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## CASE REPORT

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Effectiveness of a Pilot Breastfeeding Educational Intervention Targeting High BMI Pregnant Women

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ABSTRACT

Introduction. Overweight and obesity during pregnancy are associated with adverse health outcomes leading to increased maternal and neonatal morbidity and mortality. Women with a high body mass index (BMI) also experience low breastfeeding rates. There is limited evidence of effective educational programs that aim to improve length of breastfeeding among this population. The main objective of this pilot educational intervention was to determine knowledge and skills retention at six weeks after completion of a breastfeeding class.

Methods. A two-hour breastfeeding class was offered during the second and third trimester of pregnancy targeting high BMI women. A longitudinal, survey study design was conducted using two data collection points. No comparator group was employed.

Results. Baseline mean age of respondents was 26.6 years (SD = 5.7). Respondents who completed post-intervention surveys were largely white (69.2%) followed by Hispanic (15.4%) and non-Hispanic black (15.4%), some college (57.1%), earned less than $50,000/year (64.3%), had employer-provided insurance (53.8%), and did not receive WIC benefits (78.6%). Most respondents had a pre-pregnancy BMI category of overweight (28.6%) or obese (57.1%). The intervention appeared to have some impact on responses. The following were observed: an increased understanding that baby may be fussy in the evening hours and wants to nurse more often (p < 0.002), how to bring baby to the breast (p = 0.004), knowing what to do if breastfeeding hurts (p = 0.031), and knowing what to do when baby has trouble breastfeeding (p = 0.021).

Conclusion. Consistent with previous findings, all participants in our study reported increased knowledge to breastfeed. Thus, women’s confidence to breastfeed their infant is enhanced through knowledge obtained from breastfeeding education. Additional studies are underway to assess breastfeeding behaviors.

INTRODUCTION

In the United States, 68% of all women are either overweight (27%) or obese (41%).1 Globally, from 2005 to 2014, the U.S. was the fourth leading country with an increased burden of overweight and obesity among pregnant women, trailing India, China, and Nigeria, respectively.2 The number of overweight and obese pregnant U.S. women increased from 1,853,400 women in 2005 to 1,923,400 in 2014, a rise of 3.8%. Most notably, in 2014, the U.S. had the highest number of obese pregnant women (1.07 million), followed by China at 1.06 million, India at 1.01 million, and Nigeria at 830,000.

Overweight and obesity during pregnancy are associated with adverse health outcomes for mother and child, including gestational diabetes, preeclampsia, cesarean section, prematurity, shoulder dystocia, and macrosomia, leading to increased maternal and neonatal morbidity and mortality.3-4 Women with a high body mass index (BMI) also experienced low breastfeeding rates due to an increased likelihood of high intervention births, delayed lactogenesis II, postpartum edema, and psychosocial factors.5-7

Breastfeeding duration is associated with a reduction in maternal postpartum weight among overweight and obese women.8,9 However, there is limited evidence of effective educational programs that aim to improve length of breastfeeding among this population.10 Given current recommendations that infants be exclusively breastfed for the first six months,11 a two-hour breastfeeding class was offered during the second and third trimester to pregnant women. The aim of this pilot educational intervention was to determine knowledge and skills retention at six weeks after completion of a breastfeeding educational class offered in an urban and rural setting.

METHODS

This project was approved by the university’s Institutional Review Board. A longitudinal, survey study design was conducted utilizing two data collection points. No control or comparator group was employed. Maternal baseline data were obtained via a survey instrument administered immediately prior to the breastfeeding class. Approximately four to six weeks after class completion, respondents were contacted via telephone and asked to re-take the survey (post-intervention). The GREET (Guideline for Reporting Evidence-based practice Educational Interventions and Teaching) checklist was used to prepare this brief report.12

Curriculum Content. The breastfeeding curriculum was based on the Office on Women’s Health Your Guide to Breastfeeding that is aligned with nutritional requirements set by the U.S. Department of Agriculture’s Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) including parenting and maternity care practices of specific state-based and nonprofit organizations.13-15 Content of the two-hour breastfeeding curriculum focused on the following topics: establishing and maintaining a sufficient and safe breast milk supply, breast anatomy and physiology, maternal diet and lifestyle choices, prescription and non-prescription medications, infant stomach capacity, baby behavior feeding cues, breast milk expression, safe handling and storage of breast milk, returning to work, safe preparation of infant formula, biologically appropriate bottle feeding, and local community breastfeeding resources. Participants received the following hand-outs: 1) A hard copy of the Your Guide to Breastfeeding; and 2) A hard copy of the instructor’s PowerPoint presentation that was part of the breastfeeding curriculum.

Participants and Procedures. The two-hour breastfeeding class was offered at two locations: an obstetrical clinic in a midwestern metropolitan city and a critical access hospital in a rural region of a midwestern state (Table 1). Each of these settings carried a patient...
load of pregnant women with an average BMI of 29; therefore, pregnant women with high body mass index (BMI ≥ 25 and < 40) were targeted but no woman who had a BMI outside of these parameters was denied participation in the class. At the urban obstetrical clinic, participants were contacted and recruited by a nurse at their prenatal appointment. The breastfeeding class was held in the early evening hours in a conference room at the obstetrical clinic.

At the rural location, participants were recruited to participate in a comprehensive prenatal program including the breastfeeding class by a prenatal nursing supervisor who was employed with a critical access hospital. The breastfeeding class, Session 4-Feeding your Baby, was offered as part of a prenatal program that comprised six prenatal educational sessions described as follows: Session 1-You and Your Pregnancy; Session 2-Healthy Pregnancy; Session 3-Labor and Delivery; Session 4-Feeding your Baby; Session 5-Newborn and Infant Care; and Session 6-Health after Pregnancy. The breastfeeding class was held in the afternoon in a conference room at the critical access hospital. At both locations, light snacks were provided, and women could bring a support person to class with them.

The principal investigator was present during all classes at both locations. Instruction of all classes was provided in a group setting. Participants spent two hours of face-to-face contact with the instructor; they did not engage in self-directed learning activities. Participants could ask questions at any time during the two-hour breastfeeding class. The curriculum for the breastfeeding class is taught to all pregnant women across Kansas regardless of BMI category; course material was neither modified nor adapted for the learners in the current pilot study. A $20 gift card was provided to participants upon post-survey completion.

Table 1. Schedule of breastfeeding classes (educational intervention).

| Class date | Participants | Support personnel | Instructor | Location          |
|------------|--------------|-------------------|------------|-------------------|
| Apr. 2017  | 1            | 1                 | 1          | Urban obstetrical clinic |
| Apr. 2017  | 10           | 5                 | 1          | Urban obstetrical clinic |
| May 2017   | 5            | 2                 | 1          | Urban obstetrical clinic |
| May 2018   | 3            | 1                 | 1          | Critical access hospital |
| June 2018  | 3            | 1                 | 1          | Critical access hospital |
| Oct. 2018  | 2            | 2                 | 1          | Critical access hospital |
|            | **16**       |                   |            |                   |

Two additional participants completed the survey instrument but did not attend the breastfeeding class.

Each breastfeeding class was taught in-person by an International Board-Certified Lactation Consultant (IBCLC). An IBCLC is a professional designation for a healthcare professional who specializes in the clinical management of breastfeeding and who is certified by the International Board of Lactation Consultant Examiners. Each instructor taught three classes at the same location. Both instructors were female, used the same PowerPoint slide deck for each class, and used props including a baby doll and a mock stuffed breast to convey knowledge. Each instructor had a master’s degree in nursing and a combination of more than five years of teaching experience in human lactation within academic and/or clinical settings.

Survey Instrument. A survey instrument was designed and administered to measure learners’ knowledge of breastfeeding. The following eight constructs were measured: 1) physiology of breastfeeding (six response items); 2) bringing baby to the breast and nursing positions (six response items); 3) birthing experience (six response items); 4) signs breastfeeding goes well (six response items); 5) breast milk supply and supplementation (five response items); 6) common breastfeeding concerns (seven response items); 7) length of breastfeeding (four response items); and, 8) caution with breastfeeding (four response items). The survey instrument was pretested on eight women of reproductive age who were not affiliated with the study. Their feedback was used to shorten a few of the questions, simplify wording, and condense the length of the survey.

The paper version of the survey instrument was administered immediately prior to the breastfeeding class (baseline). Respondents were asked to choose an identifier and enter the code in the upper right-hand corner. Approximately four to six weeks after completion of the breastfeeding class, participants were asked via telephone to re-take the survey (post-intervention). Upon participants’ consent, a paper copy of the survey was then mailed to them via regular U.S. mail. Similarly, they were asked to enter their code in the upper right-hand corner of the instrument.

Data Management and Statistical Analysis. Research staff entered the baseline- and post-intervention data into Research Electronic Data Capture (REDCap®), a secure web-based application designed to support and manage data capture for research studies. Descriptive statistics were presented on maternal demographics, body mass index (BMI), smoking status, stage of pregnancy, parity, diabetes status, prematurity, and pregnancy complications. Frequencies and percentages were used to summarize all baseline and post-survey data (Table 2). Because data were sparse, all item responses were collapsed into three categories. Matched pair responses were assessed with two-sided, exact sign tests. To adjust for multiple tests, a Bonferroni correction was used to establish the criterion level significance, alpha = 0.05/22 or 0.00227.

RESULTS

Maternal demographic and health characteristics are described in Table 2. Baseline mean age of respondents was 26.6 years (SD = 5.7). Respondents who completed post-intervention surveys were largely white (69.2%) followed by Hispanic (15.4%) and non-Hispanic black (15.4%), some college (57.1%), earned less than $50,000/year (64.3%), had employer-provided insurance (53.8%), and did not receive WIC benefits (78.6%). Most respondents had a pre-pregnancy BMI category of overweight (28.6%) or obese (57.1%), did not smoke...
(92.9%), and were in their third trimester of pregnancy (66.7%). More than three quarters of women (78.6%) reported not having had a live birth and did not have prematurity (85.7%). Two women reported that they were diagnosed with type 1 diabetes mellitus and seven women reported their pregnancy was considered high-risk for reasons not known.

Comparison of baseline and post-intervention survey responses are shown in Table 3. Results showed responses differed significantly for the item “It is normal that my baby may be fussy in the evening hours and wants to nurse more often”: 57.1% agreed or strongly agreed prior to the intervention versus 100.0% after the intervention, p < 0.002. While no other item differed significantly per the adjusted alpha, the intervention appeared to have some impact on responses. For example, we observed differences in women’s responses to the questions on how to bring baby to the breast (p = 0.004), knowing what to do if breastfeeding hurts (p = 0.031), and knowing what to do when baby has trouble breastfeeding (p = 0.021).

