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ABSTRACTS

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GA101- Immunomodulatory Photoacoustic Nanoparticle-engineered Macrophages for Solid Cancer Immunotherapy and Longitudinal Monitoring

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Category: Oncology

Abstract Body:
Background: Reinforcing antitumor functions of macrophages, phagocytosis of cancer cells and secretion of inflammatory cytokines, can be a potent approach to treat solid tumors. Several strategies including CAR-macrophages and phagocytosis-enhanced macrophages (engineered via anti-CD47 antibody treatment) have been recently reported and have shown promise in preclinical models [1, 2]. However, these approaches lack mechanisms for monitoring transferred macrophages and assessing their therapeutic efficacy against tumors, limiting the ability to implement longitudinal therapeutic interventions throughout the treatment. Integrating imaging and contrast agents offers a possibility for real-time and non-invasive tracking of macrophages within the tumor microenvironment. Specifically, labeling macrophages with imaging contrast agents allows for longitudinal visualization of their migration, infiltration, and persistence in tumors, which could serve as an indicator of therapeutic response. Photoacoustic (PA) imaging is a technique that combines ultrasound and optical imaging by leveraging the light-to-sound conversion under laser irradiation of optical absorbers with high-intensity nanosecond laser pulses. PA imaging offers a powerful tool for real-time and noninvasive tracking of adoptively transferred cells. Here, we propose a macrophage engineering strategy for PA image-guided cancer immunotherapy. A nanoparticle formulation with both PA contrast and immunomodulatory effects is synthesized. Macrophages labeled with the formulated nanoparticles demonstrated strong antitumoral phenotypes and allowed longitudinal PA imaging. Our work provides perspectives on engineering macrophages for image-guided cancer immunotherapy.
Methods: Macrophages were derived from murine bone marrow cells. Bone marrow cells were extracted from the femur and the tibia from 5 - 8 weeks old mice. The cells were cultured with 20 ng/mL M-CSF for differentiation into macrophages. The hyperbranched gold nanoconstructs (HBGNCs) were synthesized via surface-blocker assisted seeded growth. Briefly, the surface of 35 nm-sized gold nanospheres was partially blocked during the seeded growth to yield the hyperbranched structure with a construct dimension of 100 nm.
For PA imaging, macrophages were labeled with HBGNCs. Afterwards, cells were washed with PBS and collected. The cell solution was embedded in gelatin phantom. The phantom was submerged in water and imaged under Vevo2100/LAZR imaging system.
The effect of particle labeling on key cellular functions, such as viability, migration, and antitumoral functions (CD80, CD87, MHCII, and CD206 expression), was investigated by confocal microscopy and flow cytometry.
Results: Photostable HBGNCs with high optical absorption efficiency, ~90% in the near-infrared I (NIR I) region, were synthesized. The enhanced optical absorption was attributed to the hyper-branched structure. Due to the enhanced optical responses at NIR I region, the HBGNCs produced robust photoacoustic (PA) responses at corresponding wavelengths, offering high sensitivity in PA imaging. When macrophages were labeled with HBGNCs, the size and the granularity of the cells increased as the particles were internalized. The labeling did not affect the viability of the cells. HBGNC-labeled macrophages embedded in tissue-mimicking phantoms yielded high PA signal.
The migration ability of the labeled macrophages was evaluated. Compared to IFNg-primed macrophages that are known to migrate at a high rate, macrophages labeled with either HBGNCs or HBGNC-Gs displayed a superior migration ability.
