MRI Radio-frequency Heating Amelioration for Metallic Braided Catheters

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Technology description

Unmet Need

Over 1,000,000 cardiac catheterizations are performed annually in the United States. Catheters with a braided surface are most commonly used in vascular intervention because of their superior mechanical properties. While braided catheters made of metal provide the best mechanical manipulation, metallic catheters longer than a quarter of the magnetic resonance imaging (MRI) scanners wavelength heat up considerably when exposed to the radiofrequency field (RF) fields inside an MRI scanner, making them unfit for implantation within the body. This is due to large electric fields induced by the MRIs RF coils onto long metallic surfaces placed within them. Meanwhile, nonmetallic braided catheters are brittle and mechanically weaker than metallic catheters. Also, RF fields can easily penetrate into the interior of nonmetallic catheters and heat up sensor cables, which transport electrical information from various sensors at the catheter tip along the catheter shaft to signal receivers at the catheter near end. Current catheter designs apply heat mitigation techniques such as transformers and resistors to each cable individually, but the added components take up space within the catheter. Since most catheters have a diameter of less than 3mm, the space restrictions reduce the number of sensors that each catheter can carry. Also, the transformers and resistors may degrade the signal quality within the cables, leading to deterioration of the electrical information traveling up the catheters. Thus, there is a need for a metallic braided catheter design that is MRI-compatible and can protect cables inside the catheter from heating up.

Technology Overview

Four possible designs of MRI-compatible metallic braided catheters are proposed. The surfaces of these catheters can be constructed from any non-ferromagnetic and preferably minimally paramagnetic metals. Also, unlike existing catheters which utilize brittle nonmetallic materials, the ductility of the metal surfaces in these catheter designs results in improved mechanical properties such as flexibility and ability to resist rotational stress. The braid has added components specifically constructed to trap and dissipate the induced electric fields from the catheter, which reduces the heating of the catheters metallic braid in the RF fields, and also shields the catheter interior from RF field penetration, which prevents the interior cables from heating up. This enables these catheters to safely be used during MRI scanning. This is an advantage compared to existing catheters because there is no need to apply individual heat protection components to each cable inside the catheter, which frees up more space. Compared to existing catheters, these designs allow each catheter to carry more sensors and cables and improves the signal quality of the data transmitted through the cables.

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