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An Anti-inflammatory Diet in Osteoarthritis Prevention & Management

Nursing 997

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PERMISSION

Title An Anti-inflammatory Diet in Osteoarthritis Prevention & Management

Department Nursing

Degree Master of Science

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Abstract

Osteoarthritis (OA) is the third highest cause of disability in the United States, with estimates as high as 20% of Americans living with OA (Clinton, O'Brien, Law, Renier, & Wendt, 2015). Upwards of 14 million of those diagnosed with OA are suffering from knee osteoarthritis (KOA). The case presented is that of a 62-year-old female undergoing a pre-operative history and physical prior to having total knee arthroplasty (TKA) for KOA. The patient reported symptomology consistent with KOA and had undergone several conservative interventions for KOA management prior to resorting to TKA. Of note was the absence of aggressive diet and weight management in the patient's treatment. A literature review was undertaken to determine the most appropriate diet for those with OA. Searches were completed in ClinicalKey and CINAHL with accepted literature meeting the requirement of being either a systematic review, meta-analysis, or random control trial published within the last five years. The literature supported an anti-inflammatory diet such as the Mediterranean or whole food plant-based (WFPB) diet as beneficial in reducing OA symptoms. Outcomes were related not only to the benefit of decreasing inflammation but also by decreasing joint load through body weight reduction. The evidence of this review is limited by lack of OA specific research, relying on correlation of results to known pathology in OA.

Keywords: osteoarthritis, anti-inflammatory, obesity, diet

An Anti-inflammatory Diet in Osteoarthritis Prevention and Management

Background and Rationale

Given the prevalence of KOA and the relative risk of disability with the condition, it is relevant to examine factors involved in the pathology and management of KOA. The patient presented in this case report has a long-standing history of KOA which slowly progressed to the point of requiring TKA. The hope, with a TKA, is to restore function and improve quality of life. This specific patient reported decreased ability to ambulate, perform positional transitions, and instability which negatively impacted her willingness to engage in physical activity.

The case report provides an all-too-stereotypical example of an instance in which a weight reducing diet may have slowed and possibly negated the development of not only OA, but the obesity and metabolic syndrome the patient also suffers from. Weight reduction is current practice for OA management as outlined by several guidelines (American Academy of Orthopaedic Surgeons, 2013; McAlidon et al., 2014; National Institute for Health Care and Excellence, 2014). Therefore, a literature review was done to determine which diet is ideal for those with OA. Such a diet should help reduce weight and OA symptoms (i.e. joint pain and stiffness, deformity).

Prior to completing the review, it was hypothesized that an anti-inflammatory diet such as a WFPB or Mediterranean diet will be supported in the literature as not only treatment for weight reduction, but also in reducing pro-inflammatory compounds that have only recently been considered in the pathogenesis of OA.

Case Report

The patient is a 62-year-old female presenting for pre-operative history and physical. She is scheduled to undergo a left TKA for left KOA. This diagnosis has been confirmed by her orthopedic provider. Her past medical history is significant for obesity, type 2 diabetes mellitus (T2DM), hypertension (HTN), and hypercholesterolemia. T2DM is managed with diet and Metformin 1000 mg twice daily. HTN is managed with Lisinopril 10 mg daily. Cholesterol is managed with diet and Simvastatin 20 mg daily. She also takes an 81 mg aspirin daily for prophylactic treatment of cardiovascular disease. She has no drug allergies.

The patient received her diagnosis of left KOA more than 10 years ago. Prior to seeking surgical intervention for disease management, she used conservative interventions including non-steroidal anti-inflammatories (NSAIDs), ice application, activity modification, physical therapy, and both steroidal and lubricating joint injections. Most interventions provided moderate relief until the disease progressed, requiring more aggressive treatment.

The patient reports that her blood glucose is well managed, with home monitoring values averaging around 110. She does not recall her most recent hemoglobin A1C. She reports that she does not monitor blood pressures at home, however she recalls values under 140/90 since being started on Lisinopril. Her clinical health record supports her report. Cholesterol levels have been non-concerning since the initiation of statin therapy. Pain related to left KOA has limited her ability to participate in regular physical activity for the past year or more. Because of inactivity, her weight has gradually increased, consequently worsening the pain in her left knee.

