml)

Restitution d'un concentré érythrocytes (Hte 50-60%)
Transfusion au travers filtre anti-leucocytaire 200 µm



PRINCIPES (TRAITEMENT CONTINU)



Concentration et
lavage continu (≥ 50 ml et restitution à partir de 175 ml)

Autolog Medtronic

Xtra Sorin

Haemonetics Elite

C.A.T.S Fresenius

Munoz M et al. Blood Transfus 2011;9:248-61

PERFORMANCES COMPARÉE DES SYSTÈMES

Parameter	Sequestra* (Medtronic)	BRAT 2* (Cobe)	CATS* (Fresenius)	Cell Saver* (Haemonetics)	AUTOLOG* (Medtronic)	OrthoPAT* (Haemonetics)	Colloid ** sedimentation
RBC recovery; %	65 - 76	71 - 93	51 - 87	64 - 94	79	80	90
WBC removal; %	31 - 78	30	45 - 80	22 - 55	78	72	60
PLT removal; %	87 - 93	68	92 - 96	86 - 87	99	88	48
PFHB removal; %	89	63	65 - 95	85 - 93	92	96	53
TP or ALB removal; %	97 - 98	91 - 93	93 - 99	NA	NA	97	76
K^+ removal; %	92	90	90 - 98	91	89	97	NA
Cytokine removal; %	95	95	95	91 - 95	NA	90	70 - 77

Values are minimum – maximum interval. CATS: continuous autotra nsfusion system; RBC: red blood cells; WBC: leucocytes; PLT: platelets; PFHB: plasma free haemoglobin; TP: total protein; ALB: albumin. NA: not assessed. References: * (68-77), ** (51).

Munoz M et al. Blood Transfus 2011;9:248-61

PERFORMANCES COMPARÉE DES SYSTÈMES

Parameter | Sequestra* (Medtronic) | BRAT 2* (Cobe) | CATS* (Fresenius) | Cell Saver* (Haemonetics) | AUTOLOG* (Medtronic) | OrthoPAT* (Haemonetics) | Colloid ** sedimentation
RBC recovery; % | 65 - 76 | 71 - 93 | 51 - 87 | 64 - 94 | 79 | 80 | 90
WBC removal; % | 31 - 78 | 30 | 45 - 80 | 22 - 55 | 78 | 72 | 60
PLT removal; % | 87 - 93 | 68 | 92 - 96 | 86 - 87 | 99 | 88 | 48
PFHB removal; % | 89 | 63 | 65 - 95 | 85 - 93 | 92 | 96 | 53
TP or ALB removal; % | 97 - 98 | 91 - 93 | 93 - 99 | NA | NA | 97 | 76
K+ removal; % | 92 | 90 | 90 - 98 | 91 | 89 | 97 | NA
Cytokine removal; % | 95 | 95 | 95 | 91 - 95 | NA | 90 | 70 - 77

Values are minimum – maximum interval. CATS: continuous autotra nsfusion system; RBC: red blood cells; WBC: leucocytes; PLT: platelets; PFHB: plasma free haemoglobin; TP: total protein; ALB: albumin. NA: not assessed. References: * (68-77), ** (51).

Waters JH et al. Anesth Analg 2007; 104:684-7

HÉMOLYSE INDUITE….

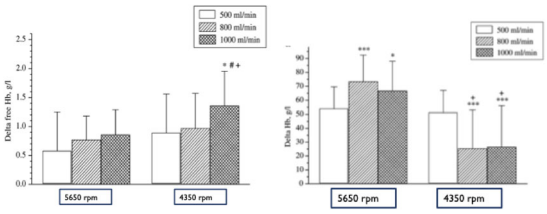
Tests	Increase in plasma-free hemoglobin from baseline (mg/dL)	Relative hemolysis (%)
Surgical surface at 100 mm Hg† (n = 10)	135.5 ± 35.9	1.02 ± 0.27
Surgical surface at 300 mm Hg* (n = 10)	304.3 ± 60.6	2.29 ± 0.46
Surgical surface at 300 mm Hg + dilution (n = 10)	119.3 ± 15.0	0.90 ± 0.11
Beaker at 100 mm Hg (n = 10)	36.0 ± 12.8	0.27 ± 0.10
Beaker at 300 mm Hg (n = 10)	63.9 ± 15.2	0.48 ± 0.11
Beaker at 300 mm Hg + dilution (n = 10)	27.7 ± 8.6	0.21 ± 0.06

Data presented as Mean ± SEM.

- Eviter aspiration -150 à -200 mmHg
- Limiter aspiration simultanée d'air
- Maintenir dilution > 100 ml/h (1 goutte/2 sec minimal)

Konstantin S et al. Interactive Cardiovasc Thorac Surg 2008; 7:759-63

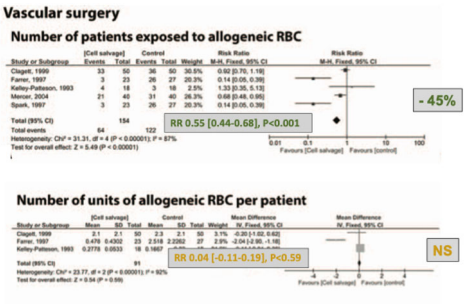
Vitesse de centrifugation et débit de lavage



