

BIOENGINEERING AND MEDICAL-SURGICAL SCIENCES

UNITO - Artificial Intelligence in Head and Neck cancer: a new tool for tumor staging and treatment planning

Funded By	UNIVERSITA' DEGLI STUDI DI TORINO [P.iva/CF:02099550010]
------------------	--

Supervisor	PECORARI GIANCARLO -
-------------------	----------------------

Contact	
----------------	--

Context of the research activity	Artificial Intelligence (AI) represents an increasingly exciting area of research in medicine because of its capability to automatically perform complex tasks with great speed and precision. Significant recent strides have been made in otolaryngology research using AI and machine learning (ML), across all ears, nose and throat (ENT) subspecialties, including neurotology, head and neck (H&N) oncology, laryngology, rhinology, and sleep surgery. Potential applications suggested by recent publications include screening and diagnosis, predictive tools, clinical decision support, and clinical workflow improvement via large-language models (LLMs). In the field of H&N oncology, ML methods have been extensively investigated in all imaging modalities including ultrasound (US), computed tomography (CT), magnetic resonance (MR), and nuclear medicine. Some authors have also recently proposed a classification neural network to distinguish between normal from pathological tissue using hyperspectral imaging (HIS); in consists in a non-invasive diagnostic tool that provides information about tissue abnormality by measuring the reflected, fluorescent, and transmitted light that interacts with tissue itself. Moreover, AI was also adopted to delineate the Positron Emission Tomography – Gross Tumor Volume (PET GTV) prior to radiotherapy for H&N cancers, in order to accurately assess nodal involvement and to distinguish healthy metabolic activity in the proximity of malignant tissue. In fact, it was demonstrated that ML methods could delineate tumor volumes similar to clinical quality; under these assumptions, the adoption of AI in determining the PET GTV would help to reduce clinical tumor delineation variability, so increasing the accuracy and the reliability of radiotherapy.
---	---

	In recent years, ML methods have been used to predict the tumor staging and classification of H&N tumors, including malignancies of sinonasal cavity, oral cavity, oropharynx, hypopharynx, and larynx. Some recent applications of AI in tumor characterization are the following: - to differentiate squamous cell carcinoma from other malignant histotypes; - to improve the preoperative T-staging accuracy in locally advanced laryngeal carcinoma;
--	---

Objectives	- to predict tumor grade and nodal status in oropharyngeal and oral cavity squamous-cell carcinoma; - to predict the human papillomavirus (HPV) status, tumor grade, extracapsular spread, and perineural and lymphovascular invasion in H&N cancer; - to differentiate lymph nodes caused by metastatic H&N squamous cell carcinoma, lymphoma, inflammation, and those that are normal. - to predict cervical lymph node metastases based on radiomic features of H&N squamous cell carcinoma. However, studies on H&N tumor staging considering both tumor size and pathological lymph node involvement are still lacking.
Skills and competencies for the development of the activity	This research project aims to define how AI and ML based on LLMs could define the complete H&N tumor staging on the basis of radiological imaging, in order to provide an accurate and standardized treatment strategy for these malignancies. The project would be carried out on multiple (at least 500) CT or MR scans performed on patients with first diagnosis of H&N tumor in the period between 2007 and 2027. Only radiological imaging performed at “Città della Salute – Molinette” Hospital will be considered for the project. Exclusion criteria are age under 18 years old, tumor recurrences, metastases from other secondary malignancies not of H&N origin, and radiological scans with significant artifacts. The project will not involve experiments on animals or humans but will exclusively focus on the adoption of radiological investigations to develop an AI method that provides clear staging of the tumor and its appropriate therapeutic management.