

UVM Project ECHO: Bone Health

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Didactic presentation is recorded. Registered participants will receive the link.

Session Agenda

- Welcome Participants and Presenters
- Objectives
- Didactic Presentation (20-30 min)
 - Q&A
- Case presentation(s)
 - Clarifying questions
 - Discussion
 - Recommendations
- Closing Announcements
 - Submission of new cases
 - Completion of evaluations



ECHO Model: All Teach, All Learn



Cohort-based learning on ZOOM

- Have your camera on as much as possible, especially when joining the meeting and during discussions
- Questions and comments are welcome – use the “raise hand” feature or put them in the chat
- This is not a webinar! Participation is key

Case-based learning

- 1-2 participant cases each session using provided template



Series Objectives

Learning objectives for this ECHO series include the ability to:

- Identify which patients to screen for fracture risk
- Determine who to recommend for treatment
- Discuss the different medications available to treat osteoporosis and their potential side effects

CMIE Disclosures

- University of Vermont (UVM) Office of Continuing Medical and Interprofessional Education (CMIE) is approved as a provider of Continuing Medical Education (CME) by the ACCME. UVM designates this internet live activity for a maximum of 1 **AMA Category 1 credit**[™].
- UVM CMIE is accredited by the American Nurses Credentialing Center (ANCC) to provide CE for the healthcare team. This program has been reviewed and is acceptable for up to 1 **Nursing Contact Hour**.
- Successful completion of this CME activity, which includes participation in the evaluation component, enables the participant to earn up to: **1 MOC point** in the American Board of Internal Medicine's (ABIM) Maintenance of Certification (MOC) program; It is the CME activity provider's responsibility to submit participant completion information to ACCME for the purpose of granting ABIM or ABP MOC credit.

Participants should claim only the credit commensurate with the extent of their participation in the activity.

CMIE Disclosures

Interest Disclosures: As an organization accredited by the ACCME to sponsor continuing medical education activities, UVMCMIE is required to disclose any real or apparent conflicts of interest (COI) that any speakers may have related to the content of their presentations.

Meeting Disclaimer: Regarding materials and information received during this educational event, the views, statements, and recommendations expressed during this activity represent those of the authors and speakers and do not necessarily represent the views of the University of Vermont.

METABOLIC BONE CHANGES FOLLOWING BARIATRIC SURGERY

DONALD SKOR MD
ENDOCRINOLOGY UVMHC

OBJECTIVES

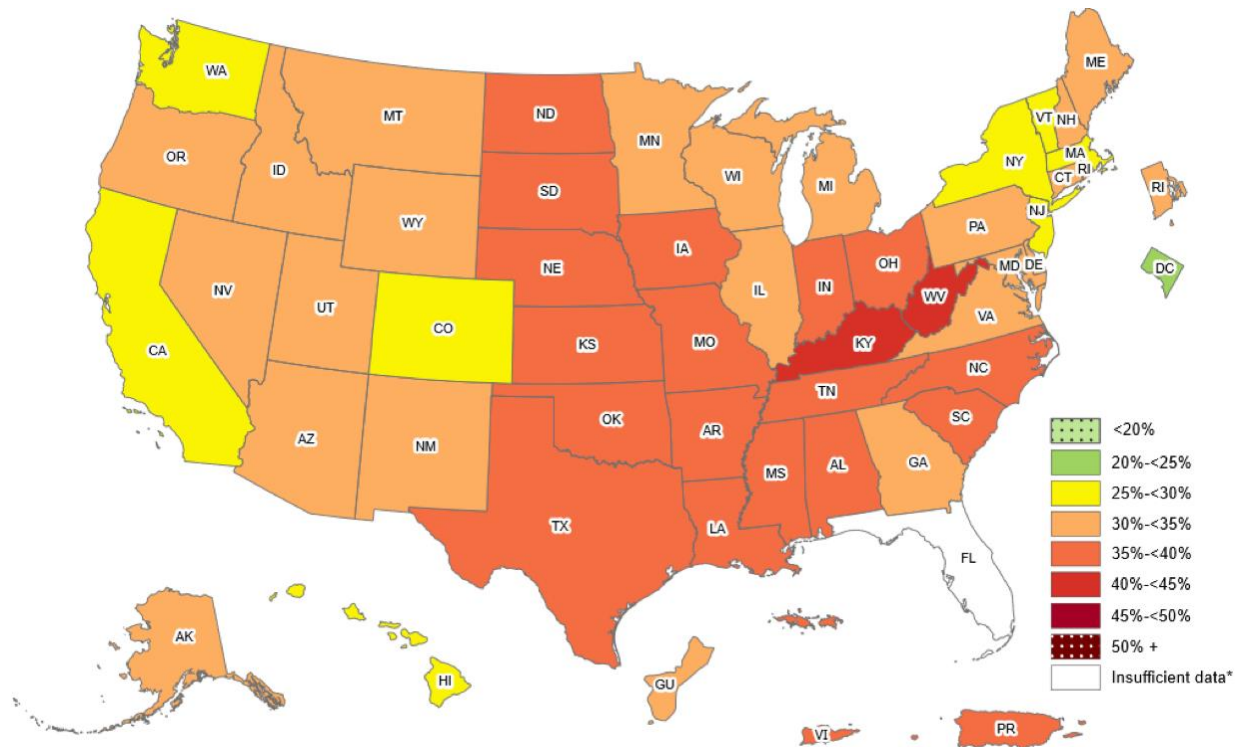
- Review the relationship between obesity and bone density
- Discuss bariatric surgical procedures and outcomes
- Discuss strategy for preoperative management
- Identify factors contributing to metabolic bone loss following bariatric surgery
- Review post operative prevention and treatment of metabolic bone consequences of surgery