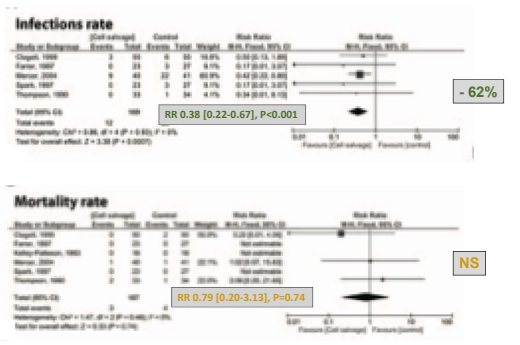
Meybohm P et al. Medicine 2016;95:31(e4490)

Washed cell salvage in surgical patients

A review and meta-analysis of prospective randomized trials under PRISMA



Meybohm P et al. Medicine 2016;95:31(e4490)



Al Khabori et al.Vox Sanguinis 2019;114:553-65

REVIEW ARTICLE

Impact of cell saver during cardiac surgery on blood transfusion requirements: a systematic review and meta-analysis

Méta-analyse sur études randomisées (>2010)

Chirurgie cardiaque (PAC isolé et chirurgie valvulaire)

Exclusion chirurgie aorte ascendante et redo (faible risque hémorragique)

Recours périopératoires aux produits sanguins labiles (pas de notion d'unités ni volume)

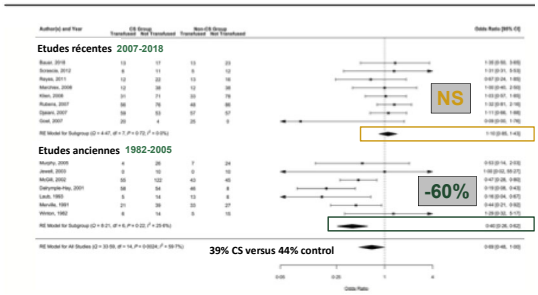
15 études dans l'analyse finale (n=1727)

Traitement **sang épanché + volume résiduel CEC** (6 études).

Volume retransfusé **105-715 ml**

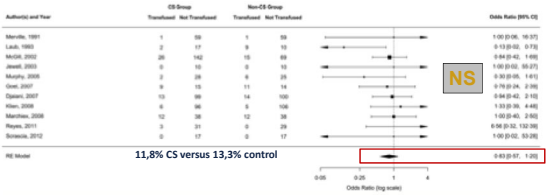
Al Khabori et al.Vox Sanguinis 2019;114:553-65

Transfusion périopératoire de concentré globules rouges



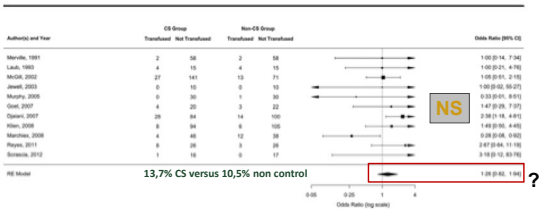
Al Khabori et al.Vox Sanguinis 2019;114:553-65

Transfusion périopératoire plaquettes (11 études)



Al Khabori et al.Vox Sanguinis 2019;114:553-65

Transfusion périopératoire plasma frais congelé (11 études)



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Boer C et al. J Cardiothorac Vasc Anesth 2018;32:88-120

2017 EACTS/EACTA Guidelines on patient blood management for adult cardiac surgery

The Task Force on Patient Blood Management for Adult Cardiac Surgery of the European Association for Cardio-Thoracic Surgery (EACTS) and the European Association of Cardiothoracic Anaesthesiology (EACTA)

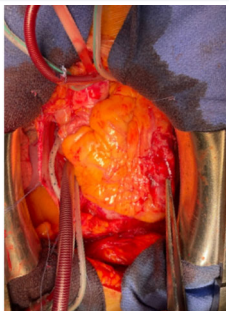
Background. Cell salvage of operative blood loss and residual blood from the circuit after CPB may contribute to a reduction in the use of allogeneic blood products, especially PRBCs. A specific rationale for cell salvage is its use during CPB instead of cardiotomy suction, since the retransfusion of whole blood using cardiotomy suction through the ECC may contribute to systemic inflammation and bleeding.

VOLUME À RÉCUPERER CONSÉQUENT

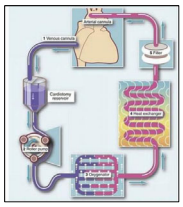
- Sang épanché du site chirurgical (médiastin, plèvre, rétropéritoine…)
- Volume résiduel de la CEC (500-600 ml)
- Volume du saignement postopératoire (?)

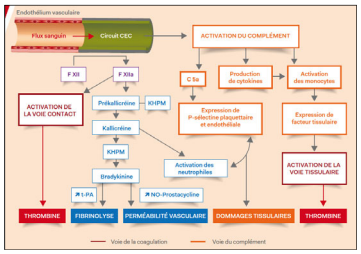
SOUPE INFLAMMATOIRE PÉRICARDIQUE

- Interface air/sang
- Activation coagulation (surexpression FT)
- Activité fibrinolytique excessive (t-PA)
- Produits de dégradation de la fibrine
- Hémolyse (hémoglobine libre)
- Microparticules graisseuses (dissection sous-cutanée, sternotomie, péricardotomie, prélèvement mammaire….)
- Débris osseux
- Héparine
- Cytokines pro et anti-inflammatoires
- Protéines…



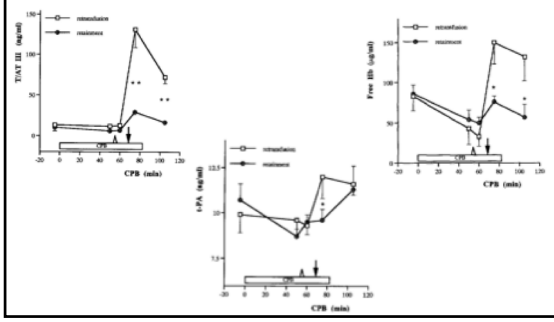
CIRCULATION EXTRA-CORPORELLE





de Haan J et al. Ann Thorac Surg 1995;59:901-7

SEQUESTRATION DES ASPIRATIONS MÉDIASTINALES?



