BES9SM / Junior Colleges / Oral Presentation

Name	To Yi Hui
Level of Study	A Level
Institution	Hwa Chong Institution
Title of Abstract	Spinal muscular atrophy: Identifying rare mutations in patients and detecting gene copy number carriers through a novel droplet digital PCR approach
Authors	To Yi Hui and Lai Poh San (Mentor)
Abstract	"Spinal muscular atrophy (SMA) is an autosomal-recessive neuromuscular disorder caused by mutations in the SMN1 gene. Accurate diagnosis is impeded by the similarity of SMA symptoms with other muscular disorders. Genomic complexity and duplication of the SMA locus also hinders carrier detection. This study aims to identify mutations in patients and detect copy number carriers of SMN genes. Firstly, intragenic point mutations were screened through PCR and sequencing in 11 patients with suspicion of SMA but negative for homozygous deletion of SMN1 gene, the common mutation underlying 95% of all SMA patients. Two novel mutations were identified, a missense mutation (c.704C>A) and a frameshift deletion (c.837delT). SNP analysis showed that genotypes of all the patients were tightly linked, suggesting close relationships in the population. Secondly, copy number analysis of SMN genes was performed using a novel digital droplet PCR (ddPCR) approach to detect for carriers in 13 subjects. 1 to 2 copies of SMN1 and 1 to 3 copies of SMN2 genes were detected. Three subjects were found to be carriers. This is the first report of ddPCR for carrier screening based on a simple method that does not require labeled probes. Results show that this approach allows for the resolution of small fold copy number differences with extreme precision, accuracy and sensitivity by partitioning 20 µL PCR reaction into 20,000 nanoliter-sized droplets and randomly distributing the target DNA into each droplet. Results of this study have clinical applications for molecular diagnosis, carrier screening and genetic counselling in SMA families. "

BES9SM / Junior Colleges / Oral Presentation

Name	Cao Shuo
Level of Study	A Level
Institution	Hwa Chong Institution
Title of Abstract	Fall Detection System Usin Arduino Fio
Authors	Cao Shuo
Abstract	For elderly, falling at home is a serious issue. The project aims to build and design an accurate fall detection system using Arduino Fio which is able to notify designated people for help if the user falls down at home. The project focuses on detection of end posture a falling action and consists of two phases of experiments. Phase One experiment includes determination of threshold and designation of the prototype. Phase Two includes three experiments on human subjects to further testify the sensitivity, specificity and accuracy of the system. All participants will fall down on crash mats with protection pads under supervision of the researcher. Studies of simulated falls and Activities of Daily Living (ADL) assess the sensitivity and specificity respectively. The ADL tested in this project are activities that can produce impacts or abrupt changes in a person's movement and result in false triggering of the detection system. Participants will also perform a random combination of actions but the researcher himself does not know the sequence and number of falls or ADL performed, aiming to assess the accuracy. The system has achieved sensitivity of 97.2%, specificity of 77.8% and accuracy of 84.1%, higher than peer-reviewed accelerator-based benchmark (Bourke et al.2007) but lower than its multiple-sensor counterparts which include cameras and infra-red sensors. Its performance is relatively acceptable for a single-accelerometer fall detection system with simple algorithms and more accurate than counterparts in literature measuring impact (Bourke et al.2007).

BES9SM / Junior Colleges / Oral Presentation

Name	Xue Guanying
Level of Study	A Level
Institution	National Junior College, Dunman High School
Title of Abstract	Wearable Sensors with Potential Integration with Middleware like Handphones
Authors	Xue Guanying, Ji Yaqi, Holden Li King Ho
Abstract	Wearable sensors have extensively benefited soldiers with fitness-tracking function. The work embodied in this report involves the design of an easily used and portable wearable device, in order to obtain real-time pollution data for fine particles (diameter of 2.5 micrometres or less). The data collected is synchronously transmitted to user's middleware life handphone. The present work intends to initiate research into a wearable sensor integration with middleware like handphone for detection of particle pollution, with the ultimate goal of providing a militarily-proven wearable device for air pollution.

BES9SM / Junior Colleges / Oral Presentation

Name	Yap Dian Ang
Level of Study	A Level
Institution	National Junior College, Raffles Institution
Title of Abstract	Click Reactions and Application in New Molecular Materials
Authors	Yap Dian Ang, Su Mengyue and Dr. Bai Shi-qiang
Abstract	"The copper catalyzed azide-alkyne cycloaddition (CuAAC) reaction is one of the crucial in organic synthesis. Functional small molecules can be created for targeted applications through this highly efficient, stereospecific click reaction (CuAAC) with simple purification methods and benign conditions. The aim is to study the coordination property in molecular materials formation through the synthesis of new hybrid triazole ligand via click reaction, and to investigate the photoluminescence property of these molecular materials. Hybridized 1,2,3-triazoles are building blocks for functional (chiral and photo-luminescent) coordination molecules. In this project, two new 1,2,3-triazole-based NS ligand, 2-((4-(2-(cyclopentylthio)ethyl)-1H-1,2,3-triazol-1-yl)methyl)pyridine (L1) and 2-[(4-(3-methylphenyl)-1H-1,2,3-triazol-1-yl)methyl]-quinoline (L2) have been designed and synthesized via click reactions characterized by NMR and ESI-MS. Reactions of CuCl2 with L1 and CuI with L1 and L2 yielded three coordination complexes, Cu2Cl2(L1)2 , Cu6I6(L1)2 and Cu4I4(L2)2. Crystal structure by XRD showed that complex 1 presents a dinuclear five-coordinated [CuCl]m (m=2) complex whereas complex 2 presents stair-step [CuI]m (m = 6) cluster structure with two supporting ligands of L1, 700 nm in the solid state while 3 has yellow emission of ~560nm. All complexes displayed good thermally stability under 180oC. The variations of complexes structures and luminescent property with corresponding ligands have been discussed.}respectively. Complex 3 shows a four-coordinated stair-step [CuI]m (m=4) cluster structure. The L1 and L2 molecules are blue emissive molecules. The copper complexes (1 and 2) have shown strong blue emissions between 500-700 nm in the solid state while 3 has yellow emission of ~560nm. All complexes displayed good thermally stability under 180oC. The variations of complexes structures and luminescent property with corresponding ligands have been discussed."

BES9SM / Junior Colleges / Oral Presentation

Name	Lim Pei Ying
Level of Study	A Level
Institution	NUS High School of Mathematics and Science
Title of Abstract	Beyond the Skin: Establishing a Novel Method for CEA delivery
Authors	Lim Pei Ying, Bill Chang Rong Qin, Tak Hyoseo, Dr. Tan Tuan Lin, Dr Alvin Chua, Dr Low Kai Leng
Abstract	Cultured Epithelial Autograft (CEA) is commonly used to treat severe burns and restore burnt tissues in patients by growing CEA on a piece of a thin fibrin gel for delivery onto the wound. However, current methods of delivery have a risk of failure and are inconvenient and cumbersome when transporting the lab-grown skin tissue from the growth medium in the petri dish to the patient's wound. This project aims to design and engineer a novel, sterile and efficient method for CEA delivery, through redesigning the current skin cell growth culture medium (petri dish in which the skin cells are grown), or improving medical tools to assist in transporting the skin grafts, hence reducing chances of failure in CEA delivery and increasing the simplicity in the delivery procedure. Various parameters such as a sterile environment, waterproofing, convenience, accuracy and cost were considered in discussing the feasibility of each prototype. The prototypes were materialised with polylactide (PLA) through 3D printing, silicone and acrylic. Tests simulating the CEA delivery process were then performed and the efficiency of each prototype was analysed. A survey was also conducted to assess potential patients' trust in the prototypes. Professional opinions were sought from a Senior Principal Scientific Officer with first-hand experience in CEA surgeries too. A total of 5 concepts and 6 designs were tested with the most feasible prototype being the Ladle, followed by the Push-pop, Removable Walls and Breakable Petri Dish. The Third Hand also shows potential to become a useful tool in CEA delivery.

BES9SM / Junior Colleges / Oral Presentation

Name	Chew Xin Hui
Level of Study	A Level
Institution	Anderson Junior College
Title of Abstract	3D Printed Prosthetic Hand
Authors	Chew Xin Hui, Daryll Wong Ye Qi, Christabelle Tee Jie Ying
Abstract	Our research project aims to modify the current design of the Cyborg Beast Prosthetic Hand, to further capacitate the prosthetic hand to use modern day touchscreen devices, increasing the functionality of the hand in a technology-driven era, hence improving the quality of lives of those who have lost their fingers. It uses 3D printing as digital models can be easily modified and attain high levels of customizability and increased precision of the object's functionality. The Prosthetic Hand produced allows the contraction of all fingers while keeping index finger erect, enabling users to touch their touchscreen gadgets. Capacitive Sensing Feature allows the user to use their touchscreen device with the prosthetic hand.

BES9SM / Junior Colleges / Oral Presentation

Name	Leonard Sim Jun Jie
Level of Study	A Level
Institution	Anderson Junior College
Title of Abstract	Properties Enhancements of Waterborne Polyurethane by introducing Dopamine-modified Graphene Oxide
Authors	Leonard Sim Jun Jie, Chua Chong Er, Chen Hui Ting Rachel
Abstract	This project aims to study the effects of incorporating Dopamine-modified Graphene Oxide (DGO) into Waterborne Polyurethane (WPU). It is hypothesized that Dopamine, a free radical scavenger and a biomimetic inspired from mussel adhesive proteins, when combined with Graphene Oxide, made from oxidizing graphene sheets using a modified Hummers' Method, will provide, when incorporated into WPU, the WPU with anti-UV properties as well as mild electrical conductivity for additional uses and improved mechanical properties.