Table 2. Maternal demographic and health characteristics.

| Description | Baseline | | | Post-intervention | | |
|---|---|---|---|---|---|---|
| | n | % | | n | % | |
| What is your age? mean ± sd | 26.6 ± 5.7 | 26.4 ± 5.1 | |
| What is your ethnicity/race? | | | | |
| White, not of Hispanic origin | 14 | 53.8 | 9 | 69.2 | |
| Black, not of Hispanic origin | 2 | 7.7 | 2 | 15.4 | |
| Hispanic | 4 | 15.4 | 0 | 0 | |
| White, of Hispanic origin | 4 | 15.4 | 2 | 15.4 | |
| Asian or Pacific Islander | 1 | 3.8 | 0 | 0 | |
| Multiracial | 1 | 3.8 | 0 | 0 | |
| What is the highest level of education that you have completed? | | | | |
| Some high school | 2 | 8 | 1 | 7.1 | |
| Graduated from high school | 4 | 16 | 0 | 0 | |
| Some college | 8 | 32 | 8 | 57.1 | |
| Graduated with an associate degree | 2 | 8 | 1 | 7.1 | |
| Graduated with a bachelor’s degree | 4 | 16 | 1 | 7.1 | |
| Advanced degree (e.g., Masters, Ph.D., M.D., J.D.) | 5 | 20 | 3 | 21.4 | |
| During the last 12 months before your current pregnancy, what was your gross yearly total household income before taxes?* | | | | |
| $9,999 or less | 4 | 16 | 2 | 14.3 | |
| $10,000 to $24,999 | 3 | 12 | 4 | 28.6 | |
| $25,000 to $49,999 | 6 | 24 | 3 | 21.4 | |
| $50,000 to $74,999 | 5 | 20 | 2 | 14.3 | |
| $75,000 to $99,999 | 3 | 12 | 0 | 0 | |
| $100,000 or more | 4 | 16 | 3 | 21.4 | |
| Do you currently have health insurance? | | | | |
| No | 1 | 4.2 | 0 | 0 | |
| Yes | 23 | 95.8 | 13 | 100 | |
| If yes, please check one of the following | | | | |
| Private (employer provided) | 13 | 56.5 | 7 | 53.8 | |
| Public (e.g., Medicaid, KanCare) | 10 | 43.5 | 6 | 46.2 | |
| During your current pregnancy, are you on WIC (the Special Supplemental Nutrition Program for Women, Infants, and Children)? | | | | |
| No | 21 | 80.8 | 11 | 78.6 | |
| Yes | 5 | 19.2 | 3 | 21.4 | |
| BMI category 3 months prior to pregnancy | | | | |
| Normal 18.5-24.9 | 3 | 12 | 2 | 14.3 | |
| Overweight 25.0-29.9 | 6 | 24 | 4 | 28.6 | |
| Obese 30+ | 16 | 64 | 8 | 57.1 | |
Table 2. Maternal demographic and health characteristics, cont.

| Description                                                                 | Baseline |          | Post-intervention |          |
|------------------------------------------------------------------------------|----------|----------|-------------------|----------|
|                                                                              | n        | %       | n                 | %       |
| Do you currently smoke cigarettes?                                          |          |         |                   |         |
| No                                                                           | 25       | 96.2    | 13                | 92.9    |
| Yes                                                                          | 1        | 3.8     | 1                 | 7.1     |
| How far along are you in your pregnancy?                                    |          |         |                   |         |
| 2nd trimester                                                                | 10       | 38.5    | 4                 | 33.3    |
| 3rd trimester                                                                | 16       | 61.5    | 8                 | 66.7    |
| Not including your current pregnancy, how many live births have you had?     |          |         |                   |         |
| None                                                                        | 17       | 65.4    | 11                | 78.6    |
| 1 birth                                                                     | 4        | 15.4    | 1                 | 7.1     |
| 2 births                                                                    | 4        | 15.4    | 2                 | 14.3    |
| 3 births                                                                    | 1        | 3.8     | 0                 | 0       |
| If you have been diagnosed with pre-gestational diabetes, please indicate what type: |          |         |                   |         |
| Type 1 diabetes                                                              | 2        | 100     | 2                 | 100     |
| Type 2 diabetes                                                              | 0        | 0       | 0                 | 0       |
| Have you had a pre-term delivery (your baby was born before 37 weeks of pregnancy)? |          |         |                   |         |
| No                                                                           | 24       | 92.3    | 12                | 85.7    |
| Yes (reason given: premature rupture of membranes)                          | 2        | 7.7     | 2                 | 14.3    |
| Why is your current pregnancy considered high risk? Check all that apply.    |          |         |                   |         |
| Other reason                                                                 | 10       | 41.7    | 7                 | 50      |
| Not considered a high-risk pregnancy                                         | 7        | 29.2    | 2                 | 14.3    |
| Gestational diabetes (diabetes associated with pregnancy)                    | 4        | 16.7    | 1                 | 7.1     |
| Abnormal fetal testing (for example: abnormal sonogram findings, abnormal growth, etc.) | 2        | 8.3     | 1                 | 7.1     |
| Family history of birth defect or genetic condition                          | 2        | 8.3     | 0                 | 0       |
| Pre-gestational diabetes (diabetes diagnosed before pregnancy)              | 2        | 8.3     | 2                 | 14.3    |
| Gestational hypertension or pre-eclampsia (high blood pressure associated with pregnancy) | 1        | 4.2     | 2                 | 14.3    |
| Thyroid disease                                                              | 1        | 4.2     | 0                 | 0       |
| Chronic hypertension (high blood pressure before pregnancy)                  | 0        | 0       | 1                 | 7.1     |
| Vaginal bleeding                                                             | 0        | 0       | 1                 | 7.1     |

* Includes your income, your spouse’s income, and any other income you may have received.

Response differences also were observed regarding women’s awareness of baby being more awake and crying more during the second night after birth (p = 0.016), being more comfortable expressing milk by hand (p = 0.016), and understanding that when using formula during the early days would mean that she will produce less breast milk later (p = 0.039). Last, response differences were found in women’s understanding that baby’s colickiness is not a sign of low milk supply (p = 0.021). There were no statistically significant differences to the response items on the following breastfeeding constructs: physiology of breastfeeding, signs that breastfeeding goes well, length of breastfeeding, and caution with breastfeeding.

**DISCUSSION**

This study’s objective was to determine knowledge and skills retention of breastfeeding after completion of an educational class. Consistent with previous findings that breastfeeding education enhances women’s knowledge and skills to breastfeed, all participants in our study reported increased knowledge of bringing baby to the breast. Thus, women’s confidence to breastfeed their infant is enhanced through knowledge obtained from breastfeeding education. As such, breastfeeding education becomes an important strategy to improve breastfeeding rates.
Table 3. Comparison of pre- and post-intervention survey responses.

| Constructs                                      | Baseline |          |          |          |          |          |          |          |
|-------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|
|                                                  | n        | %        | n        | %        | n        | %        | p        |
| Description/responses                            |          |          |          |          |          |          |          |
| Physiology of breastfeeding                       |          |          |          |          |          |          |          |
| The nutrients and antibodies contained in early breast milk (called colostrum) is just the right amount for my baby. |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 24       | 92.3     | 13       | 92.9     | 14       | 100.0    | 0.180    |
| Don’t know                                       | 1        | 3.8      | 0        | 0.0      | 0        | 0.0      |          |
| Disagree: somewhat-strongly                      | 1        | 3.8      | 1        | 7.1      | 0        | 0.0      |          |
| In the early days, my baby’s stomach is very small so that he/she only needs less than 1 ounce at each feeding. |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 20       | 76.9     | 11       | 78.6     | 13       | 92.9     | 0.625    |
| Don’t know                                       | 3        | 11.5     | 1        | 7.1      | 0        | 0.0      |          |
| Disagree: somewhat-strongly                      | 3        | 11.5     | 2        | 14.3     | 1        | 7.1      |          |
| By about one month of age, my baby needs about 2.5 to 5 ounces of breast milk per feeding. |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 18       | 69.2     | 10       | 71.4     | 13       | 92.9     | 0.375    |
| Don’t know                                       | 7        | 26.9     | 3        | 21.4     | 1        | 7.1      |          |
| Disagree: somewhat-strongly                      | 1        | 3.8      | 1        | 7.1      | 0        | 0.0      |          |
| Bringing baby to the breast and nursing positions|          |          |          |          |          |          |          |
| I know how to bring my baby to the breast so that he/she can get a good latch. |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 14       | 53.8     | 5        | 35.7     | 14       | 100.0    | 0.004    |
| Don’t know                                       | 9        | 34.6     | 7        | 50.0     | 0        | 0.0      |          |
| Disagree: somewhat-strongly                      | 3        | 11.5     | 2        | 14.3     | 0        | 0.0      |          |
| I know what to do if breastfeeding hurts.        |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 15       | 57.7     | 7        | 50.0     | 13       | 92.9     | 0.031    |
| Don’t know                                       | 7        | 26.9     | 4        | 28.6     | 1        | 7.1      |          |
| Disagree: somewhat-strongly                      | 4        | 15.4     | 3        | 21.4     | 0        | 0.0      |          |
| I know what to do when my baby has trouble breastfeeding. |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 14       | 53.8     | 8        | 57.1     | 12       | 85.7     | 0.021    |
| Don’t know                                       | 7        | 26.9     | 3        | 21.4     | 2        | 14.3     |          |
| Disagree: somewhat-strongly                      | 5        | 19.2     | 3        | 21.4     | 0        | 0.0      |          |
| Most babies will nurse 8 feedings or more in 24 hours with more being very common. |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 21       | 80.8     | 10       | 71.4     | 14       | 100.0    | 0.125    |
| Don’t know                                       | 4        | 15.4     | 3        | 21.4     | 0        | 0.0      |          |
| Disagree: somewhat-strongly                      | 1        | 3.8      | 1        | 7.1      | 0        | 0.0      |          |
| Birthing experience                              |          |          |          |          |          |          |          |
| Skin-to-skin contact right after birth will help my baby learn how to breastfeed. |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 22       | 84.6     | 12       | 85.7     | 14       | 100.0    | 0.500    |
| Don’t know                                       | 3        | 11.5     | 1        | 7.1      | 0        | 0.0      |          |
| Disagree: somewhat-strongly                      | 1        | 3.8      | 1        | 7.1      | 0        | 0.0      |          |
| It is normal that my baby will be more awake and cry more during the second night after birth. |          |          |          |          |          |          |          |
| Agree: strongly-somewhat                         | 10       | 38.5     | 6        | 42.9     | 13       | 92.9     | 0.016    |
| Don’t know                                       | 16       | 61.5     | 8        | 57.1     | 1        | 7.1      |          |
| Disagree: somewhat-strongly                      | 0        | 0.0      | 0        | 0.0      | 0        | 0.0      |          |
Table 3. Comparison of pre- and post-intervention survey responses, cont.