OBESITY

- Worldwide predicted prevalence of 18% of men and 21% of women by 2025
- Morbid obesity with BMI > 40kg/m in 6% of men and 9% of women
- U.S.A. Had 40% obesity rate in 2020

Prevalence* of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2021

* Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.



*Sample size <50, the relative standard error (dividing the standard error by the prevalence) $\geq 30\%$, or no data in a specific year.



BONE PROTECTIVE BENEFITS OF OBESITY

- Increase in mechanical loading
- Larger bone size
- Increase aromatization of androgens from adipose tissue and adipokines
- Increase in soft tissue surrounding the hip

FACTORS AFFECTING BONE LOSS IN OBESITY

- Low levels of vitamin D in 60-84% of pre-op patients
- High levels of PTH in as many as 49% of pre-op patients
- Leptin, a hormone produced by adipocytes and found to be increased in people with higher fat mass, regulates bone mass directly and indirectly via PTH. It increases cortical bone mass but may reduce trabecular bone mass through a mitogenic effect on PTH mass.

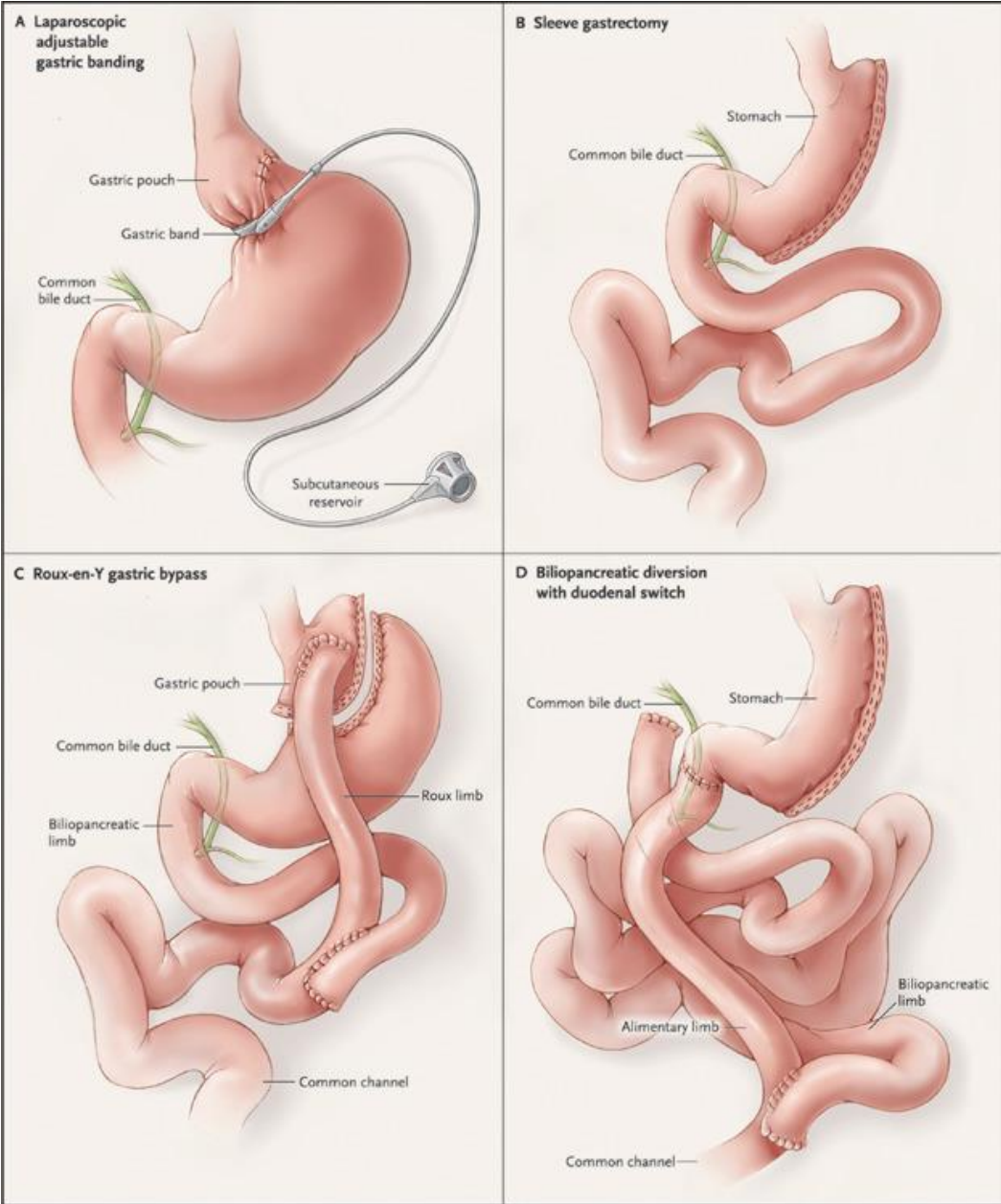
BARIATRIC SURGERIES IN THE U.S. 2020

• SLEEVE GASTRECTOMY	122000 PROCEDURES
• RYGB	41000
• BILIO-PANCREATIC DUODENAL SWITCH	3500
• GASTRIC BANDING	2400

SURGICAL POPULATION

- 80% FEMALE
- AVERAGE AGE EARLY- MID 40's
- BMI > 43.5
- HIGH RATE OF COMORBIDITIES OF HYPERTENSION AND DIABETES MELLITUS

GASTRIC BYPASS SURGERY



LAPAROSCOPIC ADJUSTABLE GASTRIC BANDING

- < 5% of all bariatric procedures
- Purely restrictive
micronutrient malabsorption is not expected
- Modest excess weight loss of 40-50%
- High rate of weight gain
- High longterm rates of re-operation, 8-60%
- Bone loss is similar that expected from weight loss of any cause

SLEEVE GASTRECTOMY

- Most commonly performed procedure worldwide
- Restrictive, leaving 20% of stomach in place, but also induces functional malabsorption by altering nutrient transit time
