25ème CONGRÈS NATIONAL DE RÉANIMATION

Solutés de remplissage en réanimation : quel produit choisir ?

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Hammamet, Décembre 2021

SOLUTÉS DE REMPLISSAGE: PRÉSENTATION

- **SR:** produits les plus utilisés en réanimation / contexte péri-opératoire
- **Objectif:** Expansion volémique:
  - Restaurer la volémie: augmenter le volume «contraint» et donc la PAM
  - En réduisant la résistance au retour veineux
- **2 classes : CRISTALLOÏDES & COLLOÏDES**
- Spécificités souvent mal connues

SOLUTÉS DE REMPLISSAGE: PRÉSENTATION

CRISTALLOÏDES :

- **Différence de tonicité**:
  - **Isotoniques:** osmolarité entre 280 et 310 mOsm/L
  - **Hypertoniques** : osmolarité >> 2000 mOsm/L (NaCl 3%, NaCl 7,5%, 10%, 20%)
- **Différence de concentration en chlore et de composition ionique**:
  - **SOLUTÉS «NON BALANCÉS»** :
    - Non physiologique (sodium=chlore)
    - Forte charge chlorée (SSI NaCl 0,9 % , hyperT)
  - **SOLUTÉS DE RINGER BALANCÉS**:
    - Contiennent un anion organique métabolisable (lactate ou acétate)
    - Effet tampon (Métabolisme du lactate en pyruvate dans le foie puis transformation en bicarbonate)
    - Limitant la charge en chlore
    - Composition en ions plus proche du plasma

Composition des principaux cristalloïdes isotoniques

SNB

SB

Composition (mmol/l)	Plasma	NaCl 0.9%	Ringer Lactate	Ringer Acétate		Unité
				Plasmalyte®	Isofundine®	
Na^+	140	154	130	140	145	mmol/l
K^+	4	0	5,4	5	4	mmol/l
Mg^{2+}	1	0	0	1,5	1	mmol/l
Ca^{2+}	2,2	0	1,8	0	2,5	mmol/l
Cl^-	100	154	111	98	127	mmol/l
Lactates	1	0	27,7	0	0	mmol/l
Malates	0	0	0	0	5	mmol/l
Acétate	0	0	0	27	24	mmol/l
Pyruvate	0	0	0	0	0	mmol/l
Gluconate	0	0	0	23	0	mmol/l
Osmolarité	285	308	277	295	309	mOsm/l
pH	7,40	4,5-7,0	6,0-7,5	6,5-8,0	5,1-5,9	-

D'autres SB (UK)…

Composition of commonly used crystalloids

Content	Plasma	Sodium chloride 0.9%*	Sodium chloride 0.18%/ 4% glucose[a]	0.45% NaCl/ 4% glucose[a]	5% glucose[a]	Hartmann's	Lactated Ringer's (USP)	Ringer's acetate	Alternative balanced solutions for resuscitation**	Alternative balanced solutions for maintenance**
Na^+ (mmol/l)	135–145	154	31	77	0	131	130	130	140	40
Cl^- (mmol/l)	95–105	154	31	77	0	111	109	112	98	40
$[Na^+]:[Cl^-]$ ratio	1.28–1.45:1	1:1	1:1	1:1	-	1.18:1	1.19:1	1.16:1	1.43:1	1:1
K^+ (mmol/l)	3.5–5.3	*	*	*	*	5	4	5	5	13
HCO_3^- / Bicarbonate	24–32	0	0	0	0	29 (lactate)	28 (lactate)	27 (acetate)	27 (acetate) 23 (gluconate)	16 (acetate)
Ca^{2+} (mmol/l)	2.2–2.6	0	0	0	0	2	1.4	1	0	0
Mg^{2+} (mmol/l)	0.8–1.2	0		0		0	0	1	1.5	1.5
Glucose (mmol/ l)	3.5–5.5	0	222 (40 g)	222 (40 g)	278 (50 g)	0	0	0	0	222 (40 g)
pH	7.35–7.45	4.5–7.0	4.5		3.5–5.5	5.0–7.0	6–7.5	6–8	4.0–8.0	4.5–7.0
Osmolarity (mOsm/l)	275–295	308	284		278	278	273	276	295	389

* These solutions are available with differing quantities of potassium already added, and the potassium-containing versions are usually more appropriate for meeting maintenance needs.
** Alternative balanced solutions are available commercially under different brand names and composition may vary by preparation.
[a] The term dextrose refers to the dextro-rotatory isomer of glucose that can be metabolised and is the only form used in IV fluids. However IV fluid bags are often labelled as glucose so only this term should be used. Traditionally hospitals bought a small range of fluids combining saline (0.18-0.9%) with glucose but several recent NICE/NPSA documents have recommended specific combinations, which are now purchased to enable guidelines to be followed. Glucose–saline combinations now come in 5 different concentrations, and the addition of variable potassium content expands the pre-mixed range to 13 different products. Prescribers must therefore specify the concentration of each component; the term dextrose-saline (or abbreviation D/S) is meaningless without these details. What is specified also impacts significantly on the cost of the product.
Note: Weight-based potassium prescriptions should be rounded to the nearest common fluids available (for example, a 67 kg person should have fluids containing 20 mmol and 40 mmol of potassium in a 24-hour period). Potassium should not be added to intravenous fluid bags as this is dangerous.

Source: This table was drafted based on the consensus decision of the members of the Guideline Development Group.

'Intravenous fluid therapy in adults in hospital', NICE clinical guideline 174 (December 2013. Last update December 2016)

Effets secondaires des cristalloïdes:

	Effets secondaires	Autres Rq
SSI: NaCl 0,9%	▪ Ac. métabolique « minérale » hyperchlorémique ▪ Pouvoir EV 25%: Surcharge H-S ▪ Dilution du plasma+	Ac. metab: impact (Ice rénale, dysf Pq, diminution de la sensibilité aux catécho, hyperk de transfert) : **non démontré!** Peu couteux : 1,5 DT/ 500ml
	F. coagulation	
Ringer lactate: RL	▪ Risque d'aggravation de l'acidose lactique ▪ Surcharge hydro sodée, ▪ Dilution du plasma, des facteurs de la coagulation	**A éviter** : ▪ hyperkaliémie ▪ cirrhose avec acidose lactique sévère ▪ Hypercalcémie Peu couteux : 1,7 DT/ 500ml
Ringer acétate: **-Plasmalyte®** **-Isofundine®**	Surcharge dilution	▪ L'acétate a des effets VD et inotrope négatif lorsqu'il est utilisé dans les solutés de dialyse!
Cristalloïdes hypertoniques	Hyper Na	▪ Diffusion au compartiment EC+++ ▪ Faible volume perfusé ▪ **Baisse de la PIC++** Peu couteux (NaCl 10%) : 2,1 DT/ 500ml

SOLUTÉS DE REMPLISSAGE: PRÉSENTATION

COLLOÏDES:

- Macromolécules diluées dans un cristalloïde (SSI ou Ringer)
  - Colloïdes **naturels** (albumine, PFC)
  - Colloïdes **synthètiques** (hydroxyéthylamidon, gélatine, dextrans)
- **Pouvoir d'expansion +++ (>80-100%)**
- **EI: fréquents et graves :**
  - Insuffisance rénale aiguë par néphrose osmotique
    (endocytose des molécules avec vacuolisation des cellules tubulaires proximales)
  - Troubles de l'hémostase
  - Anaphylaxie

COLLOÏDES: spécificités

	Origine Pouvoir EV	EI/CI	Coût/ Flacon
ALBUMINE HUMAINE: **Isooncotiq 4%** **Hyperoncotiq 20%**	**NATURELS:** fractionnement du plasma humain •Pouv EV 80-400% •Durée d'efficacité : 6-8 h	**CI:** Surcharge volémique, IC décompensée	Alb 20%: **84 DT**
GÉLATINES FLUIDES MODIFIÉES (GFM): Sans Ca: gelofusine, plasmion Avec Ca: haemacel, plasmagel	**SYNTHÉTIQUE:** **Collagène de bœuf (Gélatine dénaturée)** •Pouv EV 100%	**EI :** Surcharge HS, OAP, R°anaphyl, toxicité rénale **CI:** Hypersensibilité aux gélatines, Grossesse	Haemacel **9,2 DT/500 cc**
HYDROXY ÉTHYL AMIDONS (HEA): Elohes, Hesteril, **Voluven**	**SYNTHÉTIQUE:** **Amidons de maïs** •Pouv EV> 120%	**EI :** Surcharge HS, OAP, R°anaphyl, toxicité rénale Dilution des fact de la coagulation **Altération possible des tests RAI+** **CI**: Hypersensibilité connue aux HEA, Tr de l'hémostase, mdie de Willebrand, hémophilie, Ice rénale, IHC, Grossesse	Voluven **21,4 DT/500cc**
DEXTRANS: Dextran 40, Hemodex Plasmacair, macrodex	**SYNTHÉTIQUE:** **Polysaccharide bactérien** •Pouv EV > 120%	Action anti Ag plaq	Dextran **4,2 DT/500 cc**

SOLUTÉS DE REMPLISSAGE: ÉTUDES COMPARATIVES

Colloïdes

Versus

Cristalloïdes

Cristalloïdes balancés (ou équilibrés ou tamponnés)

versus

Cristalloïdes isotonique NB

Colloïdes versus cristalloïdes

- **But:** Évaluer l'effet des colloïdes par rapport aux cristalloïdes (SSI)
- **Population**: malades de réanimation nécessitant une EV
- **69 études (65 RCT, 4 quasi-RCT), 30 020 participants**
- **4 types de colloïdes:** amidons (28), dextrans (20), gélatines (7) et albumine ou FFP (22)
- **C. jugement**:
  - Mortalité,
  - Nécessité d'une transfusion sanguine
  - EER
  - EI (réactions allergiques+)

Cochrane Library

Cochrane Database of Systematic Reviews

Colloids versus crystalloids for fluid resuscitation in critically ill people (Review)

Lewis SR, Pritchard MW, Evans DJW, Butler AR, Alderson P, Smith AF, Roberts I

Amidons versus cristalloïdes

Analysis 1.1. Comparison 1 Starches vs crystalloid, Outcome 1 Mortality at end of follow-up.

