Pharmacist Involvement in the Management of Adverse Effects Related to Chemotherapy and Targeted Therapies

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Objectives

1. Identify patients at high risk for the following adverse effects: nausea and/or vomiting, mucositis, and peripheral neuropathy
2. Describe treatment options for chemotherapy induced nausea and vomiting based on the chemotherapy emetic potential
3. List 3 treatment options for management of chemotherapy induced peripheral neuropathy
4. Name 2 topical treatments and 1 oral treatment for management of targeted therapy induced rash
5. Identify 3 indications for initial treatment with vancomycin in patients with febrile neutropenia

Technician Objectives

1. Review common adverse effects associated with chemotherapy
2. Recognize agents used to treat chemotherapy induced nausea and vomiting, mucositis, peripheral neuropathy, rash, and febrile neutropenia
3. Compare and contrast the different agents used to treat chemotherapy induced nausea and vomiting

I have nothing to disclose

- Side effects of chemotherapy may lead to increased morbidity and mortality, increased cost of cancer care, and decreased quality of life.
As the pharmacist, we can contribute by adding specific drug-related knowledge and offering patient-related services.

Chemotherapy Induced Nausea and Vomiting (CINV)

There was a significant impact on patients' daily functioning and quality of life in those who developed chemotherapy induced nausea and vomiting.

Types of CINV

- Anticipatory
- Acute
- Delayed
- Breakthrough
- Refractory

Risk Factors for Acute-Onset CINV

- Younger age (<50 y/o)
- Female
- Poor control of symptoms in prior cycles
- History of motion sickness or nausea with pregnancy
- Anxiety/depression
- Absence of alcoholism
Other Risk Factors for CINV
- Delayed-Onset CINV
- Female
- Poor control of symptoms in acute onset
- Chemotherapy regimens with higher doses and faster infusion times
- Increasing number of cycles or chemotherapy regimens administered over several days
- Combination regimens
- Most predictive factor: chemotherapy agent’s tendency to cause CINV

High Emetic Risk Intravenous Chemotherapy
- AC combination defined as either doxorubicin or epirubicin with cyclophosphamide
- Carmustine > 250 mg/m²
- Cisplatin ≥ 50 mg/m²
- Cyclophosphamide > 1,500 mg/m³
- Dacarbazine
- Doxorubicin > 60 mg/m³
- Epirubicin > 90 mg/m³
- Ifosfamide ≥ 10 g/m³
- Mechlorethamine
- Streptozocin

Moderate Emetic Risk IV Chemotherapy
- Aldesleukin > 12-15 million international units/m³
- Amifostine > 500 mg/m²
- Azacitidine
- Bendamustine
- Busulfan
- Carboplatin
- Carmustine ≤ 250 mg/m²
- Cisplatin < 50 mg/m²
- Clofarabine
- Cyclophosphamide ≤ 1,500 mg/m³
- Cytarabine > 200 mg/m³
- Dactinomycin
- Daunorubicin
- Doxorubicin ≤ 60 mg/m³
- Epirubicin ≤ 90 mg/m³
- Ifosfamide < 10 g/m³
- Interferon alfa ≥ 10 million international units/m³
- Irinotecan
- Melphalan
- Methotrexate ≥ 250 mg/m³
- Oxaliplatin
- Temozolomide

Low Emetic Risk IV Chemotherapy
- Amifostine ≤ 300 mg
- Aldesleukin ≤ 12 million international units/m³
- Carmustine ≤ 250 mg/m²
- Cisplatin < 50 mg/m²
- Cytarabine (low dose) 100-200 mg/m²
- Docetaxel
- Doxorubicin (liposomal)
- Eribulin
- Etoposide
- 5-Fluorouracil
- Fludarabine
- Gemcitabine
- Interferon alfa ≤ 5 < 10 million international units/m³
- Irinotecan
- Melphalan
- Methotrexate ≤ 1,500 mg/m³
- Oxaliplatin
- Paclitaxel
- Paclitaxel-albumin
- Pemetrexed
- Pentostatin
- Pentostatin
- Vinorelbine
- Vinorelbine

