NMDC221 Session 25: Musculoskeletal System Disease: Part II
Topic Summary

Musculoskeletal System Disease: Part II
Nutritional management of complex & multisystem conditions with consideration of drug-nutrient interactions
- Ankylosing spondylitis
- Rheumatoid arthritis
Ankylosing Spondylitis
Ankylosing Spondylitis

A chronic inflammatory arthritis in the spondyloarthritide group of conditions.

These conditions are characterized by the presence of;
- HLA B27 antigen
- the absence of the rheumatoid factor (seronegative)
- autoimmune diseases of unknown origin.

(Wolf & Fasching 2010)
Ankylosing Spondylitis

Prevalence
- 1% of the population
- Male predominance at 3:1
- Presentation of symptoms before 40 years old
- Cross reactivity of antibodies between bacterial protein (Klebsiella pneumoniae carry two molecules that have sequences that resemble HLA-B27) and HLA B27 commonly presents

(Rayman & Pattison 2008; Wolf & Fasching 2010)
Ankylosing Spondylitis

Symptoms

- Inflammation of the spine, especially the sacroiliac joints which causes stiffening in the sagittal and frontal planes
- Lower back pain that is worse in the morning, at night, and for rest & is better for exercise
- Decreased chest expansion
- Hips and shoulders can be implicated (50% of cases)
- Gastrointestinal inflammation is common (50% of cases)
- Depression, fatigue, sleep disturbances
- Heart can be affected

(Wolf & Fasching 2010)
Ankylosing Spondylitis

Investigations
- Raised ESR and CRP
- Serum RA factor is negative
- X-ray, CT & MRI present with bone proliferation and joint degradation (erosion & narrowing)

(Wolf & Fasching 2010)
Ankylosing Spondylitis

Therapeutic Actions

Vitamin A

- Vitamin A commonly presents as deficient in ankylosing spondylitis (O’Shea et al. 2007)

Vitamin D

- Lange et al. (2005) observed that highly active ankylosing spondylitis is associated with reduced vitamin D metabolism and subsequent increased bone resorption.
Ankylosing Spondylitis

Therapeutic Actions

Vitamin D

Deficiency of Vitamin D is implicated in autoimmunity.

- Inhibits antibody secretion and autoantibody production in B cells.
- Immunosuppressive on dendritic cells (regulating immune activation and responses to self)
- Promotes the induction of monocytic differentiation to macrophages and to modulate macrophage responses, preventing them from releasing inflammatory cytokines and chemokines.

(Arnson et al 2007)
Ankylosing Spondylitis

Nutritional Considerations

Dietary Implications

- Common GIT symptoms with ankylosing spondylitis (pain, loose stools) have been related to the consumption of dairy products, vegetables/fruits, fatty foods, and food rich in flour (Sundström et al. 2011)

Low Starch Diet

- Antibodies to Klebsiella bacteria is common.
- Klebsiella require a high starch diet for growth, therefore the introduction of a low starch diet to reduce bacterial numbers may be useful (Rayman & Pattison 2008)
Ankylosing Spondylitis

Inflammatory markers

- Increased proinflammatory cytokines – IL-1 & TNF-alpha have been found to increase osteoclastogenesis and apoptosis of osteoblasts.

(Lange et al. 2005)
Ankylosing Spondylitis

Physical Therapy

- Regular exercise that does not exacerbate connective tissue damage is extremely beneficial in the management of ankylosing spondylitis.
- With regular exercise posture, range of motion and strength can be maintained.

(Scalapino & Davis 2003; Sarris & Wardle 2010)
Ankylosing Spondylitis

Treatment Aims

Alleviate Symptoms
- Reduce the production of pro-inflammatory cytokines while supporting the production of regulatory cytokines
- Reduce the effects of free radical damage

Promote Healing
- Provide nutrients to repair affected tissues
- Reduce metabolic acidosis
- Re-establish homeostasis

(Lange et al. 2005; O’Shea et al. 2007; Sarris & Wardle 2010)
Ankylosing Spondylitis