Study or subgroup	Starch n/N	Crystalloid n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Annane 2013	181/645	372/1107		16.71%	0.84[0.72,0.97]
Bechir 2013	8/23	6/22		1.72%	1.28[0.53,3.08]
Brunkhorst 2008	107/261	93/274		12.81%	1.21[0.97,1.51]
Cifra 2003	1/11	3/16		0.31%	0.48[0.06,4.08]
Du 2011					
Dubin 2010					
Guidet 2012					
Heradstveit 2010					
James 2011					
Jie 2015					
Kumar 2017					
Li 2008					
Lu 2012					
McIntyre 2008					
Myburgh 2012					
Nagy 1993					
Perner 2012					
Rackow 1983					
Van der Heijden 2009					
Vlachou 2010					
Wills 2005					
Younes 1998					
Zhao 2013					
Zhu 2011					
Total (95% CI)					
Total events: 1223 (Starc					
Heterogeneity: Tau²=0.0					
Test for overall effect: Z=					

Comparison 1. Starches vs crystalloid

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method	Effect size
1 Mortality at end of follow-up	24	11177	Risk Ratio (M-H, Random, 95% CI)	0.97 [0.86, 1.09]
2 Mortality within 90 days	15	10415	Risk Ratio (M-H, Random, 95% CI)	1.01 [0.90, 1.14]
3 Mortality within 30 days	11	10135	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.90, 1.09]
4 Transfusion of blood product	8	1917	Risk Ratio (M-H, Random, 95% CI)	1.19 [1.02, 1.39]
5 Renal replacement therapy	9	8527	Risk Ratio (M-H, Random, 95% CI)	1.30 [1.14, 1.48]
6 Adverse event: allergic reaction	3	7757	Risk Ratio (M-H, Random, 95% CI)	2.59 [0.27, 24.91]
7 Adverse event: itching	2	6946	Risk Ratio (M-H, Random, 95% CI)	1.38 [1.05, 1.82]
8 Adverse event: rash	2	7007	Risk Ratio (M-H, Random, 95% CI)	1.61 [0.90, 2.89]

Comparison 2. Dextrans vs crystalloid

Outcome or subgroup title	No. of studies	No. of partici-pants	Statistical method
1 Mortality at end of follow-up	19	4736	Risk Ratio (M-H, Ra
2 Mortality within 90 days and 30 days	10	3353	Risk Ratio (M
3 Transfusion of blood products	3	1272	Risk Ra
4 Adverse events: allergic reaction	4	738	R .93]

Comparison 3. Gelatins vs crystalloid

Outcome or subgroup title	No. of studi		Effect size
1 Mortality at end of follow-up		om, 95% CI)	0.89 [0.74, 1.08]

Comparison 4. Albumin or FFP

Outcome or subgroup title		nethod	Effect size
1 Mortality at en		Risk Ratio (M-H, Random, 95% CI)	0.98 [0.92, 1.06]
2 Mortality		Risk Ratio (M-H, Random, 95% CI)	0.98 [0.92, 1.04]
3 Mortality w	2506	Risk Ratio (M-H, Random, 95% CI)	0.99 [0.93, 1.06]
4 Transfusion of b	290	Risk Ratio (M-H, Random, 95% CI)	1.31 [0.95, 1.80]
5 Renal replacement the	3028	Risk Ratio (M-H, Random, 95% CI)	1.11 [0.96, 1.27]

Test for overall effect: Z=1.17(P=0.24)

Conclusions

Using colloids (starches; dextrans; or albumin or FFP) compared to crystalloids for fluid replacement probably makes little or no difference to the number of critically ill people who die. It may make little or no difference to the number of people who die if gelatins or crystalloids are used for fluid replacement.

Starches probably increase the need for blood transfusion and renal replacement therapy slightly. Using albumin or FFP may make little or no difference to the need for renal replacement therapy. We are uncertain whether using dextrans, albumin or FFP, or crystalloids affects the need for blood transfusion. Similarly, we are uncertain if colloids or crystalloids increase the number of adverse events. Results from ongoing studies may increase our confidence in the evidence in future.

JAMA | Original Investigation

Effect of Hydroxyethyl Starch vs Saline for Volume Replacement Therapy on Death or Postoperative Complications Among High-Risk Patients Undergoing Major Abdominal Surgery

The FLASH Randomized Clinical Trial

TRIAL REGISTRATION ClinicalTrials.gov Identifier: NCT02502773

Emmanuel Futier, MD, PhD; Matthias Garot, MD; Thomas Godet, MD, PhD; Matthieu Biais, MD, PhD; Daniel Verzilli, MD; Alexandre Ouattara, MD, PhD; Olivier Huet, MD, PhD; Thomas Lescot, MD, PhD; Gilles Lebuffe, MD, PhD; Antoine Dewitte, MD, PhD; Anna Cadic, MD; Aymeric Restoux, MD, PhD; Karim Asehnoune, MD, PhD; Catherine Paugam-Burtz, MD, PhD; Philippe Cuvillon, MD, PhD; Marion Faucher, MD, PhD; Camille Vaisse, MD; Younes El Amine, MD; Hélène Beloeil, MD, PhD; Marc Leone, MD, PhD; Eric Noll, MD, PhD; Vincent Piriou, MD, PhD; Sigismond Lasocki, MD, PhD; Jean-Etienne Bazin, MD, PhD; Bruno Pereira, PhD; Samir Jaber, MD, PhD; for the FLASH Trial Group

JAMA. 2020;323(3):225-236. doi:10.1001/jama.2019.20833

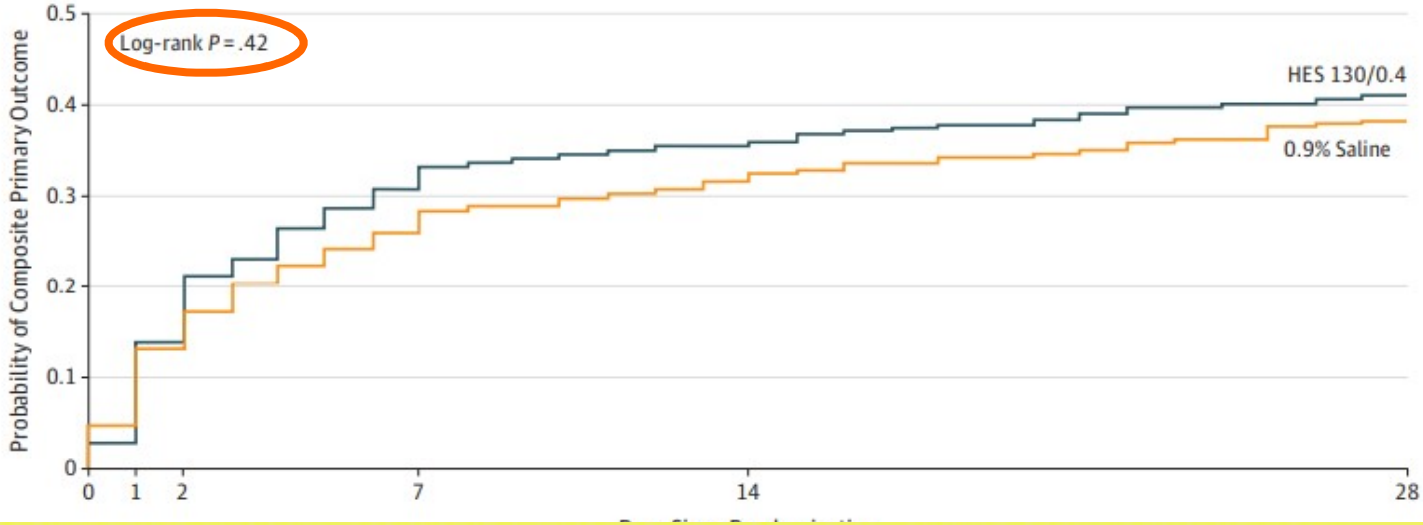
- RCT Multicentrique (20 CHU français) , double aveugle, randomisé de patients adultes subissant une Chgie abdominale majeure

- HEA (n=389) vs SSI 0,9% (n=386) en bolis de 250 ml
  - en utilisant un algorithme HD individualisé pd la chgie et jusqu'à H 24

- **C. Jugement principal:** composite :
  - décès ou
  - complications post-op (14j) majeure (IRIeA-EER , IRpA+recours VM, IC aigue, ESG)

- **C. jugement secondaires:**
  - Complications postop prédéfinies dans les 14 j suivant la chirurgie (def rénale, HD, resp,…)
  - DS en USI et à l'hôpital
  - Mortalité à J28 et J90

Figure 2. Kaplan-Meier Estimates of the Probability of the Composite Primary Outcome



CONCLUSIONS AND RELEVANCE Among patients at risk of postoperative kidney injury undergoing major abdominal surgery, use of HES for volume replacement therapy compared with 0.9% saline resulted in no significant difference in a composite outcome of death or major postoperative complications within 14 days after surgery. These findings do not support the use of HES for volume replacement therapy in such patients.

Table 3. Pri

Outcomes					alue[b]
Secondary Outcomes					
Kidney dysfunction up to day 14, No. (%)[f]	85 (22)	63 (16)	5.5 (0.1 to 11.1)	1.34 (1.00-1.80)	.05
Acute kidney injury KDIGO stage, No. (%)					
Stage 1	59 (15)	39 (10)	5.5 (0.5 to 10.4)	1.61 (1.04-2.48)	.03
Acute kidney injury up to day 28, No. (%)[n]	88 (23)	64 (17)	6.0 (0.5 to 11.6)	1.36 (1.02-1.82)	.04
Day 1 fluid balance, median (IQR)[o]	3200 (2450-4200)	3800 (2650-5100)	575 (304 to 846)	NA	<.001
Need for blood transfusion, No. (%)	75 (19)	45 (12)	7.6 (2.6 to 12.7)	1.65 (1.18-2.33)	.003

Cristalloïdes balancés versus Cristalloïdes NB (SSI 0.9%)

Zayed *et al. Journal of Intensive Care* (2018) 6:51
https://doi.org/10.1186/s40560-018-0320-x

Journal of Intensive Care

REVIEW Open Access

Balanced crystalloids versus isotonic saline in critically ill patients: systematic review and meta-analysis

Yazan Z. M. Zayed[1,3*], Ahmed M. Y. Aburahma[1], Mahmoud O. Barbarawi[1], Kewan Hamid[1], Momen R. N. Banifadel[2], Laith Rashdan[1] and Ghassan I. Bachuwa[1]

- **6 RCT, 19 332 patients**
- Critères de jugement principaux:
  - insuffisance rénale aiguë (IRA)
  - mortalité Hosp
- Critères de jugement secondaires:
  - mortalité en USI et recours EER

Table 1 Summary of included studies

From: Balanced crystalloids versus isotonic saline in critically ill patients: systematic review and meta-analysis

First author	Year	Study design	Follow-up period for outcomes	Reported outcomes	Fluid type	Number of total patients
Young	2015	Multi-center double-blind, cluster randomized, double-crossover trial	90 days after randomizations for all variables	Hospital and ICU mortality, AKI and RRT	Plasma-Lyte	1152
					Saline	1110
Verma	2016	Multi-center double-bind randomized controlled trial	AKI during the first 4 days while other outcomes till discharge	Hospital and ICU mortality, AKI and RRT	Plasma-Lyte	33
					Saline	34
Semler (SMART trial)	2018	Single center unblinded, cluster randomized, multiple crossover trial	Death at 60 days, AKI after enrollment, RRT at 28 days.	Hospital and ICU mortality, AKI and RRT	LR or Plasma-Lyte	7942
					Saline	7860
Semler (SALT trial)	2016	Single-center prospective, open-label, cluster-randomized, multiple crossover trial	Death at 60 days, AKI after enrollment, RRT at 28 days.	Hospital and ICU mortality, AKI and RRT	LR or Plasma-Lyte	520
					Saline	454
Young	2014	Single center randomized, double-blind, parallel-group clinical trial	In-hospital mortality at 30 days	Hospital mortality	Plasma-Lyte	22
					Saline	24
Ratanarat	2017	Single-center randomized controlled trial	AKI during the first 7 days	AKI and RRT	Balanced	88
					Saline	93