The phenotype of macrophages became more strongly anti-tumoral when labeled with IFNg-conjugated HBGNCs (HBGNC-Gs) compared to HBGNC and IFNg alone. This was supported by the increased expression of costimulatory receptors CD80 and CD86, MHCII, and the decreased expression of pro-tumoral marker CD206.
Conclusion: In the current study, a new strategy of macrophage engineering for cancer immunotherapy was introduced. Labeling macrophages with HBGNC-Gs have enabled PA imaging of macrophages and, at the same time, enhanced their migration ability and antitumoral phenotype. Results suggest that HBGNC labeling approach can provide insights into developing strategies for macrophage-based cancer immunotherapy.
Disclosures: The authors have no conflicts of interest to disclose.
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important. Currently, digestive endoscopy is the only effective method for screening and diagnosing early gastric cancer (EGC). However, it relies on equipment and the expertise of endoscopists, as well as their technical proficiency. Some EGC lesions are located in concealed positions and exhibit atypical characteristics under endoscopic examination, making them difficult to detect and diagnose. Near-infrared fluorescence molecular imaging, capable of visualizing minute lesions, uses a wide field of view and fluorescence amplification through probes constructed to target specific marked cellular molecules. Nevertheless, there is a lack of imaging agents that exhibit molecular specificity for EGCs in digestive endoscopy.
Methods: In this study, we utilized dye-labeled tight junction molecule Claudin18.2 (CLDN18.2) antibody IMAB362 and a small molecule inhibitor of fibroblast activation protein (FAP), FAPI-46, as imaging nanoprobes to achieve specific EGC imaging using confocal laser endomicroscopy (CLE). First, we validated the expression of CLDN18.2 and FAP in early gastric cancer tissues and constructed high-expressing CLDN18.2 gastric cancer cell lines MKN-45 and HGC-27, as well as primary cultured early gastric cancer-associated fibroblasts (CAFs). After confirming the expression of the relevant molecules, we mixed and implanted them in situ in mice to be detected via whole-body fluorescence imaging and CLE imaging. Subsequently, we locally applied dye-labeled IMAB362 and FAPI-46 to resected human tissues for EGC detection.
Results: CLDN18.2 and FAP were found to be highly expressed in early gastric cancer tissues, FAP with a significant expression difference between cancerous and adjacent non-cancerous tissues. Successful construction of CLDN18.2 and FAP high-expressing gastric cancer cell lines and early gastric cancer-associated fibroblasts was achieved. Small animal in vivo fluorescence imaging and CLE imaging targeting CLDN18.2 and FAP showed good specificity and the ability to distinguish tumor tissue from non-tumor tissue, closely correlating with immunohistochemical results.
Conclusion: CLE approach based on IMAB362 and FAPI-46 probes enhances the accuracy of EGC detection, aiding in the identification of EGC and the assessment of margins during endoscopic procedures. As a readily accessible hollow organ, the stomach allows for localized delivery of high concentrations of imaging contrast agents directly to suspicious mucosa, thereby minimizing potential systemic toxicity. Moreover, this technique enables visualization of tumor margins and facilitates endoscopic resections. Overall, the use of near-infrared fluorescence molecular endoscopic technology targeting gastric cancer-specific markers presents a novel approach for the early diagnosis of gastric cancer, intraoperative margin determination, and treatment guidance through endoscopic channels sprayed with specific targeting near-infrared fluorescence molecular probes.
Disclosures: The authors have no conflicts of interest to disclose.

