55th Annual Midwest Student Biomedical Research Forum

Saturday, March 2, 2024

ROOM 3047

8:00 a.m. **O-04** EVALUATING THE ASSOCIATION BETWEEN MATERNAL DIETARY VITAMIN A STATUS AND FETAL KIDNEY DEVELOPMENT
Presenter: Anum Akbar, UNMC

8:15 a.m. **O-11** DIFFERENTIAL PATTERNS OF URBAN AND RURAL CARDIOVASCULAR EMERGENCY DEPARTMENT UTILIZATION AND CLINICAL OUTCOMES
Presenter: Alec Czaplicki, Creighton University

8:30 a.m. **O-36** PREDICTORS OF EMERGENCY DEPARTMENT UTILIZATION AND READMISSION AFTER LUMBAR SPINE FUSION SURGERY
Presenter: Stevin Lu, Creighton University

8:45 a.m. **O-44** ENHANCED DETECTION OF EPILEPTOGENIC ZONE USING PRISMA MRI IN PATIENTS WITH MRI-NEGATIVE FOCAL EPILEPSY
Presenter: Jack Mordeson, UNMC

9:00 a.m. **O-57** IMPACT OF MATERNAL SOCIOECONOMIC STATUS ON MATERNAL DIETARY B-VITAMIN INTAKE
Presenter: Rebekah Rapoza, UNMC

9:15 a.m. **O-64** CONES VS SLEEVES: A COMPARISON OF METAPHYSEAL FIXATION TECHNIQUES IN MANAGING SEVERE PROXIMAL TIBIAL BONE LOSS
Presenter: Jamal Salaymeh, UNMC

9:30 a.m. **O-72** NORMALIZED BMI MEASURES SCALE WITH ABERRANT NEURAL DYNAMICS UNDERLYING WORKING MEMORY PROCESSING IN YOUTH
Presenter: Thomas Ward, Creighton University

9:45 a.m. **O-74** OPTIMAL FILLING SOLUTION FOR THE DOUBLE BALLOON URINARY CATHETER: A LABORATORY ANALYSIS
Presenter: Clare Wieland, Creighton University

10:00 a.m. BREAK

EVALUATING THE ASSOCIATION BETWEEN MATERNAL DIETARY VITAMIN A STATUS AND FETAL KIDNEY DEVELOPMENT.

Authors: Anum Akbar[1], Matthew VanOrmer[1], Rebecca Slotkowski[1], Taija Hahka[1], Rebekah Rapoza[1], Melissa Thoene[1], Corrine Hanson[2], Ann Anderson-Berry[1], Teri Mauch[1]
1. Department of Pediatrics, University of Nebraska Medical Center, Omaha, NE
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Background:
Vitamin A is a fat-soluble vitamin that plays a crucial role in the development of fetal organs. In vitro, studies have indicated that total number of nephrons is impacted by vitamin A status; however, the effect of maternal dietary vitamin A intake on fetal kidney development remains unknown.

Significance of Problem:
suboptimal kidney growth and development can contribute to later renal dysfunction, it is important to identify potential etiologies and any modifiable factors such as maternal intake of vitamin A.

Hypothesis:
We hypothesize that maternal Vitamin A intake is associated with fetal and infant kidney development.

Experimental Design:
An IRB-approved study recruited pregnant women at 18-22 weeks of gestation. Women completed a food frequency questionnaire (DHQ III) to evaluate vitamin A intake between 24-28 weeks of gestation (n=72). Vitamin A intake was measured in retinol activity equivalents (RAE, mcg/day), and included food and supplemental sources. Bilateral kidney size and volume was measured both between 16-23 weeks gestation (n=69) and 24-48 hours after birth (n=61). Kidney length and volume were correlated with maternal vitamin A intake using Spearman's R. The Kruskal-Wallis test was used to compare kidney length and volume across quartiles of maternal vitamin A intake. A p-value of <0.05 was considered statistically significant.