The patient states that she is trying to maintain a low carbohydrate, high protein diet due to her T2DM. Proteins are primarily from an animal source and the majority from low fat meats

such as chicken and turkey. She uses alcohol moderately and has never used tobacco or illicit drugs.

Vital signs during clinical visit are as follow: blood pressure 142/92, heart rate 78, respiratory rate 24, and temperature of 98.6° Fahrenheit. The patient is well-nourished and shows no signs of acute distress. There is no evidence of a possible infection. Cardiovascular, respiratory, and gastrointestinal exams are unremarkable. The patient's musculoskeletal exam is unremarkable except for the left knee being positive for joint line tenderness, mild edema, decrease in knee flexion to approximately 135°, and strength of 3/5. Neurological exam is unremarkable apart from a gait deviation, where the left knee shows a decrease in ROM and a shorter length of stride.

Regarding pre-anesthesia concerns, the patient's airway was assessed and found patent with no tracheal deviation or thyromegaly. Mallampati class I was assessed, indicating normal airway size. The patient denies a personal or familial history of anesthesia issues. She has no history of cardiovascular or respiratory issues. Studies ordered prior to anesthesia included an electrocardiogram showing a normal sinus rhythm and laboratory values for a complete blood count with differential, C-Reactive protein, comprehensive metabolic panel, and hemoglobin A1C, which were all within normal limits. Imaging of the patient's left knee has been completed by her surgeon.

The patient's history and physical exam supported the diagnosis of left KOA. She is fit for anesthesia and cleared for a left TKA. Proper documentation was completed, and her surgeon was notified. Follow-up to be completed by her orthopedic surgeon.

Search Development and Methods

The patient from the above case is a prime example of the path of KOA. As previously mentioned, KOA is a huge source of disability, often progressing to surgical management (Vina & Kwoh, 2018). Weight management has been a long-standing recommendation in KOA care and continues to be included in the Osteoarthritis Research Society International's guideline for non-surgical management of KOA (McAlidon et al., 2014). Yet, the patient made no mention of weight management as part of her care plan prior to requiring surgery. Perhaps weight management was thought to have been addressed by the provider managing her other comorbidities, nonetheless it should be an important aspect of her care. Other non-surgical interventions were attempted as well, but apart from physical therapy, the interventions were symptom management, not intended to slow the disease progression. Weight management would have likely slowed the progression of her KOA by decreasing the joint load and overall "wear and tear" on the joint.

There is no cure for KOA. Most treatment options act as a "bandage" rather than attempting to correct the pathological source of the problem, raising inquiry about interventions to slow the progression of the disease. Recently, information regarding the role diet plays in our overall health has flooded mainstream media, prompting this specific literature review. Diet is unquestionably related to body weight, but it may also affect one's underlying level of inflammation (Clinton et al., 2015).

Determining how weight and inflammation may impact the progression of OA, one must understand the pathogenesis of OA. Dunphy, Winland-Brown, Porter, and Thomas (2015) discuss that OA is most often sourced back to either a single macrotrauma or repetitive microtrauma. Examples being, a fall resulting in a bad knee injury or activities such as hair

dressing that require repetitive hand motions. Furthermore, increasing the joint load will always increase the resultant trauma, and obesity is the most common increase in joint load (Dunphy et al., 2015).

Trauma whether, micro or macro, causes remodeling of articular cartilage. Just as bones constantly turnover, so does cartilage. But the process is markedly slower in cartilage because it does not have the rich blood supply that bones have (Grossman & Porth, 2014). Because cartilage has a decreased ability to repair tissue trauma, it repairs itself with a simpler form of cartilage called fibrocartilage, rather than the more complex articular cartilage. Change in the cartilage type sacrifices joint lubrication and flexibility and is largely regulated by proteinases called Matrix Metalloproteinases (MMPs) (Dunphy et al., 2015). MMPs are secreted by damaged chondrocytes and synovial cells. Just as the inflammatory and healing process is affected by cytokines throughout the rest of body, MMPs are also regulated by cytokines. The known role of these inflammatory mediators in the remodeling of articular cartilage raises questions about modifying cytokines to influence MMP activity. Would it be possible to modify a person's diet to influence his or her underlying "level" of inflammation? And if so, what other benefits would such a diet produce?