Minimal Emetic Risk IV Chemotherapy
- Alemtuzumab
- Asparaginase
- Bevacizumab
- Bleomycin
- Bortezomib
- Cetuximab
- Cisplatin (single day)
- Cytarabine
- Decitabine
- Denileukin difitox
- Dexrazoxane
- Fludarabine
- Interferon alpha ≤ 5 million international units/m³
- Iplimumab
- Ipilimumab
- Methotrexate ≤ 50 mg/m³
- Nelarabine
- Ofatumumab
- Panitumumab
- Pegaspargase
- Peginterferon
- Rituximab
- Temsirolimus
- Trastuzumab
- Valrubicin
- Vinblastine
- Vinorelbine
- Vincristine

Moderate to High Emetic Risk Oral Chemotherapy Agents
- Altreminine
- Busulfan (≥ 4 mg/day)
- Cyclophosphamide (≥ 100 mg/m³/day)
- Estramustine
- Etoposide
- Etomustine
- Lomustine (single day)
- Procarbazine
- Temozolomide (>75 mg/m³/day)
Minimal to Low Emetic Risk
Oral Chemotherapy Agents
- Bexarotene
- Busulfan (< 4 mg/day)
- Capecitabine
- Cyclophosphamide (< 100 mg/m²/day)
- Dasatinib
- Erlotinib
- Everolimus
- Fludarabine
- Gefitinib
- Hydroxyurea
- Imatinib
- Lapatinib
- Lenalidomide
- Melphalan
- Mercaptopurine
- Methotrexate
- Nitrofurantoin
- Pazopanib
- Sorafenib
- Sunitinib
- Temozolomide (< 75 mg/m²/day)
- Thalidomide
- Thioguanine
- Topotecan
- Tretinoin
- Vandetanib
- Vorinostat

Emesis Prevention for IV Chemotherapy

<table>
<thead>
<tr>
<th>Day</th>
<th>High Emetic Risk</th>
<th>Moderate Emetic Risk</th>
<th>Low Emetic Risk</th>
<th>Minimal Emetic Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>5-HT3 Antagonist AND Dexamethasone</td>
<td>5-HT3 Antagonist AND Dexamethasone</td>
<td>Dexamethasone OR Metoclopramide OR Prochlorperazine (start prior to chemo)</td>
<td>No routine prophylaxis</td>
</tr>
<tr>
<td>Days 2-3(4)</td>
<td>Dexamethasone (days 2-3) AND Neurokinin 1 Antagonist (days 2-3) OR 5-HT3 Antagonist</td>
<td>5-HT3 Antagonist (days 2-3)</td>
<td>No routine prophylaxis</td>
<td></td>
</tr>
</tbody>
</table>

Breakthrough Medications:
- Lorazepam, dexamethasone, haloperidol, metoclopramide, olanzapine, scopolamine, prochlorperazine, promethazine, 5-HT3 antagonists, dexamethasone

Emesis Prevention for Oral Chemotherapy

Start before chemotherapy and continue daily

<table>
<thead>
<tr>
<th>Emetic Risk</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>High to moderate</td>
<td>PO granisetron or PO ondansetron</td>
</tr>
<tr>
<td>Low to minimal</td>
<td>Recommend PRN initially; then if not controlled, may switch to: Metoclopramide 10-40 mg PO, then every 4-6 h PRN OR Prochlorperazine 10 mg PO, then every 4-6 h PRN OR Haloperidol 1-2 mg PO every 4-6 h PRN If continued N/V, recommend PO 5-HT3 antagonists</td>
</tr>
</tbody>
</table>

Prevention of Anticipatory Nausea and Vomiting
- Use optimal antiemetic therapy during every cycle of treatment
- Behavioral therapy
  - Relaxation/systemic desensitization
  - Hypnosisguided imagery
  - Music therapy
- Acupuncture/acupressure
- Lorazepam PO the night before and morning of treatment OR alprazolam PO TID beginning on the night before treatment

Treatment of Breakthrough Nausea and Vomiting
- Conduct a careful re-evaluation of emetic risk, disease status, concurrent illnesses, and medications
- Clarify that the best regimen is being administered
- Give an additional agent from a different drug class PRN
- If controlled, continue breakthrough medications on a schedule, not PRN
- If not controlled, consider changing to higher-level primary treatment

Nausea and Vomiting Prevention
- Patient education
  - Prevention Prevention
  - Stress to the patient importance of taking antiemetics
  - Encourage patient to *use* prn medication
  - Life-style modifications
Dietary Approaches to Manage Nausea

