A minimally invasive surgical platform for pancreatic and biliary tract cancers using cold atmospheric plasma: The EIC project "IgnitePLASMA"

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The project "IgnitePLASMA" spans across the field of plasma biomedicine, and it has been recently (2024) awarded by the EIC. The consortium encompasses members from the academia and industry across four different countries. In the present short report, the concept of the project is outlined, with a special focus on the development of a closed-loop, computer-trainable platform for the generation of cold atmospheric pressure plasma, which concerns a key technological objective of the project.

1. Introduction

Pancreatic cancer and biliary tract cancer are classified as rare gastrointestinal adenocarcinomas with an increasing incidence particularly among elderly and women in an ageing European population. Cold atmospheric plasmas (CAPs) have shown potential in regressing neoplasia. Despite the great promise of this concept, there is no medical device available based on CAP to treat carcinomas.

The EIC-funded "IgnitePLASMA" project (https://igniteplasma.eu) proposes to develop a novel solution using cutting-edge plasma technology. It integrates an advanced platform that ensures stabilized plasma parameters, guided by *in silico* modelling. The model combines plasma fluid dynamics with solid tumour biophysics simulations, while it takes inputs from pre-surgery diagnostics for model initialisation and plasma operational window determination. During surgery, real-time diagnostics will feed optimisation algorithms for the adaptation and delivery of CAP dose. In this project, the technology will be demonstrated through *in vitro* and *in vivo* biological experiments.

2. Experimental Setup

The platform comprises: (i) the cold plasma reactor; (ii) the pneumatic gas mixture feeding system; (iii) the sinusoidal high voltage power supply; (iv) the ns-pulsed high voltage power supply; (v) the plasma probing sensors; (vi) the micro-positioning stage; (vii) the *in silico* model, and (viii) a closed-loop control system which schedules the entire operation.

3. Discussion

Fig. 1 illustrates the front panel of the main part of the plasma platform, depicting the user interface touch screens and the plasma parameter (electrical, spectroscopic, thermal, *etc.*) monitoring display. A closed-loop design ensures different operational modes, like "constant power", "constant species density", "constant temperature", among others.

Figure 1. The main part of the implemented prototype of the closed loop, computer-trainable cold plasma platform.

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