Gäbel J et al. Eur J Cardiothorac surg 2013;44:506-11

Table 2: Cytokines in cardiotomy suction blood and in the systemic circulation at the same time point ($n = 25$)

	Cardiotomy suction blood	Systemic circulation	P-value
IL-1Ra (pg/ml)	312 (88–1534)	82 (32–309)	<0.001
IL-4 (pg/ml)	<2 (<2–7.2)	<2 (<2)	0.43
IL-10 (pg/ml)	19.7 (<2–113)	31 (<2–122)	0.21
IL-6 (pg/ml)	210 (13–2678)	45 (3–1119)	<0.001
TNF-α (pg/ml)	4.3 (<2–40)	2.5 (<2–62)	0.033
IL-6-to-IL-10 ratio	10.2 (1.1–75)	1.7 (0.2–24)	<0.001

Gäbel J et al. Eur J Cardiothorac Surg 2013;44:506-11

Table 3: Cytokines in cardiotomy suction blood before and after cell-saver processing ($n = 13$)

	Before cell salvage	After cell salvage	P-value
IL-1Ra (pg/ml)	260 (88–526)	73 (28–359)	0.002
IL-4 (pg/ml)	<2 (<2)	<2 (<2–3.0)	0.18
IL-10 (pg/ml)	17 (8.4–62)	7 (<2–27)	0.011
IL-6 (pg/ml)	140 (13–2678)	57 (<1–760)	0.10
TNF-α (pg/ml)	4.3 (<2–39)	<2 (<2–15)	0.008

The values represent the median and range.
IL: interleukin; TNF: tumour necrosis factor.

Ann Thorac Surg 2010;89:1511-7

Cell Saver for On-pump Coronary Operations Reduces Systemic Inflammatory Markers: A Randomized Trial

Sune Damgaard, MD, PhD, Claus H. Nielsen, MD, PhD, Lars W. Andersen, MD, DMSc, Klaus Bendtzen, MD, DMSc, Michael Tvede, MD, and Daniel A. Steinbrüchel, MD, DMSc
Departments of Cardiothoracic Surgery, Anesthesiology, Clinical Microbiology and the Institute for Inflammation Research, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark

Table 2. Concentrations of Inflammatory Markers

Marker	Group	Induction	Cross-clamp: Before	Cross-clamp: After	After Cardiopulmonary Bypass: 5 Minutes	6 Hours[a]	24 Hours	72 Hours	Interactive
Median (IQR) pg/mL									
IL-6	Cell saver	0 (0–5)	0 (0–6)	13 (4–31)	38 (13–67)	112 (66–168)	89 (45–153)	38 (17–84)	0.021
	Control	0 (0–0)	3 (0–8)	17 (7–59)	51 (29–116)	228 (142–331)	90 (44–190)	44 (29–64)	
IL-8	Cell saver	6 (5–8)	8 (4–11)	15 (7–34)	17 (10–40)	25 (17–38)	17 (11–31)	11 (7–42)	0.058
	Control	7 (5–9)	8 (6–11)	23 (15–38)	28 (24–46)	42 (25–68)	18 (13–31)	18 (10–26)	
IL-10	Cell saver	0 (0–1)	0 (0–2)	6 (0–9)	9 (4–19)	2 (0–2)	0 (0–3)	0 (0–3)	0.530
	Control	0 (0–2)	1 (0–3)	7 (4–12)	10 (8–22)	3 (2–8)	3 (1–5)	2 (1–3)	
Median (IQR) ng/mL									
sTNF-RI	Cell saver	0.9 (0.8–1.8)	0.7 (0.5–1.1)	1.8 (1.5–2.4)	2.1 (1.5–2.8)	1.9 (1.1–2.7)	1.7 (1.2–2.7)	1.8 (1.5–4.4)	0.158
	Control	1.0 (0.8–1.6)	0.9 (0.5–1.2)	1.9 (1.7–2.5)	2.4 (1.8–2.9)	2.6 (1.2–3.8)	2.0 (1.3–2.9)	2.4 (1.8–4.1)	
sTNF-RII	Cell saver	2.5 (1.5–2.9)	1.6 (1.0–2.0)	3.0 (1.6–3.4)	3.0 (2.1–3.8)	3.4 (2.6–4.7)	2.8 (1.6–3.9)	3.1 (2.7–5.8)	0.40
	Control	2.4 (1.6–2.9)	1.5 (1.1–1.9)	2.8 (2.3–3.4)	3.5 (2.7–3.9)	4.4 (2.8–4.9)	3.3 (2.0–4.6)	3.6 (2.7–5.0)	
PCT	Cell saver	0.1 (0.1–0.2)	0.1 (0.1–0.1)	0.1 (0.1–0.1)	0.1 (0.1–0.2)	0.2 (0.2–0.6)	0.4 (0.3–1.1)	0.4 (0.2–2.3)	0.472
	Control	0.1 (0.1–0.1)	0.1 (0.1–0.1)	0.1 (0.1–0.1)	0.1 (0.1–0.2)	0.5 (0.3–1.0)	0.7 (0.3–1.4)	0.4 (0.3–0.8)	

