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خاص بطلبة كليات الصيدلة /المرحلة الخامسة

(تدريب مستشفيات / ردهة الأطفال)

إعداد

فرع الصيدلـــــــة السريـــــــريـــــــة

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Age Group Terminology

Premature	**Birth before 37 completed weeks gestation**
Neonate	**0-4 weeks**
Infant	**1month-1 year**
Child/children	**1-12 years**
Adolescent	**13-18 years**
Adult	**>18 years**

A-Neonatology

1-Hyperbilirubinemia in the Newbornb (Neonatal Jaundice)

Background

1-Bilirubin is derived primarily **from the breakdown of heme in the reticuloendothelial system**. Nonpolar and water-insoluble unconjugated bilirubin is conjugated inside liver cells to form Water-soluble conjugated bilirubin [(1)].

2-Most conjugated bilirubin is excreted through the bile into the small intestine and eliminated in the stool. Some bilirubin may undergo hydrolysis back to the unconjugated fraction by intestinal glucuronidase, and may be reabsorbed (**enterohepatic recirculation**) [(2)].
3- Nearly all newborns develop transient hyperbilirubinemia (serum bilirubin >2 mg/dL) and nearly 65% (two third) are clinically jaundiced (serum bilirubin>5 mg/dL) [(1)].
4-Onset of jaundice in the **first 24 hours of life is always pathological** [(3)].

5-Kernicterus **(Bilirubin Encephalopathy)** results when indirect **(unconjugated)** bilirubin is deposited in brain cells and disrupts neuronal function [(2)]. Kernicterus usually does not develop in term infants when bilirubin levels are less than 20 to 25 mg/dL. **The incidence of kernicterus increases as serum bilirubin levels increase to greater than 25 mg/dL** [(2)].
6-Kernicterus may be noted at bilirubin levels less than 20 mg/dL in the presence of some conditions like **sepsis**, **meningitis**, and prematurity [(2)].

Unconjugated hyperbilirubinemia

1-Nonpathologic unconjugated hyperbilirubinemia

A-Physiologic Jaundice

1-Physiologic jaundice is **an unconjugated hyperbilirubinemia that occurs after the first postnatal day and can last up to 1 week**. Total serum bilirubin (TSB) concentrations peak in the first 3 to 5 postnatal days and decline to adult values over the next several weeks [(4)].
2-The underlying mechanisms for physiologic jaundice in newborn are related to:

(a) **Increased bilirubin production** because of elevated red blood cell volume per body weight and a shorter and shorter life span [2, 4].
(b) **Infants have immature hepatic glucuronosyl transferase**, a key enzyme involved in the conjugation of bilirubin [4].
(c) **Increased enterohepatic circulation** in newborn [2].

B-Breast milk jaundice

1-It occurs in some breast-fed infants because **breast milk may contain an inhibitor of bilirubin conjugation or may increase the enterohepatic recirculation of bilirubin because of breast milk glucuronidase** [2].

2-Jaundice appears in the **seventh** day and it **gradually increased in severity** till it reaches its peak during third week [5]. It may persists for several weeks [5].
3-**Interruption of breast feeding and use of formula feeding for 1–3 days causes a prompt decline in bilirubin**[1] (which do not increase significantly after breastfeeding resumes) [2] but is only recommended for infants with serum bilirubin concentrations that put them at risk for kernicterus [1].

C-Breast feeding jaundice

1-Breastfeeding jaundice occur when a breastfeeding baby **is not getting enough breast milk** , which leads to infrequent bowel movements and increased enterohepatic circulation of bilirubin. It occurs during the first week of life) [6, 7].

2-**Water and dextrose solutions should not be used** to supplement breastfeeding because they do not prevent hyperbilirubinemia and may lead to hyponatremia [4].

D-Prematurity.

1-Although preterm infants develop hyperbilirubinemia by the same mechanisms as term infants, **it is more common and more severe in preterm infants and lasts longer** (due to the relative immaturity of the red blood cells, hepatic cells, and gastrointestinal tract) [4].

2-Kernicterus is extremely uncommon. However, kernicterus in preterm infants can occur at lower TSB concentrations [4]. (see Kernicterus).

2-Pathologic Unconjugated Hyperbilirubinemia.

A-Acute Hemolysis:

In this condition, jaundice appears at birth or during the ***first day*** and it is commonly severe. Serum bilirubin level may rise rapidly to reach serious levels where kernicterus may occur.
Kernicterus is a real risk and it may occur when serum bilirubin exceeds the critical level, which depends on the birth weight and the condition of the baby. The critical level is lower in those with low birth weight and in sick neonates [5].

The cause of haemolysis can be identified by clinical and laboratory evaluation.

1-Rh incompatibility:

- It is the ***commonest*** cause of hemolysis. **It occurs in some Rh positive babies born to Rh negative mothers**. Hemolysis occurs due to placental passage of maternal antibodies active against the fetal red cells. The ***first baby*** is usually not affected as maternal sensitization usually occurs during delivery of the first baby [(5)].

- Rh incompatibility can be prevented by injection of ***Rh immune globulin to the mother within 72 hours after delivery*** which prevents her from forming antibodies which might affect subsequent babies [(5)].

2-ABO incompatibility:

ABO incompatibility may occur if the **mother's blood type is O** and **the infant's blood type is A or B** [(4)]. The ***first baby*** may be affected. ***Jaundice*** is not severe. ***kernicterus*** is rare. [(5)].

B-Neonatal septicemia:

1-Jaundice in septicemia, if present, usually appears between the ***fourth and seventh day*** or later and is usually moderate in severity [(5)].

2-The most important clinical signs are the markedly affected ***general condition(***The baby is not doing well with lethargy, poor suckling, fever or hypothermia, ...). Immediate hospitalization and combined parenteral antibiotic therapy are important [(5)].

C-Other *rare* causes :

1-Hemolysis Present :(e.g. -Red *blood cell enzyme defects*: glucose-6-phosphate dehydrogenase) [(2)].

2- Hemolysis Absent : Mutations of glucuronyl transferase enzyme (Crigler-Najjar syndrome, Gilbert disease), hypothyroidism [(2)].

Conjugated Hyperbilirubinemia

1-Conjugated (Direct-reacting) hyperbilirubinemia **is never physiologic** and should always be evaluated thoroughly [(2)].

2-Direct-reacting bilirubin (composed mostly of conjugated bilirubin) **is not neurotoxic** to the infant, but **signifies a serious underlying disorder** involving cholestasis , hepatocellular injury [(2)] or biliary atresia [(4)]. (atresia is an unusual closing or absence of a tube in the body).

Biliary Atresia:1- is an obstruction of the biliary tree that causes severe cholestasis [(10)] and is characterized by elevation of the conjugated, or direct, bilirubin fraction [(2)] , which leading to cirrhosis and death if left untreated in a timely manner [(10).]

2- The jaundice of biliary atresia usually is not evident immediately at birth, but develops in the first week or two of life. The reason is that extrahepatic bile ducts are usually present at birth, but are then destroyed by an idiopathic inflammatory process [(2)] .

3- Treatment of extrahepatic biliary atresia is the surgical **Kasai procedure**, in which the fibrotic extrahepatic bile duct remnant is removed and replaced with a roux-en-Y loop of jejunum. This operation must be performed before 3 months of age to have the best chance of success [(2)] .

4- many children require liver transplantation [(2)].

Therapy of Indirect (unconjugated) Hyperbilirubinemia

The main concern is to prevent Kernicterus [(3)]. Charts exist indicating levels at which treatment should be initiated.

Treatment options are: **A-Phototherapy. B-Exchange transfusion** [(3)].

Table 2 show the bilirubin level at which these treatment options indicated [(8)].

Table 2:bilirubin level at which phototherapy and exchange are indicated

	Phototherapy				**Exchange transfusion**			
	Healthy term baby		**Preterm or any risk factors***		**Healthy term baby**		**Preterm or any risk factors**	
	Mg/dl	**µmol/l**	**Mg/dl**	**µmol/l**	**Mg/dl**	**µmol/l**	**Mg/dl**	**µmol/l**
Day 1	Any visible jaundice**				15	260	13	220
Day 2	15	260	13	220	25	425	15	260
Day 3	18	310	16	270	30	510	20	340
Day 4 and after	20	340	17	290	30	510	20	340

* Risk factors include small size (less than 2.5 kg or born before 37 weeks gestation), haemolysis, and sepsis. ** Visible jaundice anywhere on body on day 1.

A-Phototherapy

1-Blue light (not ultraviolet) of wavelength 450 nm **converts the bilirubin in the skin and superficial capillaries into harmless water-soluble metabolites, which are excreted in urine and through the bowel** [(3)].

2-The **eyes are covered to prevent discomfort** and additional fluids are given to counteract increased losses from skin [(3)].

B-Exchange transfusion

1-This is required if the bilirubin rises to levels considered dangerous despite phototherapy [(3)].

2- Twice the infant's blood volume (i.e. 2 x 80 mL/kg) is exchanged over about 2 hours [(3)] (or 2 x 85 mL/kg) [(2)].

3-The procedure is carried out **through umbilical vein catheter** [(9)].

C-Pharmacological agents

1-High dose intravenous immunoglobulin is the only pharmacological treatment used in clinical practice for infants presenting with high jaundice levels secondary to rhesus or ABO incompatibility [(11)] .

Management of conjugated hyperbilirubinemia

Management depend on the treatment of the causative diseases (if treatable e.g. surgical correction of biliary atresia) [(5)].

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2-Neonatal Sepsis and Meningitis

Background

1-Neonates, especially preterm newborns, are at increased risk for infections and **should be considered immunocompromised** [(1)].

2-Risk factors **of neonatal sepsis** include **prematurity**, **low birth weight**, **and predisposing maternal conditions** (e.g., urinary tract infection) [(1)].

3-**Early-onset neonatal sepsis** (sepsis that presents during the first 7 days of life) usually is **caused by organisms acquired from the maternal genital tract** [(1)]. (see table 1) [(3)].

4- Late-onset sepsis (8 to 28 days) usually occurs in a healthy full-term infant who was discharged in good health [(2)]. (see table 1) [(3)].

5-**Meningitis occurs as a complication of bacterial sepsis** [(1)]. The major pathogens causing neonatal sepsis are also the primary pathogens that cause neonatal meningitis [(1)].