Treatment Aims
Address Underlying/Concomitant Conditions

- Repair micro-trauma
- Support and regulate immunity through supporting nutritional deficiencies, identifying and removing sustaining dietary triggers & supporting a low starch diet
- Improve oxygen flow to the joints and connective tissue
- Support appropriate HPA axis responses
- Support organs of detoxification

(Rayman & Pattison 2008; Sarris & Wardle 2010; Sundström et al. 2011)
## Ankylosing Spondylitis

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Dosage</th>
<th>Therapeutic Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vitamin A</strong></td>
<td>1000-5000iu</td>
<td>Deficiency presents in AS, implicated in reduced immunity. Antioxidant, supports connective tissue</td>
</tr>
<tr>
<td><strong>Vitamin C</strong></td>
<td>1000-5,000mg</td>
<td>Collagen Synthesis. Facilitates &amp; regulates immune function including increasing levels of macrophage activity, lymphocyte production &amp; antibodies (IgA, IgG, IgM). Modulates prostaglandin synthesis. Heals &amp; rebuilds damaged tissue.</td>
</tr>
<tr>
<td><strong>Vitamin D</strong></td>
<td>1000-10,000iu</td>
<td>Deficiency commonly presents in AS which is linked to increased bone resorption (Lange et al. 2005) Balance Th1 dominance</td>
</tr>
<tr>
<td><strong>Vitamin E</strong></td>
<td>100-1000iu</td>
<td>Malabsorption leading to deficiency. Balance Th1 dominance. Prevents oxidation of unsaturated fatty acids contained in phospholipids of the cell membrane</td>
</tr>
</tbody>
</table>

(Coulson et.al. 2001; O’Shea et al. 2007; Schlenker & Long 2007; Osiecki 2008)
## Ankylosing Spondylitis

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<tr>
<th>Nutrient</th>
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<tr>
<td>Magnesium</td>
<td>350-1000mg</td>
<td>Malabsorption leading to deficiency. Support nervous activity &amp; reduces pain associated with the inflammation</td>
</tr>
<tr>
<td>Zinc</td>
<td>10-100mg</td>
<td>Aids maintenance of endothelial cell integrity &amp; reduces cytokine induced damage</td>
</tr>
<tr>
<td>α-lipoic acid</td>
<td>100-600mg</td>
<td>Antioxidant, regulatory mechanism in auto-immunity</td>
</tr>
<tr>
<td>Omega 3</td>
<td>3-9 gms</td>
<td>Enhances the production of regulatory cytokines Anti-inflammatory (reduce the production of IL-1 &amp; TNF-α and reduce cellular adherence. Balance Th1 dominance</td>
</tr>
<tr>
<td>Probiotics</td>
<td>10-40 billion</td>
<td>Prevent gut dysbiosis. Balance Th1 dominance</td>
</tr>
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(Sturniolo et al. 2001; Yadav et al. 2005; Schlenker & Long 2007; Mahan & Escott-Stump 2008; Osiecki, 2008; Sarris & Wardle 2010)
## Ankylosing Spondylitis

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<tr>
<td>Glutamine</td>
<td>500-3000mg</td>
<td>Tissue repair Anti-inflammatory, Immune support for GALT, Restores gut wall integrity &amp; normal intestinal flora colonization.</td>
</tr>
<tr>
<td>N-acetyl-glucosamine</td>
<td>600-3000mg</td>
<td>Precursor to the ground substance/gap junctions for epithelial cells</td>
</tr>
<tr>
<td>Turmeric</td>
<td></td>
<td>Demonstrated therapeutic effects in various autoimmune disease states, anti-inflammatory</td>
</tr>
</tbody>
</table>

(Mahan & Escott-Stump 2008; Osiecki 2008; Sarris & Wardle 2010)
Rheumatoid Arthritis
Rheumatoid Arthritis

- Autoimmune inflammatory joint disease, characterised by persistent cellular activation, autoimmunity & the presence of immune complexes at sites of articular & extra-articular lesions.

- The synovium develops numerous folds consisting of large villi and spreads to cover the articular cartilage with a pannus. The pannus destroys the underlying articular cartilage and sub-chondral bone.

- Hyper cellularity of the synovium results from the influx of lymphocytes, plasma cells, and monocytes. The synovial lining cells proliferate and lose their organization.

