

Bionaut™: A Breakthrough Robotic Microdevice to Treat Non-Communicating Hydrocephalus in Both Adult and Pediatric Patients

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Abstract : Bionaut Labs, LLC is developing a minimally invasive robotic microdevice designed to treat non-communicating hydrocephalus in both adult and pediatric patients. The device utilizes biocompatible microsurgical particles (Bionaut™) that are specifically designed to safely and reliably perform accurate fenestration(s) in the 3rd ventricle, aqueduct of Sylvius, and/or trapped intraventricular cysts of the brain in order to re-establish normal cerebrospinal fluid flow dynamics and thereby balance and/or normalize intra/intercompartmental pressure. The Bionaut™ is navigated to the target via CSF or brain tissue in a minimally invasive fashion with precise control using real-time imaging. Upon reaching the pre-defined anatomical target, the external driver allows for directing the specific microsurgical action defined to achieve the surgical goal. Notable features of the proposed protocol are i) Bionaut™ access to the intraventricular target follows a clinically validated endoscopy trajectory which may not be feasible via 'traditional' rigid endoscopy; ii) the treatment is microsurgical, there are no foreign materials left behind post-procedure; iii) Bionaut™ is an untethered device that is navigated through the subarachnoid and intraventricular compartments of the brain, following pre-designated non-linear trajectories as determined by the safest anatomical and physiological path; iv) Overall protocol involves minimally invasive delivery and post-operational retrieval of the surgical Bionaut™. The approach is expected to be suitable to treat pediatric patients 0-12 months old as well as adult patients with obstructive hydrocephalus who fail traditional shunts or are eligible for endoscopy. Current progress, including platform optimization, Bionaut™ control, and real-time imaging and in vivo safety studies of the Bionauts™ in large animals, specifically the spine and the brain of ovine models, will be discussed.

Keywords : Bionaut™, cerebrospinal fluid, CSF, fenestration, hydrocephalus, micro-robot, microsurgery

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