Table 1 [3]

Organisms associated with early-onset and late-onset neonatal sepsis	
Early-Onset Sepsis	**Late-Onset Sepsis**
Group B *Streptococcus*	Coagulase-negative *Staphylococcus*
Escherichia coli	*Staphylococcus aureus*
Listeria monocytogenes	Enterococci
Other streptococci: *Streptococcus pyogenes*, viridans group streptococci, *Streptococcus pneumoniae*	Multidrug-resistant gram-negative rods (*E coli*, *Klebsiella*, *Pseudomonas*, *Enterobacter*, *Citrobacter*, *Serratia*)
Enterococci	*Candida*
Nontypable *Haemophilus influenzae*	

Clinical Manifestations of Neonatal Sepsis

1- The most common signs are **poor feeding**, **temperature instability** (**Hypothermia** is more common than fever in neonatal sepsis, especially in preterm newborns), **lethargy**, or **apnea** [1].

2-Other signs of neonatal sepsis include **tachycardia**, dyspnea or cyanosis, **tachypnea**, disseminated intravascular coagulation (**DIC**)and **abdominal distension** [1, 6].

3-The clinical manifestations of sepsis are difficult to separate from the manifestations of meningitis in the neonate [2].

Laboratory Diagnosis of Neonatal Sepsis

A- Positive cultures of body fluids confirm the diagnosis, including the following:

1. **Blood**: Must be obtained as a part of every evaluation for sepsis.
2. **CSF:** CSF analysis is indicated for all infants with a positive blood culture.
3. **Urine**: urine cultures are indicated, as urinary tract infections are a frequent source of infection [4].

B- Hematologic studies:

1. An extremely elevated total WBC or very depressed count is more suggestive of infection.
2. Thrombocytopenia is also associated with sepsis [4].

C- A chest radiograph is indicated in all infants with respiratory symptoms [4].

D-C-reactive protein(CRP): CRP levels are often elevated in neonatal patients with bacterial sepsis [2].

E-Coagulation studies : prolonged values may indicate DIC [4].

Treatment of Sepsis and Meningitis

1-The initial empiric antibiotic treatment of choice for early-onset neonatal sepsis and meningitis is **ampicillin plus an aminoglycoside** (Tables 2 and 3) [1].
[In some nurseries, **a third-generation cephalosporin** (e.g., cefotaxime), instead of an aminoglycoside is added to ampicillin] [1].

Table 2
Gentamicin Dosing Guidelines for Neonates and Infants

Traditional Dosing		
Age	Weight	Dosing Regimen
GA <38 weeks	<1,000 g	3.5 mg/kg/dose every 24 hours
PNA 0–4 weeks	<1,200 g	2.5 mg/kg/dose every 18–24 hours
PNA ≤7 days	≥1,200 g	2.5 mg/kg/dose every 12 hours
PNA >7 days	1,200–2,000 g	2.5 mg/kg/dose every 8–12 hours
PNA >7 days	>2,000 g	2.5 mg/kg/dose every 8 hours

GA, gestational age; PNA, postnatal age.

2-If meningitis is highly suspected**, gentamicin may be replaced by a third generation cephalosporin** (cefotaxime) owing to greater CSF penetration [1].

3-For late-onset sepsis or meningitis , a combination of **vancomycin with an aminoglycoside** (gentamicin or tobramycin) is appropriate [2].

4-Amphotericin remains the treatment of choice for invasive candidiasis when meningitis is a consideration; liposomal amphotericin or an echinocandin (caspofungin or micafungin) are options for hepatic or splenic candidiasis. Fluconazole might be an effective therapy for susceptible organisms [7] .

Duration of therapy

1-Therapy for most bloodstream infections should be continued for **a total of 7-10 days or for at least 5-7 days after a clinical response has occurred** [4].

2-**Meningitis** should be treated for **14-21 days** [4].

Table 3

Antimicrobial Dosage Regimens for Neonates: Dosages and Intervals of Administration

	Weight < 1,200 g	Weight 1,200–2,000 g		Weight > 2,000 g	
Drug	0–4 Weeks (mg/kg)[a]	0–7 Days (mg/kg)[a]	8–28 Days (mg/kg)[a]	0–7 Days (mg/kg)[a]	8–28 Days[a] (mg/kg)[a]
Amphotericin B					
Deoxycholate	1 every 24 hours	1 every 24 hours	1 every 24 hours	1 every 24 hours	1 every 24 hours
Lipid complex/ Liposomal	5 every 24 hours	5 every 24 hours	5 every 24 hours	5 every 24 hours	5 every 24 hours
Ampicillin					
Meningitis	100 every 12 hours	100 every 8 hours	75 every 6 hours	50 every 8 hours	75 every 6 hours
Other diseases	25 every 12 hours	25 every 12 hours	25 every 8 hours	25 every 8 hours	25 every 6 hours
Cefazolin	25 every 12 hours	25 every 12 hours	25 every 12 hours	25 every 12 hours	25 every 8 hours
Cefepime	30 every 12 hours	50 every 12 hours	30 every 12 hours[b]	50 every 12 hours	30 every 12 hours[b]
Cefotaxime[c]	50 every 12 hours	50 every 12 hours	50 every 8 hours	50 every 12 hours	50 every 8 hours
Ceftazidime[c]	50 every 12 hours	50 every 12 hours	50 every 8 hours	50 every 12 hours	50 every 8 hours
Ceftriaxone[c]	25 every 24 hours	50 every 24 hours	50 every 24 hours	50 every 24 hours	75 every 24 hours
Clindamycin	5 every 12 hours	5 every 12 hours	5 every 8 hours	5 every 8 hours	5 every 6 hours
Erythromycin	10 every 12 hours	10 every 12 hours	10 every 8 hours	10 every 12 hours	13.3 every 8 hours
Fluconazole	6 every 72 hours	12 every 48 hours	12 every 24 hours	12 every 48 hours	12 every 24 hours
Linezolid	10 every 12 hours	10 every 12 hours	10 every 8 hours	10 every 8 hours	10 every 8 hours
Meropenem[c]	20 every 12 hours	20 every 12 hours	20 every 8 hours	20 every 8 hours	30 every 8 hours
Metronidazole	7.5 every 48 hours	7.5 every 24 hours	7.5 every 12 hours	7.5 every 12 hours	15 every 12 hours
Oxacillin	25 every 12 hours	25 every 12 hours	25 every 8 hours	25 every 8 hours	37.5 every 6 hours
Nafcillin	25 every 12 hours	25 every 12 hours	25 every 8 hours	25 every 8 hours	37.5 every 6 hours
Penicillin G					
Meningitis	50,000 U every 12 hours	50,000 U every 12 hours	50,000 U every 8 hours	50,000 U every 12 hours	50,000 U every 8 hours
Other diseases	25,000 U every 12 hours	25,000 U every 12 hours	25,000 U every 8 hours	25,000 U every 12 hours	25,000 U every 8 hours
Piperacillin/tazobactam	50 every 12 hours	75 every 12 hours	75 every 8 hours	75 every 12 hours	75 every 8 hours
Ticarcillin or Ticarcillin/ clavulanate	75 every 12 hours	75 every 12 hours	75 every 8 hours	75 every 12 hours	75 every 8 hours
Vancomycin	15 every 24 hours[d]	15[e]	15[e]	15[e]	15[e]

Supportive care

1-**Fluids, electrolytes, and glucose levels** should be monitored carefully with correction when needed [(5)].

2-Seizures should be treated with anticonvulsants [(5)].

3-DIC may complicate neonatal septicemia. DIC may require fresh frozen plasma, platelet transfusions, or whole blood [(5)].

4-The use of **intravenous immunoglobulin** (IVIG) has been shown to decrease mortality in patients with sepsis [(5)].

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B-Nephrology

1-Nephrotic syndrome

1-**Nephrotic syndrome** (NS) is characterized by persistent heavy **proteinuria** (mainly albuminuria) ; **hypoproteinemia** (serum albumin <3.0 g/dL); **hypercholesterolemia** (>250 mg/dL); and **edema** [1].

2- Nephrotic syndrome is **primarily a pediatric disorder** and is 15 times more common in children than adults [2] with a peak age of onset in children aged <6yrs [3].

3-The underlying abnormality in nephrotic syndrome is an increase in permeability of the glomerular capillary wall, which leads to massive **proteinuria and hypoalbuminemia** [2].

4-Hypoalbuminemia causes a decrease in the plasma oncotic pressure and shift of fluid from the intravascular compartment to the interstitial space. Reduced plasma volume stimulates antidiuretic hormone (ADH) secretion and the renin–angiotensin system, producing sodium and water retention, exacerbating the edema [2, 4].

Classification:

Approximately 90% of children with NS **have idiopathic** NS. Idiopathic NS includes three histologic types [2]:

A-**Minimal change nephrotic syndrome** (MCNS) is the most common form of NS in children (accounts for about 85%) [1, 2].

2-Other less common types are [**Focal segmental glomerulosclerosis** (FSGS), **and Membranoproliferative glomerulonephritis** (MPGN)] [1].

Clinical features

1-Children usually present with mild **edema**, which is initially noted around **the eyes** (Periorbital) and in the lower extremities [2]. Periorbital oedema is often most noticeable in **morning on rising** [3].

2-With time, the edema becomes generalized, with the development of ascites, pleural effusions, and genital edema [2].

Treatment

1-NS edema is treated by **restricting salt intake**. Severe edema may require the use of **loop diuretics**. When these therapies do not alleviate severe edema, parenteral administration **of 25% albumin** (0.5 to 1.0 g/kg intravenously over 1 to 2 hours) with an intravenous loop diuretic usually results in diuresis [1].

2-Children with onset of nephrotic syndrome between **1 and 8 yr of age are likely to have steroid-responsive minimal change disease**, therefore, steroid

therapy (prednisolone 2 mg/kg/day)(60 mg/m^2/day) may be initiated without renal biopsy [2].