BES9SM / Junior Colleges / Oral Presentation

Name	Low Cher-Lyn
Level of Study	A Level
Institution	Hwa Chong Institution
Title of Abstract	Cell-based therapy for Parkinson’s disease via transplantation of induced pluripotent stem cell-derived dopaminergic progenitors
Authors	Low Cher-Lyn, Zhang Chengwu, Chai Chou, Lim Kah Leong
Abstract	"Parkinsons disease (PD) is a neurodegenerative disorder whose prevalence increases significantly with age. The disease is characterized by the progressive degeneration of dopaminergic neurons in the substantia nigra in the brain. Because these neurons produce dopamine, a neurotransmitter that plays a major role in movement coordination, PD patients are afflicted with a constellation of movement problems. To date, PD remains incurable despite intense research. However, recent development in the stem cell field holds promise to treat PD via cell-based therapies. This project seeks to create a PD mouse model and to ameliorate the effects of PD by transplanting induced pluripotent stem (iPS) cells that have been differentiated into dopaminergic progenitors. Towards fulfilling this, we have successfully generated a 6-hydroxydopamine (6-OHDA)-induced PD mouse model that displays dopaminergic neuronal loss and accompanying locomotion deficits. iPS cells generated from human adult skin fibroblasts derived from a local individual were differentiated into dopaminergic progenitors and injected into the 6-OHDA PD mouse model. Immunofluorescence staining revealed short-term engraftment of injected neurons in these mice, with evidence of the regeneration of dopaminergic neurons. Behavioural assays for 6-OHDA PD mice with iPS cell transplantation are on-going. Taken together, we have provided proof of concept that iPS cells represent a valuable source for cell-based therapy for the PD patient."

BES9SM / Junior Colleges / Oral Presentation

Name	Valerie Koh Suan Yun
Level of Study	A Level
Institution	NUS High School of Mathematics and Science
Title of Abstract	Development of a Multiplex TaqMan Real-Time RT-PCR Assay to Differentiate all known Ebolavirus Species
Authors	Valerie Koh Suan Yun
Abstract	"TaqMan Real-Time RT-PCR assays are used to diagnose the presence of pathogens. There are 5 species of Ebolavirus – Bundibugyo, Reston, Sudan, Tai Forest and Zaire. Although existing PCR assays are highly efficient in detecting the presence of Ebolavirus, an assay that is able to discriminate between the 5 species of Ebolavirus simultaneously has not been developed. However, identifying the ebolavirus species is crucial for epidemiological purposes and for the development of possible treatment options. Thus, the aim was to develop an assay that can discriminate between the 5 species of Ebolavirus. Ebolavirus was studied using the Geneious software. Analysis of existing Ebolavirus PCR assays was conducted by calculating and comparing the percentage identity sequence alignments between various primers and/or probes with the respective ebolavirus genomes, allowing the level of accuracy and specificity of each assay to be determined. Using the analysis of existing assays, three new assays were developed. The first method involved combining 5 assays (the best assay specific to each Ebolavirus species) together to form one new assay, with 5 sets of primers and probes, each of which specific to a certain Ebolavirus species. The second and third method involved optimization of current PCR essays by developing new primers and probes. A forward primer which yielded the best overall results across all species was selected. Afterwhich, sequences of reverse primers and probes from the respective assays were altered to match the corresponding Ebolavirus species. Calculation of the percentage identity sequence alignments of the new primers and probes with the 5 species of Ebolavirus show high values, confirming the feasibility of the assays developed, with the third assay being the most promising. While practical testing was not possible in Singapore due to Ebolavirus being a BSL Level 4 pathogen, the results showed that the three assays were highly feasible. "

BES9SM / Junior Colleges / Oral Presentation

Name	Choi Yun Young
Level of Study	A Level
Institution	NUS High School of Mathematics and Science
Title of Abstract	Role of septal GABAergic mechanisms in modulating indices of nociceptive processing in the formalin model of persistent pain
Authors	Choi Yun Young, Dr Andy Lee Thiam Huat
Abstract	"The formalin test is used extensively as a model of persistent inflammatory pain where a small volume of dilute formalin is injected into the paw of an animal. This results in the rapid and transient expression of the immediate early gene, c-fos, in spinal neurons, and also the activation of extracellular signal-regulated kinase (ERK) in the anterior cingulate cortex. To investigate the effect of inhibiting GABAergic neurotransmission in the forebrain medial septum (MS) on formalin-induced nociceptive behavior and indices of nociceptive processing in the brain and spinal cord, bicuculline, a GABAA antagonist, was microinjected into the region. As part of the study, the expression of c-Fos and activation of phosphorylated ERK) in rat spinal cord and brain tissue, respectively, was analyzed using immunohistochemical methods after injection of hindpaw formalin to elicit pain. The number of immunoreactive neurons was then counted using imaging softwares. Formalin resulted in a robust expression of c-Fos immunoreactivity in areas A (laminae I to II) and C (laminae V- VI) of the ipsilateral lumbar L4 spinal cord. However, microinjection of bicuculline into the septum did not affect the spinal c-Fos immunoreactivity in areas A and C but instead significantly increased the c-Fos-ir counts in area B of the ipsilateral L4 spinal cord. This correlates with the augmentation in formalin-induced ambulation with bicuculline in the MS. The highlight of my project is consequently the cogent evidence obtained on how c-fos proves to be a useful and effective marker of the effects of peripheral noxious stimulation on the postsynaptic spinal cord neurons. In addition, it also showed that manipulations to the medial septum could affect spinal markers of nociceptive processing. The novel results obtained through this project thus hold great potential in the field of pain by going in depth into the molecular and physiological extents of pain. "

Name	Huang Yanxi
Level of Study	A Level
Institution	Raffles Institution (Junior College)
Title of Abstract	Adding simvastatin to conventional chemotherapy to improve cell kill in breast cancer cells
Authors	Huang Yanxi
Abstract	This study aims to evaluate the effect of adding simvastatin to two commonly used chemotherapeutic agents in breast cancer, doxorubicin, and docetaxel. We use the combination (i.e., simvastatin + docetaxel/doxorubicin) to treat breast cancer cells (MDA-MB-231/BT-549/MCF-7/T-47D) and compare with individual drug treatment (i.e., docetaxel, doxorubicin, simvastatin). We evaluate cell viability and cell apoptosis after treatments using MTS assay and Caspase-3 assay, respectively. Quantitative analysis of changes of lipid content in treated cells compared to untreated cells is also conducted using label-free coherent anti-Stokes Raman scattering imaging technique. We find that with combined treatments (simvastatin and docetaxel or simvastatin and doxorubicin), breast cancer cells undergo higher rates of apoptosis with increased intracellular lipid droplets than single drug treatments (docetaxel, doxorubicin, simvastatin). This study suggests that simvastatin combined with docetaxel/doxorubicin is at least additive if not synergistic in nature, and is indeed more effective than single drug treatment in breast cancer therapy.

BES9SM / Polytechnics / Oral Presentation

Name	Yvonne Goh Ai Qin
Level of Study	Polytechnic
Name of School / College / Institution	Singapore Polytechnic
Department / Division	Mechanical Aeronautical Engineering
Title of Abstract	A Micro Motion Sensing System for Real-Time Tremor Compensation and Assessment
Authors	Yvonne Goh Ai Qin, Low Wei Ming, Tan Wen Ling, Bervyn Chong Han Xiang, Dr. Win Tun Latt
Abstract	More than 5% of the population with age 40 and above have pathological hand tremor which affects some activities such as writing, drawings, and fine manipulation tasks such as soldering. The other type of hand tremor that everyone has is physiological hand tremor which affects micromanipulation tasks such as those in microsurgery. To actively compensate for the hand tremor in performing these activities and tasks, hand tremor needs to be sensed in real-time with sufficient resolution in terms of microns. There is no commercially available sensing system that can sense the hand tremor with sufficient resolution and sampling rate. To fulfil the requirement, we have designed and developed a motion sensing system using position sensitive detectors. Our system is much more compact and cost-effective besides outperforming the commercial systems in terms of resolution and response. Besides being essential for real-time active tremor compensation, it can also be used to assess the hand tremor.

BES9SM / Polytechnics / Oral Presentation

Name	Chua De Jun
Level of Study	Polytechnic
Name of School / College / Institution	Nanyang Polytechnic
Department / Division	Biomedical Engineering
Title of Abstract	Antibacterial Insoles
Authors	Chua De Jun
Abstract	Many people suffer from foot odour or infections on their feet particularly patients suffering from diabetes. To alleviate this we are developing antibacterial shoe insoles using silver nanoparticles that are known to have strong antibacterial properties. We have customized a formulation of silver nanoparticles that are faster and cheaper to produce than traditional methods. For inclusion of silver nanoparticles into insoles, we changed the polymer capping agent and dispersing solvent to suit the insole material. Silver nanoparticles were either coated onto an insole or mixed with the adhesive used to assemble the different layers of the insole. The treated insoles were then tested against Staphylococcus and Streptococcus bacteria using a modified Kirby-Bauer technique. Our formulation was shown to have a much higher bacterial resistance than current market products.

BES9SM / Polytechnics / Oral Presentation

Name	Kee Wei Jie
Level of Study	Polytechnic
Name of School / College / Institution	Ngee Ann Polytechnic
Department / Division	School of Engineering / Electronic & Computer Engineering Division
Title of Abstract	Active Rehabilitation of Lower Limbs using Exoskeleton: Predicting Leg Movement via EMG
Authors	Kee Wei Jie & Lee Fang Ting. Mentor: Chua Kok Poo
Abstract	Previously thought to remain immutable after its development period, a rising amount of new research has found the brain to be capable of changing its own anatomy and physiology, adapting itself to necessary neurological demands throughout its lifetime. Dubbed as neuroplasticity, this gives hope for the recovery of an impaired brain after stroke, as sufficient stimulation can assist the brain into relearning and reconnecting the neurons for specific functions lost from the damage / trauma. For this project, we will be aiding in the “relearning” of control in leg muscles among stroke patients. An exoskeleton will provide a small force to assist the leg when the patient tries to move his, allowing the brain to associate the muscle intention to leg movement. This project will focus on detecting leg movement via EMG signals generated when “weak” nerve signals order the muscles to move, thereby controlling the exoskeleton. Rehabilitation is an important intervention into improving a patient’s quality of life; and the signal the exoskeleton processes will be dependent on the quality of our project. The portable device we have developed incorporates careful circuitry design necessary to detect and amplify EMG signals from electrodes placed at strategic locations on the body. It will then feed those signals into a microcontroller’s ADC for it to calculate and interpret the patient’s intended direction of movement into 6 degrees of movement: Flexing, Extending, Adduction, Abduction, Stomping & Lifting. It has a touch screen as a medium of interface for the rehabilitation session, used to start the EMG recording session and adjusting the gain of the amplifier in the circuit. The screen will also display the EMG envelope waveform detected and its peak amplitude, as means of quantifiable feedback in a patient’s rehabilitation progress report, keeping track of his/her improvement.