- Eat foods that are easy on your stomach
- Eat 5 or 6 small meals each day
- Do not skip meals and snacks
- Choose foods that appeal to you
- Sip only small amounts of liquids during meals
- Eat dry toast or crackers before getting out of bed if you have nausea in the morning
- Plan when it is best for you to eat and drink

Dietary Approaches to Manage Vomiting

- Prevent nausea
- Wait for vomiting to stop before eating or drinking
- Once the vomiting stops, drink small amounts of clear liquids
- Once you can drink clear liquids without vomiting, try full-liquid foods and drinks
- Eat more small meals instead of less larger meals

Case #1

AB is a 49 year old male recently diagnosed with head and neck cancer. He will begin treatment today with Cisplatin 100 mg/m² every 3 weeks for 3 doses.

Which antiemetic regimen should AB receive prior to chemotherapy?

a. Ondansetron + Dexamethasone + aprepitant
b. Ondansetron + Dexamethasone + prochlorperazine for breakthrough
c. Dexamethasone + prochlorperazine for breakthrough
d. Ondansetron + Dexamethasone

Chemotherapy-Induced Mucositis

Mucositis
Pathophysiology of Mucositis

- Epithelial lining of the GI tract turns over every 7-14 days
- Ranges from mild inflammation to bleeding ulcerations
- Affects non-keratinized oral mucosa (labial, buccal and soft-palate mucosa, floor of the mouth, ventral aspect of the tongue)

Pathophysiology of Mucositis

- Usually progresses in a stepwise fashion
- Asymptomatic redness/erythema occurring 0-5 days after therapy
- Desquamation with white patches occurring 0-7 days after therapy
- Contiguous pseudomembranes occurring 6-12 days after therapy
- Painful lesions with or without ulceration occurring 12-16 days after therapy

WHO Grading System for Mucositis

- Grade 0: None
- Grade 1: Soreness +/- redness, no ulceration
- Grade 2: Redness, ulcers. Patients can swallow solid diet
- Grade 3: Ulcers, extensive redness. Patients cannot swallow solid diet
- Grade 4: Oral mucositis to the extent that eating is not possible

Chemotherapy-Induced Mucositis

- 40-75% will experience mucositis
- 70-80% undergoing bone marrow transplantation with radiation-based condition regimens will develop mucositis
- Course parallels neutrophil nadir
- Continuous infusions cause more mucositis than short IV infusions
- Chemotherapy combined with radiation leads to worse mucositis than either given alone

Risk Factors for Mucositis

- Pre-existing oral lesions
- Poor dental hygiene or ill-fitting dentures
- Combined modality treatment with chemotherapy plus radiation
- Ethnicity (Caucasians > African Americans)

Outcomes of Mucositis

- Mucositis can lead to:
  - Delaying subsequent chemotherapy cycles
  - Dosage reductions
  - Discontinuation of chemotherapy regimens
  - Feeding tubes
  - Development of fever and increased risk for infection
  - Increased hospitalizations
Prevention and Treatment of Mucositis

Diet recommendations
- Avoid rough foods (toast, chips, etc), spices, salt and acidic fruit (lemons, grapefruit, oranges)
- Eat soft or liquid foods (puras, ices, custards, non acidic fruits (peaches, banana, mangos, and melon), soft cheeses, and eggs)
- Avoid smoking and alcohol

Mouth Care Strategies
- Pre-treatment dental screening
- Salt and soda rinses BID-QID
- Soft-bristled tooth brush to minimize gingival irritation
- Flossing
- Saliva substitute for radiation-induced xerostomia

Prevention Strategies
- Cryotherapy for patients receiving bolus-dosed 5-FU or edatrexate therapy or high-dose Melphalan before HCT
- Bland oral rinses
- Avoid topical oral antimicrobials (chlorhexidine) to prevent oral mucositis
- Palifermin recommended for patients receiving TBI-containing conditioning regimens before autologous stem cell transplantation
- Amifostine recommended for prevention of xerostomia related to head and neck irradiation and can reduce mucositis associated with high dose melphalan
- Pain management

Management of Mucositis

Treatment Strategies
- Bland rinses for mild-moderate OM pain PRN
- Topical anesthetics for pain relief
- Mouthwashes containing topical anesthetics ("magic mouthwashes")
- Avoid alcohol containing mouthwashes
- Prophylactic antiviral and antifungal therapy may be considered in myelosuppressive therapy to prevent infections that can aggravate OM

Case #2
JL is a 45 year old male currently receiving radiation and chemotherapy for treatment of head and neck cancer. Today he returns to clinic for an unscheduled visit due to a patient complaint of "my mouth is raw and I can't eat". After talking with JL further, you see that his mouth is bright red with multiple white patches. His oral intake is limited to ensure liquids.