3-After the initial 4-6 wk course, the prednisone dose should be tapered to 40 mg/m^2/day given every other day as a single morning dose. The alternate-day dose is then slowly tapered and discontinued over the next 2-3 mo [2].
4-**Steroid-dependent patients** (relapse while on alternate-day steroid therapy or within 28 days of stopping prednisone therapy), **frequent relapsers**, and steroid- resistant patients may be candidates for **alternative agents** (e.g. Cyclophosphamide) [2].
5-Rituximab has been effective in the treatment of refractory NS in children, and it could reduce the use of steroid and immunosuppressants [5] .
6-Acute hypertension (HTN) is treated with β -blockers or calcium channel blockers. Persistent HTN usually responds to ACE inhibitors [1].

7-**ACE inhibitors and angiotensin II blockers** may be helpful as an adjunct therapy to **reduce proteinuria** in steroid-resistant patients [2].

Complications

1-**Infection is the major complication of nephrotic syndrome**. Children in relapse have increased susceptibility to bacterial infections owing to urinary losses of immunoglobulins and use of immunosuppressive therapy. Spontaneous bacterial peritonitis is the most frequent type of infection [2].

2-The role of **prophylactic antibiotic** therapy during relapse remains **controversial** [2].
3-Children with nephrotic syndrome are also at **increased risk for Thromboembolism (TE).** (related to increased prothrombotic factors (e.g. fibrinogen,) and decreased fibrinolytic factors) . **Prophylactic anticoagulation is not recommended in children unless they have had a previous TE**. Warfarin, low-dose aspirin, or dipyridamole may minimize the risk of clots in NS patients with a history of TE or high risk for TE [1, 2].

Prognosis

1-The majority of children with steroid-responsive NS have repeated relapses, which generally decrease in frequency as the child grows older [2].

2-**Steroid-responsive patients have little risk of chronic renal failure** [1].
3-Children with **steroid-resistant NS**, most often caused by focal segmental glomerulosclerosis, generally have a much **poorer prognosis**. These children develop progressive renal insufficiency, ultimately leading to end-stage renal failure requiring dialysis or renal transplantation [2].

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2-Hemolytic-Uremic Syndrome

1-The hemolytic-uremic syndrome (HUS) is the most **common cause of acute renal failure in young children** and is characterized by **hemolytic anemia, thrombocytopenia, and uremia** (1).
2- HUS typically occurs in children **less than 5 years of age** but can occur in older children (2).
3-Two forms of HUS are recognized.
A-HUS following infection with Shiga toxin-producing Escherichia coli **(STEC-HUS or typical HUS, formally D+HUS)** is the most common cause of HUS, responsible for up to 90% of cases in children.
B- Atypical HUS **(aHUS, formally D−HUS)** describes HUS in the absence of evidence of STEC infection(3).
Note: D+ HUS diarrhea associated, D-HUS not diarrhea associated.

Clinical Manifestations.

1-Classic D+HUS begins with **gastroenteritis** characterized by fever, vomiting, and diarrhea that is often bloody. **Followed in 7 to 10 days** by weakness, lethargy, and oliguria/anuria. Physical examination reveals irritability,pallor, and petechiae (1, 2).

Treatment and Prognosis

1-Therapy for HUS is **supportive** and includes **volume repletion**, and managing complications of renal insufficiency, **including dialysis when indicated** (2).

2-**Red blood cell transfusions** are provided as needed (2).

3-**Antibiotics and antidiarrheal agents may increase the risk of developing HUS** (2). [Antibiotics should be avoided in patients with acute enteritis presumed secondary to *E. coli* 0157:H7 as they may increase the risk of developing HUS.

4-Most children (>95%) with D+HUS survive the acute phase and recover normal renal function, although some may have evidence of long-term morbidity (2).

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C-Infections

1-Bronchiolitis

1-**Bronchiolitis,** a lower respiratory tract infection (LRTI) that primarily affects the small airways (bronchioles), is a common cause of illness and hospitalization in infants and young children [(1)].
2-Bronchiolitis is seasonal, with **peak activity during winter and early spring** [(2)].
3-Bronchiolitis occurs almost **exclusively during the first 2 years of life**, with a peak age at 2 to 6 months [(3)].

4- Acute bronchiolitis is characterized by bronchiolar **obstruction with edema, mucus, and cellular debris** [(2)].

Etiology

1-Acute bronchiolitis is predominantly a viral disease. **Respiratory syncytial virus (RSV)** is responsible for more than 50% of cases [(2)].

2-Other agents include parainfluenza, adenovirus, *Mycoplasma,* and occasionally other viruses [(2)].

Clinical Manifestations.

1-The infant first develops a mild upper respiratory tract infection with **sneezing and clear rhinorrhea**. This may be accompanied by diminished appetite and fever [(2)].
2-Gradually, respiratory distress ensues, with paroxysmal **wheezy cough**, **dyspnea**, and **irritability**. The infant is often **tachypneic**, which interferes with feeding [(2)].

3-As a result of limited oral intake due to coughing combined with fever, infants are frequently **dehydrated** [(6)].

Diagnosis

The diagnosis of bronchiolitis is based primarily on **history and clinical findings** [(6)].

Treatment

1-The mainstay of treatment is **supportive**. Therapy of bronchiolitis primarily consists of administration of supplemental **oxygen** and replacement of fluid deficits (**hydration**) as needed [(2, 4)].

2-The risk of aspiration of oral feedings may be high in infants with bronchiolitis owing to tachypnea and the increased work of breathing. **The infant may be fed through a nasogastric tube** [(2)].

3-A number of agents have been proposed as adjunctive therapies for bronchiolitis:

A-Bronchodilators produce modest short-term improvement in clinical features. **Nebulized epinephrine may be more effective than β-agonists** [2].

B-Corticosteroids, whether parenteral, oral, or inhaled, are widely used despite **conflicting studies** [2].

C-Ribavirin, is a compound with antiviral activity against RSV administered by **aerosol**, has been used for infants with congenital heart disease (CHD)or chronic lung disease (CLD) [2, 4]although **its benefit is uncertain** [5].

D-Antibiotics have no value unless there is secondary bacterial pneumonia [2].

Prophylaxis

1-Palivizumab is a monoclonal antibody to RSV and can be used as prophylaxis [5] initiated just before the onset of the RSV season (monthly IM injection for 5months starting in October) confers some protection from severe RSV disease [3, 5]

2-Palivizumab is indicated for some infants under 2 years old with CLD, severe CHD or prematurity [2, 3] .

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2-Pneumonia

1-Pneumonia is defined as **infection of the lung parenchyma** (that is of the alveoli rather than the bronchi or bronchioles) and **characterized by consolidation** [1].

(**Consolidation** is a pathological process in which the alveoli are filled with a mixture of inflammatory exudate, bacteria and WBCs that on chest X-ray appear as an opaque shadow in the normally clear lungs) [1].

Etiology

Viruses alone account for 14–35% of all community acquired pneumonia in childhood [2].

M. pneumoniae and *Chlamydophila pneumoniae* are principal causes of **atypical pneumonia** [3]. Common infecting bacterial agents by age are [ليست للحفظ] [2] :

1-**Neonates**: group B streptococcus, *Escherichia coli*, *Klebsiella*, *Staphylococcus aureus*.

2-**Infants**: *Streptoccus pneumoniae*, *Chlamydia*.

3-**School age**: *Streptococcus pneumoniae*, *Staphylococcus aureus*, group A

streptococcus, *Bordetella pertussis*, *Mycoplasma pneumoniae*.

Clinical Manifestations

In many cases these symptoms are preceded by minor upper respiratory tract infection symptoms. The patient may also be complaining of pleuritic chest pain or abdominal pain. The typical history will have:

- **Temperature** ≥ 38.5 ^{0}C;
- **Tachypnea and Shortness of breath**;
- **Cough**; [with sputum production in older children (>7yrs)] [2, 4].

Diagnosis

- Diagnosis of pneumonia in many cases is made based on the **presence of clinical signs and symptoms.**
- **Chest x-ray** are often used to confirm the diagnosis [4].

Treatment [2].

1-Oral antibiotics are safe and effective in the treatment of community acquired pneumonia. IV antibiotics are used in children who cannot absorb oral antibiotics or in those with severe symptoms.

Antibiotic therapy for pneumonia

Under 5yrs

Streptococcus pneumoniae is the most likely pathogen. The causes of atypical pneumonia are *Mycoplasma pneumoniae* and *Chlamydia trachomatis*

- *First-line treatment:* amoxicillin
- *Alternatives:* co-amoxiclav or cefaclor for typical pneumonia; erythromycin, clarithromycin, or azithromycin for atypical pneumonia

Over 5yrs

Mycoplasma pneumoniae is more common in this age group

- *First-line treatment:* amoxicillin is effective against the majority of pathogens, but consider macrolide antibiotics if mycoplasma or chlamydia is suspected
- *Alternatives:* if *Staphylococcus aureus* is suspected consider using a macrolide, or a combination of flucloxacillin with amoxicillin

Severe pneumonia

Co-amoxiclav, cefotaxime, or cefuroxime IV

2-Supportive therapies Consider whether any of the following are needed:

- **Antipyretics** for fever.
- **IV fluids**: consider if dehydrated or not drinking.

• Supplemental **oxygen**.

Complications

1-Bacterial pneumonias frequently cause inflammatory fluid to collect in the adjacent pleural space, causing an **empyema** [empyema is collection of pus in a cavity, especially in the pleural cavity] . Small empyema may not require any special therapy. **Large empyema may restrict breathing and require drainage** [3].

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1-Roger Walker, Clive Edwards (eds), ***Clinical Pharmacy and Therapeutics***, 5th Ed., Churchill Livingstone, London, 2012.
2- Robert C. Tasker. Oxford Handbook of Paediatrics. 2nd edition.2013.
3-Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition. 2015.
4-Thomas P. Green. ***Pediatrics Just the Facts***. Copyright © 2005.

3-Meningitis

1-Meningitis is an inflammation of the membranes (the meninges), whereas **encephalitis** is an inflammation of the brain tissue [1]. **75% of cases of meningitis are believed to occur in those <15yrs of age** [2].

2-**Three organisms** (***Streptococcus*** *pneumoniae*, ***Neisseria*** *meningitides* and ***Haemophilus*** *influenzae* type b) account for 80% of the cases [2]. [In newborns, *Group B streptococcus* , *E. coli*, and *Listeria monocytogenes* are the most common pathogens] [3].

