Online Proceedings

Poster Session 1

Balcony, Easel 100

11:00 AM to 1:00 PM

Human Tissue Database Development

Joaquin Enrique Batista, Senior, Physics: Applied Physics
Mentor: Alex Gong, Surgery, CREST

Reported human tissue properties and behaviors vary significantly across studies based on the characterization protocols utilized. My undergraduate research at the Center for Research in Education and Simulation Technologies (CREST) aims to address the gap between practitioners in the hospital by developing high-fidelity materials for medical simulation through data analytics. This will allow more accurate research in the field as well as better access to material properties and data. Raw uniaxial and puncture human tissue data is analyzed through MATLAB scripts to quantify human tissue behaviors. The processed data is restructured and transferred into bulk storage databases using Azure SQL servers and SQL databases, enabling cloud access. By utilizing Azure SQL databases, Tableau is used to visualize and manipulate targeted data. The human tissue property database bridges the gap between engineering and medicine. This database will be used to create the next generation of finite element models of the human body to help build virtual reality simulators.

Poster Session 1

Balcony, Easel 101

11:00 AM to 1:00 PM

Developing a High-Fidelity Model for Adipose Tissue in Humans

Agnes Yaeji Song, Senior, Bioengineering
Mentor: Alex Gong, Surgery, CREST

With reduced operating hours and additional pressures, there is a rising importance in the development of an accurate surgical simulation. In order to improve the effectiveness of surgical simulations, there must be an accurate model of the human body that can be used for practice. Although cadaver and animal models are imperative to the training of future and current surgeons, there is a rising ethical interest paving the way towards alternative solutions. My undergraduate research at the Center for Research in Education and Simulation Technologies (CREST) aims to develop an accurate model for adipose tissue in the greater and lesser omentum. We have developed four prototype recipes for simulated adipose tissue using chemically-modified polydimethylsiloxane (PDMS) composites. In order to evaluate how the prototypes compare to *in-vivo* and *in-situ* adipose tissues, we have collected quantitative data through uniaxial tensile, coefficient of friction, and puncture testing in addition to qualitative data collected through conducting surveys of physicians. By utilizing this collection of both quantitative and qualitative data, we have developed an accurate synthetic adipose tissue model.

Poster Session 1

Commons West, Easel 24

11:00 AM to 1:00 PM

Using ExoFlow to Assess Exosome Profiles of Cystic Fibrosis Patients with and without Chronic Lung Allograft Dysfunction after Lung Transplantation

Nihar Mahajan, Senior, Biology (Molecular, Cellular & Developmental), Biochemistry
Mentor: Billanna Hwang

Lung transplantation is currently the only treatment solution for end-stage lung disease in a large cohort of patients afflicted with a range of pulmonary issues including cystic fibrosis (CF) and idiopathic pulmonary disease (IPF). Despite the successes, a major setback is the development of chronic lung allograft dysfunction (CLAD). This is characterized by chronic inflammatory host responses towards the transplanted lung resulting in injury of the donor tissue. Currently, we are investigating the role of cell-derived vesicles or exosomes, in a range of immune responses such as chronic inflammation. The composition of exosome membrane components and internal signaling within exosomes depend on the cell type from where it was secreted and the current immune state. A major benefit is that unlike cells, exosomes do not change phenotype after being secreted by the parent cell due to environmental stimuli, making them ideal targets for biomarkers associated with immune responses. In these studies, we assessed exosome surface markers and investigated exosome function from retrospective patient serum, which provides insight into potential novel mechanisms in the development of CLAD. We developed a novel ExoFlow that qualitatively and quantitatively assesses exosomes at 1, 3, 6, and 12 months posttransplant using CFSE, traditional fluorescent antibod-

ies for T cell and macrophage markers, and ImageStream to generate immune profiles. We then correlated these results to clinical outcomes. In a preliminary study, it appears that macrophage exosome profiles show significance in differentiating patients who develop CLAD, while T cell specific exosomes seem to be unremarkable. This could be attributed to the heavy course of immunosuppression posttransplant. Functional studies show insight in potential polarization capabilities of exosomes as immune modulators and provides another novel area of investigation into the complex pathogenesis of CLAD.

POSTER SESSION 1

Balcony, Easel 103

11:00 AM to 1:00 PM

Delivery of CRISPR Cas9 Using Mesenchymal Stem Cell-Derived Exosomes to Reduce Fibrosis and Promote Regeneration in Lung Tissue

Sean Anthony Hoeger, Senior, Biology (Molecular, Cellular & Developmental)
Mentor: Billanna Hwang