Table 1. Median Kidney Measurements by Maternal Vitamin A Intake Quartiles

Right Kidney				
		Fetus	Infant	Change
Lowest Quartile 416-1881 µg/day	Length (cm)	2.14	4.39	2.19
	Volume (cm^3)	1.41	13.60	12.27
2nd Quartile 1881-2099 µg/day	Length (cm)	2.24	4.42	2.26
	Volume (cm^3)	1.78	13.65	11.45
3rd Quartile 2099-2561 µg/day	Length (cm)	2.15	4.14	1.99
	Volume (cm^3)	1.68	12.31	10.52
Highest Quartile 2561-5391 µg/day	Length (cm)	2.10	4.38	2.23
	Volume (cm^3)	1.81	14.01	11.90
Left Kidney				
		Fetus	Infant	Change
Lowest Quartile 416-1881 µg/day	Length (cm)	2.25	4.27	1.95
	Volume (cm^3)	1.46	11.13	10.19
2nd Quartile 1881-2099 µg/day	Length (cm)	2.20	4.48	2.19
	Volume (cm^3)	1.74	12.21	9.58
3rd Quartile 2099-2561 µg/day	Length (cm)	2.24	4.38	2.11
	Volume (cm^3)	1.77	11.92	11.55
Highest Quartile 2561-5391 µg/day	Length (cm)	2.14	4.58	2.51
	Volume (cm^3)	1.97	14.46	12.90

Result:
A total of 72 maternal-infant dyads were included in this analysis, with a median maternal age of 32 years. The median daily RAE intake was 2099 mcg/day. Infant left kidney length (R_s=0.26; p=0.04) and volume (R_s=0.26; p=0.05) were correlated with continuous maternal vitamin A intake. After adjustment for total energy intake, a 1,000 mcg/day increase in maternal RAE intake predicted a 3 cm^3 increase in infant left kidney volume (p<0.001). Similarly, a 1,000 mcg/day increase in maternal RAE intake predicted a $2.5x10^{-7}$ cm increase in infant left kidney length (p=0.01). There were no statistically significant associations between vitamin A intake and length or volume in the right kidney.

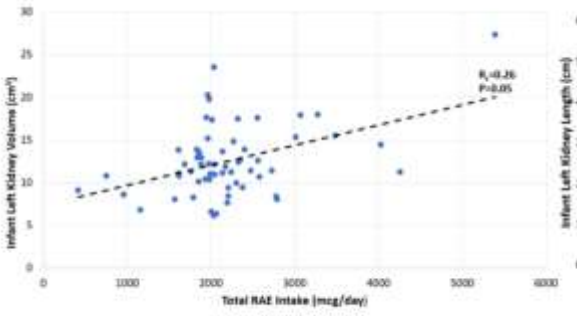

Figure 1. Infant Left Kidney Volume and Maternal RAE Intake

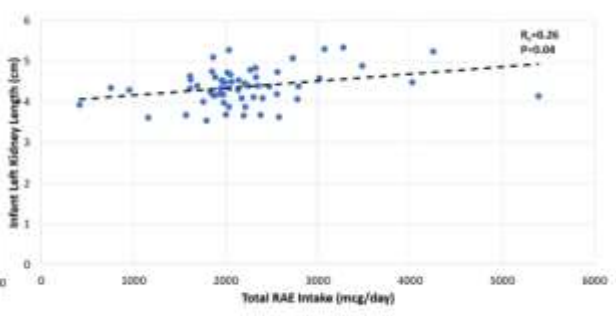

Figure 2. Infant Left Kidney Length and Maternal RAE Intake

Conclusion:
A positive correlation was found between continuous maternal vitamin A intake and infant left kidney length and volume, with a 1,000 mcg/day increase predicting a significant increase in volume and length after adjusting for total energy intake. These findings suggest a potential influence of maternal vitamin A intake on early infant kidney growth, emphasizing the importance of further research in this area.

DIFFERENTIAL PATTERNS OF URBAN AND RURAL CARDIOVASCULAR EMERGENCY DEPARTMENT UTILIZATION AND CLINICAL OUTCOMES

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Background: A recent report from The Center for Medicare & Medicaid Services detailed rural-urban disparities in health care with rural residents reporting similar experiences with care but worse outcomes compared to urban counterparts.

Significance of Problem: Previous studies highlight rural-urban disparities by patient residency; identifying these disparities in patients who present to the emergency department (ED) for cardiovascular disease (CVD) may improve the quality, care coordination, and overall care experience. More specifically, the evaluation of clinical characteristics and outcome differences by urban, micropolitan, and rural patients will provide insight into patient social risk factors and potential unmet needs.

Hypothesis, Problem, or Question: The primary aim was to identify patterns in clinical characteristics and outcomes (mortality, length of stay, cost, and revisits) of ED visits for five CVD diagnoses (myocardial infarction, heart failure, hypertension, atrial fibrillation/atrial flutter, and ischemic stroke) between urban, micropolitan and rural patients.

