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Part I – Oral Presentations

Oral Session 1: 2021 the 4th China Physiological Signal Challenge (CPSC2021)

BEB6712: Accurate Paroxysmal Atrial Fibrillation Events Detection using Deep Neural Networks

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Abstract. This study concentrates on the problem of accurate locating of paroxysmal atrial fibrillation (PAF) events from dynamic or wearable electrocardiography (ECG) recordings. Although computer-aided automatic detection of AF has been extensively studied, few work directly focus on the problem of precise detection of onsets and offsets of AF episodes (events) from ECGs.
Methods: Several deep neural networks (DNNs) and a flexible pipeline constructed on top of these DNNs are built for tackling the problem. The fundamental DNN is a QRS complex detection model. A long short-term memory (LSTM) model with RR intervals as input makes beat-wise classification. A sequence tagging (SeqTag) convolutional neural network (CNN) and a UNet model with preprocessed ECG signals as input make finer-grained tagging. The pipeline is as follows. Raw ECGs are resampled to 200Hz if necessary and bandpass (0.5 - 45 Hz) filtered. Afterwards, ECGs are sliced into segments of 30 seconds length (6000 sample points) with 8 seconds overlap, then normalized to fixed mean and standard deviation. Segments processed as such are fed into the QRS detection model to locate the QRS complexes of the original ECG recordings. Thus obtained sequences of RR intervals are fed into the LSTM model to make beat-wise tagging. The SeqTag model and the UNet model take the processed segments as input and produce sample-wise tagging.
A combination (full or part) of the outputs of the last 3 models (LSTM, Seq- Tag, UNet) is used to make the final prediction, taking union or intersection of intervals. The locations of QRS complexes are used for post-processing to filter out episodes (both normal and AF) shorter than 5 beats.
For training these models, we sliced the training data provided by CPSC2021 organizers to segments of 30 seconds length with 15 seconds overlap. Near critical points (onsets and offsets of the AF episodes), larger and randomized overlaps (25 - 29 seconds) are adopted, in order to generate more data which contain such critical points. To further make the models more sensitive to these critical points, we train the models with a novel loss function, namely the masked binary cross entropy loss, where the values of the masks in a neighborhood of critical points are significantly larger than elsewhere.
Results: The highest score evaluated via the challenge metric is 1.9766, obtained using the LSTM + SeqTag combination, under the union rule. Conclusion: We develop an effective pipeline for making accurate locating of PAF events from ECG recordings.

Keywords: QRS Detection; LSTM; Sequence Tagging; UNet; Masked Binary Cross Entropy

BEB6720: A Deep Learning Approach for Automatic Detection of Paroxysmal Atrial Fibrillation from Dynamic ECG Recordings

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Abstract. Atrial fibrillation (AF) is one of the most common arrhythmias and a potent risk factor for stroke. The risk of paroxysmal atrial fibrillation (PAF) is similar to that of persistent AF. The CPSC2021 challenge aims to detect PAF events from dynamic ECG recordings automatically. To solve this challenge, we proposed a deep residual neural network architecture which contained 39 convolutional layers and 2 fully connected layers. The length of the model output was designed to be one-sixteenth of the input. The training set was made by dividing each ECG recording into segments of 12 s long which had 2400 samples. And the corresponding labels were made into binary according to the annotations and contain 150 samples each. The model was then trained with TensorFlow framework. In the inference process, the output of the model was further processed according to the QRS wave positions, which were obtained using the open source algorithm we proposed at CPSC2019. The proposed model was evaluated on the online validation set. Our team, usstmed, received a scroe of 2.0629, ranking second on the leaderboard. It shows that our algorithm has great clinical application potential in detecting PAF events from dynamic ECGs.

Keywords: Paroxysmal Atrial Fibrillation; Deep Residual Neural Network; CPSC; ECG

BEB6723: A Deep Learning Approach to Electrocardiograph Interval Estimation and Diagnosis

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Abstract. With recent advances in deep learning algorithms, computer-assisted healthcare services have rapidly grown, especially for those that combine with mobile devices. Such combination enables the wearable and portable services for continuous measurements and facilitates real-time disease alarming based on physiological signals. However, a long-term diagnosis confronts challenges from dynamic environments, and physicians or cardiologists to spend a lot of time in reading long-term recordings, which is a laboring and tedious task. Thus, it is an urge to train a single deep learning model that can accurately diagnose and detect abnormal events over a long time period. The China Physiological Signal Challenge (CPSC) 2021 provides a time-series multi-lead Electrocardiography (ECG) data set with atrial fibrillation (AF) labels. It aims to encourage participants to develop algorithms for the paroxysmal atrial fibrillation (AFp) events diagnosis from dynamic ECG recordings. Here, we propose an approach to achieve the goal above via cutting the data into single-lead short time segments and introducing a challenge-best pre-trained model from CPSC 2018.
ECG data set of CPSC 2018 was used to construct the pre-trained model, followed by the main training using CPSC 2021 ECG data set. The model could be trained successfully under the

framework of Keras with GPU version of Tensorflow and perform precise interval estimations for AF events by averaging the predicted results of segments. After the post-processing by dilation and erosion algorithm, the AFp events are identified (AF-events-to-others ratio is larger than 5% and lower than 95%), and the CPSC 2021 official score (http://www.icbeb.org/CPSC2021) is 1.9484.

Keywords: Interval Estimation; Time-series Data; ECG

BEB6729: Convolutional Recurrent Networks for Paroxysmal Atrial Fibrillation Events Detection

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Abstract. Paroxysmal Atrial Fibrillation (PAF) is an irregular heart rhythm that occurs occasionally and terminates spontaneously. It leads to inefficient blood flow that causes the blood to pool inside the atria increasing the risk of forming blood clots. This study proposes a method for PAF events detection from dynamic ECG recordings using Convolutional Recurrent Neural Networks. In order to determine the exact time that each episode starts and ends, a combination of five 1D convolution layers (Conv1D) and three Bidirectional Gate Recurrent Unit layers (BiGRU) is used. Our method is developed and validated on the 4th China Physiological Signal Challenge 2021 dataset which consists of 2 training sets from different ECG monitoring systems. The training sets include patients with persistent atrial fibrillation (AF), PAF and non-AF patients. In order to evaluate our method on data with different distributions, one set is used for training and the second is used for validation. Precision and recall for non-AF, AF and PAF classes on the validation set are 0.99 and 0.89, 0.91 and 0.95 and 0.66 and 0.94 respectively. Precision and recall of onset and offset PAF events detection are 0.77 and 0.77 respectively and the overall Challenge defined scoring metric is 1.99. The method is further validated on the Challenge hidden test set, resulting in an overall scoring metric of 2.01.

Keywords: ECG Signals; Paroxysmal Atrial Fibrillation; Deep Neural Network; Convolutional Recurrent Neural Network

BEB6728: A Two-step Detection for Paroxysmal Atrial Fibrillation Events based on Machine Learning

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Abstract. Detection of atrial fibrillation (AF) events is significant for early clinical diagnosis and appropriate intervention. To achieve an accurate identification of paroxysmal AF (AFp) in the long-term dynamic ECGs, we present a two-step method based on machine learning. Using the features extracted from the calculated RR intervals, the rhythm type of the ECG signal is first classified into three classes (AFp, persistent AF rhythm (AFf) and non-AF rhythm (N)) by support

vector machine (SVM). In the second step, the endpoints for the AF episodes are further located based on the heartbeat recognition. By training a deep convolutional neural network (CNN), the segmented beats are divided into AF and non-AF to determine the onset and end for any AF segment. The proposed method was trained and tested on the 4th China Physiological Signal Challenge 2021 (CPSC 2021) dataset. A final score U of 1.9147 was obtained on the unpublished test set maintained by the challenge organizers, which demonstrates the advantage of the method in AFp events detection.

Keywords: Two-step Detection; Paroxysmal Atrial Fibrillation; Machine Learning; RR Intervals

BEB6731: Segmented Pyramid Network

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Abstract. We propose a beat-by-beat classification method for tasks of ECG classification and atrial fibrillation endpoint recognition. When five consecutive heartbeats are all classified as atrial fibrillation, our method will calculate endpoints of the atrial fibrillation segment and determine whether the atrial fibrillation is paroxysmal by checking if the endpoints are the start and end of the record.We take the QRS peak of a heartbeat as the center and intercept a signal segment with a length of 2000 points before and after the center. Although this signal segment exceeds the length of one heartbeat, this interception method benefits the classification of a single heartbeat. According to the dual-lead data provided by the challenge, the model is designed as a convolution block for residual calculation between the two leads for helping key feature learning and signal fusion between leads. We employ multiple convolution modules with different convolution kernel sizes for collecting signals of different sizes of receptive fields. At the end of the network, long and short-term memory model are employed to adapt to the timing characteristics of the ECG signal. The model achieves feature extraction from a larger perspective, making the learning ability of the model more powerful.

Keywords: Atrial Fibrillation; Feature Extraction; Multi-modal Fusion

BEB6722: Paroxysmal Atrial Fibrillation - A Big but Not the Only Challenge for Automatic ECG Classification

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Abstract. Within the 4th China Physiological Signal Challenge 2021 (CPSC2021), we have developed a method of paroxysmal atrial fibrillation events detection from dynamic ECG recordings. In the first step, we pre-trained a 1D convolutional neural network to classify short ECG recordings

on a training set containing more than 120,000 recordings from six large publicly available databases. Based on the resulting probabilities of atrial fibrillation for ECG slices with a shift of one second, aggregated numerical variables were calculated and the output was processed by a Random Forest model to distinguish three classes: non-AF signal (N), paroxysmal (AFp) and persistent (AFf) atrial fibrillation. To accurately determine the beginnings and ends of fibrillation events in AFp signals, we have built a second deep learning model that classifies RR intervals with the surrounding context in a 5-second window. The output of this model for successive RR intervals is then processed by a simple events localization algorithm. As demands for a medical examinations rise in recent years, it is important to look for new ways to detect not only unrecognized atrial fibrillation, but also other heart diseases. Our prototype of the automatic ECG classification, Cordelia, is up-to-date able to predict more than twenty diagnostic categories or anomalies. As the web service, it can be used in connection to ECG devices, hospital information systems and wearable devices. In the outpatient healthcare, it can be helpful for the physicians less skilled in ECG evaluation.

Keywords: Automated ECG Diagnosis; Paroxysmal Atrial Fibrillation

Acknowledgements: This work was supported by ERDF EU grant and by the Slovak Ministry of Economy under the contract No. ITMS313012S703 and by the Slovak Grant Agency for Science (VEGA) under contract 1/0177/21.

BEB6732: Identification of ECG Signal Based on CNN

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Abstract. We use deep learning technology to build a stacked 1-d convolutional network to recognize ECG signals. Firstly, ECG signals were processed. According to the sample, the signals were segmented according to each cardiac beat, and the data set was formed by classification of normal and two types of atrial fibrillation. Then we build a one-dimensional convolution layer network in two SDCNN layers. The first convolution layer is frequency domain convolution, and the second convolution layer is time domain convolution, and each channel is unrelated to each other. Compared with traditional CNN, SDCNN can achieve the same level of performance while reducing the amount of computation. Then we put the data into the model for training. Finally, we use the model to identify the type of each heart beat and get the recognition result through processing. The model recognition accuracy is related to the range and amount of data used in training, and the recognition accuracy can reach more than 97.6% in the project.

Keywords: Deep Learning; Stacked; 1-d Convolutional Network; ECG; SDCNN

BEB6727: Paroxysmal Atrial Fibrillation Detection by Combined Recurrent Neural Network and Feature Extraction

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Abstract. Paroxysmal atrial fibrillation, or intermittent atrial fibrillation is one type of atrial fibrillation which occurs rapidly and stops spontaneously within days. Its episodes can last several seconds, hours or even days before returning to normal sinus rhythm. No intervention may lead the paroxysmal into persistent atrial fibrillation, causing severe risk to the human health. However, due to its intermittent characteristics, it is normally neglected by the patients. Therefore, real-time monitoring and accurate automatic algorithm are in great need in the early screening. In this study, we proposed a two-stage algorithm, including a BiLSTM network to classify healthy and atrial fibrillation, followed by a feature-extraction based neural network to further identify the persistent, paroxysmal atrial fibrillation and the onsets. The extracted including the entropy, mean value, median value, standard deviation, median frequency and mean frequency of the RR intervals. In our validation sets, the two steps can achieve 90.14% and 92.56% accuracy respectively. This overall algorithm also has the advantage of small amount of computing load, which shows potential for a portable embedded device.

Keywords: Paroxysmal Atrial Fibrillation; Recurrent Neural Network (RNN)

Oral Session 2: Cell biology & Medicinal Chemistry (I)

BEB6598: Plasma Kallikrein-Kinin System Proteins Interaction with Breast Cancer Cells

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Abstract. Introduction: The plasma kallikrein-kinin system (KKS) is related to contact system of coagulation, fibrinolysis and inflammation. Plasma kallikrein (PKa) activates factor XII, pro-urokinase (pro-uPA) and releases bradykinin (BK) from high molecular weight kininogen (HK) generating HKa. In tumor cells (CHO) we have shown the role of heparan sulfate proteoglycans (HSPG) in assembly and endocytosis of KKS proteins on cell surface (Motta and Tersariol, 2017). The aim of the present work is to study in human breast epithelial cells the interaction of HK, the presence of PKa and BK release. Methods: The cell lineages studied were MCF-10A (non-metastatic), MCF-7 (less-metastatic) and MDA-MB-231 (highly-metastatic). The techniques employed were confocal microscopy, radioimmunoassay (RIA) and RT-PCR. The confocal microscopy analysis showed HK-Dylight-650 bound on cell surface in MCF-10A (1,947.0 ±0.003 pixels/cell), MCF-7 (648.0 ±0.002 pixels/cell) and MDA-MB-231 (1,251.00 ±0.002 pixels/cell). In endocytic vesicles HK-Dylight-650 and LT-green colocalized in MCF-10A (974.0 ±0.002 pixels/cell), MCF-7 (61.0 ±0.001 pixels/cell) and MDA-MB-231 (385.0 ±0.001 pixels/cell). In comparison, the HK binding and endocytosis was MCF10A > MDAMB-231 > MCF-7. By confocal microscopy the BK colocalized with LT-red in MCF-10A (19.7%), in MCF-7 (40.9%), in MDA-MB-231 (53%) and BK in endocytic vesicles of MDA-MB-231 allows its proliferative effect in metastatic cells. The kininogenase activity was analyzed by RIA, after incubation of cells with HK, and the amount of BK released in supernatant in presence of kininases inhibitors was MCF-10A (1.13 ±0.01 ng/106cell), MCF-7 (0.29 ±0.01 ng/106cell), MDA-MB-231 (0.78 ±0.00 ng/106cell); in presence of both serine proteases and kininases inhibitors the BK released was MCF-10A (0.03 ±0.01 ng /106cell), MCF-7 (0.19 ±0.00 ng/106cell) and MDA-MB-231 (0.21 ±0.00 ng/106cell). The higher BK release in MCF-10A cells is in agreement with its proangiogenic effect. In MDA-MB-231 plasma prekallikrein (PK) mRNA was detected, and by confocal microscopy, in both non-permeabilized and permeabilized cells, PK/PKa was shown colocalized with pro-uPA/uPA. Conclusion: Our data suggest a role for plasma KKS in breast cancer through interaction of HK with cell surface that may result in endocytosis, BK release through endogenous and pericellular proteolysis by PKa and interaction with pro-uPA that may activate uPA/uPAR system.

