1. A 13-year-old male with newly diagnosed osteosarcoma of the right distal femur is admitted for his first course of chemotherapy. He has significant nausea and complains of persistent pain in the area of his tumor that fluctuates from 6-10 out of 10 depending on his activity. He seems to respond well to a dose of IV morphine. What is the best pain regimen for this patient?

 a. IV Tylenol scheduled every 6 hours with IV morphine PRN

\*b. IV morphine scheduled every 4 hours with IV morphine PRN

 c. Vicodin scheduled every 4 hours with IV morphine PRN

 d. IV morphine PRN with no scheduled medications

 e. Morphine PCA with demand dosing without a basal rate.

Explanation:

This patient is complaining of persistent moderate to severe pain. WHO Guidelines on the pharmacological treatment of persisting pain in children with medical illness suggest that pain regimens should include dosing at regular intervals (around the clock) while monitoring for side effects. Pain regimes should also be adapted to the individual child and use the appropriate route. Oral/enteral route should be used when possible; however, this patient has significant nausea. Additionally, the WHO Guidelines use a two-step strategy for pain management. Ibuprofen and/or acetaminophen are the gold standard for mild pain, while morphine is the gold standard for moderate/severe pain relief. Combined analgesia, like Vicodin, Lortab, and Percocet, are not recommended for pain control in pediatrics.

1. A 15-year-old girl with metastatic Ewing sarcoma presents for a routine clinic visit. She has been on high doses of opioids for several weeks as an outpatient and her pain has been well-controlled. Initially, she had multiple side effects from her opioids, however, the majority of these have resolved. Which of the following opioid side effects does not improve with time?

\*a. Constipation

 b. Urinary retention

 c. Sedation

 d. Pruritis

 e. Nausea

Explanation:

Opioid use is associated with multiple adverse effects, which tend to occur more frequently with daily dosing, higher doses, long-term therapy, and decreased renal or hepatic function. Common opioid side effects include: sedation, constipation, pruritus, nausea, urinary retention, sweating, hyperalgesia, and myoclonus. While tolerance develops to most side effects, constipation does not improve with time. It is important to ensure patients receiving opioids have a proper laxative regimen. Sennosides-only therapy has been shown to be superior to sennosides + docusate in a small randomized controlled trial.

1. A 19-year-old male with AML is awaiting count recovery and develops severe mucositis. He has not been able to eat for the past 2 weeks and his pain is being managed with a morphine PCA. He becomes septic and is transferred to the ICU. As his condition worsens, he develops multi-system organ failure and the ICU attending decides to change him to a fentanyl PCA.

Which of the following is the most likely reason why the ICU attending rotated the patient onto a fentanyl PCA?

 a. Cardiac failure

 b. Oversedation

 c. Pulmonary failure

\*d. Renal failure

 e. Severe ileus

Explanation:

Sepsis with multi-organ failure likely includes a component of renal insufficiency or renal failure. Morphine and oxycodone should be avoided in patients with renal insufficiency or renal failure. Morphine is metabolized in the liver to morphine-3-glucuronide (M3G), morphine-6-glucuronide (M6G) and normorphine. These metabolites are excreted renally. In patients with renal impairment, increased levels of M6G and M3G can lead to increased opioid side effects, increased nociception, and increased hyperexcitability. Patients with renal failure should be switched to fentanyl or methadone if possible. Other reasons to rotate opioids include increased side effects with poor pain control and opioid-induced hyperalgesia.

1. An 8-year-old male, who was diagnosed with metastatic embryonal rhabdomyosarcoma at 6 years of age, presents with increased abdominal and leg pain. He is found to have multi-focal relapsed disease. His physician consults the palliative care team to meet with the family.

Which of the following is true of palliative care?

 a. Palliative care is another name for hospice.

 b. It is best to consult palliative care 3-6 months prior to anticipated death.

 c. Palliative care mainly focuses on the spiritual and psychosocial needs of patients and families and not physical needs.

\*d. Symptom management is one of the key components of palliative care.

 e. Patients cannot receive palliative care along with curative therapy.