AKI acute kidney injury, *RRT* renal replacement therapy, *ICU* intensive care unit, *LR* lactated Ringer's

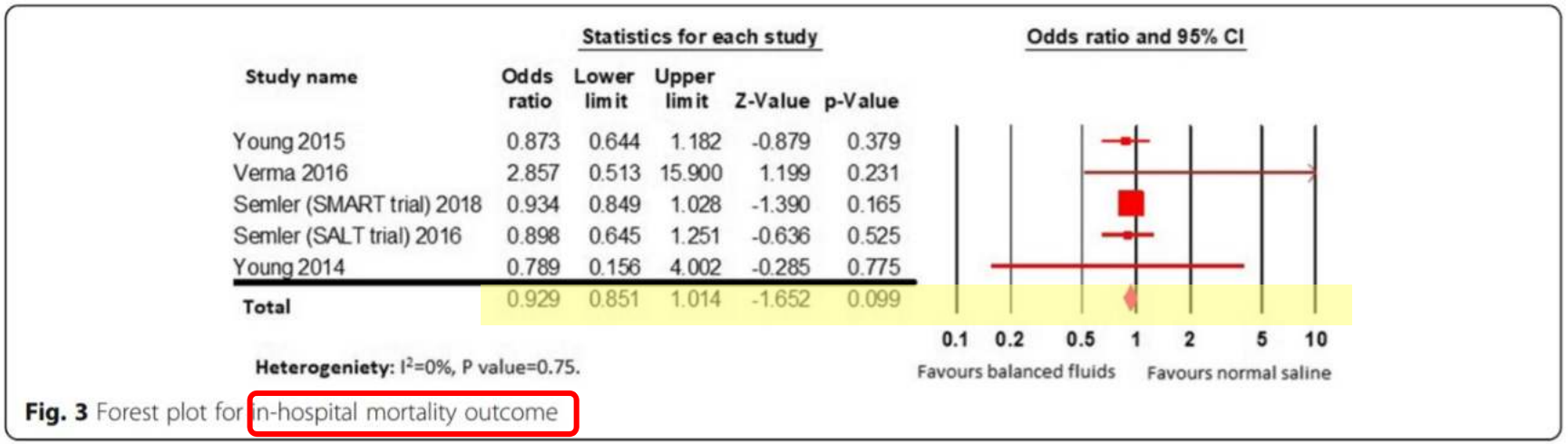


Fig. 3 Forest plot for in-hospital mortality outcome

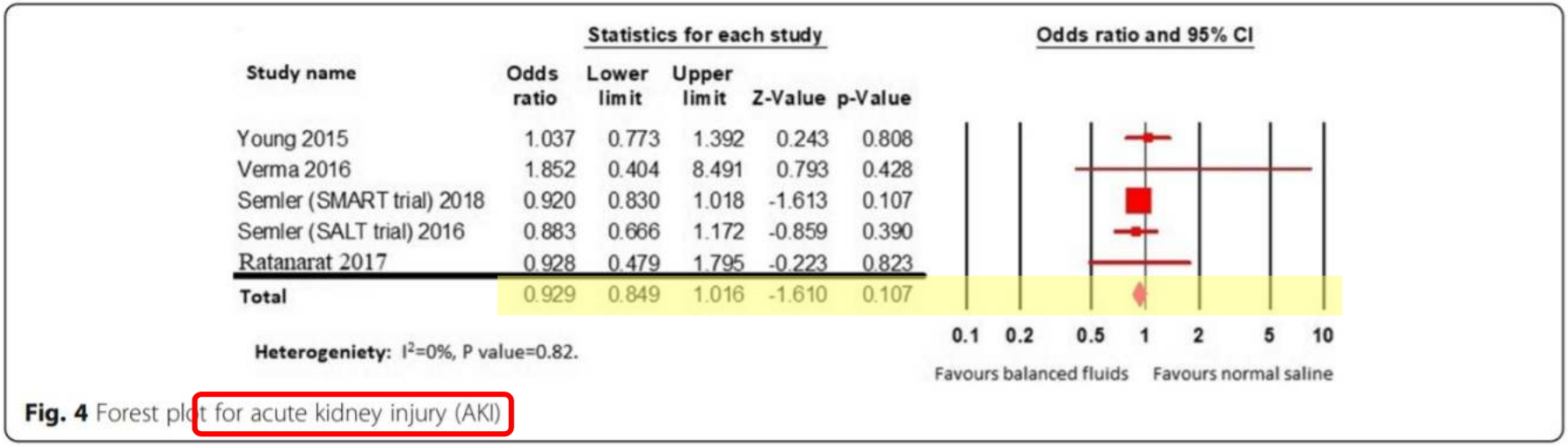
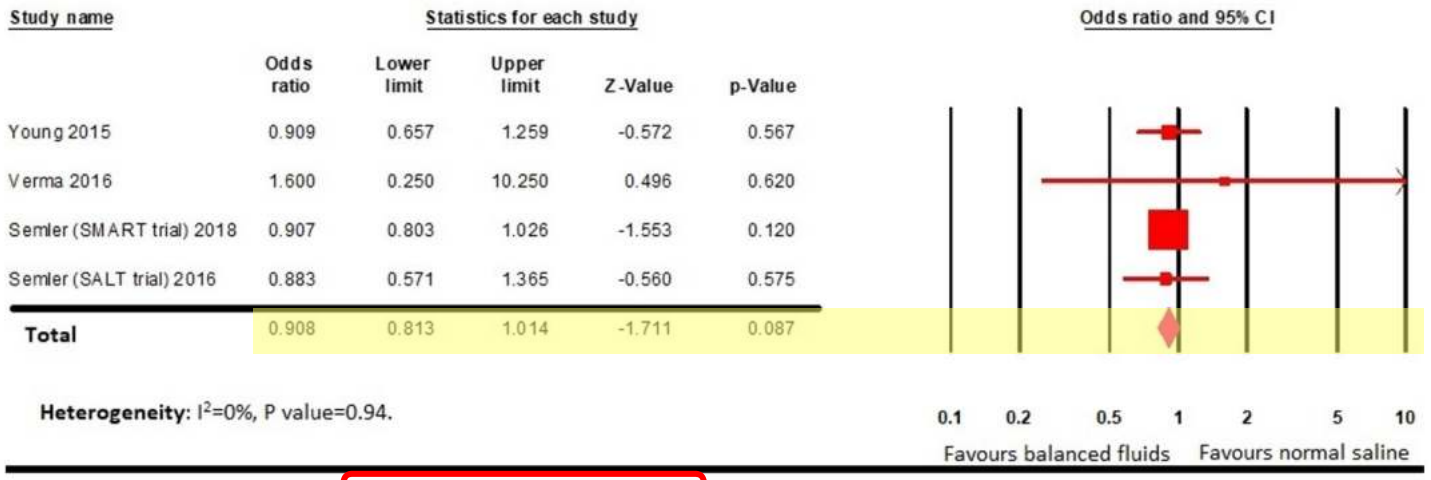
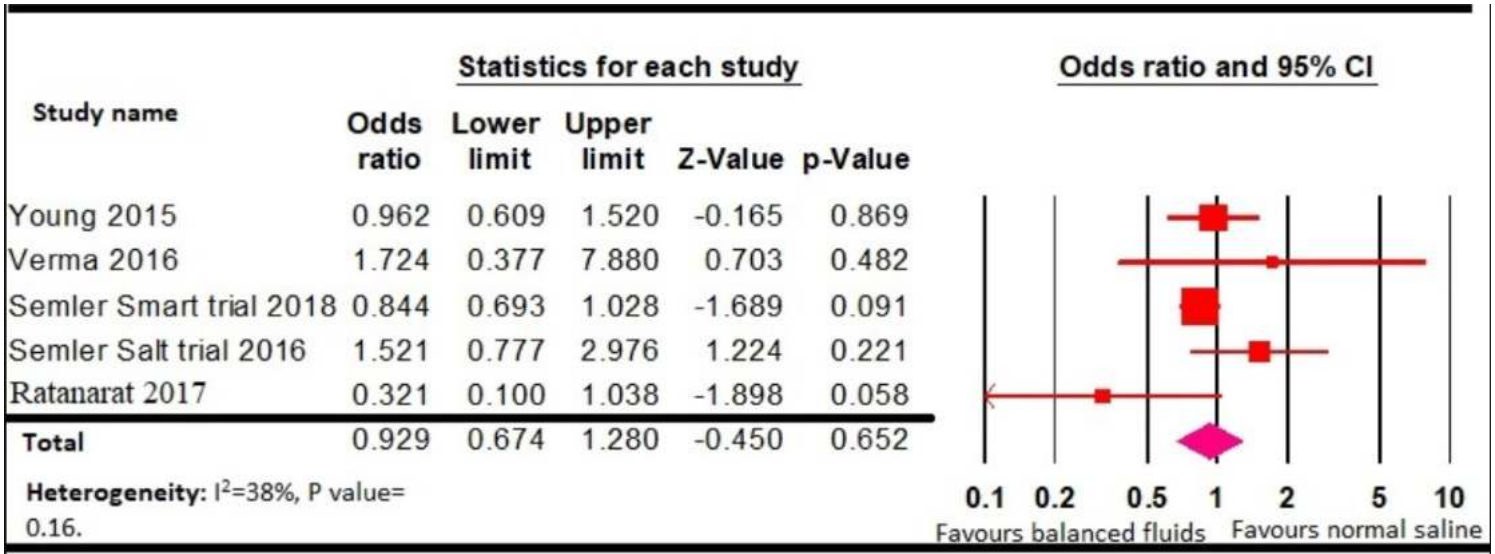


Fig. 4 Forest plot for acute kidney injury (AKI)



Supplemental figure 1: Forest plot of intensive care unit (ICU) mortality.



