Lactated Ringers is Superior to Normal Saline in the Resuscitation of Trauma Patients

S. DiRusso, MD, M. Joutovsky, DO,
Department of Surgery, St. Barnabas Hospital, Bronx, New York

Introduction
Trauma remains the leading cause of death among people between the ages of 1 and 44 and hemorrhage is a major cause of early death after trauma. As a primary treatment, definitive control of hemorrhage and volume resuscitation is the most important steps. Crystalloid solutions have been the traditional fluids of choice for early resuscitation and Normal Saline (NS) and Lactated Ringer’s (LR) are often used interchangeably for the resuscitation in our institution and others. Unfortunately, fluid resuscitation can be deleterious for patient and right choice of resuscitation fluid will have immediate and long term effect on patient’s mortality by influencing coagulation, acid-base balance and inflammatory response. In our literature review we tried to bring all recent data in this field together to make sure we make the right choice.

Summary of Article
Lactated Ringer’s is Superior to Normal Saline in a Model of Massive Hemorrhage and Resuscitation. In previous models, comparing normal saline (NS) with lactated ringer’s solution (LR) for resuscitation, researchers used only mild or moderate hemorrhage and did not address the clinical situation of massive hemorrhage and resuscitation (MHR). Mark A Healey, MD. Lactated Ringer’s (LR) compares NS and LR by using a new rat model of MHR. Methods: NS and LR were compared by both using a traditional model of moderate pressure-controlled hemorrhage and a model of MHR. Moderate hemorrhage animals were bled to mean arterial pressure (MAP) = 60 mm Hg x 2 hour and then resuscitated with NS or LR for 1 hour. MHR animals were bled to a rate of 1 estimated blood volume (EBV) per hour for 2 hours with simultaneous resuscitation by using washed red blood cells (B) and crystalloid (LR-B or NS-B). MAP was kept at 60 mm Hg during the 2 hours of hemorrhage. After bleeding was stopped, animals in both groups were resuscitated for an additional hour with blood and fluid to MAP more than 90 mm Hg or until 10x EBV was given. Results: For the moderate hemorrhage group (bled 36% of EBV), resuscitation with NS and LR was equivalent. The fatal hematocrit, pH, and base excess were not different, and all animals survived in both groups. In the MHR animals group (bled 216% of EBV) animals resuscitated with NS+B were significantly more acidic than animals resuscitated with equal volumes of LR+B (pH 7.14 +/- .06 vs. 7.39 +/- .04, respectively) and had significantly worse survival (50% vs. 100%, respectively). Conclusion: With moderate hemorrhage, NS and LR are equivalent, but in the setting of massive hemorrhage and resuscitation LR is superior to NS.

Resuscitation With Normal Saline (NS) vs. Lactated Ringers (LR) Modulates Hypercoagulability and Leads to Increased Blood Loss in an Uncontrolled Hemorrhagic Shock Swine Model. The purpose of Laszlo N. Kiraly MD (2006) was to compare the effects of LR and NS on coagulation in an uncontrolled hemorrhagic swine model. They examine effect of LR on coagulation. Methods: Central venous and arterial catheterization, celiotomy, and spleenectomy were performed on 20 anesthetized swine (35 +/- 3 kg). After spleenectomy, a blinded study fluid equal to 3 ml per gram of spleenic weight was administered. A grade V liver injury was made and animals bled without resuscitation for 30 minutes. Animals were resuscitated with the respective study fluid to, and maintained, at the preinjury MAP until study end. Protrombin time (PT), Partial Thromboplastin Time (PTT), and fibrinogen were collected at baseline (0) and study end (120'). Thrombelastography was performed at 0' and post injury at 30', 60', 90', and 120'. Results: There was no significant baseline group difference in R value, PT, PTT, and fibrinogen. There was no significant difference between baseline and 30 minutes R value with NS (p = 0.17). There was a significant R value reduction from baseline to 30 minutes with LR (p = 0.02). At 60 minutes, R value (p = 0.002) was shorter while alpha angle, maximal amplitude, and clotting index were higher (p < 0.05) in the LR versus the NS group. R value, PT, and PTT were significantly decreased at study end in the LR group compared with the NS group (p < 0.05). Blood loss was significantly higher in the NS versus LR group (p = 0.009). Conclusion: This study data show that greater hypercoagulability and less blood loss can be achieved by resuscitation with LR than resuscitation with NS in uncontrolled hemorrhagic shock.