What based on the above information, what grade of mucositis does JL have?

a. Grade 0
b. Grade 1
c. Grade 2
d. Grade 3
e. Grade 4

Chemotherapy-Induced Neuropathy
Chemotherapy-Induced Peripheral Neuropathy (CIPN) and Sensory Neuropathy

- Under-reported
- No standard measurement method
- Longest nerves in extremities usually affected first and spreads from distal to proximal areas
- Neurotoxic chemotherapeutic agents cause damage to peripheral nerves by harming microtubules, mitochondrial disruption, and cytotoxic effects on DNA

Symptoms Associated with CIPN and Sensory Symptoms

- Sensory Symptoms
  - Numbness
  - Paresthesias
  - Pain in hands and feet
  - Diminished temperature, touch, sharp/dull discrimination in patients with symptoms
- Motor weakness symptoms are less common

Chemotherapy Agents Associated with Neuropathy

<table>
<thead>
<tr>
<th>Motor and Sensory Neupropathy</th>
<th>Myopathy/Peripheral Neupropathy</th>
<th>Peripheral Neupropathy</th>
<th>Sensory Neupropathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cytarabine</td>
<td>Alitretinoin</td>
<td>Bortezomib</td>
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</tr>
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</tr>
<tr>
<td>Ifosfamide</td>
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<td>Cisplatin</td>
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<tr>
<td>Thalidomide</td>
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<td>Etoposide</td>
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<td>Levothroidine</td>
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<td>Bortezomib</td>
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</tr>
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Prevention of Oxaliplatin Associated CIPN

- Calcium and magnesium (CaMg) infusions
  - Calcium 1 gram and magnesium 1 gram administered 15 minutes before and 15 minutes after oxaliplatin
  - Less neurotoxicity in those receiving infusion
  - More patients withdrew from treatment in those in the control group versus infusion arm (p=0.000003)
  - Conflicting data about efficacy of oxaliplatin when CaMg is administered as a preventative option
  - There is data to support CaMg as an effective prevention option for oxaliplatin-induced neurotoxicity and the treatment does not interfere with oxaliplatin based antitumor activity

Treatment Options for CIPN and Sensory Neuropathies

- Gabapentin
- Pregabalin
- Alpha-lipoic acid
- Lamotrigine
- Venlafaxine
- Duloxetine
- Topical Therapies (amitriptyline, baclofen, and ketamine)
- Tricyclic Antidepressants
- Chemotherapy should be stopped if peripheral neuropathy begins to interfere with daily
- Other pain medication for neuropathic pain

Chemotherapy-Induced Dermatological Toxicity
Agents Associated with Rash (Acneiform, Foliculitis, Pustular Rash in Bold)

| Aldesleukin | Lapatinib |
| Amifostine | Levamisole |
| Arsenic trioxide | Methotrexate |
| Asparaginase | Olaratumab |
| Bendamustine | Oprelvekin |
| Bicalutamide | Oxaliplatin |
| Bortezomib | Palifermin |
| Actinomycin | Pentretrexed |
| Cetuximab | Sorafenib |
| Erlotinib | Sunitinib |
| Gefitinib | Thalidomide |
| Gemcitabine | Topotecan |
| Imatinib | Trimetrexate |
| Irinotecan | Lapatinib |
| Isabeplone |

Dermatological Toxicity-Acneiform Rash

- Associated with Epidermal growth factor receptor (EGFR) inhibitors
- Occurs in 40-85% of patients
- Onset is 7-10 days after treatment initiation
- Mechanism of rash is unclear
- Primary lesions are inflammatory follicular papules and pustules
- Intensity of rash may fluctuate over time
- Complications of rash include infection


