## Poster Session 1

**MGH 241, Easel 130**

*11:00 AM to 1:00 PM*

### Comparison of Dysphagia, Neck Pain, and Complications in Standalone versus Conventional Anterior Cervical Discectomy

*Brittni Burgess, Senior, Bioengineering*
*Mentor: Christian Fisahn, Department of Neurosurgery, Swedish Neuroscience Institute, Swedish Medical Center*

Anterior cervical discectomy and fusion (ACDF) is a well-established surgical technique used for the treatment of various disorders of the cervical spine. The two most common ACDF procedure methods are: standalone systems and traditional plating techniques. Dysphagia, the inability to properly swallow, is an extensively described complication; it has been proposed that mechanical irritation, additional dissection, or displacement of the esophagus by plate placement may contribute to a greater incidence of postoperative dysphagia. The aim of this retrospective cohort study is to assess differences in pain, clinical outcomes, and dysphagia, including complication and readmission rates, following ACDF using either a standalone cage system or a cage with anterior plating (traditional plating). Between 2014 and 2015 we identified 377 consecutive patients meeting study criteria (standalone, n= 211; plate and cage, n= 166). Pre-operatively scores were collected for patient specific characteristics, surgical characteristics, and Numeric Pain Rating Scale (NRS). In addition, complication and readmission rates, the Dysphagia Disability Index (DDI), and NRS scores were collected at one year and two years post-operatively. There was significantly greater improvement in neck pain scores for the plate and cage group after one and two years post-surgery ( 2.3 and 3.1 versus 1.6 and 1.5, respectively; $p < 0.01$). This could presumably result from biomechanical advantages when compared to stand-alone cage systems. There was no statistical difference between DDI scores either postoperatively or at two years post-surgery. These results indicate that mechanical irritation may not differ between procedure types. Further research is needed in order to determine factors that may lead to a higher rate of nonunion for patients undergoing standalone cage placement.

## Session 1O

## Cancer Biology

*Session Moderator: Hannele Ruohola-Baker, Biochemistry*

**MGH 389**

*12:30 PM to 2:15 PM*

* Note: Titles in order of presentation.

### Identification of Mutations Induced by Radiation and HER2 Overexpression in Breast Carcinogenesis

*Seung (Tony) Lee, Senior, Chemistry, Biochemistry*
*Mentor: Eun Hyun Ahn, Pathology*

Exposure to ionizing radiation is the longest-established environmental cause of human breast cancer in both women and men. Evidence indicates that HER2-positive breast cancers are more likely to spread and are more resistant to anticancer-treatments. The goal of our study is to investigate genetic variations that are introduced during breast carcinogenesis. As a progressive stages of breast carcinogenesis cell model, normal human breast stem cells were sequentially transformed with SV40 large T antigen, x-ray radiation, and HER2 (ERBB2) overexpression to generate non-tumorigenic/immortalized cells, weakly tumorigenic cells, and highly tumorigenic cells, respectively. We sequenced 82 genes that are frequently mutated in breast cancer using next generation sequencing. We identified 26 radiation-specific mutations in exonic or intronic splicing regions that are not present in immortalized cells, but are present only in weakly tumorigenic cells. Among the 26 mutations, a single nucleotide deletion in RECQL gene, which is involved in DNA repair, is highly mutated (43%). Mutations induced by the overexpression of HER2 were identified by analyzing mutations present in highly tumorigenic cells but not in weakly tumorigenic cells. Two HER2 overexpression-specific mutations PRSS1 p.K225R and RET p.F683Y were identified with the mutation RET p.F683Y present at a high prevalence of 54%. The RECQL deletion induced by radiation and the two nonsynonymous mutations PRSS1 p.K225R and RET p.F683Y induced by HER2 overexpression have not been previously reported by others. Studies are underway to further characterize genetic variations that are induced by SV40-T Ag, radiation, and HER2 overexpression in breast carcinogenesis. The identified mutations that are specific to these oncogenic treatments aid in characterizing molecular sub-

types of breast cancers and provide a foundation of identifying potential target mutations that can serve as biomarkers for the sequential stages of breast carcinogenesis.