Poster Presentation

LB215- Preclinical Evaluation of Tumor Targeting and Therapeutic Efficacy of Radiolabeled Trastuzumab Biosimilar

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Category: Oncology

Abstract Body:
Background: HER2 (receptor tyrosine-protein kinase erbB-2) is a membrane receptor that regulates cell proliferation, and its overexpression in cancer cells leads to uncontrolled tumor growth. Trastuzumab, a monoclonal antibody targeting HER2, can inhibit the growth and division of HER2-positive cancer cells. However, when conjugated with a therapeutic radioisotope, its cytotoxic potential may be significantly enhanced through localized radiation delivery. This study aimed to evaluate the feasibility of developing a radiopharmaceutical based on CT-P6, a trastuzumab biosimilar, which offers comparable efficacy and safety to the originator at a relatively lower cost.
Methods: CT-P6 was conjugated with SCN-Bn-DOTA and radiolabeled with ^{64}Cu or ^{177}Lu. Radiochemical purity and serum stability were assessed. In vitro cell binding assays were performed using HER2-positive gastric cancer cells (NCI-N87) and HER2-negative breast cancer cells (MDA-MB-231) to evaluate HER2-specific targeting. For in vivo validation, small-animal PET/SPECT imaging and biodistribution studies were conducted in NCI-N87 xenograft mouse models.
Results: HER2 expression in NCI-N87 cells was approximately 34-fold higher than in MDA-MB-231 cells. Both ^{64}Cu-DOTA-CT-P6 and ^{177}Lu-DOTA-CT-P6 were prepared with high radiolabeling yields and radiochemical purity exceeding 98.85%, and they exhibited excellent serum stability. In vitro, ^{64}Cu-DOTA-CT-P6 bound to NCI-N87 cells at a rate approximately 18.58 times greater than to MDA-MB-231 cells, confirming HER2-specific interaction. In vivo, ^{177}Lu-DOTA-CT-P6 demonstrated significantly higher uptake in HER2-positive tumors compared to HER2-negative tumors. Biodistribution analysis revealed a time-dependent increase in tumor accumulation, maintaining up to 93.16 ± 20.20 %ID/g at 168 hours post-injection. PET imaging with ^{64}Cu-DOTA-CT-P6 confirmed sustained tumor targeting, with a tumor uptake of approximately 20.12 ± 5.46 %ID/g at 72 hours.
Conclusion: ^{64}Cu- and ^{177}Lu-labeled CT-P6 effectively targeted HER2-expressing tumors both in vitro and in vivo, demonstrating that the biosimilar maintains functional integrity after radiolabeling. These findings support the potential of CT-P6 as a cost-effective, viable radioimmunotherapeutic agent, particularly for use in resource-limited settings. Further studies focusing on therapeutic efficacy and dosimetry are warranted to fully validate its clinical application.
Disclosures: The authors have no conflicts of interest to disclose.

Poster Presentation

LB218- Development of Hybrid Classical–quantum Framework for Lossy Compression of 2D Magnetic Resonance Images using a Quantum Autoencoder (QAE)

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Category: Computational & Data Science

Abstract Body:
Background: Recent advancements in both MRI scanners' hardware methods have pushed further the capabilities of medical imaging but also opened new challenges in terms of storage and sharing requirements of ever larger MRI datasets .This process creates large datasets crucial for diagnosis, posing storage and transmission challenges in digital health systems, especially for molecular imaging sequences like diffusion-weighted MRI (DW-MRI) and dynamic contrast-enhanced (DCE) MRI. Traditional compression methods often lose important clinical details, highlighting the need for advanced techniques [2–4] that preserve diagnostic accuracy while achieving high compression ratios. Classical compression techniques risk losing subtle diffusion or perfusion signatures crucial for diagnostics. Quantum autoencoders (QAEs) promise efficient representation of high-dimensional data

