POLITECNICO DI TORINO

UNIVERSITÀ DEGLI STUDI DI TORINO

New technologies and materials to improve diagnosis, therapy and surgery

PhD Program in Bioengineering and Medical-Surgical Sciences

XXX Cycle

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Abstract

The aim of this research project has been focused on improving diagnosis, therapy and surgery by using new patented technologies and materials.
The first technology that has been examined in it has been SynDiag – a new software patented at Polytechnic school of Turin that represent the first step of a new concept of accurate diagnosis without using the X-ray technology but only ultrasounds. The output will be no more qualitative but quantitative and can be obtained from an existing full console machine connected to a 3D transducer with the result of keeping the costs to the minimum. The second technology is a patent coming from the Russian Federation and called Proton Therapy. This new technology is based on the acceleration of both protons and neutrons and can be tailored on every human (child, adults, young, elderly, slim etc.…) and been effective on the detection and dissolution of brain cancer on which it is not possible to perform a surgery. Another problem that has been explored is the big problem of the antibiotic resistance and the most dangerous superbugs (ranked by the WHO in February 2017) and their biofilms currently giving infections and post-surgery complication ending into an unlucky and poor prognosis. A solution has been found with evidences of efficacity cooperating with the USA, Germany, Australia and New Zealand but due to a pending patent condition and some running experiments it is not possible now to carry on with detailed information about it. Concerning the materials, the research has been focused on medical application of polyurethane – a type of PU has been synthetized at Polytechnic School of Turin to study the complexity of the human ageing and trying to make a cardiac tissue model young and aged avoiding the use of the animal model. Finally, a medical polyurethane has been treated to become an antimicrobial or self-sterilizing surface where superbugs cannot colonize, survive or spread to control nosocomial infections and prevent the misuse of antibiotics, and consequently try to overcome the big problem of the antibiotic resistance. This research project origins from a bigger research area of the University College London that involves different knowledge and experience coming from the Medical School and the Dental Hospital, the School of Engineering, the Chemistry Dept. and the School of Pharmacy. The first prototype was a catheter containing a crystal violet and golden nanoparticles (NPs) solution that effectively kills *E. Coli*, MRSA and *Candida albicans*. The antimicrobial material of this dissertation is intended as an improvement of the existing one – most of the procedure has been changed and the solution was obtained using crystal violet and silver NPs but also silver NPs only. Silver nanoparticles showed the evidence to kill *P. aeruginosa* while staying inside the bulk of the material avoiding superficial oxidation processes. The coating material obtained can reduce bacteria biofilm caused diseases in humans and is on its way to be patented.