BES9SM / Polytechnics / Oral Presentation

Name	Vijay Kevin Solomon
Level of Study	Polytechnic
Name of School / College / Institution	Polytechnic
Department / Division	SOE/ECE
Title of Abstract	PMT Test RIg
Authors	Vijay Kevin Solomon, Edwin Tan, Dr Chua Kuang Chua and Mr Ong Wai Sing
Abstract	Photomultiplier tubes (PMTs) are essential for some biomedical machine applications. PMTs are very sensitive light detectors that can work in extreme low light situations. Over time, these devices will deteriorate and will not perform up to the desired standards. There needs to be a way to measure the deviation from the set standard and this is the problem the project aims to address. The project end goal is to be able to 1) measure the accuracy of the PMT's sensitivity and how it changes over time 2) to determine if the magnitude of the change is significant and calculate the rate of deterioration and 3) create a data log for the readings. To do this we would first need a calibrated light source that would be able give out a constant intensity of light that would be detected by the PMT. The second segment would be a PMT data logger which would be able to read the output intensity of the PMT and calculate the sensitivity level of the PMT required with a given intensity from the calibrated light source mentioned above. Lastly, the final segment would be the chassis that contains the two other modules providing a clean and sleek finished look for the test rig and keeping it portable at the same time. The current result is a device in its prototyping and development stage and is able to log values of the read from the PMT for a constant intensity light source.

BES9SM / Polytechnics / Oral Presentation

Name	Michelle chan
Level of Study	Polytechnic
Name of School / College / Institution	Ngee Ann Polytechnic
Department / Division	LSCT/MBIO
Title of Abstract	Development of a point-of-care diagnostics for Hand, Foot & Mouth Disease (HFMD) utilizing Surface Enhanced Raman Spectroscopy (SERS) to detect HDMD-causing virus: EV71
Authors	Michelle Chan, Quach Quang Huy, Ang Swee Kim, Justin Chu Jang Hann, James Chen Yong Kah,
Abstract	HFMD is a highly contagious viral illness in young children and immune-compromised adults. The re-emergence of HFMD has placed a strain on healthcare facilities while limiting the spread of the disease. Although HFMD is usually associated with mild febrile illness which is self-limiting, severe cases can result in severe neurological damage or even death. We aim to develop a clinically viable nanotechnology platform based on SERS for rapid and sensitive detection of human enterovirus 71 (EV71) that causes HFMD. In this study, we evaluate the various schemes that can be adopted to acquire the Surface Enhanced Raman Spectroscopy (SERS) signal, which will allow point-of-care diagnosis of a suspected individual for isolation and treatment. Gold Nanostars (AuNS) with a plasmon resonance peak at a wavelength of 680nm were first synthesised for the conjugation of SCARB2 receptor proteins, which is known to exhibit high affinity to the HFMD virus. Preliminary results have shown successful bioconjugation of SCARB2 receptors on AuNS that are stable in an electrolyte environment. The next step is to monitor the interaction of SCARB2-coated AuNS with EV71 based on changes in UV-Vis spectral and Raman characteristics. This will involved two detection schemes: immobilization of AuNS-SCARB2 on a solid SERS substrate vs AuNS-SCARB2 in solution phase. Future works involve the evaluation of the sensitivity and specificity of the detection schemes and utilize it for point-of-care diagnostics.

Name	Karthik Raj Naidu V
Level of Study	Polytechnic
Name of School / College / Institution	Ngee Ann Polytechnic
Department / Division	
Title of Abstract	Internet-of-Things (IoT): Remote Healthcare Monitoring
Authors	Karthik Raj Naidu V, Sum Wei Hao Alston
Abstract	Singapore is facing many challenges from her rapid aging population. One of the main concerns is whether the current healthcare infrastructure is able to support this fast growing group of elderly especially due to their higher healthcare demands. With the advent of Internet-of-things (IoT) era, remote healthcare monitoring seems to be more feasible as compared to the past and is able to resolve the problem aforementioned. This project aims to develop a low cost remote healthcare monitoring system which enables the single living elderly to be monitored at home in which will greatly reduce manpower needed to attend to the elderlies. Vital data such as heart beat, body temperature and even fall detection (determined via the data collected through an accelerometer) are collected using a microcontroller. To increase the compliance of the elderly in using such systems, the hardware is designed to take the form of an arm band. Next, the data collected will be sent via Bluetooth to Raspberry Pi, which serves as a database as well as a standalone web server. This data will then be readily accessed by healthcare personnel via internet to determine if further follow up need to be taken.

Name	Chua Ing Loon, Sean
Level of Study	Undergraduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	Renaissance Engineering Programme, School of Chemical and Biomedical Engineering
Title of Abstract	Bone Marrow-on-a-chip as a Haematopoietic Niche for the Capture of Leukemic Cells
Authors	Chua Ing Loon Sean, Nishanth V. Menon, Chong Seow Khoon Mark, Kang Yuejun, Teoh Swee Hin
Abstract	Drug resistance after traditional chemotherapy is a common phenomenon in leukemic patients and discovery of the cancer stem cell paradigm raises the prospect of personalised medicine as a form of targeted therapy. However, it remains a challenge to harvest and grow patient-derived Leukemic Stem Cells (LSCs). Hence, we propose a device capable of capturing LSC on an in vitro tumour model. Here, we describe a microfluidic chip designed with three parallel channels that were inoculated with Bone Marrow Stromal Cells (BMSCs) and Collagen I gel to replicate the bone marrow stroma and extracellular matrix respectively. As a proof of concept, THP-1 monocytic

leukemia cell line was used. Cell viability is first ascertained by Live-Dead staining upon the introduction of THP-1 cells. Over a period of three days, THP-1 cells were observed to migrate into the collagen space, possibly a result of the chemotactic effect of the cytokines released by the BMSCs and were enumerated as a measure of cell capture efficiency. Time series images were captured by a confocal microscope, which showed a 3D spatial distribution of THP-1 cells that replicated the in vivo conditions. To determine that the captured cells were similar to the subpopulation of stem cells which possessed proliferative and “stem-like” characteristics, they were immunostained for CD34 and/or Ki-67 and a significant proportion of THP-1 cells had positive staining results. Taken together, we showed the migration of THP-1 cells on the microfluidic bone marrow model, thereby suggesting that the device might be capable of efficient capture of viable “stem-like” leukemic cells. Ongoing research is underway to find a more effective treatment for leukemia and we believe that this in vitro tumour model has the potential to be translated into a clinical tool for physician to evaluate drug efficiency so that therapeutic options can be optimised before treatment.

Name	Zhang Jingling
Level of Study	Undergraduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	Bioengineering

Title of Abstract	vessel-on-a chip: An in vitro 3D model to study endothelial dysfunction and leukocyte migration
Authors	Zhang Jingling, Hou Hanwei

Abstract

Inflammation is an important protective immunovascular response to various infections in our body, which is known to cause endothelial dysfunction and promote leukocyte adhesion and transendothelial migration (TEM) through the blood endothelium. Recent advances in microfluidics has been focused to study leukocyte TEM process with the advantages of real-time and single-cell resolution imaging.

In this work, we developed a microfluidic platform to study endothelial permeability, one of the hallmarks of endothelial dysfunction, and also leukocyte adhesion and transmigration. HUVECs were cultured on-chip for several days to form a monolayer and barrier permeability were determined using FITC-dextran diffusion. Monocytic cell line (THP-1) was used to study leukocyte adhesion and transmigration. To mimic inflammatory conditions, endothelial cells were treated with tumor necrosis factor alpha (TNFα) or the addition of chemoattractant.

We found a significant increase in permeability of endothelial barrier (2-fold higher) and enhanced monocyte adhesion under the effect of TNFα. We further optimized the concentration gradient of chemoattractant (MCP-1) and demonstrated the enhancement of monocyte transmigration through endothelium. These results indicated that TNFα secreted by macrophage during the inflammatory response has a functional role of increasing the vascular permeability and enhancing monocyte TEM process, particularly the adhesion and transmigration steps.Future work in quantitative study of leukocyte transmigration process at different time frames should be done by incorporating 3D imaging technology.

Name
Koh Yi Ting

Level of Study
Undergraduate

Name of School / College / Institution
Nanyang Technological University

Department / Division
School of Chemical and Biomedical Engineering

Title of Abstract
Surface engineering of Polydimethylsiloxane with Polydopamine to Support Long-Term Cell Culture

Authors
Yi Ting Koh, Yon Jin Chuah, Kaiyang Lim, Menon Venugopal Nishanth, Yingnan Wu, Yuejun Kang

Abstract
Poly-dimethylsiloxane (PDMS) has been widely used in cell studies due to its many advantages such as transparency, flexibility, low cost and ease of fabrication. However, one of its major drawbacks is its intrinsic high hydrophobicity, which makes it difficult for cells to adhere. This will affect subsequent cascade of cell proliferation and differentiation. Therefore, it is essential to modify PDMS surface to support stable and long-term cell culture.

In this study, Poly(dopamine) (PD) was investigated as a reagent for surface modification because it is neither toxic nor health hazardous and it can be easily absorbed on a large range of substrates, including PDMS. Surface treatment using PD involves a simple, one-step process where the PDMS substrates were immersed in PD solution. Here, we investigated the effect of PD coating on PDMS surfaces for Bone Marrow Stromal Cells (BMSCs) adhesion, proliferation, stability and multipotency over a duration of 3 weeks.