Supplemental figure 2: Forest Plot for new renal replacement therapy

Cristalloïdes balancés versus Cristalloïdes NB (SSI 0.9%)

Cochrane Database of Systematic Reviews | Review - Intervention

Buffered solutions versus 0.9% saline for resuscitation in critically ill adults and children

Alba M Antequera Martín, Jesus A Barea Mendoza, Alfonso Muriel, Ignacio Sáez, Mario Chico-Fernández, José M Estrada-Lorenzo, Maria N Plana Authors' declarations of interest

Version published: 19 July 2019 Version history

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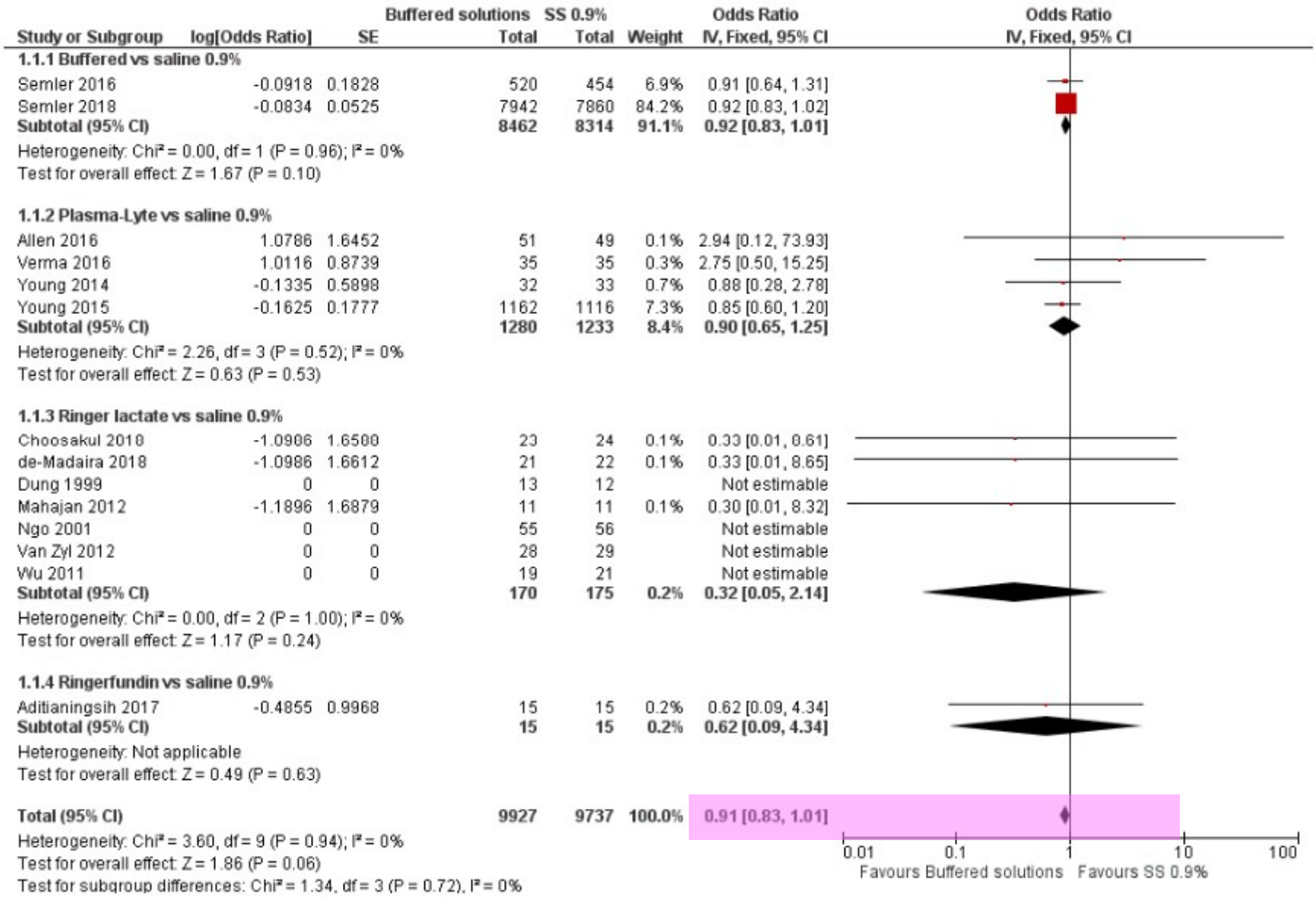
21 RCTs (20,213 participants)

Setting: ICUs in Africa (South Africa), Asia, Europe, Middle East, and North America
Intervention: buffered solutions
Comparison: 0.9% saline

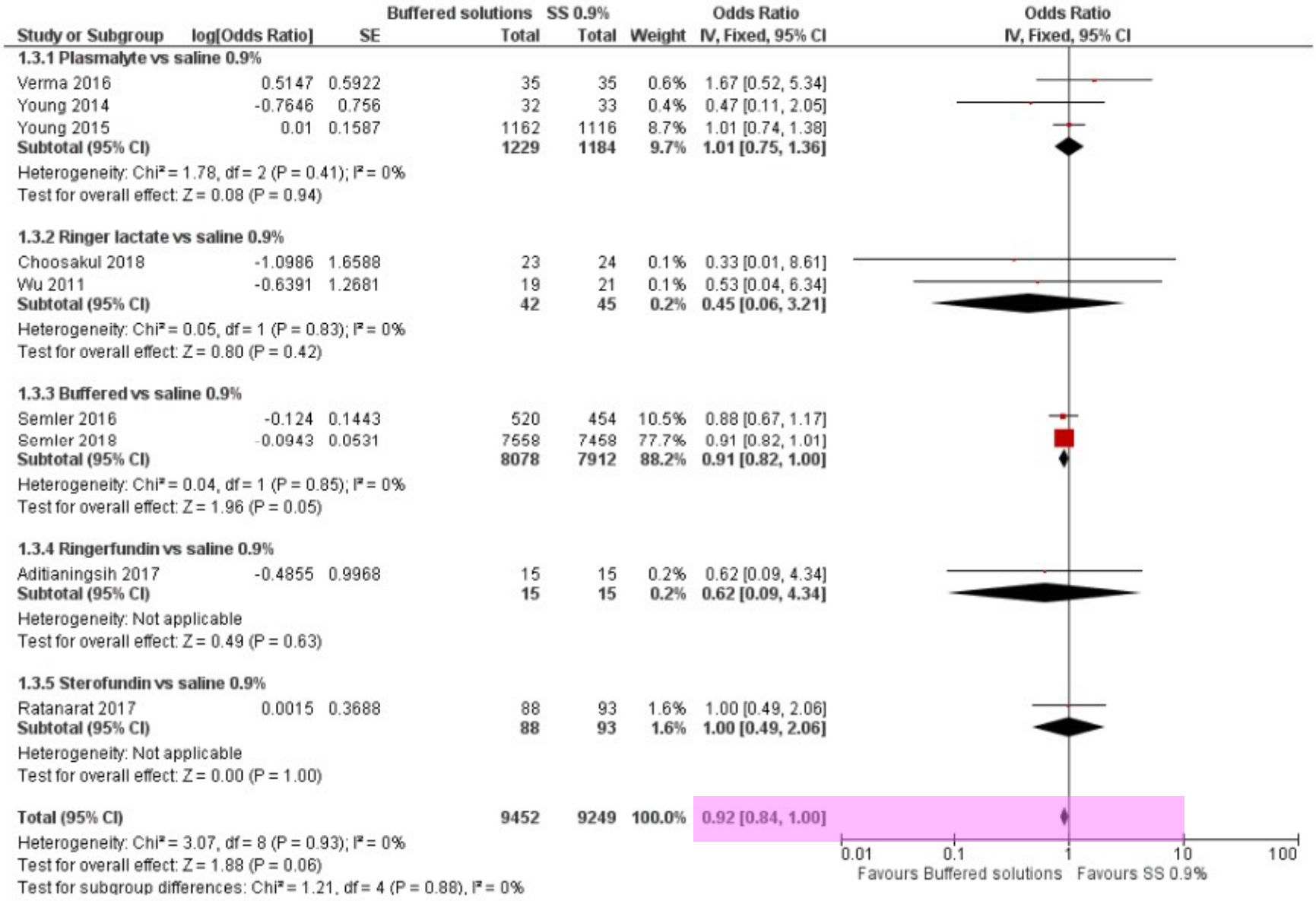
(EV ou entretien)

Primary outcomes



Forest plot of comparison: 1 Buffered solutions vs SS 0.9% (saline solution), outcome: .1 Mortality.

Primary outcomes



Forest plot of comparison: 1 Buffered solutions vs SS 0.9% (saline solution), outcome: 1. Acute renal injury.

Secondary outcomes

Outcomes	Anticipated absolute effects* (95% CI)		Odds ratio (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)
	Risk with saline 0.9%	Risk with buffered solutions			
Organ system dysfunction (during admission)	Study population 156 per 1000	137 per 1000 (81 to 235)	OR 0.80 (0.40 to 1.61)	266 (5 RCTs)	⨁⊖⊖⊖ Very low[d-g]
Electrolyte disturbances					
Plasma potassium, mmol/L (during admission)	Median potassium in control groups was 3.55	MD 0.09 (-0.10 to 0.27)	-	158 (4 RCTs)	⨁⊖⊖⊖ Very low[d-g]
Plasma chloride, mmol/L (during admission)	Median chloride in control groups was 109.75	MD -3.02 (-5.24 to -0.80)	-	351 (7 RCTs)	⨁⊖⊖⊖ Very low[d-g]
Plasma pH (during admission)	Median pH in control groups was 7.36	MD 0.04 (0.02 to 0.06)	-	200 (3 RCTs)	⨁⊖⊖⊖ Very low[d-g]
Plasma bicarbonate, mmol/L (during admission)	Median bicarbonate in control groups was 19.75	MD 2.26 (1.25 to 3.27)	-	344 (6 RCTs)	⨁⊖⊖⊖ Very low[d-g]

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the __relative effect__ of the intervention (and its 95% CI). * The basis for the basal risk assumption in continuous outcomes is the median control group response across studies. CI: confidence interval; MD: mean difference; OR: odds ratio; RCT: randomized controlled trial.

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Buffered solutions versus 0.9% saline for resuscitation in critically ill adults and children

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https://doi.org/10.1002/14651858.CD012247.pub2

Authors' conclusions

We found no effect of buffered solutions on preventing in-hospital mortality compared to 0.9% saline solutions in critically ill patients. The certainty of evidence for this finding was high, indicating that further research would detect little or no difference in mortality. The effects of buffered solutions and 0.9% saline solutions on preventing acute kidney injury were similar in this setting. The certainty of evidence for this finding was low, and further research could change this conclusion. Patients treated with buffered solutions showed lower chloride levels, higher levels of bicarbonate, and higher pH. The certainty of evidence for these findings was very low. Future research should further examine patient-centred outcomes such as quality of life. The three ongoing studies once published and assessed may alter the conclusions of the review.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Balanced Crystalloids versus Saline in Critically Ill Adults

Matthew W. Semler, M.D., Wesley H. Self, M.D., M.P.H.