## POSTER SESSION 2

**MGH 241, Easel 133**

*1:00 PM to 2:30 PM*

### Transcriptome profiling in breast cancer stem cell invasiveness

*Joon (Jason) Kim, Senior, Biochemistry, Chemistry*
*Mary Gates Scholar, UW Honors Program*
*Mentor: Eun Hyun Ahn, Pathology*

Cancer stem cells (CSCs) are small populations found within tumors and appear to be more resistant to anti-cancer treatments. Although evidence supports that CSCs play a major role in initiation and in the clinical outcome of cancers, the roles of breast CSCs in metastasis and invasiveness are not fully understood. Moreover, the association of the invasiveness of breast CSCs with genomic variations is unclear. The overall goal of this study is to investigate the migration abilities and genomic expression changes in breast CSCs. Human breast CSCs and immortalized/non-tumorigenic cells were derived from the same parental breast normal stem cells. To recapitulate tumor microenvironment, the cells were cultured on nanotopography-defined extracellular matrix (ECM)-mimetic platforms. We have employed a live cell imaging microscopy to measure migration at the single cell level as an indicator of invasiveness in breast tumorigenic and immortalized cells. Our preliminary results indicate that breast CSCs migrate significantly faster than immortalized cells on ECM mimics. Interestingly, we only find this difference under ECM-mimetic culture conditions, but not under flat control surfaces lacking ECM structures. This suggests that the invasive abilities of breast CSCs are lost when they are cultured *in vitro* on flat control surfaces without ECM structures. We will perform RNA sequencing to identify differences between the transcriptomes of breast CSCs and immortalized cells, and between cells cultured on ECM-mimics and substrates without ECM-mimics. The current study will characterize transcriptome profiling in breast CSCs and identify the genes that are differentially expressed between breast CSCs and immortalized cells. This will have implications in classifying molecular subtypes of breast cancers and in identifying potential therapeutic targets to regulate specific gene expressions for the inhibition of breast CSC invasiveness.

## POSTER SESSION 2

**Commons East, Easel 70**

*1:00 PM to 2:30 PM*

### An Organic Electrochemical Transistor with a Novel Double-in-Plane Gate Electrode

*Anna Kirchan, Senior, Electrical Engineering (Bothell), Chemistry (Bothell)*
*Mentor: Seungkeun Choi, STEM*

PEDOT:PSS-based organic electrochemical transistor (OECT) has been widely used for various sensing applications such as glucose, antigen, DNA, and pH sensing thanks to the much lower working voltages, typically less than 1 V, and known biocompatibility of a PEDOT:PSS. OECT comprises three electrodes (source, drain, and gate), a PEDOT:PSS channel between source and drain, and electrolyte solution of analytes. Electric current flows through the conductive PEDOT:PSS channel. However, upon the application of a positive gate voltage, cations from the electrolyte are injected into the channel, decreasing a conductivity of the PEDOT:PSS. Hence, electric current decreases as a gate voltage becomes more positive. In general, OECT is implemented by submerging a separate gate electrode in an electrolyte solution, thereby, making this only suitable for a laboratory environment. However, reports dealing with the impact of in-plane gate electrode on the OECT performance are relatively scarce. The proposed double-in-plane gate electrode for OECTs possesses great potential for the development of highly integrated OECT where each transistor can be separately controlled from its own gate electrode. All electrodes (gate, source, and drain) were placed in the same plane. High conductivity PEDOT:PSS was used to create a channel between source and drain. A PBS (Phosphate-Buffered Saline) was used as an electrolyte and pH value was adjusted with a hydrochloric acid. A drop of electrolyte of pH 3, 4, 5 or, 7.4 was placed just over the channel and the gate electrode. Compared to the transistor with a single gate, the double-gate transistor exhibited much higher transconductance of 35 mS. This means that the double-gate transistor can modulate larger current at the same gate voltage. Such a high transconductance with in-plane architecture will allow the development of portable OECT arrays for various chemical/biological sensing applications.

## POSTER SESSION 2

**Commons East, Easel 69**

*1:00 PM to 2:30 PM*

### A Multilevel Resistive Memory Device Based on Molybdenum Oxide

*Dinh Lam, Senior, Electrical Engineering (Bothell)*
*Mentor: Seungkeun Choi, STEM*

There has been expanding research into Resistive Random Access Memory (ReRAM) in order to replace conventional flash memory due to its lower programming voltage and faster read/write speed. In a ReRAM device, information is stored in a varying resistor whose resistance value can stay longer without an external power supply, hence making this as a good nonvolatile memory device. The resistance value can be changed by applying set/reset voltages and read by applying very small voltages. Furthermore, a ReRAM can be highly dense by implementing a cross-point array structure to store information. Recently, there has been great interest in a multilevel ReRAM in which one memory cell can have many different resistance states. This means that one memory cell can store more than one bit of digital information, i.e., ones and zeros; hence, enabling high density and miniaturization memory cell implementation. The ReRAM device that we have fabricated has a three-layered structure. The bottom electrode is a 150 nm layer of Indium-Tin- Oxide (ITO) and a 10 nm thick active layer molybdenum oxide was deposited by thermal evaporation. Finally, the top electrode of Ag (150nm) was deposited through a shadow mask by thermal evaporation. Current-Voltage (I-V) curve was measured by applying voltage between top and bottom electrode. The voltage was incremented from -2 to 2 Volts with 5 mV steps. A compliance current, or limiting current, was set to avoid breakdown due to the large current flow. The device exhibited 4 different resistance states by sweeping the device with different compliance current (10$\mu$A, 1mA, 10mA, and 100mA). Once the resistance states were set to a new value, original resistance values would not be restored. The irreversible characteristic of this device makes it suitable for many applications that need Write-Once-Read-Many (WORM) memory technology such as BIOS for computer and portable electronics.

