Immune System Medications

Medications for Organ Transplantation

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Calcineurin Inhibitors

- Cyclosporine, tacrolimus
  - Adherence is very critical
  - Change in dosage forms can result in changes in levels/bioavailability
- Monitoring
  - Immunosuppression/infection/cancer
  - Hypertension
  - Hyperglycemia
  - Hyperkalemia
  - GI side effects

Calcineurin Inhibitors

- Trough concentrations drawn
  - Goals can vary based upon:
  - Infection risk
  - Adverse effects
  - Risk of rejection
  - Time from transplant
  - 100-400 target levels
- Consistent timing of administration recommended
- CYP3A4 drug interactions
  - Monitor levels closely with changes

Corticosteroids

- Infection
- Cushing’s
- Hyperglycemia
- Osteoporosis
- GI Risk

Mycophenolate

- Adverse effects
  - GI
  - Hypertension
  - Edema
  - Immunosuppressive effects
- Administer on empty stomach

Signs of Rejection

- Loss of function of organ – examples:
  - Jaundice (liver)
  - Worsening renal function
- Patient feeling poorly
  - Flu like symptoms
- Pain/swelling
  - Location of organ
- Acute rejection
  - Week to 3 months; chronic >3 months
- Review for adherence/interaction/adverse effect potential

Nurse Monitoring

- Kidney: creatinine, urine output
- Liver: AST/ALT, bilirubin, INR
- Heart: EKG, echo, cardiac enzymes if indicate
- Lung: SpO2, ABGs, breath sounds
- Vitals (BP, Pulse)
- Electrolytes

Crohn’s Disease

Crohn’s Versus Ulcerative Colitis

- Major Differences
  - Crohn’s located “patches” throughout intestinal system
    - Can impact all the way through the intestine
  - Ulcerative colitis – continuous area in the colon and typically just the inner lining
  - Fistula’s and strictures common in Crohn’s

Treatment

- Dependent upon
  - Location
  - Severity
  - Maintenance or Remission
  - Past history

More Symptoms = Higher Score

- Fever
- Vomiting
- Obstruction
- Cachexia
- Abdominal pain
- Anemia/blood loss
- Tachycardia
- Frequency of loose stools
- Fistula or abscess

Crohn’s Treatment

- Mesalamine, sulfasalazine
  - GI adverse effects most common
  - Less expensive
  - Better option if the patient has colitis only
  - Less effective when disease involves small intestine which is more common in Crohn’s than ulcerative colitis
  - Mesalamine is recommended to be avoided in patients with active Crohn’s disease

Remission Induction - Corticosteroids

- Budesonide (Entocort EC)
  - Used to induce remission in lower to moderate risk patients with an acute flare (can be used in conjunction with a biologic in higher risk patients)
  - Typical steroid side effects, but less systemic absorption due to high first pass effect
    - Insomnia
    - Increased infection risk
    - Hyperglycemia
    - Nausea, abdominal pain
    - Mood changes
    - Adrenal (HPA axis) suppression with long term use
  - Usually used in shorter term bursts versus chronic (i.e. 8-12 weeks)

Biologics - High Risk, Remission Induction

- Used for remission induction as well as maintenance in moderate to severe Crohn's
  - If disease remission is achieved with an anti-TNF agent, then it is typically continued for maintenance therapy for a year or two and then reassessed
- Can be combined with an immunomodulator (i.e. methotrexate, azathioprine, or 6-MP, etc.) in higher risk patients
- Screen for active/latent TB prior to and during use
- Risk of infection, cancer
- Common AE's
  - Infusion/injection reaction
  - GI
- Possible increased LFT's

Biologics

- Infliximab (Remicade, Inflectra)
  - TNF-alpha inhibitor, IV administration only
  - With mild to moderate infliximab infusion reaction, you may reduce the infusion rate; severe acute reaction, you may need to stop the drug
    - Typically doesn’t involve IgE
  - Infliximab infusion reaction prevention may include the use of an antihistamine, corticosteroids, and/or acetaminophen
- Adalimumab (Humira)
  - TNF-alpha inhibitor
  - SubQ administration
  - Alternative to infliximab

Oral Options

- Azathioprine
  - GI side effects
  - Immune suppressive (risk of infection)
  - Malignancy risk
  - CBC monitoring, LFT's important to monitor
  - Really important interaction with allopurinol (possibly increases myelosuppressive effects)
  - Need to do thiopurine methyltransferase (TPMT) genetic testing
- Methotrexate
  - Usually further down the line options for non-responders to other therapies
  - Immunosuppressive activity
  - Add on to help patients who are steroid dependent
  - Supplement folic acid
  - See Rheumatoid arthritis for more information on methotrexate

