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Neurological, Digestive, and Nephrological Emergencies in Pediatric Medicine

Dr. David Tomasi¹

Introduction

A precise overview of pediatric emergencies would require taxological considerations around the differences between strictly neurological factors, as modulated both via neuroanatomical differentiation in the context of normal vs. abnormal biological development, and underlying neurofunctional mechanisms, and the connection with such processes with the neuromodulated activation of digestive processes. Furthermore, an important distinction between nephrological considerations and urological considerations is necessary, more specifically, by focusing on the treatment of diseases affecting the kidneys and their ability to function in the first case, and on the treatment of diseases affecting the urinary tract in the latter. In this paper, we will present a general overview of the most important aspects of each category, starting with the brief description of neurological emergencies as indicating a general (system-based vs. localized) deterioration of mental capacity, with added possible partial or full loss of cognitive capacities and/or impaired perceptual modalities and consciousness, with or without response to stimuli.

Focus and Main Objectives

The main scope of this review is to determine, on the basis of the current scientific literature in each of these areas, general guidelines in neurological, nephrological, urological and digestive emergencies, to be utilized by medical-clinical professionals. Furthermore, we will examine the most appropriate parameters for diagnosis in the event of neurological, urological, and digestive emergencies such as headaches vs. migraines, epileptic vs. non-epileptic paroxysmal disorders, medication-induced vs. non-medication-induced urinary tract infections (UTIs), intestinal hemorrhages / bleeding, and nephrotic syndrome.

Keywords

Pediatric Medicine, Human Development, Pediatric Disorders, Neurology, Gastroenterology, Urology, Nephrology

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General Considerations – NS

To begin our analysis, we will first investigate the most frequent primary glomerulopathy in Pediatrics, i.e., Nephrotic Syndrome, or NS. This term indicates a wide array of symptomatologic vs. clinical presentations including endocrine disorders and glomerular diseases characterized by proteinuria (>40 mg/m²/h), hypoalbuminemia (<2.5 g/dl), edema, and dyslipidemia. Proteinuria is the clinical sign of podocytopathy causing a specific loss of selective permeability of the glomerular filtration barrier to the passage of proteins via the glomerular capillary wall. Idiopathic Nephrotic Syndrome is a homogeneous entity from the clinical point of view. However, the evolution, renal histology and response to treatment cover a wide spectrum of possibilities, so that patients can show great differences in terms of prognosis, treatment, and risk of chronic kidney disease. The challenge for the pediatric nephrologist is to examine the beneficence vs, non-maleficence (i.e., risk factor analysis) between the risk inherent in the disease and the benefit of individualized therapy in each case. According to the etiology we can classify NS types as: Primary NS, or idiopathic, genetic and congenital; Secondary NS, or glomerulonephritis, collagen IV nephropathy, systemic diseases, infectious diseases, thrombotic microangiopathies, neoplasms, drugs. Furthermore, the etiology of genetic NS is biologically based on mutations in podocyte proteins and occurs from the fetal period to adult life. Congenital nephrotic syndrome is defined by the age of presentation (children under one year of age), most of which are genetic in origin. Genetic NS is defined by the presence of genetic mutations in patients with isolated steroid-resistant NS, which is generally early and severe, although it can occur at any age. Syndromic NS with genetic mutations present NS associated with characteristic malformations. From a strictly diagnostic standpoint, physical examination will rule out syndromic NS due to extrarenal features. A study of renal function, lipidogram, thyroid function, coagulation, blood count and immunoglobulins will be carried out to

evaluate secondary alterations, as well as viral serology, complement and autoimmunity study to rule out secondary NS. Genetic study is indicated in congenital, steroid-resistant, and familial NS. Renal biopsy is not essential for diagnosis but offers valuable prognostic information in selected cases. In the area of medical treatment, we can essentially address the importance of corticosteroids, indicated at the first manifestation in all patients, except in congenital, inherited vs. family history-related (the current scientific literature suggests that genetic, syndromic, and inherited NS in general do not respond to treatment), and syndromic NS. Immunosuppressants are indicated in cases of resistance, dependence or secondary effects of corticosteroids, the drugs with the best results and safety profile being cyclophosphamide (CFM), calcineurin inhibitors (cyclosporin [CsA] and tacrolimus [TAC]) and mycophenolate mofetil (MMF). Within steroid-dependent NS treatment, the main objective is to reduce the number of relapses, prolong the remission period and minimize drug toxicity. Some patients can maintain remission with low doses of alternating PRD (<0.5 mg/kg) for 1-2 years. However, in the event of side effects or recurrence of relapses, in our experience oral CPM is the first drug of choice, reconsidering this option in children at risk of therapeutic failure or toxicity: children under three years of age, FHS, severe steroid dependence and preadolescents. Focusing next on steroid-resistant NS treatment, the main clinical direction is to obtain a complete or partial remission of proteinuria to reverse or slow down the progression to kidney failure. Its poor prognosis, left to spontaneous evolution, justifies immunosuppression, except in NS with genetic mutations, where, in general, it is not effective. Initial immunosuppressive therapy is based on pulses of IV methylprednisolone (MP) and/or oral CPM associated with PRD, with no comparative efficacy studies.