Keywords: Breast Cancer; Kininogen; Plasma Kallikrein; Endocytosis; Proteolysis

BEB6384: Utilization of Neoadjuvant Intensity-Modulated Radiation Therapy and Proton Beam Therapy For Esophageal Cancer In The United States

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Abstract. Background: Randomized esophageal cancer (EC) trials have utilized two- or three-dimensional conformal radiotherapy (3DCRT). Advanced radiotherapy (RT) techniques [(ARTs): intensity-modulated radiotherapy (IMRT) and proton beam therapy (PBT)] may have benefits, but are relatively unproven. This is the first study to date evaluating utilization of ARTs versus 3DCRT in the trimodality setting in the United States.
Methods: The National Cancer Data Base (NCDB) was queried (2004–2013) for newly-diagnosed cT1bT4bN0/N+M0 EC receiving neoadjuvant CRT followed by esophagectomy. The primary objective was to assess temporal trends, with multivariable logistic regression analysis assessing factors predictive of receiving ARTs. Secondarily, Kaplan-Meier analysis evaluated overall survival (OS), Cox proportional hazards modeling determined variables associated with OS, and postoperative complications were compared between cohorts.
Results: Altogether, 3,138 patients met criteria; 1,398 (45%) received 3DCRT, and 1,740 (55%) received ARTs (99% IMRT, 1% PBT). Temporally, utilization of ARTs is steadily rising in the United States, from 20% in 2004 to 69% in 2013, corresponding with a progressive decrease in utilization of 3DCRT. ARTs were more often delivered with advancing age, squamous cell histology, N2+ disease, and at academic centers (P0.05 for all). Treatment at an academic center independently correlated with improved OS (P<0.001).
Conclusions: Utilization of ARTs (IMRT in the vast majority) is steadily rising in the United States; 3DCRT is now used in a minority of patients. This has implications for payers and insurance coverage. ART use is impacted by not only age and disease factors, but also regional and facility differences. Treatment at an academic facility independently correlated with higher survival, which has implications for patient counseling.

Keywords: Esophageal Cancer (EC); Radiation Therapy; Chemotherapy; Esophagectomy; Intensity-modulated Radiation Therapy; Proton Beam Therapy (PBT)

BEB6470: Na^+/HCO_3^- Cotransporters in the Kidney: Physiology and Functional Regulation

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The kidney plays a central role in maintaining the systemic fluid and electrolyte homeostasis in the body through epithelial reabsorption and urinary excretion. The transepithelial transport of fluid and solutes in the kidney depends on a series of membrane channels and transporters specifically expressed in the apical and/or basolateral membrane of different segments of renal tubules. The SoLute Carrier family 4 (SLC4) represents a major HCO_3^- transporter family that includes five Na^+-dependent HCO_3^- transporters (NBCs) and three Na^+-independent Cl^-/HCO_3^- exchangers. The SLC4 family HCO_3^- transporters are widely expressed in the epithelia along different segments of the renal tubule and play an essential role in the transport of acid-base and NaCl in the kidney. Genetic studies have demonstrated that dysfunction of the SLC4 family transporters are associated with the development of severe renal tubular metabolic acidosis, hypertension, mental disrorders, migraine etc.
In the past decade, enormous progresses have been made in understanding the physological roles of the SLC4 family HCO_3^- transporters in the kidney. These progresses have greatly advanced our knowledge about the pathophysiological mechanism underlying the diseases associated with the

SLC4 family genes. In the presentation, I will talk about our latest findings about the physiological roles of the SLC4 family transporters for the transport of acid-base equivalents and NaCl in the kidney, as well as new molecuar mechanism underlying the functional regulation of these transporters.

Keywords: Membrane Transporter; Renal Reabsorption; Hypertension; Metabolic Acidosis; Protein Interaction; Ion Transport; Epithelium.

BEB6701: Utilization of Intravenous (IV) Curcumin, Genistein, and Trastuzumab to Reduce HER2 receptors in Breast Cancer Patients

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In recent decades, due to the increased growth, spread, and onset of cancer, interest has arisen in studying the methods that could be used to combat it. Breast cancer is the most prevalent form of cancer in the world. Due to the growing pervasiveness of this issue, a larger body of research is forming in the area of breast cancer with the intent to contain the spread of the potentially ravaging disease or diagnose it earlier. This research is intended to propose an alternative, possibly more efficient method to inhibit the chances of metastasis and continued prevalence of breast cancer in a patient. The related work discusses similar research being done and builds on it to incorporate the novel method being proposed while explaining the components of the proposed treatment in question. The proposed method aims to deplete HER2 protein receptors in breast cancer patients through the intravenous (IV) administration of the tyrosine kinase inhibitors (TKIs) curcumin and genistein, as well as trastuzumab, which is more commonly known under the brand name Herceptin. Depleting HER2 protein receptors can potentially cause the severity of HER2-positive breast cancer to decrease substantially, as well as reduce the probability of metastasis and recurrence, the rate of which is considerably higher in HER2-positive cases when compared to that of HER2-negative cases. The future work deals with alternate methods that could be explored with a similar intent as this research study and describes the potential implications of the study.

Keywords: Breast Cancer; HER2 Receptors; Tyrosine Kinase Inhibitors (Tkis); Curcumin; Genistein; Trastuzumab (Herceptin); HER2-Positive; HER2-Negative

BEB6694: Computational Immunology Analysis on Brain Disease

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6607: SET8-Methylated SNIP1 Promotes Triple-Negative Breast Cancer Metastasis by Activating YAP Signaling

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Abstract. Smad nuclear-interacting protein 1 (SNIP1) is a transcription repressor that is related to the TGF-β signaling pathway and associate with c-MYC, a key regulator of cell proliferation and tumor development. Currently, the mechanism by which SNIP1 regulates tumorigenesis and cancer metastasis is unknown. Here, we identified SNIP1 to be a non-histone substrate of lysine methyltransferase SET8, which undergoes SET8-mediated mono-methylation to promote breast cancer cell growth, invasion and lung metastasis. Mechanistic investigations demonstrated that SET8-mediated K301 methylation of SNIP1 represents a sensing signal to release KAT2A for activated HAT activity and promotes the interaction of c-MYC and KAT2A, as well as the recruitment of c-MYC/KAT2A complex to promoter of c-MYC targets. This event ultimately inhibits the Hippo kinase cascade to enhance TNBC metastasis by transcriptionally activating MARK4. Moreover, co-inhibition of SET8 catalytic activity and YAP in TNBC xenograft-bearing animals markedly attenuates breast cancer metastasis and increases the survival period. Collectively, this study presents an SET8 methylation-dependent regulatory mechanism governing oncogenic function of SNIP1 and provides insight into how targeting an epigenetic factor for combating hyperactive SNIP1-driven TNBC metastasis.

BEB6691: Mechanism of Lycorine Induced Mitotic Disaster in Human Gastric Cancer Cell SGC-7901

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Abstract. Gastric cancer (GCA) is a cancer with a high mortality rate all over the world. However, the current therapeutic drugs for the treatment of GCA are far from satisfactory, it is necessary to develop new drugs. Lycorine has good anti-tumor activity. This experiment aims to investigate the mechanism of lycorine induced mitotic disaster in human gastric cancer SGC-7901 cells. The effect of lycorine on apoptosis of SGC-7901 cells was detected by MTT assay, the morphological changes were observed by crystal violet staining, and flow cytometry and propidium iodide staining were used to analyze the effect of lycorine on the mechanism of mitotic disaster in SGC-7901 cells. To further reveal the mechanism of cell cycle arrest induced by lycorine in SGC-7901 cells, the expression of cycle-related proteins CDK1, CyclinB1, CDC25c, FoxM1 and BubR1 was detected by western blot. The above results all demonstrated that Lycorine effectively inhibited the viability and proliferation of human gastric cancer SGC-7901 cells. It causes cell cycle arrest in G_2/M phase and induces apoptosis in a concentration and time dependent manner. This study provided a scientific basis for clarifying the mechanism of lycorine induced mitotic catastrophe in gastric cancer cells, and generated experimental data and theoretical basis for the development of lycorine as an anti-tumor drug targeting GCA.

Keywords: Lycorine; SGC-7901; Cycle Arrest; Mitotic Disaster

Acknowledgements: This project was funded by Outstanding Young Talents Project of the Central Government's Reform and Development Fund for Local Universities (Grant No.: 2020YQ12), Heilongjiang Provincial Natural Science Foundation of China (YQ2020H024), Supporting Certificate of Heilongjiang Postdoctoral Scientific Research Developmental Fund (LBH-Q20027).

BEB6638: Efects of miR-34c-5p on Sodium, Potassium, and Calcium Channel Currents in C2C12 Myotubes

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Abstract. The aim of this study was to investigate the efects of miR-34c-5p on the main voltage-dependent ion channels in skeletal muscle cells. This study focused on the efects of miR-34c-5p on sodium, potassium, and calcium currents in C2C12 myoblasts. The miR-34c-5p overexpression group, knockdown group, and control group were diferentiated for 7 days, fused into myotubes, and used for the whole-cell patch clamp recording. Compared with the control group, the whole-cell sodium current density of the other two groups had no signifcant changes. In the knockdown group, the delayed rectifer potassium current density was increased (statistically signifcant), and the whole-cell calcium channel current density did not change. In the overexpression group, the change of rectifer potassium current density was not obvious, while the peak calcium channel current density increased (−9.23 ±0.95 pA/pF, n=6 cells for the overexpression group vs.−6.48 ±0.64 pA/pF, n=7 cells for the control; $p<0.05$). Changes in the expression of miR-34c-5p can afect the electrophysiological characteristics of calcium and potassium voltage-gated channels in C2C12 myotubes. Overexpression of miR-34c-5p increased whole-cell L-type calcium channel current ($I_{Ca,L}$), while miR-34c-5p knockdown increased whole-cell delayed rectifer potassium current (I_{Kd}).

Keywords: miR-34c-5p; C2C12; Ion Channels; Patch Clamp; Denervation; Amyotrophy

BEB6620: High-Throughput Technology for Cancer Research

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Cancer is a group of diseases that involve abnormal cell growth. They may invade or spread to other parts of the body. Although there are many challenges in translating biomarker research into a clinical setting, many gene- and protein-based biomarkers are already in use at some stage of patient care. Nevertheless, we still need to speed up the discovery process.

High-throughput technology provides the tools needed to observe differences in nucleic acids, proteins, metabolites, and other cellular molecules between individuals of a species. In the era of omics, high-throughput analysis can generate a large amount of data on the functional and/or structural changes within the specimen. This has significantly promoted the discovery of cancer

biomarkers and improved our understanding of the molecular response of cancer cells.
This presentation will summarize some of my research in the discovery of cancer biomarkers using high-throughput technologies (including proteomics, microarrays, and next-generation sequencing).

Keywords: Genetic Alteration; High-Throughput Technology; Next-Generation Sequencing; Microarray, Proteomics

BEB6710: The Role of 3D Cell Culture Systems in Stem Cell Differentiation

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Abstract. Stem cell-based tissue engineering provides not only *in vitro* models for studying tissue homeostasis and disease but also *in vivo* tissue-like structures for regenerative medicine. Generation of tissue-like structures relies on three-dimensional (3D) cell culture systems. Some of the current challenges in this field include mass transfer limitation and heterogeneity of 3D multicellular structures. By performing differentiation of human pluripotent stem cells (PSCs) towards definitive endoderm (DE), we found that successful DE spheroid formation relies on dominant cell-cell interactions over cell-biomaterials/cell-matrix interactions. Mass transfer, influenced by spheroid size and viscous biomaterials, has a great impact on stem cell differentiation. We hereby demonstrate how the properties of a chosen 3D system can influence differentiation process and the importance of spheroid size control for successful human PSC differentiation. Our study provides important information in the field of tissue engineering and stem cell research.

BEB6703: Study on the Discovery of Quality Markers in Cuscuta Chinensis Acting as Estrogen and Synergistic Effects in Quality Markers

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Abstract. Objective: Exploring the material basis and its synergistic of *Cuscuta Chinensis* to play the role of estrogen-like effect. Methods: Measure the uterine coefficient of mice and detecting the thickness of the endometrium by HE staining; Uses UPLC/Q-TOFMS technology to establish the characteristic map of *Cuscuta Chinensis* and analyzes the chemical composition of *Cuscuta Chinensis*; Based on network pharmacology to predict the targets and molecular mechanisms of estrogen-like effects of four main medicinal components in *Cuscuta Chinensis*; Taking the human breast cancer cell MCF-7 (ER+) as the research object, cell proliferation was detected by MTT experiment. Results: It was found that 10 components highly correlated with the action of estrogen-like. Among them, hyperoside, kaempferol, quercetin, and apigenin exist in prototype form in the body. We have determined that hyperoside, kaempferol, quercetin, and apigenin are "four main medicinal substances" of *Cuscuta Chinensis* estrogen-like effect. There are 198 targets related to estrogen deficiency; The results of KEGG enrichment analysis show that the mechanism of *Cuscuta Chinensis* estrogen-like activity may be related to PI3K-AKT signal pathway, estrogen signal pathway and other estrogen-related signal pathways. MTT experiment results show that the

four main medicinal components can promote the proliferation of MCF-7 cells when administered alone (P <0.05, P <0.01), and joint administration has a synergistic effect. Conclusion: The research showed that hyperoside, kaempferol, quercetin, and apigenin are 95% ethanol extract of *Cuscuta Chinensis* material basis to play the role of estrogen-like effect. Combination of four components administration can have a synergistic effect. The mechanism of estrogen-like effect may be related to the PI3K-AKT signaling pathway and the estrogen signaling pathway.

Keywords: *Cuscuta Chinensis*; Quality Markers; Estrogen-Like Effect

BEB6570: Protein Misfolding and Aggregation

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Abstract. It is known that protein misfolding is governed by the hydrophobic effect of solutes at hydrophobic amino acid sidechains. The hydrophobic force or mechanical force of nonaqueous solutes acts as a driving force for the spatial rearrangement of protein sidechains, whose structural transitions need to be regulated in both time and space. Smaller hydrophobic solutes exert more effect at protein sidechains, which involves the clustering of proteins into misfolded shapes. However, sidechain rearrangements in proteins upon ligand binding are a hydrophobic effect, which plays a major role for protein aggregation. Ligand binding alters the vibrational free energy of the system that allows different conformational states of allosteric proteins, intrinsically disordered proteins. The consequences of misfolding and aggregation are loss of protein function, gain of toxic function, or both. This is a physical process, whose results have been directly linked to a large number of human diseases.

Keywords: Hydrophobic Effect; Ligand Binding; Conformational Proteins; Intrinsically Disordered Proteins; Mechanosensitive Peptides; Neurodegenerative Diseases

BEB6668: Sialoblastoma of the Submandibular Gland: A Distinct Entity?

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Abstract. Sialoblastoma is a rare congenital malignant tumor of the salivary glands. Salivary gland tumor are usaully benign, but in when they present in a paeditric populatiion, the opposite is true. A comparative analysis on 79 pediatric cases reported in the literature suggests a less aggressive

behavior for submandibular sialoblastoma in comparison with other sites. Expression of AFP and high levels of Ki-67 have been associated with poor prognosis. Classically, diagnosis is confirmed by open biopsy, but fine-needle aspiration may offer an alternative with reduced morbidity. New immunohistochemical tests with MyB and FISH-MyB might resolve current diagnostic uncertainities on FNA. Whilst early surgical resection with negative margins is widely accepted as first-line treatment, there is no consensus on therapy of recurrence and follow-up. MRI and sonography represent valid tools for the follow-up, which is usually restricted to 3-5 years.
Conclusion: Submandibular sialoblastomas may have a different biological profile in comparison with parotid tumors with the absence of metastasis and much lower rate of recurrence. Comprehensive diagnostics should include additional options such as fine-needle aspiration and markers to assess cell proliferation, AFP and differentiate basaloid cell tumors. Literature suggests that selective surgery alone is sufficient for the treatment of tumors with low malignancy. Follow-up should be tailored according to the tumor site and might be limited to 3-5 years.