Other Recommendations

- Symptom management
  - Psyllium – bulk up stool, try to reduce diarrhea
  - Loperamide – antidiarrheal
  - Acetaminophen – pain (remember to avoid NSAIDs)
  - Chronic bleeding (assess need for iron and B12)
  - Surgery
    - Symptom relief and is not curative
  - Avoid NSAIDS as they may exacerbate Crohn’s

Ulcerative Colitis

Symptoms

- ”Inflammatory” Bowel Disease
- Diarrhea, urgency
- Cramping
- Pain
- Possible blood
- Fatigue
- Fever

Crohn's Versus Ulcerative Colitis

- Major Difference
  - Crohn's located "patches" throughout intestinal system
    - Can impact all the way through the intestine
  - Ulcerative colitis – continuous area in the colon/large intestine and typically just the inner lining
  - Smoking may REDUCE symptoms in UC

Medications

- Mesalamine
  - MOA: Inhibits prostaglandin and cytokine production (pro-inflammatory mediators)
  - More appropriate in mild disease
  - Enema/suppository form can be helpful as typically only the colon is affected with Ulcerative Colitis versus Crohn's disease
    - Enemas have deeper penetration into the colon than suppository
  - Patients may not like enema form
  - Combination topical and oral may be used in mild-moderate flare

Medications

- Sulfasalazine
  - See Rheumatoid Arthritis
- Corticosteroids
  - Moderate to severe flare of ulcerative colitis (or non-responders to 5-ASA therapy)
  - Topical and/or oral can be utilized depending upon extent and severity of flare
  - 5-ASA products and steroids can be used together in severe cases
  - IV steroids in hospitalized/fulminant patients

Medications

- Immunosuppressants
  - Cyclosporine/azathioprine – one of these may be utilized in refractory patients
- Symptom management
  - Psyllium – bulk up stool, try to reduce diarrhea
  - Loperamide – antidiarrheal
    - Be very cautious with antidiarrheal agents as they can potentially cause toxic megacolon
  - Acetaminophen – pain (remember to avoid NSAIDs)
  - Chronic bleeding (assess need for iron and B12 deficiency)
- Surgery is curative for ulcerative colitis, but patients will likely have to have an ostomy bag
  - Big differentiator with Crohn’s disease

Mild-Moderate UC Flare Treatment

- Dual topical and oral 5-ASA may have highest efficacy rates
- Topical 5-ASA (i.e. mesalamine)
  - Rectal administration (suppositories/enemas)
  - Enema can have further penetration than suppositories
  - Benefit onset can be quick (few days), but healing may take a few weeks
- Unwilling to do topical therapy?
  - Oral is an option, but has lower efficacy rates
- Non-response
  - Add in topical steroid (i.e. beclomethasone)
  - Budesonide

Severe/Fulminant

- ≥6 per day bloody stools
- Systemic effects
  - Tachycardia
  - ESR elevation
  - Fever
- Severe pain
- Anemia
- Weight loss

Severe/Fulminant UC Flare

- Combination
  - Systemic steroids
  - Topical 5-ASA
  - Oral 5-ASA
- Hospitalized patient
  - IV steroids
  - Infliximab/cyclosporine/surgery
  - Watch lytes and fluid status
  - Cipro/metronidazole if infection suspected and needs to be treated

Use Caution

- Avoid drugs that slow the GI tract
  - Anticholinergics
  - Opioids
  - Loperamide
- GI bleed risk
  - NSAIDs
  - Antiplatelets, anticoagulants

Adult Vaccines

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Shingrix

- Recombinant Zoster Vaccine (Shingrix)
  - Stronger evidence/response compared to Zostavax
  - Immunocompetent patients age 50+
  - CDC also recommends vaccination in immunodeficient or immunosuppressed adults aged 19 or older
    - Ideal to give before immunosuppression if possible
  - Wait to give if active shingles episode
  - Give even if they have had shingles before
  - 2 dose course, 2-6 months apart
  - Give even if they have had Zostavax in the past
  - Not a live vaccine

Pneumococcal Vaccination

- ACIP Recommendations – Pneumococcal Vaccination
  - PCV20 (Prevnar 20) or PCV15 (Vaxneuvance) is recommended in patients who are 65 years of age or older or in patients 19-64 who have specific underlying conditions (PCV13 no longer recommended)
  - If PCV15 is used, it should be followed by PPSV23 1 year later
  - PCV20 does not require a follow up PPSV23 dose per ACIP, but some may consider this based upon clinical decision making
  - If PCV13 and PPSV23 had previously been received, revaccination with PCV15 or PCV20 is not recommended

