



LIBERTY

U N I V E R S I T Y

COLLEGE *of* OSTEOPATHIC  
MEDICINE

RESEARCH DAY

January 10, 2025

*Program & Abstracts*

Greetings and welcome to the 6<sup>th</sup> annual Liberty University College of Osteopathic (LUCOM) Research Day. LUCOM Research Day is designed to be a trainee-centric event providing students and early career professionals the opportunity to practice disseminating research and scholarly activity pertinent to the biomedical sciences.

I would like to thank you for your participation in this event. As an attendee, you will gain further insight into the scientific environment at LUCOM as you hear presentations from your colleagues and peers. Your participation and engagement will be an encouragement to our presenters as they continue to develop as professionals.

I would also like to acknowledge and thank Dr. Michael Price, Mrs. Barbara Lutz, and Mrs. Cassie Eubank for their tremendous effort in organizing the LUCOM Research Day event. Your efforts do not go unnoticed and we are thankful for your dedication to the mission and vision of LUCOM.

I wish you all a wonderful afternoon as we come together to support one another and build an exceptional academic environment at LUCOM.

“Therefore encourage one another and build another up, just as you are doing.”  
1 Thessalonians 5:11

A handwritten signature in black ink, appearing to read 'Joseph C. Gigliotti', with a stylized flourish at the end.

**Joseph C. Gigliotti, Ph.D.**  
*Director of Research and Special Projects*  
*Associate Professor and Chair*  
*Department of Physiology and Pharmacology*

## Program Overview

12:00 PM	Boxed lunch	Pick up in CMHS 1047
12:30 PM	Opening Prayer	Michael W. Neville, PharmD, BCPS, FASHP Asst. Dean for Admissions & Student Life
	Welcome & Opening Remarks	Michael S. Price, PhD Research Day Committee Chair
	Oral Presentations*	
12:35 PM	P01: Determining the efficacy of cholinergic agonists in attenuating renal ischemia reperfusion injury in mice.	Speaker: Tavin Smith (OMS-III) Mentor: Joseph C. Gigliotti
12:55 PM	P02: Modeling Ectopic Pregnancy in Murids	Speaker: Thomas Hall (Research Fellow) Mentor: RJ Swanson
1:15 PM	P03: Ongoing Purification Methods to Isolate and Identify a Large Molecular Weight Lethal Trauma Protein	Speaker: Clayton Goddard (OMS-III), Stephen Hanna (OMS-III) Mentor: Anthony Bauer
1:30 PM	P04: Panenteric Effects of the Cystic Fibrosis Corrector Drug Elexacaftor	Speaker: Wenyao A. Wu (OMS-II), Nana K. Yeboah (OMS-II) Mentor: Anthony Bauer
1:45 PM	P05: Exploring the Pathophysiological Effects of a Large Molecular Weight Lethal Trauma Protein Isolated from Skin and Skeletal Muscle	Speakers: Stephan Hanna (OMS-III), Clayton Goddard (OMS-III) Mentor: Anthony Bauer
2:00 PM	P06: Smoking and Parkinson's Disease: A Systematic Review on the Effect of Smoking on Parkinsons Disease Development	Speakers: Natasha Gaito (OMS-III), Sabrina Knudtson (OMS-III) Mentor: Charles Joseph
2:15 PM	BREAK	
2:30 PM	P07: Diet influences the immunopathology of acute kidney injury in mice	Speaker: Tabitha Hutchison (OMS-II) Mentor: Joseph Gigliotti
2:45 PM	P08: Dairy Withdrawal Pilot Study	Speaker: Evan T. Gaugler (OMS-II) Mentor: Mark E. Hemric
3:00 PM	P09: Prognostic Factors and Predictive Nomogram of Malignant Peripheral Nerve Sheath Tumor Patient Survival: A Population-Based Retrospective Surveillance, Epidemiology, and End Results Database Analysis	Speaker: Drew Thibault (OMS-IV) Mentor: Adeolu L. Olasunkanmi
3:15 PM	P10: Fight or Flight: Fact, Fiction, or Fabrication?	Speaker: Bryan Ashley (Anatomy Fellow), Austin Brown (OMS-III), Sean Verrier (OMS-III), Austin Lively (OMS-III) Mentor: Stany Lobo
3:30 – 5:00PM	Poster Presentations	CMHS Main Street & SIM Center

## Oral Abstracts

**P01: Determining the efficacy of cholinergic agonists in attenuating renal ischemia reperfusion injury in mice.**

**Category:** *Basic Science Research*

**Authors:** Tavin Smith (OMS-III), Joseph C. Gigliotti

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Introduction:** Acute kidney injury (AKI) is a significant source of morbidity and mortality among intensive care patients and is estimated to cause 2 million deaths worldwide. Clinically, AKI is primarily due to intra-renal insult, where ischemia-reperfusion injury (IRI) is a common cause. It has been found that cholinergic agonists activate an innate cholinergic anti-inflammatory pathway (CAP) leading to systemic anti-inflammation and the attenuation of renal IRI, and thus may prevent AKI. The ability to pharmacologically activate CAP and reduce systemic inflammation is of great clinical utility, however, the efficacy of cholinergic agonists has been challenged. We believe the discrepancies in the literature may be due to technical differences in the IRI model. Therefore, our goal is to establish a standardized renal IRI model and determine the optimal timing and dose of cholinergic agonist administration in the prevention of IRI.

**Materials and Methods:** All studies were performed in accordance with the animal protocols approved by the Liberty University Institutional Animal Care and Use Committee. 8-week-old male C57Bl/6 were purchased from a commercial vendor. Mice then underwent unilateral renal IRI (uIRI) using either ketamine/xylazine (KX) mixture or isoflurane (1.7% in room air). The duration of ischemia was 30 minutes. Mice were given a low, average, or high dose of nicotine (0.25, 0.5, 1.0 mg/kg) or GTS-21 (2, 4, 8 mg/kg) an hour before induction of ischemia. Another cohort of mice were given the optimized dose of either nicotine or GTS-21 at four different time points: 60 minutes prior to anesthetic injection, 15 minutes into ischemia before reperfusion, 60 minutes after reperfusion, or 360 minutes after reperfusion. Mice were euthanized a day later and kidneys harvested. Ischemic kidneys were processed for routine histology and/or mRNA expression of IL6.

**Results:** Previous work has suggested that anesthetic use during IRI can significantly influence disease severity. We compared morphological outcomes and renal IL6 mRNA expression following IRI with either K/X or isoflurane. Histological evidence of acute tubular necrosis and IL6 expression were not different between anesthetic groups in our laboratory. Preliminary studies with nicotine and the alpha-7 specific agonist GTS-21 supported reduced IRI in a dose-dependent manner.

**Conclusion:** Thus far, our model has demonstrated the renoprotective effect of cholinergic agonists in attenuating IRI. Studies are ongoing for dosing and time of administration. We hope to show that administration of cholinergic agonists during the ischemic period attenuates renal IRI and thus may hold significant clinical application.

## **P02: Modeling Ectopic Pregnancy in Murids**

**Category:** *Basic Science Research*

**Authors:** Thomas Hall (OMS-II), Swanson RJ

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, VA

### **Abstract:**

Ectopic pregnancy (EP) is a pregnancy resulting from implantation of an embryo outside of the uterus<sup>1</sup>, which in humans, occurs in the fallopian tubes over 98% of the time<sup>1</sup>. In animals, nearly all ectopic pregnancies recorded have been in the abdominal (peritoneal) cavity<sup>2</sup>.

All human tubal ectopic pregnancies (tEP) are life threatening to the mother by about 10 weeks due to rupture of the fallopian tube<sup>3</sup> and most are discovered from 6 to 10 weeks gestation<sup>4</sup>. No life-saving treatments for the fetus have been described<sup>5</sup>. No attempts could be found in the literature. Abdominal pregnancy rarely develops to term or near term<sup>6</sup>. Currently, there few animal models of ectopic pregnancy and none that faithfully represent the progression of the condition. This paucity of research has made it difficult to study the condition and even harder to develop novel, lifesaving treatments<sup>7,8,9,10</sup>.

Theories of the Pathogenesis of EP generally fall into two categories: either that the tubal transport of the embryo is inhibited (as seen with obstructions following pelvic surgeries and PID) or that the tubal environment is altered (as seen in endometriosis), leading to faulty signaling to the embryo to implant. Previous attempts at modeling EP in animals have included ligating the fallopian tube and placing an embryo within (to simulate obstruction) or ligating the tube and applying uterine fluid to the embryo<sup>11</sup>. Both of these attempts were unsuccessful. However, researchers have been successful in both transplanting sections of endometrium into the abdominal cavity of rats<sup>12,13,14</sup> and in getting embryos to attach to isolated endometrial cells *in vitro*<sup>15</sup>.

Based on this, we hypothesize that placement of sections of endometrium from the uterus into the fallopian tube, followed by placement of an embryo in the endometrial transplant will result in ectopic pregnancy at a rate significantly higher than in controls. Since tEP is exceedingly rare in animals, a success rate of 2% would satisfy this criterion. We will repeat this in separate animals, placing the endometrium in the abdominal cavity to simulate abdominal pregnancy

To accomplish this, we will superovulate a small number of female rats, mate them, and collect their embryos. In a separate group of female rats, we will surgically collect small sections of endometrium, transplant them into either the fallopian tube or the abdominal cavity, and place the embryos into the endometrial transplant. After about 5 days have elapsed for implantation and growth, the rats will be dissected and assessed for presence of an EP.

The IACUC has approved the research, # 99.240815: Modeling of Ectopic Pregnancy in Murids for three years.

### **Citations:**

1. Shaw JL, Dey SK, Critchley HO, Horne AW. Current knowledge of the aetiology of human tubal ectopic pregnancy. *Hum Reprod Update*. 2010;16(4):432-444. doi:10.1093/humupd/dmp057
2. Corpa JM. Ectopic pregnancy in animals and humans. *Reproduction*. 2006;131(4):631-640. doi:10.1530/rep.1.00606
3. Ashfaq S, Sultan S, Aziz S, Irfan MM, Hasan M, Siddique A. Ectopic Pregnancy With Tubal Rupture: An Analysis Of 80 Cases. *J Ayub Med Coll Abbottabad*. 2017;29(2):254-257.

4. Murray H, Baakdah H, Bardell T, Tulandi T. Diagnosis and treatment of ectopic pregnancy. *CMAJ*. 2005;173(8):905-912. doi:10.1503/cmaj.050222
5. NHS. Ectopic pregnancy - Treatment - NHS. <https://www.nhs.uk/conditions/ectopic-pregnancy/treatment/>. Updated August 21, 2024. Accessed August 21, 2024.
6. White RG. Advanced abdominal pregnancy--a review of 23 cases. *Ir J Med Sci*. 1989;158(4):77-78. doi:10.1007/BF02942151
7. PubMed. NIH, NCBI, terms: (ectopic pregnancy[Title]) AND (model[Title]), <https://pubmed.ncbi.nlm.nih.gov/?term=%28ectopic+pregnancy%5BTitle%5D%29+AND+%28model%5BTitle%5D%29&sort=>. Accessed 08/20/2024.
8. Popp LW, Gaetje R, Status S, Lierse W. A rabbit model for the evaluation of minimal access treatment of ectopic pregnancy in humans, using intrachorionic injection and local hyperthermia. *Clin Exp Obstet Gynecol*. 1993;20(4):226-235.
9. Brown JK, Horne AW. Laboratory models for studying ectopic pregnancy. *Curr Opin Obstet Gynecol*. 2011;23(4):221-226. doi:10.1097/GCO.0b013e3283481212
10. Shaw JL, Dey SK, Critchley HO, Horne AW. Current knowledge of the aetiology of human tubal ectopic pregnancy. *Hum Reprod Update*. 2010;16(4):432-444. doi:10.1093/humupd/dmp057
11. Bronson R, Cunnane M. Transfer of uterine implantation blastocysts to the oviduct in mice. *Fertil Steril*. 1975;26(5):455-459. doi:10.1016/s0015-0282(16)41117-9
12. Pelch KE, Sharpe-Timms KL, Nagel SC. Mouse model of surgically-induced endometriosis by auto-transplantation of uterine tissue. *J Vis Exp*. 2012;(59):e3396. Published 2012 Jan 6. doi:10.3791/3396
13. Abdolmaleki A, Jalili C, Mansouri K, Bakhtiari M. New rat to mouse xenograft transplantation of endometrium as a model of human endometriosis. *Animal Model Exp Med*. 2021;4(3):268-277. Published 2021 Sep 3. doi:10.1002/ame2.12181
14. Jafarabadi M, Salehnia M, Sadafi R. Evaluation of two endometriosis models by transplantation of human endometrial tissue fragments and human endometrial mesenchymal cells. *Int J Reprod Biomed*. 2017;15(1):21-32.
15. Moore GD, Eddy CA, Pauerstein CJ. Rabbit endosalpinx inhibits implantation in vitro. *Fertil Steril*. 1992;57(4):902-907.