Keywords: Sialoblastoma; FNA; Paediatric Oncology; Salivary Glands; Submandibular Gland

Oral Session 3: Medical Imaging Technology & Signal Processing

BEB6631: Wearable Electrochemical Sweat Sensor for Patients with Chronic Kidney Disease (CKD): Year II

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Abstract. Chronic kidney disease hinders the kidneys' ability to filter the blood and, in most cases, result in renal failure, forcing patients to depend on blood dialysis machines at scheduled appointments to filter their blood for the rest of their life. This project aims to mitigate this problem by designing an at-home, point-of-care, wearable biosensor that detects the biomarker urea from sweat. This helps determine how often patients need to get their blood filtered, saving time and money. Previous literature suggests that the level of urea in sweat is correlated to that of urea in blood. For this project, an electrochemical sweat sensor was created utilizing an Arduino microcontroller that determines the voltage created when urease enzyme is added to a solution with known concentration of urea. This voltage produced is said to be directly proportional to the amount of urea. The hypothesis is that there will be a direct relationship between the voltage produced and concentration of urea in the solution. It is also hypothesized that the relationship will be independent of volume such that miniaturization will be possible. Varying concentrations of urea were used (0.2M-1.0M). The biosensor was used to determine the relationship, if any, of the voltage created and the concentration of urea. 15 readings were taken for each concentration at 10mL, 50mL, and 100mL of solution. The result of the experiment suggests that there is a direct relationship between concentration of urea and voltage produced that is independent of volume, such that miniaturization is possible in future experiments.

Keywords: Non-Invasive; Biosensor; Point-of-Care; Nephrology

Acknowledgements: I would like to thank my family, who helped supply the necessary costs for this experiment and allowed me to conduct my experiment in the makeshift laboratory in my room. I would also like to thank my teacher and science mentor for their support.

BEB6568: Timing Optimization of Head and Neck CT Angiography via the Inverse Problem Algorithm: In-vivo Survey for 1001 Patients in 2020-2021

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6669: Attachment Dynamics of Saccharomyces Cerevisiae Yeast Cells to the Surfaces of Micropatterned UV-irradiated SiO2 Substrates

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Abstract. Microscale surface topography is made up of a variety of features (single topographic unit, such as a peak or a valley) with varying roughness feature characteristics (feature height, shape, etc.). The usage of surfaces with well-defined microscale characteristics may aid in determining which surface topography is best for target cell attachment. The attachment of cells can also be governed by physical forces such as electrostatic interactions between the substrate surface and the target cell. The influence of this kind of interaction can be ascertained by changing the substrate's surface potential through irradiation with UV light. The purpose of this presentation is to demonstrate in real time the effects surfaces with precisely specified microscale features created utilizing MEMS manufacturing techniques coupled with the modification of substrate surface charge through UV irradiation can have on the attachment of Saccharomyces cerevisiae cells to said surface.
Silicon dioxide (SiO2) substrates with an array of microscale structures on their surfaces (micropatterns) were fabricated with the microscale structures having different shape, size and interstructural distance parameters. S. cerevisiae yeast cells (Sc-77) were deposited from suspension onto the surface of each microscale platform for a period of 60 minutes in a custom-made flow chamber equipped with a view port for optical microscopy. Time-lapse imaging was performed during the whole period of cell deposition. Twelve different types of micropatterned surfaces were studied. Additionally, the effect of induced surface charge on cell attachment was studied by irradiating the micropatterned substrates with polychromatic UV light for 30- and 60-minutes.

Keywords: Cell Attachment; Micropatterned Surfaces; Electrostatic Surface Functionalization

Acknowledgements: This research is funded by the Latvian Council of Science, project "Engineered surface platform for immobilization of microorganisms", project No. lzp-2018/ 1-0460.

BEB6697: Use of 2D Transvaginal Ultrasonography and Hysterosalpingo-foam Sonography for Assessment of the Efficacy of Essure Hysteroscopic Sterilization

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Abstract. After Essure (Bayer AG, Leverkusen, Germany) hysteroscopic sterilization procedure, a confirmation test is performed to assess the success of sterilization with evaluation of the micro-insert position or tubal occlusion. The imaging techniques used for ascertaining the correct microinsert position or tubal occlusion may vary among countries and include hysterosalpingography (HSG), sonography, plain pelvic radiography, and hysterosonography. However, HSG remains reference standard. Non-HSG techniques are preferred because HSG is an invasive procedure that exposes the patient to ionizing radiation, is uncomfortable for the patient, and can be associated with adverse effects. Recently, hysterosalpingo-foam sonography (HyFoSy) was introduced and was suggested to be a possible less invasive alternative to HSG. Our prospective study included patients, who underwent Essure hysteroscopic sterilization, followed by 2D transvaginal ultrasonography, HyFoSy and HSG 12 weeks after sterilization. The purpose of our study was to evaluate the accuracy of 2D tranvaginal ultrasonography and HyFoSy compared to HSG for assessment of the efficacy of

Essure hysteroscopic sterilization.

Keywords: Hysteroscopic Sterilization; 2D Transvaginal Ultrasonography; Hysterosalpingo-Foam Sonography; Hysterosalpingography

Acknowledgements: We would like to thank the University Medical Centre Maribor for help and support.

BEB6702: P3b Amplitude as a Signature of Cognitive Decline in the Older Population: An EEG Study Enhanced by Functional Source Separation

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Abstract. With the greying population, it is increasingly necessary to establish robust and individualized markers of cognitive decline. This requires the combination of well-established neural mechanisms and the development of increasingly sensitive methodologies. The P300 event-related potential (ERP) has been one of the most heavily investigated neural markers of attention and cognition, and studies have reliably shown that changes in the amplitude and latency of the P300 ERP index the process of aging. However, it is still not clear whether either the P3a or P3b sub-components additionally index levels of cognitive impairment. Here, we used a traditional visual three-stimulus oddball paradigm to investigate both the P3a and P3b ERP components in sixteen young and thirty-four healthy elderly individuals with varying degrees of cognitive ability. EEG data extraction was enhanced through the use of a novel signal processing method called Functional Source Separation (FSS) that increases signal-to-noise ratio by using a weighted sum of all electrodes rather than relying on a single, or a small sub-set, of EEG channels. Whilst clear differences in both the P3a and P3b ERPs were seen between young and elderly groups, only P3b amplitude differentiated older people with low memory performance relative to IQ from those with consistent memory and IQ. A machine learning analysis showed that P3b amplitude (derived from FSS analysis) could accurately categorize high and low-performing elderly individuals (78% accuracy). A comparison of Bayes Factors found that differences in cognitive decline within the elderly group were 87 times more likely to be detected using FSS compared to the best performing single electrode (Cz). In conclusion, we propose that P3b amplitude could be a sensitive marker of early, age-independent, episodic memory dysfunction within a healthy older population. In addition, we advocate for the use of more advanced signal processing methods, such as FSS, for detecting subtle neural changes in clinical populations.

Keywords: P300; P3a/P3b; Aging; Cognitive Impairment; Functional Source Separation (FSS) ;

Electroencephalography (EEG); Support Vector Machine Learning

BEB6633: The Utility of FDG-PET Imaging in Differential Diagnosis of Parkinsonism

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Abstract. Introduction: Differential diagnosis of parkinsonian disorders can be difficult on clinical grounds, especially in the early stage. Recent advancements in 18-F-fluorodeoxyglucose positron emission tomography (FDG-PET) imaging reveals different patterns of regional glucose metabolism in idiopathic Parkinson's disease (IPD) and atypical parkinsonian syndromes, such as multiple system atrophy (MSA), progressive supranuclear palsy (PSP) and corticobasal syndrome (CBS), which may help differentiating between these conditions.
Purpose: To assess the utility of FDG-PET imaging in differential diagnosis of Parkinsonism in clinical practice.
Methods: FDG-PET was performed in 72 patients with parkinsonism (age 34 to 80) referred to our Center by movement disorder specialists. FDG-PET diagnosis was obtained by visual assessment of individual scans combined with voxel-based statistical parametric mapping analysis. FDG-PET diagnosis assigned at the time of imaging was compared with the final clinical diagnosis made after ≥2 years follow-up.
Results: IPD is characterized by preserved and pronounced glucose metabolism in the basal ganglia with preserved cortical metabolism, or reduced cortical metabolism frontal parietal and posterior paroietotemporal in the patients with cognitive disorders. MSA is characterized by hypometabolism in the striatum, especially putamen, cerebellar and brainstem level (pons). In PSP hypometabolism is found frontal (medial, basal, lateral premotor), striatal (caudate), thalamic and midbrain. CBD is presented with asymmetrical cortical and subcortical hypometabolism, most notably frontoparietal, in the hemisphere contralateral to dominant clinical symptomatology. FDG-PET findings were consistent with IPD in 27/29, MSA 18/20, PSP 19/21, CBS 2/2. Concordance between the FDG-PET and clinical diagnoses was 92% in the overall sample (IPD 93%, MSA 90%, PSP 91% and CBS 100%). The diagnostic accuracy of FDG-PET was 93% for IPD and MSA and 97% for PSP.
Conclusion: FDG-PET may help differentiate between IPD, MSA, PSP and CBS among patients presenting with parkinsonian symptoms, which is important for patient counselling and making early decisions about treatment.

BEB6411: I Want to Control Your Move: Human-Human Interface (HHI) Neuromuscular Electrical Stimulator (NMES)

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6657: Abnormality Detection based on ECG Segmentation

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Abstract. SCA (Sudden Cardiac Attack) is an emerging disease in the twenty-first century irrespective of a person's age. Heart failure is one of the essential reasons that cause many people to lead to death. ECG is a technique used to measure the electrical activity of the human heart. It is useful in determining heart rate, breathing rate, abnormality, heart sound, proper heart functioning, blockage in the veins. ECG segmentation is a process of locating waves, segments and intervals and carry out comparison of this with the known patterns through its time and characteristics. So, by applying segmentation technique on ECG one can predict the normality and abnormality present in the waveform of ECG.ECG segmentation which detects the QRS complex and based on the detection system computes bpm, breathing rate and statistical features like SDNN, SDSD of ECG. as after that based on the input BPM detail classification of normality and abnormality of ECG takes place. The purpose of the article is to provide an effective solution on the present system so that life efficiency of any patient suffering from the heart disease increases. Python framework was utilized to calculate various ECG features and state the normality or abnormality of ECG like Hyperkalaemia, Hypokalaemia, Hypocalcaemia, Ventricular Tachycardia and Junctional Tachycardia.

Keywords: ECG; ECG Segmentation; Python; Hypokalemia; Hyperkalemia; Junctional Tach-Ycardia, Hypocalcemia; Ventricular Tachycardia; SDNN; SD1; SD2.

BEB6644: How to Maximize Clinical Effectiveness and Safety with High Intensity Micro-Focused Ultrasound for Face and Neck Lifting

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Abstract. Introduction: Recent studies have shown autologous collagen regeneration, efficacy on face and neck lifting and safety of transcutaneous micro-focused ultrasound procedures. Despite this, guidelines on clinical indications and technical aspects such as the proper number of energy spots to be delivered to the patients are lacking. For this reason, I set up a clinical protocol to maximize clinical effectiveness and safety.
Materials and methods: I treated 925 women with a mean age of 51,3 years (range 33 – 64 years) in my cosmetic medical center in Milan (Italy), which presented soft to severe skin ptosis of the face according to APSS (Araco Ptosis Scale System). They received and average of 1.060 spots of micro-focused ultrasound as sole treatment.

I assessed patients with digital photographs, anthera skin analysis and 3d reconstructions with VectraH2.
Result: All patients completed the follow-up after 12 months and no major side effects were reported and good results were recorded.
Conclusion: My protocol of treatment proved that high intensity micro-focused ultrasound micro-focused ultrasound is a safe and effective treatment for face and neck lifting.
Objective: Evaluate the clinical efficacy and safety of microfocused ultrasounds.
Establish guidelines for indication to microfocused ultrasounds.
Evaluate the number of energy spots needed to produce an appreciable clinical result on facial rejuvenation.

BEB6660: Development and Validation of A Navigation System Allowing Motion Tracking of Dissociated Fragments

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Abstract. In the fields of reconstructive surgery, prosthetic alignment, orthognathic surgery, or knee and hip replacement surgeries, precision is essential, and misalignments as small as 2 °can result in complications. Traditional surgical navigation based on images relies on position information provided by a probe but lacks orientation data between structures, while imageless systems estimate the centers of rotation of the joints from motion tracking but are not suitable for cases of deformed anatomy.
We developed an image-based navigation system using multiple registrations, that allows tracking and aligning two separate pieces and that provides the alignment error relative to the preoperative plan, in real-time.
We designed a phantom experiment to measure the precision and accuracy of the system and simulated a complete workflow for a real clinical case in plastic bones. We believe that this intraoperative tool could bring significant advantages for the personalized treatment of complex surgical cases.

Keywords: Bone Alignment; Multiple Registration; Prosthesis Alignment; Motion Tracking.

Oral Session 4: Cell biology & Medicinal Chemistry (II)

BEB6684: Inhibitory Regulation of Purple Sweet Potato Polysaccharide on the Hepatotoxicity of Tri-(2,3-dibromopropyl) Isocyanate

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Abstract. Tri-(2,3-dibromopropyl) isocyanate (TBC), a new emerged persistent organic pollutant, is widely used in fields of flame retardant, textile, rubber and plastic with strong hepatotoxicity. Purple Sweet Potato Polysaccharide (PSPP) has antioxidant and hepatoprotective effects. This study aims to answer the scientific question whether PSPP has a protective effect on TBC induced liver injury. The effect of PSPP on the apoptosis of HepG2 cells was detected by MTT assay, the morphological changes were observed by morphological observation, and the apoptosis rate was determined by flow cytometry. The apoptotic genes were detected by qPCR assay, the relevant protein express was detected by western blot. The correlation between proteins and genes in the apoptosis pathway of HepG2 cells was calculated. To further reveal the apoptosis mechanism of TBC hepatotoxicity in vivo, 19 target genes and 14 apoptotic related proteins of inhibiting apoptosis via death receptor and mitochondria were discussed, all the above results proved that PSPP had protective effect on liver injury induced by TBC. This study provided a scientific basis for clarifying the mechanism of TBC hepatotoxicity and the protective effect of PSPP, and generated a new point and method of the prevention in advance and early intervention of diseases.

Keywords: Purple Sweet Potato Polysaccharide; Tris-(2,3-Dibromopropyl) Isocyanurate; Apoptosis

Acknowledgements: This project was funded by Outstanding Young Talents Project of the Central Government's Reform and Development Fund for Local Universities (Grant No.: 2020YQ12), Heilongjiang Provincial Scientific Research Project of Basic Scientific Research (Grant No.: 2020CX09), Scientific research project of Heilongjiang Provincial Health Commission (No.: 2019-021).

BEB6689: Multi-target Identification of Anastatica Hierochuntica L. Active Compound and Its Role for Oxytocin Receptor (OXTR)

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Abstract. Mode of action study of natural products is challenging. We employed a bioinformatic approach to reveal the molecular mechanism of *Anastatica hierochuntica L.* active compounds such as quercetin, myricetin, kaempferol, genistein, daidzein, chrysin, apigenin, rhamnoside, and anthracene. Protein target identification was conducted based on a ligand-protein network in stitch web services. Downstream interaction to OXTR was evaluated by StringdB. Enrichment pathway analysis and pathway visualization were done using Cytoscape software. The result showed that All actives compounds have an indirect network with OXTR. Multi-target was identified for potential ligand. We found that Genistein and Daidzein have the main role as ESR2 activators and interact

with OXTR via its ligand (OXT). Apigenin and kaempferol have different targets that are CYP1B1 and AHR, respectively. Both ligands can reach OXTR via ESR1. In addition, Quercetin, Anthracene, and Rhamnoside have different target and cascade signalling tp OXTR but they are mainly through ESR1. It is aligned with enrichment analysis that showed ESR1 is the shortest path length for activating OXTR with a value (1.35). This study concluded that *Anastatica hierochuntica L.* active compounds have multitarget and can interfere OXTR via ESR1. further exploration of ESR1 or ESR2 activator will be promising to explain the therapeutic effect of *Anastatica hierochuntica L.*

Keywords: Mode of Action; *Anastatica Hierochuntica L.* ; Oxytocin Receptor; ESR1

BEB6662: Skin Chip based Anti-inflammatory Effect Analysis of Gentiopicroside in Cosmetic Applications

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Abstract. Gentiopicroside (GPS), one of the active components of Gentianascabra, has been reported to exhibit various pharmacological effects including cancer treatment, hepatic-protective, and analgesic [1-3]. In this study, we investigated the anti-inflammatory effects for cosmetic applications utilizing skin chips, which mimic epidermal microenvironment. A PET membrane was used to coculture fibroblast and Hacat cells with culture medium flowing underneath, an air liquid interface was formed on top, after 10 day's of Coculture, the cell viability, proliferation test was carried out, the Keratin 5 and 10 was evaluated, it was found that the K5 was in a similar lever compared with culture with additional Ca+. LPS of 1mg/ml was given to the skin model to create inflammatory model, when GPS of different doses were given to the inflammatory skin model, it was found that the concentration of 50μg/ml gave the best anti-inflammatory treatment.

