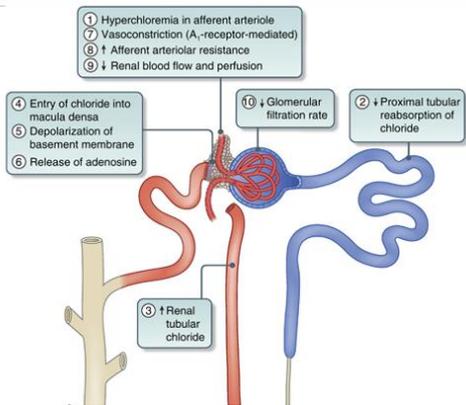


# Clinical update no. 510

21 March 2018

What fluid is best? 2 studies in ICU and ED.

"I don't care if you use dog's piss, as long as you use it carefully."  
Malcolm Fisher AO



Hyperchloraemia gives vasoconstriction in the glomerulus leading to reduced GFR and urine output, with worsening of renal function.

0.9% saline has a strong ion difference (SID) of 0, i.e. Na 155 mmol/L, Cl 155 mmol/L, and induces a hyperchloraemic (non gap) acidosis. Fluids with a SID of about 24 have a neutral effect on pH (e.g. Hartmann's). Fluids with SID >24 lead to alkalosis, e.g. Plasmalyte.

Compare SID of fluid and s. HCO3

- Same: pH unchanged
- SID > HCO3: alkalotic
- SID < HCO3: acidotic



Albumin is weak acid  
Balanced fluid has SID 24-28

Intens Care Med 2011;37:461-

Whats the evidence?

THE NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Balanced Crystalloids versus Saline in Critically Ill Adults

and Todd W. Rice, M.D., for the SMART Investigators and the Pragmatic Critical Care Research Group\*

N ENGL J MED 378:9 NEJM.ORG MARCH 1, 2018

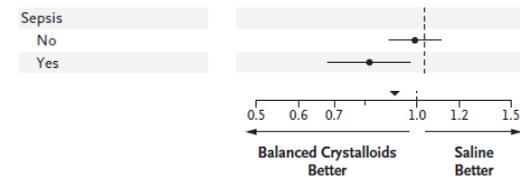
15,802 adult ICU patients were randomised to 0.9% saline or balanced crystalloids (lactated Ringer's/Hartmann's or Plasma-Lyte A). Primary outcome was a 30 day composite of death, renal-replacement therapy, or persistent renal dysfunction (elevated creatinine ≥200% of baseline) at hospital discharge or 30 days.

A composite outcome event occurred in 14.3% given balanced crystalloids v 15.4% given saline, OR 0.91 (CI 0.84 - 0.99; p = 0.04). Individual outcome measures were not significantly different.

Table 2. Clinical Outcomes.\*

Outcome	Balanced Crystalloids (N=7942)	Saline (N=7860)	P Value†
<b>Primary outcome</b>			
<b>Components of primary outcome</b>			
In-hospital death before 30 days — no. (%)	818 (10.3)	875 (11.1)	0.06
Receipt of new renal-replacement therapy — no./total no. (%)‡	189/7558 (2.5)	220/7458 (2.9)	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)	0.60

Subgroup analysis suggested balanced crystalloids are better in sepsis. Not conclusive but warrants further study in septic patients.



About 2000ml were given to day 2 – not huge. Chloride concentration was higher and HCO3 was lower respectively in the saline group.

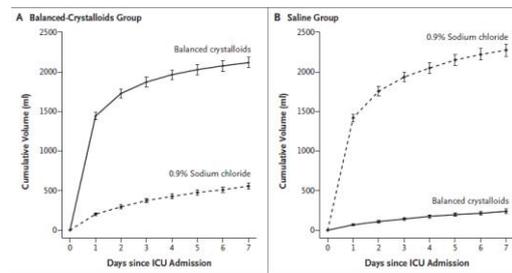


Figure 1. Volume of Intravenous Isotonic Crystalloid Administered According to Group.

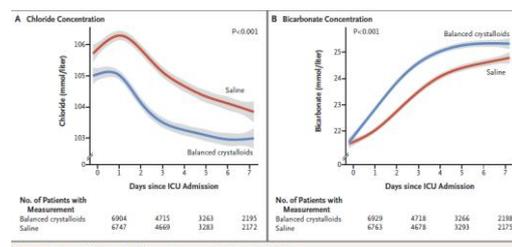


Figure 2. Plasma Chloride and Bicarbonate Concentration According to Group.

