

Antimicrobial treatment of neonatal meningitis.

Calculation skills CPD

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Neonatal meningitis is characterised as an infection within the meninges, the protective membranes surrounding the brain and spinal cord, occurring within the first 28 days of life. Neonates are at their most susceptible to infection in this period due to the immature activation and function of their immune responses (Verklan et al. 2021).

When neonatal meningitis is suspected early initiation of antimicrobial therapy is essential. Antibiotic therapy is guided by whether the infection is early onset- less than 7 days of age when the origin may be from in-utero, maternal or at birth exposure, or late onset after 7 days of life and origin of the causative pathogen may be environment including hospital acquired infection.

With early onset suspected meningitis amoxicillin and cefotaxime are the antibiotics of choice until a specific organism is cultured and sensitivity known. Amoxicillin is a semisynthetic penicillin, with bactericidal activity against both Gram-positive and Gram-negative organisms (Huttner et al. 2020). Cefotaxime, as a third generation cephalosporin, has increased antimicrobial activity against gram-negative bacilli in addition to enhanced penetration across the blood–brain barrier when compared to gentamicin (NICE, 2021). (Table 1)

There should be regular evaluation of the neonate's condition and response to treatment. Reconsideration of the antibiotic regime may be warranted if there is clinical deterioration and surveillance of local bacterial resistance patterns may indicate a specific antibiotic is more appropriate than those recommended by universal guidelines.

Neonates have altered pharmacokinetic responses with a slower rate of oral drug absorption and a higher volume of distribution. They also exhibit less efficient metabolism and

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elimination of medications (Rivera-Chaparro et al., 2017). With the use of nephrotoxic and ototoxic antibiotics such as gentamicin regular monitoring of drug concentrations is required to ensure safe and effective therapy.

TABLE 1: Neonatal meningitis antimicrobial therapy (NICE, 2021)

| CAUSATIVE AGENT | THERAPY |
|--|---|
| Suspected infection with causative agent unknown | <p><u>IV amoxicillin</u></p> <ul style="list-style-type: none"> • Neonate up to 7 days: 30 mg/kg every 12 hours. Increase to 60 mg/kg every 12 hours, in severe infection. • Neonate 7 to 28 days: 30 mg/kg every 8 hours. Increase to 60 mg/kg every 8 hours in severe infection. <p>PLUS</p> <p><u>IV cefotaxime</u></p> <ul style="list-style-type: none"> • Neonate up to 7 days: 50 mg/kg every 12 hours. • Neonate 7 to 20 days: 50 mg/kg every 8 hours. • Neonate 21 to 28 days: 50 mg/kg every 6–8 hours. |
| Confirmed Gram-negative infection | <p><u>IV cefotaxime</u></p> <ul style="list-style-type: none"> • Neonate up to 7 days: 50 mg/kg every 12 hours. • Neonate 7 to 20 days: 50 mg/kg every 8 hours. • Neonate 21 to 28 days: 50 mg/kg every 6–8 hours. |
| Confirmed Gram-positive bacterium | <p><u>IV amoxicillin</u></p> <ul style="list-style-type: none"> • Neonate up to 7 days: 30 mg/kg every 12 hours. Increase to 60 mg/kg every 12 hours, in severe infection. • Neonate 7 to 28 days: 30 mg/kg every 8 hours. Increase to 60 mg/kg every 8 hours in severe infection. <p>PLUS</p> <p><u>IV cefotaxime</u></p> <ul style="list-style-type: none"> • Neonate up to 7 days: 50 mg/kg every 12 hours. • Neonate 7 to 20 days: 50 mg/kg every 8 hours. • Neonate 21 to 28 days: 50 mg/kg every 6–8 hours. |
| Confirmed positive for Group B streptococcus | <p><u>IV benzylpenicillin</u></p> <ul style="list-style-type: none"> • 50 mg/kg every 12 hours <p>PLUS</p> <p><u>IV gentamicin*</u></p> <ul style="list-style-type: none"> • starting dosage of 5 mg/kg every 36 hours** |
| Confirmed positive for listeria | <p><u>IV amoxicillin</u></p> <ul style="list-style-type: none"> • Neonate up to 7 days: 50–100 mg/kg every 12 hours. • Neonate 7 to 28 days: 50–100 mg/kg every 8 hours. <p>PLUS</p> <p><u>IV gentamicin</u></p> <ul style="list-style-type: none"> • Neonate up to 7 days: 5 mg/kg every 36 hours***. • Neonate 7 to 28 days: 5 mg/kg every 24 hours***. |

Key: * a dosage of 5 mg/kg every 36 hours is an off-label use of gentamicin. ** gentamicin subsequent doses and intervals adjusted if necessary based on blood gentamicin concentrations. ***gentamicin given in an extended interval dose regime based on response. (BNFc, 2024)

Table 1: Neonatal meningitis antimicrobial therapy (NICE, 2021)

Drug calculations

Based on the information given in Table 1 what antimicrobial therapy should be prescribed.

Question 1

Baby A, weight 3500g and 4 days of age, is clinically unwell with suspected neonatal meningitis.

Question 2

Baby B, weight 1700grams and 10 days of age, presents with suspected severe neonatal meningitis.

Question 3

Baby C, weight 2200g and 12 days of age with meningitis and confirmed gram negative infection.

Question 4

Baby D, weight 700grams and 2 days of age with meningitis and confirmed gram positive infection.

Question 5

Baby E, weight 2600grams and 10 days of age with confirmed Group B streptococcus meningitis. Baby E's gentamicin concentration returns as greater than acceptable levels and dose should be reduced by 20% prior to next administration. What is the new dose?

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Antimicrobial treatment of neonatal meningitis: calculations skills answers

Answer 1

Baby A, weight 3500g and 4 days of age, with suspected neonatal meningitis.

IV amoxicillin: 30 mg/kg every 12 hours.

Weight 3500g =3.5kg

30mg x 3.5kg= 105mg/12hourly.

IV cefotaxime: 50 mg/kg every 12 hours.

50mg x 3.5kg=175mg/12 hourly.

Answer 2

Baby B, weight 1700grams and 10 days of age, with severe neonatal meningitis.

IV amoxicillin: 60 mg/kg every 8 hours in severe infection.

60mg x 1.7g = 102mg /8 hourly.

IV cefotaxime: 50 mg/kg every 8 hours.

50 x 1.7g = 85mg / 8 hourly.

Answer 3

Baby C, weight 2200g and 12 days of age with confirmed gram negative infection.

IV cefotaxime: 50 mg/kg every 8 hours.

50mg x 2.2g= 110mg / 8 hourly.

Answer 4

Baby D, weight 700grams and 2 days of age with confirmed gram positive infection.

IV amoxicillin: 30 mg/kg every 12 hours.

30mg x 0.7g = 21mg /12 hourly.

IV cefotaxime: 50 mg/kg every 12 hours.

50 x 0.7g = 35mg / 12 hourly.

Answer 5

Baby E, 2600grams and 23 days of age with confirmed Group B streptococcus infection.

IV benzylpenicillin 50 mg/kg every 12 hours

50mg x 2.6g = 130mg /12hourly

IV gentamicin 5 mg/kg every 36 hours

5mg x 2.6g = 13mg/ 36 hourly

IV gentamicin reduced by 20%.

13/100 x 80 = 10.4mg.