Clinical Presentation of Pediatric UTIs

In any examination of Urinary tract infection (UTI), we have to refer to the scientific literature analyzing the important factors, both in terms of causation and added comorbidities resulting from the combination of pre-existing forms of UTI and pharmacological interventions for the treatment of other medical problems, including, most importantly, psychiatric symptoms. From the perspective of Pediatric Medicine, UTIs are among the most frequent bacterial infections in pediatrics, since 8-10% of girls and 2-3% of boys will have a symptomatic UTI before the age of seven, being more frequent in males in the first three months of life and producing a progressive increase with a predominance of girls after one year of life, with a high probability of recurrence (>30%) due to reinfections with germs other than the first manifestation, especially during the first year after the initial episode. The general symptomatology of UTI can be classified into those that affect the renal parenchyma and those that do not. A UTI is considered recurrent if there are two or more episodes of acute pyelonephritis (APN), one episode of APN and one or more episodes of cystitis, or three or more episodes of cystitis during a year. From a diagnostic standpoint, in all children with suspected urinary tract infection, information should therefore be collected on the following risk factors for UTI and/or underlying pathology: a) Poor urinary flow and/or bladder distention, b) Lower urinary tract dysfunction and/or constipation, c) History suggestive of previous UTI or confirmed previous UTI, d) Recurrent episodes of fever of unknown cause. Furthermore, important elements should also be considered in the areas of prenatal diagnosis of nephrological-urological malformation. Family history of VUR or chronic kidney disease, and pondostatural retardation. When performing physical examination, it is necessary to keep in mind that we take into account different circumstances that may be present in a child with UTI. High blood pressure, positive renal fist percussion, existence of pain or presence of masses with abdominal palpation, may be symptoms of

UTI. On the other hand, it will be necessary to observe spinal injuries and appreciate alterations in the external genitalia. From a pediatric emergency perspective, especially in the context of ER admission, when determining whether a child with UTI should be admitted or not, we must take into account different presentations and issues. It is thus very important to know the existence of fever or analytical results suggestive of pyelonephritis. In the same way, we must assess the possible systematic repercussion, renal alterations, the immediate start of antibiotic therapy, treatment and follow-up. Furthermore, among general admission criteria we should include the presence of some of the following parameters: Age (less than three months, due to the risk of bacteremia and urinary sepsis); History of immunodeficiency; Affectation of the general condition and/or septic appearance; Malformations of the urinary system. Intolerance to medication or oral feeding; Electrolyte disturbances or renal function. Antibiotic (oral) treatment of UTI is recommended for children with a presumptive diagnosis of UTI after acquisition of an appropriate sample for culture. The recommended treatment duration for febrile UTIs is 10-14 days. In patients with afebrile urinary tract infection, short treatment regimens lasting 3-5 days are acceptable (except for recurrent episodes or in children under two years of age, where 7-10 days are recommended). While the current scientific literature in the area of symptomatologic treatment is still not yielding clear evidence to support this clinical therapeutic routine, corticosteroids and non-steroidal anti-inflammatory drugs have also been utilized.

Child Headache vs. Migraine

Migraines and Headaches are often a common reason for consultation in pediatric patients, both in the ER and in PCP primary care. Child Headaches are generally defined as pain or discomfort referred to the head, originating in cranial structures or radiating to them. From a clinical assessment perspective,