Gäbel J et al. Eur J Cardiothoravsc surg 2013;44:506-11

IL-6/IL-10

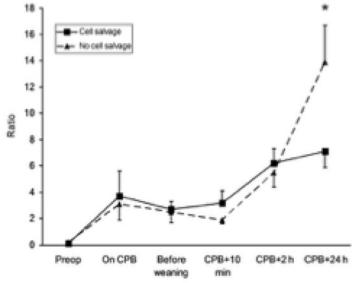
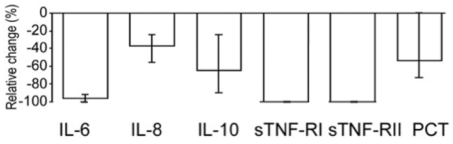


Figure 1: The mean IL-6-to-IL-10 ratio in patients where cardiotomy suction blood was either cell salvaged or not before retransfusion. *P < 0.05. The vertical lines represent the standard deviations.

RELATIVE CHANGES OF INFLAMMATORY MARKERS (BEFORE AND AFTER CELL SAVING)



Damgaard S et al. Ann Thorac Surg 2010; 89:1511-7

Munoz M et al. Blood Transfus 2011;9:248-61

PERFORMANCES COMPARÉE DES SYSTÈMES

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TP or ALB removal; %	97 - 98	91 - 93	93 - 99	NA	NA	97	76
K^+ removal; %	92	90	90 - 98	91	89	97	NA
Cytokine removal; %	95	95	95	91 - 95	NA	90	70 - 77

Values are minimum – maximum interval. CATS: continuous autotra nsfusion system; RBC: red blood cells; WBC: leucocytes; PLT: platelets; PFHB: plasma free haemoglobin; TP: total protein; ALB: albumin. NA: not assessed. References: * (68-77), ** (51).

DOI:10.5152/TJAR.2022.21121

Original Article
Cardiovascular and Thoracic Anesthesia

Turkish Journal of Anaesthesiology & Reanimation

Postoperative Atrial Fibrillation Reduced by Intraoperative and Postoperative Cell Saver System in Coronary Artery Bypass Graft Surgery

Muharrem Koçyiğit, Özgen Işgar Koçyiğit, Ahmet Ümit Gülle, Şahin Şenay, Cem Alhan
Department of Anesthesiology, Acibadem Mehmet Ali Aydinlar University Vocational School of Health Services, Istanbul, Turkey
Department of Cardiovascular Surgery, Acibadem Mehmet Ali Aydinlar University Faculty of Medicine, Istanbul, Turkey

Table 2. Logistic Regression Analysis of AF

	Adjusted Odds Ratio	95% CI	P
Age >70 (years)	1.229	0.645-2.345	.534
Non-elective surgery	1.017	0.516-2.008	.960
EF <30%	1.391	0.288-6.712	.671
Euroscore ≥5	2.092	1.018-4.298	.045
Without cell-saver system	3.516	1.690-7.316	<.001

EF, ejection fraction.

Kincaid EH et al. Ann Thorac Surg 2000; 70:1296-300

Processing Scavenged Blood With a Cell Saver Reduces Cerebral Lipid Microembolization

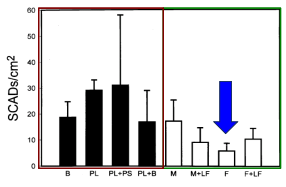
Rôle micro-emboli lipidiques

Morbidité neurologique (ischémie ou dysfonction cognitive) après chirurgie cardiaque sous CEC

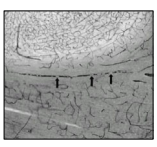
Dilatation capillaire ou artériolaire (small capillary and arteriolar dilation SCADs)

Etude expérimentale (comparative moyens de diminuer micro-emboli graisseux)

Filtre artériel versus cell saver



Arterial filter

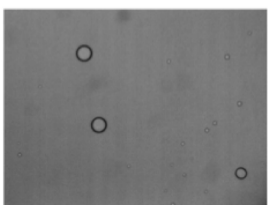


Cell saver process

Ann Thorac Surg 2003; 75:555-9

Elimination of Fat Microemboli During Cardiopulmonary Bypass

Aditya K. Kaza, MD, Jeffrey T. Cope, MD, Steven M. Fiser, MD, Stewart M. Long, MD, John A. Kern, MD, Irving L. Kron, MD, and Curtis G. Tribble, MD



Fat microemboli after oil red O staining

Fat micro emboli in processed blood

Small (10-50 µm in diameter)

- Pericardial blood 4.00 (saturation)
- Cardiotomy group 3.43±0.20
- Cell saver group 3.33±0.33
- **Dual filtration 0.67±0.21**
- Arterial blood 1.86±0.14 only for cardiotomy group

Large (> 50 µm in diameter)

- Pericardial blood 4.00 (saturation)
- Cardiotomy group 2.57±0.30
- Cell saver group 1.50±0.22
- **Dual filtration 0±0**
- Arterial blood 1.00±0.38 only for cardiotomy group