(Kumar & Clark 2009)
Rheumatoid Arthritis

**Symptoms**

- Symmetrical inflammation of the joints
- Pain & stiffness of the hands, feet, wrists, elbows, shoulders, knees &/or ankles
- Feel tired & unwell, sleep disturbance
- Pain & stiffness worse in the mornings, better for movement
- T cell production of the rheumatoid factor, anti-CCP antibodies, inflammatory cytokines, activated mast cells (histamine & TNF-α) may present in serum tests
- Other connective tissue structures can be involved

(Kumar & Clark 2009)
An example showing the differences between a normal, healthy joint, a joint affected by osteoarthritis, and one affected by rheumatoid arthritis.
Rheumatoid Arthritis

Risk Factors
- Female – 3x more prevalent before menopause
- Familial
- Genetic predispositions – HLA-DR4 presents in 50-75%

Investigations
- Blood count – ESR &/or CRP raised
- Serology – Anti-CCP, rheumatoid factor
- X-rays of affected joints
- Joint aspiration

(Kumar & Clark 2009)
Rheumatoid Arthritis

Therapeutic Actions

Anti-oxidants

- Free oxygen radicals and proinflammatory cytokines (TNF-α) have been implicated as mediators of tissue damage in rheumatoid arthritis.
- Thought to be generated by activated macrophages, monocytes and granulocytes and anoxic reperfusion reactions that may occur with the movement of affected joints.
- Altered activity of blood antioxidant enzymes including GSH peroxidase, CuZn superoxide dismutase, and catalase

(Bae et al. 2003)
Rheumatoid Arthritis

Therapeutic Actions
Antioxidants
- RA patients have lower serum levels of antioxidants - Vitamin E, Vitamin C, β-carotene, Selenium, Zinc
- Overall all antioxidant index was inversely associated with the later development of RA
- Strong inverse association between greater consumption of fruits and cruciferous vegetables
  (Cerhan et al. 2003; Rayman & Pattison 2008)
Rheumatoid Arthritis

Nutritional Considerations

Breastfeeding

- Among genetically susceptible women, breastfeeding is associated with an increased risk of rheumatoid arthritis, particularly after the first pregnancy.
- There was a 60% reduction of joint swelling and pain.
- Six months postpartum 62% report increase in number of sore joints, 66% report aggravation of swelling.
- This may be due to alterations in oestrogen and progesterone (immunosuppressive) & prolactin (immuno-stimulatory).

(Hampl et al. 2001)
Rheumatoid Arthritis

Nutritional Considerations

Omega 3: Omega 6

- Rayman & Pattison (2008) found that balancing the ratio of omega 3: omega 6 improved symptoms of morning stiffness, pain, number of swollen joints & overall health assessment scores.
- This was only relevant in those presenting with a low omega 3: omega 6 at the beginning of the intervention.
- Restricted intakes of AA (<90 mg/d) while supplementing with fish oil presented with significantly reduced number of tender and swollen joints and a reduction in CRP, IL-6 and TNF-α.
Rheumatoid Arthritis

Nutritional Treatment

- Elimination of foods to which the patient is allergic or intolerant can reduce GIT permeability, reducing disease symptoms

Implicated foods include:
- Gluten-free
- Spiced foods
- Strong coffee / tea
- Alcohol
- Cereal grains
- Lectins (legumes / cereals)

(Rayman & Pattison 2008)
Rheumatoid Arthritis

Nutritional Treatment

Intestinal Flora

- The intestinal flora of RA patients appears to present with dysbiosis of small intestinal bacteria.
- Vegan / vegetarian diets are associated with changes in the bowel flora presentation and improvement in disease symptomatology.

(Rayman & Pattison 2008)
Rheumatoid Arthritis

Therapeutic Actions

Iron
- Micro-trauma in the joint can lead to the production of iron free radicals, so high iron status is contra-indicated in RA.
- RA patients are commonly deficient in iron possibly due to GIT bleeds as a result of NSAID use.

Zinc & Copper
- Required for the production of CuZnSOD (antioxidant enzyme). Copper aids the crosslinking of collagen and elastin to sustain connective tissue strength.