Pulmonary fibrosis is a disease marked by irreversible scarring and thickening of the lung tissue causing significant decline in lung function. Individuals afflicted will struggle to perform simple physical activities and often require mechanical assistance at some point in their lives. Currently, there are no permanent solutions for those with pulmonary fibrosis as most treatments only aim to slow down the progression of the disease. In these studies, we developed a novel therapeutic that could stop the progression through DNA modification of fibrotic gene targets using exosomes as a delivery vehicle. Additionally, regeneration of lung tissue is imperative for reinstating lung function and by using similar technologies we aim to target and overexpress critical regenerative genes. Using CRISPR Cas9 gene editing technology, we were able to knockdown key cytokine specific genes responsible for the development of fibrosis. We specifically targeted TGFß(Transforming Growth Factor ß) and Interleuken-6 (IL-6), both known to play a significant role in pro-inflammatory responses and fibrosis through exosome-mediated delivery mechanisms. CRISPR Cas9 vectors were designed to contain unique guide RNAs that could effectively target specific genes that the Cas9 complex could use to repress TGFßand IL-6. Cell lines were treated with the modified CRISPR Cas9 vectors and assessed for gene and protein expression. This study provides key insight into a novel therapeutic platform using a new delivery mechanism that mitigates and reduces fibrosis and promotes recovery of pulmonary function.

POSTER SESSION 2

Balcony, Easel 116

1:00 PM to 2:30 PM

Possible Role of Exosomes in Colon Cancer

Sharda Raina, Senior, Psychology, Biochemistry
Mentor: Peter Wu, Department of Surgery
Mentor: Daniel Wu

Exosomes are 40-50nm extracellular vesicles released by all cell types, and are involved in a variety of cellular mechanisms including modulation of immune response and cancer microenvironment. Exosomes embed proteins, lipids, and nucleic acids from the parent cells and circulate in abundance in human serum. Recently, exosomes have been shown to have potential application as cancer biomarkers with potentially increased sensitivity and specificity compared to traditional protein or nucleic acid markers. In cancer patients, exosomes are also shed in real time, allowing potential applications in directing therapy, monitoring treatment response, and surveying recurrent disease. Using a known tumor marker, carcinoembryonic antigen (CEA), we examined the role of CEA-specific exosomes as a colorectal cancer biomarker. To establish the methodology, we used CEA-secreting colorectal cancer cell lines LOVO and HT29. We compared exosome isolation methodologies and established an ultracentrifugation-based technique to maximize both purity and yield. Through this methodology, we isolated exosomes from cell-free media and demonstrated that CEA co-localizes with coxasackie-adenovirus receptor (CAR), a senescence-related marker of interest in our laboratory. This finding suggests that tumor-derived exosomes could be used to quantitatively define certain cellular events. We then used archival and fresh patient samples to examine whether the CEA-exosomes could be applied in disease monitoring in patients with metastatic colorectal cancers receiving chemotherapy. Efforts are ongoing to define whether CEA-specific exosomes are tumor specific, and whether exosome conjugate protein and nucleic acid can be further used as novel biomarkers in selective clinical situations.

POSTER SESSION 4

Balcony, Easel 106

4:00 PM to 6:00 PM

What is the Time Burden Associated with Completion of Health-Related Quality of Life Questionnaires after Cancer Treatment?

Wesley Jenq, Junior, Biology (Physiology)
Mentor: Fredrik Klevebro, Thoracic Surgery, Virginia Mason Medical Center

Patient reported outcomes (PRO) are becoming increasingly important in the follow-up of patients after cancer treat-

ment. The specific aim of this study was to investigate the time taken and completeness of PRO questionnaires. Study subjects were identified from an institutionally approved database of patients who had undergone surgical management of esophageal cancer with curative intent (1991-2018). Patients that were alive in April 2018 were asked to complete six questionnaires, including: Digestive Symptom Questionnaire (DSQ, 23 questions); Dumping Syndrome Rating Scale (DSRS, 25 questions); SF36 (36 questions); EORTC-QLQ-C30 (30 questions); EORTC-QLQ-OG25 (25 questions); and EuroQol 5D (6 questions). Patients were offered either hard-copy (paper) or Electronic versions of the questionnaires. Electronic questionnaires compiled in RedCap were completed consecutively by patients allowing for accurate quantification of the time taken to complete each questionnaire. In total, 144 patients were asked to participate, 117 patients (81.3%) agreed to complete questionnaires, of whom 60 (51%) of the patients choose the electronic version. Completion rates for all of the questionnaires was 91% (52 patients) and 85% (51 patients) for paper and electronic versions respectively. The average age of patients choosing electronic questionnaires was 74 (range 55-96) years compared to 71 (range 53-91) years in the paper questionnaire group. On average, the 6 questionnaires, consisting of 145 questions, took 26.9 (range 10-55) minutes to complete: 7.5 minutes for DSQ, (range 1-39 min), 4.4 min for DSRS, (range: 1-19 min), 6.8 min for SF-36, (range: 3-18 min), 3.7 min for EORTC-QLQ-C30, (range: 2-8 min), 2.7 min for EORTC-QLQ-OG25, (range: 1-5 min), 1.7 min for EuroQol 5D, (range: 0-6 min). In conclusion, the high response rate in the study, indicates that it is feasible to ask patients to answer multiple PRO questionnaires after cancer treatment. Continued focus on PROs is warranted to further increase the knowledge of cancer survivorship.