- Restricts food passage through a narrow stomach
- Promotes satiety by reducing ghrelin, and increasing GLP-1 and peptide YY
- Excess weight loss of >50%

ROUX-EN-Y GASTRIC BYPASS (RYGB)

- Restrictive-restricts stomach pouch
- Malabsorptive by shortening intestine allowing for reduced nutrient absorption
- Results in increased levels of GLP-1 and PEPTIDE YY
- Excess weight loss of 70-80%
- Calcium deficiency in 10-25% 2 years post-op: 25-48% by 4 years

BILIOPANCREATIC DIVERSION WITH DUODENAL SWITCH

- Reduces the size of the gastric pouch and diverts gastric contents directly into the last part of the small intestine
- Results in greater risks of vitamin D deficiency, greater protein calorie malnutrition and secondary hyperparathyroidism. Low serum albumin levels are strong predictor of protein malnutrition after BPD-DS
- Bone loss appears to be similar to RYGB and SG
- <1 % of all procedures

BARIATRIC SURGERY OUTCOMES

- 30-50% of weight loss occurs in the first 6 months, and up to 80% by 12 months
- Hypertension: 70-80% of patients discontinue medication within 6 months and maintain normal blood pressure
- T2DM: 90% see reduction or discontinuation of medication within several weeks of surgery

- Cleveland Clinic Bariatric and Metabolic Institute

BARIATRIC SURGERY AND LIFE EXPECTANCY

- 90 day post-op mortality 0.2%
 - 2.9% underwent repeat surgery
 - Life expectancy 3 years longer in the surgery group v control group
 - Life expectancy 5.5 years shorter in the surgical group v general reference population
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- NEJM 2020; 383:1535-1543
 - Swedish study of 2007 patients in the surgical group (mortality data 24 years median f/u) and 2040 patients in the control group (22 years median f/u), with 1135 people in the reference group (20 year median f/u). Mortality data was available on 100% of participants.

