

# Simple method to avoid overlooked pain and disease during metabolic tolerance tests

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Research on diabetes, obesity, and cardiometabolic diseases often involves experiments in mice and rats, where the regulation of blood sugar in the animals is measured by injecting solutions of glucose and other substances (such as lactate and pyruvate) into the abdominal cavity. In 2023, we found that injections of lactate (i.e. sodium lactate) can cause severe pain and illness in the animals. This is because solutions with extremely high concentrations of sodium lactate are often injected in this field of research. The content of osmotically active particles in the administered solution is therefore many times higher than the osmolarity in the body tissue fluids. This causes pain and can be compared to having salt rubbed into an open wound. In addition, the injections cause damage to the tissues near the injection site and - in the worst case - the animals die from the injections. Unfortunately, this is not only a problem with injections of sodium lactate. The same problem is seen with injections of pyruvate and probably also glucose, where mice and rats are also exposed to injections of concentrated solutions. Unfortunately, the problem is overlooked by both veterinarians and researchers, which emphasizes the importance of our research project, which aims to develop new and better ways to perform these types of tests. Through simple refinements of metabolic tolerance tests, our project holds potential to avoid pain and promote the welfare of hundreds of thousands of laboratory animals every year.