| Constructs                                      | Baseline | Baseline | Post-intervention | Matched pairs |
|-------------------------------------------------|----------|----------|-------------------|---------------|
| Description/responses                           | n        | %        | n | % | n | % | p   |
| Signs breastfeeding goes well                   |          |          |                |               |
| How likely are you to identify your baby’s mid hunger cues (for example, stretching, increasing physical movement, hand to mouth)? |          |          |                |               |
| Very likely-Likely                             | 16       | 64.0     | 7 | 53.8 | 13 | 92.9 | 0.063 |
| Somewhat likely                                | 8        | 32.0     | 5 | 38.5 | 1  | 7.1  |      |
| Not likely-Not likely at all                   | 1        | 4.0      | 1 | 7.7  | 0  | 0.0  |      |
| I understand it is normal for my baby to lose some weight in the first few days of life. |          |          |                |               |
| Agree: strongly-somewhat                       | 22       | 84.6     | 10 | 71.4 | 13 | 92.9 | 0.625 |
| Don’t know                                      | 2        | 7.7      | 2  | 14.3 | 0  | 0.0  |      |
| Disagree: somewhat-strongly                    | 2        | 7.7      | 2  | 14.3 | 1  | 7.1  |      |
| Sleeping through the night for baby means 5 hours in a row. |          |          |                |               |
| Agree: strongly-somewhat                       | 18       | 69.2     | 10 | 71.4 | 13 | 92.9 | 0.625 |
| Don’t know                                      | 7        | 26.9     | 3  | 21.4 | 0  | 0.0  |      |
| Disagree: somewhat-strongly                    | 1        | 3.8      | 1  | 7.1  | 1  | 7.1  |      |
| Breast milk supply and supplementation         |          |          |                |               |
| I am comfortable expressing my milk by hand.   |          |          |                |               |
| Very comfortable-Comfortable                   | 6        | 24.0     | 2  | 15.4 | 9  | 64.3 | 0.016 |
| Somewhat comfortable                           | 11       | 44.0     | 8  | 61.5 | 4  | 28.6 |      |
| Not comfortable-Not comfortable at all         | 8        | 32.0     | 3  | 23.1 | 1  | 7.1  |      |
| In the early days, using formula because my milk has not come in yet will mean I will make less breast milk later. |          |          |                |               |
| Agree: strongly-somewhat                       | 12       | 46.2     | 4  | 28.6 | 11 | 78.6 | 0.039 |
| Don’t know                                      | 9        | 34.6     | 5  | 35.7 | 1  | 7.1  |      |
| Disagree: somewhat-strongly                    | 5        | 19.2     | 5  | 35.7 | 2  | 14.3 |      |
| Common breastfeeding concerns                  |          |          |                |               |
| Engagement is the result of milk building up and can lead to plugged ducts or a breast infection. |          |          |                |               |
| Agree: strongly-somewhat                       | 22       | 84.6     | 11 | 78.6 | 14 | 100.0 | 0.250 |
| Don’t know                                      | 3        | 11.5     | 2  | 14.3 | 0  | 0.0  |      |
| Disagree: somewhat-strongly                    | 1        | 3.8      | 1  | 7.1  | 0  | 0.0  |      |
| As my baby experiences growth spurts, it is important to nurse my baby more so that my breasts produce more milk. |          |          |                |               |
| Very important-Important                       | 22       | 84.6     | 10 | 71.4 | 13 | 100.0 | 0.125 |
| Somewhat important                             | 4        | 15.4     | 4  | 28.6 | 0  | 0.0  |      |
| Not important-Not important at all             | 0        | 0.0      | 0  | 0.0  | 0  | 0.0  |      |
| It is normal that my baby may be fussy in the evening hours and wants to nurse more often. |          |          |                |               |
| Agree: strongly-somewhat                       | 17       | 63.4     | 8  | 57.1 | 13 | 100.0 | 0.002* |
| Don’t know                                      | 8        | 30.8     | 5  | 35.7 | 0  | 0.0  |      |
| Disagree: somewhat-strongly                    | 1        | 3.8      | 1  | 7.1  | 0  | 0.0  |      |
| I understand that if my baby is colicky, this is not a sign of low milk. |          |          |                |               |
| Agree: strongly-somewhat                       | 12       | 46.2     | 5  | 35.7 | 11 | 78.6 | 0.021 |
| Don’t know                                      | 12       | 46.2     | 7  | 50.0 | 2  | 14.3 |      |
| Disagree: somewhat-strongly                    | 2        | 7.7      | 2  | 14.3 | 1  | 7.1  |      |
Table 3. Comparison of pre- and post-intervention survey responses, cont.

| Constructs                        | Baseline |           | Baseline |           | Post intervention |           | p     |
|-----------------------------------|----------|-----------|----------|-----------|-------------------|-----------|-------|
| Description/responses             | n        | %         | n        | %         | n                 | %         |       |
| Length of breastfeeding            |          |           |          |           |                   |           |       |
| Exclusive breastfeeding means that my baby will not be given any foods or liquids other than breast milk for the first 6 months. |          |           |          |           |                   |           |       |
| Agree: strongly-somewhat          | 22       | 84.6      | 11       | 78.6      | 14                | 100.0     | 0.250 |
| Don’t know                        | 3        | 11.5      | 2        | 14.3      | 0                 | 0.0       |       |
| Disagree: somewhat-strongly       | 1        | 3.8       | 1        | 7.1       | 0                 | 0.0       |       |
| It is recommended that infants should breastfeed for at least 12 months with exclusive breastfeeding for the first 6 months. |          |           |          |           |                   |           |       |
| Agree: strongly-somewhat          | 23       | 88.5      | 12       | 85.7      | 14                | 100.0     | 0.500 |
| Don’t know                        | 3        | 11.5      | 2        | 14.3      | 0                 | 0.0       |       |
| Disagree: somewhat-strongly       | 0        | 0.0       | 0        | 0.0       | 0                 | 0.0       |       |
| Caution with breastfeeding         |          |           |          |           |                   |           |       |
| If a breastfeeding mother drinks a single serving of alcohol, then she should wait at least 2 hours before breastfeeding her baby. |          |           |          |           |                   |           |       |
| Agree: strongly-somewhat          | 16       | 61.5      | 10       | 71.4      | 14                | 100.0     | 0.125 |
| Don’t know                        | 8        | 30.8      | 3        | 21.4      | 0                 | 0.0       |       |
| Disagree: somewhat-strongly       | 2        | 7.7       | 1        | 7.1       | 0                 | 0.0       |       |
| I understand that in rare circumstances, it is not in the best interest for me and my baby to continue breastfeeding. |          |           |          |           |                   |           |       |
| Agree: strongly-somewhat          | 21       | 80.8      | 11       | 78.6      | 14                | 100.0     | 0.250 |
| Don’t know                        | 4        | 15.4      | 2        | 14.3      | 0                 | 0.0       |       |
| Disagree: somewhat-strongly       | 1        | 3.8       | 1        | 7.1       | 0                 | 0.0       |       |

Results are from 2-tailed exact Sign tests with the binomial distribution. *Significant difference using Bonferroni correction: alpha = 0.05/22 = 0.00227

Many studies reported on the positive relationship between breastfeeding knowledge and breastfeeding initiation and duration. In our study, participants reported increased understanding that it was normal for baby to be fussy in the evening hours, wanting to nurse more often, and that coliciness was not a sign of low milk supply. This knowledge appears critical when continuing to breastfeed, as fussiness and nursing frequency could lead a mother to believe that the infant may not be getting enough milk, leading to formula supplementation that would reduce one’s milk supply.

Most women reported that they knew what to do when breastfeeding would hurt and that they knew what to do if baby had trouble breastfeeding. It would have been interesting to find out what problem-solving techniques women would apply when faced with these situations as breastfeeding pain and baby’s trouble with breastfeeding frequently are reported as barriers to continue breastfeeding. Thus, follow-up studies in this area of research are warranted.

Most women reported their knowledge on the composition of breastmilk and feeding practices in the early days had increased. Women’s knowledge and skills also increased on their ability to identify hunger cues, understanding that some weight loss in the early days would be normal, and understanding infant sleeping patterns. Further, all participants understood the definition of exclusive breastfeeding and agreed with the recommended breastfeeding guidelines. Last, participants agreed about what course of action should be followed when drinking alcohol while breastfeeding.

Findings indicated that the majority of high BMI pregnant women in our study obtained increased knowledge and skills from breastfeeding education that could lead to increased confidence to breastfeed their infant. Breastfeeding reduces postpartum weight and improves women’s long-term cardiovascular health. Women who fall into higher BMI categories stand to benefit the most from breastfeeding and can be as successful breastfeeding their infant as women in normal BMI categories.

As Kendall-Tackett, one of the leading experts on breastfeeding, so eloquently stated, “let’s not automatically assume that a high BMI woman will fail or will have problems breastfeeding just because of her size”. When developing educational interventions to increase breastfeeding rates among high BMI women, the following factors should be considered: (1) Be aware of the traumatic impact of high-intervention births leading to potential breastfeeding problems, (2) Understand that weight affects ethnically and racially diverse women differently requiring a more culturally sensitive approach toward intervention programming, and (3) Adopt follow-up techniques with all women after birth to help her achieve her breastfeeding goals.
Limitations and Future Direction. There are several limitations to this study. First, small sample size limits generalization of study findings. Though the majority of women in our study were overweight or obese, a few pregnant women with normal BMI were included. As there were only two women with normal BMI who completed post-intervention data, we did not feel that this would influence the outcome of our study so these women were included in the analysis. Second, there was no control or comparison group comprising of normal BMI pregnant women. As the curriculum for this breastfeeding class is taught to all pregnant women across Kansas regardless of BMI category, a follow-up study with a control or comparison group of normal weight BMI women is needed to determine the true impact of this intervention. Third, this was an educational intervention to assess breastfeeding knowledge and skills retention; there was no follow-up after participants gave birth to assess whether they started breastfeeding and for how long they continued breastfeeding. However, the breastfeeding curriculum used in this study also was used in a follow-up feasibility three-arm randomized controlled trial (RCT) with high BMI pregnant women who participants receive consistent breastfeeding follow-up upon birth through six months postpartum. Results of this feasibility RCT will show whether high BMI women are able to translate their increased breastfeeding knowledge to breastfeeding initiation and duration. Altogether, breastfeeding knowledge and breastfeeding confidence leading to behavioral change among high BMI women should continue to be examined in prospective future studies.

CONCLUSION

This pilot study shed light on a breastfeeding curriculum offered to pregnant women with predominantly high BMI. Findings indicated that women's knowledge and skills to breastfeed their infant are improved. Study results present opportunities for additional education surrounding the idea that perhaps high BMI women may require intense follow-up upon delivery. Additional studies are underway to assess breastfeeding behaviors among this population.

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Increasing Resident Physician Well-Being through a Motivational Fitness Curriculum: A Pilot Study

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ABSTRACT

Introduction. Healthcare professionals who participate in regular exercise better manage job related stressors, utilize fewer sick days, and discuss fitness with patients at increased rates. Although resident physicians are aware of the health benefits of exercise their rates of exercise are much lower than among medical trainees and practicing physicians. Resident physicians have reported lack of time for traditional structured workouts as one of the greatest barriers to fitness. This study sought to increase resident physician well-being by providing brief workouts through a motivational fitness curriculum.

Methods. This pilot study utilized a nonexperimental design; a pre-/post-intervention consisted of a 10-month motivational fitness curriculum. Thirteen family medicine residents at a training program in the midwestern United States participated in this study. The Depression Anxiety Stress Scale-21 (DASS-21) and the Abbreviated Maslach Burnout Inventory (MBI-9) were used to measure the participants’ well-being, pre- and post-curticulum. Standard descriptive statistics and paired samples t-test were used to analyze the data.

Results. Twenty-eight percent (13/36) of eligible first-year and second-year family medicine resident physicians participated in the study. On the DASS-21, study participants displayed an improvement in depression, anxiety, and stress scores post-curticulum. On the MBI-9, the participants reported decreased score in emotional exhaustion, but there were no changes in depersonalization and personal accomplishment scores over time.

Conclusion. A motivational fitness curriculum may be a convenient way to support well-being among resident physicians. These findings were salient, as graduate medical education programs can implement similar initiatives to support resident physicians’ psychological and physical well-being. Kans J Med 2020;13:228-234

INTRODUCTION

Excessive workload, clerical burden, decreased control over workload, struggles with work-life integration, and dissolution of meaning in work are factors that are associated with burnout.1,2 Over 50% of University of Kansas School of Medicine-Wichita (KUSM-W) resident physicians experienced at least one manifestation of burnout in 2017.3 Throughout the U.S., declining psychological health related to learner depression and burnout has led graduate medical educators to instill trainees with interpersonal skills and personal well-being habits.3 These interventions have targeted increasing learner confidence, satisfaction, self-validation, tolerance, and compassion.4 Although somewhat effective, these efforts fall short in accounting for the value of exercise on resident well-being.4-6 Healthcare professionals who participate in regular physical activity manage job related stressors better, utilize fewer sick days, and discuss fitness activities with patients at increased rates.4-6

In addition, resident physicians experiencing positive mental and behavioral health are more satisfied with their jobs, make fewer errors, and display increased levels of empathy. Experiencing positive mental and physical health leads to better patient care; patient compliance increases and positive health related outcomes are experienced.6-10 Although resident physicians are aware of the health benefits of physical activity, resident physicians exercise less than medical students and practicing physicians.4,6,11 Resident physicians have reported lack of time for traditional structured workouts as being the greatest barrier to fitness.3 Given these findings, the current study sought to provide a motivational fitness curriculum targeted at providing workouts adaptable to the time constraints of residency to promote resident well-being.