Having these questions in mind, a literature review was shaped to determine what kind of dietary habits can impact inflammation in the body, specifically those with OA, and whether said diet would reduce body weight. Several general searches were initiated in Cumulative Index to Nursing and Allied Health Literature (CINAHL) and ClinicalKey. Using the terms "diet" and "osteoarthritis" in CINAHL produced 265 articles. When requirements for articles that have been peer reviewed and of English language from the last five years were applied, 54 sources remained. Of those, four met the requirements for review. In the same database, a search with the

restrictions for a meta-analysis, RCT, or systematic review for “Mediterranean diet” and “inflammation” produced 32 sources. Of the 32, two were chosen for their relevance.

The second database, ClinicalKey, was searched using the terms “osteoarthritis” and “diet” and then refined to sources from the last five years that were systematic review, meta-analysis, or random controlled trials. This search produced 121 sources and two were chosen for their relevance. Another search of the same database, with the same restrictions, used the terms “osteoarthritis” and “cytokines”. This search resulted in 84 sources, two of which were chosen for their relevance. In whole, ten articles were chosen from the two databases for this review.

Literature Review

Risk factors for OA

Epidemiology review of OA applies to the above-mentioned case report; therefore, it is reasonable to review the latest research. Although epidemiology cannot infer causation but only correlation, such studies are useful in pointing a finger in the right direction. Vina and Kwoh (2018) provide a review of the latest epidemiological research and several findings from their article have already been reported in this review. However, their article delves further than prevalence and incidence. Discussion of risk factors is relevant to the case study and OA development. The study reports those with an increased risk for OA are older, female, African-American, have a genetic predisposition, are obese, and/or have metabolic syndrome (Vina & Kwoh, 2018). Other joint-related elements include a person’s occupation, sports participation, overall physical fitness, and whether an injury or surgical procedure has affected the joint (Vina & Kwoh, 2018). The patient from the case study had several risk factors. She is female, obese, physically deconditioned, advanced in age, and has metabolic syndrome. Her obesity and

metabolic syndrome could have been better managed, possibly even eliminated, with a better diet.

The role of inflammation

Vina and Kwoh (2018), make note of recent research supporting the role synovitis plays in KOA progression. With increasing synovitis, radiographic evidence of KOA progression increases. These findings are of note because they raise a question of whether joint degeneration causes synovitis or whether the two have a synergistic effect.

Although not an answer to whether synovitis causes progression or is the result of KOA, de Lange-Brokaar et al. (2012) demonstrate the definite role of inflammation in synovial fluid of those with OA. Their systematic review established that the entire immune system could be involved. Synovial fluid of those with OA showed several immune cells, including macrophages, T cells, B cells, Mast cells, Natural killer cells, plasma cells, and dendritic cells have been isolated from OA patients (de Lange-Brokaar et al., 2012). The cytokines, mentioned in the pathogenesis review above, are also discussed in their research. The most common cytokines found in OA are tumor necrosis factor-alpha (TNF- α), interleukin 1-alpha and beta (IL-1 α and IL-1 β), and interleukin 6 (IL-6) (de Lange-Brokaar et al., 2012). The inflammatory research opens the door for immune modification in OA.

The role of obesity

Kwoh and Vina (2018), report obesity is a risk factor for OA development and most evidence-based OA guidelines recommend weight reduction as primary treatment ((AAOS, 2013; McAlidon et al., 2014; NICE, 2014). The reasoning behind this recommendation is that weight reduction reduces joint load, there for curbing further damage and inflammation (Dunphy, 2015).

Obesity also ties back to inflammation. The link between excessive adipose tissue and inflammation is well established. Such tissues increase insulin insensitivity and basal serum glucose levels. Elevated basal glucose levels cause epithelial damage and triggers the inflammatory process (Dunphy et al., 2015; Grossman & Porth, 2014) Since blood glucose is a system value, one can suspect that inflammation can be triggered systemically with elevated glucose levels, therefore having an impact on the body's "level of inflammation" and any process that may be related to it.

A whole food plant-based diet

The literature identifies the Mediterranean and WFPB diets as beneficial for OA prevention and management. Clinton et al. (2014), demonstrated that a WFPB diet can improve OA symptoms. The WFPB diet is a low arachidonic acid diet. Arachidonic acid a major component in the inflammatory process. It is seen in large amounts in animal products but very low amounts in plant-based products (Clinton et al., 2014). The study reported significantly improved BMI, blood pressure, and functioning in the intervention group receiving the WFPB diet versus the control (Clinton et al., 2014).

