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May 4th, 12:00 AM

Brief Review: IV Fluid Choice in the Emergency Department

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Saed, Kaywan; Espinosa, James; and Lucerna, Alan, "Brief Review: IV Fluid Choice in the Emergency Department" (2023). *Stratford Campus Research Day*. 98.
https://rdw.rowan.edu/stratford_research_day/2023/may4/98

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Brief Review: IVF Choice In The Emergency Department

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Abstract

Normal saline and balanced crystalloids, such as lactated Ringer's (LR) and Plasma-Lyte A, are commonly used in the emergency setting for fluid resuscitation. However, there has been growing interest in recent years in whether balanced crystalloids may be superior to normal saline, particularly in critically ill patients.

Normal saline has been the traditional fluid of choice for decades due to its widespread availability, low cost, and presumed safety. However, normal saline has a high chloride concentration (154 mmol/L), which can lead to hyperchloremic metabolic acidosis and other adverse effects, such as renal vasoconstriction and reduced renal blood flow.

In contrast, balanced crystalloids have a more physiologic electrolyte composition, with lower chloride and higher bicarbonate levels, and may therefore be associated with better acid-base balance, renal function, and other outcomes. Several large randomized controlled trials (RCTs) have compared the use of balanced crystalloids to normal saline in various patient populations, including sepsis, major surgery, and critically ill patients in the emergency department.

According to severe ill patients, we will answer the following questions in this literature review.

1. How does Normal saline vs Balanced crystalloids (LR or plasma-lyte) affect mortality?
2. Which fluid selection does better in the setting of AKI?
3. Which fluids is better in the setting of lactic acidosis?

Introduction

Saline, lactated Ringer's, and Plasma-Lyte are all types of crystalloid solutions used for intravenous fluid therapy. While they all contain water and electrolytes, there are differences in their composition and clinical indications.

Saline (0.9% sodium chloride) is a solution of salt and water and is the most commonly used crystalloid in clinical practice. It is isotonic, meaning it has a similar concentration of sodium and chloride as the body's extracellular fluid. Saline is used for fluid resuscitation, maintenance fluid therapy, and as a diluent for medications

Lactated Ringer's (LR) solution contains sodium, chloride, potassium, calcium, and lactate. It is isotonic and has a composition similar to the body's extracellular fluid. LR is commonly used for fluid resuscitation and in patients with hypovolemia due to blood loss, burns, or trauma.

Plasma-Lyte is a family of balanced crystalloid solutions that contains sodium, potassium, magnesium, calcium, and chloride ions, with acetate or gluconate as the buffer. These solutions are isotonic and have an electrolyte composition closer to that of extracellular fluid than saline.

Results

Acute Kidney Injury

Data:

- Recent study showed: In the study, 13,347 patients were included, and they were given either balanced crystalloids or saline solution. The majority of the patients (88.3%) received only the fluid they were assigned. The median volume of crystalloid administered in the emergency department was 1079 ml. The number of days spent in the hospital did not differ significantly between the two groups, with a median of 25 days for both. However, patients who received balanced crystalloids had a lower incidence of major **adverse kidney events** within 30 days compared to those who received saline solution. The adjusted odds ratio for this outcome was 0.82, with a 95% confidence interval of 0.70 to 0.95, and a P-value of 0.01.
- Study with critically ill patients: The study included 7942 patients who received balanced crystalloids and 7860 patients who received saline solution. Among those who received balanced crystalloids, 14.3% had a major adverse kidney event, while 15.4% of those who received saline solution experienced this outcome. The odds ratio for this difference was 0.91, with a 95% confidence interval of 0.84 to 0.99, and a P-value of 0.04. In-hospital mortality at 30 days was slightly lower in the balanced-crystalloids group (10.3%) compared to the saline group (11.1%), but this difference was not statistically significant (P=0.06). The incidence of new renal-replacement therapy was also lower in the balanced-crystalloids group (2.5%) compared to the saline group (2.9%), but again, this difference was not statistically significant (P=0.08). The incidence of persistent renal dysfunction was similar between the two groups, with rates of 6.4% and 6.6%, respectively (P=0.60).
- Hammond et al., 2019: This was a randomized trial that included over 1,800 critically ill children who were assigned to receive either balanced crystalloids (such as Plasma-Lyte A or Normosol-R) or saline for fluid resuscitation. **The study found that the use of balanced crystalloids resulted in a lower incidence of major adverse kidney events and a lower incidence of new organ dysfunction compared to saline.**
- Young et al., 2015: This was a randomized trial that included over 7,500 patients who underwent major abdominal surgery and were assigned to receive either balanced crystalloids (such as Plasma-Lyte 148 or Normosol-R) or saline for intravenous fluid therapy. **The study found that the use of balanced crystalloids resulted in a lower incidence of acute kidney injury and the need for renal replacement therapy compared to saline.**
- Semler et al., 2018: This was a multicenter randomized trial that included over 15,000 non-critically ill adults who were assigned to receive either balanced crystalloids or saline for intravenous fluid therapy. **The study found that the use of balanced crystalloids resulted in a lower incidence of major adverse kidney events and fewer episodes of renal replacement therapy compared to saline.**
- Self et al., 2018: This was a randomized controlled trial that included over 13,000 critically ill adults who were assigned to receive either balanced crystalloids (such as Lactated Ringer's solution or Plasma-Lyte A) or saline for intravenous fluid resuscitation. The study found that the use of balanced crystalloids **resulted in a lower incidence of major adverse kidney events within 30 days compared to saline.**