Acneiform Eruption

Patient Education of Acneiform and Pustular Rash

- Facial area only-camouflage cosmetics
- Moisturize dry areas twice daily with thick alcohol free emollient
- Avoid activities and skin care products that dry the skin (long, hot showers, OTC acne medications)
- Minimize sun exposure
- Use a sun screen of SPF 15 or greater
- Oatmeal baths

Classification and Treatment of EGFR Associated Rash

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>mild pustular or papular eruption with little or no symptoms</td>
<td>Topical clindamycin 1% PLUS Hydrocortisone 1% BID</td>
</tr>
<tr>
<td>Grade 2</td>
<td>moderate pustular or papular eruption or erythema/mildly symptomatic; may or may not interfere with daily life</td>
<td>Topical clindamycin 1% PLUS Hydrocortisone 1% BID PLUS Minocycline 100 mg BID OR Doxycycline 100 mg daily OR BID x minimum of 4 weeks</td>
</tr>
<tr>
<td>Grade 3</td>
<td>severe, extensive, painful, intolerable rash; interferes with daily life</td>
<td>Panitumumab withheld treatment until toxicity improves to a grade ≤ 2; restart at reduced dose + Topical clindamycin 1% PLUS Hydrocortisone 1% PLUS Minocycline 100 mg BID OR Doxycycline 100 mg daily OR BID X minimum of 4 weeks</td>
</tr>
</tbody>
</table>

Case #3

AJ is a 53 year old male who was recently started on cetuximab for treatment of colorectal cancer. He developed a rash after his first treatment and was started on topical clindamycin 2% + hydrocortisone 1% BID. Upon return to clinic, AJ’s rash has not improved and is bothersome, but not affecting his daily life. AJ’s oncologist asks for your help in recommending a treatment. You suggest:

a. Continue the topical treatment, it hasn’t had enough time to “kick-in”
b. Stop the topical clindamycin + hydrocortisone and start doxycycline 100 mg daily
c. Hold the cetuximab for 1 week, restart at a reduced dose. Then restart topical clindamycin + hydrocortisone and doxycycline 100 mg daily
d. Add doxycycline 100 mg daily to the topical clindamycin + hydrocortisone treatment
Neutropenia
- ANC < 0.5 x 10^9/L or a count of < 1 x 10^9/L with a predicted decrease to ≤ 0.5 x 10^9/L over the next 48 hours
- Increased risk for developing serious infections
- Rate of decline of the ANC and duration of neutropenia are critical factors

Febrile Neutropenia (FN)
- ANC < 0.5 x 10^9/L and a single oral temperature > 101˚F or ≥ 100.4˚F for at least an hour
- Usual signs/symptoms of infection (abscess, pus, infiltrates on chest x-ray) are absent with fever being the only reliable indicator
- Primary sites of infection include the alimentary tract, lungs, sinuses, and skin

Risk Factors for Febrile Neutropenia
- Immune system function
  - Neutropenia
  - AIDS, transplant recipients, lymphoma, prolonged CCS therapy
  - B-cell malignancies
- Other defects in host defense
  - Poor nutrition status
  - Physical barriers
- Patient specific risk factors
  - Type of malignancy
  - Asplenic patients
  - Genetic factors
- Regimen specific risk factors

Microbiology in Febrile Neutropenic Patients
- Bacterial infections
  - 80%-85% of infections in neutropenic patients
  - Polymicrobial
- Fungal infections
  - Incidence is increasing
  - Risk increases with longer duration of neutropenia
  - Candida and Aspergillus sp are most common in cancer patients
- Other infections
  - Viral infections due to reactivation of herpes viruses
  - RSV and influenza

Prevention of Infection
- Minimize invasive procedures
- HANDWASHING
- Isolation
- Neutropenic diets
- Frequent oral care
- Enteral vs. peripheral route
- Amifostine may be considered for reduction of grade 3 and 4 neutropenia, however dose reduction and CSF are alternatives

Antimicrobial Prophylaxis
- NCCN guidelines recommend consideration of fluoroquinolone (FQ) prophylaxis (levofloxacin is preferred) in patients with an ANC < 1 x 10^9/L who are expected to have a duration of neutropenia > 7 days
**Vaccination Use in Neutropenic Patients**

- Live attenuated vaccines should not be given for at least 3 months after chemotherapy or radiation has been completed.
- Patients should not be vaccinated at least 2 weeks before receiving cytotoxic or immunosuppressive therapy.
- Do not administer vaccines on the same day of chemotherapy.
- Influenza vaccine is recommended yearly for all individuals at increased risk from immunosuppressive disease.
- FluMist® is contraindicated in this patient population.

