Objectives

- Provide a review of the medical nutrition therapy recommendations for the management of polycystic ovarian syndrome (PCOS).
- Learn the symptoms of and criteria for medical diagnosis; learn which lab values are monitored and evaluated in association with polycystic ovarian syndrome.
- Understand the current research associated with dietary supplementation in association with MNT for the management of polycystic ovarian syndrome.
- Understand the medical demographics associated with polycystic ovarian syndrome diagnosis.
- Practical application: Case study reviews of normal weight PCOS and overweight PCOS patients.

PCOS: Facts and History

PCOS: Set of symptoms caused by a hormonal imbalance affecting females of reproductive age. Cause unknown, possibly genetic?
- Most common endocrine disorder in females
- Characterized by hyperinsulinemia and hyperandrogenism
- 50% of women are overweight, 61-76% obese
- 60-80% have insulin resistance

Historical thoughts:
- Insulin resistance, fat storage, appetite, beneficial for survival rate during famine
- Stored fat was also considered helpful for pregnancy and to extend reproductive years, as cycle increases with age
- Early treatment was high protein and low carbohydrate = binge eating!

History of PCOS

- 1935: Irving F. Stein and Levanthal published case studies of women with menstrual disturbances and labeled as a reproductive disorder
- 1990: PCOS and insulin resistance were connected = endocrine and reproductive disorder
- 1990: NIH defined PCOS as chronic anovulation with clinical biochemical hyperandrogenism, without thyroid/adrenal dysfunction
- 2009: Definition was revised to include hyperandrogenism for diagnosis
- Early treatment was high protein and low carbohydrate = binge eating!
- Cysts originally thought to cause hormonal imbalance; we now know that cysts are the result of hormonal imbalance.
PCOS Diagnosis and Symptoms

**Diagnosis:** No one test to diagnose
- Need 2 of 3 criteria:
  - Menses: infrequent, irregular, prolonged cycles
    - <9 periods/year, >35 days between cycles, abnormally heavy cycles
  - Physical symptoms of hyperandrogenism (male hormones)
    - Ovarian cysts
    - Adolescents: focus on hyperandrogenism and persistent oligomenorrhea vs. anovulation
  - Ovarian cysts
  - Adolescents: focus on hyperandrogenism and persistent oligomenorrhea vs. anovulation

**Symptoms:** Develop around first menstrual cycle, or with significant weight gain
- Excessive facial and body hair, male pattern hair loss, acne
- Irregular menses, skin tags, acanthosis nigricans

“Skinny” PCOS

Normal-weight (NW) vs. Overweight (OW)
- NW more likely to be diagnosed at an older age & more likely to have polycystic ovaries
  - Late diagnosis may be due to clinicians having lower suspicion of symptoms being related to PCOS
- OW more likely to have a family history of overweight/obesity
  - Also more likely to have acanthosis nigricans & higher androgen levels
  - Many symptoms seen in OW individuals may be due to their excess weight, which is why they aren’t seen as much in leaner individuals, such as insulin resistance and hyperglycemia

Causes of PCOS Symptoms

- High levels of androgens
  - Interfere with normal ovulation
  - Cause cysts to form
  - Produce other symptoms, including excess hair growth and acne
- High levels of insulin
  - Increase androgen levels
  - Can increase appetite and lead to weight gain
  - Linked to acanthosis nigricans

Barthelmes & Nis, 2015

National Institute of Health, Mayo Clinic
Goals of Treatment

No cure: manage symptoms and associated conditions

- Maintain or decrease weight
- Decrease insulin and androgens
  - Nutrition, exercise, and medications
  - Treatment of insulin resistance favors fertility, metabolic issues, and weight loss
- Prevent and treat heart disease risk factors
- Improve reproductive function/regulate menses
  - Medications, supplements, diet, exercise

Conditions Associated with PCOS

- Impaired glucose tolerance (IGT)
- T2DM
- Metabolic syndrome
- Higher risk of CAD
- NASH (non-alcoholic steatohepatitis)
- Obstructive sleep apnea
- Overweight and obesity
- Mood disorders
- Endometrial hyperplasia
- Disordered eating
PCOS Treatment Team