Design:
Essai simple aveugle, randomisé en grappes, à croisements multiples
5 ICU de CHU-Vanderbilt (USA)

Groupe SSI 0,9% IV
Groupe SB: soit RL soit Plasmalyte A, selon la préférence du clinicien traitant

Critère de jugement principal :

- •EI rénal majeur dans les 30 jours ,
- •Critère composé: décès quelle qu'en soit la cause, EER, ou dysfonctionnement rénal persistant (élévation du taux de créatinine à ≥ 200 % de la valeur initiale)

SMART-MED and SMART-SURG ClinicalTrials.gov numbers, NCT02444988 and NCT02547779.)

N Engl J Med 2018;378:829-39.
DOI: 10.1056/NEJMoa1711584

Table 1. Participant Characteristics at Baseline.*

Characteristic	Balanced Crystalloids (N = 7942)	Saline (N = 7860)
Age — yr		
Median	58	58
Interquartile range	44–69	44–69
Male sex — no. (%)	4540 (57.2)	4557 (58.0)
White race — no. (%)†	6384 (80.4)	6322 (80.4)
Weight — kg‡		
Median	80	79
Interquartile range	69–96	68–95
Coexisting renal conditions — no. (%)		
Chronic kidney disease of stage 3 or higher§	1388 (17.5)	1360 (17.3)
Previous receipt of renal-replacement therapy — no. (%)	384 (4.8)	402 (5.1)
Source of admission to ICU — no. (%)		
Emergency department	3975 (50.1)	3997 (50.9)
Operating room	1732 (21.8)	1649 (21.0)
Transfer from another hospital	1038 (13.1)	1018 (13.0)
Hospital ward	788 (9.9)	780 (9.9)
Outpatient	363 (4.6)	359 (4.6)
Another ICU within hospital	46 (0.6)	57 (0.7)
Diagnosis on ICU admission — no. (%)		
Sepsis or septic shock	1167 (14.7)	1169 (14.9)
Traumatic brain injury	698 (8.8)	665 (8.5)
Mechanical ventilation — no. (%)	2723 (34.3)	2731 (34.7)
Vasopressors — no. (%)	2094 (26.4)	2058 (26.2)
Mean predicted risk of in-hospital death — % (95% CI)¶	9.4 (9.0–9.9)	9.6 (9.2–10.0)
Baseline creatinine level — mg/dl‖		
Median	0.89	0.89
Interquartile range	0.74–1.10	0.74–1.10
Acute kidney injury of stage 2 or higher — no. (%)**	681 (8.6)	643 (8.2)

There were no significant differences in baseline characteristics between the two study groups (P values range from 0.12 to 0.94)

Table 2. Clinical Outcomes.*

Outcome	Balanced Crystalloids (N=7942)	Saline (N=7860)	Adjusted Odds Ratio (95% CI)†	P Value†
Primary outcome				
Major adverse kidney event within 30 days — no. (%)‡	1139 (14.3)	1211 (15.4)	0.90 (0.82 to 0.99)	0.04
Components of primary outcome				
In-hospital death before 30 days — no. (%)	818 (10.3)	875 (11.1)	0.90 (0.80 to 1.01)	0.06
Receipt of new renal-replacement therapy — no./total no. (%)§	189/7558 (2.5)	220/7458 (2.9)	0.84 (0.68 to 1.02)	0.08
Among survivors	106/6787 (1.6)	117/6657 (1.8)		
Final creatinine level ≥200% of baseline — no./total no. (%)§	487/7558 (6.4)	494/7458 (6.6)	0.96 (0.84 to 1.11)	0.60
Among survivors	259/6787 (3.8)	273/6657 (4.1)		
Among survivors without new renal-replacement therapy	215/6681 (3.2)	219/6540 (3.3)		
Secondary renal outcomes§				
Stage 2 or higher AKI developing after enrollment — no./total no. (%)‖	807/7558 (10.7)	858/7458 (11.5)	0.91 (0.82 to 1.01)	0.09
Creatinine — mg/dl**				
Highest before discharge or day 30			1.01 (0.97 to 1.05)	0.58
Median	0.99	0.99		
Interquartile range	0.78 to 1.53	0.78 to 1.52		
Change from baseline to highest value			0.98 (0.94 to 1.02)	0.35
Median	0.04	0.04		
Interquartile range	−0.08 to 0.31	−0.08 to 0.32		

Secondary outcomes				
In-hospital death — no. (%)				
Before ICU discharge	528 (6.6)	572 (7.3)	0.89 (0.78 to 1.02)	0.08
Before 60 days	928 (11.7)	975 (12.4)	0.92 (0.83 to 1.02)	0.13
ICU-free days¶				0.94
Median	25.3	25.3	1.00 (0.89 to 1.13)	
Interquartile range	22.1 to 26.6	22.2 to 26.6		
Mean	21.8±8.3	21.7±8.6		
Ventilator-free days¶			1.06 (0.97 to 1.16)	0.22
Median	28.0	28.0		
Interquartile range	26.0 to 28.0	26.0 to 28.0		
Mean	24.2±8.6	23.9±8.9		
Vasopressor-free days¶			1.05 (0.97 to 1.14)	0.26
Median	28.0	28.0		
Interquartile range	27.0 to 28.0	27.0 to 28.0		
Mean	24.7±8.5	24.4±8.8		
Renal-replacement therapy–free days¶			1.11 (1.02 to 1.20)	0.01
Median	28.0	28.0		
Interquartile range	28.0 to 28.0	28.0 to 28.0		
Mean	25.0±8.6	24.8±8.9		

Outcome	Balanced Crystalloids (N=7942)	Saline (N=7860)	Adjusted Odds Ratio (95% CI)†	P Value†
Final value before discharge or 30 days			1.02 (0.97 to 1.06)	0.51
Median	0.83	0.83		
Interquartile range	0.70 to 1.11	0.70 to 1.11		

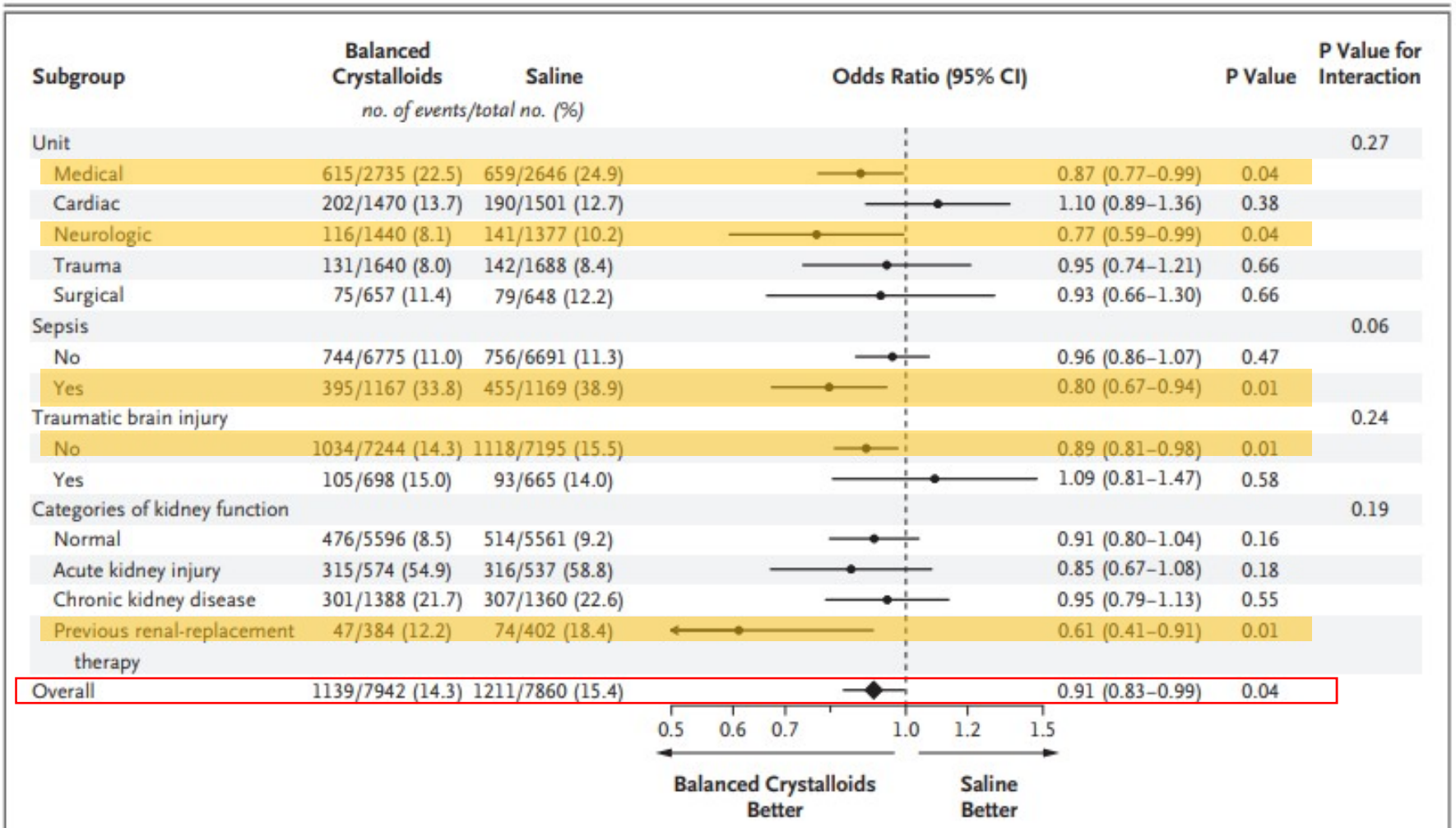


Figure 3. Subgroup Analysis of R **placement Therapy, or Persistent Renal Dysfunction.**

In conclusion, in this trial involving critically ill adults, intravenous administration of balanced crystalloids rather than saline had a favorable effect on the composite outcome of death, new renal-replacement therapy, or persistent renal dysfunction.

Research

JAMA. 2021;326(9):818-829. doi:10.1001/jama.2021.11684
Published online August 10, 2021.