Experimental Design: ED visits for CVD were identified in the 2016-2020 Nebraska Emergency Department Database (SEDD) and Nebraska State Inpatient Database (SID). The SID captures all inpatient visits within Nebraska; we specifically identified those admitted from the ED. The SEDD captures all ED visits that do not result in a hospital admission. ED visits were stratified by patient urbanity as defined by Rural Urban Continuum Codes (Urban: 1-3, Micropolitan: 4-7, Rural: 8-9). Outcomes were assessed via logistic regression and lognormal models with a random intercept to account for the inherent correlation of patients treated at the same facility. Multivariable models were estimated to adjust for type of CVD diagnosis, Charlson Comorbidity Index, age, biological sex, insurance status, and income.

Results: Overall, in Nebraska from 2016-2020, there were 47,370 ED visits for a CVD diagnosis; 25,190 ED visits resulted in admission to the same treating facility. Compared to micropolitan and rural patients, urban patients presented younger (Urban median age= 68 vs. Micropolitan median age = 72, Rural median age = 73), more commonly had private insurance (Urban = 29% vs. Micropolitan = 24%, Rural = 25%) and were in the highest income quartile (Urban = 20% vs. Micropolitan = 0.5%). Notably, patient transfers were more common for micropolitan (26%) and rural patients (32%) compared to urban patients (17.42%; $p < .0.001$). Compared to urban patients, micropolitan and rural patients who were admitted to their treating facility had 60% and 97% greater adjusted odds of in-hospital mortality, respectively (Micropolitan v. Urban- aOR:1.60, 95% CI: 1.18-2.17, $p = 0.003$; Rural v. Urban- aOR 1.97, 95% CI: 1.34-2.89, $p < 0.001$). Hospital cost was higher for micropolitan and rural patients compared to urban patients; for those admitted to their treating facility, micropolitan patients had 10% increased cost (aOR: 1.10, 95% CI: 1.05-1.14, $p < 0.001$) and rural patients had 13% increased cost (aOR: 1.13, 95% CI: 1.07-1.20, $p < 0.001$). Similarly, ED visits of micropolitan and rural patients not admitted to their treating facility had increased cost compared to urban patients (Micropolitan v. Urban- aOR 1.09, 95% CI: 1.02-1.16, $p = 0.013$; Rural v. Urban – aOR: 1.13, 95% CI: 1.13 (1.06-1.22), $p < 0.001$). However, micropolitan and rural patients had lower adjusted odds of 30- and 90-day ED revisits. Overall, 20% of patients admitted to their treating facility revisited the ED within 30-days and 34% revisited the ED within 90-days. For patients who revisted the ED within 30 days, compared to urban patients, micropolitan patients had 18% lower adjusted odds of revisiting and rural patients had 25% lower adjusted odds of revisiting (Micropolitan v. Urban- aOR: 0.82, 95% CI: 0.73-0.93, $p = 0.002$; Rural v. Urban- aOR: 0.75, 95% CI: 0.61-0.92, $p = 0.006$). For patients who revisted the ED within 90 days, compared to urban patients, micropolitan patients had 15% lower adjusted odds of revisiting and rural patients had 40% lower adjusted odds of revisiting (Micropolitan v. Urban- aOR: 0.85, 95% CI: 0.76-0.96, $p = 0.008$; Rural v. Urban- aOR: 0.60, 95% CI: 0.50-0.74, $p < 0.001$).

Conclusions: In this statewide sample of ED presentations with CVD, we demonstrated urban-rural variation in patient characteristics, total cost, revisit rate, and death for five CVD diagnoses. A disparity in cardiovascular clinical outcomes is suggested in more rural areas. These findings warrant further investigation and inform population health initiatives in the delivery of clinical care.

PREDICTORS OF EMERGENCY DEPARTMENT UTILIZATION AND READMISSION AFTER LUMBAR SPINE FUSION SURGERY

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Background

Presentation to the emergency department (ED) following lumbar fusion surgery is common. Many of these visits can lead to increasing health care costs and low patient satisfaction, even when patients are not readmitted to the hospital. The patient and surgical factors that contribute to ED encounters and readmission remain unclear. The purpose of this study is to identify predictors associated with return to ED and readmission after lumbar spine fusion surgery.