METHODS

Study Design. This pilot study involved 13 first- and second-year family medicine residents at a training program in the midwestern United States. The KUSM-W Institutional Review Board approved the study. A sample size of 13 was calculated as necessary for adequate power (0.75) to detect significant group differences among the variables with 0.8 effect size and p < 0.05.12 A motivational fitness curriculum was created by one of the authors (JTG), who had experience with fitness programming. This curriculum was provided to the participants (see Appendix A) as an intervention.

This curriculum consisted of three, 30-minute, high-intensity workouts (see Appendix B) per week for ten months (from September 2018 and June 2019). The workouts could be done independently or with others and required minimal equipment that could be purchased or made available with a gym membership. Workout activities were provided in a GroupMe chat where participants could post their times and repetitions. In addition, articles, books, and podcasts on physical, psychological, spiritual, and financial wellness were provided to the participants. Depression Anxiety Stress Scale-21 (DASS-21)13-15 and the Abbreviated Maslach Burnout Inventory (MBI-9)16-18 were used to measure participants’ well-being, pre-/post-curticulum.

Study Instruments. Each survey consisted of the two validated measures: the DASS-21 and MBI-9. The baseline survey also included demographic questions such as age, gender, and post graduate year. Participants were asked to provide general comments and feedback regarding the curriculum during the post-intervention data collection.
Depression, Anxiety, Stress. The DASS-21 consists of 21 questions in three scales designed to measure negative emotional states of depression, anxiety, and stress.6,13 These scales have been found to have high internal consistency and can be used in a variety of settings to measure current state or changes over time.19 Participants recorded how much a statement applied to them over the past week on a 4-point Likert scale (0 = Never, 3 = Almost Always). Scores for the seven questions specific to each of the three scales were summed with a possible score ranging from zero to 21. Higher scores indicate greater levels of the emotional state.

Burnout. The MBI-9, a validated 9-item questionnaire, is considered a criterion tool to measure manifestations of burnout among health care professionals, including physicians, medical trainees, and nonclinical professionals.6,15-18 The inventory assesses professional burnout across three dimensions: emotional exhaustion, depersonalization, and perception of personal accomplishment. Participants recorded their feelings for each item on a 7-point rating scale (0 = Never, 6 = Every day). Scores for the three questions specific to each of the dimensions were summed with a possible score ranging from zero to 18. We conceptualized burnout as a continuous variable along a spectrum ranging from low to high experienced feelings. For the emotional exhaustion and depersonalization dimensions, higher scores are indicative of greater emotional exhaustion and depersonalization, and greater burnout. For the personal accomplishment dimension, higher scores indicate a greater sense of personal accomplishment, and less burnout.

Statistical Analysis. Standard descriptive statistics and paired samples t-test were performed to analyze the quantitative data. All analyses were 2-sided with alpha of 0.05. The IBM SPSS (Statistical Package for the Social Sciences), version 26 was used for these analyses.

Qualitative Analysis. Two of the authors (RN and SO-D) used a phenomenological approach to analyze the open-ended responses. This approach focused on the commonality of a lived experience within a group to develop a description of the nature of the phenomenon.20 The researchers were intentional to convey the overall essence of participants’ experiences by incorporating description and context.

RESULTS

Twenty-eight percent (13/36) of eligible first-year and second-year family medicine residents participated in this study. The average age of the participants was 29.5 years (SD = 2.4); 54% (7/13) were males and 46% (6/13) were females; 62% (8/13) were first-year resident physicians and 38% (5/13) were second-year resident physicians.

On the DASS-21, study participants displayed an improvement in depression, anxiety, and stress scores post-curriculum (Table 1). On the MBI-9, the participants had a decrease in emotional exhaustion score but there were no changes in depersonalization and personal accomplishment scores over time (Table 1).

Narrative Feedback. Analysis of the open-ended responses showed that the participants had a positive feedback regarding the wellness intervention. Three major themes emerged: unique and convenient workouts, motivational environment, and time constraints as a continued barrier (Table 2). Resident physicians identified the workouts as convenient and engaging as there were three unique workouts provided each week. Motivation and a sense of community were fostered through participants posting their workout times and scores, as well as pictures of their workouts on the GroupMe application. Conversely, some participants felt a sense of guilt during the weeks their participation was lower due to residency-related time restrictions.

Table 1. Outcome scores of surveys before and after the curriculum.

| Subscale (possible range) | Time pointa | Pre-curriculum (N = 13) | Post-curriculum (N = 13) | t     | p value | Mean difference (95% CI) |
|---------------------------|-------------|-------------------------|--------------------------|-------|---------|------------------------|
| MBI-9 Emotional Exhaustion (0-18) | 11.0 (4.4) | 10.1 (5.2) | -0.71 | 0.048 | -0.9 (-3.4 to 1.7) |
| MBI-9 Depersonalization (0-18) | 6.4 (3.8) | 6.8 (4.3) | 0.45 | 0.704 | 0.4 (-1.9 to 2.9) |
| MBI-9 Personal Accomplishment (0-18) | 13.6 (2.6) | 13.7 (2.5) | -0.08 | 0.935 | 0.1 (2.3 to 2.1) |
| DASS-21 Depression (0-21) | 8.4 (10.8) | 6.7 (6.9) | -0.54 | 0.048 | -1.6 (-8.4 to 5.1) |
| DASS-21 Anxiety (0-21) | 6.5 (5.6) | 3.8 (4.7) | -1.68 | 0.046 | -2.6 (-5.4 to 0.7) |
| DASS-21 Stress (0-21) | 12.2 (8.8) | 8.0 (6.1) | -2.05 | 0.042 | -5.2 (-8.6 to 0.3) |

MBI-9 = Abbreviated Maslach Burnout Inventory. DASS-21 = Depression Anxiety Stress Scales-21.

Notes: On MBI-9, higher scores on the Emotional Exhaustion and Depersonalization subscales, and lower scores on the Personal Accomplishment subscale indicate greater burnout. On the DASS-21 subscales, higher scores indicate greater levels of that emotional state.

Values shown are mean score (SD).

DISCUSSION

The findings suggested that a motivational fitness curriculum consisting of brief, high-intensity workouts may improve emotional exhaustion, symptoms of depression and anxiety, and stress among resident physicians. Resident physicians who participated in the motivational fitness curriculum experienced decreased symptoms of depression, anxiety, and overall stress, and emotional exhaustion decreased. This was crucial because although prior studies have shown that residents were aware of the benefits of physical activities, the rates they have been exercising were lower compared to medical students and practicing physicians.14,16
Table 2. Participants’ open-ended comments.

| Themes                          | Significant Statements                                                                                                                                 |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Theme 1: Unique and Convenient Workouts.** The motivational fitness curriculum provided residents with three physically and mentally rewarding workouts per week. Participants identified that the workouts were feasible and alleviated the need to spend time deciding on workouts to complete. | 1. “Good, quick workouts that helped me get a workout in when I had a small amount of time.”  
2. “It was great to have new workouts throughout the week.”  
3. “I enjoyed receiving three workouts per week, so I didn’t have to think about what I was going to do at the gym.” |
| **Theme 2: Motivational Environment.** With utilization of the GroupMe application, community and motivation were fostered through participants posting their workout pictures and times/scores. Whether or not residents were able to engage in all three workouts each week, they continued to feel encouraged by participants’ posts. | 1. “It was great motivation knowing others were doing great workouts as part of a community.”  
2. “I was encouraged to see the results of other participants.”  
3. “It was great to see others do well. That was motivation for me.” |
| **Theme 2: Time Constraints as a Continued Barrier.** Time constraints created a barrier to completion of all three weekly workouts. With decreased completion rates, a sense of guilt could be experienced. | 1. “I sometimes chose easier workouts for time and learning ease.”  
2. “I participated some weeks more than others.”  
3. “I felt guilt when there wasn’t time to get a workout in.” |

Though several academic studies have shown the benefits of physical activity among physicians, this study demonstrated potential benefits of a motivational fitness curriculum that consisted of brief, high-intensity workouts to improve the well-being of resident physicians, while simultaneously providing a sense of community through a mobile application. The findings are of pertinence as graduate medical education programs nationally have increased well-being initiatives for resident physicians. To assist graduate medical education programs in implementing similar well-being initiatives, a detailed description of the exercise curriculum and sample workouts are provided in the appendices. Exercise programs will likely be most successful when championed by a resident or a fellow physician, due to increased buy-in from peers. In addition, it is paramount that this champion is well educated in fitness regimens to develop engaging workouts that are physically safe and effective for all participants.

This study was limited by having been conducted in a single residency program. The small sample size and nonprobability-based nature of the convenience sample limit generalizability of the findings. Also, there was a potential for sample bias in residents who participated in this study. The residents with the least amount of time, greatest burnout, and most emotional distress may not have participated in the study. In addition, social desirability bias may limit the findings of the study as respondents’ responses to the survey questions might not be reflective of their true thoughts or feelings. The lack of control group makes it difficult to infer causation and reduces generalizability as there was no way to know if the improvements were linked directly to the motivational fitness curriculum. Additional research is warranted. A prudent next step would include implementing a motivational fitness curriculum in multiple residency programs (both family medicine and other residency programs) to see how the effects of the curriculum compared across different specialties. Given the exploratory nature of the study, the statistical findings should be viewed cautiously.

**CONCLUSIONS**

In conclusion, the findings suggested that a motivational fitness curriculum consisting of brief, high-intensity workouts provided a convenient way to reduce depression, anxiety, stress, and emotional exhaustion among resident physicians. The improvement in resident physicians’ mental and behavioral health potentially could translate to better patient care as a result. These findings are salient, as graduate medical education programs can implement similar initiatives to support resident physicians’ psychological and physical well-being.

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**Keywords:** Physical fitness, internship and residency, professional burnout, health, family practice
Motivational Fitness Curriculum

Introduction

What is fitness? If you ask 10 different health or fitness “professionals,” you will likely get 10 different answers. To me, fitness is the pursuit of health that allows one to enjoy a quality life that is not limited by one’s inability to participate in its many opportunities. As healthcare “professionals” (yes, I used quotes for a reason), we stand on a prestigious platform to encourage change - lifelong, personal, community, national, and international change. We all know the benefits of healthy lifestyle affecting literally every disease process we study. But we are so unfit and unhealthy ourselves, that we as a medical community have become a poor conduit for true health information or leadership changing the choices of those brought into our care. Sure, we can check all the USPSTF boxes, keep our patients up to date on current recommended medications, and be available when they become sick; but can we actually lead our patients to truly healthier lifestyles if we ourselves never move except from hospital room to hospital room, always take the elevator, “fuel” ourselves with soda and pastries from the cafeteria, and manage our time so poorly that we never sleep? Residency is, without a doubt, hard. Next to being a husband and father, it is one of the hardest things I have ever done. So, why barely scrape by, gain 30 lbs., suffer through depression/anxiety, and finish residency feeling like all you’ve done is prescribe medications that only half of your patients take anyway?

Enter, Via Christi Family Medicine Residency’s 13 block exercise curriculum. The goal of this curriculum is to help you, as the resident, pursue your own health so that you might not only enjoy life through these grueling years more, but so that you might become a better conduit for healthy life changes in your patients’ lives. The curriculum will consist of workouts, reading, and cooking. Being such a large residency, it can even grow into a culture of pursuing health and excellence. I can think of no better way to conclude this introduction to inspire cultural change than by quoting Greg Glassman’s Fitness in 100 Words.