(Rayman & Pattison 2008)
Rheumatoid Arthritis

Body Composition

- Rheumatoid cachexia (15%) is characterized by increased catabolism and REE (resting energy expenditure), muscle wasting and anorexia, and is associated with the production of the pro-inflammatory cytokines that play a key role in inflammation-mediated loss of appetite, weight loss and joint destruction.

- Overweight RA patients (40%) may be due to reduced physical activity may increase the risk of cardiovascular disease. The risk is increased with the presentation of RA.

(Rayman & Pattison 2008)
Rheumatoid Arthritis

Treatment Aims

Alleviate Symptoms
- Reduce free radical damage
- Regulate Th1 dominance
- Encourage the production of anti-inflammatory cytokines
- Support the healing of micro-trauma
- Reduce physical pain

Promote Healing
- Provide nutrients to repair affected tissues
- Reduce metabolic acidosis

(Osiecki 2006; Sarris & Wardle 2010)
Rheumatoid Arthritis

Treatment Aims
Address Underlying/Concomitant Conditions

- Support and regulate immunity through supporting nutritional deficiencies, identifying and removing sustaining dietary or environmental triggers
- Improve oxygen flow to the joints and connective tissue
- Support appropriate HPA axis responses
- Support organs of detoxification
- Calculate appropriate BMR and REE, protein, carbohydrate and fat requirements for ideal weight.

(Shils et al. 2006; Sarris & Wardle 2010)
## Rheumatoid Arthritis

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<td>Vitamin A</td>
<td>1000-5000iu</td>
<td>Implicated in reduced immunity. Antioxidant, supports connective tissue</td>
</tr>
<tr>
<td>Vitamin B6</td>
<td>10-100mg</td>
<td>Lowered serum PLP levels in RA patients</td>
</tr>
<tr>
<td>Vitamin B12</td>
<td>1000mcg</td>
<td>Elevated TNF-a with B_{12} deficiency</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>500-5,000mg (up to 10,000mg)</td>
<td>Synthesis &amp; repair of glycosaminoglycan, collagen. Commonly deficient in RA</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>1000-10,000iu</td>
<td>Reduces T helper 1 activity and modulates immune response. Commonly deficient in RA</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>100-1000iu</td>
<td>Inhibits the release of AA &amp; reduces eicosanoid formation</td>
</tr>
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<td>α-lipoic acid</td>
<td>100-600mg</td>
<td>Antioxidant, regulatory mechanism in auto-immunity</td>
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(Bae et al. 2003; Cerhan et al. 2003; Yadav et al. 2005; O’Shea et al. 2007; Leventis and Patel 2008; Rayman & Pattison 2008)
### Rheumatoid Arthritis

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<tr>
<td>Copper</td>
<td>2-5mg</td>
<td>Cross links collagen &amp; elastin for improved strength in extracellular matrix. Deficiency presents with CuZnSOD, excess is contra-indicated</td>
</tr>
<tr>
<td>Iron</td>
<td>15-50mg</td>
<td>Anemia is common in RA, excess is contra-indicated</td>
</tr>
<tr>
<td>Selenium</td>
<td>200-600ug</td>
<td>Component of SGH peroxidase to reduce free radical damage. Deficiency presents in RA</td>
</tr>
<tr>
<td>Zinc</td>
<td>10-100mg</td>
<td>Deficiency presents with CuZnSOD. Aids maintenance of endothelial cell integrity &amp; reduces cytokine induced damage</td>
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<tr>
<td>Omega 3</td>
<td>3- 9gm</td>
<td>Reduction in inflammatory PG &amp; RA symptoms . Anti-inflammatory (reduce the production of IL-1 &amp; TNF-α and reduce cellular adherence Balance Th1 dominance</td>
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(Sturniolo et.al. 2001; Bae et al. 2003; Cerhan et al. 2003; Osiecki 2006; Mahan & Escott-Stump 2008; Proudman et al. 2008; Rayman & Pattison 2008)
presentation talk – Clint Paddison – Natural dietary approaches to treating RA. (approx. 40 min)

https://www.youtube.com/watch?v=CUeS2vTGWKo
NMDC221 Session 25
Class Discussion
Case Study

42 year old female

**Presenting Symptoms:**

- Rheumatoid arthritis that initially presented in her fingers (now the joints on her little & ring fingers on both hands are lumpy and deformed) and is now presenting in her knees and ankles.