Methods

Patients aged ≥ 18 years undergoing elective lumbar or lumbosacral fusion surgery for degenerative pathology from 2018 to 2022 at a single academic institution were included. Patients undergoing surgery for trauma, tumor, and/or deformity were excluded. A retrospective review of medical records was conducted. Patient and surgical characteristics and preoperative patient reported outcomes (PRO) scores including Oswestry Disability Index (ODI), 12-Item Short Form Survey (SF-12), Charlson Comorbidity Index (CCI), and Patient-Reported Outcomes Measurement Information System Computer Adaptive Testing (PROMIS/CAT) were obtained. ED visits or readmission within 3 months postoperatively were recorded. Univariate and multivariate regression models and chi-square tests were used to identify factors associated with ED presentation.

Results

495 patients were included. 268 (54.1%) were male. Average age was 65.3±11.2 years. Average CCI was 3.4±2.0. Average number of levels fused was 2.0±1.0. 59 patients (11.9%) had fusion to the pelvis. 93 patients (18.7%) returned to the ED and 74 patients (14.9%) were readmitted to the hospital within 3 months after their operation. For each one-unit increase in ODI, the odds of returning to the emergency department increased by 3.6% ($P = 0.09$). For each one-unit increase in PROMIS/CAT Depression Subscale, the odds of returning to the emergency department increased by 4.1% ($P = 0.06$). For patients who have fusion to the pelvis, the odds of returning to the emergency department is increased by 111.7% ($P = 0.06$). For each additional day stay in the hospital, the odds of returning to the emergency department increased by 8.3% ($P = 0.08$). Patients who had higher preoperative CCI scores (4.6±2.5 vs. 3.1±1.9) and longer hospital length of stay (4.1±1.9 vs. 3.5±2.5 days) were significantly more likely to be readmitted. ($P < 0.01$).

Discussion and Conclusion

ED utilization and readmission to the hospital following elective spine surgery is an under-recognized source of healthcare costs, leading to patient dissatisfaction. This study demonstrated increased odds of ED utilization and readmission in patients with poorer preoperative PRO scores, higher CCI, and longer hospital length of stay. This information may assist in patient counseling, selection, and optimization prior to elective lumbar spine surgery.

ENHANCED DETECTION OF EPILEPTOGENIC ZONE USING PRISMA MRI IN PATIENTS WITH MRI-NEGATIVE FOCAL EPILEPSY

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Background. Patients diagnosed with medically refractory focal epilepsy (MRFE) undergo brain imaging to identify an epileptogenic zone with an expectation of attaining seizure control via subsequent surgical treatment. The Prisma 3 Tesla (T) MRI utilizes 204 receiver channels, with 64 coils, and applies a faster gradient resulting in increased signal-to-noise ratio, which provides enhanced image resolution compared to conventional 3T MRI. The utility of Prisma MRI technology for presurgical evaluation of MRFE patients has not been formally evaluated.

Significance of Problem. Epilepsy is one of the most common neurologic diseases, affecting approximately 50 million people worldwide according to the World Health Organization. Approximately 20-30% of these patients suffer from medically refractory epilepsy defined as failure of seizures to respond to a trial of two adequately dosed anti-seizure medications. Long-term seizure freedom in MRFE—the goal of epilepsy surgery—is more likely in patients with a seizure-onset zone (SOZ) corresponding to a magnetic resonance imaging (MRI) detectable lesion. Unfortunately, 20-40% of patients with focal epilepsy do not have an identifiable lesion on 3T MRI. Currently, patients with MRI-negative focal epilepsy undergo lengthy presurgical evaluation which includes several imaging studies as well as invasive intracranial electroencephalographic (EEG) monitoring to identify an epileptogenic focus that can be removed to provide seizure control. The presurgical workup is time-intensive, costly, and carries risk of complications. Despite an extensive pre-operative evaluation, only about one-third of the patients without detectable lesions on conventional MRI become seizure free following resection. Our objective was to assess the capability of Prisma 3T MRI in identifying the relevant signal abnormalities when conventional 3T MRI has failed to detect an abnormality that corresponds to epileptogenic zones in patients with MRFE.

Research Hypothesis. Utilization of Prisma 3T MRI in the workup of patients with MRFE will enable discovery of epileptogenic zones not previously seen on conventional 3T MRI. This will in turn identify candidates for surgical intervention and lead to improved outcomes.

Experimental Design. Following Institutional Review Board (IRB) approval and informed consent, patients with MRFE who were 19 years or older and underwent Prisma 3T MRI in addition to the conventional MRI were identified. Those who did not have an identifiable etiology for their seizures based on prior 3T MRI or had discordant scalp EEG and MRI findings were included. All patients underwent brain imaging via Prisma 3T MRI using a standardized protocol. Primary outcome was defined as a new MRI finding that correlated with seizure onset zone (SOZ) determined via scalp electroencephalogram (EEG), stereotactic EEG (SEEG), or electrocorticographic (ECOG) grid implantation.