JAMA | Original Investigation

Effect of Intravenous Fluid Treatment With a Balanced Solution vs 0.9% Saline Solution on Mortality in Critically Ill Patients
The BaSICS Randomized Clinical Trial

Fernando G. Zampieri, MD, PhD; Flávia R. Machado, MD, PhD; Rodrigo S. Biondi, MD; Flávio G. R. Freitas, MD, PhD; Viviane C. Veiga, MD, PhD; Rodrigo C. Figueiredo, MD; Wilson J. Lovato, MD; Cristina P. Amêndola, MD, PhD; Ary Serpa-Neto, MD, PhD; Jorge L. R. Paranhos, MD; Marco A. V. Guedes, MD, PhD; Eraldo A. Lúcio, MD, PhD; Lúcio C. Oliveira-Júnior, MD; Thiago C. Lisboa, MD, PhD; Fábio H. Lacerda, MD; Israel S. Maia, MD; Cintia M. C. Grion, MD, PhD; Murillo S. C. Assunção, MD, PhD; Airton L. O. Manoel, MD, PhD; João M. Silva-Junior, MD, PhD; Péricles Duarte, MD; Rafael M. Soares, PhD; Tamiris A. Miranda, MSc; Lucas M. de Lima, IT; Rodrigo M. Gurgel, Biomed Sci; Denise M. Paisani, PhD; Thiago D. Corrêa, MD, PhD; Luciano C. P. Azevedo, MD, PhD; John A. Kellum, MD; Lucas P. Damiani, MSc; Nilton Brandão da Silva, MD, PhD; Alexandre B. Cavalcanti, MD, PhD; for the BaSICS investigators and the BRICNet members

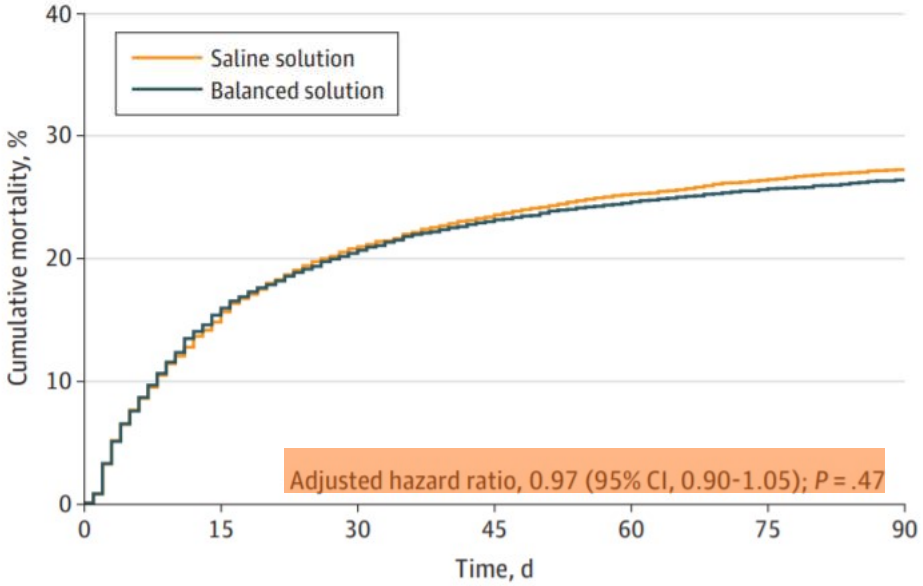
TRIAL REGISTRATION ClinicalTrials.gov Identifier: NCT02875873

- Essai clinique randomisé en double aveugle
- 75 USI au Brésil
- Patients: besoin d'au moins 1 EV
- **SB (**Plasma-Lyte /RL**)(n=5522) VS SS à 0,9% (n=5530)**
- Critère de jugement principal: survie à 90 jours

- chirurgie planifiée: 48,4 %
- 60,6 % hypotension ou vasopresseurs
- 44,3 % ventilation mécanique
- 1,5 L en moy de liquide J1

Caractéristiques de base: similaires

Figure 3. Cumulative Incidence of the Primary Outcome of 90-Day Survival for a Balanced Solution vs Saline Solution (0.9% Sodium Chloride)



No. at risk							
Saline solution	5290	4492	4172	4034	3937	3875	3829
Balanced solution	5230	4407	4139	4004	3922	3863	3821

The median follow-up was 90 days (interquartile range, 59.2-90.0 days) for the balanced solution group and 90 days (interquartile range, 54-90 days) for the saline solution group.

Adverse Events

There were no unexpected treatment-related severe adverse events in either group.

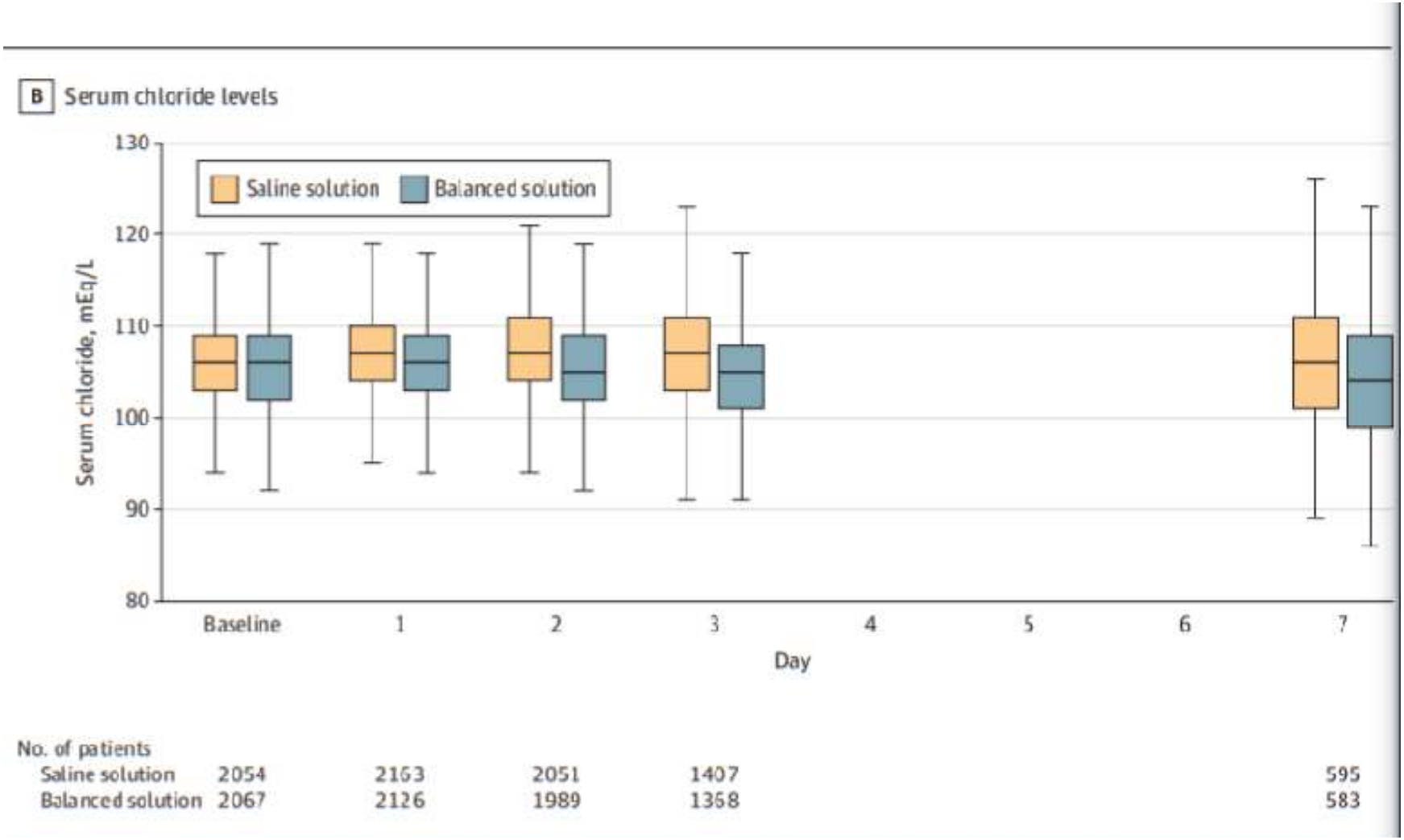
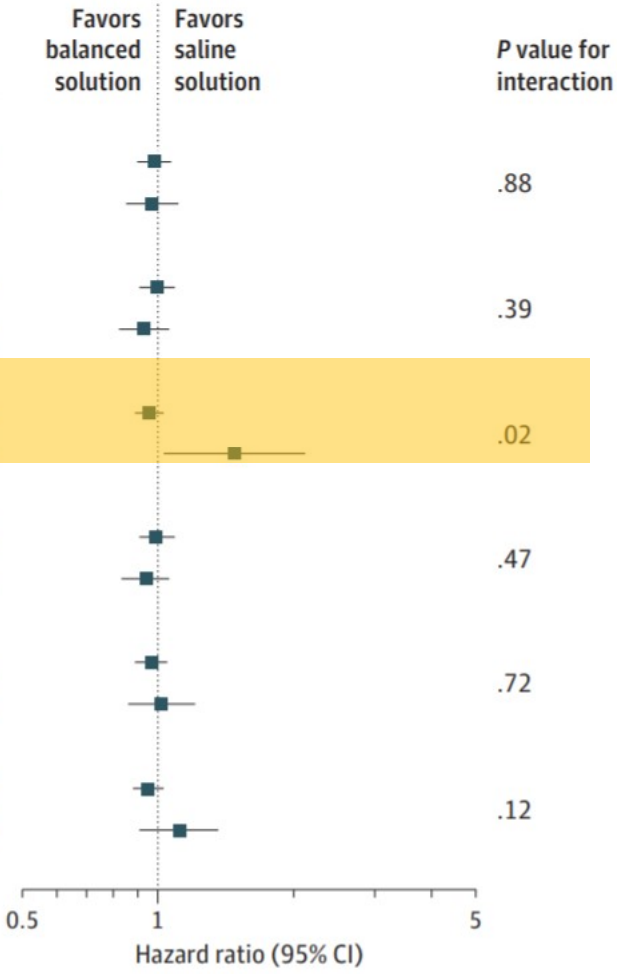


Figure 4. Forest Plot for the Primary Outcome of 90-Day Survival in the Prespecified Subgroup Analyses

Subgroup	No. for 90-d mortality/total (%)[a] Balanced solution	Saline solution[b]	Hazard ratio (95% CI)	*P* value for interaction
KDIGO stage for acute kidney injury[c]				
<2	989/4360 (22.7)	995/4350 (22.9)	0.98 (0.90-1.07)	.88
≥2	392/870 (45.1)	444/940 (47.2)	0.97 (0.85-1.11)	
Sepsis				
No	928/4260 (21.8)	941/4273 (22.0)	1.00 (0.91-1.09)	.39
Yes	453/970 (46.7)	498/1017 (49.0)	0.93 (0.82-1.06)	
Traumatic brain injury				
No	1303/4981 (26.2)	1389/5053 (27.5)	0.96 (0.89-1.03)	.02
Yes	78/249 (31.3)	50/237 (21.1)	1.48 (1.03-2.12)	
Surgical patients				
No	880/2078 (42.3)	891/2046 (43.5)	0.99 (0.91-1.09)	.47
Yes	501/3152 (15.9)	548/3244 (16.9)	0.94 (0.83-1.06)	
APACHE II score[d]				
<25	1131/4865 (23.2)	1170/4886 (23.9)	0.97 (0.89-1.05)	.72
≥25	250/365 (68.5)	269/404 (66.6)	1.02 (0.86-1.21)	
Administration of saline solution 24 h before randomization, L				
<1.0	1181/4277 (27.6)	1229/4286 (28.7)	0.95 (0.88-1.03)	.12
≥1.0	193/935 (20.6)	203/994 (20.4)	1.12 (0.91-1.36)	



CONCLUSION AND RELEVANCE Among critically ill patients requiring fluid challenges, use of a balanced solution compared with 0.9% saline solution did not significantly reduce 90-day mortality. The findings do not support the use of this balanced solution.