Keywords: Skip Chip; Gentiopicroside; Anti-Inflammatory Effects

Acknowledgements: The authors would like to thank the support from Shanghai Inoherb Co., Ltd.

BEB6537: Traditional Chinese Medicine for the elderly

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Abstract. At present, advanced countries are in the super-aging era. In Japan, the recently reported average life expectancy is about 90 years. Kampo medicine (traditional Japanese medicine) is a part of the official medical service in Japan and well applied to the treatment of older people. Kampo is a variation of traditional Chinese medicine (TCM), modified according to Japanese environment, character, and society. However, general physicians often use Kampo prescriptions without Kampo iatrology. Kampo prescriptions are beneficial in geriatrics, but they were developed and applied according to the medical principles of TCM. If they are misused, the results are severe. Therefore,

we describe the efficacy of TCM for geriatric syndromes and refer to the traditional meaning and rules of those prescriptions simply.

Keywords: Traditional Chinese Medicine; Geriatric Syndrome; Older People; Dementia; Aspiration Pneumonia; Behavioral and Psychiatric Symptom of Dementia; Constipation

BEB6692: Saponins of Tribulus Terrestris Attenuated Neuropathic Pain Induced with Vincristine through Central and Peripheral Mechanism

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Abstract. Objective: The study objective is to explore the effects of saponins of *Tribulus terrestris* TT (S) in attenuating pain and inflammation.
Methods: The toxicity and the effect of the extract were tested on LPS intoxicated RAW 264.7 cells via MTT assay and evaluation of inflammatory markers. Peripheral neuropathy was induced by vincristine (in two 5 days cycle with 2 days pause in between) at a dose of 100 µg/ml in order to assess TT (S) effect on mitotic arrest induced overall pain and inflammation induced by vincristine. Mechanical hyperalgesia, allodynia, Chemical induced nociception, Neurophysiological effect and sciatic nerve conduction velocity of the extract was evaluated on test days (7, 10, 14, 21). Mediators (TNF-α, IL-1β and IL-6) and neurotransmitters glutamate and aspartate were estimated.
Results: The TT (S) treated group were found to be effective in the behavioral experiments implying effective in attenuating pain. The inflammatory mediators (TNF-α, IL-1β and IL-6) were found to be attenuated with TT (S) treatment in comparison to vincristine treated group indicating its anti-inflammatory property. The excitatory neurotransmitters L-glutamic acid and L-aspartic acid were also found to be attenuated with TT (S) implying restoration of neuronal damage and synaptic activity.
Conclusion: TT(S) is active in lowering the inflammatory mediators, reversing the neuronal damage and increasing the nociceptive threshold caused due to peripheral neuropathy.

Keywords: Hyperalgesia; *Tribulus Terrestris* Saponins; Pregabalin; Cytokines; Inflammatory Mediators; Inflammation.

Acknowledgements: The authors would like to thank PSG Sons and Charities for providing all the facilities to carry out the work, Sami-Labs, Bangalore, India for gifting 20% saponin enriched *Tribulus terrestris* as a gift sample, and Department of Biotechnology (DBT) Govt of India for funding the work.

BEB6735: The Anti-AD Effects of Natural Compounds and the Mechanism Related to Ferroptosis

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Abstract. During the pathological process of Alzheimer's disease (AD), ferroptosis gradually emerges, becoming a study target for AD treatment. Besides ferroptosis, brain tissue is particularly vulnerable to neuroinflammation, which can aggravate Aβ deposition and tau phosphorylation. GV-971, a drug that reduces peripheral and central inflammation, was approved by the FDA in April 2020 for an international multi-center phase III clinical trial IND (IND 144482), which provides a strong basis for neuroinflammation as a promising target for the treatment of AD. Natural plants have attracted many researchers to screen for candidate agents because of their extensive pharmacological activities and few adverse effects. In our group, isoforsythiaside has been confirmed to inhibits ferroptosis and neuroinflammation in erastin-damaged HT22 cells and APP/PS1 mice, at least partially by regulating the activation of Nrf2 and NF-κB signaling. Furthermore, Forsythoside A (FA), the main ingredient in *Forsythia suspensa* (Thunb.) Vahl, possesses anti-inflammatory, anti-bacterial, anti-oxidant and neuroprotective activities. We first revealed the anti-AD properties of FA via modulation of ferroptosis-mediated neuroinflammation by targeting the activation of the Nrf2/GPX4 axis. According to our data, the inactivation of the Nrf2/GPX4 axis activates the NF-κB signaling, which further aggravates neuroinflammation.

BEB6690: Study on the Treatment Of Liver Cancer By Multicomponent Traditional Chinese Medicine of Andrographis Paniculata (Burm. f.) Nees

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Abstract. Andrographis paniculata, a herb, has functions of clearing heat and detoxifying, anti-inflammatory, detumescence, and analgesic, and is known as a natural antibiotic. One main purpose of pharmacological studies of traditional Chinese medicine is to find a compound that is consistent with its clinical efficacy. However, not every herbs or prescription can get suitable monomer active substances, and the vast majority of the attempt failed，which suggests the material basis for the traditional Chinese medicine (TCM) play an active compounds is not necessarily a monomer,Most likely a combination of several compounds. Therefore, this study changed the way of thinking, instead of trying to find a single compound in andrographis for the treatment of liver cancer, it sought to find a multi-component Traditional Chinese medicine (MCCM) in andrographis for the treatment of HCC. Based on the theory of *Multi-component Traditional Chinese Medicine*, this study took andrographis andrographis and its components in the treatment of liver cancer as the research object, optimized the "component-target-pathway" of andrographis andrographis in the treatment of liver cancer and studied its molecular mechanism.This study provides a basis for finding effective targets of andrographis andrographis in the treatment of liver cancer and clarifying the components of traditional Chinese medicine in the treatment of liver cancer.

Keywords: Multi-Component Chinese Medicine, Network Pharmacology, Pharmacology Of Chinese Medicine, Andrographis Paniculata (Burm. f.) Nees, Liver Cancer

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BEB6681: Tackling Neurocysticercosis a Neglected Zoonotic Brain Infection through Innovative Brain Targeted Delivery

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Abstract. Neurocysticercosis (NCC) is an infection of brain caused by the cystic larval stage of Taenia solium or the tape worm. It is a tropical disease and zoonotic in nature. It is among the most important parasitic disease of the human central nervous system and represents a major cause of acquired epilepsy. It is prevalent in tropical countries and countries where a infected pig meat associated with spread of NCC, is a common food product. Nevertheless, NCC remains a neglected disease with limited therapeutic options, coupled with long term therapy, which is very inconvenient for patients. The standard therapy for NCC is Praziquantel or albendazole often in combination with corticosteroids to tackle the associated inflammation. Toxicity due to long term corticosteroids is an additional challenge. A serious constraint in treatment is blood brain barrier (BBB) which severely restricts the drug transported into the brain. Insufficient drug concentration is stated to be one of the major causes of treatment failure. Targetted brain delivery provides exciting opportunity for improved therapy of NCC. Crossing the BBB by the intravenous route or bypassing the BBB through intranasal administration are two approaches that can be considered. The present talk would focus on an interesting new drug combination for enhanced therapeutic efficacy in NCC embedded in a targeted nanoformulation designed to effectively cross the BBB. Brain targetting and high cysticidal efficacy would be demonstrated to highlight the promise of this new approach for tackling NCC.

Keywords: Neurocysticercosis; Brain Targetting; Albendazole; Intranasal; Cysticidal Efficay

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BEB6457: DNA Intercalating Novel Benzimidazole Derivatives as Heavy Metal Ion Filtering Agents

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Abstract. In the field of DNA ligand binding research, the intercalating agents are thought to be most powerful DNA binding having potential of cytotoxicity among reversible DNA binders. But their cytotoxic/cytostatic activity needs to be specified against cancer cell in order to have pharmaceutically beneficial properties. But the intercalation of chelating ligands can be explored for their useful physical applications. Here we have attempted to incorporate DNA intercalation power

of some novel nitrobenzimidazole derivatives for selective filtration hazardous metal ions utilizing DNA immobilizing unit consisted of water insoluble (3- aminopropyl) triethoxysilane (APTES) films. The four benzimidazole derivatives simultaneously exhibiting metal chelation and DNA intercalation power were allowed to chelate metal ion (M = Cu(II), Fe III, Cr(III), As(III), Hg(II), Pb(II), Cd(II), Sb(V) form solution either directly or in intercalated forms. The studied Benzimidazoles (BI) were able to chelate metal ions in 1:1 spontaneously and their DNA intercalation strength in both bare and chelated forms were of the order of 103–105M-1. Three sequentially different filtration assemblies were investigated for their filtration efficiency. Metal ion (M) filtration though BI intercalated DNA trapped APTES (BI-DNA-APTES) filter films were most efficient towards- 2-metal ion removal (99%) than M-BI retained in DNA-APTES (85%) network which in turn was more efficient than BI-DNA-APTES trapping into APTES (54%). The relative strength of interaction between different components as well as the metal chelation is influential in determining the filtration efficacy of our system. It was also anticipated that other intercalating BI can also be utilized filtering assembly depending upon its affinity towards the ion of interest. The work successfully demonstrated the usefulness of the method for ion filtration in chemical, biological and environmental systems.

Keywords: Intercalation; Filteration; Metal Chelation

Acknowledgements: Prof. Dr. Romana Quershi, Department of Chemistry Quaid-i-Azam University Islamabad Pakistan.

BEB6641: Extraction and Characterization of Zein Protein: A New Approach

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Abstract. Zeins are prolamin-like storage proteins which are classified into four classes, with different molecular weights: α-zein (19 kDa and 26 kDa), β-zein (16 kDa), γ-zein (16 kDa and 27 kDa) and δ-zein (10 kDa). These proteins are insoluble in water but soluble in ethanol due to the high proportion of non-polar amino acid residues (e.g. tryptophan, proline, and leucine). Moreover, zeins have a wide range of applications, especially in medical and pharmaceutical (drug delivery, coating, and cosmetics, etc.) or food technology (chewing gum, etc.). New syntheses and applications have been described, such as zein-based conjugates which can be used as controlled drug release. However, due to the complexity of zeins structures, new analytical techniques such as mass spectrometry and electrophoresis are mandatory for analysing the composition of this class of proteins.
In this research, we present a new procedure which involves grinding and sieving corn seeds, various ethanol concentrations (65% to 95%), and zein extraction under normal and ultrasonic conditions. Moreover, the extracted zein was further used to synthesize zein-based conjugates. Techniques such as UV-Vis spectrophotometry, MALDI-ToF mass spectrometry, SDS-PAGE electrophoresis and FT-IR spectroscopy were used to characterize the extracted zein and the newly synthesized zein-based conjugates.
According to our data, the 65% ethanol solution extracted the most amount of zein in just 15 minutes under ultrasound conditions and the zein-based conjugates were successfully characterized by FT-IR spectroscopy.

Keywords: Zein; Mass Spectrometry; Extraction; FT-IR Spectroscopy; Conjugates

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BEB6521- Copper Containing Amine Oxidase Purified from Vegetal Sources as a Powerful Tool to Control Intestinal Dysfunctions: Molecular Mechanisms Underlying Its Beneficial Effect

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6550: Sevoflurane: Impurities and Stability Testing

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Abstract. We report an impurities and stability testing study on two different batches of three different commercial formulations of sevoflurane, the widely used fluorinated inhalation anesthetic agent. Our analyses focused on identifying the starting presence of volatile impurities as well as the formation of degradants after storage also under accelerated ageing conditions. We found that the analyzed samples show differences in quality and quantity of impurities as a likely consequence of the different manufacturing processes. Impurities may vary from one batch to the other of a given formulation, but in all case, they are well below limits specified by
regulatory agencies for clinical use, the content in sevoflurane being always>99.99%. Fluoride anion concentrations were below 0.1 mg/L in all analyzed samples, consistent with no degradation occurring in the examined timeframe.
Several fluorinated ethers, such as desflurane, enflurane, isoflurane, and sevoflurane, are used as inhalation anesthetic agents in modern clinical practice [1]. Among these, sevoflurane, i.e., 1,1,1,3,3,3-hexafluoro-2-(fluor methoxy) propane (Scheme 1), is the most commonly used because of its rapid onset of action and the quick recovery from anesthesia induced by this agent [2]. Sevoflurane is produced by several manufacturers. Currently marketed sevoflurane formulations (SFs) differ in their methods of synthesis [3], and the anesthetic is frequently.
prepared from hexafluoro isopropanol (HFIP) via a one-step synthesis (by using formaldehyde and HF under acid catalysis, Scheme 2), or via a three-step synthesis, sevomethyl ether (CF3)2CH-O-CH3 (SME) and chlorosevo ether (CF3)2CH-O-CH2Cl (CSE) being reaction intermediates.

BEB6613: Multi-Target Compounds based on Hydroxy- and Amino-Quinoline Scaffolds

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Abstract. Multi-target drugs represent an innovative approach of medicinal chemistry. This approach contrasts with the "one goal, one drug" paradigm and is based on the concepts of privileged scaffolds, polypharmacology and multifactorial diseases. It appears to be a useful tool in the design of anti-invasive drugs, as the therapeutic agents designed in this way interact with multiple targets and thus prevent resistance or are able to destroy resistant pathogens/cells. Similarly, multi-target drugs can be designed for the simultaneous treatment of autoimmune and inflammatory diseases. Quinoline-based compounds have a wide range of promising biological properties; therefore, special attention is paid to them in drug design and medicinal chemistry. The quinoline scaffold can be easily and rapidly synthesized, which shows the importance of this privileged structure. In addition, this simple scaffold has unique physicochemical properties and provides the possibility of a large number of targeted modifications. This contribution is focused on effective anti-invasive agents derived from the hydroxyquinoline and aminoquinoline scaffolds.

Keywords: Multi-Target Compounds; Privileged Scaffolds; Quinolines

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Oral Session 5: Biomedical Science & Biotechnlogy

BEB6591: Telemetry Device for First Stage Covid Patient Monitoring: Case Study Mexico

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Abstract. The SARS-CoV-2 pandemic in 2019 caused the role of the pulse oximeter to be a key tool for health professionals to quickly determine oxygen saturation levels and correlate them to clinical symptoms and track the development of their patient condition through time. In Mexico during peaks of positive cases the system couldn't monitor and control all positive ambulatory cases due to workforce shortage, by July 27th of 2021 Mexico has a population of 126 million and estimated active COVID cases of 101,630. The objective is to present in detail the development of a low-cost optical pulse oximeter telemetry prototype with use of commercially available technology and its complementary mobile application that allows remote monitoring chronologically and in real time, allowing the prioritization of human and economical resources to the most critical cases. The prototypes developed were tested on 50 patients of a geriatric facility and were evaluated with the System Usability Scale. Data of 38 of the patients that completed the System Usability Scale resulted in mean age of 84 years (S.D. = 10.63), 73% (n=31) female gender participants, 94.9% stated that the device was comfortable and 79.5% that they would like to continue using it. The mean difference between the prototype and the commercial equipment for oxygen saturation values was 2.29% (S.D = 2.56%), with minimum and maximum of 0 and 10. The results suggest the acceptance of the device and viability of the prototype for remote domiciliary monitoring.

