

A Pediatric Laparoscopic Tool for Epicardial Lead Removal

Alex Wahl, Manav Parikh, Amelia Hurley-Novanty, Lauren Fowlkes, Shaanit Sen

Infants with severe cardiac problems may require implantation of a pacemaker into the abdomen with a lead which is attached to the epicardial surface. These pacemakers only last up to 10 years, and eventually must be replaced with a transvenous lead. During this procedure, the epicardial lead, which lies in the abdominal and thoracic cavities, is abandoned except in emergency situations. Given that these leads have adhesions to vital organs and directly to the heart, removal requires open heart surgery. Leaving this lead results in decreased quality of life for these patients since they can no longer undergo magnetic resonance imaging procedures or go through metal detectors without issue. Current laparoscopic devices, which would make the procedure less invasive, are not appropriately sized for a pediatric population. Additionally, many tools are difficult to use and require many manual inputs to achieve relatively little mobility. We have designed and prototyped a laparoscopic device with five degrees of freedom and higher precision than current models, in order to remove adhesions in the size scale found in pediatric patients. This device couples existing electrocautery components with a novel articulation mechanism, which includes an articulating tip directed by mechanical surgeon inputs. The articulation mechanism within the body has a small, <1 cm bending radius to maneuver around small adhesions and organs for patient safety and efficacy during surgery. The direction of the electrocautery wire will be controlled by this articulation mechanism. This modality will allow adhesions to be easily cut, is widely used in the operating room, and reduces the risk of patient bleeding. It is also physician-controlled to prevent damage to any surrounding tissue. This tool will be utilized with a laparoscopic camera, insufflation, and a pediatric port designed at Children's National Hospital. The system of these tools is expected to allow removal of adhesive epicardial leads in pediatric patients, increase the safety of the removal procedure, and improve the overall quality of life for these patients. Beyond this immediate intended use, this tool may also be used in other pediatric surgeries, which could lead to better surgical outcomes from less invasive procedures.