Chapter 1 : Endocrine and metabolic emergencies: thyroid storm

Authors Judith Toski Welsh, MD, Emergency Services Institute, Cleveland Clinic, Cleveland, OH Purva Grover, MD, FACEP, Emergency Services Institute, Cleveland Clinic, Cleveland, OH Core Content Outline: Inborn Errors of Metabolism Urea Cycle Defects Recognize the initial signs and symptoms of urea cycle defects Plan the management of acute life-threatening processes resulting from urea cycle.

PO, oral; IV, intravenous; q4â€”6h, every 4â€”6 hours; q6h, every 6 hours; q8h, every 8 hours; q4min, every 4 minutes; q15min, every 15 minutes; od, once daily; bd, twice daily. Thyroid-specific therapy The immediate goals when treating thyroid storm are to decrease thyroid hormone synthesis, prevent thyroid hormone release, decrease peripheral action of circulating thyroid hormone to reduce heart rate and support the circulation, and to treat the precipitating condition [Nayak and Burman,]. The therapeutic options for thyroid storm are the same as those for uncomplicated thyrotoxicosis, except that the drugs are given in higher doses and more frequently. An antithyroid drug i. PTU or carbimazole or methimazole can be used, but PTU was traditionally preferred because of its more rapid onset of action and the additional benefit of inhibition of peripheral deiodinase enzyme-mediated conversion of T4 into T3. PTU should be administered orally or via a nasogastric NG tube in the unresponsive patient with a loading dose of mg followed by a dose of â€” mg every 4â€”6 hours. Carbimazole or methimazole is administered at a dose of 20â€”30 mg every 4â€”6 hours. Both agents can be administered rectally if needed. As no head-to-head trial has demonstrated clear superiority of PTU over either carbimazole or methimazole in thyroid storm or thyrotoxicosis, where the latter agents are generally preferred over PTU , many experts now recommend using either carbimazole or methimazole in all thyrotoxic patients unless other compelling reasons exist for using PTU such as pregnancy , and achieving T4 into T3 conversion inhibition solely with beta-blockers and corticosteroids [Food and Drug Administration, ; Malozowski and Chiesa,]. Iodine should be administered at least 1 hour after the thionamide to block the release of preformed thyroid hormone. This apparent paradox makes use of the acute Wolffâ€” Chaikoff effect, whereby large doses of iodine suppress thyroid hormone release. The effect lasts for up to 2 weeks, because escape from this effect occurs and is therefore unsuitable as a long-term therapeutic option. The thionamide should be administered prior to iodine administration so as to prevent undesired tyrosine residue iodination and enrichment of thyroid hormone stores. The minimal time required between thionamide administration and iodine treatment is debated with 1â€”6 hours commonly prescribed. Iodine is administered in the various formulations, including saturated solution of potassium iodide SSKI 5 drops orally every 6â€”8 hours equalling mg iodide with 1 drop containing 50 mg iodide. Iapanoic acid, an iodinated contrast agent, although rarely available now, is effective at a dose of 1g IV 8-hourly for the first 24 hours of treatment followed by mg twice daily. Beta-blockade should be instigated immediately unless contraindicated so as to block the adrenergic consequences of thyroid hormone excess. Caution is warranted in patients with heart failure, although beta-blockade may be beneficial when tachycardia is a significant precipitant to decompensated cardiac function. Contraindications to propranolol use include a history of asthma or reversible chronic obstructive pulmonary disease COPD , and a cardiose-lective beta-blocker such as metoprolol or atenolol could be used in these patients. Alternatively, the calcium-channel blocker, diltiazem can be used at a dose of 60â€”90 mg orally 6â€—8-hourly or the appropriate dose by IV. If anticoagulation is required for atrial fibrillation or other indications , thyrotoxic patients are very sensitive to warfarin and should be monitored closely. Corticosteroids inhibit peripheral conversion of T4 into T3 and have been shown to improve outcomes in patients with thyroid storm. Adrenal axis dysfunction in the context of thyrotoxicosis of any degree is documented, and responds to exogenous steroid therapy. Hydrocortisone mg 6-hourly should be administered IV or IM and continued until resolution of the thyroid storm. Alternatively, dexamethasone 2 mg IV every 6 hours can be used. Treatment should be tapered appropriately based on the required duration of steroid therapy. Lithium carbonate, at a dose of mg every 8 hours, can be used when there is a contraindication or previous toxicity to thionamide therapy. Lithium inhibits thyroid hormone release from the gland and reduces iodination of tyrosine residues, but its use is complicated by the toxicity that can ensue. Potassium perchlorate