Keywords: Telemetry; Oxygen Saturation; Pulse Rate

Acknowledgements: The completion of this work is a result of the efforts and cooperation of many people, whose names may not all be mentioned, nevertheless their contribution is greatly valued and acknowledged. The group would like to express their appreciation for all the support and understanding particularly to: Geriatrician Miriam Benavides M.D., the Le Grand Senior Living geriatric facility staff, members and residents and Carlos J. Vera M.D., Ph.D.
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BEB6512: Novel Urinary Detection of Prostate Cancer via Facile Silver Colloidal Strategy

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Abstract. Molecular profiling *via* analysis of disease biomarkers is a powerful tool for disease diagnosis and risk prediction. Due to simplicity and minimal instrumentation requirement,

colloidal-based colorimetric DNA/RNA assays are attractive for driving molecular profiling toward widespread clinical usage. Still, the reliability and speed of current colorimetric assays need to be further improved upon for eventual clinical use. Herein, we propose a “mix-to-go” colloidal strategy that utilizes the electrostatic attraction between negatively charged target sequences and positively charged silver nanoparticles (AgNPs) to induce aggregation of AgNPs to profile a panel of clinically validated urinary prostate cancer (PCa) RNA biomarker (prostate cancer antigen 3, PCA3). Our strategy is unique in inducing a rapid (10 s), unambiguous solution color change in the presence of target sequences, without the additional NP aggregation agents that are used in existing electrostatic-mediated aggregation assays. Our strategy is analytically specific and sensitive for the detection of 10^5 and 10^4 target copies by the naked eye and UV−*vis* spectrophotometry, respectively. Analytical accuracies of our strategy in detecting PCA3 biomarkers was 97.3%, as validated by quantitative reverse transcription-polymerase chain reaction. To further evaluate clinical molecular profiling performance beyond conventional proof-of-concept demonstration, we tested our colloidal strategy for noninvasive PCa risk prediction of 50 patients, using the urinary RNA biomarker PCA3. We found that elevated PCA3 levels were positively associated with high-risk PCa and obtained a corresponding area-under-the-curve values of 0.833 for predicting PCa and high-risk PCa on biopsy, respectively. We believe our “mix-to-go” strategy may serve as a reliable and accessible Ag colloidal-based molecular profiling approach for clinical applications.

Keywords: Next-generation Biomarker; Silver Colloidal; Prostate Cancer; Urinary Analysis

Acknowledgements: This work is supported by Creative Biosciences, Guangzhou. We thank Prof. Matt Trau for insightful discussion.

BEB6572: Challenges of Design, Interoperability to Telemedicine

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Abstract. Telehealth refers to a broad scope of remote healthcare services whereas telemedicine is narrower in scope and is typically associated with direct clinical services. Telemedicine leverages on the healthcare provider’s interoperable system in providing consultation/services to patients without the need of physical interaction. This presentation provides a perspective of the importance in managing risk associated with the system and processes that may impact the quality and safety of care provided through telemedicine. In the pursue of great possibilities with telemedicine, the journey towards success is mounted with various challenges. This discussion can include the readiness or consistency of current system interoperability, design of the system, process improvement including liability mitigation, technical skills of relevant stakeholders involved, patient acceptance, regulatory compliance, cybersecurity prevention, etc.
In summary, concerns and unknowns persist in the complicated network systems and challenging the effectiveness and efficacy of interoperability, telemedicine requiring other services of care must be carefully reviewed.

Keywords: Telehealth; Telemedicine; System Interoperability

BEB6559: Effect of Pindolol on Antidepressants and Serotonin Response in Dorsal Raphe Nucleus Neurons

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Abstract. Serotonin has a pivotal role in the pathophysiology of the mood disorders. Especially dorsal raphe nucleus (DRN) neurons send serotonergic projections to postsynaptic neurons in forebrain regions like hippocampus and affect mood of body. These neurons also affect themselves through $5HT_{1A}$ receptors and serotonin molecules in DRN region. Antidepressants that increase the amount of serotonin in the neurosynaptic junction in the brain are very effective especially in the treatment of mood disorders. However, the therapeutic effects of these drugs start with a long delay and involve in several dose-related side effects. Especially in the first few days of their usage, they lead to an increase in serotonin level in the somatodendritic region of dorsal raphe nucleus neurons where serotonergic neurons are dense, which, in turn, inhibits serotonergic neurons locally. The inhibition induced by antidepressants is the exact opposite of the intended use of these drugs. It has been reported in previous studies that pindolol may eliminate this inhibition when used in combination with antidepressants like SNRI. Pindolol is thought to achieve this inhibition by antagonizing the somatodendritic 5-HT1A autoreceptors. Pindolol, which inhibits 5-HT1A autoreceptors, has the potential to block the inhibition of serotonergic neurons due to increased serotonin levels in the dorsal raphe nucleus when antidepressant drugs is used. Pindolol can potentiate antidepressant effect of SNRI and SSRI when used with them. In mood disorders that do not respond to antidepressant treatment, it seems to be likely to increase the effectiveness by combining reuptake inhibitor antidepressant drugs with pindolol.

Keywords: Dorsal Raphe Nucleus; Mood Disorders; Pindolol; Serotonin

BEB6687: Development of DNA Aptamer-Functionalized Collagen Fibrous Scaffolds for Bone Regeneration Applications

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Abstract. Human Bone morphogenetic protein 2 (BMP-2) is a U.S. Food and Drug Administration (FDA)-approved osteoinductive growth factor used for bone regeneration in the clinic. The major constraints for the clinical application of BMP-2 are a variety of adverse effects such as inflammations, adipogenesis, bone cyst formation, and epidotic bone that are associated with supra-physiological dosage. Attempts are being made to reduce the clinical dose of BMP-2 by developing functional protein scaffolds with enhanced drug retaining ability and osteoinductive potential. Here, we report an extracellular matrix (ECM)-mimic DNA aptamer-collagen fibrous scaffold that can deliver BMP-2 to achieve improved osteoinductive efficacy. The scaffold was self-assembled into fibrous structures by mixing BMP-2-specific DNA aptamers with collagen molecules at an optimal ratio. Results demonstrate that this scaffold was as large as ~200 μm in length and was able to load BMP-2 with a higher capacity than free collagen or DNA aptamers. Meanwhile, it strengthened BMP-2-mediated osteoinductive potential as indicated by the enhanced alkaline phosphate activity (ALP) and wound healing efficiency of C2C12 cells compared to free BMP-2 at a low concentration. Given the superior effects, the aptamer-collagen fibrous scaffold has

promise to benefit BMP-2-induced bone regeneration with increased efficacy coupled with reduced side effects. Future work will examine the efficiency of this scaffold to promote BMP-2-induced osteogenesis in vivo on a rat posterolateral lumbar intertransverse spinal fusion model.

Keywords: Aptamers; Collagen; Fibrous Scaffolds; Bone Regeneration

BEB6621: Birch Allergen Challenges in Allergic Conjunctivitis using Standard Conjunctival Allergen Challenge and ALYATEC Environmental Exposure Chamber

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Abstract. Background: Environmental exposure chambers (EEC) have been extensively used to study allergic rhinoconjunctivitis. Few studies have been published using EEC in conjunctivitis only, but none using conjunctival allergen challenge as a selection criterion. The objective was to validate ALYATEC EEC in allergic conjunctivitis to birch allergens.
Methods: Sixteen patients with a positive Conjunctival Allergen Challenge (CAC) were exposed to 60 ng/m^3 of Bet v 1 in the EEC, on two consecutive days for 4 hours maximum. Reproducibility of EEC was tested among 7 of them. A positive conjunctival response during the CAC and the EEC exposure was defined as a Total Ocular Symptom score (TOSS) ≥ 5.
Results: Fifty percent of patients had a positive conjunctival response during Expo 1, and 75% on Expo 2. There was no statistical difference in the mean time to obtain a positive conjunctival response 81.2 ±33.9 minutes on Expo 1 and 101.6 ± 57 on Expo 2. No difference on the TOSS was obtained on Expo 1 and Expo 2. The time necessary to obtain a positive response during the CAC was significantly shorter compared to EEC. The estimated quantity of Bet v 1 inducing positive responses was dramatically different: 0.07 ± 0.03 ng (Expo 1), 0.07 ± 0.07 ng (Expo 2), 980 ± 784 ng (CAC). The frequency of conjunctival responses and quantity of Bet v 1 was reproducible in all 6 EEC exposures.
Conclusions: Environmental exposure chamber appears to be closer to the natural exposure compared to conjunctival allergen challenge.

Keywords: Birch Allergy; Conjunctivitis; Conjunctival Allergen Challenge; Environmental Exposure Chamber

BEB6640: Analysis of Difference in Skin Ridge Density among Identical Twins

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Abstract. Introduction: Of all the methods of identification known to mankind till date, fingerprint has been the most successful as this method possesses all the major qualities of an effective identification medium.
The objective of my research was to analyse the ridge density among identical twins and to assess its potential as a tool for individual identification.
Materials and methods: This study was conducted among 30 pairs of identical twins. Impressions of the finger prints were made on a duly prepared proforma. A line was drawn from the delta to the core and ridge density was calculated by counting the number of ridges intersecting along the line in an area of 0.5cm x 0.5cm. Results were analysed by paired student's T-test using SPSS software version 18.
Results: The mean total ridge count of the first born twins was 12.34 and that of the second born twins was 14.23 (p value= 0.001). Mean ridge count among male pair of twins was 13.05 in first born twins and 16.07 in second born twins (p value= 0.000). Mean ridge density among male pair of twins was 10.77 in first born twins and 12.64 in second born twins (p value= 0.003).
Conclusion: There is a significant variation in ridge count and density in first born and second born among pair of monozygotic twins and thus these parameters can be used as a reliable source of identification among monozygotic twins.

Keywords: Identical Twins; Identification; Ridge Count; Ridge Density

BEB6643: Fluid-Structure Interaction Simulation of Tissue Degradation and Its Effects on Intra-Aneurysm Hemodynamics

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Abstract. Tissue degradation plays a crucial role in vascular diseases such as atherosclerosis and aneurysms. We present a novel finite element method-based approach to model the microscopic degradation of an aneurysmal wall due to its interaction with blood flow. The model is applied to study the combined effects of pulsatile flow and tissue degradation on the deformation and intra-aneurysm hemodynamics. Our computational analysis reveals that tissue degradation leads to a weakening of the aneurysmal wall, which manifests itself in a larger deformation and a smaller von Mises stress. Moreover, simulation results for different heart rates, blood pressures and aneurysm geometries indicate consistently that, upon tissue degradation, wall shear stress increases near the flow-impingement region and decreases away from it. These findings are discussed in the context of recent reports regarding the role of both high and low wall shear stress for the progression and rupture of aneurysms.

Keywords: Tissue Degradation; Aneurysm; Hemodynamics; Fluid-Structure Interaction (FSI)

BEB6498: The Laboratory of Applied Biotechnology-from 3D Bioprinted Meniscus to COVID-19 Immunodiagnostics

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Abstract. The topics of our research revolve around tissue engineering, 3D bioprinting, meniscus regeneration, and most recently, COVID-19 diagnostics. We are also actively participating in efforts directed towards the automation and robotization of biotech laboratories. Our mission is to venture beyond the boundaries of basic science and bridge academic discoveries with real-life applications. We strive to establish meaningful partnerships with both scientific and industrial entities to drive innovation in biotechnology.
3D bioprinting allows mimicking spatial characteristics of biological structures with the use of bioinks, composed mainly of biocompatible hydrogels. 3D bioprinting enables precise cell deposition while providing optimal conditions for cellular growth and proliferation. This technology is suitable for the creation of various models, reflecting tissue environment more precisely in comparison to monolayer cell cultures. Additionally, 3D bioprinting as a part of novel tissue engineering approaches offers a possibility to restore the physiological functions of an organ without resorting to artificial implants. Our main focus is to utilize 3D bioprinting for meniscus regeneration.
The main diagnostic tool utilized to detect ongoing infection with SARS-CoV-2 is based on the real-time polymerase chain reaction (RT-PCR), which detects viral genetic material in patients. It is a precise and reliable method to determine the carriers of the infection. Immunodiagnostics of COVID-19 is a crucial supplement for RT-PCR diagnostics, as the gradual development of herd immunity may affect policies employed to countermeasure the effects of the ongoing pandemic. Additionally, it will be crucial for the evaluation of the vaccines, including long-term immunity, and their efficacy against novel strains of the virus. Our team is focused on developing an in-house, high-throughput system for COVID-19 diagnostics, utilizing a robotic station and optimized ELISA.

Keywords: Applied Biotechnology; Bionanotechnology; 3D Bioprinting; Tissue Engineering; Covid-19 Immunodiagnostics

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BEB6475: Tio2 Anodic Nanotubes: Current Status and Prospects in Biomedical Applications

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Abstract. In the field of implant biomaterials, titanium and titanium-based alloys have proven to be ideal materials, due to their increased osseointegration and corrosion resistance. Moreover, their biological response is governed by the surface properties. Therefore, nanoscale surface modifications of these materials have received extensive focus especially as such surface modifications have led to improved biocompatibility and corrosion resistance [1,2].
Self-organized TiO_2 nanotubes obtained by electrochemical anodization have the advantage of a well controlled nanoscale topography, high aspect ratio and high surface area, directional charge, and ion transport properties, etc., which led to their widespread use in a multitude of applications. Anodization can also be used on a wide range of elements and alloys (Ta, Nb, Zr, TiZr, TiNb, Ti6Al7Nb, etc.) [1,2]. With respect to biomedical applications, this includes specific directions such as osseointegration, biosensors, antibacterial activity, drug delivery, mitigation of the inflammatory response, etc. [2,3] which are built on the excellent control over the morphology and nanotopography. Moreover, cells respond to the nanoscale dimensions of the surface and can be synergistically influenced by the nanotopograhy and by addition of growth factors [1,2,5].
Here we present the key anodic parameters that are necessary for establishing different nanotubular morphologies, as well as their effect on the top morphology of the nanotubes (initiation layer, open-top, nanograss). Moreover, the focus is on crucial aspects for tailoring the nanotube morphology for biomedical applications. We further discuss the key interactions with osteoblast cells or stem cells in *in vitro* tests (osteoblasts or stem cells in cell culture models), thus evaluating the use of various nanotubular structures in biomedical applications and their advantage for further use in biomedical applications, as well as future prospects with respect to drug delivery, osseointegration and tissue engineering.

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Keywords: Electrochemical Anodization; Tio_2 Nanotubes; Biomedical; Osseointegration

BEB6654: Renal Artery Embolization of Non-Functioning Graft: An Effective Treatment for Graft Intolerance Syndrome

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Abstract. Background: Percutaneous renal artery embolization is a valid non-invasive technique alternative to nephrectomy for patients with symptomatic non-functioning allograft (graft intolerance syndrome—GIS). The purpose of this article is to report the experience of our centre.
Methods: We analysed retrospectively 15 patients with symptomatic non-functioning renal allograft treated with percutaneous embolization from 2003 to 2017. Occlusion was obtained with the injection of calibrated microspheres of increasing size (from 100 to 900 μm) and completed with 5 to 8 mm metal coils placement in the renal artery.
Results: Technical success was achieved in all cases at the end of the procedure. Clinical success was obtained in 11 patients (73%). In four cases, nephrectomy was necessary: in one case because of septic fever and in three cases because of GIS persistence. In one case, it was possible to perform another procedure to embolize a perirenal collateral from a lumbar artery. Four patients (27%) reported minor complications which spontaneously resolved during the hospital stay.
Conclusions: According to the scientific literature, we believe that, in selected patients, percutaneous renal artery embolization is a valid treatment option for GIS thanks to its efficacy, repeatability, minimal invasiveness and the absence of severe complications.