Results. Of 48 patients identified, 30 met the inclusion criteria. In seven patients, previously undiscovered imaging abnormalities including focal cortical dysplasia, mesial temporal sclerosis, a lesion in the pulvinar of the thalamus, choroid fissure cyst, and increased T2 hippocampal signal on Prisma 3T MRI, were identified. Fifteen of these patients completed surgical intervention, three of whom had discordant imaging findings on Prisma 3T MRI compared to conventional 3T MRI.

Conclusions. Inclusion of Prisma 3T MRI in the presurgical assessment of MRFE can enhance the diagnostic imaging capabilities and detect imaging abnormalities that were missed on conventional 3T MRI. Identification of these abnormalities can facilitate hypothesis generation for intracranial EEG implantation and can help delineate seizure-onset zone. Use of Prisma 3T MRI has the potential to decrease use of other diagnostic tests and reduce cost of presurgical evaluation.

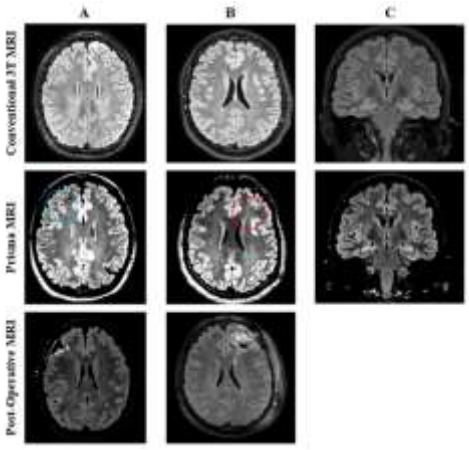

Figure 1. Comparisons of conventional (upper panel) and Prisma (middle panel) magnetic resonance imaging (MRI) scans with post-operative MRI if applicable in the lower panel. **(A)** Focal cortical dysplasia (blue circle) in patient 2. Axial T2 fluid-attenuated inversion recovery (FLAIR) weighted image on conventional 3 Tesla (T) MRI (upper panel) and Prisma 3T MRI (middle panel) demonstrating subtle cortical blurring in the right frontal cortex. Post-operative MRI (lower panel) with interval resection of focal cortical dysplasia. **(B)** Focal cortical dysplasia (red circle) in patient 3. Axial FLAIR weighted image on conventional 3T MRI (upper panel) and Prisma 3T MRI (middle panel) demonstrating left frontal linear hyperintensity extending from the left frontal horn of lateral ventricle to cortex. Post-operative MRI (lower panel) demonstrates interval resection of focal cortical dysplasia. **(C)** Possible hippocampal sclerosis in patient 12. Coronal FLAIR weighted image on conventional 3T MRI (upper panel) and Prisma 3T MRI (lower panel) demonstrating bilateral hippocampal hyperintensities. This patient is currently scheduled for bilateral RNS placement.

IMPACT OF MATERNAL SOCIOECONOMIC STATUS ON MATERNAL DIETARY B-VITAMIN INTAKE

Authors: Rebekah Rapoza[1], Matthew VanOrmer[1], Rebecca Slotkowski[1], Anum Akbar[1], Taija Hahka[1], Allison Zetterman[1], Anita Zhou[1], Megan Ott[1], Colman Freel[1], Kayla Adams[2], Andrea Rodriguez Dasta[3], Aly Freeman[1], Sarah Sweeney[1], Melissa Thoene[1], Corrine Hanson[4], and Ann Anderson-Berry[1]

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Background: The B-vitamins are critical metabolic co-factors in neurocognitive, immunological, hematological, endocrine, and gene regulation pathways. Insufficiencies of these micronutrients can have profound, deleterious effects on both fetal and maternal health outcomes. These include increased rates of neural tube defects, intrauterine growth restriction, and anemia for the fetus and increased risks of insulin resistance, depression, and cardiovascular dysfunction for the mother.

Significance of Problem: While previous studies have demonstrated the negative influence of low maternal socioeconomic status (SES) on maternal dietary intake, none to our knowledge have focused specifically on the effects of low maternal SES on B-vitamins.

Question: What is the relationship between markers of maternal SES (such as Food Security Score (FSS) and insurance type) and reported maternal intake of B-vitamins?

