BIOENGINEERING AND MEDICAL-SURGICAL SCIENCES

Unito - AI IN TELEREHABILITATION AFTER SURGERY

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Supervisor	FIORI CRISTIAN - cristian.fiori@polito.it
Contact	
Context of the research activity	Urologic surgery has moved from open surgery to laparoscopic surgery and lastly to robotic surgery. The main goals of this change have been functional outcomes, to prevent or otherwise reduce those morbidities related to demolitive surgery, always respecting the criteria of oncologic radicality. Although enormous strides have been made in this regard urologic surgery may result in temporary and/or permanent impairment of some physiological functions (e.g., urinary continence, erectile function, renal function etc.) of the patient. Early postoperative monitoring and rehabilitation protocols have been shown to offer better opportunities for recovery of these functions, but their adoption is limited by lack of human resources and local services. Therefore, very often patients find themselves falling outside the time window of early rehabilitation only to approach it later. In this scenario, telehealth and telemedicine can be a useful tool to overcome these limitations as they do not require the physical presence of the patient or physician, can be carried out remotely. In addition, the patient is more adherent to the treatment protocols that are recommended (both in terms of taking medications and physical rehabilitation) as he or she can manage the time, manner, and location of these activities.
	The primary objective of this research is to develop an informatic platform for perioperative management, home monitoring, and postoperative rehabilitation of patients undergoing urologic surgery. The secondary objectives of the study are to evaluate the utility of telemonitoring by the patient and health care provider; to prospectively collect preoperative, intraoperative, postoperative, and functional data of patients undergoing urologic surgery according to their risk category of developing postoperative functional sequaele; and to compare the rates of recovery of these functions with a contemporary or historical series of patients not undergoing telemonitoring. In addition, at the end of enrollment and follow-up, the study aims to use the prospectively collected data for the development of a predictive mathematical model using Machine Learning techniques for the identification of variables that can best characterize the risk categories of development of postoperative sequaele, as well as for the identification of rehabilitation protocols that can produce better postoperative functional outcomes. Subsequently, the development, through artificial intelligence, of

Objectives	independent predictors that can be considered risk factors or protective factors for functional recovery after surgery is desirable. The first phase of the project involves the design of a telemedicine informatics platform, in collaboration with engineers, to meet the clinical needs of urological practice. Patients undergoing robotic surgery for urological malignencies who have Internet access via PC/Tablet/Smartphone will be included in the study. Preoperative, intraoperative, and postoperative data of enrolled patients will be prospectively collected and classified into risk categories for the development of postoperative functional sequelae. Patients will follow predefined telemonitoring and telerehabilitation protocols. Monitoring of functional parameters is planned at predefined intervals based on the risk category identified for the patient: - High risk; - Low risk. In the example of radical pelvic surgery: In high risk patients, the protocol involves performing first-level pelvic floor exercises virtually guided by APP on a daily basis, monitoring by checking the number of PADS used/day and PAD weight by PAD testing every 2 days in the first 2 weeks after bladder catheter removal (if the preset maximum thresholds for these parameters are met, monitoring will be performed every 4 days for the next 2 weeks); if preset maximum thresholds for these parameters are not met, performance of second-level pelvic floor exercises virtually guided by APP), performance of penile exercises by Vacuum Device virtually guided by APP on a daily basis, production of alerts by notification to take PDE5i therapy every 2 days, monitoring of clinical response by computerized performance of IPSS, Qol and IIEF5 questionnaire on a weekly basis. In the low risk, the protocol involves daily performance of level 1 pelvic floor exercises virtually guided by APP, monitoring by checking n PADS used/day and PAD weight by PAD test every 4 days in the first 2 weeks after bladder catheter removal (if the predetermined maximum thresholds for these parameters are met, monitoring every 7 days for the next 2 weeks; if preset maximum thresholds for these parameters are not met, performance of second-level pelvic floor exercises virtually guided by APP will be indicated), production of alerts by notification to take PDE5i therapy every 2 days, monitoring by computerized performance of IPSS, Qol, and IIEF5 questionnaire every week. Similar protocols will be established for all the robot assisted surgeries for urological malignancies. Evaluation of the usefulness of telemonitoring by the patient and health care provider will be done through face and content questionnaires. At the end of enrollment and follow-up, prospectively collected data will be used to develop a predictive mathematical model using Machine Learning techniques for defining risk categories and identifying the correct individual telerehabilitation and telemonitoring protocol for each patient. Finally, thanks to the big data collected, artificial intelligence software will be used that can predict the risk of developing postoperative sequelae and therefore set the most congruent rehabilitation program based on perioperative data alone.

Skills and competencies for the development of	For the development of this project the candidate must have experience in urology clinical practice for diagnosis, rehabilitation, and treatment of dysfunction arising after urologic oncological surgery. In addition, the candidate must be fully conversant with all surgery procedures with special emphasis on robotic-assisted oncological surgery. Knowledge of rehabilitation protocols, pharmacologic and second-line management of surgical sequelae is fundamental among the basic requirements. The

the activity	candidate must also have familiarity with data managing and big data to develop in synergy with the engineering counterpart artificial intelligence systems capable of defining appropriate rehabilitation programs for individual patients.