competitively inhibits iodide transport into the thyrocyte but has traditionally been associated with aplastic anaemia and nephritic syndrome. Several studies however have demonstrated its use when used over short periods in the treatment of amiodarone-induced thyrotoxicosis [Erdogan et al. A suggested dose is 1g daily and, similarly to iodide therapy, should be combined with a thionamide. Cholestyramine 4g orally two to four times each day has been used in the management of thyrotoxicosis due to reduced reabsorption of metabolized thyroid hormone from the enterohepatic circulation [Tsai et al. Thyroidectomy is occasionally employed in the management of thyroid storm refractory to medication [Nayak and Burman,], but is associated with a risk of storm exacerbation if preoperative thyroid hormone levels are high. Treatment of precipitating illness Management of thyroid storm should not disregard the search for and treatment of precipitating factors. An active search should be made for infection and antibiotics chosen on the basis of likely pathogens or microbial cultures. Other likely precipitants such as trauma, MI, DKA, and other underlying processes should be managed as per standard care. Maintenance therapy Through adequate rehydration, repletion of electrolytes, treatment of comorbid disease such as infection and the use of specific therapies antithyroid drugs, iodine, beta-blockers and corticosteroids , a marked improvement in thyroid storm usually occurs within 24â€”72 hours. Once haemodynamic, thermoregulatory and neurological stability has been achieved attention should switch to maintenance therapy. Escape from the Wollfâ€”Chaikoff effect is usually seen between 10 and 14 days after commencement of iodine therapy, and therefore continuation of iodine therapy beyond this point is unlikely to be beneficial and could exacerbate the situation. Furthermore, future treatment with radioactive iodine RAI is delayed if thyroid iodine stores are saturated. Corticosteroid therapy should be stopped as soon as possible, but beta-blockade should be used whilst the patient remains thyrotoxic. The antithyroid treatment should be continued until euthyroidism is achieved, at which point a final decision regarding antithyroid drugs, surgery or RAI therapy can be made. Emerging treatments Thyroid storm can occasionally be refractory despite the above measures, and other treatment options should be considered. Plasmapharesis, with removal of thyroid hormone, has been used successfully both in the thyrotoxic state and to prepare those with thyrotoxicosis for surgery [Ezer et al. Charcoal haemoperfusion has also been demonstrated to be useful in thyrotoxic states [Kreisner et al. There is great interest in the role of biological agents in treatment of immune-mediated thyrotoxic states. Conclusions Thyroid storm is a rare endocrine emergency but is associated with high mortality. Prompt recognition of the condition with timely intervention is crucial, and management of the patient in an AMU, high-dependency or intensive care unit is essential. Treatment is based on immediate blockade of thyroid hormone synthesis, prevention of the release of further thyroid hormone from thyroid stores, and alleviation of the peripheral effects of thyroid hormone excess. A search for a precipitant for the thyroid storm is critical and should be treated promptly. Maintenance therapy takes into account disease-specific factors and patient preference, with measures taken to prevent a recurrence of thyroid storm. Funding This article received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. Conflict of interest statement None declared. Therapeut Clin Risk Managem 6: N Engl J Med Endocrinol Metab Clin North Am J Clin Apharesis Philadelphia, PA Nayak B. Endocrinol Metab Clin N Am Clin Endocrinol Oxf

Chapter 2 : Hypercalcemia : Endocrine and Metabolic Medical Emergencies

Metabolic acidosis is defined as an increase in the [H +] of the blood as a result of increased acid production or bicarbonate wasting from the gastrointestinal (GI) or renal tract. The cause is often multifactorial and can be further classified into 'anion-gap' and 'non-anion-gap' (or hyperchloraemic) metabolic acidosis.

