“MICROWAVE SURGICAL DEVICE”

Summary
The present invention relates to a method and a device, e.g. the Microwave Surgical Device (MSD) for the in vivo thermal ablation and microwave assisted surgical resection of biological tissues. This device can be used in minimally invasive surgery for interstitial, endoscopic, endocavitary, laparoscopic and intra-surgical applications, based on the coagulative necrosis of solid biological tissues obtained by highly localized application of microwave power. An example of interstitial application relates to the minimally invasive treatment of the inner walls of a natural cavity, such for example the oesophagus, stomach, colon, bile ducts, heart cavities, vagina etc. However, it is meant that the MSD can be used even for the intra-surgical destruction of lesions of greater volume, by means of microwave assisted resection wherein the MSD acts as a thermo-coagulating scalpel.

The emission and the application of microwave power takes place by means of the particular design of the active end of a coaxial cable antenna. The internal conductor is not protruding from the distal end of the coaxial cable like a needle, to obtain a heating pattern with axial (rotation) symmetry and a substantially quasi-spherical shape, as in ordinary coaxial dipole antennas utilized for thermo-ablation purposes. Instead, according to this invention, the inner uncovered conductor at the distal end of the coaxial cable is asymmetrically curved with respect to the cable axis, approaching in a short section the external surface of the external conductor. The said curved inner conductor enables to obtain a microwave electric field of very high amplitude in the near field region of the coaxial antenna, featuring a highly asymmetric distribution of the microwave power density available for heating. The main advantage of the present invention lies in the fact of producing with said antenna an asymmetric and laterally placed heating pattern. Furthermore, the emission of microwaves takes place with a high efficiency.

In a first group of embodiments the asymmetric antenna, at the distal end of a thin flexible or conformable coaxial cable, can be introduced in a natural cavity using a plastic catheter or the working channel of a surgical endoscope, for the localized thermo-ablation of surface lesions of whatsoever geometry.

In a second group of embodiments a very efficient coagulating tool (a microwave scalpel) is designed for applications of microwave assisted surgery. In this case the asymmetric emission of a rigid or semi-rigid coaxial cable, delivering microwave power at very high density level, is utilized to obtain fast and safe resection of big volumes of perfused tissues.

Background
Minimally invasive microwave thermo-ablation is a key method in surgery, specially in oncological surgery. In fact, it is well known that the interstitial heating of biological tissues with microwave applicators enables to obtain faster, deeper, safer and, most of all, more reproducible thermo-ablations through coagulative necrosis in comparison with all other thermo-ablative technologies currently adopted, namely radiofrequency, laser, ultrasounds, cryogenic probes, etc. The present invention is a good candidate for the development of a new class of microwave applicators to be utilized for endocavitary, endoscopic, laparoscopic and intra-surgical thermal ablations.

Technology offer
Minimally invasive microwave coaxial applicators with asymmetric heating pattern. Microwave coagulating device for fast and safe microwave assisted surgical resection and debulking.

Patent applicant
CNR (Italy)

Industry sectors
R&D of new surgical devices
Electro-medical devices
Endoscopic thermo-ablation devices and technologies

Applications
Research studies on hyperthermia and solid tumor surgery
Manufacturing of advanced microwave interstitial applicators

Advantages
Compactness, miniaturization, absence of ground electrodes, velocity, low cost, flexibility, versatility, safety, reproducibility, control, robotic and/or telesurgery.

Intellectual property rights
EP 2571442 A1
Offer
Patent license
Patent sale
Executive drawings
Know-how

Technology
The technology is twofold, comprising the miniaturized flexible coaxial cable applicator, useful for the thermal ablation of surface lesions of the inner wall of natural cavities, and the high power coagulator, useful for safe resection of highly perfused tissues.
In mini invasive applications the MSD can be introduced inside a plastic catheter provided with expandable balloon and temperature sensor, and operated under ultrasound imaging methods.
In endoscopic application the MSD provided with cooling can be introduced inside the 4 mm working channel of a video endoscope, for the thermal ablation of non-circumferential lesions of the inner wall.
The MSD, being a high power coagulative applicator, is the advanced version of the microwave intra-operative coagulator, an utmost efficient tool utilized for very large liver tumor resection assisted by the attainment of heat coagulative necrosis in the Habib method of debulking.

Stage of Development
Pre-executive drawings of the MSD in various embodiments are available, as well as laboratory exemplars and know-how. Experiments conducted with intermediate MSD prototypes have shown the feasibility and the advantages of thermal ablation in tissue models and in ex vivo tissues.

Trends
The microwave interstitial applicator is an essential tool for the thermal ablation of biological tissues. The microwave applicator allowing the reliable, safe, standardized and reproducible destruction of solid perfused tissues, especially in cases where ordinary surgery is not applicable, represents an enabling tool for the economically and clinically sustainable procedures for cancer treatment.
Also the thermal ablation of atrial fibrillation using microwave energy today is applied in thousand of procedures during open heart surgery carried out worldwide and no procedure-related complications has been reported so far, demonstrating that microwave interstitial heating is a winner technology also for non tumoral tissue ablation.
Accordingly, the MSD, due to its unique heating characteristics, shall compare favorably in all cases, being deemed to replace the microwave applicators actually on the market.
The addition of routinely available MSD technology will boost in more ways than one the surgical armamentarium of the sanitary services of all industrialized countries, being suitable for a compliant use in a number of important clinical setting.

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