Ex vivo porcine model to measure pH dependence of chemical exchange saturation transfer effect of glycosaminoglycan in the intervertebral disc.

Abstract:
Studies have linked low pH and loss of glycosaminoglycan (GAG) in the intervertebral discs (IVDs) of patients with discogenic back pain. The purpose of this study is to determine whether the chemical exchange saturation transfer (CEST) effect of GAG (gagCEST) is pH dependent and whether it can be used to detect pH changes in IVD specimens. Iopromide, a Food and Drug Administration approved agent for CT/X-Ray, was also evaluated as a pH-sensitive CEST probe to explore the agents’ potential to measure IVD pH. The pH dependency of the CEST effect of chondroitin sulfate (containing GAG) and Iopromide phantoms was investigated at 7 T. Z-spectra from porcine IVD specimens were acquired before and after manipulating the pH with sodium lactate. Iopromide was injected into the specimens and the calibration curve was used to determine the pH status. Chondroitin sulfate showed a non-linear dependence of gagCEST effect with pH and gagCEST signal differences were detected in the specimens. The CEST effect of Iopromide resulted in a sigmoidal relation with pH and was used to measure pH. gagCEST is sensitive to pH and enables investigation of the IVD pH status. Iopromide CEST is independent of the local GAG concentration and has the potential for measuring pH in the IVD.