## **P04: Panenteric Effects of the Cystic Fibrosis Corrector Drug Elexacaftor**

**Category:** *Basic Science Research*

**Authors:** Wenyao A. Wu (OMS-II), Nana K. Yeboah (OMS-II), Clayton J. Goddard (OMS-II), Stephan L. Hanna (OMS-II), Xena Zelena Sawyer, Craig A. Hodges, Daniel C. Devor, Anthony J.M. Bauer

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Background and Aim:** The cystic fibrosis transmembrane conductance regulator (CFTR) is a membrane channel protein that acts as an anion channel that conducts chloride and bicarbonate ions across epithelial cell membranes. Interestingly, CFTR channels have been found to play a role in many cell types, including epithelial, neuronal, Schwann, endothelial, immune, and smooth muscle cells. Cystic fibrosis (CF) is caused by over 2000 different mutations in the CFTR channel, with nearly 90% of patients harboring the F508del mutation. Trikafta is a lifesaving, highly effective triple drug combination consisting of two trafficking correctors (Elexacaftor and Tezacaftor) and the channel potentiator Ivacaftor, which synergistically enhances CFTR membrane activity. However, these drugs produce significant side effects in approximately 20% of the patients. Common side effects include headaches, upper respiratory tract infections, abdominal pain, diarrhea, constipation, nausea, rash, dizziness, and mental health issues. Based on data from our group, Elexacaftor has demonstrated significant off-target effects on various potassium channels which could explain some of these adverse events. Therefore, we sought to characterize the panenteric motility effects of Elexacaftor using a murine model.

**Methods:** C57Bl/6 mice were used to assess *in vivo* upper gastrointestinal motility by orally feeding non-digestible FITC-dextran (70 kDa) and generating gastrointestinal transit distribution histograms with calculated geometric centers (GC) after 80 min. *In vitro* circular muscle contractility was measured from muscle strips dissected from the gastric antrum, jejunum, proximal pellet-forming region of the colon, and middle colon in a standard organ bath. *In vivo* telemetry pressure measurements were also recorded from the middle segment of the colon.

**Results:** Combined Elexacaftor (5.97 mg/kg) and Ivacaftor (3.92 mg/kg) given at clinically relevant dosages intraperitoneally 30 minutes before the assessment of gastrointestinal motility demonstrated a delay in gastrointestinal transit distribution histograms with a calculated geometric center of  $8.8 \pm 0.37$  compared to control  $10.4 \pm 0.6$  (N=4,  $p < 0.05$ ). *In vitro* Elexacaftor (10  $\mu$ M) caused a slight excitatory effect on the gastric antral circular muscle, but a transient inhibitory effect on jejunal circular muscle contractions. *In vivo* colonic telemetry pressure measurements were also reduced in response to the intraperitoneal injection of low dose Elexacaftor (1.5 mg/kg). Interestingly, *in vitro* circular muscle contractions from the proximal pellet-forming region of the colon were nearly abolished by Elexacaftor (10  $\mu$ M) after a period of 20 minutes. However, giant clustered contractions of the middle colonic circular muscle were significantly increased in frequency in response to Elexacaftor (10  $\mu$ M) over a 10-minute period (control =  $4.2 \pm 0.33$  vs. Elexacaftor =  $8.4 \pm 0.61$ , N=5,  $p < 0.001$ ).

**Conclusion:** Each region of the gastrointestinal tract exhibited a distinct native motor pattern that was differentially altered by Elexacaftor. These data suggest that Elexacaftor has significant effects on gastrointestinal motility, which could explain the adverse events associated with the lifesaving pharmacological therapeutic effects of Trikafta in patients with cystic fibrosis.

## **P06: Smoking and Parkinson's Disease: A Systematic Review on the Effect of Smoking on Parkinson's Disease Development**

**Category:** *Systematic Review/Meta-analysis*

**Authors:** Sabrina Knudtson (OMS-III), Natasha Gaito (OMS-III), Charles Joseph

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

### **Abstract:**

Parkinson's disease (PD) is the second most common neurodegenerative disorder with 90,000 new patients diagnosed each year. This adult-onset neurological disorder was traditionally viewed as a motor disorder due to key symptoms such as tremor, rigidity, and bradykinesia. However, it is now being viewed as a complex disorder based on its multifocal neurologic involvement including cognitive decline, autonomic dysfunction, psychotic symptoms, and mood disorders. Although medications have been created along with various treatment guidelines, a cure has yet to be found and symptom management remains consistently elusive. A significant inverse relationship has been consistently identified between smoking and PD development as well as PD symptoms. One study observed that those who smoked had a 60% lower risk of developing PD. While the neural mechanisms are not yet fully understood, it is thought that nicotine specifically may play a role in decreasing the risk of developing PD. Extensive literature and data analysis was performed on journal articles from 2002 to date. Based on the current data, the inverse relationship between smoking and developing Parkinson's disease is likely due to confounding variables such as other chemicals found in cigarettes or underlying personalities of patients that develop PD which leads them to avoid novelty-seeking behaviors such as smoking. Further research is necessary to determine neuronal mechanisms induced by chemicals in cigarettes that may decrease the risk of PD development such as 2,3,6-trimethyl-1,4-naphthoquinone (TMN), an inhibitor of monoamine oxidase A and B activity, which has already been used in treatment of PD symptoms. However, based on the currently available research, it is likely that the correlation between smoking and PD is an association rather than a directly contributing factor that will be useful in the reduction of PD development.



## **P07: Diet influences the immunopathology of acute kidney injury in mice**

**Category:** *Basic Science Research*

**Authors:** Tabitha Hutchison (OMS-II), Riley Lutz, Joseph C. Gigliotti

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, VA

### **Abstract:**

Acute kidney injury (AKI) is a prevalent condition among hospitalized patients, significantly contributing to increased morbidity and mortality rates. Currently, no effective treatments for AKI have been discovered. Recent studies have found resazurin to be a *in vivo* biomarker for evaluating kidney function in mouse models of AKI. However, the relationship between diet and kidney health and function remains underexplored, particularly within AKI. Our laboratory has established that diet can profoundly influence kidney function. Our lab wanted to determine if resazurin was sensitive enough to detect the impact of diet alone on kidney function. Additionally, we wanted to determine how dietary factors may alter markers of kidney function and inflammatory response in the context of AKI.

All studies were performed in accordance to protocols approved by the Liberty University Institutional Animal Care and Use Committee. Weanling (three-week old) male C57Bl/6 mice were purchased from the Jackson Laboratory and allowed to acclimate for one-week (N=23). Mice were then randomly assigned diets (n=3/4) *ad libitum*. The diets included a commercially available chow, AIN-93G, high-fat diet (HFD), Western Diet (WD), and our novel Americanized diet (AD). The AD diet and Chow diet were additionally used for unilateral renal ischemia reperfusion injury (uIRI) study (N=6, n=3). Mouse body weights were recorded the day of diet assignment and again during the final week of study. Mice fed the AD and chow diet underwent uIRI using a ketamine/xylazine mixture (1 uL per 1 g BW with 10% overage). The duration of ischemia was 27 minutes. Mice were euthanized 24 hours later and the uIRI kidneys and control kidneys were harvested for histological assessment of AKI and flow cytometry. Cytological markers used for flow analysis were live/dead, CD11c, CD11b, LY6G, CD45, F480, LY6C, and CD103. Prior to euthanasia, mice from each diet were injected (*i.v.*, retro-orbital plexus) with resazurin solution in normal saline (100uL) (N=17, n = 3/4). Spot urine collection was performed 10 minutes after injection and urine concentration of resazurin metabolite (resorufin) was determined by spectrophotometric quantification (530 nm excitation, 590 nm emission) of 100 uL of diluted urine after sample dilution in PBS (1:100). Final concentration absorption values were corrected for urinary creatinine concentrations.

Preliminary results revealed that renal clearance of resazurin successfully detected a reduction in the renal tubular function in mice fed WD compared to those of the other diets. Additionally, flow cytometry analysis demonstrated reduced histological evidence of AKI and a 50% reduction in neutrophil infiltration in the kidneys of AD mice compared to those on a standard chow diet.

Data thus far support the hypothesis that resazurin is a sensitive biomarker for assessing renal function in the context of dietary influences. Our findings suggest that diet, particularly the AD may reduce inflammatory responses in the kidney as evidenced by decreased neutrophilic infiltration. Our understanding of the relationship between nutrition and kidney function can pave the way for future investigations aimed at developing dietary interventions for mitigating AKI in clinical settings.

## **P08: The Impact of Dairy Consumption and Withdrawal on Cognitive and Physical Performance**

**Category:** *Educational Project*

**Authors:** Evan T. Gaugler (OMS-II), Mark E. Hemric

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

### **Abstract:**

Although Dairy Withdrawal is well established in popular nutrition and exercise publications, proven by a simple Google search, no studies appear in the current scientific literature. Estrogen withdrawal as seen in women experiencing menopause (1) and individuals who have stopped taking estrogen supplements (2,3) are frequently studied and are as close as current scientific literature has gotten to our topic of interest.

The lead author (Gaugler) experienced symptoms when he removed dairy from his diet - 2 cups daily. Up until this diet change, he experienced insomnia (5.5-year history), excessive hair loss (4.5-year history), fatigue (4), impaired cognitive performance, and impaired physical performance (5-month history).

Within 36 hours of starting the dairy cut, the lead author experienced additional symptoms that were menopause-like: night sweats, insomnia, hot flashes, and lethargy. These symptoms lasted for 5 days or until he accidentally consumed a cup of milk, after which the withdrawal symptoms reinitiated and resolved after 9 additional days.

Following the initial period of dairy withdrawal, the lead author had no night sweats, insomnia, hot flashes, no excessive hair shedding, slowly improved lethargy (1 month for a full return to normal energy), improved cognitive performance (4-week initial recovery period), and improved physical performance (length-of-withdrawal recovery period).

Consumption of dairy after the initial withdrawal also reestablishes reproducible symptoms and timelines: Insomnia lasting until nights 2-4, Night Sweats lasting until nights 1-4, Hot Flashes lasting until days 1-3, Cognitive Lethargy lasting 6 days with a full return after 2 weeks, and Physical Lethargy lasting 1.5 weeks.

For the purposes of the study we have identified Progesterone as the hormone of interest, which has been shown to increase by nearly 50% in serum with regular modern dairy consumption (5). Other dairy proteins of interest include Estrogen, Casein/Casomorphin (6), Insulin-like Growth Factor-1 (IGF-1), and Recombinant Bovine Growth Hormone (rRGH or rBST), as possible contributors to the symptoms of dairy withdrawal, though only Estrogen will be measured in serum for this study. Other proteins such as Luteinizing hormone (LH) and Follicle-stimulating hormone (FSH) will be measured in serum and monitored to be ruled out, or in for further investigation.

The methods of the study are intended to determine whether dairy consumption and withdrawal are the causative agents of physical and cognitive fatigue and body temperature changes, and whether those symptoms are mediated through specific hormone and protein levels.