Methods, cont’d: Tissue mRNA levels of interleukin-6 (IL-6), granulocye colony-stimulating factor (G-CSF), and tumor necrosis factor-alpha (TNFalpha) were determined using quantitative reverse transcription polymerase chain reaction (Q-RT-PCR) on lung tissue. Sections of lung were processed and examined for neutrophils sequestered within the alveolar walls. Methods: Twenty-six pigs were randomized to four groups (P = 0.83). Both resuscitation groups had significantly more alveolar neutrophils present than controls (P < 0.05). There was no significant difference between one another (P = 0.83). Conclusion: This study supports previously published results of in vitro studies demonstrated that LR and NS resuscitation in the model of uncontrolled hemorrhagic shock produced similar effect on indices of inflammation.

Lactated Ringer’s is superior to normal saline in the resuscitation of uncontrolled hemorrhagic shock. Normal saline (NS) and lactated ringer’s solution (LR) continue to be used interchangeably for the resuscitation of hemorrhagic shock in some institutions. S Rob Todd weights hypothized that, aside from hyperchloremic acidosis, NS resuscitation would be similar to that of LR in a swine model of hemorrhagic shock.

Methods: Twenty-six pigs weighting a mean of 37 kg underwent invasive line placement, midline celiotomy, and splenectomy. After a 15-minute stabilization period, a balloon catheter control was placed in the NS group (46.6 +/- 39.2 g) and a grade V liver injury was created. Blood loss was measured after 30 minutes. The swine were blindly randomized to receive 10 mL/kg of LR versus LR (10 animals). Laboratory values were obtained at baseline and upon completion of the 2-hour study period.

Results: Initial blood loss was 25 mL/kg in the NS group and 22 mL/kg in the LR group (p = 0.54). Animals required 256.3 +/- 145.4 mL/kg of fluid in the NS group as compared with 125.7 +/- 67.3 mL/kg in the LR group (p = 0.04). The unresuscitated animals in the NS group (46.6 +/- 39.2 g) versus LR group (18.9 +/- 12.9 g/mL/kg, p = 0.04). The NS group had a significant hyperchloremia (119 +/- 1.9 mEq/L versus 105 +/- 2.9 mEq/L, p < 0.01) with acidosis (7.28 +/- 0.12 versus 7.45 +/- 0.16, p < 0.01) and significantly lower fibrinogen levels (99 +/- 21 mg/dL versus 123 +/- 20 mg/dL, p = 0.02). The serum lactate was 4.7 +/- 2.2 in the LR group and 1.7 +/- 1.7 in the NS swine (p = 0.01) at the end of the study.

Conclusions: Resuscitation of uncontrolled hemorrhagic shock with NS requires significantly greater volume and is associated with hyperchloremic acidosis, and dilutional coagulopathy as compared with LR. Resuscitation with LR results in an elevation of the lactate level that is not associated with acidosis. Lactated Ringer’s solution is superior to NS for the resuscitation of uncontrolled hemorrhagic shock in swine.

Conclusions
Based on multiple studies review, we came to the conclusion that the resuscitation of trauma patients with uncontrolled hemorrhagic shock with LR is superior to NS. Resuscitation with LR doesn’t lead to increased inflammatory response or hyperchloremic acidosis, and dilutional coagulopathy. We recommend to use Lactated Ringer’s solution as primary resuscitation solution in Trauma Unit of our Institution and other Hospitals.

Bibliography
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S Rob Todd, Darren Malinski, Patrick J Muller, Martin A Schreiber
Department of Surgery, Oregon Health and Science University, Portland, Oregon
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Department of Surgery, Oregon Health and Science University, Portland, Oregon 97239, USA
watters@ohsu.edu