Clinical Manifestations [2, 4].

1- In **young infants symptoms may be non-specific** including fever, poor feeding, lethargy.

2-In older children clinical features include:

- ***General****:* fever, with headache.
- ***Central****:* irritability, disorientation, altered mental state.
- ***Seizures****:* occur in 30%.
- ***Neck stiffness****:* more common in older children.
- **Kernig** and **Brudzinski** signs of meningeal irritation are often positive in children older than 12 months.

Diagnosis

1-If bacterial meningitis is suspected, a **lumbar puncture** should be performed . Routine CSF examination includes a white blood cell count, differential, protein and glucose levels, and Gram stain [4].

Treatment

1-Treatment of bacterial meningitis focuses on **sterilization of the CSF by antibiotics** (Table 1) [4].

2-Duration of treatment is 5 to 7 days for *N. meningitidis,* 7 to 10 days for *H. influenzae,* and 10 to 14 days for *S. pneumoniae* [4].

3-Steroids In bacterial meningitis:

• Do not use corticosteroids in children younger than 3mths [2].

• There is benefit from the use of dexamethasone and the dosing schedule is 0.15mg/kg qds for 4 days **to reduce the severity of neurological sequelae**, **particularly deafness**, after bacterial meningitis) [2].

• If dexamethasone was not given before the first dose of antibiotics, but was indicated, try to give the first dose within 4hr of starting antibiotics, but do not start dexamethasone more than 12 hours after starting antibiotics [2].

Table 1: Initial Antimicrobial Therapy by Age for Presumed Bacterial Meningitis

AGE	RECOMMENDED TREATMENT	ALTERNAT TREATME
Newborns (0–28 days)	Cefotaxime or ceftriaxone plus ampicillin with or without gentamicin	Ampicillin plus gentamicin Ceftazidime p ampicillin
Infants and toddlers (1 mo–4 yr)	Ceftriaxone or cefotaxime plus vancomycin	Cefotaxime or ceftriaxone plu rifampin
Children and adolescents (5–13 yr) and adults	Ceftriaxone or cefotaxime plus vancomycin	Cefepime or ceftazidime pl vancomycin

References

1-Marie A. Chisholm-Burns .*Pharmacotherapy Principles & Practice Copyright* © 2008 by The McGraw-Hill Companies.

2- Robert C. Tasker. Oxford Handbook of Paediatrics. 2nd edition.2013.

3-Thomas P. Green. ***Pediatrics Just the Facts***. Copyright © 2005 by The McGraw-Hill Companies, Inc.

4-Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition. 2015.

4-Encephalitis

1-Encephalitis is an inflammation **of the brain tissue** . **Viruses are the principal causes** of acute infectious encephalitis [1].

Clinical Manifestations

1-Acute infectious encephalitis usually is preceded by a prodrome of several days of nonspecific symptoms such as sore throat, fever, and headache followed by the **characteristic symptoms** of progressive **lethargy**, **behavioral changes**, and **neurologic deficits**. **Seizures are common** at presentation [(1)].

Diagnosis

The diagnosis of viral encephalitis is supported by **examination of the CSF** [(1)].

Treatment

1-With the exception of HSV, varicella-zoster virus, cytomegalovirus, and HIV, there is no specific therapy for viral encephalitis. **Management is supportive** [(1)].

2-Intravenous **acyclovir is the treatment of choice for HSV** and **varicella-zoster virus** infections. **Cytomegalovirus** infection is treated with **ganciclovir**. HIV infections may be treated with a combination of antiretroviral agents [(1)].

References

1-Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition. 2015.

5-Visceral Leishmaniasis (Kala-azar) (Black fever)[(1, 2)]

1-Visceral Leishmaniasis (VL) is caused by the protozoon **Leishmania donovani**.

2- Infection are introduced by the feeding female **sand fly**.

3- The great majority of people infected remain asymptomatic. In visceral diseases the spleen, liver, bone marrow and lymph nodes are primarily involved.

Clinical features

1-VL is predominantly a disease of small children and infants.

2-The **first sign of infection is high fever**, usually accompanied by rigor and chills.
3-**Splenomegaly** develops quickly in the first few weeks and becomes massive as the disease progresses. Moderate hepatomegaly occurs later. Lymphadenopathy may also seen .

4-Blackish discoloration of the skin, from which the disease derived its name, kala-azar (the Hindi word for 'black fever'), is a feature of advanced illness and is now rarely seen.

5-**Pancytopenia** is a common feature.
6-Without adequate treatment most patients with clinical VL die.

Diagnosis

1-Demonstration of amastigotes in **splenic smears** is the most efficient means of diagnosis, with 98% sensitivity ; however, it carries a risk of serious haemorrhage in inexperienced hands.

2-Serodiagnosis, by ELISA or indirect immunofluorescence antibody test (**IFAT**). A significant proportion of the healthy population in an endemic region will be positive for these tests due to past exposure.

Treatment

1- The pentavalent antimony compound [**sodium stibogluconate** (Pentostam®)]. The daily dose is 20 mg/kg body weight, given either intravenously or intramuscularly **for 28 days.**
2-Side-effects are common and include arthralgias, myalgias, raised hepatic transaminases, pancreatitis and ECG changes.

3-**Amphotericin B** is very useful in the treatment of antimony-unresponsive VL

References

1- Nelson Textbook of pediatrics. 29th edition.
2- Nicholas A. Boon, Nicki R. Colledge and Brian R. Walker. ***Davidson's Principles and Pracrtice of Medicines*** . 21st Edition 2010.

6-Cytomegalovirus [1-3].

1- **Cytomegalovirus** (CMV) **is the most common congenital infection** and the leading cause of hearing loss, mental retardation, retinal disease, and cerebral palsy.
2-Transmission occurs **transplacentally or perinatally** through contact with cervical secretions or through breast milk. Perinatal exposure is not usually associated with disease in term infants, but preterm infants may be infected.

3-When primary infection occurs in mothers during a pregnancy, the virus is transmitted to the fetus in approximately 35% of cases.

4-The earlier in gestation that the primary maternal infection occurs, the more symptomatic the infant will be at birth.

Presentation

1-More than 90% of infants who have congenital CMV infection **exhibit no clinical evidence of disease at birth.**

2-Approximately 10% of infected infants are small for gestational age and have symptoms at birth. The characteristic signs and symptoms include:

Intrauterine growth retardation, **prematurity**, **hepatosplenomegaly** and **jaundice**, **thrombocytopenia and purpura, microcephaly (small head)and intracranial calcifications**. Other neurologic problems include **retinitis**, and **hearing abnormalities**.

3-Mortality is 10% to 15% in symptomatic newborns.
4-In case of perinatal CMV infection acquired during birth or from mother's milk, the majority of infants remain asymptomatic and do not exhibit sequelae.

Diagnosis.

1-Congenital CMV infection is diagnosed by detection of virus in the urine or saliva.

2- Positive CMV immunoglobulin M (IgM) serology is highly suggestive, but NOT diagnostic.

Treatment

1-There are limited options for treatment of CMV infection. Treatment is not indicated for immunocompetent persons, but is recommended for immunocompromised persons, and remains controversial for infants with symptomatic congenital infection.
2-first, **ganciclovir** and, then, **valganciclovir** have been evaluated for the treatment of babies with symptomatic disease [(4)] .
3-only those children with symptomatic and congenital CMV infection should be treated as no data exist on the potential efficacy of valganciclovir in the treatment of **asymptomatic disease** [(4)] .
4-Treatment of Congenital Infection: Trial studies in severely symptomatic newborns of the antiviral agent **ganciclovir** have shown a lack of progression of **hearing loss**.
Dose: 6 mg/kg I.V every 12 hours for 6 weeks.
5-Ganciclovir is related to aciclovir but it is more active against cytomegalovirus; it is also much more toxic (**Myelosuppression**) than aciclovir.

References

1- Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition. 2015.
2- Nelson Textbook of pediatrics. 29th edition.
3-Thomas P. Green. Pediatrics Just the Facts. Copyright © 2005 by .
4-Whitley RJ. Congenital Cytomegalovirus and Neonatal Herpes Simplex Virus Infections: To Treat or Not to Treat?. The Pediatric infectious disease journal. 2019 Jun 1;38(6S):S60-3.

D-Neurology

1-Guillain–Barré syndrome [1-3].

1-Guillain-Barré syndrome (GBS): is a postinfectious autoimmune **peripheral neuropathy** that can occur about **10 days after a respiratory or gastrointestinal infection** (bacterial or viral).

2-It occurs in people of all ages and is the most common cause of acute flaccid paralysis in children.

Clinical Manifestations

1-The characteristic symptoms are **flaccidity**, and symmetrical **ascending weakness**.

2-**Ascending weakness**: Weakness begins usually in the lower extremities and progressively involves the trunk, the upper limbs, and finally the bulbar muscles ((tongue, pharynx, larynx).

3-**Respiratory insufficiency** may result.

4-**Recovery**: should begin within 2–4wks, in a descending manner, though full recovery sometimes takes a number of months.

Diagnosis

The **main diagnostic features of GBS is clinical**(muscle weakness, with loss of reflexes in an ascending fashion).

Prognosis

1-**The clinical course is usually benign**, and spontaneous recovery begins within 2-3 wk. Most patients regain full muscular strength, although some are left with residual weakness.

2-Bulbar and respiratory muscle involvement may lead to death if the syndrome is not recognized and treated.

Treatment

1-Intravenous **immunoglobulin** (IVIG)(400mg/kg/day **for 5 days**) is normally used initially.

2-**Plasmapheresis** and immunosuppressive drugs are alternatives when IVIG treatment is unsuccessful[4] .

References

1- Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition. 2015.
2- Nelson Textbook of pediatrics. 29th edition.
3- Robert C. Tasker. Oxford Handbook of Paediatrics. 2nd edition.2013.

4-Maheshwari A, Sharma RR, Prinja S,et al. Cost-minimization analysis in the Indian subcontinent for treating Guillain Barre Syndrome patients with therapeutic plasma exchange as compared to intravenous immunoglobulin. Journal of clinical apheresis. 2018 Dec;33(6):631-7.