The study aims to provide insight and information on the impact of dairy consumption on daily life activities such as mental and physical performance, overall energy levels, sleep quality, and all other aspects that could be impacted by diet and hormone levels.

**References:**

1. Symptoms of menopause: <https://www.liebertpub.com/doi/abs/10.1089/15409990260363661>
2. Symptoms of stopping ERT 1: <https://jamanetwork.com/journals/jama/article-abstract/201216>
3. Symptoms of stopping ERT 2:  
[https://journals.lww.com/menopausejournal/FullText/2010/17050/Menopausal\\_symptom\\_experience\\_before\\_and\\_after.13.aspx?casa\\_token=AqUVwkUz\\_48AAAAA:LvGylerhkh1CW4ND2MRjJBwmLWTcgdV1YZIY-507JxpR7zDhsvZRzqnbYCKwC--PXIGqeWCfL4L03sx0ZujMBKD](https://journals.lww.com/menopausejournal/FullText/2010/17050/Menopausal_symptom_experience_before_and_after.13.aspx?casa_token=AqUVwkUz_48AAAAA:LvGylerhkh1CW4ND2MRjJBwmLWTcgdV1YZIY-507JxpR7zDhsvZRzqnbYCKwC--PXIGqeWCfL4L03sx0ZujMBKD)
4. Fatigue Definition: Fatigue, Sleepiness, and Safety Definitions, Assessment, Methodology Max Hirshkowitz, PhDa,b,\*: “diminished performance or increasing need for effort to maintain performance over time in response to operational environmental stressors.”
5. Progesterone influenced by dairy: <https://pubs.rsc.org/en/content/articlehtml/2022/fo/d2fo02321k>
6. Casomorphin information: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8345738/>

## **P09: Prognostic Factors and Predictive Nomogram of Malignant Peripheral Nerve Sheath Tumor Patient Survival: A Population-Based Retrospective Surveillance, Epidemiology, and End Results Database Analysis**

**Category:** *Systematic Review/Meta-Analysis*

**Authors:** Abhishek Bhutada<sup>1,2</sup>, Kristine Ravina<sup>1,2</sup>, Drew Thibault (OMS-IV)<sup>3</sup>, Srijan Adhikari<sup>1,2</sup>, Adoelu, L. Olasunkanmi<sup>1,2</sup>

**Affiliation:** <sup>1</sup>Department of Neurosurgery, Carilion Clinic, Roanoke, Virginia; <sup>2</sup>Virginia Tech Carilion School of Medicine, Roanoke, Virginia; <sup>3</sup>Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Objective:** Malignant peripheral nerve sheath tumors (MPNSTs) are exceedingly rare, highly aggressive sarcomas most commonly affecting peripheral nerves of the proximal upper and lower extremities. Given the rarity of these tumors, there is limited data available to aid in clinical decision making and prognostication. Within this study we sought to characterize MPNST patient survival determinants based on the nation-wide Surveillance, Epidemiology, and End Results (SEER) database.

**Methods:** SEER 18 database was queried for MPNST between 2000 and 2020. Patient demographics, tumor histologic characteristics and treatment data was extracted and analyzed. A predictive nomogram was built to predict MPNST patient 5- and 10-year survival probability.

**Results:** A total of 2832 patients were identified and included in the analysis. The overall survival rate at 1-, 2-, 5-, and 10-years was 76%, 64%, 50%, and 41%, respectively. Multivariable analysis revealed that male sex ( $p<0.05$ ), age 18 years or older ( $p<0.001$ ), rhabdomyoblastic differentiation ( $p<0.05$ ), tumor size  $>3$  cm ( $p<0.001$ ), tumor location in the spine ( $p<0.01$ ), non-surgical management ( $p<0.001$ ), gross total resection combination with adjuvant treatments except radiation ( $p<0.05$ ) were associated with worse overall survival. Female sex ( $p<0.05$ ), age  $<18$  years ( $p<0.001$ ), tumor location in the brain ( $p<0.01$ ) and surgical management ( $p<0.001$ ) were associated with better overall survival. Patients that received gross total resection (GTR) with radiation, subtotal resection (STR) or STR with radiation had no difference in OS when compared to patients receiving GTR alone. Patients that received any other treatment or no treatment at all had worse OS when compared to patients that received GTR alone ( $p<0.001$ ). The nomogram demonstrated good accuracy in predicting survival at 5- and 10-years with C-index of 0.67 (95% CI of 0.64 to 0.70) and AUC of 0.71.

**Conclusions:** This is the largest comprehensive study on MPNST survival determinants incorporated into a prognostic nomogram to date. Patient's age, sex and race, tumor histology, location and size as well as the treatment modality used were significant predictors of overall survival. Surgical treatment in general offered a significant survival advantage over other treatment modalities. When used as a stand-alone modality, surgical treatment extent itself did not prove to be a significant survival determinant.

## **P10: Fight or Flight: Fact, Fiction, or Fabrication?**

**Category:** *Systematic Review*

**Authors:** Bryan Ashley (OMS-III), Daniel Shtirmer (OMS-III), Margaret Rose Vitale (OMS-III), Austin Curtis Brown (OMS-III), Austin Lively (OMS-III), Sean Patrick Verrier (OMS-III), Stany Lobo

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

### **Abstract:**

To explain the normal functions and pathological basis of diseases of the nervous system, an understanding of functional classification of the nervous system is essential. Functionally, the nervous system can be classified into two main divisions: the autonomic nervous system, responsible for involuntary functions, and the somatic nervous system, governing voluntary actions. The autonomic nervous system, a part of the motor nervous system, is further divided into the sympathetic nervous system (SNS) and the parasympathetic nervous system (PSNS), which has opposite effects on the normal functioning of the body. In traditional teaching, it is a common practice to use phrases/metaphors like “fight or flight” for SNS and “rest and digest” for PSNS functions. Even the standard textbooks of neurosciences will use flight or fight to explain the functions of the sympathetic nervous system. Considering the structure and actual functions of the sympathetic nervous system, this description seems to be incorrect.

To fight or flight a particular situation is a completely voluntary phenomenon which must begin in the cerebral cortex. In contrast to this, the higher control of the autonomic nervous system is the diencephalic area which does not have voluntary motor function. Considering the classification of the nerve fibers based on the velocity of neuronal transmission, the autonomic fibers are very thin and least myelinated. This makes the autonomic nervous system slow in action in contrast to the quick action needed for the fight or flight response. Another noteworthy point is that the sympathetic nervous system does not innervate the skeletal muscles and has no role on its actions. For the extremities and for the trunk, the course of the postganglionic sympathetic fibers are completely dependent on spinal nerves. Based on these facts, we hypothesize that the sympathetic nervous system has no direct role in fight or flight actions, and it is designed to save the life by supporting the functions of vital organs in life threatening condition.

The SNS has been called the main regulator of fight or flight since Walter Cannon introduced the theory in the early 20<sup>th</sup> century. New information, however, has cast doubt on Cannon's theory that the SNS is the sole contributor to the actions involved in fight or flight. In this presentation, we have made an attempt to further question Cannon's theory by rationalizing the structure and actual functions of the SNS.

**Key words:** Sympathetic nervous system, flight or fight,

## Poster Abstracts

### **P11: A Unique Variant and Unusual Prevalence of Sciatic Nerve High Division**

**Category:** *Basic Science Research*

**Authors:** Caleb Smith, Vhuthuhawe Madzinge

**Affiliation:** Liberty University, Lynchburg, Virginia

#### **Abstract:**

High division of the sciatic nerve (SN) occurs in approximately 16.9% of individuals and often has significant clinical implications, such as failed SN blocks for anesthesia or nerve injuries during deep intramuscular procedures. Existing literature classifies SN high division and provides large-scale prevalence data; however, this case study reports a unique type of SN high division discovered in a sample of 23 cadavers with an unusually high prevalence of SN high division.

This study examines the SNs in 46 limbs from 23 cadavers dissected in cadaver labs at Liberty University. Among these, 14 cases of SN high division were identified, nearly doubling the prevalence reported in existing literature. Notably, one case involves a unique type of high division where the common fibular nerve (CFN) forms from sacral nerves S1 and S2 distal to the piriformis muscle (PM), a variation not described in the conventional Beaton and Anson classification system. This study documents these findings and proposes a new classification for the observed variation. The study involved detailed dissection and examination of 46 limbs from 23 cadavers. The incidence of SN high division was recorded, with each case classified according to the traditional system. Photographs documented notable findings, and comparisons were drawn between the unique case and a typical SN.

The prevalence of SN high division in this sample was 30.4%, significantly higher than the literature-reported 16.9%. Of the 14 cases, 12 were type B high division, 1 was type C, and 1 was unclassifiable according to the existing system. The heightened prevalence observed in this sample may be linked to environmental factors, though the exact cause is still unknown. The unclassifiable case may result in clinical symptoms distinct from traditional piriformis syndrome, as the tibial nerve remains unaffected. This study proposes a new classification type to account for this variation and discusses areas for future research on SN high division prevalence and its clinical implications.

## **P12: Development of a Technical Procedure to Assess the Induction of Cerebral Microvascular Leak by a Trauma Skeletal Muscle Tissue Protein Extract**

**Category:** *Basic Science Research*

**Authors:** Emma Davison (OMS-II), Alexis Lewars (OMS-II), Deijah Patterson (OMS-II), Tiffany Cho (OMS-III), Anthony J.M. Bauer, Betsy L. Schloo

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Background:** The acute mechanisms underlying mortality due to blunt trauma in civilian patients and combat soldiers are not well understood. The role of the relatively small molecule myoglobin (16.7 kDa MW) in rhabdomyolysis has been investigated as a cause of traumatic acute nephrotoxicity. Recently, we have discovered the existence of a lethal, large molecular weight protein extract (> 500 kDa) designated “traumacidin” which is released from damaged skeletal muscle. Intravenous injection of the traumacidin protein extract into Fischer 344 rats leads to a catastrophic precipitous drop in blood pressure that is lethal within minutes. A subsequent evaluation of the gastrointestinal tract revealed an associated intense enteric microvascular leak. We hypothesized that a similar vascular leak may occur in the brain and complicate traumatic brain injury. This study aimed to develop an experimental procedure to evaluate traumatic vascular leak within the brain.

**Methods:** C57Bl/6 mice were selected to establish the best method for histological processing of the rodent brain. Mice were anesthetized using 2% isoflurane via inhalation. Paraformaldehyde (4%, PFA) or 10% neutral buffered solution (NBF) was used for intracardiac perfusion fixation, and the brain was excised. The brains were then stored in 10% NBF or 4% PFA for 24 or 48 hours. The tissue was either paraffin-embedded and stored at room temperature or placed in Optimal Cutting Temperature compound (OCT) within plastic molds and stored at -25 °C or -80 °C. After the initial histology of frozen sections, sucrose was also added to determine if it would allow for better preservation of frozen sections (use of sucrose was investigated based on a literature review, which indicated that this method would provide the most optimal histology). The samples obtained at 7 µm intervals using microtome for paraffin embedded and cryostat for OCT embedded. Histology was examined using light microscopy.

**Results:** The use of 4% PFA or 10% NBF fixation and paraffin embedding led to the best histological preservation of tissue isolated from the brains of a murine species. Artifacts were identified in the samples embedded in the OCT.

**Conclusion:** In these experiments, a method for the histological evaluation of brain tissue from rodents was established. This method will be utilized to evaluate the induction of microvascular leakage within the rodent brain after intravascular injection of the blunt tissue injury protein extract traumacidin.