Studies on surface properties of PD-coated surfaces indicated changes in hydrophobicity and presence of hydroxyl and amine groups as compared to non-coated PDMS, which may affect cell adhesion, proliferation and differentiation. Cellular analysis further revealed an increase in cell adhesion and enhanced cell proliferation over the 2-week culture. In addition, it was found that BMSCs displayed the ability to differentiate into osteogenic and adipogenic tissues on PD-coated PDMS surfaces. The additional coating of collagen on top of PD-coated surfaces showed further enhancement to the stabilization of osteogenic differentiation. These findings suggest that PD coating on PDMS provides a biocompatible surface for stable BMSCs adhesion and long-term culture. This will aid in future research that requires a simple and effective surface treatment on PDMS substrates, including its extended applications such as mechanobiology and microfluidic studies.

Name
Raditya Anggara

Level of Study
Undergraduate

Name of School / College / Institution
Nanyang Technological University

Department / Division
School of Chemical and Biomedical Enginering

Title of Abstract
Long Term Tracking of Mesenchymal Stem Cells Differentiation to Adipocytes with Photostable Fluorescent Biodegradable Nanoparticles

Authors
Raditya Anggara, Shiying Liu, Li Min Tay, Yuejun Kang

Abstract
Many scientists explore the promising potential of stem cell for future medicine, leveraging from self-renewal and differentiation properties of stem cell. However, recent clinical studies showed conflicting results, due to lack of understanding in the distribution, homing process, engraftment, survival, and fate of stem cells after injection to application site in vivo. Fluorescent labeling of stem cell, being affordable and easily accessible, rises as one of prospective methods to overcome those difficulties.
This study aims to intracellularly label mesenchymal stem cells (MSC) by a novel fluorescent biodegradable polymeric nanoparticle for long-term stem cell tracking. After MSC was incubated with nanoparticles for 3 days and 7 days of uptake, cellular uptake was analyzed by confocal laser scanning microscopy (CLSM) and flow cytometry. Influence on cell viability and proliferation was analyzed by PrestoBlue® assay. Adipogenic differentiation potential was examined by quantifying marker genes by real-time RT-PCR and histology staining. Confocal microscopy and flow cytometry results demonstrated successful nanoparticle uptake and retention up to 21 days after differentiation induction. Cell viability and proliferation were unaffected. Adipogenic differentiation capability was found to be unaffected qualitatively and quantitatively. Thus, this novel nanoparticle has a strong foundation to be potential fluorescent label for long-term tracking of MSC during adipogenic differentiation. Future studies can extend to other differentiated lineages of MSC and other types of stem cell for a thorough performance analysis.

BES9SM / Polytechnics / Oral Presentation

Name	Tan Wei Ling
Level of Study	Undergraduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of Chemical and Biomedical Enginering

Title of Abstract	The study of human bone marrow derived stem cells proliferation and multi-lineage differentiation in various spatial parameter microwells
Authors	Wei Ling Tan, Yingnan Wu, Yon Jin Chuah, Menon Venugopal NIshanth, Yuejun Kang
Abstract	Stem cells-scaffold constructs were widely applied in tissue engineering, in which pore size and porosity are important parameters of traditional scaffold and 3D customized device for regenerative medicine. To optimize the pore shapes and sizes, a diverse array of environmental factors were prepared for studying stem cell fate. In this study, we investigated influence of geometrical cue in manipulating cell fate control for long term cell confinement. Four fundamental shapes (rectangle, square, circle and triangle) with four specific surface areas of 657.7 μm2, 1208.7 μm2, 1796.7 μm2 and 2312.1μm2 of microwells have been fabricated. The microstructures were characterized by SEM. Interestingly, high cell seeding efficiency was observed regardless of shape and size factors of microwell arrays. Cell proliferation profile revealed constant cell cycle progression under long term culture inside the microwells. Immunocytochemical staining and biochemical analysis showed larger size (size ratio of 1: 2) of the microwells were able to promote adipocytes formation while smaller size (size ratio of 1: 2) of the microwells were able to differentiate into chondrocytes. Furthermore, rectangular shapes of the microwells were able to induce fibroblasts formation. Collectively, this preliminary research provides a screening of board range of physical parameters of size and shape factors precise control of local environment that promotes proliferation and differentiation of cells in which play a vital role in gaining insight into future research studies and clinic application in tissue regeneration.

Name: Lim Chee Seong
Level of Study: Undergraduate
Name of School / College / Institution: Nanyang Technological University
Department / Division: School of Chemical and Biomedical Enginering

Title of Abstract: The Role Of Topography In The Micro-Fabrication Of An Intervertebral Disc

Authors: Chee Seong Lim, Yon Jin Chuah, Yingnan Wu, Menon Venugopal Nishanth, Yuejun Kang

Abstract
Cell behavior can be manipulated by the topography of the culture substrate. In this study, we examined the cell alignment of multipotent mesenchymal stem cell (MSC) on a grill topographical pattern of porous poly(L-lactide/Caprolactone) (PLC) substrate. Electron microscopy showed that MSC integrated and interacted well with PLC substrate and promoted directional growth through the grill guidance. Subsequently, we embossed this finding on the microfabrication of intervertebral disc (IVD) construct that posed a multilayer concentric-orientated and alternate cross-aligned organization to resemble the fibrocartilagenous Annulus Fibrosus (AF). Samples were cultured under growth medium for 2 weeks and rolled up for another 4 weeks chondrogenic medium culture. Histology revealed the microarchitecture of PLC scaffold and distribution of fibrocartilagenous tissue. Biochemical analysis showed that the expressions of chondrogenic marker genes (COL1, COL2 and Aggrecan) were significant and expression of COL2 was the most significant. The mean tensile modulus of control and grill-topographic PLC scaffolds were 2.18 MPa and 3.3 MPa respectively. This studies document the feasibility of creating biphasic tissue-engineered intervertebral disc construct in mimicking microarchitecture of native AF.

BES9SM / Polytechnics / Oral Presentation

Name	Tan Ching Fen
Level of Study	Undergraduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of Chemical and Biomedical Enginering

Title of Abstract	Controlling of Stem Cell Fate Through Geometrical Micropillars during Cell Expansion
Authors	Ching Fen Tan, Yon Jin Chuah, Yingnan Wu, Yuejun Kang

Abstract

Multipotency is the ability of stem cells to differentiate into adipocytes, osteocytes and chondrocytes. In general, stem cells lose their multipotency during cell expansion. The purpose of this study is therefore to slow down the loss of multipotency of stem cells during cell expansion by using different surface topographies which are circle, rectangle and grill. In this study, human mesenchymal stem cells (hMSCs) were expanded from passage 3 to 13 on different surface topographies and they underwent adipogenesis, osteogenesis and chondrogenesis at different time points. The results show that different surface topographies can direct the morphology of stem cells thus affect their multipotency during cell expansion. hMSCs were grown disorderly on rectangle and circle topographies and it was observed that circle performed best in early passage while rectangle promote multipotency in late passage. hMSCs which were aligned with grill surface topography performed weakest throughout the study. It was believed that stem cells which were grown orderly on grill surface proliferate fastest hence they get exhausted and thus terminating their multipotency earlier than the rest. The future works include reducing the sizes of circle or rectangle to increase their contact point of surface to stem cells in order to retain the multipotency in long term passage.

Name
Esther Hee Xuan Yi

Level of Study
Undergraduate

Name of School / College / Institution
Nanyang Technological University

Department / Division
School of Chemical and Biomedical Enginering

Title of Abstract
Cells and Matrix Alignment through Micro-topographies and its influence on later lineage differentiation

Authors
Xuan Yi Esther Hee, Yon Jin Chuah, Yingnan Wu, Yuejun Kang

Abstract
Challenges are constantly being encountered in the area of scaffold free tissue engineering and cell sheet engineering has been advancing to develop as an alternative approach to improve mesenchymal stem cell-mediated tissue regeneration. This interdisciplinary engineering has gained much attention due to the need to overcome the drawbacks in the current tissue regeneration.

Many studies have investigated the potential use of cell sheet for regenerative medicine but the optimization of these technologies remains unclear. One of it is the controlling of the cells and matrix alignment through micro-topographies. A few studies have shown that topographies were known to affect cell proliferation, migration and differentiation. However, the use of micro-topography in cell sheet engineering has yet to be explored. Hence this article gives a better understanding of micro-topographies for its potential to enhance the regenerative therapies.

This study shows the overview on the advanced cell sheet engineering involving the array of different micro-topographies which have been created with photo and soft-lithography for cell alignment. Histological and RNA analysis had been performed to verify the presence of various proteins and to assess the level of different genes markers respectively on cell sheet and the differentiated cells, osteocytes and chondrocytes. Cell proliferation assay was performed to ensure the viability of the cell sheet in this project. We demonstrated that different micro-topographies could direct the alignment of the cells and resulted in the differences in later differentiation in terms of proteins and genes marker. Therefore, based on these results, we conclude that the array of different micro-topographies could guide cell alignments which lead to different stem cell fate.

Name
Cheong Mei Ling, Shirlynn

Level of Study
Undergraduate

Name of School / College / Institution
Nanyang Technological University

Department / Division
School of Chemical and Biomedical Engineering

Title of Abstract
The development of an annulus fibrosus in vitro tissue model with ascorbic acid induced mesenchymal stem cells

Authors
Mei Ling Cheong Shirlynn, Yon Jin Chuah, Yingnan Wu, Yan Qing Chia, Yuejun Kang

Abstract
The Intervertebral Disc (IVD) is a complex tissues that comprises of multiple layer of annulus lamellae and the central nucleus pulposus. When experiencing disc degeneration, the IVD composition tends to alter, leading to a thinner disc as well as losing its natural function to resist spinal compression and absorbing shock. For the past decades, research has shifted focus to Intervertebral disc tissue engineering with the hope to restore the biological function of the degenerated IVD. The complexity of the multiple layer of annulus fibrosus and the absence of an in vitro tissue model slow down the advancement of IVD engineering. The use of autologous annulus fibrosus cells in IVD engineering is challenging, due to the limited availability of tissue, thus limiting the possibility of AF cells for such purposes. On the other hand, mesenchymal stem cells (MSCs) are characterized by their colony forming ability, self-renewal, and their multi-linage differentiation ability which presented as a reliable source of cells in IVD engineering. However, the induced of MSCs to form fibrocartilage tissues remains poorly understood and thus need to be further investigated. It was known that ascorbic acid (AA) could upregulate collagen matrix which is one of the major component in IVD.