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**Treatment of Febrile Neutropenia**

- Empiric antibiotic therapy is the standard of care.
- Treat immediately!!! High mortality rate.
- Use bactericidal agents.
- Use agents effective against the most common organisms in your institution.
- Minimize toxicity whenever possible.
- Consider most cost-effective regimen.

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**MASCC/IDSA Scoring Index for Identification of Low-Risk Febrile Neutropenic Patients at Time of Presentation with Fever**

<table>
<thead>
<tr>
<th>Illness Extent (Choose 1 Item Below)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No symptoms</td>
<td>5</td>
</tr>
<tr>
<td>Mild symptoms</td>
<td>5</td>
</tr>
<tr>
<td>Moderate symptoms</td>
<td>3</td>
</tr>
<tr>
<td>No hypotension (systolic BP ≥ 90 mmHg without pressors)</td>
<td>5</td>
</tr>
<tr>
<td>No chronic obstructive pulmonary disease</td>
<td>4</td>
</tr>
<tr>
<td>Solid tumor (if have hematological malignancy-no previous fungal infection)</td>
<td>4</td>
</tr>
<tr>
<td>No dehydration</td>
<td>3</td>
</tr>
<tr>
<td>Age ≤ 60 years (does not apply to patients ≤ 16 years of age)</td>
<td>2</td>
</tr>
</tbody>
</table>

Score of ≥ 21 indicates patient is likely low risk.

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**FN Risk Differentiation**

**High Risk Patients**

- MASCC score < 21
- Patient in hospital at fever onset
- Clinically unstable or significant comorbidity
- Prolonged severe neutropenia anticipated (ANC ≤ 0.1 x 10⁹/L for ≥ 7 days)
- Abnormal organ function
- Progressive or uncontrolled cancer
- Pneumonia or other complex infection
- Grade 3 or 4 mucositis

**Low Risk Patients**

- MASCC score ≥ 21
- None of the high risk factors
- Patient outpatient at fever onset
- No associated acute comorbid illness which would require inpatient therapy or close observation
- Anticipated short duration of severe neutropenia (ANC ≤ 0.1 x 10⁹/L for < 7 days)
- No hepatic or renal insufficiency
- ECOG performance status 0 or 1

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**Indications for Vancomycin (or other antibiotics active against gram-positive organisms) to the empirical regimen for FN**

- Hemodynamic instability or other evidence of severe sepsis
- Pneumonia documented radiographically
- Positive blood culture for gram-positive bacteria, before final identification and susceptibility testing is available
- Clinically suspected serious catheter-related infection (chills or rigors with infusion through catheter and cellulitis around the catheter entry/exit site)
- Skin or soft tissue infection at any site
- Colonization with MRSA, VRE, or penicillin-resistant Streptococcus pneumoniae
- Severe mucositis, if fluoroquinolone prophylaxis has been given and cefazidime is employed as empirical therapy
Case #4

JL is a 63 year old female who received her first cycle of chemotherapy with paclitaxel and carboplatin for stage III ovarian cancer 12 days ago. She has a PMH of COPD. She reports to clinic today (after a 3 hour drive) complaining of a fever this morning of 101˚F (38.8˚C). Her ANC is 0.1 x 10^9/L. She denies any signs and symptoms of infection. Her blood pressure is 125/72 mmHg; pulse is 80; respiratory rate is 15 and SCR is 1.1 mg/dL.

What is JL’s MASCC/IDSA score for low risk FN?

a. 24
b. 21
c. 20
d. 19

Case #4 continued

Based on her MASCC/IDSA score, JL should be admitted to the hospital for IV antibiotics. Which one of the following antibiotic regimens should JL receive?

a. Amoxicillin/clavulanate plus oral ciprofloxacin
b. Piperacillin-tazobactam
c. Ertapenem
d. Piperacillin + vancomycin
Pharmacist Involvement in the Management of Adverse Effects Related to Chemotherapy and Targeted Therapies

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