

## DOGMA DETECTIVES CASE #03-13-13-01: RINGERS VS. SALINE

For medical resuscitations, is there a physiological benefit using one resuscitation fluid -- lactated ringers or saline -- in lieu of the other? How about for trauma patients?

It is well known that infusing large amounts of Normal Saline 0.9% solution (NSS) will cause a hyperchloremic metabolic acidosis. This is from the addition of the chloride ion to the circulation, which combines with water to produce HCl and NaOH. While HCl and NaOH should cancel each other out, the baseline sodium level in the plasma is higher than the chloride (the kidneys also clear excess sodium from the body), hence the chloride level increases much more rapidly than the level of sodium. This tips the balance towards the acidic HCl.

In addition, there must be electrical neutrality in the body. The negative chloride ion ends up taking the place of the negative bicarb ion ( $\text{HCO}_3$ ), and the excess sodium and bicarb ions are excreted by the kidneys. Hence the levels of acidic chloride ions increase rapidly, and take the place of the basic bicarb ions, causing a hyperchloremic acidosis.

Lactated Ringer's (LR) solution is a mixture of sodium, chloride ion, lactate, potassium, and calcium. The sodium and chloride ions are much closer to the baseline physiologic levels of these ions. (NSS is 154 meQ of Sodium and Chloride ions, LR is 130 meQ of sodium and 109 meQ of chloride. Normal blood plasma is 140 meQ sodium and 100 meQ of chloride.)

This article evaluated normal saline versus lactated ringers in patients undergoing major surgery. In a double blind study published in Anesthesia and Analgesia, more acidosis was seen in patients treated with NSS compared to those who received LR. While it did not change duration of mechanical ventilation, ICU length of stay, or most post-operative complications, it did lead to more need to give bicarb due to an acidotic state, and also more hemorrhaging and more need for perioperative administration of blood products.

<http://www.anesthesia-analgesia.org/content/93/4/817.short>

This article from the Journal of Intensive care medicine also comments on the problems of development of acidosis due to NSS resuscitation. The population studied in this group was children in DKA.

<http://jic.sagepub.com/content/early/2012/11/18/0885066612467149.abstract>

This study from Trauma and Acute Care Surgery used a porcine model to simulate uncontrollable hemorrhage and then compared LR to NSS in resuscitation. The pigs resuscitated with NSS became more coagulopathic and hemorrhaged more than those resuscitated with LR. The pigs resuscitated with LR showed less blood loss.

[http://journals.lww.com/jtrauma/Abstract/2006/07000/Resuscitation\\_With\\_Normal\\_Saline\\_NS\\_vs\\_Lactated.8.aspx](http://journals.lww.com/jtrauma/Abstract/2006/07000/Resuscitation_With_Normal_Saline_NS_vs_Lactated.8.aspx)

This study also from Trauma and Acute Care Surgery that predated the above study by ten years also came to the same conclusion. It did note that for moderate resuscitation there was little difference, but porcine models undergoing massive resuscitation with NSS fared worse than those that received LR.

[http://journals.lww.com/jtrauma/Abstract/1998/11000/Lactated\\_Ringer\\_s\\_Is\\_Superior\\_to\\_Normal\\_Saline\\_in.10.aspx](http://journals.lww.com/jtrauma/Abstract/1998/11000/Lactated_Ringer_s_Is_Superior_to_Normal_Saline_in.10.aspx)

Resuscitation with NSS also requires a greater volume of fluid, is associated with more hyperchloremic acidosis, and dilutional coagulopathy compared to LR.

[http://journals.lww.com/jtrauma/Abstract/2007/03000/Lactated\\_Ringer\\_s\\_is\\_Superior\\_to\\_Normal\\_Saline\\_in.14.aspx](http://journals.lww.com/jtrauma/Abstract/2007/03000/Lactated_Ringer_s_is_Superior_to_Normal_Saline_in.14.aspx)

There are no good head-to-head studies of LR and NSS in medical resuscitations.

So where does this leave us in the LR vs. NSS debate?

For Trauma and Surgical patients: These patients show a trend to better outcomes with the use of LR, especially during prolonged surgeries or massive resuscitations.

For Medical patients undergoing resuscitation (i.e. sepsis): Certainly large amounts of NSS will induce an acidotic state. In most circumstances, the difference between NSS and LR is likely minimal. However, in cases of severely acidotic patients, or conditions that require large volume resuscitations, a consideration should be placed towards switching to LR from NSS due to the possible worsening of the acidotic / coagulopathic state.

This is more of an important discussion for long term management and care of these patients. For the EMS or pre-hospital arena, unless the transport time is prolonged, there will be little physiologic difference between LR or NSS when used for resuscitative purposes.