ORIGINAL

Sodium chloride or Plasmalyte-148 evaluation in severe diabetic ketoacidosis (SCOPE-DKA): a cluster, crossover, randomized, controlled trial

Mahesh Ramanan[1,2,3,4*], Antony Attokaran[5], Lauren Murray[6], Neeraj Bhadange[7], David Stewart[8], Gokulnath Rajendran[9], Raju Pusapati[10], Melissa Petty[1], Peter Garrett[6], Peter Kruger[11], Sandra Peake[12], Laurent Billot[3] and Balasubramanian Venkatesh[3,13] on behalf of the SCOPE-DKA Collaborators and Queensland Critical Care Research Network (QCCRN)

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Intensive Care Med
https://doi.org/10.1007/s00134-021-06480-5

- Essai phase 2 croisé, ouvert, randomisé et contrôlé
- Patients admis ds 7 USI australiennes pr CAD sévère
- Critère de jugement principal: résolution CAD (base excess à ≥−3 mEq/L à 48 h)

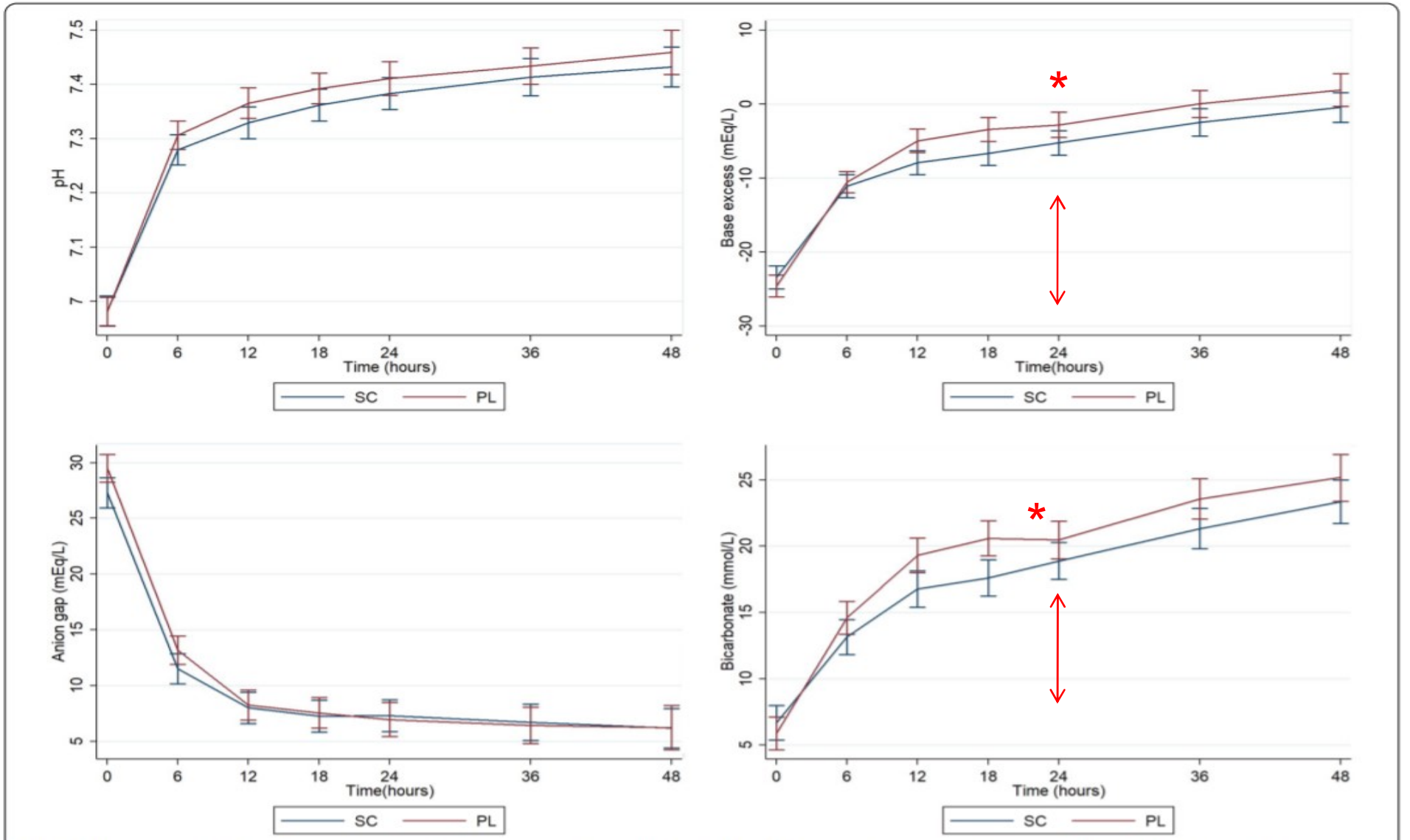

Fig. 2 Changes in pH, base excess, anion and bicarbonate during the first 48 h in the intensive care unit are shown here with 95% confidence intervals. Estimates presented here were generated using mixed-effects models to account for repeated measures. *SC* 0.9% sodium chloride, *PL* Plasmalyte-148

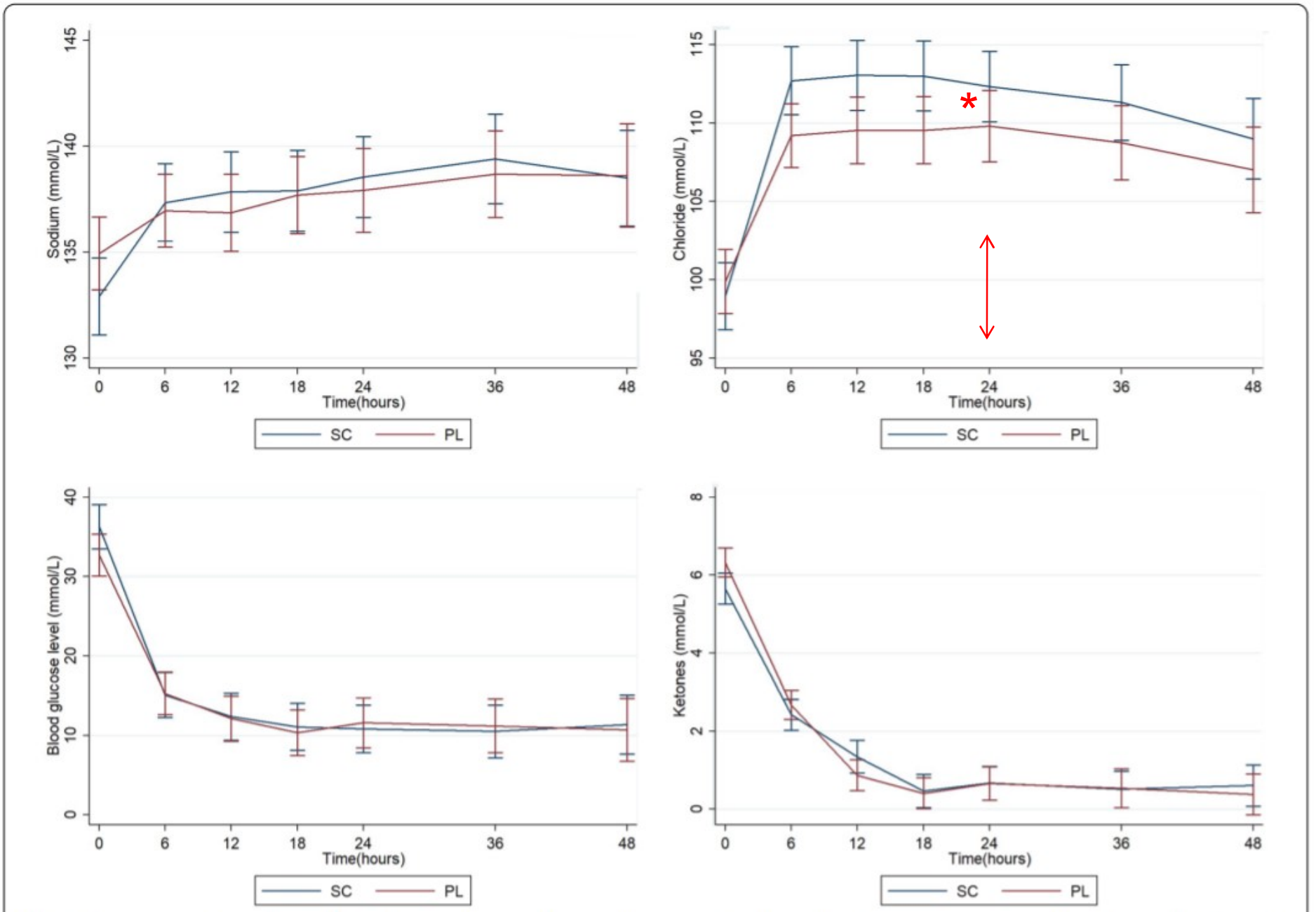

Fig. 3 Changes in sodium, chloride, blood glucose level and ketones during the first 48 h in the intensive care unit are shown here with 95% confidence intervals. Estimates presented here were generated using mixed-effects models to account for repeated measures. *SC* 0.9% sodium chloride, *PL* Plasmalyte-148

Table 2 Resolution of diabetic ketoacidosis

Outcome	PL $n=48$	SC $n=42$	Odds ratio (PL vs NS)	95% confidence interval	*p* values*
Primary outcome					
Base excess > − 3.0 mEq/L at 48 h	46 (96%)	36 (86%)	3.93	0.73–21.16	0.111
Pre-specified sensitivity analyses					
Base excess > − 3.0 mEq/L at 24 h	33 (69%)	15 (36%)	4.24	1.68–10.72	0.002
ADA criteria for DKA resolution at 24 h	29 (60%)	22 (52%)	1.47	0.61–3.52	0.390
Post-hoc sensitivity analyses					
Addition of base excess at presentation	46 (96%)	36 (86%)	4.15	0.77–22.34	0.097
Addition of diabetes type	46 (96%)	36 (86%)	3.15	0.52–18.96	0.211
Addition of both base excess at presentation and diabetes type	46 (96%)	36 (86%)	2.95	0.50–17.54	0.234

Data in columns 'PL' and NS' are *n* (%)

PL Plasmalyte-148, *SC* 0.9% sodium chloride, *ADA* American Diabetes Association, *DKA* diabetic ketoacidosis

**p* values: All results were generated from a mixed effects logistic regression model with treatment allocation (PL versus SC) as a fixed effect and site as a random effect. For the post-hoc sensitivity analyses, the specified fixed effect/s were added. The odds ratio for resolution of diabetic ketoacidosis in PL group compared to the SC group are presented, therefore, an odds ratio greater than 1 indicates an increase in resolution with PL treatment

Conclusion

In conclusion, for patients with severe DKA, treatment with PL compared to SC may result in faster resolution of metabolic acidosis. The use of PL was not associated with an increase in ketone generation.