Experimental Design: An IRB-approved study enrolled 448 women who presented to Nebraska Medicine for delivery. The Harvard Food Frequency Questionnaire was utilized to quantify average daily B-vitamin intake during pregnancy. The USDA Household FSS Survey Module was collected to categorize participants into high (n=337), marginal (n=49), or low (n=62) food security groups. Insurance payor group, which was obtained from the electronic medical record, was dichotomized into public (n=187) and private (n=261) insurance groups. Kruskal-Wallis and Mann-Whitney U tests were performed to assess differences in reported maternal dietary intake of B1, B2, B3, B5, B6, B9, and B12 across FSS and insurance payer groups. Median B-vitamin intake between FSS groups was assessed post-hoc. A p-value < 0.05 was considered statistically significant.

Results: The median maternal age in our cohort was 29 years old (IQR: 25-33). There was a statistically significant difference in maternal B-vitamin dietary intake across the FSS groups for B1 (p=0.01), B2 (p=0.01), B3 (p=0.01), B6 (p=0.01), B9 (p=0.02), and B12 (p=0.02). Median B-vitamin intake was consistently lowest in the marginal FSS group compared to both high and low FSS groups. Median B9 (folate) intake was lower in the public insurance payor group as compared to the private insurance payor group (808.53 mcg vs 1007.33 mcg, p=0.02).

B vitamin	US Household FSS Median intake (mcg) IQR			p-value
	High	Marginal	Low	
B1 (Thiamin)	2.73 (1.92-3.47)	2.30 (1.41-3.08)	2.86 (1.96-3.82)	**0.013**
B2 (Riboflavin)	3.26 (2.39-4.14)	2.60 (1.98-3.57)	3.29 (2.59-4.56)	**0.010**
B3 (Niacin)	37.70 (27.38-46.02)	29.64 (22.49-40.40)	39.56 (31.02-49.70)	**0.013**
B5 (Pantothenic acid)	6.51 (5.02-10.03)	5.99 (4.38-9.54)	7.26 (5.85-12.42)	0.066
B6 (Pyridoxine)	3.96 (2.72-5.17)	3.12 (2.01-4.46)	4.20 (3.08-5.50)	**0.012**
B9 (Folate)	910.77 (608.97-1251.78)	694.41 (434.45-1151.86)	971.27 (641.89-1323.72)	**0.020**
B12 (Cobalamin)	11.02 (6.90-14.52)	7.72 (5.55-13.32)	11.01 (8.12-16.21)	**0.015**

Conclusion: We found that pregnant women with marginal FSS had the lowest intake of B vitamins during pregnancy, which may suggest that women in this group do not have access to the same resources as women in high and low FSS groups. Future studies should expand the enrollment of women from marginal, low, and very-low FSS groups as well as measure the concentrations of these micronutrients in maternal and fetal plasma samples.

Title: CONES VS SLEEVES: A COMPARISON OF METAPHYSEAL FIXATION TECHNIQUES IN MANAGING SEVERE PROXIMAL TIBIAL BONE LOSS

Authors: Bradford P. Zitsch[1], Jamal K. Salaymeh[2], Michael Burdyny[2], Brandt Buckner[1], Elizabeth R. Lyden[1], Beau S. Konigsberg[1], Kevin L. Garvin[1], Curtis W. Hartman[1]

Affiliations:

1. Department of Orthopaedic Surgery, University of Nebraska Medical Center, Omaha, Nebraska.
2. College of Medicine, University of Nebraska Medical Center, Omaha, Nebraska.

Abstract:

Background

Severe tibial bone loss is commonly encountered in revision total knee arthroplasty (rTKA) and is often managed with metaphyseal cones or sleeves. Cones and sleeves attach to host bone via a porous surface and fill the bone defect with tantalum or titanium metal. This study compares highly porous second-generation titanium metaphyseal cones and porous-coated metaphyseal sleeves for the management of severe proximal tibial bone loss in rTKA with respect to implant survival, complications, and clinical outcomes.

Significance of Problem

Currently, there are no defined guidelines for metaphyseal fixation in rTKA. Only a small number of studies directly compare tibial cones and sleeves, and there are currently no studies comparing the two augment types in the setting of severe proximal tibial bone loss.

Question

Are metaphyseal cones or sleeves more effective in managing severe proximal tibial bone loss in rTKA with respect to implant survival, complications, and clinical outcomes?

