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ABSTRACT

0008 - Robotics, Telesurgery and Virtual Reality

MAGNETIC AIR CAPSULE ROBOTIC SYSTEM: A NOVEL APPROACH FOR PAINLESS COLONOSCOPY

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Aims: Golden standard for colonoscopy consists of the use of flexible endoscopes. Unfortunately this approach is not suitable for mass screening of colorectal cancer, because of the low compliance depending on pain and discomfort associated to the procedure. In-vivo assessment of feasibility and functionality of a novel robotically-driven softly-tethered colonoscopic capsule, based on the interaction of external and internal magnets and provided with a channel that can be used both for insufflation and instrument introduction.

Methods: The capsule, equipped with a color VGA camera and illumination, is 26mm in length and 11mm in diameter. The tether has an inner diameter of 2.6mm and an outer diameter of 3.2mm. The external magnet is held by an anthropomorphic robotic arm, guided by the endoscopist through a joystick. An on-board magnetic field sensor provides real-time clues about the magnetic link strength. The capsule was assessed in-vivo on a porcine model in terms of accuracy. The capsule was inserted trans-anally and magnetically driven by the robotic interface for about 48cm. A detailed inspection of the mucosa was performed and the capability of collecting biopsies was tested. The same procedure was performed with a standard flexible endoscope for the sake of comparison.

Results: In the case of collapsed tissue, the softly-tethered capsule was able to travel only short paths. Air was insufflated inside the intestine by the capsule in order to distend the tissue, have a better view of the lumen and allow locomotion. Thanks to air insufflation, robotic steering of the capsule provided better accuracy in motion if compared to standard colonoscopy, at the price of a longer duration. The magnetic field sensor prevented the loss of the magnetic link. Biopsy removal with the novel device was effective thanks to the magnetic stabilization of the capsule.

Conclusions: This preliminary trial demonstrated the feasibility of the magnetic air capsule robotic system. This is able to guarantee reliable diagnosis, allowing tissue interactions by means of a standard endoscopic instrument. Thanks to its small size, the proposed device has the potential for painless colonoscopy in human beings.