Another OA-specific RCT looked at adding an alkalizing powder to participants' diets. This study found a significant improvement in joint pain, stiffness, and tenderness for the intervention group when compared to the control group (van Velden, Reuter, Kidd, & Müller, 2015). Although serum CRP showed no significant change in relation to symptom improvement, urine pH did establish a change in the participants' body chemistry (van Velden, Reuter, Kidd, & Müller, 2015). The implications of this study in the case report are substantial. The patient states that she eats a diet high in lean animal protein and low in carbohydrates. Animal protein is considered one of the most acidic foods for the body (Leech, 2017). It can be concluded that her

diet may have been worsening her symptoms. Foods that are considered alkalizing are plant-based (Leech, 2017). An important downfall of the study's relevance is that it evaluated symptoms of hand OA, therefore limiting transference to the case report.

Veronese et al. (2016) showed that the closer a participant's diet was to a Mediterranean diet, the more likely they were to report a better quality of life, including decreases in pain, disability, and depression. Other findings include reports of less fractures, cancer, diabetes, COPD, strokes, heart disease, and lower BMIs with higher Mediterranean diet adherence (Veronese et al., 2016). A second study, Veronese et al. (2017), specifically looked at OA prevalence in association with Mediterranean diet adherence. This study made the correlation of lower OA rates with higher Mediterranean diet adherence. Moreover, the results were not an all-or-none pattern, they were linear. This means the closer a participant is to following the Mediterranean diet, the better the results, but there is still a benefit to loosely following the diet (Veronese et al., 2016; Veronese et al., 2017).

More evidence promoting the clinical practice of an anti-inflammatory diet is provided in a systematic review by Ricker and Haas (2017). A line can be drawn between chronic inflammatory diseases such as asthma, coronary artery disease, and diabetes mellitus and how dietary factors may influence the disease process. OA is not traditionally thought of as the "inflammatory arthritis" but previously discussed research has established that both acute and chronic inflammation have a role in disease progression. According to their review, foods with a high glycemic index (i.e. refined carbohydrates), with a high omega-6 to omega-3 ratio, reduced polyphenols (i.e. processed foods), or high caloric load are all correlated with increased levels of biological inflammatory markers such as IL-6, TNF- α , and CRP (Ricker & Haas, 2017). The authors discuss that the traditional Western diet contains many of these proinflammatory food

items, while a diet, such as the Mediterranean diet, would more closely follow the guideline for an anti-inflammatory diet. A systematic review by Santos, Oliveira, and Lopes (2013), the role of saturated fatty acids (SFA) in inflammation was explored. Results showed evidence that diets high in SFA produced elevated levels of TNF- α , IL-6, CRP, and fibrinogen. SFAs are found in animal products and would be limited in a WFPB or Mediterranean diet (Ricker & Haas, 2007).

The research presented thus far has supported an anti-inflammatory diet as a treatment for the clinical symptoms of OA, as well as providing evidence that an anti-inflammatory diet will positively alter both acute and chronic inflammation, with the possibility of slowing the progression of the disease. All studies included in this review which provided either body weight or BMI data, showed a decrease in weight when an anti-inflammatory diet was followed.

Diet versus exercise

The final study included in this review is for the benefit of a clinician looking to treat osteoarthritis while considering which recommendations to include in a patient's care plan. OA guidelines clearly state that weight reduction is a primary conservative intervention in OA management (AAOS, 2013; McAlidon et al., 2014; NICE, 2014). Those same guidelines recommend exercise. Often a clinician finds him or herself asking patients to initiate behavioral change, whilst not wishing to overwhelm the patient. Therein lies a question, which is better for weight reduction and symptom management in OA? Hart (2014), provides a concise recommendation to answer this question: both, but if the clinician must choose which route to take, dietary changes will provide the greatest improvement over exercise alone. The recommendation is first for a dietary and exercise plan, followed by dietary only, and last exercise only for weight loss. These results were established by weight loss rates, IL-6 levels, and pain and function scores (Hart, 2014).

