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TYPE : ORAL PRESENTATION

CATEGORY : NON - VASCULAR INTERVENTION

TITLE

Image-guided Stent-directed Irreversible Electroporation for Gastrointestinal Tract

BACKGROUND

Irreversible electroporation (IRE) is a local tissue ablation technology using short high electric pulses to cause irreversible cell membrane pore resulting in apoptotic cell death and has established as an alternative to thermal ablation for unresectable tumor, particularly those near critical vascular structures. Herein, a novel stent-based electrode was developed by nitinol wire braiding technique for IRE treatment in hollow viscera. The aim was to investigate the efficacy and safety of image-guided stent-directed IRE in the rat esophagus.

METHODS

A novel bipolar self-expandable electrode (SE) for IRE was developed and designed to allow electric energy delivery to the non-vascular luminal organs. IRE dose range study by electrical field strength of 250 V/cm, 375 V/cm and 500 V/cm was investigated in potato cell viability using Cryo-FESEM and TEM. The 40 rats underwent IRE with use of SE by electrical field strength of 250 V/cm and were randomly sacrificed 10 hours (n = 10), 3 days (n = 10), 7 days (n = 10), and 28 days (n = 10) after IRE procedure. Image-guided IRE treatment using the SE with interventional approaches, follow-up esophagography, serial gross and histological changes after IRE, along with the statistical analysis demonstrated that effectiveness and safety of a newly developed stent-direct IRE system for gastrointestinal tract and tissue regeneration process after IRE treatment in the rat esophagus.

RESULT

Stent-directed IRE under fluoroscopic guidance was technically successful in all rats without procedure-related complications. Upon application of IRE, mild muscle contraction was observed in all rats. Esophagography with histological analysis revealed that luminal diameter of the IRE-treated esophagus was significantly decreased at 3 days, however gradually improved. Although esophageal narrowing was observed at 3 and 7 days, dysphagia symptoms such as poor food intake, nausea, and vomiting did not occur during the follow-up duration. Heart rate dropped immediately and gradually recovered at 180 s. IRE treatment with use of SE was significantly increased the expression of apoptosis markers such as TUNEL and Caspase3 at 10 hours and 3 days after IRE. These markers were gradually decreased over time. There were no differences in HSP70-positive deposition of thermal effect marker at 10 hours, 3, 7, and 28 days compared with sham control. The markers of cellular regeneration such as Ki67 was significantly increased at 3 days and 7 days compared with the sham control. All variables were similar with the sham control at 28 days.

CONCLUSIONS

IRE treatment with use of novel SE effectively induced the expression of apoptosis with luminal narrowing at initial stage of IRE in the rat esophagus, however, gradually improved with cellular regeneration. Although further preclinical studies are needed to investigate the efficacy and safety of localized endoluminal IRE treatment, the developed stent-directed IRE should be promising new approach for the treatment of endolumianl malignancies in non-vascular luminal organs.

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