Klein AA et al. Anesth Analg 2008 107:1487-95

A Randomized Controlled Trial of Cell Salvage in Routine Cardiac Surgery

Etude randomisée (n=213)
Chirurgie cardiaque non urgente (PAC, valve, combinée)
Cell saver pour sang épanché et CEC (+ postopératoire) vs contrôle

Volume ré-infusé **342±194 ml**

	Control (n = 111)	Cell salvage (n = 102)	P
Number of patients (%) requiring any RBC or FFP or PLT*	36/111 (32%)	33/102 (32%)	0.89
	Relative risk 1.00 (95% CI 0.63–1.60)		NS
RBC			
Patients requiring RBC	33 (30%)	31 (30%)	0.96
Total units in operating room	25	24	0.88
Total units in first 6 h	21	20	0.91
Total units >6 h	54	35	0.11
Total	100	79	0.32
	Relative risk 0.86 (95% CI 0.64–1.15)		
FFP			
Patients requiring FFP	6 (5%)	8 (8%)	0.66
Total units transfused	28	31	0.48
	Relative risk 1.20 (95% CI 0.72–2.00)		
PLT			
Patients requiring PLT	5 (5%)	6 (6%)	0.89
Total	14	7	0.19

Wahba A et al. Br J Anaesthesia 2025;134:917-1008

CARDIOVASCULAR

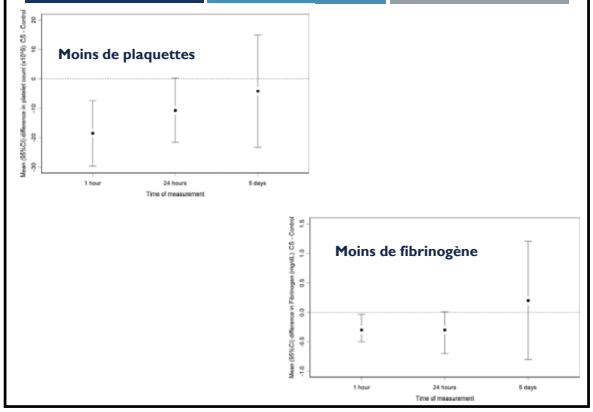
2024 EACTS/EACTAIC/EBCP Guidelines on cardiopulmonary bypass in adult cardiac surgery

Recommendation Table 49 Recommendations for shed mediastinal blood management

Recommendations	Class [a]	Level [b]	Ref [c]
Discarding shed mediastinal blood should be considered.	IIa	B	711–713
Processing and secondary filtration of red blood cells, for example by use of red blood cell salvage, should be considered to decrease the deleterious effects of reinfused shed blood.	IIa	B	712,713

Recommendation Table 56 Recommendations for residual blood management

Recommendations	Class [a]	Level [b]	Ref [c]
Retransfusion of the residual volume of the CPB circuit at the end of the procedure is recommended as a part of a blood management programme to minimize allogeneic blood transfusions.	I	C	-
Retransfusion of the processed residual volume of the CPB circuit at the end of the procedure should be considered to minimize the risks of allogeneic blood transfusions.	IIa	B	823,827,829



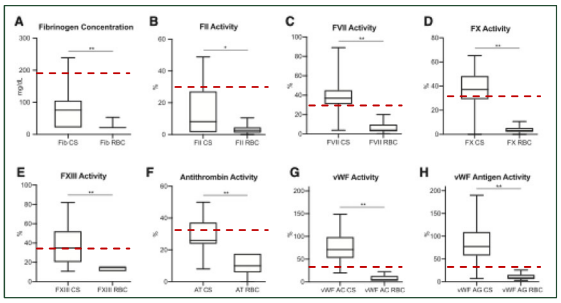
Munoz M et al. Blood Transfus 2011;9:248-61

PERFORMANCES COMPARÉE DES SYSTÈMES

Parameter	Sequestra* (Medtronic)	BRAT 2* (Cobe)	CATS* (Fresenius)	Cell Saver* (Haemonetics)	AUTOLOG* (Medtronic)	OrthoPAT* (Haemonetics)	Colloid ** sedimentation
RBC recovery; %	65 - 76	71 - 93	51 - 87	64 - 94	79	80	90
WBC removal; %	31 - 78	30	45 - 80	22 - 55	78	72	60
PLT removal; %	87 - 93	68	92 - 96	86 - 87	99	88	48
PFHB removal; %	89	63	65 - 95	85 - 93	92	96	53
TP or ALB removal; %	97 - 98	91 - 93	93 - 99	NA	NA	97	76
K^+ removal; %	92	90	90 - 98	91	89	97	NA
Cytokine removal; %	95	95	95	91 - 95	NA	90	70 - 77

Values are minimum – maximum interval. CATS: continuous autotra nsfusion system; RBC: red blood cells; WBC: leucocytes; PLT: platelets; PFHB: plasma free haemoglobin; TP: total protein; ALB: albumin. NA: not assessed. References: * (68-77), ** (51).

Adam EH et al. Anesth Analg 2020; 130:1389-95



Coagulation factor activity 10 à 30% for pseudnormal coaguation
Palla R et al. , Peyvandi F, Shapiro AD. Rare bleeding disorders: diagnosis and treatment. Blood 2015;125:2052–61

Xie Y et al. Int J Med Sci 2015;12:322-8

Etude prospective randomisée (n=150)
Chirurgie cardiaque sous CEC à risque hémorragique (aorte, combinée, redo,...)