Pearls and Pitfalls Author: It is your last night shift of the month in the emergency department ED. So far, the night has been quiet until about 1: The nurses are working on obtaining a blood pressure. The infant appears mottled and has poor tone. You order laboratory work and attempt to remember pediatrics facts from medical school and residency training. In addition to the laboratory work, you obtain a lumbar puncture and four limb oxygen saturations and blood pressures, all of which are normal. Background Inborn errors of metabolism can be divided into four parts, based on the defect of a metabolic pathway. These separate parts include: Neonatal presentations correlate with an absence of or complete block of the metabolic pathway, while presentations later in life are usually due to a partial or incomplete blockage of the affected pathway. They often present with vomiting, tachypnea, gasping, altered mental status, and lethargy. Unfortunately, at this age, infants are unable to communicate and thus, making the diagnosis may be difficult. Usually, patients present in the setting of an acute stressor such as acute gastroenteritis or upper respiratory infection. Ultimately the diagnosis comes down to clinical suspicion. When should you suspect these disorders, and how can you definitively diagnose an inborn error? When should an inborn error of metabolism be suspected? The following situations should raise your suspicion of a metabolic disorder: Physical exam and laboratory findings that assist in the diagnosis may include organomegaly, abnormal tone, abnormal mental status, neutropenia, thrombocytopenia, hyperpnea, dysrhythmia, liver failure, cataracts, abnormal hair, and unusual rashes. If older patients have recurrent severe presentations in the setting of normally self-limited illnesses such as gastroenteritis, suspect an inborn error of metabolism. Metabolic emergencies S-Sepsis meningitis, pneumonia, urinary tract infection F-Formula mishaps under- or over-dilution I-Intestinal catastrophes volvulus, intussusception, or necrotizing enterocolitis T-Toxins S-Seizures When evaluating an infant you are concerned for an inborn error of metabolism, several steps should be taken. If the patient needs airway protection, address this first. At times, these patients have been tachypneic for an extended period to compensate for a metabolic acidosis, and thus, they may soon tire. Thus, patients may require mechanical ventilation. In addition, these patients are often volume depleted due to vomiting, diarrhea and insensible losses from tachypnea, so a fluid bolus will be beneficial. Ensure blood glucose testing is obtained, as most patients will be hypoglycemic. Look for signs of infection and rash when you expose the patient. Important laboratory tests include a venous blood gas VBG , electrolytes, a complete blood count CBC , a renal function panel, a urine dipstick, an ammonia level, ketones, lactate, and liver function LFTs testing. In the setting of a sick neonate, an ECG, chest X-ray, four limb oxygen saturations, blood pressures, blood cultures, and a lumbar puncture should also be obtained. A sick neonate may have an ammonia level around 80, however this is not necessarily consistent with an inborn error of metabolism. If a tourniquet is used for blood collection, hemolysis can occur and lead to falsely elevated ammonia levels as well. Hypoglycemia may be present, though this is usually a later finding. CBC may show neutropenia. Most pediatric critical care physicians will want these labs drawn before glucose is provided, as these tests will help definitively diagnose the mechanism and condition. These tests will not return quickly and in this setting, it may be helpful to ask the inpatient physicians what additional laboratory tests should be drawn in the ED. Make sure that the patient is nothing by mouth NPO as it is essential to remove protein sources from the diet as soon as possible. Finally, in conjunction with the inpatient physicians, consider removing the toxin and metabolites. Dialysis is also an option to assist in removal of the toxin s. If a neonate is seizing, pyridoxine at 1mg intramuscularly IM should be given. Importantly, the above treatments should be given after consulting with the pediatric intensive care team. Call the pediatric intensive care unit PICU as soon as possible to discuss the patient, testing, and management. A genetics and or metabolism consultation can also assist in correct testing and management. Finally, nephrologists can be helpful if dialysis is necessary for refractory hyperammonemia. In fact, early dialysis in these patients is associated with improved neurologic

