

Hyperglycemia in Critically Ill Patients

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Abstract

Despite a high amount of medical monitoring in one of the highest levels of care in the hospital, Acute Hyperglycemia still occurs in critically ill patients. Reasons for and consequences of acute hyperglycemia in this fragile patient population are complex. Controversy exists regarding what the exact treatment regimen should be because there is conflicting data from large clinical trials the most recent of which is in the NICE-SUGAR study (2009). This paper reviews why controversy still surrounds treatment of acute hyperglycemia and how severe hypoglycemia is theorized to be the primary confounder of large clinical trials. I have compiled and analyzed the preliminary data in a rat model to show that treating hyperglycemia while avoiding severe hypoglycemia in an acute lung injury rat model can improve markers of lung injury, which may warrant future clinical trials with a stricter definition of acute hypoglycemia. The data was presented at the Western Society of Clinical Research in Carmel, California in 2021. There is an ongoing need to further investigate and gain additional understanding hospitalized patients to improve patient morbidity and mortality.

Introduction

Intensive insulin therapy on patients in critically ill units has a mixed clinical trial results. The most recent 2009 NICE-SUGAR study guides most ICU and floor hyperglycemia management, but the study admits that severe hypoglycemia likely affected the results. Studies concluded that intensive insulin therapy not different than normal insulin therapy.

Conflicting Studies

van de Berghe, G.: NEJM 354:449, 2006 – 1,548 ICU patients - “Intensive insulin therapy designed to reduce blood glucose to 110/dL reduces morbidity and mortality.”

NICE-SUGAR Study: NEJM 360:1283, 2009 – 6,104 ICU patients - “Intensive insulin therapy designed to achieve blood glucose of 180 mg/dL had lower mortality than patients targeted to 110 mg/dL but concerns were raised about hypoglycemia.”

Methods

Measure blood glucose levels, lung inflammation (lung lavage PMN), and acute lung injury (lung lavage protein levels “ARDS”) in rats insufflated with interleukin-1/lipopolysaccharide (IL-1/LPS). Separate rats into control (no IL-1/LPS), no insulin, low insulin (130-150 mg/dL), and high insulin groups (60-80 mg/dL).

Results

Figure 1: Effect of IL-1/LPS and Insulin on Blood Glucose Levels (mg/dL)