## SESSION 2B

## CHEMISTRY, BIOCHEMISTRY, AND MATERIALS SCIENCE

*Session Moderator: Sharona Gordon, Physiology and Biophysics*

**MGH 228**

*3:30 PM to 5:15 PM*

* Note: Titles in order of presentation.

### Immune Modulation of Electrospun Nanofibers on Dendritic Cell Activation

*Namratha Potharaj, Senior, Bioengineering*

*Levinson Emerging Scholar, Mary Gates Scholar, UW Honors Program*

*Mentor: Kim A. Woodrow, Bioengineering*

*Mentor: Jaehyung Park, Bioengineering*

Vaccines save approximately 2.5 million lives every year, and vaccine development is an ongoing area of research in immunology. A vaccine is formulated with antigen and adjuvant, the latter of which enhances the host immune response to an antigen via stimulation of antigen presenting cells (APCs) like dendritic cells (DCs). Only a few adjuvants are currently approved for clinical use, posing a significant obstacle for new vaccine development. Multiple studies have investigated a diverse array of biomaterials and highlighted chemical analogues of pathogen associated molecular patterns recognized by immune cells. However, the immunogenic effects of physical properties like stiffness and porosity, which play an important role in cell function, are not fully understood. The goal of this project is to investigate how the stiffness and porosity of electrospun nanofibers modulate DC activation states. Recent studies showed that macrophages exhibit higher activation on stiffer substrates. Both macrophages and DCs are APCs derived from myeloid progenitors, thus motivating the hypothesis that stiffer nanofiber meshes could also induce higher DC activation. We investigated poly (vinyl alcohol) (PVA) and chitosan (CS) nanofibers that were cross-linked to modulate stiffness and porosity while also improving stability in water for cell studies. PVA and CS nanofibers were both thermally cross-linked at 150C. PVA nanofibers were additionally treated with methanol for 8 hours. Thermal treatment did not cause a significant change ($p>0.05$) in the stiffness of the PVA nanofibers whereas combined methanol and thermal treatment for 20 minutes produced PVA fibers that were twice as stiff. Cross-linked nanofibers will be incubated with murine bone marrow-derived DCs for cell viability and DC activation studies. DC activation state will be measured by cytokine secretion along with CD86 and CD80 surface marker expression. The results from this study have the potential to guide engineering of immune-modulating biomaterials for novel adjuvant development.

## POSTER SESSION 4

**Commons West, Easel 22**

*4:00 PM to 6:00 PM*

### Embedded Piezoresistive Sensor Network for Strain Measurements in Fabric-Reinforced Composite Laminate

*Chayanat (Luke) Wanitthananon, Senior, Aeronautics & Astronautics*

*Mary Gates Scholar*

*Mentor: Jinkyu Yang, Aeronautics and Astronautics*

*Mentor: Seunghyun Ko, Astronautics and aeronautics*

The increase use of composites in manufacturing complex aerospace structure calls for a more robust method of inspection. Conventional metallic strain gauges currently used by the aerospace industry require extensive preparation and can be time consuming. An embedded sensor system could tremendously improve on inspection time, as well as continuously monitoring the health of a structure. The sensors being developed are able to withstand larger tensile strain compare to traditional metal based strain gauges, and can be manufactured inexpensively. The embedding offers additional protection against harsh environment for the sensor; however, the sensor could affect the performance of a composite as a foreign body defect. This study aims to investigate the capacity and effects of an embedded uniaxial fiber strain gauges, arranged in orthogonal grid network configuration, inside a fiberglass fabric-reinforced laminate. These sensor fibers are made by hot extrusion of thermoplastic elastomer, and finished with a piezoresistive chemical coating. Linear behavior of resistance changes by strains was observed when applied loadings. Bending and torsion tests have shown the embedded sensors network to be effective in distinguishing mode of deformation in the test specimens.