“Eat meat and vegetables, nuts and seeds, some fruit, little starch and no sugar. Keep intake to levels that will support exercise but not body fat. Practice and train major lifts: deadlift, clean, squat, presses, C&J, and snatch. Similarly, master the basics of gymnastics: pull-ups, dips, rope climb, push-ups, sit-ups, presses to handstand, pirouettes, flips, splits, and holds. Bike, run, swim, row, etc., hard and fast. Five or six days per week, mix these elements in as many combinations and patterns as creativity will allow. Routine is the enemy. Keep workouts short and intense. Regularly learn and play new sports.” — Greg Glassman, CrossFit Founder

The Workouts

There will be 3 workouts per week, not including Family Docs for Fitness (FDFF), which can be done on your own with minimal equipment. If you don’t have access to any equipment, the workouts will have to be modified a good amount of time. I strongly encourage you to invest in yourself, get a gym membership, purchase some basic equipment like dumbbells or kettlebells, or find a friend who has equipment (my garage is open to the residency). Tuesday nights at 1800, FDFF workouts will be an optional 4th workout for those who wish to join. These are one hour long or less, and everyone will be done no later than 1900. During these workouts, we will spend about 20 minutes learning the skills to properly lift – specifically, how to properly deadlift, squat, and clean. We will occasionally discuss a sports medicine, exercise, or nutrition article. Workouts will take anywhere from 20 to 40 minutes after the skills portion.

As everyone knows, sticking to regular exercise is extremely difficult to do alone. Since everyone participating in this curriculum should be doing these workouts, I strongly encourage you to find at least one partner, or small group, that you regular workout with to maintain consistent accountability.

The Reading

I will be occasionally posting articles on the MFC GroupMe for you to read. There will never be a test or other form of official accountability. However, there will be benefit to you and your patients in reading these articles. We will also discuss some of the posted material at FDFF as mentioned above. However, reading will not pertain to only “physical” fitness; it will include (but not be limited to) mental fitness, emotional fitness, spiritual fitness, and financial fitness (Remember how I defined fitness as not being limited by one’s inability to participate in life’s opportunities? So yes, this includes some financial fitness as well). Below, you will find a list of recommended reading and podcasts. It’s a short list, but a very motivational and helpful list.

Books:

Bergeron, B. (2017). Chasing excellence: A story about building the world’s fittest athletes. Carson City, NV: Lioncrest Publishing.

Campbell, T.C., Campbell, T.M. (2017). The China study: Revised and expanded edition: The most comprehensive study of nutrition ever conducted and the startling implications for diet, weight loss, and long-term health. Dallas, Texas: BenBella Books.

Dahle, J.M. (2014). The white coat investor: A Doctor’s guide to personal finance and investing. United States of America: White Coat Investor LLC.
Hutchinson, A. Which comes first, cardio or weights?: Fitness myths, training truths, and other surprising discoveries from the science of exercise. New York, NY: William Morrow Paperbacks.

Pollan, M. (2009). In defense of food: An eater's manifesto. New York, NY: Penguin Books.

Sanfilippo, D. (2012). Practical paleo: A customized approach to health and a whole-foods lifestyle (2nd ed.). Las Vegas, NV: Victory Belt Publishing.

The Book of Proverbs. Holy Bible: Containing the Old and New Testaments: King James Version. (2010). New York, NY: American Bible Society.

Wolf, R. (2017). Wired to eat: Turn off cravings, rewire your appetite for weight loss, and determine the foods that work for you. New York, NY: Harmony Books.

Podcasts:
Bergeron, B. (2018). Chasing Excellence.
Dahle, J. (2018). White Coat Investor.

One of the greatest things about this residency is how close everyone is and the support everyone tries to provide one another. It’s not a rare experience to be on night call and have someone randomly bring you dinner, coffee, or snacks. We often get together over food and drink. This portion of the curriculum is to help all this food evolve from doughnuts and pastries into dishes of meats, vegetables, cheeses, etc. Now, don’t get me wrong, I love myself a fresh doughnut and few things can pick me up like one, but we will all be so much better if these kinds of treats become the exception and not the rule.

There will also be occasional “Paleo Potlucks.” These usually occur on a Saturday afternoon/evening, where we start with an optional group workout then dive into a plethora of delicious and healthy dishes washed down with one or two “paleo” beverages.

Also, I am not advocating everyone eat “Paleo” diets. Paleo is something I personally enjoy, but the goal of this portion in the curriculum is to get you closer to real food and further away from food that outlasts its package. You know, all that “eat healthy” stuff we tell our patients to do, but surprisingly suck at ourselves. Hopefully, through this pursuit, we can become better prescribers of real medicine - food. “Let food be thy medicine and medicine be thy food” - Hippocrates.
Example Workouts

Workout #1
Warm Up:
- 400-meter run
- 2 to 3 minutes dynamic mobility as needed (PRN)

Workout of the Day (WOD)
- 20 minutes as many reps as possible (AMRAP), with weighted vest if you have one:
  • 10 pull-ups or ring rows
  • 20 push-ups
  • 30 squats

Post your scores and whether you used a weighted vest!

Workout #2
Warm Up:
- 400-meter run
- 2 rounds:
  • 5 eccentric hand-release push-ups
  • 5 deep eccentric squats
- 2 to 3 minutes dynamic mobility PRN

WOD:
- For time, 20-minute time cap:
  • ½ mile run
  • 50, 40, 30, 20, 10 of a doublet: Push-ups and squats
  • ½ mile run

Post your times!

Workout #3
Warm Up:
- 2 minutes jump rope
- 3 rounds:
  • 10 second hollow rock hold
  • 15 second Superman hold
  • 2 deep hip flexor stretching lunges (each leg)
  • 4 Jefferson curls
- 2 to 3 minutes of dynamic mobility PRN
- 2 to 3 minutes warming up to starting deadlift weight

WOD:
- Every minute on the minute (EMOM) to failure or max rounds of 20:
  • 1 deadlift*
  • *First round starts at 65 lbs. for women and 135 lbs. for men—add 10 lbs. each round. If all 20 rounds completed, women will end with 225 lbs. and men with 325 lbs.

Post your weights!
ABSTRACT

Introduction. Efficient execution of image-guided percutaneous biopsy is a procedural competency milestone in radiology training. Despite the importance of achieving such mastery, literature on successful execution by residents is limited. The purpose of this study was to evaluate resident performance as measured by nondiagnostic biopsy and major complication percentages, on CT-guided transthoracic core needle biopsies (TTNB) of lung and mediastinal lesions.

Methods. A 12-year retrospective cohort study was conducted using charts from an academic hospital, 2006 - 2018, to evaluate TTNBs. Inclusion criteria were ≥ 18 years of age and ≥ 1 follow-up CT scan and chest x-ray. Bivariable associations by outcome(s) were evaluated.

Results. Of 1,191 biopsies conducted, case distribution was 41%, 26%, 18%, and 15% for postgraduate years (PGY) 2 - 5, respectively. Results from biopsies were 139 (11.7%) nondiagnostic, 218 (18.3%) benign, and 834 (70.0%) malignant cases. Resident year by nondiagnostic outcome was not significant; \( p = 0.430 \). There were 148 major complications. Complication rate by PGY 2 - 5 was 13.0%, 13.3%, 12.9%, and 9.2%, respectively; differences were not significant, \( p = 0.488 \). Of the 139 nondiagnostic cases, 42 were re-biopsied during the study period with 81% re-classified as malignant; no repeat biopsy was observed for the remaining 97 nondiagnostic cases.

Conclusion. Of 1,191 lung/mediastinal biopsies analyzed, nearly 12% were nondiagnostic and over 12% had major complications; neither associated with resident level of experience. Outcomes were not affected significantly by level of training. Residency programs may benefit from affording opportunities for newer PGY classes to participate in procedures. Nondiagnostic cases may benefit from timely, repeat biopsies. *Kans J Med* 2020;13:235-241

INTRODUCTION

Computed tomography (CT) guided transthoracic needle biopsy (TTNB) is a minimally invasive diagnostic procedure for tissue diagnosis of peripheral lung nodules. Since the first use of a needle to diagnose lung pathology in 1883, percutaneous TTNB has evolved with the fields of radiology and cytopathology to become an everyday tool in safely evaluating indeterminate pulmonary nodules or inflammatory processes. TTNB is less invasive and associated with lower morbidity and mortality than an open, surgical biopsy, yet it is not without complications. Pneumothorax and hemorrhage are a common occurrence. One large meta-analysis found the overall complication rates reached 38%, with major complication rates as high as 5.7%. Further, there is always the risk of unsuccessful sampling. Expert consensus guidelines on quality improvement have set the risk of obtaining a nondiagnostic biopsy as high as 25% in CT-guided TTNBs.

The successful and efficient execution of image-guided biopsies has become a U.S. competency milestone in both diagnostic and interventional radiology training. Despite the importance of achieving mastery in this technique, research is lacking for evaluating the acquisition of CT-guided TTNB procedural skills during residency training. With the adoption of the United States Preventive Services Task Force’s 2013 recommendations for annual lung cancer screening, it is important to assess this core competency for residents. Thus, the purpose of this study was to measure diagnostic success and complication rates of CT-guided TTNB when performed by resident physicians of varying experience levels.

METHODS

This project was approved by the institutional review board at the Wichita Medical Research & Education Foundation. Study data were collected and managed using Research Electronic Data Capture (REDCap®) electronic data capture tools hosted at the University of Kansas Medical Center.

Study Population. A retrospective cohort study to evaluate TTNBs was conducted at an academic hospital in the heartland of the USA from July 2006 to July 2018. Inclusion criteria were individuals, either inpatient or outpatient, ≥ 18 years of age or older, who received a transthoracic, core-needle biopsy performed by resident, and with a follow-up CT scan and at least one follow-up chest x-ray to allow for adequate monitoring of post-procedural complications. Exclusion criteria were patients whose procedures were performed without a resident physician, without a follow-up CT scan, without a finalized pathology report, and those enrolled in a concurrent study aimed at prevention of pneumothorax.

Outcomes. Primary and secondary outcomes were diagnostic yield and major complication rates of TTNBs performed by residents. Diagnostic yield was dichotomized as diagnostic versus nondiagnostic, with diagnostic defined as procurement of sufficient material to establish a pathologic diagnosis or guide patient management. Biopsy specimens were classified as benign or malignant. Nondiagnostic biopsies were identified as such in the pathology report or if the specimen did not allow the formulation of a definitive plan for treatment. Updated diagnostic classifications from repeat biopsies also were evaluated on a subsample.

Complications were classified as major or minor. Major complications were defined as pneumothorax requiring intervention (chest tube placement or manual aspiration), hemothorax, air embolism, and needle tract seeding. Minor complications were defined as pneumothorax without need for intervention, pulmonary hemorrhage, hematoma, and transient hemoptysis.

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Other patient variables of interest included age, sex, height, and weight. Because height and weight were missing from many of the patient records, a surrogate measure for body mass index and chest wall thickness was reported. Information collected regarding the biopsy procedure included region, patient position, approach, needle size, number of cores collected, if the lesion was abutting the pleura, and total tissue traversed (measured by the entry point of the chest wall to the lesion). Lesion size was measured along its longest plane.

Because resident level of experience was important to evaluate, a bias assessment by experience was conducted utilizing all variables of interest. Resident postgraduate year was calculated using the date of the biopsy and the start date of residency based on alumni records provided by the residency program. Level of experience was classified as PGY 2, PGY 3, PGY 4, and PGY 5.