Explanation:

Palliative care is specialized medical care for people with a serious illness. It can be provided along with curative therapy as an extra layer of support to improve quality of life for patients and the family. It is appropriate for oncology patients of any age and any stage of disease and is most beneficial when introduced early in the disease course. Palliative care teams are interdisciplinary and comprehensively manage the physical, psychological, social and spiritual needs of patients and families. The key components of palliative care are communication (establishing goals of care), medical decision making and advanced care planning, care coordination, and symptom management.

1. A 17-year-old male, who was diagnosed with osteosarcoma at 15 years of age, presents with increased work of breathing and leg pain. He is found to have multi-focal relapsed disease. His sister died of rhabdomyosarcoma two years earlier and the family is interested in early admission to hospice. What is the criterion for admission to hospice?

 a. Patient has a do-not-resuscitate (DNR) order

 b. Medical condition requiring skilled nursing assistance at home

\*c. Prognosis estimated to be <6 months by the physician

 d. Patient/Family wishes for death at home

 e. Family needs durable medical equipment for home

Explanation:

Both palliative and hospice care work to address physical, psychological, social, and spiritual needs of patients, however, there is a key distinction. While palliative care is specialized medical care for patients of any age and any stage of disease, hospice care is a community-based service meant for patients at late stages of their disease. Patients are not eligible for hospice care unless their prognosis is estimated to be <6 months if the disease follows its usual course. Historically, children were not eligible for hospice care if they were still receiving curative/restorative therapy, were technology dependent or had block nursing at home. The Patient Protection and Affordable Care Act that was passed in 2010 included a provision termed “Concurrent Care for Children” Requirement, which requires state Medicaid programs to pay for both curative and hospice care for children <21 years old, if the child is within the last 6 months of life based on the expected disease course.

1. A 3-year-old girl with relapsed high-risk neuroblastoma was admitted overnight for end-of-life care. Her parents have noticed she has seemed more comfortable over the past several days.

Which of the following changes are NOT commonly seen in the days prior to death?

 a. Increased somnolence

 b. Respiratory changes

\*c. Warm skin with increased sweating

 d. Decreased appetite

 e. Increased secretions

Explanation:

In the days and weeks prior to death, the body begins to shut down. The dying process is different with each individual and, families often do not know what to expect. Changes that occur in the days prior to death include: increased somnolence, less interactivity, decreased appetite, weight loss/gain, respiratory changes, skin changes (pallor, cool, mottled), and increased secretions. Individuals may also develop urinary/bowel incontinence or terminal delirium which can be marked by agitation, confusion, decreased attention, altered cognition, and hallucinations. At the end of life, interventions to consider include discontinuation of vital sign assessment, non-essential medications/testing and other interventions that cause distress (e.g., suctioning, turning, and repetitive awakening). Excessive artificial nutrition and hydration should be avoided. Providers should work with families to provide comfort care consistent with their wishes.

1. A 12-year-old boy with refractory Ewing sarcoma is admitted for end-of-life care. He develops worsening dyspnea and appears to be afraid and complains of shortness of breath. Which of the following is NOT suggested for the management of dyspnea at the end of life:

\*a. Oxygen saturation monitoring

 b. Opioids

 c. Fan to the face

 d. Nasal cannula if hypoxic

 e. Decreased intravenous fluids

Explanation:

At the end of life, dyspnea is a common, subjective finding. Treatment should not be based on objective data, such as oxygen saturation measurements or respiratory rate. Patients can experience dyspnea even with normal saturations and respiratory rate. Instead, treatment should be based upon subjective data, like patient-reported shortness of breath, a startled/anxious expression, or distressed appearance. First-line medical treatment of dyspnea is opioids. If that patient does not have concurrent pain, a lower dose (1/3-1/2 of the typical pain dose) can be used. Additionally, blowing air from a fan onto the face, decreasing intravenous fluids, and increasing the head of the bed or repositioning can provide comfort. If the patient is hypoxic, oxygen via nasal cannula or other non-invasive oxygen delivery mode may improve symptoms. Benzodiazepines may be helpful if there is a component related to anxiety, but should be used after having tried opioids. Vital sign monitoring is not necessary at the end of life, and management of dyspnea will be based off subjective findings or the patient experience rather than oxygen saturation monitoring.