by embedding classical preprocessed features into a small quantum latent space. In this work, we integrate principal component analysis (PCA) with a QAE to compress single 2D MRI slices, enabling potential acceleration in molecular imaging pipelines.
Methods: Data Preprocessing: We made use of a contrast-enhanced T1 weighted image (patient W33) from a public database. The central axial slice of a 3D NIfTI MRI volume was then extracted and downsampled to a 128×128 resolution: Pixel intensities were then scaled to [0, π] to match quantum rotation angles. A noisy training set of PCA inputs was generated by adding Gaussian noise and PCA reduces the flattened slice (H×W) to an L-dimensional vector (PCA_DIM_IN) to capture maximal variance. Quantum Autoencoder Encoding Circuit: RY rotations by PCA components on L qubits were applied, followed by N_LAYERS variational blocks. Latent measurement was performed by extracting PCA_DIM_LAT < L qubit expectation values as the compressed code. The decoding circuit then reverses the process thus preparing latent angles on PCA_DIM_LAT qubits, zero-initializes the rest, applies the same variational blocks, and measures all L qubits to reconstruct PCA-space data.
Model parameters: Variational weights parameters of shape (N_LAYERS, n_qubits, 2) were initialized randomly and updated through the Adam optimizer with learning rate, LR.
Model training: The mean-squared error (MSE) between the decoder outputs and target noisy PCA vectors was minimized over a batch of size BATCH_SIZE according to eqn (1). The model was trained for 1000 epochs.
Optimization and Implementation: AdamOptimizer from PennyLane has been employed. Stable training and noise-robust latent maps were enabled. Streamlit for an interactive user interface was then implemented.
Results: The model started learning as from the 200th epochs as shown in figure 1 (rapid convergence), which shows that this model is not computatuonal expensive to train. After model training, the reconstructed slice is obtained by inverse PCA on decoder outputs. Model performance was computed as shown in tables 1 and 2. These results shows that the QAE model achieved almost 30% compression rate while maintaining visual fidelity on structural features. The user interface (UI) from model deployment has been shown in figure 2. Any MR image could be easily loaded to this app and then QAE model training is started to obtained compression results. The reconstructed compressed image and error maps has been shown in figure 3 and 4. Figure 4 is basically a colored version of figure 3 so as to highlights residual differences at edges and high-contrast regions. Side-by-side comparison demonstrates preserved anatomical detail in the compressed image slice, with localized error maps highlighting <5% pixel deviations. It is important to note that the app lets user download two files; latent Code NIfTI: this is the compressed data such that instead of saving full 2D image, this small latent file (plus the PCA basis) is all that is needed to reconstruct later while PCA Basis NIfTI allow users to decode the latent code back into image-space. Together, the latent code file and the PCA-basis file can be used to reconstruct (or share) the slice at far lower storage cost than the original NIfTI volume.
Conclusion: This study illustrates a practical pathway to deploy quantum-inspired autoencoders for MRI compression in a browser-based app, with prospects for future hardware demonstrations and clinical data workflows. QAEs promise a path to far more compact, entanglement-powered latent representations and, eventually, true quantum speed-ups in compression and inference. These models are not a drop-in replacement for classical models yet, but as quantum hardware advances, their unique ability to intrinsically operate in exponentially large feature spaces could translate into powerful new compression and reconstruction tools for molecular imaging and beyond. This PCA+QAE pipeline demonstrates feasible compression for single slices. Future studies could extend this concept to 3D volumes, incorporate noise models specific to molecular imaging, and explore error-correction codes on quantum hardware.

Disclosures: The authors have no conflicts of interest to disclose.
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Poster Presentation

LB221- 18 F-FDG PET/CT Usefulness for the Detection of Local and Regionallaryngeal Cancer Recurrence

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Category: Oncology

Abstract Body:
Background: Laryngeal cancer ranks as the second most prevalent head and neck cancer, it's leading causes of mortality are locoregional disease recurrence and distant metastasis. The aim of this study was to highlight the ^{18F}-FDG-PET/CT usefulness for the detection of local and regional recurrences in patients with squamous cell laryngeal carcinoma.
Methods: This is a retrospective descriptive study of fifteen patients who previously underwent surgical treatment, chemoradiotherapy for primary laryngeal squamous cell carcinoma and who underwent examination using FDG-PET/CT imaging in the follow up workout.
Results: All the patients in this study were men with a mean age of 60 years. All the patients were diagnosed with squamous cell carcinoma of the larynx, 8 of these patients underwent total laryngectomy with lymph node dissection, 5 of them received chemoradiotherapy, one underwent total laryngectomy followed by chemoradiotherapy and one underwent immunotherapy after progressing under chemoradiotherapy. The ^{18}F-FDG-PET/CT was done for the recurrence suspicion management. The ^{18}F-FDG-PET/CT was positive in height patients and negative in seven; in the positive PETCT scan: six cases, had a local recurrence: the highest SUVmax detected was 10.22, among these six patients two had a lymph node and lung metastasis recurrence (13.3%) associated to the local relapse. In postif ^{18}F-FDG-PET/CT patients, the SUV max ranged at (3.9 −10.22) in local relapses, (5.6 −7.89) in lymph node recurrence and (3.5 −5).
Conclusion: PET/CT is a useful tool for suspecting locoregional recurrence where conventional imaging (CT and MRI) is unable to resolve the diagnostic doubt. Most studies indicate that overall specificity, sensitivity, and accuracy of PET/CT were found to be 88%, 100%, and