- Worse on waking and being stationary, better for cool applications (in acute flare ups) and moving.

- Arthritis flares are presenting 1-2 x per year and lasting for 4-5 days. With flare-up the joints present as hot and swollen, with reduced movement. Client loses appetite, is lethargic, feels ‘fluey’ and has trouble sleeping.
Case Study

Presenting Symptoms:
- Osteopenia picked up by DEXA
- This client would like support and management of her condition including an exercise regime.

Investigations
- Serum: raised ESR & CRP, rheumatoid factor present
- X-rays of hands, knees and ankles
- DEXA showing reduced bone density
- Monthly LFT to monitor methotrexate
Case Study

Medications / Supplements

- Ibuprofen 200mg (NSAID): 2 tablets taken with food up to three times per day as required
- Methotrexate 10mg (Cyto-toxic Immuno-suppressant): 1 tablet taken on a Sunday on an empty stomach ½ hour before breakfast
- Imipramine 30mg (tricyclic antidepressant): 1 tablet taken at night
- Calcium carbonate 600mg: 2 tablets taken with breakfast
Case Study

Family History
- Mother: RA, bowel & breast cancer (Dec. 78)
- Father: lung cancer (smoker), hypertension (Dec. 67)
- Brother: diverticulitis, bowel polyps
- Sister: SLE, early menopause & hysterectomy

Past Medical History
- **Infant:** vaginal delivery, breastfed. Solids introduced at 3 months. Full set of vaccinations.
- **Childhood:** pneumonia at 3yo.
- **Adolescence:** broke her leg falling off a horse at 12yo.
Case Study

System Presentation

- **Urinary**: increased nocturnal urination. Waking 2-3 times per night to urinate (goes back to sleep easily). Has reduced her water intake in the afternoon onwards to try to minimize night-time urination.

- UTI’s infrequent but has had 2 in the last year: frequency, urgency and pain. Resolved after 3 days on antibiotics.

- Urinates 5-6 times per day, yellow throughout the day

- **Respiratory/ Immune**: wounds heal easily (2-3 days). Colds 1 x year, resolve within 5-6 days.
Case Study

System Presentation

- **Female reproductive:** menstruation is progressively getting heavier (3-4 days with heavy bleed). Cycle varies: between 24 to 42 days. Mood is fine but energy fluctuates. Premenstrually, craves sugar and coffee.

- **Endocrine:** craves sugar throughout the day and energy drops after lunch. Worse on waking (3/10) and better midday (5/10)

- **Nervous system:** can get angry on days when her rheumatoid arthritis flares up
Case Study

Physical Examination Results

- **Nails**: thin and weak, no moons, nails split lengthways
- **Skin**: dry and cracked. Hair is becoming very dry and frizzy
- **Appearance**: slim build
- **Height**: 161cm  **Weight**: 46kg  **Waist**: Hip 0.81  
  (Female>0.85)  **BP**: 112/72
- **Zinc tally**: immediate strong taste, spat out straight away
## Case Study

<table>
<thead>
<tr>
<th>Time</th>
<th>Daily Dietary Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.30am</td>
<td>Kellogg’s ® Just Right, soy milk. 1 cup of black tea (white with 2 teaspoons of sugar)</td>
</tr>
<tr>
<td>10am</td>
<td>Shortbread biscuit 1 cup of black tea (white with 2 teaspoons of sugar)</td>
</tr>
<tr>
<td>12pm</td>
<td>Ham, cheese &amp; tomato toasted sandwich (white bread – hi fibre) 1 cup of black tea (white with 2 teaspoons of sugar)</td>
</tr>
<tr>
<td>3pm</td>
<td>Cheese &amp; crackers 1 cup of black tea (white with 2 teaspoons of sugar)</td>
</tr>
<tr>
<td>7pm</td>
<td>Steak &amp; boiled vegetables (masked potato, corn &amp; carrots) Water 2-3 glasses to take her tablets White wine (3/7 days)</td>
</tr>
</tbody>
</table>
Discuss

- The development of complementary diagnosis and formulation of goals, application of goals to specific actions, identifying the nutrients related to each action, and developing a nutritional prescription.