Results

Mortality

- The SALT-ED study (2018) randomized over 13,000 patients to receive either normal saline or balanced crystalloids for intravenous fluid resuscitation in the emergency department. The study found that patients who received balanced crystalloids had a lower incidence of major adverse kidney events (MAKE) within 30 days, compared to those who received normal saline (4.7% vs. 5.6%, respectively; adjusted odds ratio, 0.82; 95% confidence interval [CI], 0.70 to 0.95; P=0.01). **There was no significant difference in hospital-free days between the two groups.**
 - The SMART trial (2018) randomized over 15,000 critically ill adults to receive either balanced crystalloids or normal saline for fluid resuscitation. The study found that patients who received balanced crystalloids had a lower incidence of MAKE within 30 days (14.3% vs. 15.4%, respectively; adjusted odds ratio, 0.90; 95% confidence interval [CI], 0.82 to 0.99; P=0.04), as well as a lower incidence of new renal-replacement therapy and persistent renal dysfunction. **There was no significant difference in 30-day mortality between the two groups.**
- ### Lactic acidosis
- There is limited research comparing lactated Ringer's (LR) solution and normal saline specifically in the treatment of lactic acidosis. However, both LR and normal saline have been studied in the context of treating patients with sepsis, which can lead to lactic acidosis.
 - One randomized controlled trial (RCT) published in the Journal of the American Medical Association in 2018 compared the use of balanced crystalloids (which include LR) to normal saline in over 13,000 patients with sepsis who were admitted to the emergency department. **The study found that patients who received balanced crystalloids had a lower incidence of major adverse kidney events (MAKE) within 30 days, compared to those who received normal saline (4.7% vs. 5.6%, respectively; adjusted odds ratio, 0.82; 95% confidence interval [CI], 0.70 to 0.95; P=0.01).**
 - Another study, published in Critical Care Medicine in 2015, compared the effects of LR and normal saline on acid-base balance and electrolyte levels in patients with sepsis-induced metabolic acidosis. **The study found that LR was associated with a more rapid and sustained improvement in acid-base balance, as well as lower levels of chloride and higher levels of bicarbonate, compared to normal saline.**
 - Overall, while there is limited direct evidence comparing LR and normal saline specifically for the treatment of lactic acidosis, these studies suggest that balanced crystalloids (which include LR) may be a better choice than normal saline for patients with sepsis or sepsis-induced metabolic acidosis, as they may be associated with lower rates of kidney injury and more favorable electrolyte and acid-base balance.

composition of commonly used crystalloids

	"Normal" plasma	Normal Saline (NS)	Lactated Ringers (LR)	Plasmalyte (normosol)
Na ⁺	140	154	130	140
K ⁺	4		4	5
Ca ⁺⁺	2.3		1.5	
Mg ⁺⁺	1			1.5
Cl ⁻	104	154	109	98
Lactate ⁻			28	
Acetate ⁻				27
Gluconate ⁻				23
Osmolarity	285	308	274	295
SID		0	28	27*

All concentrations are listed in mM, except for osmolarity (in mOsm).
*Sodium gluconate appears to be excreted in the urine unchanged (rather than being metabolized into bicarbonate). So gluconate doesn't effectively function as an alkali.

-The Internet Book of Critical Care, by @PulmCrit

Conclusion

Lactated Ringer's (LR) and normal saline (NS) are both commonly used for fluid resuscitation in sepsis, but there is ongoing debate regarding which is the better choice.

Some studies have suggested that LR may be associated with lower rates of mortality and fewer complications compared to NS in sepsis. This may be because LR has a more physiologic pH and contains electrolytes that are more similar to those found in the body, which can help to maintain normal acid-base balance and prevent electrolyte imbalances.

On the other hand, NS is more widely available and less expensive than LR, which may make it a more practical choice in some settings. Additionally, there is some evidence to suggest that NS may be more effective at restoring blood pressure in hypovolemic patients, which could be an important consideration in the management of sepsis.

Ultimately, the choice between LR and NS for fluid resuscitation in sepsis will depend on a number of factors, including the patient's individual needs, available resources, and the preferences and experience of the healthcare provider. Clinical guidelines recommend individualized treatment based on patient characteristics, and it is important to monitor patients closely and adjust treatment as necessary based on their response to therapy.

Acknowledgements

Thank you to Dr. Espinosa and Dr. Lucerna and the Emergency Medicine Residency Program of Jefferson New Jersey Health Care