**Procedure.** All TTNBs were performed with the patient placed in a CT scanner. The biopsy site was marked and anesthetized, and a coaxial needle was inserted percutaneously under fluoroscopic guidance (Figure 1). Biopsy of the lesion was attempted through the coaxial needle. A post-procedure CT scan was performed immediately afterward, followed by at least one chest x-ray to assess for complications. Specimens were sent to the pathology lab for processing and analysis and on-site cytology was not used during the 12-year study period.

![Coaxial needle placement into a peripheral lesion of the left lung.](image)

**Statistical Analysis Plan.** A power analysis was conducted in IBM SPSS SamplePower 3.0 using logistic regression to test the difference in nondiagnostic yield between PGY 2 and PGY 5. Yield rates were established from a prior study evaluating fine needle aspiration biopsies of thyroid nodules;11 event rates were 14.6% for PGY 2s and 9.5% for PGY 5s. A sample size of 1,297 would be sufficient to detect a difference of 5.1% between groups with 80% power and a 5% significance level.

Data were de-identified and descriptive statistics conducted by outcome(s). Continuous variables were assessed for normality with the Kolmogorov-Smirnov test and were summarized with medians, means, and standard deviations. Bivariant associations by outcome(s) were evaluated with nonparametric Mann-Whitney U tests, Chi-square tests of independence, and, when data were sparse, by Fisher’s exact tests. Missing values were evaluated; however, due to non-randomness, no imputations were conducted.

**RESULTS**

Data were collected from 1,318 cases where lung biopsies were conducted (Figure 2). One case was excluded where the patient was less than 18 years of age. Forty-eight cases were excluded where a resident did not participate. Seventy-four cases were excluded where patients were participants in a clinical trial to prevent pneumothorax, and four cases were excluded in which the patient was both involved in the clinical trial and did not have a resident participating in the procedure. The analysis included 1,191 cases. Of these, 53% (626 of 1,191) patients were male and 47% (565/1,191) were female; the average age was 67 years, and median lesion size was 3.2 cm. A total of 51 residents conducted biopsies under supervision. Case distribution was 41%, 26%, 18%, and 15% for PGY 2 - 5, respectively. Percentage of nondiagnostic yield was 11.7% (139/1,191), while major complication was 12.4% (148/1,191).

![Participant flow](image)

Bivariate associations with diagnostic yield are shown in Table 1. Incidence by PGY 2 - 5 was 13.0%, 13.3%, 12.9%, and 9.2%, respectively (Figure 3). No significant results were observed by postgraduate year, p = 0.430. Significant differences were observed for patient age, lesion size, needle size, and number of biopsy cores. Incidence of benign findings on initial biopsy was 18.3% (218/1,191), and malignant was 70.0% (834/1,191). Updated classifications revealed that a total of 74.2% [(834+50)/1,191] were malignant after taking into account repeated biopsies.
Incidence of major complications included pneumothorax not requiring intervention was 32.9%, for pulmonary hemorrhage it was 20.4%, and for pneumothorax requiring intervention it was 12.0%, among others. Table 2 shows characteristics of patients, procedure, and findings by major complication. Compared to females, a greater proportion of males experienced major complications, 61.5% vs. 38.5%; \( p = 0.020 \). Major complications were observed for smaller median lesion, 25.0 cm vs. 34.1 cm, \( p < 0.001 \); and were more likely to occur when the patient position was supine, \( p = 0.039 \). Significant differences also were observed when lesions abutted the pleura, and when greater median total tissue was traversed.

Incidence of major complication(s) by PGY 2-5 was 11.4%, 14.2%, 10.1%, and 10.4%, respectively (Figure 4). No significant results were observed by postgraduate year, \( p = 0.575 \).

There was no indication of bias by resident level of experience. Bivariate results of the bias assessment for resident year showed that, except for needle size, \( p = 0.008 \), no other variables were significant, demonstrating that residents conducted biopsies on similar patients and obtained similar outcomes (results not shown).

A total of 87 patients were re-biopsied after their initial pathology reading. Of the 10 cases originally classified as malignant, all 10 were confirmed as malignant. Conversely, repeated biopsies showed that 50 patients had malignant lesions originally classified as either benign (16 cases) or nondiagnostic (36 cases), representing approximately 46% and 86% missed cancer diagnosis rate when benign or nondiagnostic biopsies were repeated, respectively. Figure 5 shows the proportion of malignancies confirmed on repeat biopsy by resident experience level. While PGY 5 had the highest proportion, they also had the fewest repeated biopsies. Last, repeated biopsies for the remaining 27 patients (originally classified as benign or nondiagnostic) were not malignant. Important, however, was the finding that no repeated biopsy was observed during the study period for 97 of the nondiagnostic cases or for 183 of the benign cases.

DISCUSSION

Over the last 40 years, hundreds of articles have been published about CT-guided core needle lung biopsies. We believe that we have the first study to evaluate the role that resident seniority plays in the outcomes of such biopsies. Our results showed that an increasing level of resident experience was not associated significantly with lower nondiagnostic rates or complication rates. Similarly, the incidence of repeated biopsy and the incidence of missed malignancy discovered on repeated biopsy were not significantly different between postgraduate years. These results suggested that outcomes are not affected significantly by level of training and that programs may benefit from affording opportunities for newer PGY classes to participate in procedures.
Table 1. Characteristics of patients and procedure by diagnostic yield.

| Description                        | Diagnostic yield | p     |
|------------------------------------|------------------|-------|
|                                    | Diagnostic biopsy| Nondiagnostic biopsy |      |
| Description                        | Male             | Female |       |
| Nondiagnostic biopsy               | 88.3%            | 11.7%  | 0.463 |

| Sex                                | n = 1,052        | n = 139 |
|------------------------------------|------------------|---------|
| Male                               | 557              | 69      |
| Female                             | 495              | 70      |

| Median patient age; year; mean (SD)| < 60              | > 60    | 0.017* |
|------------------------------------|-------------------|---------|--------|
|                                     | 68.0; 67.0 (12.0) | 65.0; 64.0 (14.0) |       |

| Age group, years                   | < 60              | > 60    | 0.021  |
|------------------------------------|-------------------|---------|--------|
| < 60                               | 301               | 751     |
| > 60                               | 286               | 71.4    |

| Median chest wall thickness; mm; mean (SD)| < 60              | > 60    | 0.294  |
|-------------------------------------------|-------------------|---------|--------|
|                                          | 39.2; 41.4 (15.8) | 40.9; 42.6 (15.4) |       |

| Biopsy site                          | Lung              | Mediastinum |       |
|--------------------------------------|-------------------|-------------|-------|
|                                     | 1,003             | 49          | 0.843 |

| Biopsy region                        | Right upper lobe  | Left upper lobe |       |
|--------------------------------------|-------------------|----------------|-------|
|                                     | 285               | 241           | 0.566 |

| Biopsy region                        | Right lower lobe  | Left lower lobe |       |
|--------------------------------------|-------------------|----------------|-------|
|                                     | 217               | 193           | 0.205 |

| Biopsy region                        | Right middle lobe |       |
|--------------------------------------|-------------------|-------|
|                                     | 67                | 6.7    | 0.76  |

| Median lesion size, cm; mean (SD)    | < 20              | 20 - 29.99 | 30 - 49.99 | ≥ 50     | 0.013*  |
|--------------------------------------|-------------------|------------|------------|----------|---------|
|                                     | 236               | 224        | 47         | 33.8     | 0.032   |

| Lesion size; cm                      | 20 - 29.99        | 30 - 49.99 | ≥ 50       | 0.032     |
|--------------------------------------|-------------------|------------|------------|-----------|
|                                     | 226               | 215        | 26         | 187       |

| Lesion size; cm                      | 20 - 29.99        | 30 - 49.99 | ≥ 50       | 0.032     |
|--------------------------------------|-------------------|------------|------------|-----------|
|                                     | 285               | 27.1       | 23         | 23.0      |

| Resident year**                      | PGY 2             | PGY 3      | PGY 4      | PGY 5     | 0.430  |
|--------------------------------------|-------------------|------------|------------|-----------|--------|
|                                     | 429               | 265        | 195        | 155       | 0.430  |

| Patient position                     | Prone             | Supine     | Other      | 0.880     |
|--------------------------------------|-------------------|------------|------------|-----------|
|                                     | 470               | 432        | 150        | 0.880     |

| Biopsy approach                      | Anterior          | Posterior  | Lateral    | Other     | 0.806  |
|--------------------------------------|-------------------|------------|------------|-----------|--------|
|                                     | 332               | 482        | 129        | 105       | 0.806  |

| Needle size (gauge)                  | ≤ 18              | > 18       | 0.001     |
|--------------------------------------|-------------------|------------|-----------|
|                                     | 782               | 269        | 51.1      |

| Number of biopsy cores               | ≤ 2               | 3          | 4          | > 4       | 0.001  |
|--------------------------------------|-------------------|------------|------------|-----------|--------|
|                                     | 225               | 418        | 230        | 173       | 0.001  |

| Lesion abutting the pleura           | Yes               | No         | 0.623     |
|--------------------------------------|-------------------|------------|-----------|
|                                     | 611               | 438        | 0.623     |

| Median total tissue; mm; mean (SD)   | < 20              | 20 - 40    | > 40       | 0.732*    |
|--------------------------------------|-------------------|------------|------------|-----------|
|                                     | 53.2; 56.3 (23.8) | 54.0; 57.4 (24.3) | 0.732*     |

| Tissue traversed; mm                 | < 20              | 20 - 40    | > 40       | 0.730     |
|--------------------------------------|-------------------|------------|------------|-----------|
|                                     | 36                | 259        | 754        | 0.730     |

* Mann-Whitney U test.
** Eight cases had missing resident experience level data.
Table 2. Characteristics of patients, procedure, and findings by major complications.

| Description                              | Yes         | No          | p     |
|------------------------------------------|-------------|-------------|-------|
| Description                              | n = 148     | n = 1,043   |       |
| Sex                                      |             |             |       |
| Male                                     | 91          | 535         | 0.020 |
| Female                                   | 57          | 508         |       |
| Median patient age; year; mean (SD)      | 67.0; 66.0  | 68.0; 67.0  | 0.265*|
| Age group, years                         |             |             |       |
| < 60                                     | 43          | 311         | 0.849 |
| > 60                                     | 105         | 732         |       |
| Median chest wall thickness; mm; mean (SD)|           |             |       |
| Lung                                     | 38.2; 40.0  | 39.8; 41.8  | 0.264 |
| Mediastinum                              | 5           | 51          | 0.416 |
| Biopsy site                              |             |             |       |
| Right upper lobe                         | 52          | 275         | 0.111 |
| Left upper lobe                          | 34          | 242         |       |
| Right lower lobe                         | 29          | 215         |       |
| Left lower lobe                          | 17          | 194         |       |
| Right middle lobe                        | 11          | 66          |       |
| Median lesion size, cm; mean (SD)        | 25.0; 30.3  | 34.1; 41.3  | <0.001*|
| Lesion size group; cm                    |             |             |       |
| < 20                                     | 49          | 234         | <0.001|
| 20 - 29.99                               | 39          | 213         |       |
| ≥ 30 - 49.99                             | 39          | 278         |       |
| ≥ 50                                     | 21          | 318         |       |
| Resident year**                          |             |             |       |
| PGY 2                                    | 63          | 421         | 0.575 |
| PGY 3                                    | 41          | 268         |       |
| PGY 4                                    | 28          | 189         |       |
| PGY 5                                    | 16          | 157         |       |
| Patient position                         |             |             |       |
| Prone                                    | 57          | 472         | 0.039 |
| Supine                                   | 75          | 416         |       |
| Other                                    | 16          | 155         |       |
| Biopsy approach                          |             |             |       |
| Anterior                                 | 56          | 320         | 0.062 |
| Posterior                                | 58          | 488         |       |
| Lateral                                  | 13          | 136         |       |
| Other                                    | 19          | 97          |       |
| Needle size (gauge)                      |             |             |       |
| ≤ 18                                     | 94          | 756         | 0.023 |
| > 18                                     | 54          | 286         |       |
| Number of biopsy cores                   |             |             |       |
| ≤ 2                                      | 41          | 215         | 0.209 |
| 3                                        | 53          | 401         |       |
| 4                                        | 33          | 227         |       |
| > 4                                      | 21          | 192         |       |
| Lesion abutting the pleura               |             |             |       |
| Yes                                      | 121         | 574         | <0.001|
| No                                       | 25          | 468         |       |
| Median total tissue traversed; mm; mean (SD)|           |             | <0.001*|

*Mann-Whitney U test.
**Eight cases had missing resident experience level data.
Many previous studies have analyzed the impact of resident experience level on non-procedural competency. One study which analyzed image reading discrepancies between PGY 2-5 residents and the attending physician found a small but significant decrease in discrepancy rate between 1st/2nd year residents and the 3rd/4th year residents. As expected, the highest discrepancy rates were among the 1st and 2nd year residents. Another study looking at diagnostic discords for diffusion-weighted magnetic resonance imaging in the emergency department found similar results with the rate of discordance between residents and attendings to be highest for the PGY 2 resident and lowest for the PGY 5 resident.