In this study, we created a tissue model annulus fibrosus comprising of multiple layer with the use of Interfacial Polyelectrolyte Complexation (IPC) technique, and investigated the use of AA induced MSCs on annulus fibrosus development. AA induced hMSCs has proven its ability to increase collagen secretion during normal expansion, with enhanced Col 1, Col 2, Aggrecan and Sox 9 expression in the later engineered AF tissue as compared to the non induced AA MSCs. Cells were also observed with minimal cell death within lamellar structured encapsulation. Hence, the developed AF model could be useful for future therapeutics and pathological studies.

BES9SM / Polytechnics / Oral Presentation

Name: Cuebong Wong

Level of Study: Undergraduate

Name of School / College / Institution: Nanyang Technological University

Department / Division: School of Mechanical and Aerospace Engineering

Title of Abstract: The Formation of Trajectories for Post-Stroke Patients During Visual and Non-Visual Human Locomotion

Authors: Cuebong Wong (Author), Quang-Cuong Pham (Mentor)

Abstract

Stereotypy in human locomotion can be observed across humans under varying sensori-motor conditions, despite the theoretically infinite number of possible ways a human can navigate within a space to achieve a goal (which may be a target location, for example). However, there is still very little understanding in the neural mechanisms which govern locomotion in humans. In hopes of shedding new light on the control of human locomotion, a study on patients with neurological disorders was conducted to better understand the relationship between cognitive processes and motor functionality in the formation of locomotor trajectories. Subjects suffering motor deficits caused by different neurological disorders participated in an experiment in which they walked from a defined starting point towards a target end location under two visual conditions, namely with vision and without vision. With no restrictions set on the shape of the trajectory path nor walking speed, it was found that the shape of trajectories were similar across all subjects and controls. In other words, there were insignificant differences in the function of cognitive processes (which govern the route-planning behaviour) across all subjects. However, through assessment of the subjects' stepping pattern, there is sufficient significance in the findings to suggest that the execution of trajectories differ across subjects based upon the classification of their neurological disorder. These results support the hypothesis that there is a dissociation between cognitive and motor processes across the various stages which underlie spatial navigation and the control of human locomotion.

Name
Wong Cyndia

Level of Study
Undergraduate

Name of School / College / Institution
National University of Singapore

Department / Division
Biomedical Engineering

Title of Abstract
PRE-SURGICAL PLANNING OF BONE FRACTURE FIXATION USING 3D PRINTING TECHNOLOGY

Authors
Wong Cyndia, Dr Desmond Chong, Dr Choo Jian Huei, Dr Gen Foo

Abstract

The aim of this investigation is to develop an innovative pre-surgical planning method using 3D printing technology for lower limb bone fracture fixation.

Introduction: Complex fractures require a great deal of pre-surgical planning in order to maximise surgery success. Current methods include the use of two-dimensional (2D) images from computer tomography (CT) scans along with virtual three-dimensional (3D) reconstruction of fracture models. It is hypothesized that the use of physical models of bone fractures printed out by 3D printers can better assist surgeons in planning, implant selection and even pre-operative plate contouring.

Materials and Methods: To produce these synthetic models, data obtained from a patient’s CT scan were processed using Materialise Interactive Medical Image Control System’s (MIMICS) software to obtain sterolithographic (STL) files of individual bone fragments of a fracture. The models were then printed using 3D printers.

Results and Discussion: Three case studies involving different anatomical regions, namely the proximal tibia, pelvis and distal tibia were examined. The 3D printed synthetic fracture models obtained for each case study were accurate and the fragments were reducible to form a foundation for surgical planning, implant selection and placement, plate contouring and estimation of screw length. The model was also solid enough to allow instrumentation in the form of drilling and plate fixation.

Conclusion: The models proved useful in understanding fracture configuration, planning the order of reduction and fixation as well as pre-operative plate contouring, which can bring about shorter operation time, reduced blood loss and increased precision. Therefore, despite considerations regarding the additional costs of 3D printing, the aforementioned merits of using this new method should sufficiently justify its preference over current methods.

Name
Shen Shen

Level of Study
Undergraduate

Name of School / College / Institution
National University of Singapore

Department / Division
Biomedical Engineering

Title of Abstract
Magnetic Actuated Microrobotics for Biomedical Applications

Authors
Shen SHEN; Hongliang REN; Jun LI

Abstract

Targeted drug delivery is playing an important role in the modern medicine as their potential for minimizing invasive medical procedures. Magnetic actuated drug delivery is attracting more attention as magnetic fields scarcely affect the internal environment and are nearly transparent to the normal tissue. This project aims to design a magnetic actuated drug delivery system and evaluate its performance.

The magnetic actuated drug delivery system consists of magneto-responsive microcapsules as drug carriers, as well as an electromagnetic actuation (EMA) system for the control of locomotion of the microcapsules. The core-shell structured microcapsules have evenly distributed magnetic stripes inside it formed by magnetic nanoparticles. Alignment, movement and rotation of those microcapsules can be observed in the designed EMA system, of which the current to generate magnetic field is controlled by a programmable current control system.

Name: Jaclyn Chong Shu Yeen
Level of Study: Undergraduate
Name of School / College / Institution: National University of Singapore
Department / Division: Department of Biomedical Engineering

Title of Abstract: Adapting the Layer-by-Layer Deposition Technique using Silk Fibroin and Chitosan for Annulus Fibrosus Tissue Engineering.

Authors: Jaclyn Shu Yeen Chong, Puay Yong Neo, Siew Lok Toh, James Cho-Hong Goh

Abstract:
The intervertebral disc (IVD) consists of the nucleus pulposus surrounded by the annulus fibrosus (AF) - a multi-lamellar structure with oriented collagen fibres. The limited self-repair ability of the AF makes tissue engineering an attractive alternative to restore the complex architecture and biomechanics of the degenerated AF. Studies in literature today however often do not achieve fibre alignment and mechanical properties comparable to that of the native AF. In this study, layer-by-layer deposition technique (LBL) is used to fabricate silk-based films to recapitulate the architecture of the native AF, while silk/chitosan blend films were incorporated with the LBL films to improve handling and mechanical properties. Fibre alignment was achieved for LBL films with silk concentrations of up to 0.05%. Silk substrate concentration was also shown to have no effect on fibre deposition. With the LBL films conferring topological cues, the blend films form the bulk of the scaffold. Adipose-derived stem cells (ASCs) were subsequently cultured on blend films with a range of Silk:Chitosan ratios. 20:80 films were shown to maintain metabolic levels comparable to 100:0 and 0:100 films, with a corresponding upregulation of Agg and Sox9 genes. Fluorescence staining showed that blend films of ratios 100:0, 80:20 and 20:80 have comparatively better Col I deposition and presence of intracellular F-actin, and uniaxial mechanical tests showed that tensile moduli were generally higher in the blend films compared to 100:0 and 0:100 films. Based on these results, 20:80 blend films was identified to be combined with the aligned LBL layer. Fibre alignment from the LBL layer was then successfully transferred to the blend film to form the final combined scaffold. In conclusion, the LBL technique presents a novel method for fabrication of films with fibre alignment, while Silk:Chitosan blend films improve the properties of the composite films for an AF application.

Name
Tan Jenn Sern Gabriel

Level of Study
Undergraduate

Name of School / College / Institution
National University of Singapore

Department / Division
Engineering/Biomedical

Title of Abstract
Portable single-lead ECGs with built-in wireless connectivity and in-house developed diagnosis algorithm

Authors
Prof.Raye Yeow(mentor), Peter Wong, Gabriel Tan, Tang Jing En, Teoh Zhi Hao, Zanelle Lee

Abstract
Based on a student trip to rural hospitals in Mahidol, Thailand, we were tasked to brainstorm solutions to certain issues the hospital was facing in order to improve the standard of healthcare it could offer to their patients. Initial findings showed that ambulances in rural communities lacked basic Electrocardiograms (ECGs), which delayed precious treatment time. Translating this finding into Singapore’s context, we found that the need for ambulatory ECGs was more apparent and our team decided to focus on this aspect. After preliminary research on current devices in the market, with NUH as a case study, we identified certain features lacking in certain models and thus set about designing a new ECG device that addressed these shortcomings. We wanted to make the transfer of patient records more efficient by allowing the storage of essential patient data inside the device. Secondly, we wanted to produce a cheap, portable and user-friendly ECG that is versatile and intuitive. The Port-A-Heart single-lead ECG device is the solution our group has come up with to address these needs. Our device is an event monitor, a kind of ambulatory ECG, which records cardiac events over short periods of time, from which the ECG data might prove useful for the diagnosis of cardiovascular diseases (CVDs). The prototyping cost of SGD$200 makes it a cheaper alternative to current devices. Weighing in at 189g, it is also very portable and lightweight. The presence of an LCD display enhances user-friendliness and user feedback. The device has an in-house developed diagnosis algorithm that is able to diagnose tachycardia/brachycardia in patients. These features make the Port-A-Heart a device that addresses all the shortcomings apparent in current models, and we feel that with further prototyping, this device can be further improved into a market-competitive product.