- Consider individual nutrient dosage with clinical decisions, integrative management of each condition giving mechanisms of actions relevant for nutrient-drug interactions.
Class Activity

- In the formulation of the goals and prescription of this case, consider the following questions:
- What nutritional deficiencies present with this case?
- What contra-indications present with the long-term drug use that presents with this case?
- Have the contra-indications around these drugs been considered thoroughly in the presentation of this case?
- Consider relevant diet and lifestyle advise.
- Include an exercise regime with a review of the implications on maintaining bone density while considering client comfort and ability.
Musculoskeletal System Disease
Drug Therapy
# Musculoskeletal System Disease

<table>
<thead>
<tr>
<th>Drug</th>
<th>Action</th>
<th>Side Effects</th>
<th>Interactions</th>
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</table>
| **Non-Steroidal Anti-inflammatory Drugs** | Anti-inflammatory via inhibition of PG (reduced COX). Used in bouts of active inflammation to allow continued movement affected joints in **Ankylosing Spondylitis & Rheumatoid Arthritis** | GIT - nausea, vomiting, gastritis due to inhibition of mucous productive PG’s. Paracetamol overdose can cause acute liver failure | **Vitamin E**: Additive pain relief  
**Fish oils + Aspirin**: reduce anti-inflammatory pain markers.  
**Garlic, Ginger, Grape seed, Turmeric + Aspirin**: Theoretical blood thinning interaction  
**Vitamin C**: Aspirin reduces absorption and cell delivery.  
**Garlic, Quercetin, SAMe**: Act as a hepatoprotective agent when used concurrently with paracetamol |

(Bullock et.al, 2007; Kumar & Clark 2009; Braun & Cohen 2010; Bryant & Knights 2011)
## Musculoskeletal System Disease

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<tbody>
<tr>
<td>Oral Corticosteroid: Prednisolone</td>
<td>Decreases inflammatory cytokines (reduce pain &amp; allow continued movement in acute flare-ups minimizing loss of mobility in Ankylosing Spondylitis &amp; Rheumatoid Arthritis)</td>
<td>May accelerate osteoporosis without decreasing the rate of disease. Sodium retention (potassium loss) with increases in blood pressure, fluid retention Protein losses (thinning skin, hair, reduced wound healing, immune dysregulation). Adrenal atrophy</td>
<td>Calcium Prednisolone reduces the intestinal absorption of calcium. Monitor &amp; supplement as required Chromium: Concurrent use may reduce corticosteroid induced diabetes</td>
</tr>
</tbody>
</table>

(Harkness & Bratman 2003; Scalapino & Davis 2003; Bullock et.al. 2007; Bryant & Knights 2011)
## Musculoskeletal System Disease

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<tr>
<td>5-Aminosalicylic Acid: Sulfasalazine</td>
<td>Salicylic acid derivative attached to an antibiotic that is activated by colonic bacteria. Pro-drug that has a local prostaglandin inhibitor action in the colon. Used in Ankylosing Spondylitis &amp; Rheumatoid Arthritis</td>
<td>GIT – nausea, anorexia, Rashes, tinnitus, headache, dizziness Haemolytic anaemia, thrombocytopenia</td>
<td>Folate: Sulfazaline is a competitive inhibitor of folate transport, absorption &amp; metabolism. May increase homocysteine levels. Monitor for folate deficiency signs</td>
</tr>
</tbody>
</table>

(Harkness & Bratman 2003; Scalapino & Davis 2003; Wei et al. 2007; Bryant & Knights 2011)
# Musculoskeletal System Disease

