The Effects of the Gut Microbiome on Osteoarthritis

Denise Alabi
Hernandez Lab
What is Osteoarthritis?

- Cartilage of bones at joints degrades and bones grind against each other
  - Cartilage degrades, bone structure changes
- Osteoarthritis affects 27 million Americans and costs $185.5 billion a year
- Causes immense pain and loss of mobility in victims but has no cure
Why is this Research Important?

- The U.S. Department of Defense funded this project to find a way to alleviate osteoarthritis cause by high impact loads in veterans
- Could lead to understanding the disease in more specific contexts of the stomach’s bacteria
• Used the joint at the femur and tibia because it is typical for osteoarthritis to develop here
• Used mice models
Choice in Study Subjects

- WT (Wild Type) mice
  - Lean body with an natural microbiome
- WT + high fat diet mice
  - Highest bodily fat content
- TLR5KO mice
  - TLR5 receptor (receptor for bacterial flagellin) is removed, which changes gut microbiome and causes metabolic syndrome
  - Low-grade chronic inflammation cause gut inflammation and increase adiposity
- TLR5KO + antibiotics mice
  - Antibiotics eliminate metabolic syndrome and give lean body type of WT but with altered gut microbiome similar to TLR5KO
Portrayal of Subjects

WT
- Normal weight
- Balanced diet
- TLR5KO

WT + high fat diet
- Weight gain
- Unhealthy diet
- TLR5KO

TLR5KO
- Genetic disorder
- Obese

TLR5KO + antibiotics
- Weight loss
- Healthy diet
- TLR5KO
• Raised to 16 weeks
• Sedated
• A single load of 9N applied to the joint at the femur and tibia
• Euthanized after 2 weeks
• The femur and the tibia were dissected
MicroCT Scans

- All analysis done to match preexisting data
- MicroCT: High resolution X-ray to see individual trabeculae
  - Outlined spongy bone to so that the percentage of spongy bone could be analyzed
  - Should notice thicker subchondral bone and due to osteoarthritis

Cortical bone: Hard, outer bone
Cancellous bone: spongy bone
Staining

- Hemotoxylin (nucleus, purple), Safranin-O (cartilage, red), Fast Green (bone, blue)

- Cartilage degradation, cartilage thickness and thickness of subchondral bone plate in analyzed under microscope

  - Greatest cartilage degradation in mice with most fat and systematic inflammation

Less cartilage, more bone
Conclusions/Future Directions

• Hoping that study contributes to further understanding osteoarthritis to help affected U.S. veterans

• Understanding the disease based on body type and microbiome could help find ways to accurately prevent and slow down the disease
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