development as well as improved morbidity and mortality. Presentation of inborn errors of metabolism occurs in two different phases of life: Obtaining a CBC, VBG, renal function panel, LFTs, ketones, ammonia level, lactate, and urinalysis are the most important tests to obtain during initial assessment Stop toxin metabolism, stop catabolism, provide glucose, and remove the toxin. Consult the PICU, genetics, and nephrology as early as possible. Inborn errors of metabolism of acute onset in infancy. Initial assessment of infants and children with suspected inborn errors of metabolism. Emerg Med Clin North Am. Inborn errors of metabolism in infants: Pediatr Emerg Med Rep. Inborn errors of metabolism. Clinical approach to inherited metabolic disorders in neonates: Textbook of Pediatric Emergency Medicine. Investigation and initial management of suspected metabolic disease. Inborn errors of metabolism in infancy: The emergency department approach to newborn and childhood metabolic crisis. Ammonia clearance by peritoneal dialysis and continuous arteriovenous hemodialysis filtration.

Chapter 3 : Metabolic emergencies | Clinical Gate

Inborn errors of metabolism (IEM) can present as acute metabolic emergencies resulting in significant morbidity, progressive neurologic injury, or death. As a result, optimal outcome for children with IEM depends upon recognition of the signs and symptoms of metabolic disease, prompt evaluation, and.

Immediate access to this article To see the full article, log in or purchase access. Address correspondence to Mark L. Reprints are not available from the authors. The opinions and assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the U. Army or the U. Army Service at large. Hematologic and oncologic emergencies. Doing the most good in the least time. Neurologic complications of systemic cancer [Published correction appears in Am Fam Physician ; Kattlove H, Winn RJ. Ongoing care of patients after primary treatment for their cancer [Published correction appears in CA Cancer J Clin ; CA Cancer J Clin. Rhodes V, Manzullo E. Oncologic emergencies for the internist. Cleve Clin J Med. Gucalp R, Dutcher J. Accessed March 9, , at: Biology of osteoclast activation in cancer. American Society of Clinical Oncology clinical practice guidelines: Superior vena cava syndrome. Clinical features and diagnosis of epidural spinal cord compression, including cauda equina syndrome. A randomized comparison between rasburicase and allopurinol in children with lymphoma or leukemia at high risk for tumor lysis. Hypercalcemia associated with cancer. N Engl J Med. Its metabolic basis, signs, and symptoms. Diseases of Bone and Calcium Metabolism. Zoledronic acid is superior to pamidronate in the treatment of hypercalcemia of malignancy: Long-term efficacy and safety of zoledronic acid compared with pamidronate disodium in the treatment of skeletal complications in patients with advanced multiple myeloma or breast carcinoma: Bisphosphonates for breast cancer. Cochrane Database Syst Rev. The evolution of the empirical management of fever and neutropenia in cancer patients. Risk assessment in cancer patients with fever and neutropenia: Outpatient therapy with oral ofloxacin for patients with low risk neutropenia and fever: Randomized trial of oral versus intravenous antibiotics in low-risk febrile neutropenic patients with lung cancer. Jpn J Clin Oncol. Medical management of medical disease. The Washington Manual of Medical Therapeutics. Steroids, radiotherapy, chemotherapy and stents for superior vena caval obstruction in carcinoma of the bronchus. American College of Chest Physicians. Indications for emergent MRI of the central nervous system. The diagnosis and treatment of metastatic spinal tumor. Yamada KA, Awadalla S. Acute spinal cord dysfunction. Effect of high-dose dexamethasone in carcinomatous metastatic spinal cord compression treated with radiotherapy: High incidence of serious side effects of high-dose dexamethasone treatment in patients with epidural spinal cord compression. Long-term results of intrapericardial chemotherapeutic treatment of malignant pericardial effusions with thiotepa. The management of extravasation injury in neonates.