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| Cyto-toxic Immuno-suppressant-Methotrexate | Inhibition of dihydrofolate reductase reduces DNA synthesis & lymphocyte proliferation. Utilized for peripheral inflammation but not for spinal inflammation of in Ankylosing Spondylitis. Also in Rheumatoid Arthritis. | Toxic effects have been seen at low doses Bone marrow suppression, immunosuppression GIT symptoms – nausea, vomiting, anorexia, ulceration Liver toxicity | **Folate:** Drug action is a folate antagonist. Reduces drug side effects. Increases homocysteine levels. Low dose of folic acid supplementation at 1 mg/day has a beneficial effect on methotrexate toxicity  
**Vitamin A & Vitamin E:** Found to reduce drug side effects  
**Garlic:** Immuno-stimulant activity of garlic may present with theoretical potential for reduced drug effectiveness |

(Scalapino & Davis 2003; Wei et al. 2007; Kumar & Clark 2009; Sarris & Wardle 2010; Bryant & Knights 2011)
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<td><strong>TNF-alpha Antagonists:</strong></td>
<td>Persistent, active AS, presents with high levels of TNF-α in the sacroiliac joints, peripheral synovium and serum. Blocking the production of TNF-α has been found to stabilize the inflammation in Ankylosing Spondylitis &amp; Rheumatoid Arthritis</td>
<td>Supressing the body’s initial response to invasion leaves the body open to secondary opportunistic infections Abdominal pain, nausea Cough, dizziness, headache, itch, fatigue</td>
<td>None listed</td>
</tr>
<tr>
<td>Infliximab</td>
<td></td>
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(Scalapino & Davis, 2003; Kumar & Clark 2009; Bryant & Knights 2011)
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<td><em><em>Tricyclic Antidepressant</em> (TCA’s): suffix ‘ine’</em>*</td>
<td>Potent noradrenaline (some serotonin) reuptake inhibitors. Used in <strong>Ankylosing Spondylitis &amp; Rheumatoid Arthritis</strong> at low dose for pain relief, aid sleep &amp; subsequently fatigue management.</td>
<td>Sedation, Impaired thinking, concentration &amp; memory, Blurred vision Orthostatic hypotension, Tachycardia Weight gain, Constipation</td>
<td><strong>Cruciferous vegetables:</strong> increase CYP450 hepatic metabolism = faster drug clearance <strong>Vitamins B1, B2, and B6 &amp; SAMe</strong> increase efficacy of drug. <strong>Vitamin B2 &amp; Co Q10</strong> is depleted by TCA’s <strong>5-HTP, tryptophan, SAMe</strong> can potentiate serotonin syndrome. Avoid <strong>Alcohol:</strong> increases drowsiness</td>
</tr>
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(Kishi et al. 1980; Pantuck et al. 1984; Threlkeld et al, 1990; Bell et al. 1992; Braun & Cohen 2010)
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<td>Gold Salt Injections</td>
<td>Suppress the synovitis in acute inflammation. This may inhibit sulfhydryl systems, suppress macrophages and leukocytes and reduce immune activation. Used in <em>Rheumatoid Arthritis</em>.</td>
<td>Allergic skin reaction, Mucous membrane irritation</td>
<td>None Listed</td>
</tr>
</tbody>
</table>

(Kumar & Clark 2009; Bryant & Knights 2011)
## Musculoskeletal System Disease

<table>
<thead>
<tr>
<th>Drug</th>
<th>Action</th>
<th>Side Effects</th>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillamine</td>
<td>Heavy metal chelator with alteration of lymphocyte function &amp; reduced IgM rheumatoid factor. There are reduced inflammatory complexes present in the blood &amp; synovial fluid. Used in Rheumatoid Arthritis.</td>
<td>Impaired renal and haematological function GIT – anorexia, nausea, vomiting, loss of taste, abdominal pain</td>
<td>Copper, Iron, Magnesium &amp; Zinc: Binds to metals reducing bioavailability and increasing excretion. Monitor for deficiency signs &amp; supplement 2-4 hours apart. <strong>Vitamin B6</strong>: Penicillamine is a vitamin B6 antagonist, increasing excretion. Monitor for deficiency signs &amp; supplement 2-4 hours apart</td>
</tr>
</tbody>
</table>

(Stargrove et al. 2008; Kumar & Clark 2009; Bryant & Knights 2011)
References

References


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