- OB/GYN
  - Fertility and menses regulation
- Endocrinologist
  - Hormone irregularities, medication management, IGT, etc...
- Registered Dietitian
  - Nutrition management
  - Relationship with food
  - Disordered eating patterns
- Psychologist
  - Potential psychiatrist if psychiatric medications needed
  - Body image work
  - Depression, anxiety, stress management

Summary of Nutrition Therapy

- Consume variety of foods from all food groups
- Limit sugar-sweetened beverages
- Eat carbohydrate-containing foods evenly throughout the day
- Eat every 3-5 hours, listen to body cues
- Limit refined carbohydrates and simple sugars
- Lean protein and Omega-3 fats with most meals/snacks
- Limit trans and saturated fats, and foods high in Omega-6
- Consume fatty fish twice per week
- Take a 1000 mg fish oil (EPA + DHA) supplement daily

Nutrition Therapy - Carbohydrates

- Limit vs. avoid refined carbohydrates and simple sugars
- PCOS carbohydrate cravings related to hyperinsulinemia
- Choose unrefined carbohydrates and whole grains
  - Increase fiber, chromium, magnesium, selenium = decrease insulin
  - Increase phytochemicals, fiber and antioxidants = decrease risk for cancer, heart disease, and diabetes
- Consistent Carbohydrates
  - Meals: 1-3 servings = 15-45 grams
  - Snacks: 1-2 servings = 15-30 grams

Nutrition Therapy – Fats

- Fats
  - Trans and saturated fats = increase insulin resistance
  - Fat restricted = decreases fertility
  - Increase Omega-3 and decrease Omega-6 intake
  - Goal ratio of 4:1, Americans diet 10:1
- Omega-6
  - Palm, corn, soy, safflower, cottonseed, grapeseed and sunflower
    - Increase risk of heart attacks, arrhythmias, arthritis, inflammation, stroke, osteoporosis, and disturbed mood
- Omega-3
  - ALA – chia seeds, walnuts, flax seeds, hemp, canola oil
  - EPA & DHA – enriched egg yolks, salmon, tuna, trout, halibut
  - Improve mood, hair and skin quality
  - Decrease total cholesterol, triglycerides, insulin and blood pressure
Nutrition Therapy – Protein

- Protein
  - Moderate protein intake
  - Excessive protein increases infertility
  - High protein intake is associated with increased saturated fats, limited whole grains, fruits, and starchy vegetables
  - Low carbohydrate intake can lead to overeating and weight gain = PCOS!
  - Choose plant-based protein
    - Nuts, beans, soy, lentils, peas, seeds
    - Exceptions: Omega-3 enriched eggs, full-fat dairy, and fish for fertility

Labs to evaluate with PCOS

<table>
<thead>
<tr>
<th>Lab Test</th>
<th>Lab Value</th>
<th>Lab Test</th>
<th>Lab Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting Glucose</td>
<td>&gt;100 mg/dL elevated</td>
<td>Triglycerides (TG)</td>
<td>&gt;150 mg/dL elevated</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>&gt;120/80 mmHg elevated</td>
<td>High-Density Lipoproteins (HDL)</td>
<td>&gt;40 mg/dL &gt; 55 mg/dL low goal</td>
</tr>
<tr>
<td>Hemoglobin A1C</td>
<td>&gt;6% elevated</td>
<td>Low-Density Lipoproteins (LDL)</td>
<td>&gt;100 mg/dL elevated</td>
</tr>
<tr>
<td>Vitamin D, 25-hydroxy</td>
<td>&lt;35 ng/dL low</td>
<td>Total Cholesterol</td>
<td>&gt;200 mg/dL elevated</td>
</tr>
<tr>
<td>Luteinizing Hormone (LP)</td>
<td>~18 mIU/ml normal 5-20</td>
<td>Total Testosterone</td>
<td>&gt;50 mg/dL elevated</td>
</tr>
<tr>
<td>Follicle Stimulating Hormone (FSH)</td>
<td>~6 mIU/ml normal 5-10</td>
<td>Free Androgen Index</td>
<td>&gt;4.5 elevated</td>
</tr>
<tr>
<td>LH:FSH Ratio</td>
<td>1:1 normal</td>
<td>Free Insulin</td>
<td>&gt;10 elevated</td>
</tr>
</tbody>
</table>