Keywords: Graft Intolerance Syndrome; Embolization; Kidney; Renal Artery

BEB6670: Estimation of Stature by Percutaneous Measurement of Upper Arm Length Among Native Adult Population of Dakshina Kannada District

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Abstract. Aim: Stature estimation among native adult population of Dakshina Kannada district by percutaneous measurement of upper arm length. Objectives of the study: 1. To find out the correlation between stature and upper arm length 2. To derive a statistical model to estimate stature for the native adult population of Dakshina Kannada district, Karnataka. Materials and method: Upper arm length and stature of 200 adult subjects comprising of 100 males and 100 females in the age group of 19-39 years were measured separately on the left and right side of each individual with sliding calipers and stadiometer respectively. The collected data was analyzed using SPSS software to obtain the results. Results: The statistical analysis indicated that the correlations between the upper arm length and the stature in both males and females were statistically significant ($p<0.001$). Linear regression equations for stature estimation were formulated separately for left and right sides in both sexes. Conclusions: Upper arm length and stature are positively correlated with each other. Linear regressions equations derived from upper arm length can be reliably used for the estimation of the stature in the native adult population of Dakshina Kannada district and neighboring regions. From this study, left upper arm length is the best parameter for estimation of stature in both males and females.

Keywords: Regression Equation; Stature Estimation; Upperarm Length

BEB6685: Achillon Versus Open Surgery in Acute Achilles Tendon Repair

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The incidence of ruptured Achilles tendon appears to have increased over recent decades and optimal management of acute ruptures remains under debate. Open Achilles tendon repairs (OATR) are associated with high complication rates. Minimally invasive surgery (MIS) techniques like the Achillon Achilles tendon repair (AATR) were developed to reduce this. We performed a systematic review and meta-analysis to compare OATR with AATR and this presentation will outline our methods used, discussion and results with the aim of improving how we manage acute Achilles tendon rupture in the future.
Our literature search included all studies comparing the two techniques and resulted in eight studies suitable for inclusion totalling 443 patients. Outcomes assessed included overall complication rate, re-rupture, sural nerve injury, wound length, The American Orthopaedic Foot and Ankle Scores (AOFAS) and return to sports.
The overall complication rates were significantly reduced in the AATR group (5.2%) when compared with OATR (28.3%) however no significant differences were found in re-rupture rate, sural nerve injury, return to sports or AOFAS scores. The debate continues and patient specific factors play a part in deciding management but moving forward we believe AATR and other MIS techniques should be considered as an alternative in the treatment of Achilles tendon rupture.

Keywords: Achilles Tendon Rupture; Achilles Tendon Repair; Achillon; Minimally Invasive Surgery; Foot And Ankle Surgery

BEB6409: Pseudocapsule Thickness in Reproductive Surgery: A Further Possible Correlation between Submucous Fibroids and Fertility.

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Abstract. Uterine fibroid, during its growth, cause the progressive formation of a peripheral anatomical structure, a pseudocapsule. This structure originates from the fibroid compression of the surrounding myometrium and separates fibroid from the healthy myometrium. The pseudocapsule shifts the myometrial muscular fibers, maintaining the integrity and contractility of uterine musculature. Fibroid is structurally anchored to its pseudocapsule by connective bridges, but it lacks its own true vascular pedicle. Occasionally, bridges of collagen fibers and vessels anchoring fibroid to myometrium interrupting the pseudocapsule surface. Those physio pathological phenomena result in the formation of a clear cleavage plane either between myoma and the pseudocapsule, or between the pseudocapsule and the surrounding myometrium, as well. At the ultrastructural level, visualized by transmission electron microscopy (TEM), the pseudocapsule cells have the features of smooth muscle cells like the myometrium, indicating that the pseudocapsule is part of the myometrium

compressed by the myoma. Moreover, pseudocapsule is plentiful of collagen fibers, neurofibers and blood vessels, as a neurovascular bundle surrounding fibroid. Genetically, the pseudocapsule of the myoma has the same biological structure as the myometrium and the biochemical growth factors evaluation showed intense angiogenesis in pseudocapsule vessels. Angiogenetic factors identified in the pseudocapsule vessels are already widely involved in the physiology of the myometrium and these substances are thought to have a pivotal role in wound healing and muscular innervation. Myometrial wound healing is an interactive, dynamic process involving neuromodulators, angiogenetic factors, neuropeptides, blood cells, extracellular matrix, and parenchymal cells that follows three complex and overlapping phases: inflammation, tissue formation, and tissue remodeling. In the physiology of these processes, they also fit also nervous system and its neurotransmitters, as Substance P (SP), Vasoactive Intestinal Peptide (VIP), neuropeptide Y (NPY), Oxytocin (OXT), Vasopressin (VP), PGP 9.5, calcitonin gene-related peptide (CGRP), growth hormone-releasing hormone (GHRH). They play a role in mediating inflammation and wound healing, involved in physiology and scar repair in different tissues, including uterine muscle. In regenerative processes associated to pseudocapsule sparing, neuropeptides and neurotransmitters are speculatively involved also in wound healing. Moreover, growth factors present in the myoma pseudocapsule induce angiogenesis peripherally to myometrium. The intracapsular myomectomy can be done by laparotomic, laparoscopic, robotic, vaginal and hysteroscopic approach. The surgical benefit is visible during and after myomectomy: the bleeding is reduced, the myometrial anatomy is largely respected, the myometrial healing is preserved and enhanced, as confirmed by clinical and ultrasound investigations on scar site after intracapsular myomectomy. The study of the thickness of the pseudocapsule showed an increase in submucosal fibroids, compared to intramural and subserosal ones. This feature has a further impact on female reproduction to be investigated, as submucosal fibroids have been shown to negatively impact fertility.

BEB6652: Reinforcement Learning for Control of a Time-Varying, Fatigable Biomechanical Model of Spinal Cord Injury

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Abstract. Cervical spinal cord injuries (SCI) frequently lead to tetraplegia. Functional electrical stimulation (FES) can elicit contractions in paralysed muscles, restoring some functional movements to people with paralysis. However, chronic paralysis causes muscles to become weaker and more fatigable, which can limit the effectiveness of FES systems. In this study, we explore the feasibility of using reinforcement learning (RL) to train deep neural networks (DNN) to control FES systems for restoring motor function in fatigable, time-varying biomechanical systems. Recent studies have demonstrated that RL-DNNs can successfully control non-fatigable biomechanical arm models to precisely reach to targets. Because RL-DNN controllers can be trained quickly and automatically, they could potentially expand the clinical adoption of FES neuroprostheses. However, current RL-DNN controllers converge to high muscle activations, which may result in suboptimal control of highly fatigable, chronically paralysed muscles. Here, we developed a fatigable biomechanical arm model to explore the impact of fatigue on RL-DNN controller performance. We estimated model parameters to approximate the biomechanics of healthy controls, as well as the biomechanics of people with chronic SCI before and after FES exercise. Also, we implemented an intermittent training paradigm that included resting intervals in order to optimize controller performance. Our

simulations confirmed that RL-DNN controller performance was negatively impacted by fatigue. Also, FES exercise improved controller performance, but FES exercise alone was insufficient to counteract controller training paradigms that used high muscle activations. However, the simulations also suggested that an optimized intermittent training paradigm could result in effective control of highly fatigable biomechanical systems. Our results support the use of RL-DNN controllers to restore upper-limb motor function to people with SCI.

Keywords: Reinforcement Learning; Functional Electrical Stimulation; Biomechanical Modelling; Spinal Cord Injury; Time-Varying Control

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Oral Session 6: H2020 BAMOS - Biomaterials and Additive Manufacturing for early intervention of osteoarthritis

Keynote Speech: Toward Realisation of Early Treatmetn of Osteoarthritis: Clinical Specification, Requirement and Translation

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Abstract. Osteoarthritis (OA) is a degenerative joint disease, typified by a loss of quality of cartilage and changes in bone at the interface of a joint, resulting in pain, stiffness and reduced mobility[1, 2]. It is one of the most revalent chronic conditions as identified in Bone & Joint Decade. According to the World Health Organisation, 40% of people over 70 years old have OA. This joint disease affects around 0.4 billion people's life, with patients in Europe accounting for up to 30%. Patients with OA often suffer pain, loss of mobility and go on to require an end stage total joint replacement.
The current state of the art in terms of medically necessary surgical intervention of large cartilaginous defects (greater than 1.5 square cm) is autologous chondrocyte implantation (ACI). This is two stages surgical procedure, the associate costs and infection are the main concern; For small osteochondral defects, microfracture (MF) marrow stimulation is considered medically necessary treatment. However, MF produces fibrocartilage not native hyaline cartilage [3].
The treatment of cartilage defects remains a challenge because treatments to date have failed to achieve a complete restoration of the joint cartilage surface and its properties. However, none of these products promote satisfactory durable regeneration of large osteochondral defects.
In order to address this challenge, we have invented a novel biomimetic osteochondral scaffold system for repair of large osteochondral defects. The in vivo sheep condyle model and clinical dog shoulder model have demonstrated that bone can ingrowth into the bone section of the scaffold achieving a stable mechanical fixation that provided strong support to the overlying cartilage healthy growth. The novel osteochondral scaffold technology is being evaluated in first in man clinical study. It is expected that this novel biomimetic osteochondral scaffold that will bridge the gap between small osteochondral defect treatment and joint replacement. It gives clinicians a viable treatment option in situations where the osteoarthritis has progressed beyond a small defect, but where a full joint replacement could still be avoided.

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BEB6693: Modelling Methodologies for the Mechanical Simulation of Polymeric Scaffolds obtained by Material Extrusion Additive Manufacturing

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Abstract. The material extrusion additive manufacturing (AM) results in porous structures, which are desired in tissue engineering. Most scaffolds are 3D printed, but there are several methodologies to model these printed parts and to estimate their mechanical behaviour by finite element analysis (FEA). In this work, two different approaches are defined and compared in terms of computational efficiency, dimensional accuracy, and mechanical behaviour prediction of printed parts: geometry-based and voxel-based modelling techniques. Both methodologies are applied in a real scaffold, starting from the manufacturing G-code file, and FEA was applied to the resulting models. The results of the compression tests and dimensional measurements were compared with experimental and theoretical data. Moreover, the time and CPU requirements were also studied to determine which methodology is more suitable for each application. In terms of scaffolds manufacturing, the geometry-based modelling methodology is a more efficient process for simple parts, such as rectilinear patterned scaffolds, while the voxel-based one is more advantageous for complex geometries, such as gyroids. The whole process, modelling and simulation, is useful to optimise parts before printing.

Keywords: Tissue Engineering; Scaffold; Material Extrusion Additive Manufacturing; 3D Geometry Modelling; Finite Element Analysis; Mechanical Properties

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BEB6704: Development of Carbon Nanotubes-Reinforced Cell-Derived Matrix-Silk Fibroin Scaffolds for Bone Tissue Engineering

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Abstract. The bone tissue engineering approaches have been focused on mimicking bone tissue structure, composition, and hierarchy. With this in mind, the present work's main goal was to produce an improved scaffold that mimicked bone tissue structure, mechanical properties, and composition. For that, silk fibroin was mixed with decellularized cell-derived extracellular matrix and strengthened with carbon nanotubes. Then, enzymatic cross-linking, freeze modeling, and

decellularization methods were combined to create carbon nanotubes-strengthened cell-derived matrix-silk fibroin scaffolds. The evaluation of carbon nanotubes-strengthened cell-derived matrix-silk fibroin scaffolds' structure and mechanical properties showed that scaffolds were elastic, presented pore sizes of ≈ 112 ± 22 μm, a total porosity of ≈ 75 ± 3%, and stiffness of ≈ 5 kPa. After, their in vitro bioactivity was investigated, showing the formation of mineral deposits.
The biological evaluation *in vitro* revealed that scaffolds supported the adhesion, spreading, the proliferation of human adipose-derived stem cells (hASCs). Ultimately, developed carbon nanotubes-strengthened cell-derived matrix-silk fibroin scaffolds promoted the differentiation of hASCs along the osteoblastic lineage without the need for an osteogenic supplemented medium. This positive influence was confirmed by collagen secretion, increased ALP activity, and expression of osteogenic-related genes (e.g., ALP, Runx-2, Col Iα, and OPN). Furthermore, carbon nanotubes-reinforced cell-derived matrix-silk fibroin scaffolds were hemocompatible and enabled the infiltration of cells.
Overall, these favorable results confirmed that the developed carbon nanotubes-strengthened cell-derived matrix-silk fibroin scaffolds hold an excellent promise for bone tissue engineering scaffolding applications.

Keywords: Bone Tissue Engineering; Hierarchical Scaffolds; Decellularized Cell-Derived Matrix; Carbon Nanotubes; Silk Fibroin.

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BEB6705: Using Anatomy to Define and Enhance Interfacial Tissue Engineering

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Abstract. Traumatic injury and pathology frequently affect musculoskeletal interfaces, such as the osteotendinous/osteoligamentous (enthesis) and osteochondral junctions. Surgical reconstructions are often unfeasible or heal inadequately, and tissue engineered replacement or augmentation grafts offer enhanced and novel treatment options. Interfacial tissue engineering (ITE) is the challenging discipline aiming to replace or regenerate such interfaces between tissue types of distinct

biochemical and biomechanical properties. The translational potential of *in vitro* ITE models is however hampered by neglection of anatomically relevant proportions, structural relationships and *in vivo* interconnectivity. One common and debilitating interfacial injury with unsatisfactory surgical outcomes is bony avulsion of the deep flexor tendon in the finger. We have designed a 3D *in vitro* replicate co-culture model of this tendon-bone insertion with enhanced clinical applicability as an insertable graft or region-specific laboratory enthesis model informed by real human morphometric data. Morphological features crucial to biomechanical function, such as the shape, size and surface area of the interface and tendon fibre attachment angle, were defined through in-depth analysis of cadaveric anatomy and histology. These dimensions were integrated into the ITE design via a silicone impression system of 3D printed molds, directing formation of a fibroblast-seeded fibrin hydrogel tendon component attached to an osteoblast-seeded ceramic bone component. This culture system has also been incorporated into a bioreactor, where mechanical loads aim to mature and improve interfacial strength. This enhanced translational approach to medical device design through appreciation of constituent and surrounding anatomy is now also being applied to other interfacial regions, including the shoulder rotator cuff.

Keywords: Interfacial Tissue Engineering; Enthesis; Bioengineered Scaffolds; Co-Culture; Anatomy; Histomorphology.

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BEB6706: Preclinical Evaluation of A Novel Osteochondral Scaffold Showed Enhanced Bone and Cartilage Regeneration

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Abstract. INTRODUCTION: Treatment of large osteochondral defects presents an unmet clinical need in orthopaedics. This study investigated the efficacy of a multi-layered osteochondral scaffold for repair of large defects in vivo using sheep condyle model. In addition, the effect of bone marrow concentrate (BMC) as a source of growth factors and stem cells1 was evaluated in conjunction with the osteochondral scaffold.
METHODS: The multi-layered scaffold was fabricated using additive manufacturing techniques. A collagen/hydroxyapatite scaffold was used as control. 24 sheep were randomly assigned to one of the four treatment groups: scaffold ± BMC and control ± BMC. The tissue was retrieved 6 months post-operation. Bone regeneration was evaluated using μCT, while cartilage regeneration and quality were examined macroscopically (modified ICRS) and by histology and gene expression. Gait was examined pre-operation and before termination.
RESULTS: Gross evaluations of the joint showed minimal to slight reactions for all groups. Regenerated cartilage was not macroscopically different between the groups, however, a significant upregulation of mRNA for type-II collagen showed an enhance cartilage quality with the novel

scaffold. μCT data revealed that the bone ingrowth was higher in the scaffold group, while bone voids remained in the control groups. Gait parameters were not affected by the choice of the treatment.
CONCLUSIONS: Collectively, these data illustrate that the novel scaffold support bone ingrowth and a hyaline-like cartilage formation. Our results indicated that the addition of BMC to scaffold has some potentially beneficial effects on tissue regeneration but not on the functional endpoint of orthopaedic interest.

Keywords: Osteoarthritis; Osteochondral Scaffold; Biomaterial; *In Vivo* Evaluation.