Name	Chng Yuxuan Mark
Level of Study	Undergraduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering
Title of Abstract	Development of a Dysphagia Rehabilitation Trainer (DRT)
Authors	Mark Yuxuan Chng, Ernest Xuan-Hao Tan, Hee-Youn Shim, Huai-Zhi Goh, Fang-Ming Lim, Eng-Keng Soh
Abstract	Oropharyngeal Dysphagia (OD) is a debilitating symptom present in a wide range of diseases. If left unattended, lethal complications can result. Patients suffering from OD have weaker Suprahyoid Muscles (SHM) which results in weaker swallowing reflexes and therefore increased chances of aspiration. After an intensive scientific study of OD, firsthand observation of OD therapeutic practices in SGH and the critical evaluation of existing methods, a functional prototype of the DRT was developed with the aim of strengthening the SHM via physical exercise in order to overcome OD. Taking into account the limitations of current practices faced by both patients and clinicians alike, the DRT employs 3 main principles to effectively achieve its goal. They are: (1) an ergonomic mechanical design. The DRT ensures that the patient is performing the exercise correctly by comfortably fitting a wide range of physiques. This limits any compensatory actions and thus effectively targets and restores the strength of the SHM. (2) An electronic biofeedback system. SHM training progress can be tracked via downward chin forces instead of Surface Electromyography (SEMG). This also doubly ensures the effective targeting of the SHM with little conscious effort by integrating a posture correction mechanism. (3) A sound exercise protocol. This feature is specifically tailored towards different patients with varying SHM strengths. By first establishing an individual’s baseline, training can be more effective. The exercise can involve a game as well to further motivate patients to exercise. The DRT was then employed in a pilot study involving healthy subjects, during which SEMG signals were collected while subjects were exercising on the DRT and performing the Shaker’s Exercise, a rehabilitation technique widely used currently. Results obtained show that the DRT is a promising device in terms of achieving comparable training effect on the SHM, when compared with the Shaker’s Exercise.

Name	BUDHOTA AAMANI
Level of Study	Graduate

BES9SM / Polytechnics / Oral Presentation

Name of School / College / Institution	Nanyang Technological University
Department / Division	MAE
Title of Abstract	EMG in the loop: using muscular motor synergies for real-time control of rehabilitation robots
Authors	Budhota Aamani
Abstract	Motor control is the active co-ordination of muscles and limbs to perform any specified task. The fundamental challenge or complexity of motor control paradigm lies in the well-known ‘degrees of freedom (DOF) problem’, which states that there are many possible ways to achieve a single task and the central nervous system(CNS) needs to select a subset from these near-infinite solutions. To explain this, Bernstein in his ‘muscle synergy’ hypothesis, suggested that CNS simplifies the motor co-ordination by grouping co-activated muscles, called synergies rather than individual muscles. Electromyogram (EMG) signals collected from respective muscles are believed to provide the evidence to this hypothesis. Synergies are the low dimension structures that represent the spatio-temporal modularity of the nervous system and are modulated by sensory information to adapt efficiently to the task environment. Studies reveal that muscle synergies are conserved in stroke population and imply that impaired motor performance post stroke can be an indication to the alterations in recruiting patterns of these muscle synergies. The present state-of-art rehabilitation robotic devices are equipped with functions like assistive exercise, resistive exercise and constrained exercises, that can be made adaptive to the subject relying mostly on kinematiic and dynamic measures. For more efficient and faster recovery, there is a need to understand the reason for this motor control deficit from a neuromuscular perspective i.e. modular organization of motor control.My research work is intended to validate the synergy hypothesis and its alteration post stroke and later study the motor learning strategies developed by stroke affected subjects to compensate for the neural loss. The heterogeneity in stroke location and its effects would provide a need to develop a user specific robotic rehabilitation controller based on muscle synergie recruitment to reduce the task errors for efficient motor learning by minimizing the motor-coordination difficulty.

BES9SM / Polytechnics / Oral Presentation

Name	Ho Yan Teck
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	NGS/Biomedical Engineering/SMART BioSyM
Title of Abstract	Microfluidic platform for the probing of nanoparticle permeability in vitro
Authors	Yan Teck Ho, Sebastian Beyer, Giulia Adriani, Roger D Kamm, James Chen Yong Kah.
Abstract	The conjugation of biomolecules, drugs, and targeting ligands onto nanoparticulate materials for biomedical applications has seen promising results in vitro, but translation in vivo has faced obstacles due to the presence of protein corona – the non-specific adsorption of these proteins onto the particle's surface when introduced into protein rich environments, such as serum and blood. This results in the masking of active functional groups on the nanoparticles (NPs), which markedly hinders their biological interactions. While the protein corona has recently been exploited as a drug carrier, their effectiveness in vivo depends in part on their ability to extravasate across the endothelial cell barrier. However, little is known about how the protein corona affects particle extravasation. In vivo studies – a lack thereof as well at present - while valuable, offer little control over confounders in data obtained. In this study, we developed an in vitro microfluidic platform for mimicking vascular models in vivo to study the vascular permeability of corona-coated polystyrene NPs. We have successfully developed an in vitro microfluidic permeability assay for probing NP permeability in the presence of Human Umbilical Vein Endothelial Cells (HUVECs), in the process also demonstrating the tunability of the HUVEC permeabilities with cytokines to mimic varying degrees of cancer physiology; more significantly achieving close to healthy physiological levels of permeability in vitro. Probing with corona coated polystyrene NPs showed that these particles extravasate in a size dependent manner. Confocal imaging targeting endothelial cell specific markers also show healthy gap junction and adheren junction protein expression. We therefore present a flexible and viable in vitro platform that allows for a fine degree of control for mimicking a gamut of vascular physiologies; a system that might prove valuable for NP optimization for a myriad of biomedical applications.

BES9SM / Polytechnics / Oral Presentation

Name	Ho Yan Teck
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	NGS/Biomedical Engineering/SMART BioSyM
Title of Abstract	A study on how different serum proteins affect the colloidal stability of nanoparticles.
Authors	Yan Teck Ho, Gokce Engudar, James Chen Yong Kah
Abstract	In recent years, we have gained a better understanding of how different nanoparticles (NPs) physical properties and external environments affect the nano-bio interactions, leading to differences in protein corona composition. These in turn affect downstream biological responses. However, the converse of how different proteins affect the behavior of NPs, and their downstream biological response is not as well studied. Aggregation is one such behavior that can occur in NPs during protein adsorption on their surface. While some groups have shown that the coat of protein corona conferred colloidal stability to NPs, other have shown that the formation of protein corona induced aggregation of NPs. In this study, we focus on elucidating how the protein corona formed from different blood plasma proteins and their concentration affects the colloidal stability of NPs differently. Here, we used gold NPs as our model NP of interest to exploit its strong optical absorption that is sensitive to aggregation. We formed a specific protein corona on them using each of the four human plasma proteins known to have the most abundance in the serum protein corona: human serum albumin (HSA), apolipoprotein A1 (ApoA-1), fibrinogen (FBG), and immunoglobulin G (IgG). We examined the hydrodynamic diameter and aggregation of NPs induced by the addition of these proteins as a function of incubation amount and time. We also performed the classical titration on salt-induced aggregation to determine the minimum protective amount (MPA) of proteins needed to confer colloidal stability to NPs. We found that the aggregation induced by all four proteins was concentration dependent, and each protein showed a unique aggregation signature and different MPA. The aggregation profile between as-synthesized and purified gold NPs was also unique. For some proteins, the NP aggregation changed with time, while remained the same for others. The present study showed that the protein corona does not simply coat the NP’s surface, but also alter their effective size that biological systems see and interact with. The unique aggregation signature of specific plasma proteins suggested possible use of NP aggregation as a technique to identify and characterize corona composition. This holds potential downstream implications in exploiting the aggregation traits for biosensing of proteins, diagnosis and prediction of diseases.

BES9SM / Polytechnics / Oral Presentation

Name	Ajay Tijore
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of Materials Science and Engineering
Title of Abstract	Modulating Human Mesenchymal Stem Cell Plasticity Using Micropatterning Technique
Authors	Ajay Tijore, Feng Wen, Chee Ren Ivan Lam, Chor Yong Tay and Lay Poh Tan
Abstract	Previously, we demonstrated that human mesenchymal stem cells (hMSCs) elongation through micropatterning induced their myocardial lineage commitment. However, whether this approach is robust enough to retain the commitment when subsequently subjected to different conditions remains unsolved. Herein, we investigated the robustness of micropatterning induced differentiation by evaluating the retention of myocardial differentiation in patterned hMSCs when challenged with non-myocardial differentiation cues. Altogether, we designed four groups of experiments; 1) Patterned hMSCs cultured in normal growth medium serving as a positive control; 2) Patterned hMSCs cultured in normal growth medium for 14 days followed by osteogenic and adipogenic media for next 7 days (to study the robustness of the effect of micropatterning); 3) Patterned hMSCs (initially grown in normal growth medium for 14 days) trypsinized and recultured in different induction media for next 7 days (to study the robustness of the effect of micropatterning without any shape constrain) and 4) Patterned hMSCs cultured in osteogenic and adipogenic media for 14 days (to study the effects of biochemical cues versus biophysical cues). It was found that hMSCs that were primed to commit to myocardial lineage (Groups 2 and 3) were able to maintain myocardial lineage commitment despite subsequent culturing in osteogenic and adipogenic media. However, for hMSCs that were not primed (Group 4), the biochemical cues seem to dominate over the biophysical cue in modulating hMSCs differentiation. It demonstrates that cell shape modulation is not only capable of inducing stem cell differentiation but also ensuring the permanent lineage commitment.

Name	Chuah Yon Jin
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of Chemical and Biomedical Engineering

Title of Abstract	Microfabrication Strategy for Intervertebral Disc Tissue Engineering
Authors	Yon Jin Chuah, Yingnan Wu, Chee Seong Lim, Hwan Tak Hee, Yuejun Kang

Abstract

Lower back pain associated with disc degenerative diseases has been a major musculoskeletal health concern worldwide, causing significant sufferings to the patients and economical burden to the society. While surgical managements involving spinal fusion or replacement prostheses have some efficacy pain management for serious disc degenerative diseases, these treatments often underscore the importance of biological approaches to regenerate the intervertebral disc (IVD). Development of a biological IVD constructs for tissue regeneration has been ongoing for the past decades but most are still inferior to the native disc, thus limiting its advancement towards translational application. In our studies, we developed a strategy to develop an IVD construct that comprises of annular regions structurally similar to the macro/micro-architectures of the native annulus fibrosus. The annular ring of the IVD construct was first generated by microfabrication techniques with the use of co-polymers containing cells followed by filling the central scaffold with cellular hyaluronic acid hydrogel to form the central nucleus pulposus. The assembled IVD constructs were then subjected to differentiation media in vitro, and its cellular morphology, cell viability, and biochemical composition were evaluated. The developed IVD construct showed cellular morphologies and biochemical composition that was similar to that of a native disc. Therefore, we had designed and constructed a novel intervertebral disc construct that can potentially become a promising avenue for biological replacement of degenerated IVD disc in future clinical applications.