Labs

- Inflammation markers:
  - C-reactive protein: >3 mg/L, elevated
  - CRP levels are 96% greater in PCOS
  - Interleukin 18 (IL-18): high
    - Pro-inflammatory associated with insulin resistance and metabolic complications, correlates with testosterone levels
  - Inflammation is found in both obese and non-obese patients
  - Non-obese patients are thought to have more visceral fat, causing inflammation

Medications

- Oral contraceptives are standard
  - Manage menstrual/hormonal abnormalities, hirsutism and acne concurrently
- Metformin
  - Usually second line of defense, mainly used in women with T2DM or IGT and unsuccessful lifestyle modification
  - Not approved specifically for treating PCOS
- Statins
  - Not indicated for all women with PCOS, instead only in women who meet current indications for statin therapy outside of PCOS
Medications

- Anti-androgens (testosterone blockers)
  - Prevent androgen production or limit its effects on the body
  - Can lower androgen levels, reduce excess hair growth, and clear acne
  - Can cause birth defects, recommended to pair with contraceptives
  - Not FDA-approved for treatment of PCOS

Dietary Supplements

- Vitamin D
  - ~73% have low vitamin D levels
  - Can improve autoimmune complications, metabolic abnormalities and potentially PCOS
  - Obesity is a risk factor of vitamin D deficiency

- Inositol – 9 forms, 2 studied most in PCOS
  - MYO 2-4 grams and DCI(d-chiro) 50-100mg
  - Assist in signaling insulin and follicle stimulating hormone
  - Deficiency can lead to impaired insulin signaling and insulin resistance

- Fish oil
  - Omega-3’s in fish oil have been shown to decrease lipid profile, inflammation, and time between periods
  - 1000mg EPA + DHA daily

- Chromium Picolinate
  - 200-500 mcg per day
  - 3 month trial showed a significant decrease in fasting blood sugars and increase in insulin sensitivity
  - Chromium had less side effects than Metformin when used to regulate insulin

- Zinc
  - 30-50 mg daily
  - Plays role in cholesterol and glucose metabolism and fertility
  - Reduce hair loss, clear up skin, reduce inflammation and bind insulin

- Magnesium
  - 100 -365 mg/day
  - Helps regulate glucose, insulin and blood pressure
  - Can improve mood, prevent migraine, and relieve PMS
  - 100 mg = 5 slices of whole grain bread, ½- 1 cup of beans, 1/4 cup of nuts, 1 cup of cooked spinach, or 3 bananas
Dietary Supplements

- Berberine
  - 500 mg, 3 times per day
  - Lowers cholesterol, blood pressure, testosterone and insulin levels
  - Fights inflammation, boosts fertility and pregnancy and aids in weight loss
  - Unsafe during pregnancy

- Cinnamon Cassia
  - Regulates menstrual cycle, improves insulin and cholesterol levels
  - 2 tsp/day or capsule form
  - 1 tsp = 4.75 grams, sold in 500 to 1000 mg doses

Case Study #1

- June 2015: OB/GYN started letrozole for ovulation, Vitamin D, and Omega-3 supplements. Ovulation, pregnant, miscarried at 6 weeks, two more rounds of letrozole, with no pregnancy – referred to fertility clinic.
- August 2015: Fertility clinic not covered, started Ovasitol (Inositol) supplement. Started PCOS diet recommendations; limited carbohydrates and high-sugar foods, carbohydrate/protein ratio at meals/snacks, and intuitive eating principles.
- December 2015: Pregnant, healthy baby, stopped Ovasitol at 30 weeks; no breast milk production, unable to breastfeed. OGTT result was 99 at week 28 of pregnancy.
- Summer 2017: Started Ovasitol again, pregnant December 2017, plans to take Ovasitol for entire pregnancy and post delivery.