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BEB6714: Three-dimensional Printed Hydroxyapatite/Polyether-ether-ketone Scaffolds for In-growth and Bonding of Soft Tissue

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Abstract. The poor bonding with soft tissue presented one of the major challenges in the application of PEEK in orthopaedic implant, which mainly contributed by its chemical inertness. In this study, the effect of HA content and geometry dimension of HA/PEEK scaffolds on the bonding ability with soft tissue was investigated. PEEK scaffolds with different HA contents and pore size was fabricated by fused filament fabrication (FFF), then the surface topography, porosity and pore size were characterized. Animal experiments were conducted to investigate the effect of material and porous structure on the adhesion and bonding between soft tissue and PEEK-based implant. The results demonstrated that the bonding strength depends mainly on the geometry dimension which also showed a certain effect on the adhesion of soft tissue on the scaffolds. The material component was confirmed to make little contribution to the bonding strength but only affect the adhesion of soft tissue. The maximum separating force reached 5.61 ± 2.55 N which was even higher than that of the strength of natural soft tissue. The present study provides a basis for the design and additive manufacturing of implants with PEEK-based composites and gradient porous structure.

Keywords: Polyether-Ether-Ketone Composites; Three-Dimensional Printing; Porous Scaffolds; Soft Tissue

BEB6715: 3D Printing PEEK Flexible Implant For Chest Wall Reconstruction

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Abstract. Rigid metallic implants used for the chest wall reconstruction disrupt the deformability of the complete thoracic cage, and seriously affect the postoperative respiratory. The failure reason mainly neglected the functional role of natural costal cartilage. In this study, a novel 3D printing PEEK flexible implant was designed by the bionic spring structure in the different rib segments. The mechanical properties of flexible implant under the stimulated chest compression were analyzed by the finite element method, and compared with rigid implant. The implant samples were fabricated by fused deposition modeling technology to carry out experimental evaluation under the chest compression, impact testing and fatigue testing. The results show the flexible implant meet strength demand in the chest compression and exhibit similar stiffness to natural thorax tissue. The maximum impact force reached to 536 N without the protection of soft tissue. The fatigue failure mechanism of complete flexible implant was revealed from the initiation of interlaminar crack to continuous crack propagation until fracture in a zigzag manner. Therefore, the flexible PEEK implant provided these advantages of perfect replication of thoracic shape, reliable safety, and great deformation capacity to response respiratory movement, which given a superior choice for chest wall reconstruction.

Keywords: Flexible PEEK Implant; 3D Printing; Mechanical Properties; Chest Wall Reconstruction

BEB6716: 3D-printed Porous PEEK-based Composites Implant for Paranasal Augmentation

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Abstract. Paranasal augmentation is a popular procedure to correct midface concavity with the placement of implants in the paranasal area. However, problems such as unsatisfactory aesthetic result, bone resorption and implant migration remain due to little awareness of implant design and biomechanical analysis. This study provided a novel paranasal augmentation method using 3D-printed porous PEEK/BasiO_4 implant and estimated the effect of preload and pore size on the mechanical behavior of implant and bone. Guided by three criteria including anatomical fit, mechanical matching and long-term stability, the personalized implants were designed and fabricated by additive manufacturing technology to reconstruct the depressed area of maxilla. Biomechanical analysis of the implantation and three-dimensional soft tissue change after augmentation were investigated through finite element method. As the preload increased, the von Mises stress on bone

and the implant increased significantly, while the changing in pore size had little effect. Bone fracture and bone atrophy occurred when the preload torque exceeded 0.09Nm. Finally, 0.05 Nm preload torque and 600 μm pore size were chosen with safety factor larger than 1.5 and effective interfacial bone growth area more than 90%. This method was used to treat five patients clinically and got good postoperative performance.

Keywords: Paranasal Augmentation, PEEK Implant, Biomechanical Analysis, Individualized Design

BEB6699: Mg-Doped Mesoporous Bioactive Glass Nanofibrous Scaffold Adsorbed with Matrix Fusion Protein for Bone Defect Repairment

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Abstract. Mesoporous bioactive glass (MBG), a potential biomedical material, has good bioactivity, biocompatibility, and osteoinduction properties in bone defect repairment. Here we report that 3:1 Ca/Mg ratio in Mg-doped MBG scaffold (MBG-Ca/Mg-3) is good for osteoblast differentiation and mineralization. Osteocalcin-Osteopontin-Biglycan (OOB), a new matrix fusion protein, adsorbed in MBG-Ca/Mg-3 to form OOB@MBG-Ca/Mg-3 scaffold through electrospinning to mimicking bone extracellular matrix structure. This kind of scaffold has multifunctional ability in calvarial bone defect repairment *in vivo*. Interestingly, OOB@MBG-Ca/Mg-3 scaffold could enhance the expression of osteoblastic marker genes, including *Bone morphogenetic protein* (*Bmp2*), *Osteopontin* (*Opn*), *Osterix*, *Runx2* through activation of Erk1/2. In conclusion, OOB@MBG-Ca/Mg-3 scaffold enhance osteoblast differentiation and mineralization through Erk1/2 pathway *in vitro* and it could also promote bone formation *in vivo*, that provides a new biomaterial in bone defect repairment.

Keywords: Mg-Doped MBG; OOB Protein; Nanofibrous Scaffold; Erk1/2 Pathway; Bone Defect Repairmen

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BEB6452: Computational Prediction of Contact Pressure for Different Sizes of Knee Implants in Total Knee Replacement

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Abstract. Clinical and laboratory testing of knee implants are highly expensive and the time frame for testing is not practical most of the time. Finite element techniques are a good alternative to laboratory testing provided that the numerical model is well established to approximate results close

to laboratory results. In this paper, a fixed-bearing knee implant developed by Adler Ortho company has been considered for static analysis using Abaqus for seven different implant sizes. The purpose of the analysis is to study the variation of contact pressure with the implant size at the articulating surfaces of the knee implant. SolidWorks was used to model the knee implants according to dimensions obtained for Adler Ortho knee implants. A linear elastic model for Ultra High Molecular Weight Polyethylene (UHMWPE) tibial insert was used for the analysis. The penalty stiffness model was used to define friction between CoCrMb (Cobalt-chromium molybdenum alloy) femoral component and the top surface of the polyethylene insert. A reference point was created on which boundary condition was applied to restrict the rotation of the femoral component against the bearing. Furthermore, the polyethylene bearing was fixed by applying an encastre boundary condition. Static analysis was carried out for concentrated loads of 300 N and 400 N for each of the sizes. The range of contact pressure for 300N is from 0.573 MPa to 0.4296 MPa. The contact pressure is maximum for size 1 and minimum for size 7. Overall, a decreasing trend for contact pressure is observed as the size is increased except for size 2. A similar trend was observed for 400 N with contact pressure ranging from 0.697 MPa to 0.523 MPa. The results show that for the same load, a larger implant will have a greater area of contact due to which the contact pressure will be lower as compared to that in a smaller implant.

Keywords: Total Knee Replacement; Fix Bearing Knee Implants; UHMWPE

Part II – Poster Presentations

BEB6094: RNA-Based Artificial Fish Swarm Algorithm for Edge Detection of Medical Images

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Abstract: This study aimed to propose the ribonucleic acid (RNA) with the artificial fish swarm algorithm (RNA-AFSA) optimization method for edge detection of medical images. The gradient matrix of the gray image pixels was obtained based on the medical image matrix, and RNA-AFSA was applied to search for the maximum of gradient to achieve edge detection of medical images. RNA-AFSA introduced RNA conversion, recombination, and substitution in the later stage of AFSA operation, improving fish swarm diversity and quickly jumping out of local optimization. The simulation results demonstrated that the proposed RNA-AFSA was an effective method for edge detection of medical images.

Keywords: Conversion; Recombination; RNA; Substitution; Medical Images; Edge Detection

BEB6129: Liver Vessel Segmentation based on Inter-Scale V-Net

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Abstract. Segmentation and visualization of liver vessels is a key task in preoperative planning and computer-aided diagnosis of liver diseases. Due to the irregular structure of liver vessels, segmentation of liver vessels is a challenging task. This paper proposes a method of liver vessel segmentation based on improved V-Net network. Firstly, we introduce dilated convolution to the network, so that the network can still enlarge the receptive field without reducing down-sampling as well as save detailed spatial information. Secondly, we introduce the 3D deep supervision mechanism in the network to speed up the convergence of the network and help the network learn better semantic features; Finally, we design inter-scale dense connections in the decoder of the network to prevent the loss of high-level semantic information during the decoding process and effectively integrate multi-scale feature information. In order to verify the effectiveness of the above method, we perform liver vessel segmentation experiments on the public dataset 3Dircadb and the clinical dataset. The experimental results show that this method can automatically and accurately segment the labeled or even unlabeled liver vessels from the CT image, which can be used for liver surgery planning.

Keywords: Liver Vessel; V-Net; Dilated Convolution; 3D Deep Supervision Mechanism; Inter-Scale Dense Connections

Acknowledgements: This work is supported by the Fund for the Open Project of the Key Laboratory of Medical Imaging (80119008).

BEB6325: Intelligent Immune Clonal Optimization Algorithm for Pulmonary Nodule Classification

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Abstract. Computer-aided diagnosis (CAD) of pulmonary nodules is an effective approach for early detection of lung cancers, and pulmonary nodule classification is one of the key issues in the CAD system. However, CAD has the problems of low accuracy and high false-positive rate (FPR) on pulmonary nodule classification. To solve these problems, a novel method using intelligent immune clonal selection and classification algorithm is proposed and developed in this work. First, according to the mechanism and characteristics of chaotic motion with a logistic mapping, the proposed method utilizes the characteristics of chaotic motion and selects the control factor of the optimal chaotic state, to generate an initial population with randomness and ergodicity. The singleness problem of the initial population of the immune algorithm was solved by the proposed method. Second, considering on the characteristics of Gaussian mutation operator (GMO) with a small scale, and Cauchy mutation operator (CMO) with a big scale, an intelligent mutation strategy is developed, and a novel control factor of the mutation is designed. Therefore, a Gauss-Cauchy hybrid mutation operator is designed. Ultimately, in this study, the intelligent immune clonal optimization algorithm is proposed and developed for pulmonary nodule classification. To verify its accuracy, the proposed method was used to analyze 90 CT scans with 652 nodules. The experimental results revealed that the proposed method had an accuracy of 97.87% and produced 1.52 false positives per scan (FPs/scan), indicating that the proposed method has high accuracy and low FPR. Keywords: computer-aided diagnosis (CAD), pulmonary nodule, immune clonal selective, feature selection, classification

BEB6414: Test-retest Reliability of Static Postural Balance Variables in Natural and Feet-together Stance Conditions

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6469: The Fabrication of a Microfluidic Tumor-on-a-Chip Model for Personalized Cancer Therapy

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Abstract. Current two-dimensional and animal models are insufficient in reproducing the tumor microenvironment effectively, exacerbating the low turnout for the clinical use of anti-cancer drugs. These models lack the three-dimensional human tumors' biophysical and biochemical aspects as well as intratumoral heterogeneity – factors that cause each person's tumor to be unique and allow cell

therapeutic response to vary drastically within a tumor. Therefore, this project hopes to characterize phenotypic heterogeneity in a more accurate, efficient, and cost-effective tumor model. A microfluidic polydimethylsiloxane tumor-on-a-chip was designed to replicate a three-dimensional tumor microenvironment, incorporating model blood vessels and embedded A549 cell spheroids. The project paired this reusable 3D-printed microfluidic device with computer vision to characterize phenotypic heterogeneity spatiotemporally. The specific factors of cell cycle patterns, spatial patterns, cell size, and motility were analyzed through light and fluorescence microscope images to evaluate tumor aggressiveness and identify tumor subtypes in a tumoroid. Heterogeneity was successfully identified in the tumor-on-chip device through 82 tumoroid trials. Significant differences were found in cell diameters, cell motility, cell cycle, and spatial patterns compared to control flasks and between cell subtypes to identify significant subtypes. Compared to the industry standard of petri dishes and animal models, these results demonstrate that an independently-forming three-dimensional tumor model could be created, providing an optical lens to the tumor microenvironment. The tumor-on-chip allows for a more ethical and cost-effective model to study cancer. This device paired with subtype identification can test therapeutics against patient-derived cells to create personalized therapy for patient subtypes.

Keywords: Tumor Heterogeneity, Microfluidics, Oncology, Computer Vision

BEB6474: Analysis of the Effect of the Difference Between Standing and Sitting Postures on Neck Proprioception using Joint Position Error Test.

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Abstract. BACKGROUND: The proprioceptive sense is a very important function for the body, and JPET is commonly used to measure it.
OBJECTIVE: This study was to analyze the difference of proprioception in standing and sitting postures through joint position error test.
METHODS: A total of 60 students (M/F, 12/48) in D University in Gyeongsangbuk-do, South Korea participated in this study. A joint position error test (JPET) was performed with the subject's eyes closed to assess the neck proprioception. The movement of the neck was measured in flexion, extension, and lateral flexion, and separately measured when sitting and standing. The difference in repositioning errors between sitting and standing postures was analyzed using paired t-test.
RESULTS: There was a significant difference in repositioning errors between sitting and standing posture in neck extension. There was no significant difference in repositioning errors between sitting and standing posture in neck flexion and lateral flexion.
CONCLUSIONS: In conclusion, in sitting posture, posterior neck muscles are used more than in standing posture, which may negatively affect the proprioceptive accuracy of the neck and may also increase the neck repositioning errors.

Key words: Joint Position Error Test; Proprioception; Posture

BEB6491: Baduanjin Exercise for Lumbar Disc Herniation: A Systematic Review and Meta-analysis

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6492: In vivo Estimation of Human Breast Cancer Tissue Volume in a Subcutaneous Xenotransplantation Mouse Model Using a High-sensitivity Fiber-based THz Scanning Imaging System

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Abstract. Absorption contrast between the terahertz (THz) frequency range of fatty and cancer tissues allows cancer diagnosis by THz imaging. We successfully demonstrated the ability of THz imaging to measure small human breast cancer volume in a subcutaneous xenotransplantation mouse model even without external comparison. We estimated the volume detection limit of the fiber-based THz scanning imaging system using a highly sensitive cryogenic-temperature operated Schottky diode detector to be smaller than 1 mm^3, thus showing the potential application of this technique in preliminary early cancer diagnosis.

Keywords: Thz Absorption Spectra; Imaging; Mouse; Breast Cancer

BEB6724: Anticancer Effects of Two Oleanane-type Triterpenoid Saponins from Ardisia lindleyana D.Dietr in Vitro

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6516: Research on Strategies of Home Care and Intervention for Stroke Based on Knowledge Rules

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6517: Arrhythmia Classification using Deep Residual Neural Networks

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6564: Cutaneous Leishmaniasis in Male Schoolchildren in the Upper and Lower Dir Districts of Khyber Pakhtunkhwa, and a Review of Previous Record in Pakistan

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Highlights

Present study revealed a noticeable incidence of cutaneous leishmaniasis (CL) in 113 male schoolchildren studied in nineteen schools of the Upper and Lower Dir districts of Khyber Pakhtunkhwa, Pakistan.

Out of 8,833 studied schoolchildren, CL infected local and Afghan refugees schoolchildren were 100 and 13, respectively.

The CL clinico-epidemiology of infected schoolchildren were *L. tropica*-associated.

Previous records revealed the abundance of *L. tropica* in Pakistan: dry mountains and plateaus in the northwestern and southwestern regions were CL foci.