one of the first processes that the medical practitioner ought to perform, is to determine if it is a benign pathology or if there is a serious neurological process. The diagnosis of headaches is usually clinical. Analgesic treatment is fundamental in clinical crises, although in the case of migraines it is important to consider prophylactic treatment as well. While in the general population there might be some confusion, both in terms of overall diagnostic considerations and clinical (empirical) presentations between general headaches and migraines, a useful guideline is represented by the Rothner classification, which differentiates headaches based on their chronological evolution: a) Treble - These are headaches lasting less than 5 days and without a history of previous headaches; b) Recurring, acute - Headache attacks that recur periodically, with symptom-free intervals; c) Non-progressive, chronic - Headaches that last more than 15-30 days with similar frequency and intensity of episodes, stable, with no abnormal neurological signs; d) Progressive, chronic - Headaches that last more than 15-30 days with a daily-weekly frequency, with increasing intensity and the presence of abnormal neurological signs; e) Mixed – As the name implies, the combination in the same patient of several headache patterns. In the areas of diagnosis and treatment, a thorough clinical history is the fundamental element (particularly in comparison to complementary tests and bloodwork) to arrive at the diagnosis of a headache. It is necessary to identify if the headache is of primary or secondary cause, so symptoms and warning signs that suggest secondary headaches should be sought. Anamnesis is possible and should be carried out with the child himself without disregarding his ability to transmit the symptoms, considering a series of factors such as personal history of vomiting and cyclic abdominal pain, dizziness, recurrent fever, etc. Family history of headaches and type of the same epilepsy and psychiatric diseases. Characteristics of the headache, more specifically type, time and periodicity (i.e., chronological development/evolution of the issue), frequency and duration of the episode, location, accompanying symptoms, as well as

triggering or co-causal factors. Other important areas to consider include the so-called migraine phenomena related to the aura, as well as visual disturbances of the aura. Of course, the medical scientist and practitioner should also take into clinical-evaluation consideration a series of criteria which indicate that the child should be admitted to the hospital. Thus, admission will be decided if we suspect potential seriousness or if the general condition is not good and, in addition, in the cases of CNS infection, Status migrainosus. Neurological deficit, Uncontrollable vomiting, Severe intensity and refractory headache. Moderate and severe TCE, and HTE syndrome. Following diagnostic confirmation, it is necessary to reassure and explain to the patient the nature of the disorder and inform them about the different therapeutic alternatives available. In any case, scientifically informed clinical treatments for child headaches include: a) General measures, i.e. preventive medical evaluations, including a healthy life with a balanced diet, proper sleep hygiene, and avoiding stress, alcohol and certain foods that can trigger crises, as well as physical exercise. If it is an acute episode, it is recommended to rest in a quiet, dark and quiet environment; b) Treatment of the acute phase, which must be established quickly, since the longer the headache lasts, the more difficult it is to suppress it. It should be individualized for each patient based on the child's headache pattern, her pain tolerance, and her lifestyle; c) Prophylactic treatment, indicated in migraine headaches when there are more than 2 to 5 crises per month. The duration of this type of treatment will be from 3 to 6 months, with a progressive withdrawal and subsequently evaluating the frequency of the episodes.

Child Non-epileptic Paroxysmal Disorders

The medical acronym NPDS defines sudden episodes of short duration and spontaneous recovery from baseline, caused by a brain dysfunction other than an abnormal and synchronous discharge of a neuronal group (non-epileptic origin). Diagnostic errors must

be avoided due to therapeutic, social, and economic implications. They are usually benign, and for their correct differential diagnosis it is necessary: a) Detailed anamnesis of the patient and any companion who witnessed the episodes, with a time interval as short as possible, to obtain a greater wealth of details and avoid forgetfulness; b) Personal history: heart disease, neurological or metabolic diseases, and history/examination of pharmacological background, including medications, other drugs, and supplements; c) The possibility of a Neurological examination yielding normal parameters. The diagnosis is thus fundamentally based on clinical criteria, but could be further corroborated by the inclusion of complementary tests such as Neurophysiological tests, Cardiological tests, Structural neuroimaging tests, and comprehensive Blood work. While we recommend a thorough review of the current scientific literature in the area of classification and related treatment procedures (especially in regard to the specific presentations in each age group), Non-epileptic paroxysmal disorders can be classified based on their etiology, their age of presentation or the mechanism of production, more specifically: a) Syncope - Transient and brief loss of consciousness and postural tone. They can be neurally mediated (vasovagal, situational, due to hypersensitivity of the carotid sinus or associated with glossopharyngeal neuralgia), due to orthostatic hypotension, cardiac cause (obstruction of blood flow or arrhythmias) or other etiologies (metabolic, psychiatric, subclavian steal syndrome, etc.), b) Transient ischemic attacks - These are focal and transient perfusion deficits (generally lasting less than one hour), with greater clinical variability than epileptic seizures. They usually occur in patients with vascular risk factors. The symptoms are often motor or sensory, but if they affect the vertebrobasilar territory, they can be accompanied by loss of consciousness; c) Periodic leg movements - Involuntary movements of the lower limbs (tonic contractions of longer duration than myoclonus, periodically every few seconds; may be accompanied by clonic jerks), leading to sleep little repairing. They are referred by

the bed partner or constitute polysomnographic findings. They can appear in isolation or associated with pathologies (insomnia, restless legs syndrome, narcolepsy, fatal familial insomnia, or drugs).