Chapter 4 : Endocrine and metabolic emergencies: hypercalcaemia

Life-threatening metabolic complications observed in cancer patients are: hypercalcaemia, hyponatremia, hyperurcaemia, tumour lysis syndrome, hypoglycaemia, hyperuremia and hypercreatininemia secondary to renal failure, hyperammoniemia, lactic acidosis and adrenal failure.

Open in a separate window PTH, parathyroid hormone. Hypercalcaemia secondary to malignancy usually presents in the context of advanced clinically obvious disease. Many solid tumours are associated with hypercalcaemia and include squamous cell carcinomas of the lung, head, neck and oesophagus, renal cell carcinoma and breast carcinoma. Humoral-mediated bone resorption accounts for the majority of hypercalcaemia in these malignancies even when lytic metastatic bone disease is present. Finally, haematological malignancies such as multiple myeloma can be associated with hypercalcaemia via locally produced osteolytic peptides i. A number of administered drugs can cause hypercalcaemia. Thiazide diuretics reduce renal calcium excretion and mild hypercalcaemia is frequently seen. The effect of lithium is discussed above. Calcium supplementation rarely causes hypercalcaemia if normal physiological mechanisms of calcium regulation are intact. In milkalkali syndrome, a high intake of milk or calcium carbonate used to treat dyspepsia or more commonly now osteoporosis may lead to hypercalcaemia mediated by the high calcium intake plus metabolic alkalosis, which augments calcium reabsorption in the distal tubule. Hypercalcaemia in the context of vitamin D intoxication is well recognised but rare [Holick,]. Prolonged immobilization may be associated with hypercalcaemia due to a marked increase in bone resorption. Patients with underlying high bone turnover states are at particular risk [Shoback et al. Finally, a number of endocrinopathies are associated with hypercalcaemia. Hypercalcaemia in thyrotoxicosis is postulated to be secondary to increased bone resorption [Igbal et al. Albumin levels should therefore be considered when assessing hypercalcaemia, although most laboratories now provide a corrected calcium level. Severe hypercalcaemia, suspected clinically or detected biochemically, should prompt immediate treatment. The first step in the evaluation of hypercalcaemia is to establish whether the process is PTH dependent. Other tests include measurement of serum creatinine, hydroxyvitamin D, thyroid function, serum electrophoresis and urinary Benceâ€”Jones protein, and bone markers such as alkaline phosphatase as soon as possible to direct specific treatment. PTHrP can be assayed in many laboratories but adds little to the management if malignancy-associated hypercalcaemia is suspected, especially if PTH levels are suppressed. Assessment of 1,dihydroxyvitamin D is only required if the patient is on synthetic versions, or has a confirmed or suspected diagnosis of granulomatous disease or lymphoproliferative disorders. PTH is an unstable peptide and therefore blood samples should be delivered to the laboratory promptly. It should be remembered that PHPT is a common condition and is therefore occasionally the cause of hypercalcaemia in patients with concurrent cancer [Stewart,]. Other investigations should be directed by the clinical situation and include electrocardiogram ECG and imaging tests as required. Clinical signs and features The symptoms and signs of hypercalcaemia predominantly relate both to the volume contraction that accompanies this finding, and the neuromuscular dysfunction that occurs. Aside from underlying specific features e. Acute hypercalcaemia strongly favours a diagnosis of neoplastic disease, although sudden volume contraction secondary to diarrhoea, vomiting, surgery or immobilization can dangerously exacerbate pre-existing hypercalcaemia. As a consequence of hypercalcaemia induced nephrogenic diabetes insipidus, the initial symptoms relate to polyuria and the resultant adaptive increased thirst. Neurological dysfunction, secondary to the central neuronal depressant effect of increased calcium, is prominent and may manifest as confusion, drowsiness, agitation, stupor or coma. Myopathy is occasionally seen. Hypertension as a consequence of calcium-mediated vasoconstriction can occur in chronic disease [Ayuk et al. Bradyarrhythmias or heart block are frequently seen in severe hypercalcaemia, however, and relate to detrimental effects on the cardiac action potential as a consequence of increased extracellular calcium. Gastrointestinal symptoms resulting in part from smooth muscle hypotonicity include constipation, nausea, anorexia, vomiting and abdominal pain, and are often severe. Renal stones and pancreatitis can occur. The term hypercalcaemic crisis is frequently used to describe the severely