## **P13: Surgical Correction of Severe Cervical Kyphosis Secondary to Tuberculoid Pott's Disease**

**Category:** *Case Report*

**Authors:** Drew Thibault (OMS-IV)<sup>1</sup>, Jordyn Mullins (OMS-IV)<sup>2</sup>, Alejandro Pando<sup>3</sup>, Misha Movahed-Ezazi<sup>3</sup>, Timothy Wong<sup>3</sup>

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**Background:** Pott's Disease is an infection of the vertebral bodies due to *Mycobacterium tuberculosis*. Commonly presenting with back pain, the insidious nature of the disease can result in the development of kyphotic deformities, epidural collections, and neurologic dysfunction. We present a 21-year-old male patient who presented with symptoms of cervical myelopathy, found to have a kyphotic deformity involving C5 and C6 vertebrae with epidural extension. The patient was treated with a combined anterior and posterior surgical approach; anteriorly with C5-C6 corpectomy and cage placement, and posteriorly with C2-T2 instrumentation. Final pathology was positive for *Mycobacterium tuberculosis* and the patient was placed on antifungal therapy.

**Observations:** Pott's Disease often presents late with symptoms that do not match the severity of the radiologic spinal deformities. Surgical intervention is warranted in patients with severe deformity, neural element compression, and concordant neurological deficits. A literature review demonstrated the combined anterior-posterior approach provides the greatest correction of kyphotic deformities. However, both anterior and combined approaches are associated with good outcomes and relatively few surgical complications.

**Lessons:** The combined anterior-posterior surgical approach for cervical Pott's Disease is recommended when kyphosis is severe. With appropriate surgical and medical management, most patients recover well without recurrent of symptoms.



**P14: Exploring the Anatomical Differences in Patent and Non-Patent Foramen Ovale (Fossa Ovalis): A Study of their Dimensions with Demographic and Clinical Insights**

**Category:** *Basic Science Research*

**Authors:** Isaiah Adetoro (OMS-II), Wenyao Wu (OMS-II), R. James Swanson

**Affiliations:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Abstract:**

The foramen ovale (FO) is formed by the overlap of septum primum (from the left atrium) and septum secundum (from the right atrium). The FO is a necessary structure needed for fetal circulation. This fetal structure should close two days after birth, forming the fossa ovalis. However, in 25% of the population, the FO doesn't seal and this is called a Patent Foramen Ovale (PFO). Usually a PFO is asymptomatic, but some patients will have complications such as migraine, cryptogenic shock and transient ischemic attack.

We conducted research on more than 60 cadavers to explore if there was a correlation between the presence of a PFO and the area of the Fossa Ovalis. We utilized an analog caliper to measure the Fossa Ovalis and a semi-flexible cord with millimeter markings to measure the depth of the PFO. Statistical significance was determined for relationships between presence of a PFO, depth of PFO, sex of the cadaver, age of the cadaver, and known co-morbidities of the cadaver.

The existing literature on PFO is limited. We hope that this research will enhance understanding of PFO and pave the way for new directions that improve clinical care for patients experiencing PFO-related complications.

## **P15: Neglected Back: A Review of Intrinsic Muscles.**

**Category:** *Basic Science Research*

**Authors:** Joseph Ponce (OMS-II), Michael Hahn (OMS-II), Michelle Adema (OMS-II), Brittany Lawrence (OMS-II), Abigail McLaughlin (OMS-II), Stany Lobo

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### **Abstract:**

Following the development of bipedal gait, most of the human body's weight lies anterior to the vertebral column. As a result, robust muscles attached to the spinous and transverse processes of the vertebrae are essential to stabilize and mobilize the vertebral column. The musculature of the back is divided into two main groups: the extrinsic muscles, which facilitate upper limb and respiratory movements, and the intrinsic deep muscles, which specifically act on the vertebral column, supporting its movements and maintaining erect posture. The skeletal and muscular structures of the back support and transfer body weight from the vertebral column to the pelvis and lower limbs while also stabilizing the movements of the head, neck, and upper limbs. The erector spinae muscles, comprising the spinalis, longissimus, and iliocostalis groups, are a major component of the intrinsic muscle system spanning the entire back. These muscles share a common inferior attachment and, based on their superior attachments, are further classified into lumborum, thoracis, and cervicis segments. Clinical and anatomical classifications of these muscles remain subjects of ongoing debate in current literature, with discrepancies in both nomenclature and functional interpretation. Accurate consideration of these muscles requires clarification of their anatomy, physiological function, and clinical significance in human movement. One such example of these observed discrepancies applies to the inferior oblique capitis muscle in the suboccipital region, where nomenclature does not align with anatomical considerations. Recognizing the importance of a standardized, consensus-based approach to back musculature is vital in educational and clinical contexts. A consistent anatomical foundation is crucial for chiropractors, osteopathic manipulative medicine (OMM) practitioners, and surgeons to effectively treat patients and prevent iatrogenic injury. A precise understanding of these muscles and their nerve innervations is also critical for procedural techniques such as erector spinae plane blocks in regional anesthesia. Recent studies have shown that the erector spinae muscle group reflects physical activity levels, is linked to mortality in conditions like pulmonary tuberculosis, and is connected to the pathogenesis and management of chronic lower back pain. Addressing disparities in current literature regarding the muscles of the back has the potential to improve clinical outcomes across multiple settings. This review aims to highlight inconsistencies in the nomenclature, anatomical classification, functional understanding, and surgical considerations of the intrinsic back muscles and explore how these inconsistencies may influence clinical practice.

**Key words:** Erector spinae, intrinsic back muscles, low back pain, inferior oblique capitis.

## **P16: PRM1 Influences mating and virulence In *Cryptococcus neoformans***

**Category:** *Basic Science Research*

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### **Abstract:**

For opportunistic pathogens like *Cryptococcus neoformans*, homeostasis, environmental stability, and adaptation are important for their growth and development. *C. neoformans* mostly infects the immunocompromised, which allows for the propensity to invade the central nervous system. *C. neoformans* was recently listed as a Critical Priority fungal pathogen by the WHO given its high mortality rate and ubiquitous nature. *C. neoformans* has the ability to adapt to host environment pH, a property that is to pathogenicity and survival. The *C. neoformans* gene CNAG\_05866, an ortholog of *PRM1* in *S. cerevisiae* that is involved in plasma membrane fusion and mating, was recently identified by colleagues at Duke University in a mutagenesis screen for genes important for pH adaptation. In this study, we have deleted the *PRM1* gene in *C. neoformans* and examined various phenotypes related to pH adaptation. Growth at alkaline pH is severely impeded in the *prm1*Δ mutant. Furthermore, qPCR data show that *PRM1* may repress activity of the *SRE1* pH regulatory pathway. However, the expression of *PRM1* itself is induced by the *RIM101* pH regulatory pathway and is repressed by the *SRE1* regulatory pathway. Additionally, *PRM1* influences mating and basidiospore production in *C. neoformans* consistent with its role in mating in *S. cerevisiae*. Future studies will examine the role of *PRM1* in virulence in a mouse model of disease and further examine its relationship to the major pH regulatory pathways in this important fungal pathogen.

## **P17: Diet influences the immunopathology of acute kidney injury in mice**

**Category:** *Basic Research Science*

**Authors:** Tabitha Hutchison (OMS-II), Riley Lutz, Joseph C. Gigliotti

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, VA

### **Abstract:**

Acute kidney injury (AKI) is a prevalent condition among hospitalized patients, significantly contributing to increased morbidity and mortality rates. Currently, no effective treatments for AKI have been discovered. Recent studies have found resazurin to be a *in vivo* biomarker for evaluating kidney function in mouse models of AKI. However, the relationship between diet and kidney health and function remains underexplored, particularly within AKI. Our laboratory has established that diet can profoundly influence kidney function. Our lab wanted to determine if resazurin was sensitive enough to detect the impact of diet alone on kidney function. Additionally, we wanted to determine how dietary factors may alter markers of kidney function and inflammatory response in the context of AKI.

All studies were performed in accordance to protocols approved by the Liberty University Institutional Animal Care and Use Committee. Weanling (three-week old) male C57Bl/6 mice were purchased from the Jackson Laboratory and allowed to acclimate for one-week (N=23). Mice were then randomly assigned diets (n=3/4) *ad libitum*. The diets included a commercially available chow, AIN-93G, high-fat diet (HFD), Western Diet (WD), and our novel Americanized diet (AD). The AD diet and Chow diet were additionally used for unilateral renal ischemia reperfusion injury (uIRI) study (N=6, n=3). Mouse body weights were recorded the day of diet assignment and again during the final week of study. Mice fed the AD and chow diet underwent uIRI using a ketamine/xylazine mixture (1 uL per 1 g BW with 10% overage). The duration of ischemia was 27 minutes. Mice were euthanized 24 hours later and the uIRI kidneys and control kidneys were harvested for histological assessment of AKI and flow cytometry. Cytological markers used for flow analysis were live/dead, CD11c, CD11b, LY6G, CD45, F480, LY6C, and CD103. Prior to euthanasia, mice from each diet were injected (*i.v.*, retro-orbital plexus) with resazurin solution in normal saline (100uL) (N=17, n = 3/4). Spot urine collection was performed 10 minutes after injection and urine concentration of resazurin metabolite (resorufin) was determined by spectrophotometric quantification (530 nm excitation, 590 nm emission) of 100 uL of diluted urine after sample dilution in PBS (1:100). Final concentration absorption values were corrected for urinary creatinine concentrations.

Preliminary results revealed that renal clearance of resazurin successfully detected a reduction in the renal tubular function in mice fed WD compared to those of the other diets. Additionally, flow cytometry analysis demonstrated reduced histological evidence of AKI and a 50% reduction in neutrophil infiltration in the kidneys of AD mice compared to those on a standard chow diet.

Data thus far support the hypothesis that resazurin is a sensitive biomarker for assessing renal function in the context of dietary influences. Our findings suggest that diet, particularly the AD may reduce inflammatory responses in the kidney as evidenced by decreased neutrophilic infiltration. Our understanding of the relationship between nutrition and kidney function can pave the way for future investigations aimed at developing dietary interventions for mitigating AKI in clinical settings.

## **P18: Biomechanical Analysis of Lumbar Vertebrae: Insights for Surgical Management of Vertebral Fractures**

**Category:** *Basic Science Research*

**Authors:** William Dedmond (OMS-II), Joseph DiPetto (OMS-II), Alexander Baur (OMS-IV), Keith Lustig

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**Background:** Lumbar vertebral fractures, particularly burst and compression types, are complex injuries often resulting from high-energy impacts. These fractures can lead to spinal instability, severe pain, and neurological deficits. The lumbar spine, which bears significant mechanical load, is especially vulnerable to such injuries. Despite surgical interventions being commonly required for unstable fractures, the biomechanical behavior of lumbar vertebrae across different levels and its influence on surgical outcomes remains underexplored.

**Methods:** This study analyzed the biomechanical forces acting on lumbar vertebrae and assessed their compressive stress to failure. Fourteen lumbar vertebrae (L1-L4) were harvested from four cadavers, cleaned, and prepared for testing. The specimens were subjected to compressive loading using an Instron machine, generating stress-strain curves and calculating Young's modulus. Each sample was compressed until reaching approximately 4 MPa to determine stress to failure.

**Results:** Young's modulus values varied significantly among specimens, ranging from 1.81 MPa to 8.54 MPa, with no consistent trend indicating higher stress to failure in lower lumbar vertebrae. Contrary to expectations, the results did not demonstrate that lower lumbar levels, which bear greater mechanical loads, have higher compressive strength. The mechanical properties were highly variable and did not correlate with vertebral level (p-value .64).

**Conclusions:** This study challenges the assumption that lower lumbar vertebrae are structurally stronger due to their load-bearing role. The findings suggest that while lumbar vertebrae have similar initial mechanical properties, cumulative mechanical stress may contribute to uneven degenerative changes, increasing fracture susceptibility over time. These insights are critical for managing degenerative spinal conditions and informing surgical planning.

## **P19: OSTEOPATHIC MANIPULATIVE TREATMENT FOR POSTOPERATIVE ARTHRITIS FOLLOWING MIDFOOT OPEN REDUCTION AND INTERNAL FIXATION: A CASE REPORT**

**Category:** *Case Report*

**Authors:** Allison F. Aldridge (OMS-III), Ethan D. Rich (OMS-IV), Bridget M. Moe (OMS-II), Allison Bardowell

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Introduction:** Unstable Lisfranc injuries can lead to significant disability and can be difficult to manage. Treatment commonly involves open reduction and internal fixation (ORIF) or primary arthrodesis (PA). However, common complications one year after surgery are diminished joint mobility, soft tissue trauma, and early development of arthritis within the foot, resulting in persistent pain and physical activity limitations. Osteopathic manipulative treatment (OMT) has been shown to be a positive adjunct to standard postoperative management to improve pain and quicken recovery.

