Antibiotics (neonatology)

The initial clinical signs of infection in the newborn tend to be non-specific, however, delays in starting treatment can have serious consequences. Therefore, in case of clinical suspicion of infection, empirical antibiotic therapy should be initiated immediately after collections of samples for culture cultivation. The duration of treatment depends on the clinical response, the type of pathogen and the location of the infection. Combinations of antibiotics are often given to cover a wider range of pathogens, to exploit the synergistic effect and to prevent the development of resistance.

The following groups of antibiotics are most often used in neonatology:

- Beta-lactam antibiotics:
  - narrow-spectrum penicillins: penicillin G, oxacillin;
  - broad-spectrum penicillins: ampicillin, amoxicillin;
  - penicillins with beta-lactamase inhibitors: clavulanic acid (Amoxiclav®, Augmentin®), sulbactam (Unasyn®), tazobactam (Tazocin®);
  - 3rd generation cephalosporins: ceftriaxone, cefotaxime, ceftazidime
    - → gram-negative meningitis, pneumococcal infections, etc.; ceftazidime → pseudomonas infections.
  - carbapenems: meropenem
    - → very broad spectrum (all bacteria except Enterococcus faecium, Burkholderia cepacia, MRSA); parenteral administration only.
- Aminoglycosides: gentamicin, amikacin
  - → gram-negative aerobic bacteria; parenteral administration only; bactericidal.
- Glycopeptides: vancomycin, teicoplanin;
  - → gram-positive bacteria;
- Nitroimidazoles: metronidazole;
  - → anaerobic bacteria;
- Macrolides: azithromycin.

Empirical antibiotic therapy

Early neonatal sepsis

- development of sepsis in the first 48 (72) hours of life;
- most commonly caused by mother-borne bacteria (Streptococcus agalactiae, Escherichia coli);
- 1st choice antibiotics: penicillin + gentamicin, if Listeria monocytogenes is supected then ampicillin + gentamicin;
- empirical antibiotic therapy should be discontinued after 36-48 hours if the blood culture is negative and the newborn has no clinical signs of infection.

Late neonatal sepsis

- development of sepsis after the first 48 (72) hours of life;
- most often caused by staphylococci (CoNS, S. aureus) or enterobacteria;
- 1st choice antibiotics: oxacillin + gentamicin;
- in suspected sepsis with negative blood culture ("clinical sepsis"), are antibiotics usually administred for 5 days;
- in case of positive blood culture, antibiotics are administered for at least 10 days; in the treatment of St. aureus for at least 14 days - in consultation with a microbiologist;
- in case of positive cultivation of cerebrospinal fluid or clinical signs of meningitis, the treatment lasts at least 21 days;
- treatment of osteomyelitis, endocarditis or deep abscess takes number of weeks

You can find more detailed information on the page Neonatal Sepsis

Meningitis

- antibiotics: cefotaxime + amoxicillin or penilin G ± gentamicin.

You can find more detailed information on the page Purulent meningitis (pediatrics)

Necrotizing enterocolitis

You can find more detailed information on the page Necrotizing enterocolitis

Urinary tract infections

You can find more detailed information on the page Urinary tract infections

The most used antibiotics

An overview of beta-lactam antibiotics most commonly used in neonatology:

Antibiotic		Intensity and mechanism of action	Spectrum of effect	Side effects	Extra notes
Penicillin G	basic penicillin		Gram-positive cocci (except staphylococcus aureus) including all sensitive species of streptococci (not enterococci), Gram-positive bacilli (Clostridium tetani, Corynebacterium diphtheriae), some Gram-negative organisms (Neisseria meningitidis, Haemophilus influenzae, Neisseria gonorobacteria) , E. coli and other Gram-negative organisms are resistant due to their ability to produce beta-lactamase		poor blood-brain barrier permeability
Ampicillin	semi-synthetic penicillinase-sensitive penicillin (aminopenicillin)	bactericidal; inhibits cell wall synthesis	streptococci, pneumococci, enterococci, penicillinase-non-producing staphylococci, Listeria, meningococci, some species of Haemophilus influenzae, Proteus mirabilis, Salmonella, Shigella, E. coli, Enterobacter, Klebsiella		
Oxacillin	semi-synthetic penicillinase-resistant penicillin; antistaphylococcal penicillin	bactericidal	osteomyelitis, septicemia, endocarditis and CNS infections caused by sensitive penicillinase-producing staphylococci		
Flucloxacillin	antistaphylococcal penicillin				
Piperacillin/tazobactam (Tazocin)	combination of acylureidopenicillin and a beta-lactamase inhibitor (tazobactam)		sepsis, intra-abdominal infections, skin, lower respiratory tract and urinary tract infections caused by sensitive beta-lactamase-producing species of St. aureus, H. influenzae, Bacteroides fragilis, Klebsiella, Pseudomonas, Proteus mirabilis, E. coli and Acinetobacter	serum urea and creatinine elevations, interstitial nephritis, renal failure, leukopenia, thrombocytopenia, neutropenia, hemoglobin / hematocrit decline, eosinophilia, AST and ALT elevations, hyperbilirubinemia, cholestatic jaundice, hypokalaemia	good permeability to tissues and body fluids including lungs, intestinal mucosa, interstitial fluid, gallbladder and bile, poor permeability to cerebrospinal fluid without the presence of meningitis
Ampicillin/sulbactam (Unasyn)	combination of aminopenicillin and beta-lactamase inhibitor (sulbactam)	bactericidal	beta-lactamase-producing organisms - St. aureus, H. influenzae, E. coli, Klebsiella, Acinetobacter, Enterobacter and anaerobes		
Amoxicillin/clavulanate (Augmentin)	combination of aminopenicillin and beta-lactamase inhibitor (clavulanate)				
Cefotaxim	3rd generation cephalosporin				
Ceftazidim	3rd generation cephalosporin	bactericidal	Gram-negative aerobic bacteria including Neisseria, H. influenzae, some Enterobacteriaceae, Pseudomonas		synergistic effect with aminoglycosides; good permeability to cerebrospinal fluid
			pneumococcal and		

Meropenem	carbapenem		pseudomonas meningitis, Klebsiella pneumoniae ESBL (extended-spectrum beta-lactamase), multidrug-resistant Gram-negative organisms and Gram-positive aerobic and anaerobic pathogens		good permeability to cerebrospinal fluid and most body tissues

An overview of non-beta-lactam antibiotics most commonly used in neonatology:

Antibiotic		Intensity and mechanism of action	Spectrum of effect	Side effects	Extra notes
Gentamicin	aminoglycoside	bactericidal	Gram-negative aerobic bacteria including Pseudomonas, Proteus, Serratia		
Metronidazole	nitroimidazole		meningitis, ventriculitis and endocarditis caused by Bacteroides fragilis and other penicillin-resistant anaerobes; severe intra-abdominal infections; colitis caused by Clostridium difficile		
Vancomycin	glycopeptide	bactericidal (bacteriostatic against enterococci)	Gram-positive cocci and bacilli including streptococci, staphylococci (including methicillin-resistant staphylococci, MRSA), clostridia, corynebacteria and Listeria monocytogenes	ototoxicity, nephrotoxicity, thrombophlebitis at the site of administration, allergy (rash, fever)	
Rifampicin	rifamycin	bacteriostatic	mycobacteria, Neisseria meningitidis, Gram-positive cocci; elimination of meningococci in symptomatic carriers; prophylaxis of contacts of patients with H. influenzae type B infection; in combination for the treatment of active tuberculosis and staphylococcal infections	anorexia, vomiting, diarrhea, rash, pruritus, eosinophilia, leukopenia, thrombocytopenia, haemolytic anemia, rarely hepatitis, elevated serum urea and uric acid levels, red-orange discoloration of body fluids	good permeability through the blood-brain barrier and into body tissues and fluids, hepatic metabolism, undergoes enterohepatic circulation; it should always be used in combination, as resistance develops rapidly during monotherapy

Bacterial resistance

More detailed information can be found on the pages Antibiotic resistance, Beta-lactamases, Resistance to macrolides and lincosamides (main causes of resistance, efflux).

Side effects of antibiotics

References

Related articles

- Neonatal infections
- Antibiotics

External links

- Mechanisms in Medicine: ß-Lactams - Mechanisms of Action and Resistance (video) (https://www.youtube.com/watch?v=qBdYnRhdWcQ)
- JJ Medicine: Aminoglycosides | Bacterial Targets, Mechanism of Action, Side Effects (video) (https://www.youtube.com/watch?v=h1d2meyYpOE)
- Mechanisms in Medicine: Macrolides - Mechanisms of Action and Resistance (video) (https://www.youtube.com/watch?v=oC21vLFtsjo)
- Mechanisms in Medicine: The Role of Amphotericin (video) (https://www.youtube.com/watch?v=H11LP48mbTI)
- Mechanisms in Medicine: The Role of Azoles (video) (https://www.youtube.com/watch?v=T-dwE11AhqA)

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