Discussion of Evidence

This literature review demonstrates a deficit of information on the correlation of diet, weight loss, inflammation, and OA. However, several themes can be synthesized from the evidence. As mentioned, OA development is a progressive disease resultant from trauma and a newly recognized positive feedback mechanism of inflammation (Dunphy, 2015). Guidelines support weight reduction to decrease joint load (AAOS, 2013; McAlidon et al., 2014; NICE, 2014). The decrease in joint load has a positive influence on the development of inflammation in the affected joint (Dunphy, 2015). Furthermore, not only can a reduction in weight improve articular cartilage remodeling but having an overall lower “level of inflammation,” may positively influence the process of healing related to trauma and modify the process of arthritis progression (Clinton et al., 2015; de Lange-Brokaar et al., 2012; Kolverou et al., 2015; Ricker & Haas, 2017; Santos, Oliveira, & Lopes, 2013; van Velden et al., 2015; Veronese et al., 2016; Veronese et al., 2017).

Mediterranean or WFPB diets are similar in definition and are recognized as anti-inflammatory diets that also assist in maintaining a lower BMI, but these outcomes only describe half the picture (Clinton et al., 2015; Mayo Clinic, 2017; van Velden, 2015; Veronese et al., 2016; Veronese et al., 2017). To prove an improvement in a quantitative outcome, such as inflammatory markers or weight, is beneficial, qualitative outcomes must be met. The literature shows a Mediterranean diet improves qualitative outcomes of pain and functioning in OA (Clinton et al., 2015; Messier et al., 2014; Ricker & Haas, 2017; van Velden et al., 2015). Messier et al. (2014), specifically denotes that dietary change should be the primary conservative intervention for weight reduction and overall symptom improvement in OA. The above-

mentioned research shows that the specific dietary change should be to a Mediterranean or WFPB diet.

As it applies to the case study, this literature review demonstrates that had the patient been following a Mediterranean or WFPB diet since birth, she would have been less likely to have OA or at least decreased its severity and therefore possibly offset the need for a TKA. In addition to improvements regarding OA, the patient would have been less likely to develop metabolic syndrome. Had the patient started following a Mediterranean or WFPB diet upon diagnosis of either OA or metabolic syndrome, she would have improved her overall prognosis of both diseases (Kolovery et al., 2015; Ricker & Haas, 2017; Veronese et al., 2016; Veronese et al., 2017; Vina & Kwoh). Obviously, the fact that this specific diet is not mentioned in OA guidelines is unfortunate and may point to the need for further OA specific research to meet inclusion requirements (AAOS, 2013; McAlidon et al., 2014; NICE, 2014).

Recommendations for Practice

The completed literature review provides several take away points for clinicians. These points are synthesized from the research and the author's own theoretical conceptualization as it applies to the presented case report.

- Weight management is a consistent recommendation by all the guidelines reviewed for OA treatment and should be a part of the initial conservative treatment of OA.
- Acute and chronic inflammation is involved in both the genesis and progression of OA, but the extent and exact mechanism of its involvement requires further research.

- One's diet has an impact on weight and general "level of inflammation" in the body.
- All providers should be recommending an anti-inflammatory diet because it has been proven beneficial in more than OA management.
- Diet should be the initial behavior adjusted in OA management if diet *and* exercise is unsuitable for a patient.

Conclusion

In whole, the prevalence OA and the disability it causes is a major burden on Americans. Although not specifically noted, the financial drain is large. Disability is a decrease in productivity to not only those inflicted with OA, but also their loved ones who must give up time and energy to care for them. Additionally, there is the cost to treat the disease. OA is irreversible, but as demonstrated in this review, there may be measures to slow its' progression and negate complications. It begins with what we teach our population to eat. The current Western diet that most Americans follow can be linked to cardiovascular disease, diabetes mellitus, metabolic syndrome, asthma, OA, cancer, and much more. While new, the evidence is mounting for an overhaul in our diets. The research strongly suggests an anti-inflammatory diet, such as a Mediterranean or WFPB, as an alternative. In the case report, a change in dietary habits may have decreased her OA symptoms and possibly eliminated the need for a major invasive surgery; Not to mention she may have maintained an appropriate weight and never developed metabolic syndrome. A dietary changed would have completely altered her level of functioning and overall life satisfaction. It should be strongly encouraged for all patients.

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