compromised patient with profound volume depletion, altered sensorium which may be manifest as coma, cardiac decompensation and abdominal pain that may mimic an acute abdomen. The diagnosis of hypercalcaemic crisis can sometimes be difficult to make clinically when associated with malignancy. This is because the patient may already be debilitated, anorexic, nauseated, constipated, weak or confused, from the underlying malignancy, concurrent medications, complications of chemotherapy or radiotherapy, as well as comorbid disorders. Clinical vigilance is crucial in this setting to prevent unnecessary morbidity and mortality. Acute intervention Once severe hypercalcaemia is recognized, the patient should be managed in an appropriate location such as an Acute Medical Unit AMU , high-dependency area or intensive care unit. As with all acute medical patients, prompt assessment and management of the ABCDEs should occur airway; breathing; circulation; disability, i. In malignancy-related severe hypercalcaemia it may be appropriate to adopt a palliative approach that will emphasize comfort cares and symptom control. General supportive care The cornerstone of acute management of hypercalcaemia is fluid resuscitation with correction of the volume state. As described above, hypercalcaemia potently induces a diuresis, and the subsequent volume contraction and reduction in GFR compounds renal calcium clearance. Appropriate fluid administration should depend on an assessment of volume depletion, but in most situations of hypercalcaemic crises â€" ml of 0. This regimen should be continued for several days. Whilst historical approaches advocated the use of loop diuretics e. However, loop diuretics do have a role in those patients where vigorous fluid resuscitation may provoke cardiogenic fluid overload. In these situations, once euvolaemia has been attained, aggressive fluid administration i. In most circumstances this can be achieved by inducing a forced diuresis of 2. Potassium and magnesium levels should be cautiously monitored whenever furosemide is used, and replaced appropriately if required. Central line insertion with central venous pressure CVP measurements should be considered in patients where external features of fluid state are difficult to assess, or in those who poorly tolerate initial attempts at aggressive fluid administration.

Chapter 5 : Treatment of Oncologic Emergencies - - American Family Physician

An uptodate wiki with core topics in pediatric critical care medicine, summaries of key articles, useful clinical references, and board-type questions.

Chapter 6 : Oncologic Emergencies

Metabolic diseases can vary as much in clinical presentation as they can in classification, and neonates and infants frequently present with symptoms similar to those seen with other emergencies.

Chapter 7 : Metabolic Emergencies - LearnPICU

Metabolic emergencies Creator: Frits Holleman While much of the treatment of diabetes focusses on the avoidance of long-term complications in an outpatient setting, hospitalisation of diabetes patients frequently is the result of a metabolic emergency.

Chapter 8 : Evidence-Based Management Of Metabolic Emergencies In The Pediatric Emergency Departm

Life-threatening metabolic complications observed in cancer patients are: hypercalcaemia, hyponatremia, hyperurcaemia, tumour lysis syndrome, hypoglycaemia, hyperuremia and hypercreatininemia.

Chapter 9 : Metabolic Emergencies | Clinical Gate

The management of metabolic emergencies in the pediatric population is challenging for the emergency clinician because it requires in-depth knowledge of a broad range of conditions. Some children may present with a metabolic

complication resulting from a serious illness such as sepsis.