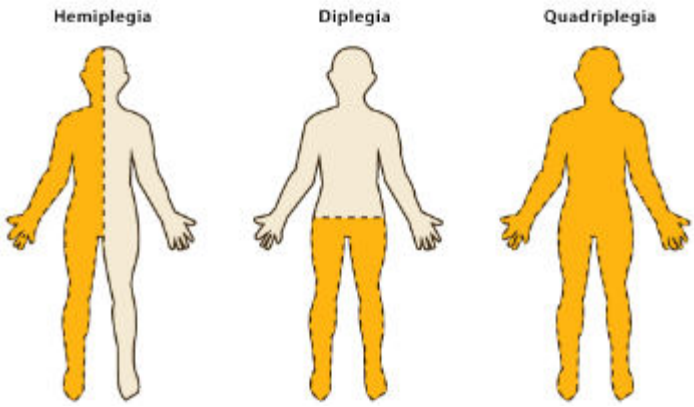
2-Cerebral palsy (CP) [1-4].

Definition: a chronic disorder of movement and/or posture that presents early (i.e. before the age of 2yrs) and continues throughout life.
Causation: CP is caused by nonprogressive (static) injury to the developing brain [1].

Causes of CP

The cause is unknown in many patients but identified risk factors can be categorized into antenatal, intrapartum, and postnatal:

A-Antenatal: congenital infections(rubella, cytomegalovirus, toxoplasmosis).
B-Intrapartum: birth asphyxia.
C-Postnatal: (hyperbilirubinemia, hypoglycemia, meningitis, encephalitis,….).



Clinical features

CP can present with:
1-**Delayed motor milestones** : Most children with CP, except in its mildest forms, are diagnosed in the first 18 months of life when they fail to attain motor milestones.

2-**Feeding difficulties** due to lack of oromotor coordination.
3-**Speech and language** delay.

Classification

1-CP classified into 4 types (Spastic CP, Ataxic CP, Dyskinetic CP, and Mixed CP).
2-**Spastic CP the most common form of CP**, it accounts for 70%–80% of cases. It can be hemiplegic (affects one side of the body), diplegic (affects legs or arms), or quadriplegic (affects all the four limbs).

Problems associated with CP

1-Mental retardation and learning difficulty.
2-seziures
3-gastro-esophageal reflux
4-feeding problems and failure to thrive (FTT).
5-Recurrent pneumonia.
6-hearing and vision abnormalities.

Diagnosis

The diagnosis is made on **clinical examination**. An MRI scan of the brain is generally indicated to determine the location and extent of lesions .

Treatment.

1-Treatment of CP required multidisciplinary approach including (Speech, physiotherapy, and occupational therapy).The primary therapists are the child's carers.

2-Several drugs have been used to **treat spasticity**, including dantrolene sodium, the benzodiazepines, and **baclofen**. These medications should be considered if severe spasticity is not controlled by other measures.

3-Patients with rigidity, and **spastic quadriparesis** sometimes respond to **levodopa**.

References

1- Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition. 2015.
2- Nelson Textbook of pediatrics. 29th edition.
3- Robert C. Tasker. Oxford Handbook of Paediatrics. 2nd edition.2013
4- Shyam Bhakthavasala. Crash course pediatrics.3rd edition 2008.

3-Febrile convulsion

1-A febrile convulsion is a fit occurring in a child (**generally between the ages of 6mths and 6yrs**), **precipitated by fever** (temp > 38 C) arising from infection outside the nervous system in a child who is otherwise neurologically normal [1-3] and in case of absence of acute electrolyte imbalance [4].

2-They occur in up to 4% of all children . The vast majority of febrile seizures are **harmless** [3].

3-Children prone to febrile seizures **are not considered to have epilepsy** (95–98% of children who have experienced febrile seizures do not go on to develop epilepsy) [3].

Etiology

1-The **etiology is unknown**. Genetic predisposition appear to be a risk factor [1,2]

2-Typically febrile seizure **occurs within the 1st 24 hour of a febrile episodes** [1] and most commonly due to acute viral respiratory infections [5].

Types of febrile seizure

1-**Simple febrile seizures** last **less than 15 minutes**, and occur **only once in a 24-hour** period [6]. The risk of subsequent epilepsy is not substantially greater than that for the general population [6].

2-If the seizure lasts **longer than 15 minutes** or **recurs within 24 hours** the seizure is referred to as a **complex or atypical febrile seizure** [6]. It signify a greater risk of later epilepsy [1,4].

Diagnosis:

Diagnosis is made by **exclusion of other causes** of symptomatic seizures like meningitis or metabolic abnormalities [4].

Treatment

1-Intervention to stop the seizure usually is unnecessary as the seizure has typically resolved by the time the child is evaluated by a physician. On the other hand, treatment should be initiated if the seizure is still ongoing by the time the child arrives at a medical facility. If that is the case, the child can be treated with **intravenous lorazepam (0.05–0.1 mg/kg) or diazepam (0.1–0.2 mg/kg)** which is very efficient in terminating the seizure [9] .

2-**Control fever** : Measures to reduce elevated temperature should be initiated. Acetaminophen (or ibuprofen) and tepid sponge baths usually are helpful [1]. However, **administration of antipyretics during febrile illnesses does not prevent febrile seizures** [6].

3-Febrile seizures always are **outgrown** [7], so typically, **Long-term treatment or prophylaxis with antiepileptic drug (AED) for simple febrile seizures is not recommended** [1].

4-Oral diazepam (Valium) prophylaxis, **started at the onset of fever**, **prevents febrile seizure** [7] (oral diazepam, 0.3 mg/kg q8h , is administered for the duration of the illness (usually 2-3 days). This strategy may be useful when parental anxiety associated with febrile seizures is severe [8].

5-Patients who have **prolonged febrile seizures** can benefit from **rectal diazepam gel** given soon after the onset of a febrile seizure to prevent additional prolonged seizures [7].

Reference:

1-Koda-Kimble and Young's. ***Applied Therapeutics***: ***The clinical use of drugs***, 10th ed., 2013 by Lippincott Williams & Wilkins.
2-Bernard Valman, ABC of first year, 5th edition, 2002.
3-Robert C. Tasker. Oxford Handbook of Paediatrics. 2nd edition.2013.
4-Current Pedaitric therapy, 18th edition, 2006.
5-Judith M. Sondheimer, Current essentials of Pediatrics, 2008
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9-Leung AK, Hon KL, Leung TN. Febrile seizures: an overview. Drugs in context. 2018.

E-Rheumatic Diseases of Childhood

1- Kawasaki disease (KD)[1-4]

1-Kawasaki disease (KD) is a **systemic vasculitis** of unknown etiology . KD most commonly occurs in children younger than 5 years of age, with a peak between 2 to 3 years.

2-The etiology is unknown but the disease process is a vasculitis affecting small to medium-sized arteries including the **most importantly the coronary arteries leading to coronary artery aneurysms.**

3-Subsequent scar formation causes vessel narrowing , myocardial ischemia or even infarction and sometimes sudden death.

Clinical Manifestations and diagnosis

1-The diagnosis can be made in children with fever present for at least 5 days, without other explanation, in the presence of 4 of the 5 following criteria

A- Bilateral **conjunctival** injection.
B- Changes in the **mucosa of the oropharynx** including dry fissured lips, and strawberry tongue.
C- Changes of the peripheral extremities, such as **edema and/or erythema of the hands or feet.**
D- **Skin rash**.
E-**Cervical adenopathy**.

Treatment

1-Intravenous i**mmunoglobulin** (IVIG) is the mainstay of therapy for KD, although the mechanism of action is unknown. A single dose of IVIG (2 g/kg over 12 hours) results in rapid resolution of clinical illness in most patients and, more important, reduces the incidence of coronary artery aneurysms.

2-Aspirin is initially given in **anti-inflammatory doses** (80 to 100 mg/kg/day divided every 6 hours) . Once the fever resolves, aspirin is reduced to **antithrombotic doses** (3 to 5 mg/kg/day as a single dose) (there is an increased coagulability) and usually given for 6 to 8 weeks, until follow-up echocardiography documents the absence or resolution of coronary artery aneurysms.

References

1- Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition. 2015.
2- Nelson Textbook of pediatrics. 29th edition.
3- Robert C. Tasker. Oxford Handbook of Paediatrics. 2nd edition.2013
4- Shyam Bhakthavasala. Crash course pediatrics.3rd edition 2008.

F-Cardiovascular Disorders

1-Acute rheumatic fever

1-Acute rheumatic fever remains an important preventable cause of cardiac disease [(1)]. Acute rheumatic fever **usually affects children** (most commonly between 5 and 15 years) or young adults [(2)].

2-The condition is triggered by **an immune-mediated response to infection with specific strains of group A streptococci**, which have antigens that may cross-react with cardiac myosin and membrane protein. Antibodies produced against the streptococcal antigens cause inflammation in **the heart as well as the joints and skin** [2].

Clinical features

1-Acute rheumatic fever is a multisystem disorder that usually presents with **fever**, and **joint pain**, **2–6 weeks after an episode of streptococcal pharyngitis** [1, 2].

Table 1: criteria for the diagnosis of rheumatic fever [2].

Major manifestations	
• Carditis	• Erythema marginatum
• Polyarthritis	• Subcutaneous nodules
• Chorea	
Minor manifestations	
• Fever	• Raised ESR or CRP
• Arthralgia	• Leucocytosis
• Previous rheumatic fever	• First-degree AV block
Plus	
• Supporting evidence of preceding streptococcal infection: recent scarlet fever, raised antistreptolysin O or other streptococcal antibody titre, positive throat culture	

2-The presence of either two **major criteria** or one major and two **minor criteria**, along with evidence of preceding **streptococcal infection**, confirm a diagnosis of acute rheumatic fever [1].
[Streptococcal antibody tests, such as the antistreptolysin O (**ASO**) titer, are the most reliable laboratory evidence of prior infection] [1].

Management of the acute attack

1-A single dose of benzyl penicillin 1.2 million U i.m. or oral phenoxymethyl penicillin for 10 days should be given on diagnosis to eliminate any residual streptococcal infection. If the patient is penicillin-allergic, erythromycin or a cephalosporin can be used [2].
2-**Bed rest is important**, as it lessens joint pain and reduces cardiac workload [2].
3-**Aspirin:** This will usually relieve the symptoms of arthritis rapidly [2]. The usual dose of aspirin is 100 mg/kg/24 hr divided qid PO for 3-5 days, followed by 75 mg/kg/24 hr divided qid PO for 4 wk [3].