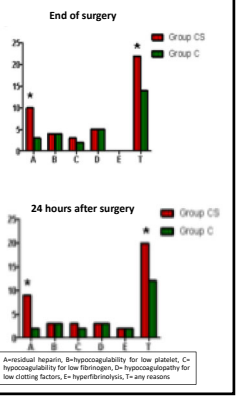
Cell-saver pour sang épanché et volume résiduel CEC

Critères de jugement: transfusion, coagulation conventionnelle et thrombo-élastographie

Variable	Group CS (n=72)	Group C (n=69)	P value
RBC			
proportion	27(37.5)	52(75.4)	0.0002
quantity (U)	2.01(2.75)	5.39(3.28)	<0.0001
FFP			
quantity (ml)	113.9(202.7)	133.3(220.6)	0.725
proportion	14(19.4.)	14(20.3)	0.909
PLT			
quantity (U)	1.97(3.57)	1.91(3.42)	0.879
proportion	16(22.2)	13(18.8)	0.627

Data are presented as mean (SD) or number (percentage).

Incidence du saignement excessif (définition?) était significativement plus élevée dans le groupe CS (p=0,034)



Héparinisation résiduelle?

Anaesthesia
Journal of the Association of Anaesthetists of Great Britain and Ireland

A quality assurance programme for cell salvage in cardiac surgery

A. Kelleher,[1] S. Davidson,[2] M. Gohil,[3] M. Machin,[3] P. Kimberley,[4] J. Hall[5] and W. Banya[6]

	2001	2002	2003	2004	2005	2006	2006	2007
	BRAT	BRAT	BRAT	BRAT	BRAT	BRAT	HCSS	HCSS
Pre-wash heparin concentration; IU.ml^{-1}	4.1 (2.5–8.2 [0–11.6])	5.1 (3.5–8.6 [2.0–20.2])	8.8 (4.5–12.7 [2.8–20.2])	4.0 (0.8–13.7 [0–17.6])	5.2 (3.7–9.1 [0.4–16.4])	6.6 (4.2–8.4 [2.9–14.1])	5.7 (4.6–9.1 [4.0–12.0])	5.3 (1.3–9.0 [0.6 –13.6])
Post-wash heparin concentration; IU.ml^{-1}	0.2 (0.0–0.4 [0–1.9])	0.2 (0.1–0.5 [0–1.7])	0.4 (0.2–2.3 [0–1.7])	0.3 (0.2–0.5 [0–0.8])	0.2 (0–0.4 [0–1.7])	0.3 (0–0.5 [0–0.6])	0.4 (0.2–0.7 [0–2.5])	0 (0.0–0.2 [0–0.4])
Pre-wash free Hb; g.l^{-1}	0.3 (0.2–0.5 [0.2–4.0])	0.3 (0.2–0.5 [0.1–10.1])	0.3 (0.2–0.5 [0.2–9.4])	0.3 (0.2–0.5 [0.4–2.9])	0.3 (0.2–0.5 [0.3–8.4])	0.3 (0.2–0.5 [0.3–2.9])	0.3 (0.2–0.5 [0.3–0.7])	0.3 (0.2–0.5 [0.3–1.7])
Post-wash free Hb; g.l^{-1}	0.5 (0.3–0.8 [0.1–2.4])	0.5 (0.3–1.0 [0.1–4.5])	0.4 (0.2–0.7 [0.1–2.3])	0.7 (0.5–1.1 [0.2–2.5])	0.8 (0.6–1.3 [0.3–5.2])*	0.8 (0.3–1.4 [0.3–1.8])*	0.3 (0.3–0.4 [0.3–2.7])‡	0.3 (0.3–0.3 [0.3–0.5])‡
Pre-wash Hb; g.dl^{-1}	7.3 (5.4–8.5 [2.6–14.7])	8.0 (5.5–8.9 [1.5–11.3])	4.4 (1.9–9.2 [2.3–11.1])	9.0 (6.8–11.7 [2.4–25.6])	6.1 (4.5–8.0 [2.9–13.0])	8.1 (4.0–9.6 [2.5–10.0])	6.8 (5.5–8.5 [1.9–9.6])	5.2 (3.1–8.1 [1.4–9.9])
Post-wash Hb; g.dl^{-1}	19.6 (16.7–22.2 [12.9–25.3])‡	19.0 (16.3–20.8 [5.6–24.4])	17.5 (13.6–20.8 [12.6–23.7])†	18.5 (15.0–21.6 [8.5–26.4])	20.3 (17.1–22.5 [10.3–26])	18.4 (18.1–20.8 [16.4–21.5])	18.3 (16.9–19.5 [11.5–24.5])	17.3 (16.4–18.0 [15.1–19.5])

Safety of Salvaged Blood and Risk of Coagulopathy in Cardiac Surgery

Domenico Paparella, MD[1] Richard Whitlock, MD, PhD[2]

[1]Division of Cardiac Surgery, Department of Emergency and Organ Transplant, University of Bari "Aldo Moro" Bari, Italy [2]McMaster University, Population Health Research Institute, Hamilton Health Sciences Center, Hamilton, Ontario, Canada

Address for correspondence: Domenico Paparella, MD, Division of Cardiac Surgery, Department of Emergency and Organ Transplant, University of Bari "Aldo Moro," Piazza Giulio Cesare 11, 70100 Bari, Italy (e-mail: domenico.paparellaburriba.it).