**Objective:** To demonstrate the utility of OMT as a successful adjunctive treatment to standard postoperative management.

**Case Description:** A 37-year-old male with an unstable Lisfranc fracture, s/p ORIF in 2015 with hardware removal in 2016, maintained moderate pain levels with sharp exacerbations to prolonged walking and running. He received corticosteroid injections (CSI) in the second and third metatarsals (MT) every 6 months with 6 weeks of pain reduction to mild levels. In 2018, he underwent PA without any further relief.

**Outcomes:** The patient received 5 OMT treatments over the course of 4 months from 2023 to 2024. Techniques used were balanced ligamentous/membranous tension, ligamentous articular strain, and osteopathy in the cranial field. He had successful pain resolution and maintenance with prolonged walking and running.

**Discussion:** Post-traumatic arthritis and other post-surgical compensatory changes of the ankle and foot will develop over time after initial Lisfranc ORIF. OMT, even after 8 years as demonstrated, is a powerful modality to restore motion and function with a return to pain free normal activities. OMT would be more effective at increasing patient satisfaction scores and relieving the undue burden of additional medical costs when performed within the first postoperative year. Further cases treated within the first year of surgery will demonstrate the full utility of OMT with post-surgical changes in variable presentations.

## **P20: An Osteopathic Approach to Failure to Thrive in Infancy**

**Category:** *Case Report*

**Author:** Ashlee Evans (OMS-IV), Arlene O'Donnell

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

### **Abstract:**

Infantile Failure to Thrive (FTT) describes inadequate growth, initially manifesting with decreased weight gain. FTT can impact overall growth and normal development, including cognitive development and immune function. FTT is used to describe infants and children with weight, body mass index, and length below the 5<sup>th</sup> percentile, decreased growth velocity, or decrease by two major percentiles. In the US, the prevalence of FTT may occur in up to 10% of children and early intervention is essential. Treatment plans include a multidisciplinary approach to address feeding issues, nutrition, and parental education.

A 10-month-old female presents to our clinic for growth delay. The child is breastfed and has developmental delay, gastric reflux, and in the 0.2 percentile for weight. Over 6 months, this infant was seen at 8 different visits with a holistic approach, a combination of parental education, lactation education, and osteopathic manipulation treatment (OMT).

After 2 months, weight increased to the 7<sup>th</sup> percentile, gastric reflux frequency decreased, and feedings were better tolerated. OMT, including cranial techniques, percussion hammer and more, was better tolerated with decreased frontal and falx tightness. After 6 months, the patient was in the 18<sup>th</sup> percentile for weight and holding treatments well.

Using an osteopathic approach, the patient's needs were addressed on multiple levels. Educating the parent on frequency of breastfeeding increased to 6 times daily in combination with OMT increased feeding duration and tolerance with a significant decrease in gastric reflux. Breastfeeding continued without needing to supplement with formula or pharmacologic intervention. The patient's growth increased over the 6-month period increasing weight from 0.2 percentile to 18<sup>th</sup> percentile demonstrating the effectiveness of an osteopathic approach to patients with failure to thrive.

**P21: Aberrant Right hepatic artery and its clinical implications: A case report.**

**Category:** *Case Report*

**Authors:** Cassandra Hill (OMS-II), Michael Biggiani (OMS-II), Jacquelyn Harvey (OMS-II), Jacob Kantzos (OMS-II), Dimitri Knepper (OMS-II), Julie Vo (OMS-II), Rebecca Zhang (OMS-II), Stany Lobo

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**Abstract:**

The blood supply to the abdominal viscera is directly related to its embryological development. The three unpaired ventral branches of the abdominal aorta namely the Celiac trunk, Superior mesenteric artery and the Inferior mesenteric artery in succession will supply the foregut, midgut and the hindgut derivatives. Variations in the blood supply to the abdominal viscera are not uncommon. The variations of the hepatic vasculature can be broadly divided as aberrant, accessory and replacing arteries. The present case report presents the finding of a replacing aberrant right hepatic artery found in a 66-year-old female cadaver, a review of the embryology of the hepatic vasculature, and the clinical significance of such a finding. Adequate knowledge of these variations will be essential for Hepatobiliary surgeons, Angioplasty procedures and for Interventional radiologists. Preoperative recognition of RHA anatomy can be provided using MDCT, which will prepare the surgeon to deal with possible variations and avoid unexpected complications during surgical and endovascular treatments of the liver. In this case report, an attempt will be made to emphasize the clinical implications and management of such variations.

**Key words:** Hepatic, Aberrant, Vasculature, GI



## **P23: Foot Drop Following L5-S1 Transforaminal Epidural Steroid Injection: A Case Report**

**Category:** *Case Report*

**Authors:** Dr. Garrett Helber<sup>1</sup>, G. Joseph Valentini (OMS-III)<sup>2</sup>, Ethan Rich (OMS-IV)<sup>2</sup>

**Affiliation:** <sup>1</sup>Rothman Orthopedics, PA, <sup>2</sup>Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Setting:** Outpatient orthopedic surgery center.

**Patient:** 83-year-old woman with lumbosacral radiculopathy of discogenic etiology

**Case Description:** Patient presented with acute right-sided pain in L5-S1 dermatomal distribution. The pain was refractory to conservative treatment and MRI was ordered. The MRI demonstrated severe right and mild left foraminal stenosis at L5-S1 with narrowing of the lateral recesses. The patient was treated with an epidural steroid injection at the L5-S1 level utilizing a right-sided transforaminal approach. The procedure was performed under live fluoroscopy and after contrast confirmed epidural flow pattern a solution of 15mg of dexamethasone and 1.5ml of preservative free saline was injected into the epidural space. No complications were noted during the procedure and no new neurological deficits were identified post-procedure. The patient followed up 3 weeks later for routine follow up and reported complete resolution of pain but did report a new onset of right foot weakness affecting her ability to ambulate. Her exam was significant for diminished 4/5 muscle strength with right ankle dorsiflexion and great toe extension. Her gait was non-antalgic with intact tandem gait and ability to toe walk but an inability to heel walk.

**Assessment/Results:** Upon review of fluoroscopic imaging, there was no evidence for nerve injection. This was confirmed on subsequent EMG/NCS testing performed 3 months after injection revealing right subacute L5 radiculopathy.

**Discussion:** This is the first case report, to our knowledge, of a patient experiencing persistent foot drop following a transforaminal epidural steroid injection done with standard protocol.

**Conclusion:** Persistent focal neurological deficits can occur following standard practice epidural spinal injections in patients with neural foraminal stenosis.

## **P24: Case Report of a Female Collegiate Athlete Using PRP for Tibia Fracture**

**Category:** *Case Report*

**Authors:** Gabrielle Jeifa (OMS-II), Joseph DiPetto (OMS-II), Stephen Despina

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Case diagnosis:** Subcortical Fracture of the Lateral Tibia

**Case description:** A 20-year-old female collegiate soccer player with a previous subcortical fracture of the lateral tibia sustained during athletics presented with ongoing knee pain. Eight months post-injury, an MRI revealed small effusion and associated capsulitis, though the fracture was healed. Initial management with osteopathic manipulative therapy (OMT) provided partial symptom relief, but further intervention was required for the patient to safely return to competitive soccer. Given the patient's age, platelet-rich plasma (PRP) therapy was selected. A single intra-articular injection of 6 mL PRP was administered into the knee joint, specifically between the quadriceps tendon and Hoffa's fat pad. Two weeks after the injection, the patient expectedly reported mild residual soreness but showed progressive improvement in symptoms in the subsequent weeks.

**Discussion:** Despite initial soreness following PRP treatment, the patient reported significantly less pain post-healing compared to pre-treatment levels and was able to return to athletics. While the effectiveness of PRP has been demonstrated in conditions such as osteoarthritis, epicondylitis, and other ligamentous injuries in sports medicine, its use in subcortical tibial fractures remains underexplored. The anti-inflammatory and tissue repair properties of PRP, mediated by growth factors like TGF- $\beta$  and various interleukins, may provide a therapeutic benefit in similar cases.

**Conclusions:** This case suggests that PRP therapy may be an effective, non-invasive alternative for managing tibial fractures in young athletes. Further research is needed to validate these findings and to assess the broader applicability of PRP in treating subcortical tibial fractures.

## **P25: Management of a Cervical Extradural Space Occupying Mass in an Elderly Female**

**Category:** *Case Report*

**Authors:** Justin Scobercea (OMM Fellow), Kebereab Feyissa (OMS-III), Stephen Despins

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Case Diagnosis:** Spinal Cord Mass

**Case Description:** We present the case of an 85-year-old woman with a history of breast cancer and osteopenia who initially presented to the clinic with right-sided neck pain with no associated neurological symptoms or deficits. Conservative management consisting of dextrose 5% (D5W) injections, triamcinolone trigger point injections, dry needling, and osteopathic manipulative treatment (OMT) was initiated with only temporary pain relief. After several follow-up appointments with no relief of the pain, the patient was sent for a cervical MRI before referral to interventional pain management. The MRI demonstrated a right-sided extradural mass at C4-C6 with likely spinal cord compression. Upon follow up, the patient still reported no neurological symptoms or deficits. She was then referred to neurosurgery who have determined the mass to be either a slow-growing meningioma or a schwannoma. A recent repeat MRI has shown little change in the mass; repeat flexion and extension X-rays showed no structural instability or neurologic compromise. The patient has decided against surgery at this time due to the absence of any neurologic deficits, she is scheduled for a repeat MRI in December.

**Discussion:** This case highlights the unique challenges of managing an extradural space occupying mass in an elderly patient. While a conservative approach to management is reasonable given the absence of neurological deficits; the potential for progression of the mass or development of neurological deficits must also be balanced with the invasiveness and risks of surgery in an elderly patient. Additionally, there is a ten-fold increase in the risk of breast cancer in women with meningiomas, so this patient likely requires increased monitoring (1).

**Conclusion:** Given that physiatry is a field that focuses on promoting patient independence and mobility, the ultimate decision in patient management is a holistic one that prioritizes the patient's preferences while minimizing any functional decline.

### **References:**

1. Degeneffe A, De Maertelaer V, De Witte O, Lefranc F. The Association Between Meningioma and Breast Cancer: A Systematic Review and Meta-analysis. *JAMA Netw Open*. 2023 Jun 1;6(6):e2318620. doi: 10.1001/jamanetworkopen.2023.18620. PMID: 37326990; PMCID: PMC10276307.

**P26: Aberrant hepatic artery and its clinical implications: A case report.**

**Category:** *Case Report*

**Authors:** Julia Spiotta (OMS-II), Corey Snyder (OMS-II), Hadley Brockbank (OMS-II), Cooper Fisher (OMS-II), Zinaida Gregor (OMS-II), Clara Savardi (OMS-II), Alexander Sher-Jones (OMS-II), Stany Lobo

**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Abstract:**

The gastrointestinal (GI) tract's development and vasculature are directly related. The three unpaired anterior visceral branches of the abdominal aorta are the celiac trunk, superior mesenteric artery, and inferior mesenteric artery which supply the foregut, midgut, and hindgut derivatives, respectively. Variations in the blood supply to the abdominal viscera are well-documented in the literature. Hepatic vasculature variations can be broadly classified into aberrant, accessory, and replacing arteries. In this case report, we describe a replacement aberrant hepatic artery originating from the superior mesenteric artery in a 72-year-old female cadaver. This artery followed a course similar to the gastroduodenal artery, which is vulnerable to damage in cases of abdominal ulcers. Understanding these variations is critical for surgeons and proceduralists. Preoperative recognition of replaced hepatic artery (RHA) anatomy can be achieved through Multidetector Computed Tomography imaging (MDCT), helping surgeons anticipate possible variations and avoid complications during liver surgery or endovascular procedures. This case report will explore the embryonic development, clinical significance, and importance of preoperative diagnosis of this vascular variation.