4-Patients with carditis and cardiomegaly or congestive heart failure should receive **corticosteroids**.
The usual dose of prednisone is 2 mg/kg/24 hr in 4 divided doses for 2-3 wk followed by a tapering of the dose that reduces the dose by 5 mg/24 hr every 2-3 days [3].

5-Supportive therapies for patients with moderate-to-severe carditis include **digoxin**, **fluid** and **salt restriction**, **diuretics**, and **oxygen** [3].

6-Sedatives may be helpful early in the course of chorea; Phenobarbital is the drug of choice. If phenobarbital is ineffective, then haloperidol or chlorpromazine should be initiated [3].

Secondary prevention

1-Patients are susceptible to further attacks of rheumatic fever if another streptococcal infection occurs, and long-term prophylaxis with penicillin should be given as **i.m benzathine penicillin monthly** [2].

2-Further attacks of rheumatic fever are unusual after **the age of 21**, when treatment may be stopped [2].

Chronic rheumatic heart disease

Chronic valvular heart disease develops in at least half of those affected by rheumatic fever **with carditis** [2]. This result in scarring and fibrosis of the heart valves (most commonly **mitral** valve) and may result in incompetent valves **requiring replacement** [4].

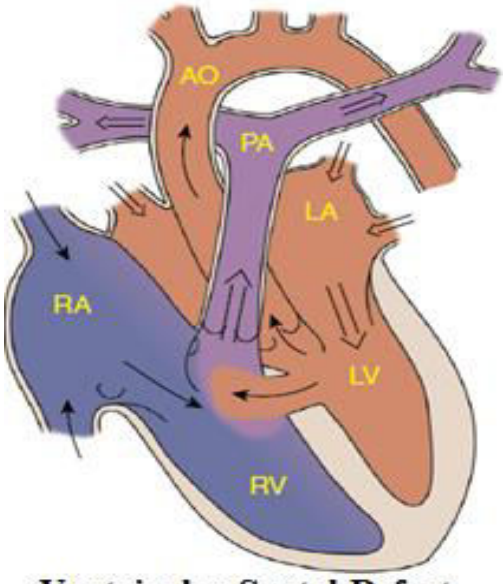
References

1- Robert M. Kliegman. **Nelson essentials of pediatrics**. 7th edition. 2015.
2- Nicholas A. Boon, Nicki R. Colledge and Brian R. Walker. **Davidson's Principles and Pracrtice of Medicines** . 21st Edition 2010.
3- **Nelson Textbook of pediatrics**. 29th edition.
4- Robert C. Tasker. **Oxford Handbook of Paediatrics**. 2nd edition.2013.

2-Congenital Heart Disease

A-Ventricular Septal Defect (VSD)

VSD is the most common congenital heart defect accounts for 25% of all congenital heart disease [1].



Ventricular Septal Defect

Clinical Manifestations

Small VSDs with little are often asymptomatic. Moderate to large VSDs result in excessive pulmonary blood flow , pulmonary hypertension and heart failure [1, 2].

Small VSD

1-The child is **asymptomatic** [3].
2-**Antibiotic prophylaxis against bacterial endocarditis** should be provided for dental visits (including cleanings) [2, 3].
3-Spontaneous closure might occur [3].

Medium VSD

1-These usually present with symptoms during infancy including **slow weight gain**, **feeding difficulties**, and **recurrent chest infections** [3].

2-Heart failure, if present, should be treated by **diuretics (± digoxin) and ACE inhibitors** [1, 3] .

3-Spontaneous improvement occurs in many childhood cases and surgical correction can be avoided. However, if there significant VSD at 4 years, closure should be considered before the child starts school [3].

Large VSD

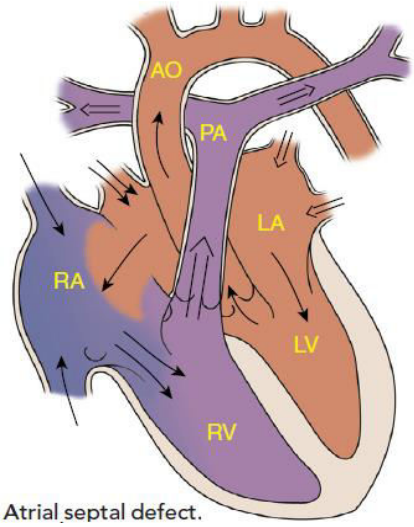
Heart failure develops early on. Initial treatment of heart failure is required and **surgical closure is usually necessary** [3].

References

1-Robert M. Kliegman. ***Nelson essentials of pediatrics***. 7th edition. 2015.
2-M. Kliegman. ***Nelson textbook of pediatrics***. 19th edition.
3-Shyam Bhakthavasala. ***Crash course pediatrics***.3rd edition 2008.

B-Atrial Septal Defect (ASD)

1-Atrial septal defects are common, representing 5–10% of all congenital heart defects [1].



Atrial septal defect.

2-Children with an atrial septal defect *are asymptomatic* [1].

3-While patients with ASD are asymptomatic in childhood, problems with **congestive heart failure**, and **pulmonary hypertension** can **develop in the third decade of life** and beyond [1].

4-**Treatment**: **ASD closure is required and advised for all patients, even if asymptomatic**. Intervention should be performed in early childhood, before school entry [2].

References

1-Thomas P. Green. ***Pediatrics Just the Facts***. Copyright © 2005 by The McGraw-Hill Companies.
2-Robert C. Tasker. Oxford Handbook of Paediatrics. 2nd edition.2013

G-Gastroenterology

1-Acute Gastroenteritis (GE)

It is an infection of the small intestine, which present with a combination of **diarrhea** and vomiting [1] , but sometimes present without vomiting [2].

Etiology

1-**Rota virus** is the most common pathogen in children **under 2 years** [3], other causes include:

A-Acute **bacterial infections** (shigellae, Salmonellae, E coli and Vibirio cholera which secrete enterotoxins) [3].
B-**Parasites** like E. histolytica, and Giardia lambilia [2].

Clinical Features

1-**Rotaviruse cause watery diarrhea** . **Respiratory illness** occur in about half of patients followed by vomiting and diarrhea [1, 2].

2-Acute **bacterial** infection cause invasion of GIT, so there is **fever**, and small volume **bloody stool** [3].

Complication of Gastroenteritis

Dehydration, **metabolic disturbances** and even **death** [4].

Treatment

1-Uncomplicated viral GE requires no specific treatment except attention to fluid and electrolyte replacement [3] Most of these episodes are self-limited [4].

2-There is **no role for antiemetic or antidiarrheal** in GE [1].

3-**Antibiotics are rarely indicated** except for specific infections such as invasive salmonellosis, cholera , amebiasis or giardiasis [1, 3].

4-The **key management of GE is rehydration** with correction of fluid and electrolyte imbalance [1].

A-Unless the child has persistent vomiting,oral fluid is the best means for rehydration, smaller more frequent sips may be better tolerated and should be encouraged [1].

B-**Mild Dehydration**: ORS are used [1].

C-**Moderate dehydration:** Oral rehydration is still indicated if tolerated.
D-**I.V fluid** should be reserved for those **with vomiting or severe dehydration** [1].

5-**Zinc supplementation** (10–20 mg for 10–14 days) has been recommended by the WHO for the treatment and prevention of diarrheal disease in children in developing countries [4].

6-**Continuation of oral feeding**, despite diarrheal episodes, decreases the duration of illness; and improves nutritional status [4].

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3- **Judith M. Sondheimer, MD**. Current Essentials Pediatrics. Copyright © 2008 by The McGraw-Hill Companies, Inc.
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2-Viral Hepatitis

Etiology

1-There are six primary hepatitis viruses: Hepatitis A virus (HAV), Hepatitis B virus (HBV), Hepatitis C virus (HCV), Hepatitis D virus (HDV), Hepatitis E virus (HEV) and Hepatitis G virus (HGV) [(1)].

2-They differ in their transmission, severity, likelihood of persistence, and subsequent risk of hepatocellular carcinoma [(1)].

	HAV	**HBV**	**HCV**	**HDV**	**HEV**	**HGV**
Transmission	Fecal -oral	Transfusion , sexual, perinatal	Parenteral, transfusion, perinatal	Similar to HBV	Fecal -oral	Parenteral, transfusion

Note - The most important risk factor for acquisition of **HBV in children is perinatal exposure to infected mother**. In most cases, transmission **occurred at the time of delivery**; virus contained in amniotic fluid or in maternal blood may be the source. However less commonly intrauterine infection occurred [(2)].

3-**HBV and HCV cause chronic infection**, which may lead to **cirrhosis** and is a significant risk factor for **hepatocellular carcinoma** [(1)].

Clinical Manifestations

1-**Asymptomatic or mild**, nonspecific illness without icterus (jaundice) **is common** with HAV, HBV, and HCV, **especially in young children**[(1)].

2-The **preicteric phase**, which lasts approximately 1 week, is characterized by headache, anorexia, malaise, abdominal discomfort, nausea, and vomiting and usually precedes the onset of clinically detectable disease [(1)].

3-**Jaundice** and tender **hepatomegaly** are the most common physical findings and are characteristic of the **icteric phase**. Hepatic enzymes may increase 15- to 20-fold [(1)].

4-Resolution of the hyperbilirubinemia and normalization of the transaminases may take 6 to 8 weeks [(1)].

Complications

1-Most cases of acute viral hepatitis resolve without specific therapy, with less than 0.1% of cases progressing to **fulminant hepatic necrosis** which is associated with a high mortality rate [(1)].

2-**HAV and HEV cause acute infection only**. HBV, HCV, and HDV may persist as **chronic infection** with chronic inflammation, fibrosis, and **cirrhosis and the associated risk of hepatocellular carcinoma** [(1)].

Diagnosis

The diagnosis of viral hepatitis is confirmed by **serologic testing** [(1)].

Treatment

1-The treatment of acute hepatitis [(1)] (**except HCV** [(3)]) is largely supportive and involves rest, hydration, and adequate nutrition. Hospitalization is indicated for severe cases [(1)].