Pneumococcal Vaccination

- Pneumococcal Conjugate Vaccine – PCV15 (Vaxneuvance), PCV20 (Prevnar 20)
  - One time lifetime dose
  - Injection
  - Inactive (non-living)
  - 1 year separation from Pneumococcal Polysaccharide 23 valent vaccine if both are to be given (8 week separation may be considered for immunosuppressed/high risk patients)
  - If PCV13 and PPSV23 had previously been received, revaccination with PCV15 or PCV20 is not recommended
  - If only PPSV23 has been given, give PCV product one year after

PCV21

- Capvaxive (PCV21)
  - Inactivated, single dose
  - The PCV21 vaccine is currently recommended as an alternative option for adults eligible to receive PCV15 or PCV20
  - Covers eight additional serotypes
  - Broadens coverage by approximately 20-30%.

Pneumococcal Vaccination

- Pneumococcal Polysaccharide 23 Valent Vaccine (PPSV23) - Pneumovax
  - Up to 3 lifetime doses (only 1 after the age of 65)
  - Injection
  - Inactive
  - Indicated for all patients 65 and older (wait at least 5 years between doses if the patient received a dose prior to age 65)
  - Indications for younger individuals
    - CHF, lung diseases, smoking, diabetes, alcoholism, liver disease, cochlear implant, cerebrospinal fluid leaks, asplenia, sickle cell disease, immunocompromising conditions
  - If 19 years of age and patient has an immunocompromising condition, give PPSV23 and may do a repeat dose 5 years later

Influenza Vaccination

- Influenza Vaccine (Fluzone, FluLaval, etc.)
  - Typically takes 2 weeks to form antibodies
  - Start giving vaccine in Fall (September/October) timeframe
  - Give vaccine until influenza is no longer circulating
    - Usually April-May timeframe
  - May be given with COVID-19 vaccine

Influenza Vaccination

- All flu vaccines are trivalent
- Given annually
  - ACIP recommends specific products for elderly (65 y/o and above) – see below
  - Trivalent high-dose inactivated influenza vaccine (HD-IIV3), or trivalent adjuvanted inactivated influenza vaccine (aIIV3), or recombinant influenza vaccine (RIV3)

Influenza Vaccination

- Inactivated vaccine (injection) - Indicated for all patients greater than or equal to 6 months of age
- Live, attenuated (LAIV) nasal indicated for patients age 2-49
  - Numerous contraindications exist for LAIV: immunocompromised patients, children age 2-17 who are receiving aspirin or salicylate containing medications, children aged 2-4 with an asthma diagnosis, close contact with immunocompromised patients, pregnancy, CSF leak, cochlear implants, recently received antiviral therapy such as oseltamivir, baloxavir, etc.
- Per CDC, “people with egg allergy may receive any (influenza) vaccine that is otherwise appropriate for age and health status”

COVID-19 Vaccination

- ONLY Bivalent COVID-19 vaccines are recommended for use
- Patients age 12 and older should receive 1 dose of current Moderna OR Pfizer-BioNTech COVID-19 vaccine
- Patients who are moderately or severely immunocompromised may receive an additional dose at least 2 months or more after the previous dose
- A 3 month delay in vaccination is reasonable for patients who have just had COVID-19 infection

Tdap/Td

- Tdap and Td
  - T=Tetanus, ap=acellular pertussis aka whooping cough, d=diphtheria
  - Inactivated
  - Give one time Tdap substituted for Td in adulthood
  - Dosing interval is every ten years
  - Tdap recommended during pregnancy

Respiratory Syncytial Virus

- Respiratory Syncytial Virus (RSV)
  - Glycoprotein vaccines
    - Adjuvanted monovalent (Arexvy)
    - Bivalent PreF (Abrysvo)
    - mRNA vaccine (MResvia)

RSV Vaccine Recommendations

- CDC recommends one dose of maternal RSV vaccine between weeks 32 and 36 of pregnancy – Abrysvo is the recommended product
- CDC recommends RSV vaccination for everyone 75 and older and ages 60-74 with at risk conditions (heart, lung disease, other comorbid conditions that may place that at higher risk, nursing home residents, etc.)
- Late summer/early fall is the best time to get vaccinated
- One time dose (not currently an annual recommendation)
- Coadministration with other vaccines like influenza is acceptable but may increase common side effects like fever and soreness at injection site; evidence on clinical efficacy for or against coadministration is insufficient