1. A 9-year-old child with osteosarcoma is being admitted for cisplatin therapy. What is the best regimen for prevention of chemo-induced nausea and vomiting?
	1. Palonosetron and olanzapine
	2. Dexamethasone and aprepitant

\*c. Granisetron, dexamethasone at 50% dosing and aprepitant

1. Granisetron, dexamethasone at 100% dosing and aprepitant
2. Lorazepam, diphenhydramine, and scopolamine patch

Children ≥6 months old receiving HEC which is *not* known or suspected to interact with aprepitant receive granisetron or ondansetron or palonosetron + dexamethasone + aprepitant. When giving aprepitant, dexamethasone should be given at 50% dosing as both are CYP3A4 substrates. Olanzapine is not currently part of the guidelines for prevention of CINV. All regimens for low, moderate, and highly emetogenic chemotherapy include a 5HT3 inhibitor such as ondansetron, granisetron, or palonosetron. Lorazepam is useful for anticipatory nausea and vomiting, although a regimen containing lorazepam, diphendydramine, and scopolamine has multiple anti-histamine and anti-cholinergic agents without any serotonin (5HT3) antagonists or dopamine (D2) antagonists.

1. A 4-year-old child with acute lymphoblastic leukemia is receiving high dose methotrexate during interim maintenance. He receives ondansetron and aprepitant during his stay which control his nausea and vomiting well. These medications work by inhibiting signaling in which part of the brain?
	1. Vestibular system
	2. Cerebral cortex
	3. Hypothalamus
	4. Vomiting center

 \*e. Chemoreceptor trigger zone

High dose methotrexate in leukemia therapy (5g/m2) is considered moderately emetogenic chemotherapy. Since dexamethasone cannot be given in patients with leukemia as an anti-emetic, and the patient is > 6 months old, the patient is on the correct regimen of a 5HT3 inhibitor (ondansetron) and a NK1 inhibitor (aprepitant). Chemotherapy, metabolic products, drugs, and toxins stimulate nausea and vomiting through their effects on the chemoreceptor trigger zone. Blocking 5HT3 and NK1 occurs at the level of the chemoreceptor trigger zone and prevents further signaling to the vomiting center (receptors in the vomiting center being histamine (H1), m-acetylcholine, and 5HT2). Medications that have anti-dopaminergics (D2) activity such as olanzapine, haloperidol, and promethazine also work at the chemoreceptor trigger zone. The vestibular system is mediated through histamine and m-acetylcholine. These are relevant in children with motion sickness or labyrinth disorders. Medications that work at the level of the cerebral cortex are lorazepam (anticipatory nausea) and dexamethasone (increased intracranial pressure).

1. A 16-year-old with a L-sided pelvic osteosarcoma is taking extended release oxycodone twice daily as well as immediate-release oxycodone for breakthrough pain ~2-3 times per day. She describes her pain as burning, tingling, and shooting in her left leg. It is worsened with hot showers. Her most recent EKG has a QTc of 495. What would be the best strategy to manage her pain?
	1. Switch from long-acting oxycodone to methadone
	2. Recommend more frequent use of her immediate-release oxycodone.
	3. Add amitriptyline daily. Start low and work up on dose.

 \*d. Add gabapentin three times daily. Start low and work up on dose.

1. Add sertraline daily. Start low and work up on dose.

This patient has both nociceptive pain (from tumor/bony erosion) which is being managed with opioids, and neuropathic pain, likely due to nerve compression from her pelvic tumor. There are multiple classes of medications used to treat neuropathic pain such as gabapentinoids (Gabapentin, pregabalin), SNRIs (venlafaxine, duloxetine), TCAs (amitriptyline, nortriptyline), opioids (methadone), and other agents like lidocaine and ketamine. As her QTc is near 500, methadone and amitriptyline should be avoided as they could worsen the QTc prolongation. Sertraline is a SSRI (anti-depressant/anti-anxiolytic). SSRIs do not treat neuropathic pain like the SNRIs (duloxetine or venlafaxine). Using more oxycodone will probably cause more opioid-induced side effects but is not the best long-term management strategy for neuropathic pain. In this setting, adding gabapentin three times daily, and working up slowly to a weight-based dose or adult dose is the best strategy. Gabapentin does not cause QTc prolongation.