Name	Mridul Sarker
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	0

Title of Abstract	Investigation on the Surface Activity of E2 Protein Nanocage at Liquid-Liquid Interface
Authors	Mridul Sarker, Dr.Nikodem Tomczac, Dr. Sierin Lim

Abstract

E2 Protein from pyruvate dehydrogenase multienzyme complex of Geobacillus stearothermophilus have capability to self-assemble into a hollow dodecahedral cage of a unique size about 25 nm. This cage is extremely thermostable and porous with 12 opening of 5nm.These inimitable characteristics of E2 protein nanocage allow encapsulating and carrying foreign molecule inside its cavity. Therefore this nanocage has found numerous applications in the fields of controlled drug delivery, nutrition delivery in foods or skin care products. In our present study, we are engineering and characterizing E2 nanocage for novel applications. Protein cages are engineered and characterized to investigate its surface activity. The existence of both hydrophilic and hydrophobic patches on the surface of E2 protein nanocage permits s to act like a surface active bionanoparticle. Therefore E2 protein nanocage can be used as a potential stabilizer of bio-inspired emulsion and gel system. Our preliminary results show the Aggregation of E2 protein nanocage at liquid-liquid interface under TIRF microscope. Considering this property, we are investigating the emulsion and gel stabilization efficiency of E2 nanocage. This study can be very functional in designing emulsion- and gel-based pharmaceutical products for topical application, skin care products and food products.

BES9SM / Polytechnics / Oral Presentation

Name	Shreyas Kuddannaya
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	Mechanical and Aerospace Engg

Title of Abstract	Neuro-glial culture on PDMS through chemically functionalized extracellular matrices
Authors	Shreyas Kuddannaya, Zhang Yilei

Abstract

PDMS has been extensively used in microfluidic studies of cell based systems due to its ease of fabrication, low cost and optical transparency. In recent years there has been a surge of microfluidic cell based investigation which has facilitated research on brain cell micro-environments, blood brain barrier, neuronal architecture and neurodegenerative disease models. Extracellular matrix proteins (ECM) are critical for growth and development of the brain cells (cortical/cerebellar). Long term investigation of brain cell cultures on ECM functionalized substrates (like PDMS) requires stable immobilization of ECM proteins to promote healthy cell growth, morphology and activity. However, due to the inherent high hydrophobicity of PDMS surface, cell culture on these surfaces is unfavorable, causing cells to eventually dis-lodge from the surface, which starts from 7 days of culture. While physical adsorption of matrix proteins can promote initial cell adhesion, this effect however is usually short-lived. In this work (3-aminopropyl)triethoxysilane (APTES) and linker glutaralde-hyde (GA) silane chemistry was employed to covalently immobilize the ECM proteins: laminin (Lam), poly-L-lysine (PLL), fibronectin (FN) or collagen type 1 (Col1) on PDMS through a covalent linking chemistry. The efficiency of these surfaces to support long term cell adhesion and viability of primary neuronal and glial cells was analyzed. ECM functionalization, cell growth and morphology on these surfaces have been characterized with relevant analytical techniques which show higher bio-affinity of ECM proteins and improved neuronal cell behavior compared to the native PDMS substrates.

Name	Christian Wiraja
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	School of Chemical and Biomedical Engineering

Title of Abstract	Non-Invasive Nanosensor Monitoring of Stem Cell Gene Expression
Authors	Christian Wiraja, David Yeo, and Xu Chenjie

Abstract

Objective
In stem cell biology, mRNA expression monitoring is important to ensure certain degree of homogeneity among cell sub-populations, address risks of tumorigenesis, and validate successful differentiation inductions. Methods employed are mostly end-point analyses (e.g. PCR) which do not provide spatial resolution and require experiment termination, or based on gene reporter techniques which are inefficient, laborious, and may introduce random mutagenesis. Molecular beacon, an oligonucleotide-based optical probe which can recognize mRNA sequences with great specificity, can be introduced into the cells to fulfil non-invasive, real-time gene expression tracking. Nevertheless, Intracellular MB applications are quite limited with its relatively short monitoring window due to endonucleases degradation (i.e. several hours).

Methodology
Herein, we reported our approach to encapsulate and deliver MBs within biocompatible and biodegradable polymeric particles. More specifically, micro/nanoparticles encapsulating MBs were synthesized through double emulsion method. These particles (nanosensors) with suitable surface modification can efficiently label cells through simple incubation. Once being internalized into the cytoplasm, these particles slowly degrade and continuously release intact and functional MBs.

Results and conclusions
As a proof-of-concept, we synthesized a nanosensor for beta actin mRNA tracking. Firstly, in vitro studies revealed steady release of functional MB from the particles under incubation with several buffer solutions for about one month. Intracellular, beta actin nanosensors provided longer signal retention as compared to free beta actin MBs introduced through bolus delivery using Streptolysin O (SLO). Finally, this platform was utilized to monitor and assess β-actin expression of MSCs seeded on 3D nanofiber scaffold. Crucially even without multiple transfections, signal intensity observed was in great agreement with the expression profile revealed with RT-qPCR.
In summary, we have developed a simple, convenient yet versatile sensor platform for non-invasive and longitudinal monitoring of intracellular mRNA expression

Name	Sathya moorthy Bhaskar
Level of Study	Graduate
Name of School / College / Institution	Nanyang Technological University
Department / Division	BIE/SCBE

Title of Abstract	PROTEIN NANOCAGES FOR CUTANEOUS DELIVERY
Authors	Sathya moorthy Bhaskar, Sierin Lim

Abstract

Clinical problem: Inability of drugs to cross cell membrane of skin cells and target specific cell type of interest.
Solution: Protein cages engineered to shuttle drugs across cell membrane of target cells.
Melanin is a pigment produced by the melanocytes in the skin responsible for the skin color, photo protection and UV induced DNA damage. Sometimes this pigment is produced excessively due to the exposure to the radiation of the sun leading to Melasma. Current treatment modalities involving the use of tyrosinase inhibitors such as hydroquinone has been observed to have some complications such as depigmentation, irritation and dermatitis, accounting for only 50% patient response. Self-assembling protein nanocages forming hollow structures are explored as potential carriers in various nanotechnology applications. Natural protein cages such as E2 (derived from Bacillus stearothermophilus E2 core domain of pyruvate dehydrogenase enzyme) and ferritin with intrinsic self-assembling properties have tunable structural and functional characteristics which can be engineered to suit various applications. In this work, E2 protein nanocages are engineered and used (Fig 1 and 2: protein conjugated to Alex fluor-green, nucleus stain-blue) as shuttles for drug delivery to skin cells such as melanocytes and keratinocytes. The cell penetration of these nanocages is brought about by decorating these cages with skin penetrating and cell entering (SPACE) peptides by genetic fusion. The protein cages could be further modified to deliver drugs to specific cell types for the treatment of skin conditions such as melasma. Successful delivery of the engineered protein can aid the formulation of novel protein based drug releasing molecules which can be biocompatible with efficient pharmacokinetics.

Name	Natalie Sheng Jie Lim
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering

Title of Abstract: Advanced Wound Care Strategy to Enhance Angiogenesis combining a Proly Hydroxylase Inhibitor with Lysophospholipid

Authors: Natalie Sheng Jie Lim, Sei Hien Lim, Sham Wai Fong Adeline, Chee Ming Ling Stella, Roger D. Kamm, Casey Chan, Michael Raghunath

Abstract

Background: The prolyl hydroxylase inhibitor ciclopirox olamine (CPX), and the lysophospholipid sphingosine-1-phosphate (S1P) both have been reported independently to be pro-angiogenic. We previously demonstrated in vitro that combining both compounds generates angiogenic synergy potentiating endothelial cell (EC) sprouting (Lim et al., 2013). We unravel here complementary mechanisms in vitro and confirm in vivo angiogenic efficacy in a rat model.

Findings: Leveraging on CPX and S1P's complementary pathways in stabilizing Hypoxia Inducible Factor-1α (HIF-1α), we show that their combination further increased HIF-1α expression from 2-fold (S1P), 10-fold (CPX) to 15-fold (CPX+S1P). Downstream MMP-2 protein expression was also increased from 1.3-fold (S1P or CPX) to 2.5-fold (CPX+S1P). CPX also potentiates EC sensitivity to S1P by post-transcriptionally increasing S1P receptor 1 and 3 protein expression by 2.5-fold. Both receptors are crucial in mediating accelerated EC migration (Paik et al.,2001). Subcutaneously implanted PVA sponges were loaded transdermally with CPX, S1P and CPX+S1P on alternate days. Lectin perfusion showed that the factors potentiated the length of functional vessel infiltration into the sponges reaching from from 2-fold (CPX or S1P, respectively) to ~5-fold (CPX+S1P) in comparison to vehicle controls.

Conclusion: CPX+S1P is a powerful angiogenic combination that holds promise for wound care, and might be efficacious particularly in diabetic ischaemic ulcers, where HIF-1α stabilization is impaired (Thangarajah et al., 2010) and where S1P plasma concentration decreases with the progression of diabetes (Tong et al., 2013). In-vivo work to assess the potency of this combination in diabetic wound healing is underway.