ORIGINAL ARTICLE

Balanced Crystalloids versus Saline in Noncritically Ill Adults

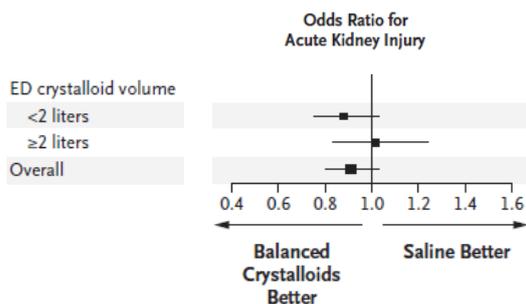
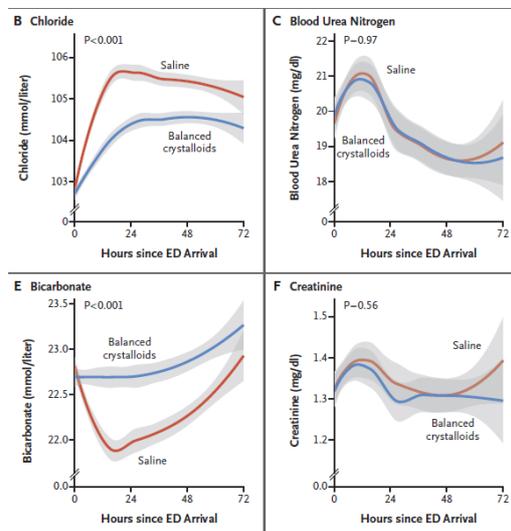
for the SALT-ED Investigators\*

N ENGL J MED 378:9 NEJM.ORG MARCH 1, 2018

13,347 patients treated in ED and admitted to a non-ICU ward were randomised to saline or balanced crystalloids. Primary outcome: hospital-free days at day 28. Secondary outcome: death, renal replacement therapy or persistent elevation of creatinine to  $\geq 200\%$  of baseline to day 30 or discharge.

A median volume of 1079 ml was given in ED. There was no difference in primary outcome. Adverse kidney events were lower with balanced fluids; 4.7 vs. 5.6%; OR 0.82; 95% CI, 0.70 - 0.95; P = 0.01).

In the initial 72 hours after ED arrival the saline group had higher Cl and lower HCO<sub>3</sub> (significant) and higher urea and creatinine (not significantly different).



Odds ratio for AKI was marginally lower with balanced crystalloids, though paradoxically less so with greater volumes given.

Patient-Centered Outcomes and Resuscitation Fluids

John Myburgh, M.D., Ph.D.

None of the currently used resuscitation fluids have been formally evaluated for safety and efficacy. Clinical trials have shown that the type of resuscitation fluid used in critically ill patients may adversely affect patient-centered outcomes. Colloids (albumin) increases mortality in traumatic brain injury. Hydroxyethyl starch gives acute kidney injury and are no longer used.

Crystalloids are preferred over colloids for use in critical care, however 0.9% saline contributes to hyperchloraemic metabolic acidosis and acute kidney injury. Crystalloids with a lower chloride concentration than saline, so called buffered or balanced solutions such as Hartmann's or Plasma-Lyte, have a lower chloride content, but are neither truly buffered nor balanced. They are hypotonic and also contribute to metabolic alkalosis. Substituted anions such as acetate, may have adverse effects and are unstudied.

The 2 trials compared saline with balanced solutions in ward admissions from ED (SALT-ED) or in ICU (SMART).

Use of balanced crystalloids was associated with a significant reduction in the composite outcome of death from any cause, new renal-replacement therapy, or persistent renal dysfunction in both trials; the difference was mostly in reduced kidney injury at day 30.

Caution is required in interpreting these results; the composite outcome of death, renal-replacement therapy, and a doubling of creatinine level as equivalent components is not applicable as a patient-centered outcome.

None of the currently used resuscitation fluids are "physiological," and the trials do not provide unequivocal clinical direction. See also [nejm.org/doi/10.1056/NEJMdo005255/full/](http://nejm.org/doi/10.1056/NEJMdo005255/full/)