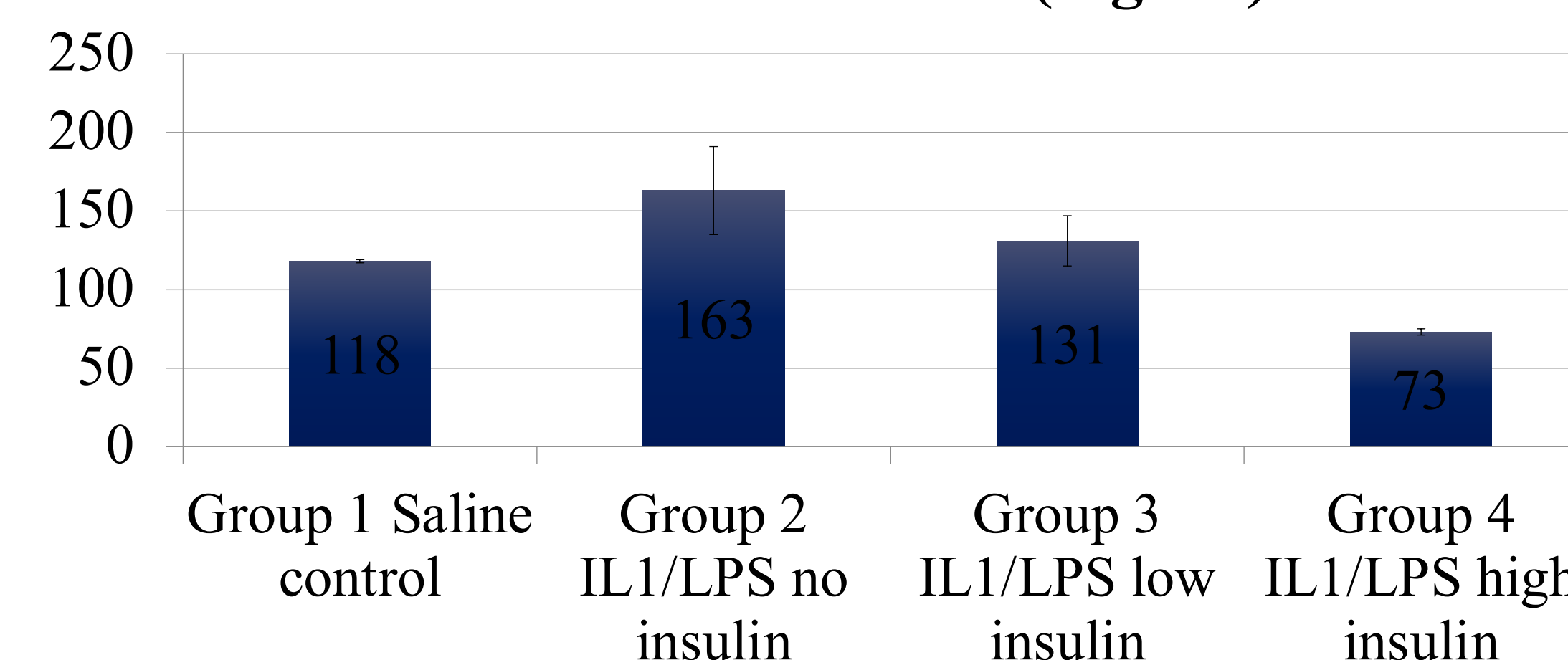


Figure 2: Effect of IL-1/LPS and Insulin on Lung Lavage PMN count (x10⁶)

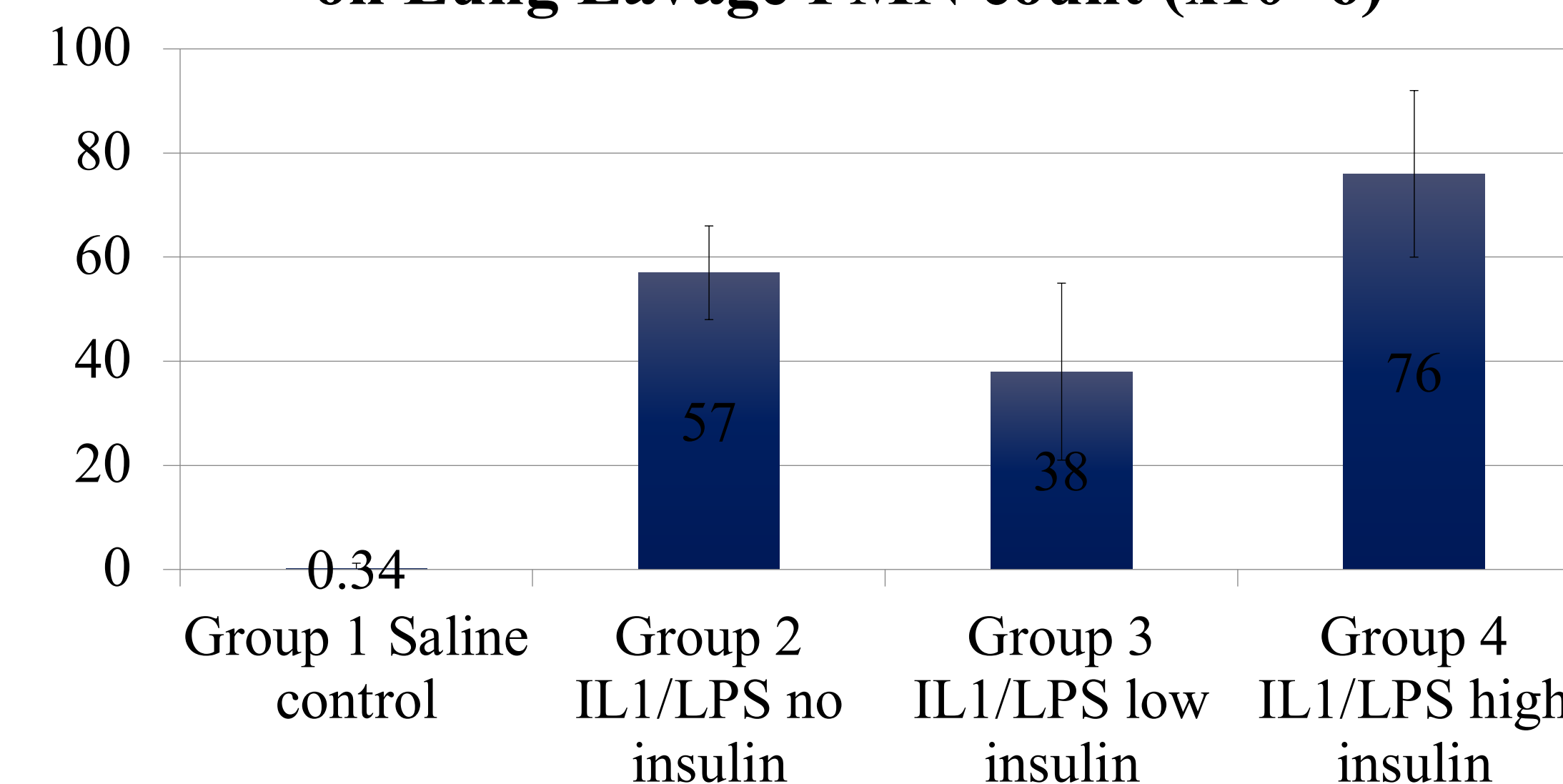
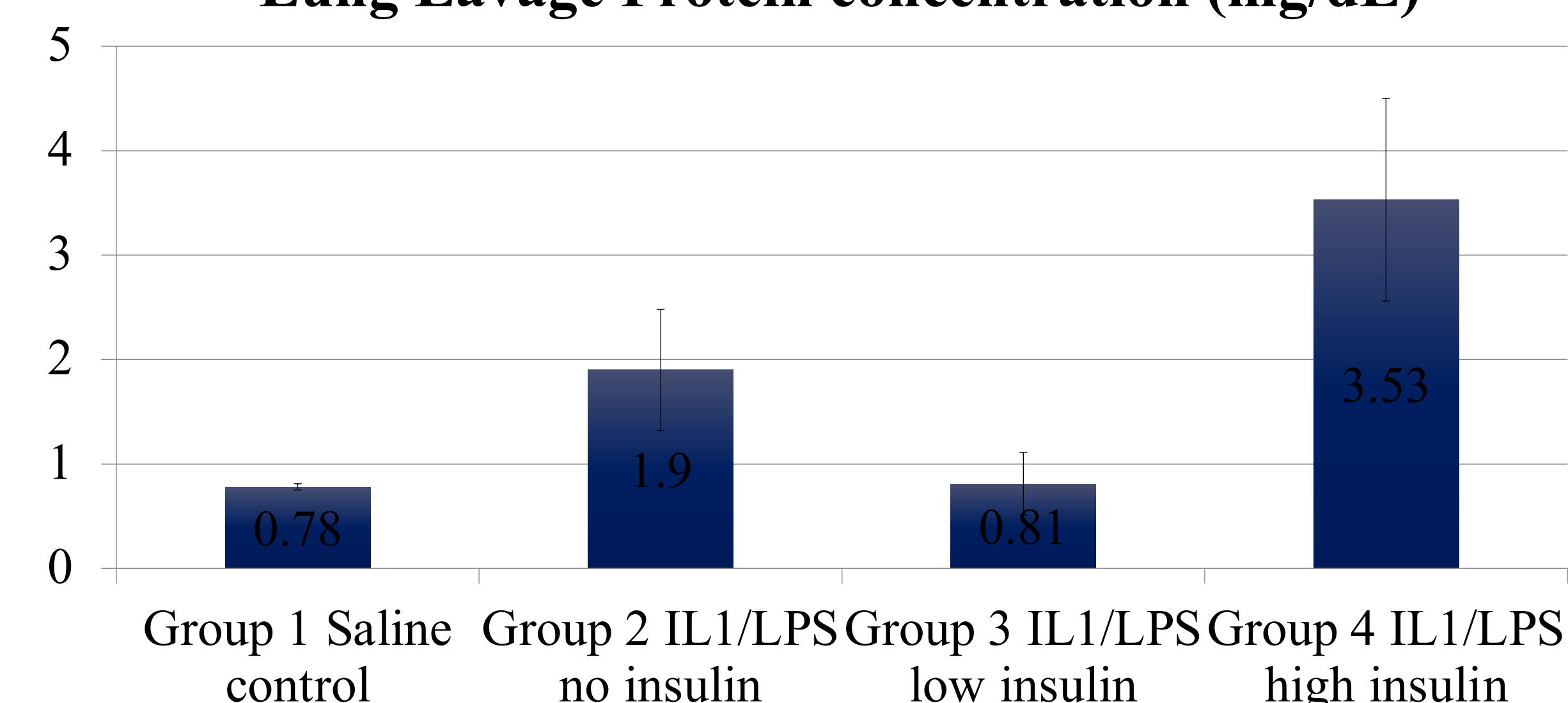