Gastrointestinal considerations

In any examination of pediatric disorder and risk factors, particularly from the perspective of proper diagnostics and clinical interventions, gastrointestinal bleeding is among the most important medical issues we should investigate in children. More in detail, digestive tract bleeding is an important reason for consultation in Pediatric Emergency Services. Most of the entities that cause gastrointestinal bleeding usually do not require surgical treatment, nor do they lead to hemodynamic instability, since they are not massive hemorrhages, but despite this, they generate concern for parents and pediatricians. For this reason, a systematic approach to the different diagnostic and therapeutic options is essential. The causes of gastrointestinal bleeding in children are numerous, its etiology is usually benign and varies according to age, which is a fundamental fact to consider for diagnostic guidance in this process. From the clinical perspective gastrointestinal bleeding can present itself in a variety of forms, more specifically: a) Hematemesis or vomiting blood, i.e., fresh blood with clots or in "coffee grounds" if the patient had suffered the effects of gastric juice; b) Hematochezia or rectal bleeding, i.e., right red or brown blood from the rectum. It can be mixed with feces or independent of them; c) Fecal occult blood, i.e., small intermittent or continuous leaks only detectable by laboratory method; d) Melaena, i.e., lack, foul-smelling, thick, shiny stools on a dark red background. It can persist up to a week after bleeding. They indicate upper gastrointestinal bleeding. A proper diagnosis evaluation must be carried out following a 4-elements diagnostic protocol: Assessment of the patient's clinical situation. The immediate evaluation of the hemodynamic situation of a patient with gastrointestinal bleeding constitutes the first action in the diagnostic

study, paying special attention to the presence of signs of shock or anemia. Vital signs should be measured with the patient lying down and standing to detect orthostatic changes. Tachycardia is the most sensitive indicator of acute and severe hemorrhage. Confirmation of gastrointestinal bleeding. The next step in the diagnostic study is to confirm that it is a frank digestive hemorrhage, so other processes that can mimic a digestive hemorrhage and that are extra-digestive must be ruled out, such as: hemoptysis or epistaxis, swallowing of maternal blood in children breastfed, tooth extractions, recent adenotonsillectomy, pharyngitis, or hematuria. Location and characteristics of bleeding. Hematemesis leads us to a lesion proximal to the angle of Treitz. Melena indicates significant blood loss, also from the upper digestive tract (>2% of blood volume), although on rare occasions, non-massive lesions proximal to the ileocecal valve (if there is slow transit) may manifest as melena. Bacteria from the intestinal flora can oxidize hemoglobin in the distal portions of the small intestine and colon, giving the stool a melena appearance. Determination of the cause of the hemorrhage. A detailed history and physical examination, accompanied by limited laboratory studies, can identify the cause and predict the severity of GI bleeding. It is important to take into account the most frequent causes according to the age of the child and the syndromes associated with digestive bleeding. Finally, treatment procedures will depend on the clinical situation, the amount and location of the bleeding and the therapeutic possibilities that exist based on the established diagnosis. In clinical cases in which hemodynamic instability is confirmed after the initial evaluation (an increase of 20 beats/min or a decrease of 20 mmHg in BP represents a loss between 10-20% of volemia) or shock, initial treatment in an Intensive Care Unit will be necessary. However, on many occasions, and until the transfer of the patient to said unit, the first actions are carried out in Hospital/clinic Emergency Rooms, more in detail maintenance of adequate oxygenation; 2-way pipeline, blood draw for testing; rapid volume expansion, initially with isotonic fluids until blood products are available; correction of

electrolyte and metabolic disturbances. Furthermore, gastric lavage catheterization is performed with physiological saline solution at room temperature. Cold physiological saline is contraindicated because it can cause a prolongation of the prothrombin time, hypothermia and a decrease in mucosal oxygenation. Specific treatments are appropriate for Low digestive bleeding, and for Upper gastrointestinal bleeding (moderate or persistent bleeding), endoscopy can be used as a diagnostic and therapeutic method, in which case bipolar electrocoagulation or heat probe is used.

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