## **P27: A Reduction in State Funded Long-term Psychiatric Hospitals Resulted in Worse Patient Outcomes: A Case Report**

**Category:** *Case Report*

**Authors:** Minaal Khan (OMS-III)<sup>1</sup>, Prutha V.K. Patel (OMS-III)<sup>2</sup>, Yash K. Desai (OMS-III)<sup>2</sup>, Daniel R. Nicholas<sup>3</sup>, Sebhat Erqou<sup>3</sup>, Patricia Harrison<sup>3</sup>, Allison Foroobar<sup>3</sup>, Partam Manalai<sup>3</sup>

**Affiliation:** <sup>1</sup> Liberty University College of Osteopathic Medicine, Lynchburg, Virginia; <sup>2</sup> Edward Via College of Osteopathic Medicine; <sup>3</sup> Mary Washington Healthcare

### **Abstract:**

Severe Mental Illness (SMI) is defined as a mental, behavioral or emotional disorder resulting in functional impairment which significantly interferes with one or more major life activities and affects 14.1 million Americans. The primary distinction between any mental illness and severe mental illness is the effect on major life activities. Following deinstitutionalization and a decline in the number of long term psychiatric hospitals, individuals with some of the gravest forms of SMI do not have the option of receiving appropriate care to meet their needs. Due to the chronic relapsing nature of SMI, most patients will need an acute inpatient level of care. For example, studies have demonstrated that relapse rates for schizophrenia vary widely depending on medication adherence, with relapse rates reaching 80% within five years for patients who discontinue antipsychotic treatment, and around 40% for those who remain on medication. In this poster, we present a sample of a case, advocating for a limited increase in the number of state funded psychiatric hospitals within the Commonwealth of Virginia. The Commonwealth of Virginia, the birthplace of the first formal psychiatric institution (Western State Hospital), currently is not able to provide adequate opportunities to its citizens suffering from SMI who need long term inpatient psychiatric care. Patients such as the one described in this poster, as well as the healthcare system as a whole, have suffered, resulting in increased rates of patient restraints and other restrictive measures in acute care psychiatric hospitals. For example, Snowden, the psychiatric facility at Mary Washington Hospital, has observed an increase in restraints from 14.57 per month to 33.53 per month after the state hospital reduced their capacity for civil patients. This poster highlights the need for a more personalized approach through long term inpatient psychiatric care, rather than flooding acute inpatient facilities with limited oversight resulting in horrific treatment as was displayed during the previous century in the United States.

## **P28: Management of Chemotherapy Induced Strains in a Breast Cancer Survivor with OMT**

**Category:** *Case Report*

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**Introduction:** Patients undergoing chemotherapy and radiation often experience post-treatment complications, including myalgia, arthralgia, and peripheral neuropathies. Conventional treatments for chemotherapy-induced arthropathy, such as nonsteroidal anti-inflammatory drugs (NSAIDs), disease-modifying antirheumatic drugs (DMARDs), and corticosteroids, frequently fail to provide consistent symptom relief. This case examines the potential of Osteopathic Manipulative Treatment (OMT) as an adjunct therapy to alleviate chronic pain in post-chemotherapy inflammatory conditions.

**Case Description:** A 54-year-old female with a history of breast cancer with multiple brain metastases underwent mastectomy with chemotherapy and radiation for 6 months in 2011, as well as left pterional craniotomy and exploratory temporal lobe resection with long-term chemotherapy. She presented to the clinic for low back pain, bilateral elbow pain, and shoulder pain. Imaging review showed left temporal encephalomalacia, mild disc bulge in the lumbar spine, and neuroforaminal stenosis in the cervical spine. Previous treatments include cervical epidurals, bilateral lateral epicondyle and bilateral sacroiliac steroid injections and gabapentin without relief.

**Results:** Osteopathic structural examination initially revealed cranial, craniocervical, and craniosacral syndrome secondary to post-surgical scar strains from craniotomy and chemo port. OMT techniques used were osteopathy in the cranial field (OCF), balanced ligamentous tension (BLT), and ligamentous articular strain (LAS). She had a tremendous response to treatment with resolution and maintenance of the strains above. Residual temporal cortical strains (encephalomalacia) remained that were also addressed and have been well maintained since.

Over subsequent appointments, she discontinued her gabapentin and has been well-maintained with OMT (OCF, LAS, percussion vibration hammer, and muscle energy) and perineural subcutaneous injections (PIT, D5W for neuralgia) to address her intraosseous strains and myofascial compensations with resolution of symptoms at each visit. The recurrence of her somatic dysfunctions was related to chemotherapy nighttime dosing with hyper-flexed postural sleeping biomechanics at her elbows and wrists. Dosing adjustments and positional changes were made with improved maintenance of her chemotherapy-induced arthropathy and peripheral neuropathies.

**Discussion:** OMT normalized inherent motions at joints, bones, and fascia and put the patient in an optimized state for healing. Changing the chemo dose from PM to AM limits the application of the insult to the system in her naturally flexed sleeping state, preventing limited distribution. This yielded sustained relief, highlighting the benefits of a holistic approach that combines OMT with individualized treatment adjustments.

With nearly 55 percent of patients experiencing pain during chemotherapy, knowing the impact and importance of OMT in management of these symptoms is crucial. These findings suggest that OMT, when integrated with lifestyle modifications, could offer a viable, non-pharmacologic option for managing persistent pain in cancer survivors. OMT could become an essential component of multidisciplinary oncology aftercare, enhancing quality of life and functional outcomes for patients where conventional treatments are insufficient.

## **P29: Osteopathic Management of Chronic Pain Following Bilateral Periacetabular Osteotomy in Developmental Hip Dysplasia**

**Category:** *Case Report*

**Authors:** Taylor Edgar (OMS-III), Gregory Heller, Madison Hutson (OMS-III), Davis Melin (OMS-III), Allison Bardowell

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**Introduction:** When diagnosed in late adolescence, the treatment of choice for hip dysplasia is periacetabular osteotomy (PAO) and post-operative physical therapy (PT). However, postsurgical compensatory changes can result in femoral anteversion (FAV) and resultant femoral acetabular impingement (FAI) which increases the risk of early-onset osteoarthritis and the need for total hip replacement (THR) in young patients.

**Case:** A 26-year-old female presents with chronic right lower extremity (RLE) pain. She was diagnosed with bilateral hip dysplasia at 13 years old. She received a right and left PAO at age 14 and 15 respectively with PT with 90% pain reduction. By age 19, right hip pain returned. She restarted PT by age 22 which achieved 50% pain reduction. At age 23, X-rays showed Tonnis grade 2 and 3 osteoarthritis of the left and right hip, respectively. Analgesics and PT were recommended until THR is indicated. Her initial osteopathic exam at the age of 26 was significant for FAV and FAI based on verbal pain scales, log roll, FADIR, range of motion, and postural and functional biomechanics.

**Results:** Osteopathy in the Cranial Field, Balanced Membranous Tension, and Ligamentous Articular Strain were applied to correct intraosseous strains, capsular compression, and myofascial strains. Following one treatment session, 90% pain reduction and resolution of postural FAV and FAI at rest were achieved. However, some proprioceptive strains persisted functionally. Treatment plans include further osteopathic re-evaluations, OMT, exercise prescription, and gait retraining with PT if needed.

**Conclusion:** Motion freedom was maintained at four weeks, despite a gradual return to 50% of original pain after a prolonged car ride. This case illustrates the benefit of osteopathic management following PAO to decrease pain and correct postsurgical compensatory changes.

### **P30: The Effects of Histamine on Cancer Cells *in vitro* and *in vivo***

**Category:** *Clinical Research*

**Authors:** Amy Nicole Yelton (OMS-II), Ann Turner (OMS-II), Olivia Curley, Christopher L. Kepley

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**Abstract:**

The role of mast cells (MC) in cancer progression is controversial with some studies suggesting pro-tumor effects while others suggesting anti-tumor effects. Mast cells have preformed and newly generated mediators, some of which have anti-cancer cell properties (e.g. TNF- $\alpha$ , GM-CSF). Indeed, strategies to harness these naturally occurring mediators through tumor targeting MC are being explored. The purpose of this study was to investigate the effects of the MC mediator histamine on cancer cell viability *in vitro* and tumor growth *in vivo*. With this information, MC-based anti-cancer therapies could be designed to maximize anti-tumor properties while eliminating potential toxic side effects. Histamine did not have any significant effect on the viability of human cancer cell lines *in vitro*. Further, histamine injected intratumorally did not have any significant effect on tumor size or survival of immunocompromised Nu/Nu mice with implanted human tumors. These studies suggest MC-derived histamine does not directly affect cancer cell viability or tumor growth and may be a target for deletion in rationally-designed, tumor targeting MC in adoptive cell therapies.



## **P31: Periacetabular Osteotomy Procedure for Hip Dysplasia Correction**

**Category:** *Clinical Research*

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**Affiliation:** Liberty University College of Osteopathic Medicine, Lynchburg, Virginia

**Introduction:** Hip Dysplasia is a common congenital pelvic bone malformation. Effects can range from avascular necrosis of the femoral head in severe pediatric cases to development of early arthritis in more mild undiagnosed adult cases. Periacetabular osteotomies are the initial surgical intervention for repair that avoids future total hip replacements.

**Objective:** The goals of this project are to highlight various approaches to periacetabular osteotomy (PAO) surgeries, the relative anatomy and possible complications from these approaches, as well their clinical significance and outcomes.

**Methods:** A detailed anatomical dissection of cadaveric tissue was completed to fully understand and identify hip joint structures. Identification of the femoral head and pelvic acetabulum was made with full visualization, prior to attempting to visualize structures from a surgical window only. Salter, Pemberton, Chiari and Steele osteotomies were reviewed and more specifically the Ganz osteotomy. The decision was then made to perform a complete Ganz surgical osteotomy on a second cadaver.

**Results:** The Ganz procedure has some unique advantages to other approaches. Specifically, when considering young female populations. It is clinically relevant that the Ganz osteotomy does not alter the pelvic outlet. Leaving the pelvic outlet intact allows for future vaginal child birth as a possibility. This approach does not alter femur length or femoral head symmetry, which significantly reduces the possibility of leg length discrepancies postoperatively. A possible downside to the superior approach of the Ganz procedure would be inability to access the joint capsule, if it were determined that the capsule needed to be opened to assess or correct the femoral head. Other complications, such as overcorrection or neurovascular damage should also be taken into consideration.

**Conclusion:** The various approaches to the PAO surgery for hip dysplasia correction should be carefully considered when it comes to the best approach for specific patient populations. Factors such as age and activity should be heavily considered when selecting an approach. Additional anatomical factors such as gait mechanics and spinal curvature can be affected by surgical changes to pelvic anatomy. It would be valuable for future research to investigate a connection between changes to structurally related spinal dynamics post-periacetabular osteotomy as related to increased scoliotic changes in the lumbar and thoracic spine.