Semin Thromb Hemost

Abstract

Cardiac surgery patients are prone to anemia from several mechanisms: intraoperative blood loss, preexisting anemia, and hemodilution. Patients are very frequently transfused with allogeneic red blood cells (RBC), which in itself is associated with harm. The use of RBC salvage technology has been advocated to salvage blood lost in the operative field and to reduce the need of homologous blood transfusion. Direct cardiotomy suction from the surgical field and unprocessed blood retransfusion is a common practice during cardiopulmonary bypass, but which is associated with a powerful activation of the coagulation and inflammatory systems: thrombin generation, excessive fibrinolysis, and release of proinflammatory cytokines. Compared with direct cardiotomy suction, the use of RBC salvage technology is able to reduce the amount of microparticles and activated proteins of autologous blood before retransfusion. However, when compared with no retransfusion of blood from the operative field, processed blood also triggers coagulopathy and inflammation. Clinical studies are discordant regarding the benefit of RBC salvage use during and after cardiac operations. Meta-analysis suggests reduced need of homologous blood transfusion, but no effects on mortality and morbidity.

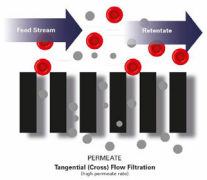
Keywords
- cardiac surgery
- coagulation
- inflammation
- cardiotomy suction
- red blood cells salvage

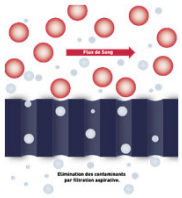
Same™: Récupération sanguine par filtration tangentielle

Nouveau dispositif d'autotransfusion innovant par ***filtration tangentielle (iSEP France)***

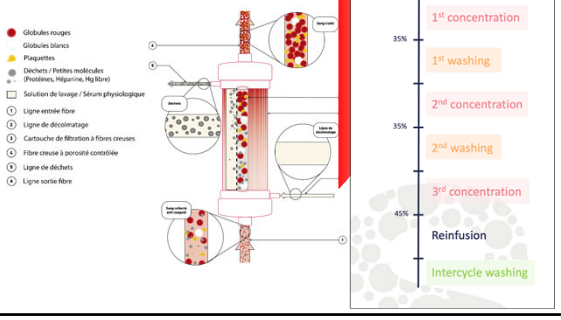
Récupération érythrocytes, les leucocytes mais aussi **les plaquettes**.

Limiter anomalies de l'hémostase périopératoire (voire une amelioration?)

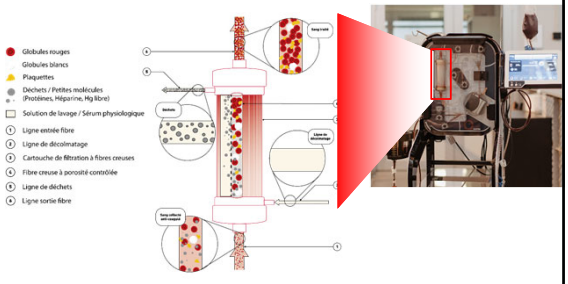


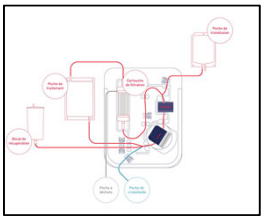


SAME™ (I-SEP, FRANCE)

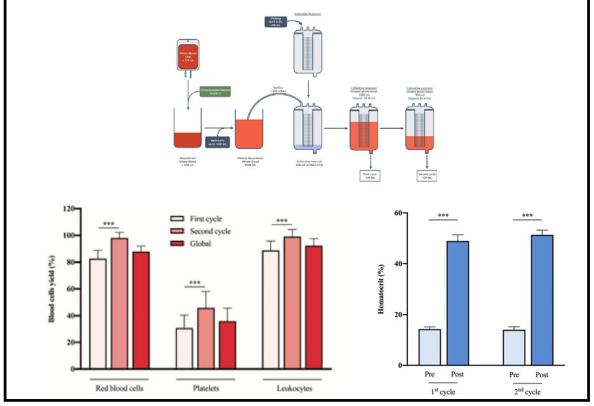


Same™: Récupération sanguine par filtration tangeantielle



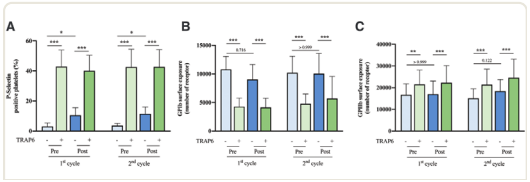


Mansour A et al. Anesthesiology 2021;135:246-57



Mansour A et al. Anthesiology 2021;135:246-57

RÉACTIVITÉ PLAQUETTAIRE PRÉSERVÉE



Mansour A et al. Anesthesiology 2023; 139:287-97

FIRST IN MAN STUDY (TRANSEP)

MULTICENTRE (NANTES, RENNES, BDX, HEGP)

Table 3. Cell Recovery Performance

Characteristics	All Patients (n = 50)
Red blood cells	
Pretreatment concentration, 10^{12}/l	1.84 (1.53–2.04)
Posttreatment concentration, 10^{12}/l	4.70 (4.43–4.99)
Recovery, %	86.1 (80.8–91.6)
Platelets	
Pretreatment concentration, 10^{9}/l	82 (67–96)
Posttreatment concentration, 10^{9}/l	146 (93–146)
Recovery, %	52.4 (44.2–60.1)
Leukocytes	
Pretreatment concentration, 10^{9}/l	3.5 (2.3–5.1)
Posttreatment concentration, 10^{9}/l	10.2 (7.4–14.0)
Recovery, %	90.0 (83.4–97.4)