BONE LOSS POST SLEEVE GASTRECTOMY

- Less weight loss in sleeve gastrectomy
- Following sleeve gastrectomy, there is uninterrupted nutrient flow across the duodenum v RYGB
- Bone loss is observed and levels of bone turnover markers (C-terminal telopeptide-CTX, osteocalcin) exceed those seen following non-surgical weight loss by almost 30%
- Mechanical unloading
- Reduced gastric acid secretion and accelerated gastric emptying, resulting in reduced calcium absorption
- Bone DXA scores are lower in the hip and femoral neck, similar to results in patients post RYGB

BONE LOSS POST RYBG

- Preferential site of calcium absorption is the proximal small intestine-RYGB bypasses this site
- Reduced calcium absorption due to reduced gastric acid
- Malabsorption of vitamin D
- Reduced mechanical loading on bones as a result of weight loss. Short term studies have shown possible mitigation with resistance training
- Markers of bone remodeling such as C-terminal telopeptide (CTX) may increase by as much as 200%, and osteocalcin by 75%, independent of weight loss or parathyroid levels
- Possible increase in osteoclast proliferation in response to higher levels of peptide YY and GLP-1 post bypass
- Reduced protein intake
- Markers of bone formation increase only slightly

PREOPERATIVE MEASURES

- Optimize vitamin D levels
- Check baseline alkaline phosphatase and PTH levels
- 24 hour urine calcium level
- DXA screening based on general population guidelines and strongly consider for all postmenopausal women, men >50, and those with risk factors (premature menopause, history of fractures and family history)
- High resolution peripheral quantitative CT where available
- Encourage regular exercise

DO PREOPERATIVE MEASURES MATTER

- 220 patients either post RYGB or SG
- Randomized to non-intervention or intervention x 24 months
- Intervention included pre-op vitamin D loading, vitamin D+calcium+protein supplement and obligatory physical exercise
- Intervention group had lower levels of bone resorption markers, lower levels of PTH, and less decline in BMD at the spine and total hip. Weight loss was comparable.

- ASBMS Guidelines/Statements, Kim et al., Surgery for Obesity and Related Diseases, 17 (2021), 1-8

DXA-DUAL ENERGY X-RAY ABSORPTIOMETRY

- Profound weight loss changes composition of the soft tissue surrounding bone-DXA changes may be artifactual and overestimate bone density
- Cannot distinguish trabecular and cortical bone
- Cannot evaluate bone microstructure, i.e. Bone strength and quality

HIGH RESOLUTION QCT ASSESSMENT OF BONE DENSITY

- Less subject to magnification errors and extraosseous tissue changes
- Distinguishes micro architectural changes in cortical and trabecular bone
- Computational models can assess bone mechanical competence (stiffness), i.e. strength
- Discordant results vs DXA in patients following RYGB. Possible overestimates of bone loss with DXA, especially in the most obese patients
- Limitations include cost, limited reimbursement and higher levels of radiation exposure

FRACTURE RISK FOLLOWING BARIATRIC SURGERY

- Meta-analysis for 10 studies published in 2016 looked at 241 surgical and 261 non-surgical controls with 10 year follow up. Bone density was reduced in the femoral neck but not the lumbar spine in the surgical group.
- Quebec study of 12000 patients post bariatric surgery compared to age, sex and BMI matched control group followed up to 4.4 years. Fracture risk was shown to be greater in the surgical group with relative risk of 1.38 vs obese and 1.44 vs non obese controls.
- Swedish national database study of almost 40000 patients post RYGB, reported 26% risk of any fracture after RYGB in T2DM
- Swedish obesity study compared 5335 weight loss surgery patients vs 2037 matched control patients with 17 year follow up. RYGB group had significantly higher rates of all fractures, osteoporotic fractures
- Highest risk has been reported in BPD-DS

Kim et al., Surgery for Obesity, 17 (2021)

FRACTURE RISK FOLLOWING BARIATRIC SURGERY

- Large population studies (2000-12000 patients) from US, UK, Canada and Taiwan
- Obese, particularly severely obese people, have higher rates of lower extremity fractures-tibia, ankle, feet
- Mixed restrictive and malabsorptive procedures increase relative fracture risk by 1.4-2.3 with short term follow up
- Post-op fracture pattern more resembles fractures associated with osteoporosis-spine, hip, femur, pelvis, radius
- Fracture risk peaks first after 3 years, then plateaus, and reaches a second peak at 11 years (? menopause effect)