Abstract. Documented reports are limited, showing cutaneous leishmaniasis (CL) as a severe threat to schoolchildren in Pakistan. The present study aimed to investigate the clinico-epidemiology and associated risk factors of CL in local and Afghan male schoolchildren between 6 and 16 years of age. The experimental strategy involved a questionnaire for the collection of information and clinical diagnosis (microscopy and semi-nested PCR) of 113 CL symptomatic schoolchildren out of 8,833 schoolchildren (7,175 local and 1,658 Afghan refugees) studying in nineteen schools of the Upper and Lower Dir Districts, Khyber Pakhtunkhwa, Pakistan. Previous records of CL in Pakistan was studied, and spatial analysis was performed on elevation and agro-ecological maps using Arc-GIS v10.3.1. Active lesions were found predominant (1.2%: cutaneous lesions, 86%, and mucocutaneous lesions, 14%) than scars (0.2%). Active lesions of both local (88%) and Afghan refugees (12%), and infected age groups were found significantly different. Majority of the lesions were dry (86.7%), single (73%), and frequently infecting facial region (52%). Avoiding bed nets, living in mud houses and animal shelters were highly associated with CL infection. Temergara (26.5%) and Rabath (12.3%) were hyperendemic CL foci. Microscopically, 63% cases were positive, while the PCR assay revealed *Leishmania tropica* in 97.3% cases. Previous record revealed that *L. tropica* is dominant throughout Pakistan, and dry mountains and plateaus of northwestern and southwestern regions are spatially at high risk. Measures should be taken to reduce CL infection by eliminating the associated risk factors, promoting PCR-based diagnosis and basic medical facilities.

Keywords: Cutaneous Leishmaniasis; Leishmania Tropica; Pakistan; Afghan Refugees; Schoolchildren.

BEB6600: Unreadable Segment Recognition of Single-lead ECG Signals based on XGBoost: Fusion of Shannon energy envelope and Empirical Mode Decomposition

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Abstract. The quality of ECG signals is commonly affected by severe noise, especially for the single-lead ECG signals acquired from long-term wearable devices. Recognizing and ignoring these interfered signals can reduce the error rate of automatic ECG analysis system, and in addition, improve the efficiency of cardiologists. Based on XGBoost classifier, we propose an unreadable ECG segment recognition method using features extracted through Shannon Energy Envelope (SEE) and Empirical Mode Decomposition (EMD). An unreadable CarePatch^{TM} ECG patch database is established, containing 8169 readable segments and 6114 unreadable segments with a length of 10 seconds. The XGBoost with 5-fold cross-validation is applied and obtained an accuracy of 99.51+/-0.15%.. In conclusion, SSE and EMD features contribute to the unreadable segments recognition and alleviate the misdiagnosis of abnormal rhythms.

Keywords: Unreadable Segments; Single-Lead ECG; Wearable Devices; Xgboost

BEB6609: Hydrogen Emission Characteristics of Zr0.9Ti0.1Cr0.6Fe1.4 Alloy under Different Temperature and Loading Conditions

To avoid repeatability issue, this abstract will be available after the full paper is published.

BEB6634: FallWatch: A Novel Approach for Through-Wall Fall Detection in Real-Time for the Elderly Using Artificial Intelligence

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Abstract. Falls are the leading cause of fatal injury in the elderly. Presently available fall-detection devices have many drawbacks including potential blind spots and low lighting, lack of privacy, and the need for the elderly to operate these devices despite cognitive decline. Radio frequency (RF) imaging presents a promising solution as it is able to traverse through most materials while remaining highly reflective off of humans. FallWatch was designed as an artificial intelligence model to detect falls in real-time in spite of visual obstruction using RF signals while overcoming the drawbacks of RF including low resolution imaging and body-part specularity. Using an RF antenna array, multiple fall and non-fall examples were captured through several mediums of obstruction in cross-person and cross-environment settings. The data obtained was trained on a deep learning model consisting of a: 1) Convolutional Neural Network to extract relevant information and capture spatial relationships, 2) Attention Mechanism to allow generalization to new people and environments, and 3) Recurrent Neural Network with Long Short-Term Memory to capture temporal relationships between RF frames. An Android app notified the caregiver when a fall occurred through a Message Queuing Telemetry Transport broker that transmits real-time data from the FallWatch setup to the app. FallWatch was successful in detecting falls not only in through-wall scenarios, but also in cross-person and cross-environment settings while surpassing the performance of other fall detection systems. In conclusion, FallWatch presents a novel end-to-end approach for fall detection in the elderly and enables their monitoring in multiple care settings.

Keywords: Fall Detection; Deep Learning; RF Imaging; CNN; Attention Mechanism; LSTM

BEB6639: Identification of Potential Micrornas and KEGG Pathways In Denervation Muscle Atrophy Based On Meta-Analysis

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Abstract. The molecular mechanism of muscle atrophy has been studied a lot, but there is no comprehensive analysis focusing on the denervated muscle atrophy. The gene network that controls the development of denervated muscle atrophy needs further elucidation. We examined differentially expressed genes (DEGs) from five denervated muscle atrophy microarray datasets and predicted microRNAs that target these DEGs. We also included the differentially expressed microRNAs datasets of denervated muscle atrophy in previous studies as background information to identify potential key microRNAs. Finally, we compared denervated muscle atrophy with disuse muscle atrophy caused by other reasons, and obtained the Den-genes which only differentially expressed in denervated muscle atrophy. In this meta-analysis, we obtained 429 up-regulated genes, 525 down-regulated genes and a batch of key microRNAs in denervated muscle atrophy. We found eight important microRNA-mRNA interactions (miR-1/Jun, miR-1/Vegfa, miR-497/Vegfa, miR-23a/Vegfa, miR-206/Vegfa, miR-497/Suclg1, miR-27a/Suclg1, miR-27a/Mapk14). The top five KEGG pathways enriched by Den-genes are Insulin signaling pathway, T cell receptor signaling pathway, MAPK signaling pathway, Toll-like receptor signaling pathway and B cell receptor signaling pathway. Our research has delineated the RNA regulatory network of denervated muscle atrophy, and uncovered the specific genes and terms in denervated muscle atrophy.

Keywords: Cell Biology; Genetics

BEB6656: Factors of Length of Stay Following Percutaneous Coronary Intervention: A Machine Learning Approach

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Abstract. Percutaneous coronary intervention (PCI) is one of the most frequently performed cardiology procedures. The length of stay (LOS) following PCI showed great influence on hospital management and medical resource utility. The aim of our study is to reveal key factors influencing LOS and develop a machine learning based model to predict in-hospital LOS following PCI to improve the utilization of medical resources.
A total of 2937 patients (age: 63.54 ± 10.45 yrs.) were included in the study who underwent the PCI procedure in Peking University First Hospital from January 2015 to October 2018. According to their LOS, patients were divided into three groups: short (LOS ≤ 3 days), medium (3 days < LOS ≤ 5 days), and long (LOS >5 days). Both clinical factors extracted from electronic health records and non-clinical factors, such as the day of week of the procedure date and the physician ID, were

considered into account in this study. After data cleaning and missing data filling, 149 variables were analysed among three LOS groups. Wilcoxon rank-sum test and Chi-square test were employed for differential analysis of numerical variables and categorical variables correspondingly. A random forest (RF) model was then established using variables with significant differences among three LOS groups.
We identified 25 numerical variables and 27 categorical variables with significant differences among three LOS groups. For clinical factors. we observed the common pattern that milder symptoms were related to shorter LOS. More importantly, we found that the non-clinical factor, the day of week of procedure date, showed the largest impact on LOS (FDR < 0.001) with the greatest mean decrease Gini in RF model. The LOS is noticeably shorter during Monday and Tuesday and longer from Wednesday to Friday, then decreases again at the weekend. The RF model developed with 52 significant variables showed predictation ability in three LOS groups with an accuracy of 0.66 and AUC of 0.73.
In conclusion, we found that day of week of procedure date, a non-clinical factor, has the highest impact on LOS among all factors including clinical factors. The RF model we developed could enable more efficient utilization of hospital resources by predicting the LOS in advance.

Keywords: Percutaneous Coronary Intervention; PCI; Length Of Stay; LOS; Machine Learning; Random Forest

BEB6659: Indocyanine Green Fluorescence Angiography: A New ERAS Item

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Abstract. The need to reduce complications rate and to improve patients' perioperative management espoused the introduction of the enhanced recovery after surgery (ERAS) programs. Another new revolutionizing facility is represented by Indocyanine Green (ICG). The Indocyanine Green (ICG) is a vital dye that when injected into a peripheral vein gives human blood fluorescence if excited with specific wavelength light in the near infrared (NIR) spectrum (820 nm). The fluorescence emitted by ICG can be detected using specifically designated scopes and cameras allowing surgeon to have a live, dynamic, and clear visual of tissue perfusion. ERAS protocol and indocyanine green fluorescence angiography (ICG-FA) represent the new surgical revolution minimizing complications and shortening recovery time in colorectal surgery.
The aim of our study was to assess whether the systematic evaluation of intestinal perfusion by ICG-FA could improve patients outcomes when managed with ERAS perioperative protocol, thus reducing surgical complication rate.
This is a retrospective case–control study. From March 2014 to August 2021, 362 patients underwent laparoscopic colorectal surgery for benign and malignant diseases. All the patients were enrolled in ERAS protocol. Two groups were created: Group A comprehended 203 patients managed within the ERAS pathway only and Group B comprehended 132 patients managed as well as with ERAS pathway plus the intraoperative assessment of intestinal perfusion with ICG-FA. Two board-certified laparoscopic colorectal surgeons jointly performed all procedures. thirteen (6.4%) clinically relevant anastomotic leakages (AL) occurred in Group A, while there was only three (2,2%) in Group B,

demonstrating that ICG-FA integrated in the ERAS protocol can lead to a statistically significant reduction of the AL. The prevalence of all other complications did not differ statistically between the two groups. Our study confirms that combination between ICG and ERAS protocol is feasible and safe and reduces the anastomotic leakage, possibly leading to consider ICG-FA as a new ERAS item.

BEB6171: Development of an Actuation System Applying of Hydrogen Storage Alloy for Rehabilitative System

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Abstract. In this study, an actuation system for rehabilitation is developed to drive the actuator using hydrogen storage alloy and to analyze the hydrogen release characteristics of the alloy. The system is developed as automatically control and report the pressure, temperature and hydrogen flow of inside the system. All the control of each sensor and part is used LabVIEW-based modules and LabVIEW software. $Zr_{0.9}Ti_{0.1}Cr_{0.6}Fe_{1.4}$ alloy was selected as hydrogen storage alloy. 5 MPa of hydrogen pressure was applied at 8.56 g of alloy powder for activation process and the temperature outside was maintained at 19 ℃ to 21 ℃. The amount of hydrogen absorption was measured about 1.47 wt%. The actuation test was conducted at the temperature from 25 ℃ to 80 ℃, increased by every 5 ℃. The actuation height was measured at each load of 5, 10, 15, and 20 kg. The voltage and current which is applied to peltier elements were set to 5.0 V and 2.5 A. The pressure changing in the system was checked for 5 min for each temperature, however, if the temperature at which the pressure inside the system changed, the time to heat the module was increased to 20 min. Hydrogen was first released at 70 ℃. The loads of 5 and 10 kg were raised by 87 and 19 mm at 70 ℃, respectively. At 75 ℃, loads of 5, 10 and 15 kg were raised by 131, 70, and 15 mm, respectively. At 80 ℃, 5, 10, 15, and 20 kg were raised by 150, the end of the actuator, 83, 55, and 28 mm, respectively. In future studies, it is necessary to conduct research for improving the quality of the alloy. The actuation system in this paper can be applied to assistive device and rehabilitation system for assisting the movement of daily life of socially underprivileged.

Keywords: Hydrogen Storage Alloy; Actuation System; Rehabilitative System; $Zr_{0.9}Ti_{0.1}Cr_{0.6}Fe_{1.4}$

BEB6678: A Single Centeropen-Lable, Self-Controlled Clinical Study of MEBO in the Treatment of Recessive Dystrophic Epidermolysis Bullosa

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Abstract: Epidermolysis bullosa is a rare skin disease characterized by tearing and blistering at the slightest touch. It usually is evident at birth, but forms with milder symptoms can become apparent later in life. Epidermolysis bullosa (EB) classified into three types based on the level of split in the skin as simplex, junctional and dystrophic . Patients with RDEB experience severe painful blistering and

skin fragility. It is a devastating blistering disease affecting skin and mucous membranes .The treatment of recessive dystrophic epidermolysis bullosa (RDEB) remains challenging. At present, treatment is mainly relief of symptoms. In this study, we had recruited six RDEB patients, Compared with the baseline, 6 patients with RDEB had good clinical outcomes.

Keywords: Dystrophic Epidermolysis Bullosa

BEB6707: How the Pain and Physiological Characteristics of the Trapezius Change when Winback Therapy is Applied to the Trapezius of Work-related Musculoskeletal Disorders

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Abstract. The purpose of this study was to investigate how the pain and physiological characteristics of the trapezius muscle change when Winback therapy is applied to the trapezius in people with work-related musculoskeletal disorders (WMSDs). The muscle tone, muscle stiffness, pressure pain threshold, and the visual analog scale (VAS) scores of the trapezius were measured before and after the application of Winback therapy to 30 adults with WMSDs. After Winback therapy, muscle tone decreased from 16.15±2.02 to 14.22±1.83, muscle stiffness decreased from 285.81±58.26 to 245.83±51.62, the pressure pain threshold increased from 62.58±23.28 to 79.38±28.27, and the VAS score decreased from 3.73±.73 to 1.01±.02. Winback therapy may therefore be effective in reducing muscle tone, muscle stiffness, and trapezius pain in people with WMSDs

Keywords: Winback Therapy; Muscle Stiffness; Pain

BEB6730: Detection of Paroxymal Atrial Fibrillation from Dynamic ECG Recordings Based on Residual Network

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Abstract. In this method, we used a deep learning model to detect the episodes of atrial fibrillation (AF). ECG data were dynamic recordings collected from 12-lead Holter or 3-lead wearable ECG monitoring device, which involved kinds of noise sources. Therefore, ECG recordings were firstly pre-processed through filters to eliminate the baseline wander and high-frequency noises. The

impulse noise was also taken into consideration and was totally removed. Pan Tompkins algorithm with correction mechanism was used to locate R peaks. ECG recordings were segmented by the positions of R peaks based on sliding window. Sliding step size was set to one cardiac cycle. Every ECG signal sample included three adjacent cardiac cycles and its time-duration was scaled to three seconds. The deep learning model was built based on residual network and Transformer encoding module structure. Here we used eight residual blocks with one layer Transformer encoder. The input of network was a series of ECG samples. The output was a sequence of 0 (represented for normal) or 1 (represented for AF). Due to one-cardiac-cycle step size, almost every rhythm was detected three times. Since the given data set was unbalanced, we added Gaussian noise into persistent AF recordings for data augmentation. We found that the performance of model apparently improved, as the balance was achieved between two kinds of samples. The locations of AF episodes were given out according to the label sequences. During the testing phase, the best score we have obtained was 1.8785.

Keywords: ECG Signal Processing; ECG Signal Classification; Deep Learning

BEB6733: 3D Bioprinting Technology: A New Biomedical Technology

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Abstract. Based on computer aided design (CAD/CAM), 3D printing technology is a new technology established and developed in the material science, mechanical engineering and other fields of mutual integration. In recent years, 3D printing technology has been widely applied in biomedical scaffold materials, clinical surgical design, artificial living tissue and organ, tissue and organ model making, drug production and screening, medical plastic surgery and other aspects. As an innovative technology, 3D printing has changed the way people think and provided a powerful tool for scientific research, and is expected to create huge social and economic benefits. Although 3D printing is widely used in biomedical field, it still needs a long way to go and faces many difficulties and challenges in its development process. First of all, it requires the improvement and establishment of industry standards, and the establishment of more standards, norms and systems to ensure the safety and effectiveness of customized medical devices. Secondly, the choice of biomaterials for 3D printing in the biomedical field is still limited. With the development of material science, especially the further combination of material science and cell biology, more biomaterials suitable for 3D printing will be developed and applied in the biomedical field. In addition, due to the particularity and rapid development of biomedical field, the efficiency and accuracy of 3D printing technology will be increasingly higher in the future, which requires further technical innovation of 3D printing technology. To sum up, 3D printing technology has high precision, fast construction speed and can be made on demand. It has a wide application space in biomedicine. In the future, IT will continue to penetrate into all aspects of biomedicine, open up personalized biomedical design and promote the qualitative improvement of medical level, and provide a broad space for human health.

Keywords: 3D Bioprinting Technology; Biomedical Scaffold Materials; Clinical Surgical Design