2-**Chronic HBV** infection may be treated with **interferon alfa-2b or lamivudine**, and HCV may be treated with interferon alfa usually in combination with Ribavirin [(1)].

References

1-Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition.2015.
2-Nelson Textbook of pediatrics. 29th edition.
3-Edward T. Bope, et al, eds. ***Conn's Current Therapy*****.** Copyright 2014.

3-Wilson's disease [(1, 2,3)]

1- Wilson's disease is a rare autosomal recessive disorder leading to **toxic accumulation of copper in the liver** and, subsequently, other tissues especially the brain and eye..

Presentation

• Kayser–Fleischer rings (**copper deposition in the eye**)
• **Hepatic problems** usually present in childhood (hepatitis, cirrhosis, fulminant hepatic failure).
• Adolescents/young adults usually present with **neurological disease**.

Diagnosis

The diagnosis is made by identifying **depressed serum levels of ceruloplasmin**, **elevated** 24-hour **urine copper excretion**, and the presence of **Kayser-Fleischer rings in the iris**.

Treatment

1-Treatment consists of administration of copper-chelating drugs (**penicillimine**) (reverses pre-cirrhotic liver disease, but not neurological damage).

2-**Zinc salts** often replace chelating agents after chelation therapy has successfully reduced excessive body copper stores.

3-Adequate therapy must be **continued for life** to prevent liver and CNS deterioration.
4-Liver transplantation is a highly effective treatment of WD as it reverses the systemic copper metabolism disturbances, changing hepatocyte copper metabolism (3).

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1- Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition. 2015.
2- Robert C. Tasker. Oxford Handbook of Paediatrics. 2nd edition.2013.
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H-Respiratory Disorders

1-Cystic Fibrosis

Background

1-Cystic fibrosis (CF) is an autosomal recessive multisystem disorder caused by mutations in the *cystic fibrosis transmembrane regulator* (**CFTR**) gene [(1)].

2- CFTR is important for the proper movement of salt and water across epithelial cell membranes especially in the airways, liver, and pancreas [(2)]. The term *cystic fibrosis* arises from the fibrotic scar tissue that replaces the destroyed pancreas [(3)].

Pathophysiology

A-Pulmonary System

1-In CF, there are reduced chloride secretion with excessive sodium resorption which lead to dehydration of the airway lining [(4)] leading to airway obstruction. This, in turn, leads to colonization with bacteria especially *Staphylococcus aureus* and *Pseudomonas aeruginosa* [(2)].
2-Chronic lung disease is a hallmark of CF, leading to death in 90% of patients [(5)]. CF patients will usually experience **chronic respiratory infections** [(6)].

B-Gastrointestinal Involvement

1- Approximately 10% of patients with CF are born with intestinal obstruction caused by inspissated meconium (**meconium ileus**). In older patients, intestinal obstruction may result from thick inspissated mucus in the intestinal lumen [(2)].

C-Hepatic Involvement

1-In patients with CF, there is reduction in water and sodium movement into the bile. **The resulting decrease in the volume and flow of bile leads to stasis and obstruction of the biliary tree**. With chronic obstruction, this leads to **biliary cirrhosis** [(3)].

D-Pancreatic Involvement

1-The obstruction of the pancreatic ducts result in the inability to excrete pancreatic enzymes into the intestine. This leads to malabsorption of proteins, sugars (to a lesser extent), and **especially fat**. Fat malabsorption manifests clinically as **steatorrhea** (large foul-smelling stools), **deficiencies of fat-soluble vitamins** (A, D, E, and K), and **failure to thrive** [2].

E-Sweat Gland

In the sweat duct, CFTR reabsorbs chloride from sweat. Dysfunctional CFTR results in a **nearly fivefold elevation in sweat chloride concentrations**. This is the principal laboratory criterion for diagnosis of CF (**sweat chloride test**) [7].

Diagnosis

CF is most commonly diagnosed on the basis of typical **signs and symptoms** and an abnormal sweat chloride concentration (>60 mEq/L) (**sweat chloride test**) [3, 7].

Treatment

The treatment of CF is multifactorial, but it is primarily directed toward the gastrointestinal and pulmonary complications [2].

A-Gastrointestinal System

1-**Pancreatic enzyme replacement** (lipase, protease, and amylase) is the mainstay of gastrointestinal therapy [5].

2-**Fat-soluble vitamins (A, D, E, and K) supplementation** is usually required in pancreatic insufficiency [5].

3-The use **of ursodeoxycholic acid (UDCA)** may improves bile flow, prevent obstruction and slow progression of liver disease [5, 7].

B-Treatment of Cystic Fibrosis Airway Disease

Treatment of CF airway disease involves the use of medications and techniques to mobilize pulmonary secretions, and antibiotics to manage infection [3].

1-Mucociliary Clearance

A-Physical Therapy: Airway clearance can be performed using various techniques. These techniques are recommended **on a daily basis to help mobilize secretions** [8].

B-Mucolytic Therapy: Sputum viscosity is increased by the large quantities of extracellular DNA that result from chronic airway inflammation and degradation of neutrophils [9]. **Inhaled recombinant human deoxyribonuclease** (rhDNase, dornase alpha) cleaves extracellular DNA in sputum [9].

C-Airway Hydration Therapies : Inhalation of hypertonic saline rehydrates the airways through osmotic flow of water [(3)].

D-Bronchodilators: β-Agonists keep airways open and facilitate airway clearance [(8)].

2-Antibiotics

1-Antibiotics are used to treat lung infection. *Typical regimens for severe infections include an antipseudomonal β-lactam plus an aminoglycoside for added synergy and delay of resistance development* [(5)].

2-**Fluoroquinolone** use is common among CF patients infected with ***P. aeruginosa*****,** even in children [(5)].

3-**Chronic maintenance antibiotic therapy may be used in patients with *Pseudomonas* colonization** in an attempt to prevent bacterial overgrowth [(5)]. **Inhaled tobramycin** has been studied the most extensively [(5)].

Pharmacokinetic Considerations

CF patients have **larger volumes of distribution of many antibiotics** and also have an enhanced total body clearance [(5)]. As a result of these pharmacokinetic changes, **higher doses of antibiotics** (e.g. aminoglycosides, and β-lactam antibiotics) are needed [(5)].

Lung transplantation

Lung transplantation is currently the only definitive treatment for advanced cystic fibrosis [(9)].

Prognosis

The longevity of patients with cystic fibrosis is increasing, and the median survival age is over 35 years. Death occurs mostly from pulmonary complications [(9)].

References

1-Thomas P. Green. ***Pediatrics Just the Facts***. Copyright © 2005 by The McGraw-Hill Companies, Inc.

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7-David J Quan, Richard A Helms. ***Textbook of Therapeutics***: Drug and Disease Management. 8th edition.

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I-Endocrinology

1-Diabetic ketoacidosis (DKA)

1-**Definition**: Arterial pH <7.30, bicarbonate <15 meq/L, glucose >250 mg/dL, and Urinary ketones [1, 2].

2-DKA is a major **medical emergency** and remains a serious cause of morbidity, principally in people **with type 1 diabetes** [3] (**More common in type 1 DM** but can occur in type 2 DM) [4].

3-A significant number of **newly diagnosed diabetic children** present with DKA. In children with known diabetes, DKA occurs in patient who omit insulin doses or who do not successfully manage an intercurrent illness [3, 5].

Risk Factors

1-**Omission of insulin** is the most common precipitant of DKA [6].

2-**Infections**, acute medical illnesses, and stress of recent surgical procedures can contribute to the development of DKA [6].

Pathophysiology

1-The **hyperglycaemia** causes a profound **osmotic diuresis** leading to **dehydration**, hyperosmolarity, and **electrolyte loss**, particularly of sodium and potassium [3, 6].

2-Owing to increased lipolysis and decreased lipogenesis, free fatty acids are converted to ketone bodies and lead to **metabolic acidosis** [6, 7].

3- **Electrolyte abnormalities** occur through a loss of electrolytes in the urine [7]. In addition, The resulting metabolic acidosis causes efflux of potassium from cells, results in intracellular potassium depletion [3, 6].

Clinical Presentation

1-Patients with DKA present initially with **polyuria**, **polydipsia**, **nausea**, and **vomiting**. **Abdominal pain** occurs frequently [7].

2-Respiratory compensation for acidosis results in **tachypnea with deep (Küssmaul) respirations**. The **fruity odor of acetone** frequently can be detected on the patient's breath [7].
3-An altered mental status can occur, ranging from disorientation to coma [7].

Management

1-DKA is a **medical emergency** which should be treated in hospital [3]. The principal components of treatment are :
• The administration of **short-acting** (soluble) insulin [3].

• **Fluid** replacement [3].
• **Potassium** replacement [3].
• The administration of **antibiotics** if infection is present [3].
Note: for more detailed about for the management of ketoacidosis , there is **a Diabetic Ketoacidosis Treatment Protocol** [5].

Complications

The most concerning complication of DKA is **cerebral oedema** (Treatment by Mannitol 1 g/kg IV) [2].

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1-Thomas P. Green. ***Pediatrics Just the Facts***. Copyright © 2005 by..
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7-Robert M. Kliegman. Nelson essentials of pediatrics. 7th edition.2015.