Pediatric Vaccines

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Pediatric Vaccines

- Rotavirus
  - Rotarix: 2 doses given at 2 and 4 months
  - RotaTeq: 3 doses given at 2, 4, and 6 months
  - Do not start the series on or after age 15 weeks
  - Maximum age for the final dose is 8 months
  - Oral liquid
  - Live vaccine
    - Can be given on the same day as other live vaccines otherwise needs to be spaced 4 weeks apart
    - If the patient received antibodies must wait at least 3 months to give the vaccine
    - After vaccination must wait at least 2 weeks to receive antibodies

Pediatric Vaccines

- Hepatitis B
  - 3 doses
    - Given at birth, 1-2 months, and 6-18 months
  - Intramuscular injection
  - Inactive (non-living)
  - Engerix-B and Recombivax HB are available for use in children
    - Supplied as different concentrations and not interchangeable
  - Comes in combination with other vaccines if the patient is due for multiple vaccines
    - Pediarix: DTaP-HepB-IPV
    - Vaxelis: DTaP-IPV-Hib-HepB

Pediatric Vaccines

- DTaP: Diphtheria, tetanus toxoids, and acellular pertussis (Daptacel and Infranrix)
  - 5 doses
    - Given at 2,4,6, 15-18 months, and 4-6 years
  - Intramuscular injection
  - Inactivated (non-living)
  - Comes in combination with other vaccines if the patient is due for multiple vaccines
    - Example: Pediarix (DTaP-HepB-IPV)

Pediatric Vaccines

- Hib: Haemophilus influenzae Type B
  - ActHIB and Hiberix: 4 doses
    - Given at 2,4,6, and 12-15 months
  - PedvaxHIB: 3 doses
    - Given at 2,4, and 12-15 months
  - Intramuscular injection
  - Inactivated (non-living)

Pediatric Vaccines

- PCV15 or PCV20: Pneumococcal 15 or 20 Valent Conjugate Vaccine (Prevnar)
  - 4 doses
    - Given at 2,4,6, and 12-15 months
  - Intramuscular injection
  - Inactive (non-living)
  - Interchange OK per ACIP

Pediatric Vaccines

- IPV: Inactivated Polio Vaccine (IPOL)
  - 4 doses
    - Given at 2,4,6-18 months, and 4-6 years
  - Intramuscular or subcutaneous injection
  - Inactivated (non-living)
  - Comes in combination with other vaccines if the patient is due for multiple vaccines
    - Example: Pediarix (DTaP-HepB-IPV)

Pediatric Vaccines

- MMR: Measles, mumps, and rubella (M-M-R-II)
  - 2 doses
    - Given at 12-15 months and 4-6 years
  - Subcutaneous injection
  - Live vaccine
    - Can be given on the same day as other live vaccines otherwise needs to be spaced 4 weeks apart
    - If the patient received antibodies must wait at least 3 months to give the vaccine
    - After vaccination must wait at least 2 weeks to receive antibodies
  - Also comes in combination with Varicella vaccine
    - ProQuad: MMRV (measles, mumps, rubella, and varicella)

Pediatric Vaccines

- Varicella (Varivax)
  - 2 doses
    - Given at 12-15 months and 4-6 years
  - Subcutaneous
  - Live vaccine
    - Can be given on the same day as other live vaccines otherwise needs to be spaced 4 weeks apart
    - If the patient received antibodies must wait at least 3 months to give the vaccine
    - After vaccination must wait at least 2 weeks to receive antibodies
  - Comes in combination with other vaccines if the patient is due for multiple vaccines
    - ProQuad: MMRV (measles, mumps, rubella, and varicella)

Adolescent Vaccines

- Meningococcal A,C,W,Y serogroups vaccines (Menveo, MenQuadfi, and Manactra)
  - 2 doses
    - Given at age 11-12 and 16 years
  - Intramuscular injection
  - Inactivated (non-living)
- Influenza
  - Annual

Adolescent Vaccines

- Tdap
  - One booster shot 11-18 y/o
- HPV: Human Papillomavirus Vaccines (Gardasil 9)
  - 2 doses
    - Given at 9-14 years and 6-12 months later
  - 3 doses if initial vaccination is at age 15 years or older
    - Given at 0, 1-2, and 6 months
  - Routinely recommend first dose at age 11-12 years
  - Intramuscular injection
  - Inactivated (non-living)

HPV Vaccine - Indication for Ages >26

- OK to give in those >26 years of age
- Most will likely have been exposed
- Insurance may not cover
- May be indicated in those with no/minimal sexual exposure history
- Now more likely to have more sexual exposure