References:
1 Lim et al. (2013) Integr. Biol.5:1474-1484
2.Paik et al.(2001).J. Biol. Chem.276:11830–11827
3.Thangarajah et al.(2010) Cell Cycle 9:1,75-79
4.Tong et al.(2013).Cardiovasc. Diabetol.13(27):1-9

BES9SM / Polytechnics / Oral Presentation

Name	Li Liang
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	Department of Biomedical Engineering

Title of Abstract	Diagnostic biomarker and therapy development using integrated analysis platform for infection-induced pneumonia
Authors	Li Liang, Prof Martin Buist, Prof Vincent Chow, Prof Andrew Tan

Abstract

Lower respiratory tract infection is the third leading cause of death in the world, and the top cause of death in developing countries. It takes away millions of lives every year worldwide, and millions more when there are occasions such as flu pandemics. Most of these deaths were caused by pneumonia following the infection. Unfortunately, till now the golden standard for pneumonia diagnosis is still X-ray, which is subjective in interpretation and potentially harmful to patients, and neglects early-stage pneumonia. New diagnosis methods are needed for fast, objective, and accurate detection of pneumonia, especially at early stage. Moreover, current anti-inflammatory treatments for pneumonia can weaken the defense of the host against pathogens. Better therapy methods are needed to treat pneumonia effectively.

In order to develop new diagnosis as well as therapy methods for pneumonia, we built a platform that integrated multiple analyses to search for suitable biomarkers and therapy targets. By linking together viral replication and spread patterns, host response factors such as inflammation-related molecules, and tissue damage characteristics for specific airway structures across the entire disease progress, we managed to identify novel biomarker and therapy target molecule. The biomarker not only appears at the specific time window when tissue damage occurs, but also co-localizes with the damaged regions of the lung and accurately reflects pneumonia severity. Antibody developed against the target molecule showed significant effect in reducing lung damage and edema, which gives a promising therapy for pneumonia treatment.

Following animal work, to transfer the technology to human background, the biomarker diagnosis has been tested on clinical samples by screening patient biopsies. The diagnosis is conserved and promising for further development. Larger scale clinical testing is being conducted and commercialization efforts are being taken. The research achievements are published with high impact and reported in media in several countries.

BES9SM / Polytechnics / Oral Presentation

Name	Yap Hong Kai
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	NUS Graduate School for Integrative Sciences and Engineering
Title of Abstract	Soft Robotic Actuators: Towards a Wearable Exoskeleton for Hand Assistive and Rehabilitation Applications
Authors	Yap Hong Kai, Lim Jeong Hoon, James Goh Cho Hong, Raye Yeow Chen Hua
Abstract	Conventional robotic devices that comprise of rigid actuators often raise compatibility issue with human such as impeding natural movement of the joints. Soft robotics is an emerging field that seeks to replace traditional hard rigid robots, particularly in applications where complex and expensive hard robots are deemed unsuitable. In recent years, soft robotic actuators are drawing increased attention due to their high compliance and customizability. In this presentation, we will present the work on soft robotic actuators and how they can be used to design a wearable exoskeleton for hand assistive and rehabilitation applications. Experimental results of actuator characterization and prototype evaluation will be covered in the presentation.

Name	Aishwarya Bandla
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	SINAPSE

Title of Abstract	Dynamic Neural Integrity Changes during rtPA Thrombolysis in a Photothrombotic Hyperacute Ischemia Rat Model
Authors	Aishwarya Bandla, Yu-Hang Liu, Nitish Thakor and Lun-De Liao

Abstract

Thrombolysis via recombinant tissue plasminogen activator (rtPA) is the only FDA-approved drug for stroke, a leading global cause of death and disability. However, rtPA therapy is largely limited by its narrow time window of safe administration. Intense research is directed towards novel therapeutic interventions for stroke, with a key focus on extending the thrombolytic time window. Improving outcomes in thrombolytic therapy is reliant on the understanding of the dynamic neurovascular functions during hyperacute ischemia; however, it is still not well-understood. Here, we investigate the hyperacute ischemic neural activity changes in a rat photothrombotic ischemia (PTI) model following rtPA thrombolysis. We employ electrocorticography (ECoG) for probing the neural activity changes and histologically confirm the infarct size via 2, 3, 5-triphenyltetrazolium chloride staining. Our study demonstrated for the first time, the dynamic neural activity changes (i.e., somatosensory-evoked potential (SSEP) and resting-state (RS) ECoG markers (i.e., inter-hemispheric coherence, alpha-delta ratio (ADR) and brain symmetry index (BSI))) at different rtPA infusion onset times. Interestingly, very early (< 1 h) administration of rtPA post-PTI resulted in deteriorated neural activity (i.e., ADR dropped to at least 71 ± 3.9% lower than baseline). Further, late (> 4 h) administration of rtPA post-PTI also resulted in worsened neural activity. On the other hand, a golden time window in the initial 1 to 3 h post-PTI is reflected by the significant recovery of neural activity (i.e., SSEP and ADR were significantly rescued to 10 ± 1.5% over baseline and 93 ± 4.2% of baseline, respectively, while BSI improved by 83 ± 5.9%). Additionally, rtPA administration in this golden time window resulted in a minimal infarct area in the ischemic hemisphere (4.6 ± 2.1%). This experimental model and corresponding data will serve as a benchmark to explore neurovascular mechanisms and to study potential interventions for bettering rtPA treatment outcomes.

BES9SM / Polytechnics / Oral Presentation

Name	Karthik Kannan
Level of Study	Graduate
Institution	National University of Singapore
Department / Division	Biomedical Engineering
Title of Abstract	Seymour Shield – An Operative Adjunct Device for Maintaining Visualization during Laparoscopic Surgery
Authors	Karthik Kannan, Research Associate, Biomedical Engineering, NUS, Singapore Dr.Leo Hwa Liang, Assistant Professor, Bio-Engineering Department, National University of Singapore, Singapore Mr. Justin Phoon, Market Segment Manager, QiG Group, Singapore Dr.Perline Teo, Research Fellow, A*STAR, Singapore Dr.Ng Tze Kiat, Senior Consultant, Urology, NUH, SIngapore Dr.Luke Tay, Registrar, General Surgery, SGH, Singapore
Abstract	During Minimally Invasive Surgery or Laparoscopic Surgery, the surgeon is absolutely dependent on the view from the camera. Yet, the rigid-endoscopic camera lens is prone to getting fouled by smoke, fog, blood and/or vaporized organic debris, all of which obstruct vision and thus necessitates removal of scope from abdomen for cleaning. So when lens fouling happens, surgical workflow halts entirely, which jeopardized patient's safety when visualization is truncated. Hence the scope is removed and the lens is manually cleaned by the nurse with the help of the gauze. Lens is warmed frequently by submerging the tip into a thermos-flask filled with warmed water and it is dried to prevent fogging. Surgeon must then return camera to its previous location and spatially re-ordinate himself in order to resume work. Disruptions in workflow may lead to conversion to open surgery for emergency measures, especially during active bleeding. Currently, conversion rate stands at 10% for most of the laparoscopic surgeries. Time lost contributes to operative duration, which is an independent risk factor for morbidity, as well as cost to the healthcare system. Given that 3.1 million laparoscopic surgeries were performed in USA in 2012 (projected to grow at 5-8%), we estimate a total of 386,000 hours spent cleaning the scope, representing wastage of USD 347 Million in terms of theater time to healthcare system. At present, laparoscopic sheaths have been devised with fluid irrigation channels that enable lens cleaning without scope removal (EndoScrub 2, Medtronic). However, this still involves loss in visualization and disruption of surgical flow while irrigation is taking place. Recently, a sheath generating air vortex distal to the lens has been developed which disperses smoke produced during electro-cautery dissection (Floshield, MID Surgical). However it is not effective against blood splatter and thus fails to protect the lens during the most critical moments of the surgery. Hence, to overcome the above defects, we developed a novel device, the one-stop solution which addresses all the problems encountered. Our product Seymour Shield is a 12mm/14mm sheath that fits over the conventional 10 mm laparoscopic camera with a distal, constantly-rotating, clear, transparent disc (shield). The rotation servers two purposes: firstly, to remove or prevent buildup of excess fluid and particulate debris on the visualization surface by centrifugal force, and secondly to produce an optical illusion of clarity exploiting physiological persistence of vision and the flicker-fusion threshold of human sight. We are using compressed air\

vacuum which is available readily in Operation Theater as a driver for the whole process. Rotor is designed in such a way that it is propelled by the compressed air and the transparent disk or the shield for the lens is embedded into the rotor. So, as the rotor rotates at high speed, the shield too rotates, thereby shattering all the foreign particles. The compressed air can be used by the doctor whenever required, by just pressing the button in the sheath. Thus Seymour Shield offers easy and instant solution for maintaining clear vision throughout the laparoscopic surgery.

Name	CHAN CHOW KHUEN
Level of Study	Graduate
Name of School / College / Institution	National University of Singapore
Department / Division	Biomedical Engineering

Title of Abstract	Assessment of Squatting with Different Speeds and Depths in Healthy Young Individuals: Kinetics and Kinematics
Authors	C.K. Chan, C.H. Yeow

Abstract

Squatting is one of the well-known exercises, which is essential in developing conditioning and power among the athletes. Nevertheless, squatting has been reported to be vital in rehabilitation treatment especially among the neurological disorder patients, namely stroke survival. It has been reported that squatting able to assist in regaining the strength and muscle tonus, which helps in improving the activities of daily living (ADL). With the squat therapy, this will further assist the stroke patient in regaining muscle strength rather than depending on gait rehabilitation program solely. At current state-of-art, research on squatting in sports biomechanics, especially with the barbell, has been heavily investigated. Squatting without barbell is not well studied. Thence, the objective of this study is sought of to address the effect of squatting without the barbell, which will be beneficial as a comparison between the elderly people or patient with movement disorder. Moreover, the study aims to investigate the kinetics and kinematics of squatting with different conditions, namely depths and speed. Experimental trial has been conducted among the healthy and young adults, which covers for partial, normal and deep squats with pre-determined slow, normal and fast speeds. The study, however, is restricted to the sagittal plane and only the lower extremity is investigated. It is expected that there are significant difference in angular velocity and moment in order to reveal the insight movement of the lower limb muscles.