Quel soluté pour quelle indication?

Le choix s'effectue en fonction:

- Propriétés physico-chimiques et pharmaco du soluté (Pouvoir EV, Durabilité)
- Effets secondaires
- Contexte clinique

PRATIQUE GENERALE…….

- **SSI 0.9%:** Hypovolémies toutes causes, déshydratation EC
- **RL:** péri-opératoire, compensation du jeûne, brulés, diarrhées, ac. Hyper chl due au SSI 0,9 %
- **HEA, Gélatines:** hémorragie absolue et ds l'attente des CGR, HypoTA au cours des AG
- **SS hypertoniques 7.5% :** ttt d'un OC majeur/TCG
- **ALBUMINE:** HypoV de la femme enceinte, Brûlures étendues, Lyell, Ech. plasma

Si

Recommandations Formalisées d'Experts

« Choix du Soluté pour le remplissage vasculaire en situation critique »

Intravenous fluids for vascular loading

2021

RFE commune SFAR - SFMU

Société Française d'Anesthésie et de Réanimation (SFAR)
Société Française de Médecine d'Urgence (SFMU)

Texte validé par le Comité des Référentiels Cliniques de la SFAR le 10/05/21, le Conseil d'Administration de la SFAR le 19/05/21, et le Conseil d'Administration de la SFMU le 29/06/21.

4 champs:
ESG/choc hémorragique/ cérébrolésés/ péripartum

Exclus: cirrhose, pancréatite aigüe, SDRA, Ice rénale et les enfants
Type de soluté++
Ni quantité de solutés ni manière d'administration

CHAMP 1 : Patients atteints de sepsis ou de choc septique

RFE: SFAR+SFMU 2021

Question 1 : Chez les patients atteints de sepsis ou de choc septique, l'utilisation d'un soluté colloïde, comparativement aux cristalloïdes, permet-elle de diminuer la morbi-mortalité ?

R1.1 – Il n'est pas recommandé d'utiliser les hydroxyéthylamidons pour le remplissage vasculaire au cours du sepsis ou du choc septique, comparativement aux cristalloïdes non hypertoniques, pour diminuer la mortalité et/ou le recours à l'épuration extrarénale.
GRADE 1-, accord FORT
R1.2 – Les experts suggèrent de ne pas utiliser les gélatines pour le remplissage vasculaire au cours du sepsis ou du choc septique, comparativement aux cristalloïdes non hypertoniques, pour diminuer la mortalité et/ou le recours à l'épuration extrarénale.
Avis d'experts, accord FORT
R1.3 – Il n'est probablement pas recommandé d'utiliser en première intention de l'albumine au cours du sepsis ou du choc septique, comparativement aux cristalloïdes, pour diminuer la mortalité ou le recours à l'épuration extrarénale.
GRADE 2-, accord FORT

Question 2. Chez les patients atteints de sepsis ou de choc septique, l'utilisation d'un type particulier de cristalloïde permet-elle de diminuer la morbi-mortalité?

R1.4 – Chez les patients atteints de sepsis ou de choc septique, il est probablement recommandé d'utiliser des solutés cristalloïdes balancés pour le remplissage vasculaire pour diminuer la mortalité et/ou la survenue d'évènements indésirables rénaux.
• **Arg: SMART RCT++** **GRADE 2+, accord FORT**

Critical Care Medicine
Society of Critical Care Medicine

Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock 2021

Evans, Laura[1]; Rhodes, Andrew[2]; Alhazz
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Schorr, Christa[11]; Simpson, Steven[12]; Wi
Yaseen[16]; Azevedo, Luciano[17]; Beale, Ric
Cecconi, Maurizio[22]; Centofanti, John[23];
Kent[27]; Du, Bin[28]; Estenssoro, Elisa[29]; Fe
Møller, Morten[33]; Iwashyna, Theodore[34]
Younsuck[38]; Kumar, Anand[39]; Kwizera, A
Mehta, Sangeeta[44]; Mehta, Yatin[45]; Mer,
Tiffany[49]; Papathanassoglou, Elizabeth[5]
Schweickert, William[54]; Seckel, Maureen
Zimmerman, Janice[59]; Levy, Mitchell[60]

Author Information

Critical Care Medicine: November 2021
doi: 10.1097/CCM.0000000000005337

Recommendations 2021	Recommendation Strength and Quality of Evidence	Changes From 2016 Recommendations
5. For patients with sepsis induced hypoperfusion or septic shock we suggest that at least 30 mL/kg of IV crystalloid fluid should be given within the first 3 hr of resuscitation.	**Weak**, *low quality of evidence*	**DOWNGRADE** from ***Strong*** , low quality of evidence "We **recommend** that in the initial resuscitation from sepsis-induced hypoperfusion, at least 30 mL/kg of IV crystalloid fluid be given within the first 3 hr"

Choix libre SSI 0,9% ou SB....

CHAMP 2 : Patients en situation de choc hémorragique

Question 1 : Chez les patients en situation de choc hémorragique, l'utilisation d'un soluté colloïde, comparativement aux cristalloïdes, permet-elle de diminuer la morbi-mortalité ?

R2.1 – Chez les patients en situation de choc hémorragique, quel que soit le contexte, il n'est probablement pas recommandé d'utiliser un colloïde comme soluté de remplissage vasculaire, comparativement aux cristalloïdes non hypertoniques, pour diminuer la mortalité et/ou le recours à l'épuration extrarénale
GRADE 2-, accord FORT

Question 2 : Chez les patients en situation de choc hémorragique, l'utilisation d'un type particulier de cristalloïde permet-elle de diminuer la morbi-mortalité?

R2.2 – Chez les patients en situation de choc hémorragique, il est probablement recommandé d'utiliser des solutés cristalloïdes balancés en première intention plutôt que du NaCl 0,9% comme soluté de remplissage vasculaire pour diminuer la mortalité et/ou les évènements indésirables rénaux.
GRADE 2+, accord FORT

R2.3 – Chez les patients en situation de choc hémorragique, il n'est pas recommandé d'administrer un soluté salé hypertonique à 3% ou 7,5% en première intention comme soluté de remplissage vasculaire pour diminuer la mortalité.
GRADE 1-, accord FORT

RFE: SFAR+SFMU 2021

Spahn *et al. Critical Care* (2019) 23:98
https://doi.org/10.1186/s13054-019-2347-3

Critical Care

RESEARCH Open Access

The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition

Donat R. Spahn[1], Bertil Bouillon[2], Vladimir Cerny[3,4,5,6], Jacques Duranteau[7], Daniela Filipescu[8], Beverley J. Hunt[9], Radko Komadina[10], Marc Maegele[11], Giuseppe Nardi[12], Louis Riddez[13], Charles-Marc Samama[14], Jean-Louis Vincent[15] and Rolf Rossaint[16*]

Type of fluid

Recommendation 15 We recommend that fluid therapy using isotonic crystalloid solutions be initiated in the hypotensive bleeding trauma patient. (Grade 1A)

We recommend the use of balanced electrolyte solutions and the avoidance of saline solutions. (Grade 1B)

We recommend that hypotonic solutions such as Ringer's lactate be avoided in patients with severe head trauma. (Grade 1B)

We recommend that the use of colloids be restricted due to the adverse effects on haemostasis. (Grade 1C)

CHAMP 3 : Patients cérébrolésés

Question 1. Chez les patients cérébrolésés, comparativement aux cristalloïdes, l'utilisation d'un soluté colloïde pour le remplissage vasculaire permet-elle de diminuer la morbi-mortalité ?

R3.1 – Il n'est probablement pas recommandé d'utiliser des colloïdes, en particulier l'albumine, comme soluté de remplissage chez les patients cérébrolésés pour diminuer la mortalité et/ou améliorer le pronostic neurologique.
GRADE 2-, accord FORT

Question 2. Chez les patients cérébrolésés, l'utilisation d'un type particulier de cristalloïde permet-elle de diminuer la morbi-mortalité?

R3.2 - Il est probablement recommandé d'utiliser des cristalloïdes isotoniques, en première intention, comme soluté de remplissage vasculaire chez les patients cérébrolésés pour diminuer la mortalité et/ou améliorer le pronostic neurologique.
GRADE 2+, accord FORT

RFE: SFAR+SFMU 2021

CHAMP 4 : Patientes en péripartum

Question 1 : Dans le péripartum, l'utilisation d'un type particulier de soluté permet-elle de diminuer la morbi-mortalité maternelle et/ou néonatale ?

RFE: SFAR+SFMU 2021

ABSENCE DE RECOMMANDATION – Du fait de l'absence de donnée disponible dans la littérature, aucune recommandation spécifique ne peut être émise concernant le choix du soluté de remplissage vasculaire à utiliser dans la prise en charge réanimatoire des femmes en péripartum.

Box 5: Recommendations for the treatment of PPH - fluid resuscitation

15. The use of isotonic crystalloids is recommended in preference to the use of colloids for the intravenous fluid resuscitation of women with PPH. (Strong recommendation, low-quality evidence)

World Health Organization 2014

Cétoacidose diabétique

JBDS-IP Joint British Diabetes Societies for inpatient care

The Management of Diabetic Ketoacidosis in Adults*

Revised June 2021

2. Colloid versus crystalloid?

A 2007 Cochrane review also did not support the use of colloid in preference to crystalloid fluid (34). A further 2013 consensus document suggested that colloids should be avoided where possible, due to a potential risk of increased mortality and morbidity associated with their use (35). Therefore, we recommend the use of crystalloid fluid as the initial fluid of choice.

3. 0.9% sodium chloride solution or balanced crystalloid solution for resuscitation?

may be given (39). The result of a systematic review on the choice of crystalloid fluid replacement in hyperglycaemic emergencies is awaited (40). Until then, we continue to recommend that 0.9% sodium chloride with pre-mixed potassium chloride be the default solution for fluid resuscitation because it is compliant with NPSA recommendations. Furthermore, diabetes specialists and physicians have a vast experience in the safe use of this fluid. We also recognise that many critical care units will prefer to use balanced crystalloids such as Hartmann's solution. This is acceptable provided local policies are followed for the safe administration of additional potassium chloride.

NPSA: National Patient Safety Agency

CONCLUSION

- L'arrivée de nouveaux solutés et la publication de grands essais cliniques : vision plus claire quant à la spécificité de prescription des SR
- De nombreuses questions persistent…
- Chaque praticien doit exercer son jugement, prenant en compte son expertise et les spécificités de son établissement

- **SB**: soluté de choix de 1ère intention dans la majorité des indications de RV
  - **SSI 0,9%:** cérébrolésés, CAD+/-, à défaut des SB
    - Colloïdes : à abandonner ?……

MERCI POUR ATTENTION