Experimental Design

A retrospective review was performed on 52 knees in 44 patients undergoing rTKA in which metaphyseal cones or sleeves were used to manage severe proximal tibial bone loss (34 cones and 18 sleeves). Tibial defects classified as 2B or 3 according to the Anderson Orthopaedic Research Institute (AORI) classification were included. All radiographs were assessed for osseointegration and radiolucency. Reason for index procedure, postoperative complications, and revision surgeries were evaluated. Implant survival was estimated using the Kaplan-Meier method. Functional outcomes were assessed pre-operatively and annually thereafter using the Knee Society Score (KSS). The median follow-up was 41.0 months.

Results

Metaphyseal sleeves demonstrated 100% survival at 4 years postoperatively; cones had 100% and 93% survival at 2 and 4 years, respectively. Compared to a pre-operative baseline, median KSS improvement 4 years postoperatively was 28 and 47.5 points for cones and sleeves, respectively. Eleven patients required revisions, with no cones and one sleeve revised due to augment loosening. Revision risk was higher for sleeves ($p < 0.01$), particularly when utilizing hybrid fixation. However, there is no difference between the two augment types when septic causes of revision are excluded ($p = 0.55$). There was no significant difference between cones and sleeves in aseptic survival at 2 and 4 years, presence of progressive radiolucent lines, cumulative incidence of revision, and KSS at any given time point.

Conclusion

For the management of severe proximal tibial bone defects, both metaphyseal cones and sleeves yielded improvements in patient functional outcomes, showed evidence of osseointegration radiographically, and subsequently demonstrated high implant survival rates four years postoperatively. Sleeves were associated with a slightly higher incidence of all-cause revision compared to cones, especially when utilizing hybrid fixation. Future studies with a larger sample size and greater power are needed to elucidate this association.

NORMALIZED BMI MEASURES SCALE WITH ABERRANT NEURAL DYNAMICS UNDERLYING WORKING MEMORY PROCESSING IN YOUTH

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Abstract

Background: Pediatric obesity is one of the most serious public health issues the modern world faces. Deleterious behavioral effects scaling with obesity have been demonstrated in cognitive tasks in children and adults, yet the neural mechanisms underlying these changes remain largely unstudied.

Methods: 89 youth (6-14 years old) performed a verbal working memory task during high-density magnetoencephalography (MEG). The MEG data was transformed into the time-frequency domain and neural oscillatory responses during encoding and maintenance phases were imaged separately using a beamformer. Each participant's height, weight, sex, and age were used to create age-and-sex-adjusted BMI (i.e., zBMI) measures. Whole-brain correlation maps were examined for effects of obesity on neural dynamics serving encoding and maintenance.

Results: Behaviorally, task accuracy and reaction time were strongly correlated with age, such that older youth were faster and more accurate than their younger peers. Behavioral metrics were not associated with zBMI. Neural oscillatory activity in the alpha and theta spectral bands (e.g., 4-7 Hz, 8-12 Hz, respectively) scaled with zBMI in several left-hemisphere regions, including occipital, temporal, and frontal cortices. During the encoding phase, elevated zBMI was associated with *stronger* alpha oscillatory activity (i.e., greater decrease in power relative to baseline) and *weaker* theta activity (i.e., smaller increase in power relative to baseline). Conversely, in the maintenance window, higher zBMIs were associated with *weaker* alpha activity.

Conclusions: Taken together, our results indicate that oscillatory dynamics in brain regions involved in the phonological loop of working memory are potentially vulnerable to process-specific effects of obesity. In the maintenance phase, weaker alpha oscillations were associated with higher zBMI, whereas during encoding processes, stronger alpha and weaker theta oscillations were associated with higher zBMI. These findings may reflect both deleterious and compensatory effects of obesity on working memory, suggesting that stronger neural recruitment during encoding is necessary to overcome weaker maintenance processes in youth with elevated zBMI.

OPTIMAL FILLING SOLUTION FOR THE DOUBLE BALLOON URINARY CATHETER: A LABORATORY ANALYSIS

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Introduction and Objectives

For patients with nerve injury to the bladder, such as those with spina bifida, multiple sclerosis, stroke or spinal cord injury, long-term indwelling catheterization (LTIC) is a necessary part of their care continuum. Duette Double Balloon Catheters (DDBC) have been developed as a newer option for LTIC to reduce the risk of catheter associated urinary tract infections (CAUTI). However, when filled with the standard sterile water typically used for single balloon catheters, they are prone to deflate within the bladder over the monthly catheterization period. This can lead to further complications such as hematuria, urinary tract infections, and bladder mucosal injury, increasing the risk of injury for patients who rely on LTIC. Titrated glycerin solutions have been proposed as an alternative to the sterile water filling solution. Our study aims to determine the glycerin concentration that best maintains the volume of DDBC balloons to prevent deflation.