Case Study #2

- 18-year-old Asian-American, high school tennis player, presents with binge eating, hiding food, and weight gain.
- Height: 5' 1" Weight: 202.8 lbs.
- MOP very thin and food focused.
- Patient adopted at 3 months of age, MOP reports patient overate until vomiting as a younger child. Patient remembers overeating in 5th grade.
- Binge eating started in 8th grade, tried multiple diet programs.
- November 2016: Referred for nutrition assessment from Children’s Hospital Behavioral Health program for binge eating. Upon nutrition assessment was recommended to see OB/GYN for possible PCOS. Diagnosis confirmed.
  - Started on Metformin, BCP, Vitamin D, and fish oil.
Case Study #2

- Patient was hiding and binge eating in her car and bedroom.
- MOP wanted her on low-carbohydrate diet.
- **November 2016 – August 2017:**
  - Treat binge eating first and started Intuitive Eating/Mindful Eating principles; encouraged mom to step back and allow patient to be in charge of foods. Patient started hunger/fullness charting.
  - Patient encouraged to not eat in car, bedroom or in front of screens for mindful eating practices.
  - 4-5 months later, started patient on PCOS diet recommendations, added snacks, smaller portions at meals, whole grains, increase fruit and vegetable consumption.
  - **Nutrition Goals:**
    - 2 fruits & 2 vegetable per day
    - Choose whole grains for 2 meals per day
    - If eating non-PCOS friendly foods, portion and balance with protein.

Outcomes, August 2017:
- No binge eating or secretive eating
- Patient increased in ability to recognize hunger/fullness cues
- Patient increased fruit/vegetable intake to once per day
- 7.7 lbs. weight loss

College Plan for 2017-2018:
- Patient transitioned to ED and IE RD at college
- **RD update:** December 2017, 1st semester - struggled with increased fried foods and large portion availability; 2nd semester - worked on IE principles and finding PCOS foods on campus or to keep in dorm room.
- **RD update:** March 2018, RD had discharged the patient and felt she no longer needed nutrition counseling.

MNT Research Study

**Intervention:**
- Subjects consumed three, 16-day, eucaloric diets, each separated by a 3-week washout period. A frequently sampled, intravenous, glucose tolerance test was administered at baseline and following each diet.

**Objective:**
- To determine whether eucaloric diets either enriched with monounsaturated fatty acids (MUFA; 17% energy) or low in carbohydrates (Low CHO; 43% energy) would increase insulin sensitivity (S_I) and decrease circulating insulin concentrations, relative to a standard diet (STD; 56% CHO, 31% fat, 16% protein), among women with PCOS.

**Results:**
- Fasting insulin was lower following the Low CHO diet relative to the STD diet.
- Acute insulin response to glucose was lower following the Low CHO diet relative to the MUFA diet.
- Fasting glucose, insulin sensitivity and the circulating concentrations of reproductive hormones were not significantly affected by the intervention.

**Conclusion:**
- A moderate reduction in dietary carbohydrate reduced the fasting and post challenge insulin concentrations among women with PCOS, which, over time, may improve reproductive/endocrine outcomes.

Darnell, Douglas, Gower, Oster & Ovalle, 2006
Dietary Intervention Research

- Articles screened on quality and a total of 25 articles including cohort, randomized controlled trial, review and meta-analysis were included in the review.
- This systematic review revealed that lifestyle interventions are effective in reducing BMI in PCOS women but due to the difficulty in maintaining low calorie diet, lifestyle interventions should be accompanied with exercise.
- Metformin was found to be effective in improving the indicators of DM in PCOS women especially if accompanied with lifestyle modification.

References

References


• The Skinny on PCOS

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