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Synthesis and characterization of an HSP27Abs-targeting gold nanorods probe for *in vivo* photoacoustic imaging of early nerve injury

Hongjiang Chen[1], **Sihua Yang**[2], **Ting Zhou**[1], **Jiankun Xu**[1], **Jun Hu**[1,2] and **Da Xing**[2]
[1]Shantou University, China
[2]South China Normal University, China

Imaging is routinely used for clinical and diagnostic purposes, but techniques capable of high specificity and resolution for the early detection of nerve injury are still limited. Photoacoustic imaging (PAI), a novel imaging modality that combines the merits of laser and ultrasound, offers high contrast, high resolution, and satisfactory tissue penetration. So we aim to exploit the novel PAI with functionalized targeted probe for detection of early nerve injury. After the sciatic nerve was crushed, we found that heat shock protein 27 (HSP27) becomes highly up-regulated within 3 to 7 days of nerve injury. Taking advantage of this expression pattern, we conjugated gold nanorods (GNRs) to HSP27-specific antibodies to generate a nanoprobe (GNR-HSP27Abs) that could be targeted to the site of nerve injury and detected by near-infrared photoacoustic imaging. The absorption spectroscopy, fluorescence spectroscopy, FTIR spectroscopy and zeta potential confirmed that the HSP27Abs was well-coupled to GNRs and was indicative of successful nanoprobe synthesis. Notably, *in vitro* and *in vivo* photoacoustic images acquired 12 hours after local administration of GNR-HSP27Abs demonstrated that the nanoprobe can distinguish between injured and uninjured nerves in rats. The toxicity assay results showed no cytotoxicity against human cell lines and no such inflammatory reactions occurred in these injection regions. Taken together, these findings expand the application of nanoprobe-targeted photoacoustic imaging to the detection of injured nerves, and prompt further development of this novel imaging platform for clinical application.

chenhongjiang28@126.com