There is scant literature describing the impact that resident experience level has on outcomes of procedures. A recent 2014 study utilized eight years of data on resident-performed fine needle aspirations of the thyroid to assess nondiagnostic rate. Results showed a significant inverse relationship with nondiagnostic rate and postgraduate year for residents without prior surgical training or subsequent training in interventional radiology, potentially serving as an indicator of procedural interest. Another study looked at the difference in fluoroscopy time for isolated temporary jugular central venous catheterization procedures performed by radiology residents versus attending radiologists. Mean fluoroscopy time of resident catheterizations was twice as long as that of attendings with increasing years of training for residents not significantly reducing fluoroscopy time. A handful of other studies have examined the associations of resident physician experience with procedural success in procedures such as chest port placement, uterine artery embolization, electromyography needle electrode placement, and prostate biopsies. Consistent with our study, these studies failed to show any significant difference between outcomes and operator experience level.

The body of literature on the attainment of procedural skills during residency has illuminated other variables that are associated with surgical skills beyond just post-graduate year. One study identified that a resident predilection toward an observation-style of learning as opposed to an action-based style was associated with transfer to a non-surgical residency or non-physician field. In addition to learning style, past hobby video game play has been suggested to predict laparoscopic surgical skills. Another study found that interns designated for a general surgery residency program performed better in a laparoscopic skills test than their peers while older trainees were slower to develop technical skills.

Our study found several significant bivariate associations with both major complications and nondiagnostic outcomes. Successful diagnostic biopsies were more common in older patients, with larger lesions, using needle size ≤ 18 gauge, and obtaining less than four biopsy cores. Complications were avoided more often in female patients, with larger lesions, lesions not abutting the pleural surface, using prone positioning, and traversing less tissue. These findings highlighted the importance of the role patient selection plays in the successful outcome of procedures. The pattern associated with nondiagnostic biopsies may have revealed a bias to take younger patients with non-cancerous, smaller lesions to biopsy that otherwise may have been observed if they were of older age.

Prior studies have attempted to demonstrate factors associated with diagnostic and complication rates with core needle lung biopsies. A recent meta-analysis of 32 of these studies reported small lesion size, mean patient age, use of a coaxial needle, use of biopsy device, and use of CT-fluoroscopy to all be risk factors for complications, though none reached significance. A previous study analyzing diagnostic accuracy similarly did not find significant risk factors for a nondiagnostic sample when using a core needle, though the depth of the lesion from the pleural surface approached significance. Another showed that nondiagnostic biopsies were most likely to occur when there was a moderate or high pretest probability of infection, as opposed to malignancy, though this study was performed with fine needle aspirations as opposed to core needle biopsies. Only a handful of studies analyzing risk factors for nondiagnostic and complication rates of core needle lung biopsies have recorded operator experience as a variable, making our study unique. One 2004 study reported radiologist experience as the third major risk factor for pneumothorax, though this study only analyzed four radiologists. The studies that looked at operator experience as a variable typically reported it as an overall mean value, rather than by individual operator.

Of the 139 biopsies classified as nondiagnostic on initial biopsy in our study, less than 1/3 were re-sampled. Over 80% of those that got re-sampled contained cancer on re-biopsy. Biopsies classified as nondiagnostic on the pathology report should be viewed with caution and integrated with other clinical information before foregoing further diagnostic testing.

Limitations. There was considerable variability at our institution in operational autonomy granted by attending physicians. Some attendings give substantial free reign to the resident, whereas others are hesitant to let even senior residents become too involved in the case. Residents in the study were on their CT rotation, thus attending-resident pairing was by chance and changed daily. We were unable to quantify how much of a role the resident played in each procedure, however, it is reasonable to presume that more senior residents likely had more procedural involvement, regardless of the attending.

As opposed to what one may think, difficult cases generally are not handled by more senior residents, but were assigned randomly a week ahead of time. We also recognized the subjective nature of our definition of a diagnostic sample: “sufficient material to establish a pathologic diagnosis or guide appropriate patient management”. This could be interpreted differently depending on the physician.

The number of additional days of hospitalization required with pneumothorax as required intervention were not recorded. This limited our understanding of which pneumothorax were truly major complications and falsely elevated our major complication rate. In addition, the retrospective nature of the study limited our data, preventing consistent recording of patient body mass index, smoking status, comorbidities, and resident level of interest in procedures. We also did not collect information on whether residents...
had completed a surgical intern year or if they eventually underwent an interventional radiology fellowship, which may have served as markers of higher interest in mastering their procedural skills. Last, the study was performed at a single institution/residency program and our procedural technique may not match that of other programs, potentially limiting its generalizability to other residency programs.

CONCLUSION

Of 1,191 biopsies analyzed, nearly 12% were nondiagnostic and over 12% had major complications; neither being associated with resident level of experience. These results suggested outcomes were not affected significantly by level of training. Programs may benefit from affording opportunities for newer PGY classes to participate in procedures. These results should provide confidence to the patients undergoing lung biopsies at an academic institution. They can be reassured that regardless of the seniority of their resident operator, they will receive an equivalent quality of care when it comes to diagnostic sampling. Furthermore, nondiagnostic cases may benefit from repeat biopsy procedure and operators should consider having a low threshold for re-biopsy.

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Severe Abdominal Pain Eight Years after Renal Transplant: A Case of Renal Transplant Atherosclerosis

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INTRODUCTION

Chronic mesenteric ischemia (CMI), also known as intestinal ischemia, is a condition that occurs when plaque builds up in the major arteries that supply the small intestine.¹,² When discussing CMI, it is important to distinguish between acute and chronic mesenteric ischemia. Acute mesenteric ischemia is a medical emergency caused by an acute loss of blood flow to the small intestine, leading to bowel infarction. This is either secondary to arterial emboli, likely originating from the heart, or soft plaque rupture leading to arterial thrombosis.³ In contrast, CMI is a constant hypoperfusion of the small intestine due to significant atherosclerosis and vessel narrowing without plaque rupture.⁴

CMI presents with weight loss, pain with eating, and food aversion often resulting in significant morbidity and a delayed diagnosis.⁴,⁵ The common risk factors that increase the likelihood of chronic mesenteric ischemia include age greater than 60 years, smoking history, uncontrolled dyslipidemia, diabetes, and hypertension.¹,⁴ This is a case of an elderly female who was diagnosed with a 90% stenosis of the superior mesenteric artery (SMA), despite having few well-known risk factors.

CASE REPORT

A 72-year-old female presented to the emergency room (ER) with severe abdominal pain after oral intake and significant malnutrition (BMI of 17.5 on admission). Her history included end stage renal disease status-post renal transplant in 2012, coronary artery disease status-post stenting of the left anterior descending coronary artery (LAD) in 2019, and dyslipidemia. She was a lifetime non-smoker, non-diabetic with no history of hypertension. Her dyslipidemia was well controlled (most recent lipid profile demonstrated a cholesterol of 170 mg/dL and low-density lipoprotein of 75 mg/dL). Upon presentation to the ER, the patient underwent emergent CT abdomen/pelvis imaging, which demonstrated non-calcified plaque at the origin and proximal SMA resulting in a high-grade stenosis. There was no evidence of bowel ischemia or bowel obstruction.

Given her abdominal symptoms and imaging findings, vascular surgery was consulted but did not recommend acute surgical intervention. The following morning, interventional radiology performed a mesenteric angiogram demonstrating a 90% stenosis of the SMA, and the SMA was stented successfully (Figure 1) with improved distal flow. Following successful endovascular revascularization, patient's abdominal pain following oral intake immediately and completely resolved.

DISCUSSION

In an older patient who presents to the emergency room with abdominal pain after oral intake, a broad differential should be maintained. The differential diagnoses include acute cholecystitis, acute mesenteric ischemia, chronic pancreatitis, chronic mesenteric ischemia, and peptic ulcer disease, among others.² As seen in our patient, the only risk factors that she had prior to presentation were age and LAD coronary artery disease. As such, her pretest probability for chronic mesenteric ischemia being the etiology of patient's abdominal pain was low.

When CMI is considered on the differential, the diagnosis is based on symptoms and imaging. Computer tomography angiography (CTA) is the primary imaging modality in patients whose clinical suspicion of CMI is moderate to high.² On CTA, atherosclerotic plaque has a sensitivity of 100% and specificity of 95%. If CTA is unable to be obtained given renal insufficiency or contrast allergy, magnetic resonance angiography (MRA) can be performed.³ While MRA has both a high sensitivity (95%) and specificity (100%) in detecting mesenteric ischemia, it has a limited role in diagnosing distal stenosis as well as nonocclusive mesenteric ischemia. Additionally, its use may delay therapeutic options in acute settings because of the lengthier testing duration, making CTA the imaging modality of choice if able.⁶

Despite limited risk factors, our patient had a significant 90% stenosis of the SMA. The factor that makes our patient's presentation unique was that she had a renal transplant. Renal transplantation can accelerate cardiac atherosclerosis and the metabolic syndrome. Courivaud et al. found 32% of renal transplant patients met criteria for metabolic syndrome one year after transplant. Kasiske found atherosclerotic cardiovascular complications developed in 15.8% of patients during the post-transplant follow-up period.⁸ Our patient had coronary artery disease requiring stenting of her LAD seven years after her renal transplant, despite being in otherwise good health. Established data demonstrated the mortality benefit of statin therapy in renal transplant patients. The ALERT trial showed that twelve-year survival rates were higher (73%) in statin users versus non-statin users (64%) in renal transplant recipients. There is a
paucity of data assessing the prevalence of renal transplantation and non-cardiac atherosclerosis as well as possible prevention of non-cardiac atherosclerosis.

Once the diagnosis has been established by CTA, revascularization is indicated in patients to relieve symptoms.\textsuperscript{2,4,10-12} Previously, open surgical revascularization was the standard therapy. However, more recently, endovascular revascularization is less invasive and is now favored as the treatment of choice.\textsuperscript{10-12} Cases of chronic mesenteric ischemic should be discussed with both vascular surgery and interventional radiology to discuss therapeutic options and the best route for revascularization.