Most commonly used ANTIBIOTICS IN PEDIATRICS (the last 2 columns to be filled by the student)

No.	Antibiotics	indication	Doses	Sever interactions	Fluid-compatibilities
1	Amoxicillin	Susceptible infections (including UTIs,otitis media, sinusitis, uncomplicated community acquired pneumonia, salmonellosis	***IV injection and IV infusion*** a.Neonate up to 7 days: **30 mg/kg every 12 hours**, increased if necessary to 60 mg/kg every 12 hours, increased dose used in severe infection, community-acquired pneumonia or salmonellosis. b.Neonate 7 days to 28 days: **30 mg/kg every 8 hours,**increased if necessary to 60 mg/kg every 8 hours,increased dose used in severe infection, community acquired pneumonia or salmonellosis. c.Child: **20-30 mg/kg** every 8 hours (max. per dose 500 mg), ↑ if necessary to 40-60 mg/kg every 8 hours (max. per dose 1 g every 8 hours), ↑dose used in severe infection		
2	Cefotaxime	Infections due to sensitive Gm+ve and Gm –ve bacteria | Surgical prophylaxis |Haemophilus epiglottitis Severe susceptible infections due to sensitive	▸ BY I.M INJECTION, or by I.V INJECTION, OR BY IV INFUSION ▸a.Neonate up to 7 days: 25 mg/kg every 12 hours. b.Neonate 7 days to 20 days: 25 mg/kg every 8 hours. c.Neonate 21 days to 28 days: 25 mg/kg every 6-8 hours. d. Child: 50 mg/kg every 8-12 hours. ▸ BY I.M Inj, OR BY I.V inj.or by I.V infus. ▸a. Neonate up to 7		

		Gm +ve and Gm -ve bacteria | Meningitis	days: 50 mg/kg every 12 hours. ▸ b.Neonate 7 days to 20 days: 50 mg/kg every 8 hours. ▸ c.Neonate 21 days to 28 days: 50 mg/kg every 6-8 hours. ▸ d.Child: 50 mg/kg every 6 hours;		
3	Ceftriaxone	Community-acquired pneumonia | Hospital-acquired pneumonia | Intra-abdominal infections | Complicated UTIs.	▸ BY INTRAVENOUS INFUSION ▸ a.Neonate up to 15 days: 20-50 mg/kg once daily, doses at the higher end of the recommended range used in severe cases. ▸b. Neonate 15 days to 28 days: 50-80 mg/kg once daily, doses at the higher end of the recommended range used in severe cases. ▸c. Child 1 month–11 years (body-weight up to 50 kg): 50-80 mg/kg once daily, doses at the higher end of the recommended range used in severe cases; maximum 4 g per day ▸ d.Child 9–11 years (body-weight 50 kg and above): 1-2 g once daily, 2 g dose to be used for hospital-acquired pneumonia and severe cases ▸e. Child 12–17 years: 1-2 g once daily, 2 g dose to be used for hospital-acquired pneumonia and severe cases ▸ BY INTRAVENOUS INJECTION ▸ a.Child 9–11 years (body-weight 50 kg and		

			above): 1–2 g once daily, 2 g dose to be used for hospital-acquired pneumonia and severe cases ▸ b.Child 12–17 years: 1–2 g once daily, 2 g dose to be used for hospital-acquired pneumonia and severe cases ▸ BY DEEP INTRAMUSCULAR INJECTION ▸ a.Child 1 month–11 years (body-weight up to 50 kg): 50–80 mg/kg daily, doses at the higher end of the recommended range used in severe cases;maximum 4 g per day ▸ b.Child 9–11 years (body-weight 50 kg and above): 1–2 g once daily, 2 g dose to be used for hospital-acquired pneumonia and severe cases ▸ c.Child 12–17 years: 1–2 g once daily, 2 g dose to be used for hospital-acquired pneumonia and severe cases ▸ BY INTRAVENOUS INFUSION ▸a. Neonate up to 15 days: 50 mg/kg once daily. ▸b. Neonate 15 days to 28 days: 80–100 mg/kg once daily, 100 mg/kg once daily dose should be used for bacterial endocarditis. ▸ c.Child 1 month–11		
		Bacterial meningitis | Bacterial endocarditis			

			years (body-weight up to 50 kg): 80‑100 mg/kg once daily, 100 mg/kg once daily dose should be used for bacterial endocarditis; maximum 4 g per day ▸ d.Child 9–11 years (body-weight 50 kg and above): 2‑4 g once daily, doses at the higher end of the recommended range used in severe cases ▸ e.Child 12–17 years: 2‑4 g once daily, doses at the higher end of the recommended range used in severe cases ▸ BY INTRAVENOUS INJECTION ▸ Child 9–11 years (body-weight 50 kg and above): 2‑4 gonce daily, doses at the higher end of the recommended range used in severe cases; doses of 50 mg/kg or more should be given by infusion ▸ Child 12–17 years: 2‑4 g once daily, doses at the higher end of the recommended range used in severe cases		
4	Meropenim	Aerobic and anaerobic Gram-positive and Gram-negative infections | Hospital-acquired septicaemia	BY I.V INFUSION, or by I.V INJECTION ▸ a.Neonate up to 7 days: 20 mg/kg every 12 hours. ▸ b.Neonate 7 days to 28 days: 20 mg/kg every 8 hours. ▸ c.Child 1 month–11 years (body-weight up to 50 kg): 10‑20 mg/kg every 8 hours		

		Severe aerobic and anaerobic Gram-positive and Gm -ve infections Meningitis	▸ d.Child 1 month–11 years (body-weight 50 kg and above): 0.5‑1 g every 8 hours ▸ e.Child 12–17 years: 0.5‑1 g every 8 hours ▸ BY INTRAVENOUS INFUSION, OR BY INTRAVENOUS INJECTION ▸ Neonate up to 7 days: 40 mg/kg every 12 hours. ▸ Neonate 7 days to 28 days: 40 mg/kg every 8 hours. ▸ BY INTRAVENOUS INFUSION ▸ a.Neonate up to 7 days: 40 mg/kg every 12 hours. ▸b. Neonate 7 days to 28 days: 40 mg/kg every 8 hours. ▸ c.Child 1 month–11 years (body-weight up to 50 kg): 40 mg/kg every 8 hours ▸d. Child 1 month–11 years (body-weight 50 kg and above): 2 g every 8 hours ▸ e.Child 12–17 years: 2 g every 8 hours		
5	Metronidazole	Anaerobic infections	BY INTRAVENOUS INFUSION ▸a.Neonate up to 26 weeks corrected gestational age: Loading dose 15 mg/kg, followed by 7.5 mg/kg after 24 hours, then 7.5 mg/kg daily usually treated for a total duration of 7 days (for 10‑14 days in Clostridium difficile infection). ▸ b.Neonate 26 weeks to 34 weeks corrected		

			gestational age: Loading dose 15 mg/kg, followed by 7.5 mg/kg after 12 hours, then 7.5 mg/kg every 12 hours usually treated for a total duration of 7 days (for 10‑14 days in Clostridium difficile infection). C,Child 1 month: Loading dose 15 mg/kg, followed by 7.5 mg/kg after 8 hours, then 7.5 mg/kg every 8 hours usually treated for a total duration of 7 days (for 10‑14 days in Clostridium difficile infection) ▸ d.Child 2 months–17 years: 7.5 mg/kg every 8 hours (max. per dose 500 mg) usually treated for 7 days (for 10‑14 days in Clostridium difficile infection)		
6	Ciprofloxacin	Severe respiratory-tract infections,gastrointestinal infection Pseudomonal lower respiratory-tract infection	▸ BY MOUTH ▸ Neonate: 15 mg/kg twice daily. ▸ Child: 20 mg/kg twice daily (max. per dose 750 mg) ▸ BY INTRAVENOUS INFUSION ▸ Neonate: 10 mg/kg every 12 hours, to be given over 60 minutes. ▸ Child: 10 mg/kg every 8 hours (max. per dose 400 mg),to be given over 60 minutes ▸ BY MOUTH ▸ Child: 20 mg/kg twice daily (max. per dose 750 mg)		

		in cystic fibrosis	▸ BY IV INFUSION ▸ Child: 10 mg/kg every 8 hours (max. per dose 400 mg),to be given over 60 minutes		
7	Co-amoxiclav	Infections due to beta-lactamase-producing strains (where amoxicillin alone not appropriate), including respiratory tract infections, bone and joint infections, genito-urinary and abdominal infections, cellulitis and animal bites	▸ BY MOUTH USING TABLETS ▸ Child 12–17 years: 250/125 mg every 8 hours; increased to 500/125 mg every 8 hours, increased dose used for severe infection ▸ BY INTRAVENOUS INJECTION, OR BY INTRAVENOUS INFUSION ▸ Neonate: 30 mg/kg every 12 hours. ▸ Child 1–2 months: 30 mg/kg every 12 hours ▸ Child 3 months–17 years: 30 mg/kg every 8 hours (max. per dose 1.2 g every 8 hours)		
8	Piperacillin with tazobactam	Hospital-acquired pneumonia | Septicaemia | Complicated infections involving the urinary-tract | Complicated infections involving the skin | Complicated infections involving the soft-tissues	▸ BY INTRAVENOUS INFUSION ▸a. Neonate: 90 mg/kg every 8 hours. ▸b. Child 1 month–11 years: 90 mg/kg every 6‑8 hours (max. per dose 4.5 g every 6 hours) ▸ c.Child 12–17 years: 4.5 g every 8 hours; increased if necessary to 4.5 g every 6 hours, increased frequency may be used for severe infections Complicated intra-abdominal infections ▸ BY INTRAVENOUS INFUSION ▸ a.Child 2–11 years: 112.5 mg/kg every 8 hours (max. per		

		Infections in neutropenic patients	dose 4.5 g) ▸ b.Child 12–17 years: 4.5 g every 8 hours; increased if necessary to 4.5 g every 6 hours, increased frequency may be used for severe infections ▸ BY INTRAVENOUS INFUSION ▸ Child: 90 mg/kg every 6 hours (max. per dose 4.5 g)		
9	vancomycin	Complicated skin and soft tissue infections | Bone infections | Joint infections | Community-acquired pneumonia | Hospital-acquired pneumonia [including ventilator-associated pneumonia] | Infective endocarditis | Acute bacterial meningitis | Bacteraemia [occurring in association with or suspected to be associated with the licensed indications]	a.Child 1 month–11 years: 10‑15 mg/kg every 6 hours adjusted according to plasma-concentration monitoring, duration should be tailored to type and severity of infection and the individual clinical response−consult product literature for further information, doses higher than 60 mg/kg/day cannot be generally recommended as the safety of increased dosing has not been fully assessed ▸ b.Child 12–17 years: 15‑20 mg/kg every 8‑12 hours (max. per dose 2 g) adjusted according to plasma concentration monitoring, duration should be tailored to type and severity of infection and the individual clinical response− consult product literature for further information, in		

			seriously ill patients, a loading dose of 25‑30 mg/kg (usual max. 2 g) can be used to facilitate rapid attainment of the target trough serum vancomycin concentration		

Some Pediatric Doses (to be filled by the student)

	Drug	Pediatric Dose
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		