## **P32: Exploring Preclinical Signs and Markers for Neurodegenerative Diseases via Indirect Testing of Blood-Brain Barrier Stability**

**Category:** *Clinical Research*

**Authors:** Charles Joseph, Joshua Ashworth (OMS-II), Hadley Brockbank (OMS-II), James Garrett Brown (OMS-II), Bill Dedmond (OMS-II), Ryan Deweese (OMS-II), Emily Dykema (OMS-II), John Hoegerl, Abiha Jafri (OMS-II), Karen Kang (OMS-II), Cathryn Martinez (OMS-II), Efosa Osayamwen, Joseph Ponce (OMS-II), Sanobar Shaikh (OMS-II), Corey Snyder (OMS-II)

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**Abstract:** Mild cognitive impairment (MCI) arises from inflammation and internal damage occurring within the brain and its surrounding tissues. By the time the various symptoms of MCI and systemic inflammation present clinically, significant damage to the blood-brain barrier (BBB) has already occurred. Given current understanding and treatment options, little can be done to reverse the damage; thus, treatment is primarily reactive. This study seeks to evaluate patients presenting with known dementia risk factors (i.e., medication history, relevant pre-existing medical conditions, genetics, etc.) and potential pre-clinical serum-based biomarkers (i.e., GFAP, NfL, IL-6, MMP-3, etc.) identified through a comprehensive literature review. Utilizing a combination of ultrasound study of the brachial artery, arterial spin labeling magnetic resonance imaging (ASL MRI), and blood tests for common biomarkers of neurovascular unit degradation (i.e., astrocytic and neuronal death, inflammation, etc.), this study aims to indirectly monitor the onset and progression of inflammatory and/or destructive processes at the BBB. With these combined testing strategies, we expect to establish a correlation between decreased systemic arterial compliance and diminished glymphatic clearance, potentially revealing the efficacy of our methods in presymptomatic detection of neurodegenerative diseases in a clinical setting.

### **P33: Differentiating Small Vessel Disease (SVD) from Neurodegenerative Dementia (Alzheimer's Disease) using Arterial Spin Labeling MRI - a Feasibility Study**

**Category:** *Clinical Research*

**Authors:** Lindsay Wanner (OMS-III), Jason Badelita (OMS-III), Lucy Conser (OMS-III), Irene George (OMS-III), Bryant Hartman (OMS-III), Harrison Kline (OMS-III), Davis Melin (OMS-III), Pranav Pradhan (OMS-III), Charles Joseph

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#### **Abstract:**

Small Vessel Disease (SVD) and neurodegenerative dementia are clinically indistinguishable and difficult to differentiate with conventional MRI. Both forms of dementia exhibit decline of capillary integrity and cognition, resulting from blood-brain-barrier (BBB) breakdown and subsequent leak. However, the consequence of BBB leak may be mechanistically divergent. SVD causes major changes in the perfusion paradigm, potentially resulting in reduced arterial mean transit time (aMTT) and capillary mean transit time (cMTT). Neurodegenerative dementia exhibits normal aMTT but prolonged cMTT. We hypothesize a shared underlying pathophysiology on a shared disease spectrum. This study looked to develop a 3D Arterial Spin Labeling (ASL) MRI biomarker detection technique to potentially distinguish SVD from neurodegenerative dementia before significant disease progression. Twenty-one subjects with no dementia (n=7), Alzheimer's (n=7) or Vascular Dementia (n=7), and Montreal Cognitive Assessment scores between 10 and 17 were recruited. Subjects underwent a 3T Skyra magnet MRI scan using 3D ASL sequencing. Average signal intensities were recorded in 6 brain regions: homologous bitemporal, biparietal, and bi-frontal regions. Early and late phases of perfusion were graphed to compare time to max arterial peak perfusion, amplitude between groups, and linear clearance rate of the late phase of perfusion. Average arterial perfusion signal strength at 800, 1000, 1200, 1400, and 1600 ms post arterial spin labeling in each region between all groups showed no significant difference. Late phase perfusion (2800-4000ms) in both dementia groups showed highly significant differences ( $p \leq 0.04$ ) from controls in all affected areas except the right parietal lobe. There are no regions where perfusion between dementia groups differed significantly. This technique is unable to differentiate arterial phase perfusion changes in either affected group from normal controls or each other. This may be related to either limitations in technique or absence in arteriolar pathology. The latter possibility suggests that both entities share the same inciting initial BBB pathology. Current pharmaceutical treatment for dementia is tailored to targeting downstream pathologic products, requiring differentiation of a specific dementia type prior to initiating treatment. However, if there is a shared inciting pathology the target of pharmaceutical treatment should then change to restoring BBB integrity.

## **P34: Four-day Cultured Mouse Embryos Developed in Uncondensed E-cigarette Fluid**

**Category:** *Basic Science Research*

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**Context:** With declining birth rates across the globe, infertility has become a major source of concern within both the health care and governmental spheres [1]. Concurrently, E-cigarette use among adolescents and young adults has increased dramatically since 2017 [2]. While there are many substances that are known to contribute to infertility, limited research has attempted to study the effect E-cigarette chemicals have on early embryological development. In this study, we will examine potential toxicity after mouse embryos are exposed to these unvaped chemical formulations. a

**Objective:** To determine whether exposure to pre-vaped e-cigarette fluid disrupts mouse embryonic pre-implantation development.

**Materials and Methods:** Methodology: To assess the effect of vaping fluid on mouse embryos, we will superovulate 10 female mice and place them with a male. After mating, vaginal ejaculation plugs will be observed to determine the mice to be euthanized. Embryos from the plugged mice will be removed from the fallopian tubes and incubated in a 96-well plate (Falcon 353077) in a culture medium containing varying quantities of vaping fluid for 84 hours.

### Production of Embryos [3]:

- Day 0: Ten female B6CBAF1/J mice will be injected intraperitoneally (ip) with 5 international units (IU) of pregnant mare serum gonadotropin (PMSG) in 0.1mL normal saline.
- Day 2: These 10 mice will be injected with 5 IU of human chorionic gonadotropin (hCG) ip in 0.1mL normal saline. Each female mouse will be placed with a CD1 male mouse.
- Day 3: Female mice will be checked for vaginal plugs, indicating fertilization, and removed from male cages. Ninety-six-well culture plates will be set up with M16 medium from Sigma Aldrich with penicillin/streptomycin (1%). Each row of 12 wells will be loaded with one of the following: 1a) negative and 1b) positive control media; 2) 1.0%; 3) 0.5%; or 4) 0.1% unvaped e-cigarette fluid. The two control rows in each plate will have only M16 medium or an appropriate percentage of normal saline added as replacement for the unvaped fluid volume.
- Day 4: Plug-positive mice will be euthanized, fallopian tubes will be collected and irrigated using a 30-gauge ½ inch needle and 1mL syringe into a 35mm petri dish of M16 medium. Two-cell embryos will be identified, recovered with a 15µL Eppendorf pipette, placed into a 96-well plate, and loaded into a BZ-X Series automated incubator-microscope at 37° C, 100% H<sub>2</sub>O, 5%CO<sub>2</sub>.
- Days 5-8: Incubation will continue in the Keyence BZ-X Series incubator/microscope, with micrographs taken every 20 to 30 minutes at 400x magnification, and statistically analyzing the developmental stage [4] from the micrographs of all embryos in the wells every 12 hours.

**Results:** Data will be recorded into an online sheet every 12-hours. Number values will be assigned for each developmental stage as follows: 2-cell embryo: 0; 4-cell embryo: 1; 8-cell embryo: 2; morula: 3; early blastocyst: 4; normal blastocyst: 5; late blastocyst: 6; hatching blastocyst: 7; hatched blastocyst: 8; degenerated or fragmented embryo: -1. For each time point, each treatment group will be paired to the control group on the same plate at the same point in time. A paired t-test will then be performed between each experimental group at each point in time and both the M16-only control and the normal saline control. Resulting p-values will then be collected. A p-value of 0.05 will be deemed significant.

## **P35: Comparative Analysis of Sleep Patterns Among Medical Students: The Impact of Study Environment on Sleep Duration and Well-Being**

**Category:** *Educational Project*

**Authors:** Brittany Lawrence (OMS-II), Danielle Cabiran (OMS-III), David Strum (OMS-III), John Yassa (PGY-2), Michael Yusuf (PGY-2), Scott Severance

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### **Abstract:**

A lack of sleep in medical students can inflict a heavy toll on students' mental and physical health, often to the detriment of their academic performance. This study compares sleep patterns of pre-clinical medical students in two distinct periods: 2020, during the height of the COVID-19 pandemic, and 2023, following the return to in-person academic environments. Participants completed daily sleep surveys to report their electronics use before bed, caffeine consumption, and sleep habits. We looked at differences in sleep hygiene and the perceived influences of sleep in students studying primarily at home (2020) and those in traditional, in-person environments (2023). The 2020 cohort reported an average of 7.1 hours of sleep per night and cited the positive impact of sleep on both mental health and academic performance in post-study surveys. Conversely, the 2023 cohort reported an average of 5.7 hours of sleep, with only 45% of participants going to sleep at their self-selected bedtime and 55% having trouble falling asleep routinely. Interestingly, students from 2020 reported higher technology use before bed compared to the 2023 cohort, raising concern about students' knowledge about the effects of pre-bedtime technology use on sleep hygiene. These findings suggest that the shift in study environments may play a significant role in sleep patterns, with potential implications for academic performance and student well-being. Further research is needed to establish the connection between study environment, sleep quality, and perceived outcomes in medical students.

### **P36: Modern Utility of Pelvimetry: A relevant tool or an outdated concept?**

**Category:** *Educational Project*

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**Abstract:**

Dystocia or cephalopelvic disproportion (CPD) is a condition in which the pelvis of the mother is proportionately too small to allow a child to pass through during normal vaginal labor. Pelvimetry is the medical practice of acquiring the measurements of the female pelvis to identify potential cases of CPD. The use of pelvimetry in current obstetric and gynecological practice to predict dystocia is a controversial subject in modern-day medicine. There are no established timelines for measuring pelvic outlet dimensions during the pregnancy, and due to the action of hormones on the pelvic ligaments, the pelvic measurements will vary at different stages of pregnancy. Additionally, suspicion of cephalopelvic disproportion is not a complete contraindication for vaginal delivery, as this diagnosis can only be made after an unsuccessful trial of labor (TOL). Although the use of pelvimetric measurements may not be a good indicator to decide the mode of delivery, there is still an emphasis on teaching the pelvimetric concepts in clinical medicine, clinical anatomy textbooks, and standard pelvic exams. In this presentation, the compiled evidence from past research studies about the clinical utility of pelvimetry and its importance in medical education will be discussed.

**Key words:** Pelvimetry, Dystocia, Cephalopelvic disproportion

## **P37: The Influence of Sleep Tracking and Education on Medical Student Sleep Hygiene and Wellness**

**Category:** *Educational Project*

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### **Abstract:**

As future physicians, medical students learn how to educate patients about the important, but often overlooked, subjects of nutrition, exercise, and sleep. Oftentimes, students and physicians fail to implement these habits in their own lives. We expect that our sleep study will train participants how to implement healthy sleep habits and will educate them about the reasons why good sleep habits are so important for medical students, both now and in their future careers. The purpose of the study is to determine if providing “sleep tips” monthly and tracking sleep habits daily facilitate an improvement in participants maintaining a consistent bed-and wake-time, getting sufficient sleep, controlling technology use before bedtime, and limiting caffeine consumption.

We recruited participants using a ten-question, pre-study survey sent to first- and second-year LUCOM students. Using the SleepScore app, students tracked their daily sleep habits seven days a week, with or without the assistance of a smart watch. We chose the Sleepscore app because it monitored all the criteria that we deemed to be essential and because it was free. Participants report their data by completing ten-question surveys daily that we sent via email two times each day. The daily surveys probed sleep duration, if participants slept and awoke within ten minutes of their self-selected bedtime and wake-time, respectively, alertness during the day, daily mood, sleep score generated by the app, duration of naps taken the day before, caffeine consumption within four hours of bedtime, and electronic use within 30 minutes of going to sleep. We sent additional seven-question surveys to participants once a month to obtain data on sleep habit improvements, likelihood of maintaining better sleep habits, and any barriers that may have affected their sleep. Survey answers are recorded anonymously via Qualtrics. We shared tips and advice in monthly emails with the goal of helping participants improve their sleep habits. These emails provided information about time management, mental health, cognition, nutrition, caffeine consumption, and the importance of maintaining sleep habits. Throughout the study, participants will be incentivized to complete the daily and monthly surveys by being entered into a monthly drawing for gift cards when they complete a certain number of surveys. This study is currently ongoing, and the collection of data will end on December 13, 2024. After data collection has ceased, we will analyze the data to determine if participants in the study experienced improvement in their sleep habits and wellness.