Methods

DDBCs were inflated using normal saline, sterile water, 10% glycerin, 20% glycerin, 30% glycerin and 40% glycerin solutions. Three replicates were measured for each solution, with 18 total catheters measured. Three 2L sterilized beakers holding 600mL of synthetic urine were maintained at 37 degrees Celsius to mimic internal body temperature. Six catheters, one of each filling solution, were placed in each beaker. Photos were taken on days 0, 1, 3, 5, 7, 14, 21, and 28. Balloon diameter was measured with photo analysis using the Tracker software. Final balloon volumes were recorded at the end of the 28-day period. A one-way ANOVA was performed to compare the mean final balloon volumes for the different solution groups.

Results

The relative volume changes (%) and final volumes of the 5cc and 10cc balloons for each filling solution are presented in Figure 1. Of note, the 30% glycerin solution and 20% glycerin solution exhibited the least change in volume for the 5cc and 10cc balloon, respectively. The sterile water solution experienced the greatest relative volume change for both the 5cc and 10cc balloon. The sterile water solution also resulted in the lowest final volumes for both balloons, 2.17mL (SD: 0.06) and 6.27mL (SD: 0.12), respectively. ANOVA analysis revealed a significant difference in the mean final volumes among the different solution groups in the 5cc balloon ($F(5,12) = 89.305$, $p =<.001$) and in the 10cc balloon ($F(5,12) = 847.778$, $p =<.001$).

Conclusions

30% glycerin solution and 20% glycerin solution demonstrated the least amount of change in the 5cc balloon volume and 10cc balloon volume over 28 days, respectively. Using 30% filing solution for 5cc balloon and 20% filing solution for 10cc balloon could help minimize DDBC balloon deflation and its associated complications. Further in-vivo studies are needed to validate these results.

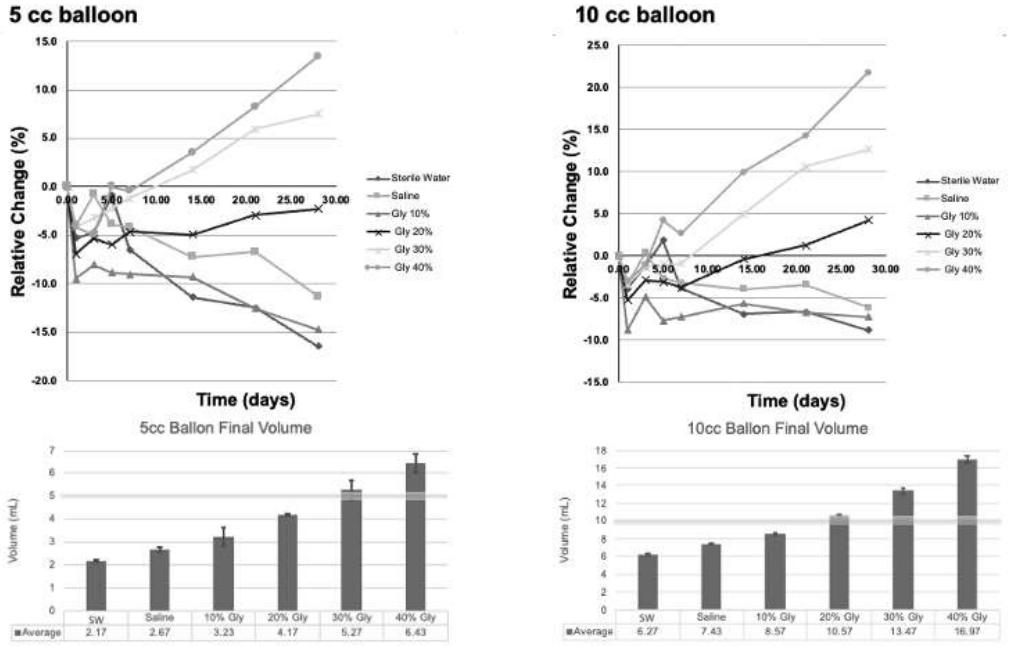

Figure 1. The relative volume changes (%) and final volumes of the 5cc and 10cc balloons for sterile water (SW), saline, 10%, 20%, 30%, 40% glycerin.