Figure 3: Effect of IL-1/LPS and Insulin on Lung Lavage Protein concentration (mg/dL)



Discussion

Group 2 serves as an uncontrolled glucose level and a model for the average amount of lung damage expected with no glucose control.

Group 3 rats who received a low dose of insulin and maintained blood glucose levels in the 131 mg per deciliter range showed statistically significant differences in lung lavage neutrophils and protein compared to group 2. This finding fits with the original paper that discussed potential benefits to reducing critically ill patients

Group 4 rat model who received a high dose of insulin and maintained blood glucose levels in the 60-80 mg per deciliter range showed statistically significant markers of lung injury for acute respiratory distress syndrome compared to group 3. However, this group never reached the value for severe hypoglycemia (<40) with their blood glucose levels.

Limitations

Rat models don't always approximate ICU complex patients
More than ARDS affects ICU patients
Other medications and diseases affect glucose levels
Technology/Manpower of continuous monitoring
Costs associated with more intensive care

Conclusion

More intensive insulin therapy aimed at a goal of 130-150 mg/dL glucose level improves markers lung injury and may be a more optimal glucose regulation for clinical practice. The hyper metabolic state that is acute illness may call for a redefining of the severe hypoglycemia (<40 mg/dL) value as rats were showing significantly worse outcomes at lower glucose values that were not hypoglycemic.

Disclosures and Conflicts of Interest

No financial disclosures or conflicts of interest.