Abstract

Gastroesophageal reflux disease is a common gastrointestinal disease in the western world with a prevalence of 20%. Today's treatment options for the less severe course of the disease include dietary and regimen measures and the administration of antacids. For more severe and/or prolonged courses, where current treatment is not helpful, treatment with proton pump inhibitors is used. However, a substantial percentage of patients is not responding to this treatment. For this group of patients, fundoplication is practically the only treatment option, but it is a controversial one due to ambiguous conclusions about its efficacy. A major problem with reflux esophageal disease, apart from the significant reduction in quality of life, is the complications, which include esophagitis causing narrowing of the esophagus associated with difficulty in swallowing, and the subsequent development of Barrett's esophagus, which is a precancerous condition. Subsequent adenocarcinoma of the esophagus is then characterised by a high mortality rate. It is only in recent years that a method of treatment consisting of neurostimulation of the lower esophageal sphincter to increase its pressure has been developed, leading to a reduction or elimination of reflux episodes. Today, the only solution available in clinical practice that targets esophageal neurostimulation is characterized by a complex implantation method - requiring a combination of laparoscopic/robotic electrode implantation and subcutaneous device implantation. The aim of this work was to develop a solution consisting of a neurostimulator and a pH sensor that could be implanted endoscopically in a single procedure and would allow feedback control of neurostimulation based on actual esophageal pH data. This goal was achieved by designing custom hardware and creating software, including a custom wireless communication protocol, and several prototypes of the resulting solution were created to demonstrate the possibility of implantation using the endoscopic submucosal tunnelling method, the possibility of wireless implant recharging, and the possibility of wireless communication. Finally, a new method of encapsulating implantable devices using epoxy followed by the application of a biocompatible polymer was developed. The final experiment confirmed the feedback control function, where the neurostimulator correctly responded to the information from the pH sensor, which it received and processed autonomously without the need for control by another device or user.