We endeavored to study the impact of tracking and education on consistent sleep hygiene and overall perceived student wellness. Our hypothesis was that sleep hygiene can improve during the course of the semester. We expect that the results will show that persistence in the study was maintained and that filling out surveys and receiving sleep education improved sleep hygiene and increased medical student perceived wellness. Ideally, this information would be used to help medical students at schools across the country who may be struggling to prioritize consistent and adequate sleep.

## **P38: Medial Branch Nerves and Their Role in Low Back Pain: Anatomical Insights and Clinical Implications**

**Category:** *Educational Project*

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**Introduction:** Low back pain (LBP) is one of the most prevalent musculoskeletal complaints, often linked to disorders involving the zygapophyseal (facet) joints. The medial branch nerves, branches of the dorsal rami, play a key role in transmitting nociceptive input from these joints. Understanding their anatomy and role in pain transmission is crucial for effective diagnosis and treatment of facet-mediated LBP.

**Objective:** This project aims to highlight the anatomy, course, and clinical significance of the medial branch nerves in relation to LBP. By focusing on the innervation of the facet joints, we explore how these nerves contribute to the sensation of pain and present potential therapeutic interventions.

**Methods:** A detailed anatomical dissection was performed to trace the course of the medial branch nerves from the dorsal rami to their innervation of the lumbar facet joints, particularly L4 and L5. The relationship between these nerves and the facet joints was examined to assess their role in LBP. Relevant clinical studies were reviewed to support anatomical findings.

**Results:** The medial branch nerves were found to innervate the lumbar zygapophyseal joints and transmit nociceptive signals from these structures. These nerves follow a predictable anatomical course from the dorsal ramus, bifurcating into the medial and lateral branches. The medial branch specifically innervates the facet joint, making it a target for interventions like medial branch blocks or radiofrequency ablation (RFA) in patients with facet-mediated LBP.

**Conclusion:** Medial branch nerves play a crucial role in the pathophysiology of LBP, particularly in cases involving the facet joints. Targeted interventions, such as RFA, Facet Rhizotomy may provide significant pain relief by disrupting these nociceptive pathways. Further research into the precise mechanisms of medial branch nerve involvement in LBP could improve treatment outcomes and guide clinical practice.



**P39: Combining electrical stimulation and hypoxia to stimulate angiogenesis and improve the prognosis for post-operative femur fractures**

**Category:** *Systematic Review/Meta-analysis*

**Author:** Brett Dowler (OMS-II), William Dedmond (OMS-II), Gabrielle Jeifa (OMS-II), Joseph DiPetto (OMS-II), Jeffrey Jasperse

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**Abstract:**

We propose that the combination of post-surgical electrical stimulation treatment with generalized whole-body hypoxia will heal open reduction internal fixation (ORIF) -treated femur fractures quicker and decrease the chance of bone nonunion complications. Electrical stimulation mimics exercise, while depleting tissues of oxygen, therefore increasing angiogenesis stimulating growth factors like VEGF, HIF-1a, and PGC-1a in those tissues. Angiogenesis, the formation of new blood vessels, is vital to wound healing by accomplishing two main functions: one, supply the high-demand healing tissues with oxygen, nutrients, osteoprogenitor cells and growth factors; and, two, provide pathways to remove harmful metabolites and substances from healing tissues, fostering an environment that facilitates bone growth and remodeling. Whole-body hypoxia will further stimulate angiogenesis due to the growth factors secreted during the oxygen-diminished state including HIF1A and VEGF. The overlap of beneficial factors released during electrically stimulated exercise and hypoxia would provide a synergetic effect on the healing process. Whole-body hypoxia is chosen for this research over localized tourniquet-induced ischemia because our concept allows circulation to remain intact, thereby preventing an accumulation of toxic byproducts such as lactic acid, potassium, ROS, ADP and ammonia. Based on an analysis of published experiments, we postulate that future studies with bone fractures in model organisms be conducted using a post-operative therapy that combines electrical stimulation and whole-body hypoxia. We hypothesize that this therapy would optimize angiogenesis and growth factor production, ultimately accelerating healing time and promoting bone union.

## **P40: Examining Barriers to Ovarian Transplantation: Ethical, Medical, and Practical Considerations.**

**Category:** *Systematic Review/Meta-analysis*

**Authors:** Brittney Ruud (OMS-II), Natalie Bell (OMS-II), Eleanor Barden (OMS-II), Alexis Lewars (OMS-II), Anna Luce (OMS-II), Abigail McLaughlin (OMS-II), Benita Gollamudi (OMS-II), Brittany Lawrence (OMS-II), Hannah Gustafson (OMS-II), Mary Jarad (OMS-II), Monika Henin (OMS-II), Stany Lobo

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### **Abstract:**

Infertility, primarily caused by ovary-related issues, is rising globally, affecting many couples with limited solutions available. This has led to the exploration of ovarian tissue and whole ovary transplantation for both fertility and hormonal treatment. Pre-procedural considerations include sourcing the ovarian tissue and the ethics of conducting these procedures. Currently, ovarian tissue used in such procedures comes from familial donations or autologous transplantation. When compared to organ donation and transplantation, there is not enough emphasis given on ovarian donation and transplantation. Availability of In-vitro Fertilization (IVF) or surrogacy options, success rate, and the ethical issues related to the procedures could be some of the reasons for this. The ovary is part of both the endocrine system and a gamete-containing organ, so there is an added complexity for these donation procedures. There are only a few successful ovarian transplants reported in the literature; we believe this area needs more exploration and research.

For transplantation, both orthotopic and heterotopic placement have been explored. Heterotopic placement may address hormonal concerns but still requires IVF for fertility. Challenges during transplantation include follicle loss, repeat transplantations required, and re-implanted malignancy if the patient receives pre-cancer treatment ovarian tissue. Some spontaneous pregnancies have been reported after transplantation, but many patients still require IVF for pregnancy.

Most current studies on ovarian transplants focus on young female cancer patients, providing a limited sample demographic. The procedure remains elective and experimental, preventing insurance from covering the costs. Further experimental studies are needed to find statistical evidence for or against using ovarian transplants as a viable fertility and hormonal option. Developing advanced techniques in ovarian transplant procedures will be a permanent solution for female infertility and hormonal issues in women's health. This presentation will discuss the medical, ethical, and other possible factors hindering ovarian transplantation procedures.

**Key words:** Infertility, IVF, Surrogacy, Ovarian transplants

## **P41: Empowering Parental Decision-Making in Infant Formula Selection**

**Category:** *Systematic Review/Meta-Analysis*

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### **Abstract:**

With breastfeeding not always feasible for all mothers, infant formula provides an essential alternative for infant nutrition. Clinicians play a pivotal role in guiding parents through the selection of the most suitable formula among the numerous options, which include both plant-based and animal-based varieties. While cow's milk-based formulas have traditionally dominated, alternative formulas are increasingly popular, particularly since the 2022 formula shortage, which spurred many parents to turn to imported options. This rise in imported formula use, often driven by social media marketing, highlights a need for careful evaluation of these products to ensure they meet the safety and nutritional standards of FDA-approved formulas. Through an initial literature review, this presentation compares ingredients and nutritional compositions of widely available formulas, aiming to support parents with science-backed guidance. By empowering both healthcare providers and families with knowledge, this presentation prepares them to make informed choices that safeguard infant nutrition, even in the face of potential future shortages.

## **P42: Hearty error: Atrioventricular valves were designed for fetal circulation and failed to adapt?**

**Category:** *Systematic Review/Meta-analysis*

**Authors:** Julia Spiotta (OMS-II), Emma Heslep (OMS-II), Isaiah Adetoro (OMS-II), Eleanor Barden (OMS-II), Benita Gollamudi (OMS-II), Michael Hahn (OMS-II), Sam Harris (OMS-II), Monika Henin (OMS-II), Mary Jarad (OMS-II), Alexis Lewars (OMS-II), Abigail McLaughlin (OMS-II), Robin Solomon (OMS-II), Nana Yeboah (OMS-II), Stany Lobo

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### **Abstract:**

Development of the heart begins during the third week of intrauterine life from the two endothelial heart tubes in the cardiogenic area. During the process, the heart tubes fuse, cardiac dilations are formed, septation of the chambers and major vessels are derived from the fused heart tubes. During the embryonic period there is an essential right to left shunt of blood in the fetal heart. After birth, changes to the fetal circulation occur and adult circulation begins. All these changes are vital for the survival of the fetus after birth. In adult circulation, the left to right shunt supports the adult circulation without any significant functional deficits. The development of the mitral and tricuspid valves is essential for proper heart functioning, ensuring unidirectional blood flow throughout the heart and the rest of the body. From an anatomical perspective, the mitral valve separates the left atrium and ventricle and consists of two leaflets; the tricuspid valve separates the right atrium and ventricle and consists of three leaflets. The leaflets of atrioventricular valves are connected to the papillary muscles by the Chordae tendineae. The frequency of mitral valve prolapse and regurgitation in comparison to the tricuspid valve can be attributed mainly to structural distinctions between the two valves. The mitral valve, which is exposed to higher pressures, is implicated in more instances of pressure-related diseases when compared to the tricuspid valve. In contrast, tricuspid valve prolapse is rare. Embryological development of the atrioventricular valves is thought to be hemodynamically driven, but evidence to support this hypothesis is lacking. In this presentation we hypothesize that, if the left side of the heart had a tricuspid valve, it would have worked better for the high-pressure chambers and incidence of prolapse would have been significantly reduced. For some unknown reasons, the heart did not adapt to this change. Further studies in the molecular signaling of cardiac valve development may be required to support this hypothesis. This presentation will also point out the improper use of “Chordae tendineae” instead of “Cordae tendineae” when there is nothing musical in the heart. Chordae Tendinea has a distinctly musical connotation, which is not reflected in other “cord” structures in the human body and our suggestion is to correct this error.

### **P43: Breaking the Rules: A Comprehensive Review of Vasculature of the Brain.**

**Category:** *Systematic Review/Meta-Analysis*

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#### **Abstract:**

The central nervous system (CNS) is the most metabolically active system in the human body with the brain receiving about 700 to 750ml of blood per minute. Interruptions in blood supply can lead to loss of consciousness within 10 seconds, and a 50% reduction may cause ischemic penumbra. The brain's metabolic demands are met by the carotid and vertebrobasilar arterial systems, while venous drainage occurs through veins that empty into the dural venous sinuses and ultimately into the internal jugular veins. Cerebral vessels are essential not only for delivering oxygen, glucose, and other significant nutrients but also for removing carbon dioxide, lactic acid, and other metabolic waste products. Additionally, the glymphatic system — a glial-dependent perivascular network — assists with metabolic waste products as well. Unlike the generalized vascular architecture of the body, the basilar and major cerebral branches of the circle of Willis lack accompanying veins and the internal carotid artery and internal jugular vein enter the cranial cavity at different locations. Moreover, the vertebral vein does not begin in the cranial cavity to accompany the vertebral artery. The presence of cerebrospinal fluid (CSF) in the subarachnoid space and its function adds another level of complexity to cerebral nourishment. This review highlights much remains to be understood about these observations in neuroanatomy and more specifically, its embryological origins and potential benefits in human physiology. We hypothesize that intracranial pressure (ICP), glymphatic system, and embryology of cerebral vasculature significantly influence the unique design of brain vasculature. The presence of veins alongside of the arteries of the circle of Willis could reduce subarachnoid space volume, increase ICP, and potentially cause edema and other complications. Furthermore, the glymphatic system, provides a pseudo-lymphatic function to the brain. This system involves CSF entering the brain via periaxonal spaces, moving into the interstitium through perivascular astrocytic aquaporin-4, and facilitating the drainage of interstitial fluid (ISF) and solutes via perivenous routes. Dysfunction in glymphatic CSF-ISF exchange is implicated in various CNS pathologies. This presentation aims to further substantiate the importance of modulating ICP, the role of CSF, and the glymphatic system's contribution to the unique vascular flow.

**Key words:** Cerebrospinal fluid, Glymphatic, Circle of Willis, Dural venous sinus, Vertebra-basilar system.