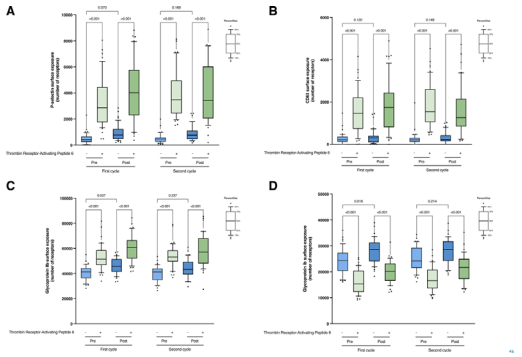
Results are presented as median (25th to 75th percentile interquartile range). Cell recovery performance was assessed for each treatment cycle by sampling pretreatment blood in the collection reservoir and posttreatment blood in the reinfusion bag.

Table 4. Washing Performance

Plasma Components	All Patients (n = 50)
Heparin	
Pretreatment concentration, U/ml	5.9 (4.4–7.7)
Posttreatment concentration, U/ml	0.3 (0.1–0.5)*
Posttreatment quantity, U	80 (19–213)
Removal ratio, %	98.9 (98.2–99.7)
Free hemoglobin	
Pretreatment concentration, mg/dl	171 (112–228)
Posttreatment concentration, mg/dl	284 (222–376)
Removal ratio, %	94.6 (92.7–96.9)
Pretreatment hemolysis index, %	2.7 (1.6–3.8)
Posttreatment hemolysis index, %	1.2 (0.9–1.6)
Total proteins	
Pretreatment, g/l	22.3 (19.0–26.7)
Posttreatment, g/l	5.7 (4.9–6.8)
Removal ratio, %	94.5 (92.2–95.3)
Potassium	
Pretreatment, mmol/l	4.9 (4.2–6.5)
Posttreatment, mmol/l	2.3 (2.0–2.8)
Removal ratio, %	89.1 (87.7–91.7)
Triglycerides	
Pretreatment, mmol/l	0.59 (0.49–0.68)
Posttreatment, mmol/l	0.17 (0.13–0.21)†
Removal ratio, %	94.0 (92.6–95.9)

Results are presented as median (25th to 75th percentile interquartile range). Washing performance was assessed for each treatment cycle by sampling pretreatment blood in the collection reservoir and posttreatment blood in the reinfusion bag.
*A total of 80 cycles had values inferior to limit of quantification (0.1 U/ml) and were substituted with 0.05 U/ml. †A total of 17 cycles had values inferior to limit of quantification (0.1 mmol/l) and were substituted with 0.05 mmol/l.

Mansour A et al. Anesthesiology 2023; 139:287-97



ETUDE COMPARATIVE : COMBINED PLATELET AND ERYTHROCYTE AUTOTRANSFUSION DURING CARDIAC SURGERY (COLTRANE) TRIAL

Etude prospective randomisée multicentrique française

Comparaison de récupération sanguine peropératoire centrifugation versus filtration tangentielle

Compétence hémostatique périopératoire (Universal Definition of Perioperative Bleeding)

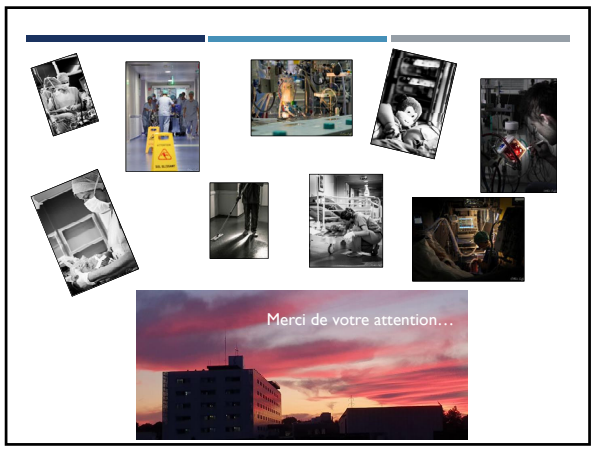
Début juillet 2024 (405 patients inclus)

Ouverture des centres en cours (7/10 centres ouverts)

Fin inclusions décembre 2025

CONCLUSIONS

- Récupération sanguine peroperatoire par centrifugation permet une épargne de CGR
- Epargne d'autant plus conséquente que volume traité est important (>1000 ml)
- Intérêt limité chez le patient à faible risque hémorragique (collecteur seul mis en place?)
- Traitement du saignement épanché et de la circulation extra-corporelle permet de limiter la réponse inflammatoire et pourrait améliorer le pronostic de nos patients
- En diminuant la charge en micro-embols graisseux, le cell-saver pourrait avoir un impact sur les complications neurologiques post CEC
- Récupération sanguine étant exclusivement limité aux GR, le traitement d'important volume sanguin peut s'associer à des anomalies de l'hémostase qu'il faut savoir déceler et traiter (idéalement préventivement)
- Mécanismes multiples (pertes de facteurs, thrombopénie, héparinisation résiduelle…)
- En récupérant les plaquettes la technologie de récupération sanguine par filtration tangentielle pourrait limiter ces anomalies de l'hémostase et ainsi améliorer la compétence hémostatique périopératoire du patient à risque (Etude COLTRANE…)


Merci de votre attention…