DO LIFESTYLE FACTORS PROTECT AGAINST BONE LOSS

- Sedentary lifestyle is common in obesity
- Physical activity often increases following surgery
- 71 swedish pre-menopausal women post RYGB and 94 age matched controls (smokers excluded) followed for 5 years
- Approximations of calcium intake (milk and cheese), minutes of weekly exercise and body weight were followed
- RYGB group had significantly lower bone densities, unrelated to the level of activity, BMI, calcium intake and medications

Stevens, Hultin et al. BMC Surgery, 21: 282 (2021)

RECOMMENDATIONS FOR BONE MAINTENANCE POST BARIATRIC SURGERY

- Calcium citrate 1200-1500mg/day in 2-3 doses
- VITAMIN D 2000-4000 units daily to maintain vitamin D levels >30 ng/ml
- Monitor albumin, calcium, PTH, alkaline phosphatase, vitamin D levels every 6 months for 2 years, then annually
- Consider markers of bone turnover (CTX levels)
- DXA screening at baseline and every 2 years
- Exercise with a target of moderate aerobic physical activity with a minimum of 150 minutes/week and a goal of 300 minutes/week, including 2-3 days of strength training.

BISPHOSPHONATES

- IV zoledronic acid is the preferred bisphosphonate treatment post bariatric surgery
- Inhibits osteoclast-mediated bone loss
- Efficacy of the oral agents is questionable, since the specific site of intestinal absorption is not known
- Oral agents may cause esophagitis, gastric and esophageal ulcers, and abdominal pain

RALOXIFENE

- Selective estrogen receptor modulator (SERM)
- Inhibits bone resorption and turnover, and reduces the risk of spine, but not hip, fractures in post-menopausal women
- Side effects include hot flashes, leg cramps, and increased risk of DVT
- Since bone loss greater in the hip following surgery, this may not be the best choice.

DENOSUMAB

- Monoclonal antibody which binds the cytokine rankl, thereby blocking osteoclast maturation, function, and survival, and reducing bone resorption
- Administered by injection every 6 months
- Side effects include hypocalcemia, myalgias, arthralgias, and headaches

CONCLUSIONS

- Bone loss commonly occurs following bariatric surgery, especially in post menopausal women
- Fracture risk is higher in the hip than the spine
- Preoperative efforts to reduce bone loss should include vitamin d and calcium supplements, and weight bearing exercise with resistance training
- Baseline DEXA scanning should be performed in post-menopausal women and others at high risk
- Treatment, when necessary, with anti-resorptives, primarily zoledronic acid or denosumab

QUESTIONS??

Case Presentation

Bringing Knowledge to Action through interactive, case-based discussions

Participant presents the case and poses the question(s) for the group



Clarifying questions about the case from group to case presenter



Ideas, suggestions, recommendations from participants



Ideas, suggestions, recommendations from ECHO faculty team



Full group discussion



Summary and wrap-up by facilitator



Case Presentation



DO NOT INCLUDE:

Names, Address, DOB, Phone/Fax #, Email address, Social Security #, Medical Record #

Consider the level of detail necessary. Go with less when possible.

The discussion and materials included in this conference are confidential and privileged pursuant to 26VSA Section 1441-1443. This material is intended for use in improving patient care. It is privileged and strictly confidential and is to be used only for the evaluation and improvement of patient care.

DATES	SESSION	DIDACTIC TOPICS (in addition to case review)
January 20	TeleECHO Session #1	Osteoporosis in Men (Ugis Gruntmanis, MD)
February 17	TeleECHO Session #2	Dental perspective on Osteonecrosis of the Jaw (Justin Hurlburt, DMD)
March 17	TeleECHO Session #3	Parathyroid disorders/bone health (Samantha Steinmetz-Wood, MD)
April 21	TeleECHO Session #4	Update on Vitamin D (David Felske, MD)
May 19	TeleECHO Session #5	Stress fractures (Ayesha Arif, MD)
June 16	TeleECHO Session #6	Metabolic Bone changes after bariatric surgery (Donald Skor, MD)



Closing Announcements

- Slides are posted at www.vtahec.org
- Recording of didactic portion will be sent by email to the full cohort
 - **All recordings are for the use of registered participants only**
- Evaluation surveys
 - Session survey - Ideas for future ECHO Topics?
 - 3-month post-series evaluation – **please complete it!**
- **UVM CMIE reminder to claim all credits for series by July 31 deadline**
- Please contact us with any questions, concerns, or suggestions:
 - Jennifer.Kelly@uvmhealth.org
 - Patti.Smith-Urie@uvm.edu