**CONCLUSIONS**

The prevalence of non-cardiac atherosclerotic conditions in renal transplant patients has not been well established in literature. As demonstrated by our case, renal transplantation should be considered a major risk factor for non-cardiac atherosclerotic disease. The prevalence of renal transplant and subsequent CMI should be assessed in larger clinical trials. In doing so, the focus can turn to prevention of non-cardiac atherosclerotic disease in this already vulnerable transplant patient population.

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Asymptomatic, Chronic Type-A Dissection of a Large Ascending Thoracic Aortic Aneurysm in a Young Patient

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INTRODUCTION

Incidence of thoracic aortic dissection (TAD) in the general population is very low, ranging from 2.6-3.5 cases per 100,000 persons per year, but it is associated with a high rate of mortality and morbidity.1-3 Based on the nature of its onset and anatomical location, TAD is classified as either acute or chronic Stanford type-A dissection involving the ascending aorta and type-B distal to the left subclavian artery.4,5 Acute type-A dissection is highly lethal with a 30-day mortality of 50% compared to 10% of type B.2 Most acute TAD patients presented with a sudden onset of severe chest, abdominal, or back pain, but 6.4% of them may have painless dissection.6 The majority of patients with TAD were older with a mean age of 63 years while only 7% of them were less than 40 years of age.7 Common predisposing factors for TAD are hypertension, atherosclerosis, and a history of cardiac surgery, while in young patients they are more likely Marfan’s syndrome, bicuspid aortic valve, and prior aortic surgery.8

We report a case of a healthy, young male veteran who presented with asymptomatic, chronic type-A dissection of a large aortic aneurysm, complicated by severe aortic regurgitation (AR). Several physical signs characteristic of chronic, severe AR were found in this patient.

CASE REPORT

A 29-year-old Caucasian male with history of “heart murmur” diagnosed years prior was evaluated in the cardiology clinic as a referral from his primary care physician. Clinically, he was free of any symptoms even with routine exercise and work-out. He was a former smoker without history of recreational drug use. His past medical history included anxiety and migraine and a family history of “bicuspid aortic valve” with surgery in his paternal uncle (details unclear).

Physical examination showed that the patient was normal in appearance. His weight was 61.6 kg and a height of 69 inches giving a body mass index of 20.02 kg/m². His vital signs showed a heart rate of 79 beats/minute and blood pressure (BP) of 108/41 mmHg, indicating a widened pulse pressure of 67 mmHg (normal range: 30-50 mmHg). His radial and femoral artery pulses were present and equal on both sides. Cardiac examination showed a laterally displaced apical pulse by palpation and a loud, harsh systolic murmur and a 3/6 diastolic rumbling murmur in the precordium by auscultation. Other physical findings of his chronic AR with their respective eponyms were as follows:

- Palpation of his radial artery pulse showed rapidly swelling/falling pulse, further accentuated by wrist elevation above his head (Corrigan’s pulse).
- There was an exaggerated drop of brachial diastolic BP from 49 mmHg (BP: 109/49) in sitting and normal arm position to 36 mmHg (BP: 97/36) when the arm was raised to shoulder height (Mayne’s sign).
- In supine position, his brachial BP was measured at 117/53 mmHg compared to his popliteal one at 161/61 mmHg (Hill’s sign).
- There was a visual examination of his thumb nail showed exaggerated nail bed pulsation or blanching when tip of nail bed was gently pressured (Quincke’s sign).
- Auscultation over his femoral artery revealed a to-and-fro murmur generated by gentle compression of the stethoscope over the artery (Duroziez’s sign).

Transthoracic echocardiogram (TTE) showed a moderately dilated left ventricle (LV) with LV ejection fraction of 50% and tricuspid aortic valve with severe AR by color-flow Doppler (Figure 1). Both his aortic root and sinuses of Valsalva were severely dilated to 5.6 and 6.8 cm respectively with intimal flaps from aortic dissection in the aortic root (Figures 2 and 3).

Chest computed tomography (CT) with contrast revealed severely dilated aortic root and proximal ascending aorta with maximal diameter of 6.4 cm extending for 8 cm before tapering quickly to normal dimension in the distal ascending aorta (Figure 4). Within the large aortic aneurysm, there were intimal flaps consistent with aortic dissection (Figures 5 and 6). The patient was referred to an academic medical center for further management. He was evaluated initially as an outpatient at that facility by a cardiothoracic surgeon and subsequently underwent successful aortic valve replacement using a St. Jude mechanical aortic valve and aortic aneurysm repair with aortic root replacement without complication. Intraoperatively, extensive dissection was identified in the ascending aorta above the valve, extending into the commissures of aortic valve AR. Pathology report showed “myxoid degeneration and fibrosis” of the resected aortic valve leaflets and aortic aneurysm.

DISCUSSION

Aortic dissection is defined as a splitting process that occurs in the aortic media.2,4 The first 14-day period after onset has been designated the acute phase, because morbidity and mortality rates are the highest and surviving patients typically stabilize during that period. The pathophysiology of the aortic dissection includes aortic intimal tear or intramural hematoma. The most common predisposing factor in International Registry of Acute Aortic Dissection (IRAD) was hypertension (72%), followed by atherosclerosis (31%) and a history of cardiac surgery (18%).2 Any mechanisms that weaken the medial layers of the aorta will lead to dissection that includes hypertension, connective tissue disorders (i.e., Marfan’s syndrome, Ehlers-Danlos syndrome, bicuspid aortic valve), vasculitis (i.e., giant cell arteritis, Takayasu arteritis, Behcet’s disease), chest-wall injury/motor vehicle accident, or iatrogenic factors like catheter intervention, prior cardiac surgery among other uncommon causes.
Figure 1. Transthoracic echocardiogram image in parasternal view showing severe aortic regurgitation by color flow Doppler.

Figure 2. Transthoracic echocardiogram image in parasternal view of aortic valve in opening position and intimal flap in supravalvular position (both indicated by white arrowheads).

Figure 3. Transthoracic echocardiogram image in 5-chamber view showing severely dilated aortic root with intimal flap mimicking congenital supravalvular membrane.

Figure 4. Sagittal view of chest computed tomography angiography showing a large proximal ascending aortic aneurysm, tapering down to normal dimension in distal ascending aorta. Arrowheads indicate intimal flaps.

Figure 5. Coronal view of chest computed tomography angiography showing a large proximal, ascending aortic aneurysm. Arrowheads points to intimal flaps mimicking congenital supravalvular members.
Patients with TAD typically presented with sudden, severe chest, back, or abdominal pain characterized as sharp, tearing, or knifelike.\textsuperscript{2,3} The chest pain was reported more common in type-A vs type-B dissection (78.9\% vs. 62.9\%) while abdominal pain was more common in type-B dissection (42.7\% vs. 21.6\% in type-A dissection).\textsuperscript{3} Most TADs occurred in patients between 40-70 years of age, but no age group was exempt. However, it occurred much less frequently (less than 7\%) in patients less than 40 years of age.\textsuperscript{7} Overall in-hospital mortality was high (27.4\%) in patients with acute thoracic dissection and highest among patients with type-A dissection (58.0\%) not receiving surgery; patients with type-B dissection treated medically had the lowest mortality (10.7\%).\textsuperscript{3} In the IRAD study, the main reasons cited for medical therapy were comorbid conditions, advanced age (mean 80 years), and patient's refusal. The most common causes of death among patients with type-A dissection were aortic rupture, acute severe AR, cardiac tamponade, and visceral ischemia.\textsuperscript{4,5} Upon follow-up of those patients who survived type-A dissection to discharge without surgical repair, 66\% of patients had a 3-year survival rate.\textsuperscript{6} Our patient likely had chronic TAD of undetermined duration. The pathology findings of myxoid, degenerative changes of his aortic valve leaflets and aorta were suggestive of underlying hereditary connective tissue disease.

Currently, the diagnostic modalities for TAD are transesophageal echocardiograph (TEE), CT, or magnetic resonance imaging (MRI) of the chest. For type-A TAD, abnormalities might be detected by TTE. The imaging hallmarks of dissection include the presence of an intimal flap dividing a true and a false lumen, intimal hematoma, peri-cardial effusion or tamponade, and aortic regurgitation.\textsuperscript{9} Both TTE and chest CT findings of this patient were consistent with chronic type-A dissection of ascending thoracic aneurysm.

The one- and three-year survival for patients with acute type-A TAD treated with surgery was 96.1\% and 90.5\% vs. 88.6\% and 68.7\% without surgery.\textsuperscript{4} Thus, surgery is the treatment of choice in patients with acute type-A TAD.

As a complication of TAD, extension of dissection to the aortic valve can result in AR. The hemodynamic consequences of AR are dependent on the rate of onset of AR, either acute or chronic.\textsuperscript{10} In acute AR, there will be a sudden increase in the volume of blood in and increased filling pressure of the left ventricle (LV) leading to pulmonary edema and hypotension. Thus, severe, acute AR is a surgical emergency. If the individual survives the acute phase or has gradual worsening of AR, his LV adapts by hypertrophy and dilatation with a subsequent compensated volume overload and a normal LV filling pressure. Patients with chronic AR may be asymptomatic and may have normal exercise tolerance. In our patient, severe AR likely was due to extension of the dissection to the aortic valve commissure as noted intraoperatively.

Several physical findings were found in our patient characteristic of severe, chronic AR. These manifestations of severe chronic AR were the results of widened pulse pressure because elevated stroke volume exists during systole and the incompetent aortic valve allows the diastolic pressure within the aorta to fall significantly. A more comprehensive list\textsuperscript{11,12} includes the following:

- Corrigan’s pulse: In 1832, Sir Dominic Corrigan (Dublin, Ireland) described a radial pulse, characterized by a rapidly swelling and falling by palpation, further accentuated by wrist elevation. It also was described later as “collapsing pulse” or “water-hammer pulse”.

- Duroziez’s sign: Paul Duroziez, a French physician, in 1891 described the “double intermittent murmur” over the femoral arteries. It described a to-and-fro femoral artery murmur generated by femoral artery compression. This is likely caused by forward flow during systole and a diastolic flow from AR.

- Hill’s sign: Sir Leonard Hill, an English physiologist, first described the findings in 1900 that BP in the lower extremity in patients with AR was consistently higher than those in the upper extremities in recumbent position, without specifying numerical criteria. Later, a gradient above 20 mmHg generally has been accepted.

- Mayne’s sign: In 1953, Mayne described that a drop of at least 15 mmHg in the diastolic blood pressure when the arm was raised above the head could be detected in some of his patients with AR.

- Muller sign: Systolic pulsations of the uvula are observed by visual examination.

- De Musset sign: The sign of a bobbing motion of a patient’s head with each heartbeat was named after a famous French writer and dentist, Alfred Louis Charles de Musset in 1877, who suffered from syphilitic aortitis and AR. It was described originally by his brother Paul and later appeared in medical literature in 1900.\textsuperscript{18}

- Quincke’s sign: It describes an exaggerated visible pulsation or blanching of red capillary color seen in nail beds when tip of the nail bed gently pressured. This was demonstrated recently by a video in a patient with severe AR.

- Taube’s sign (“pistol-shot” pulse): Booming systolic and diastolic sounds are auscultated over the femoral artery.
CONCLUSIONS

Type-A aortic dissection, a highly lethal condition, can occur in apparently healthy, young patients with atypical presentation of epigastric/abdominal pain followed by asymptomatic clinical course despite the dissection and associated severe AR. Aortic regurgitation is a common complication of type-A dissection; careful physical examination may lead clinicians to the diagnosis at bedside.

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