Clinical Guidance

Paediatric Critical Care: Pertussis Infection

Summary
Pertussis guidance reviewing pathophysiology, clinical presentation, DGH treatment. Indications for early referral, PICU management and public health.

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This clinical guideline has been produced by the South Thames Retrieval Service (STRS) at Evelina London for nurses, doctors and ambulance staff to refer to in the emergency care of critically ill children.

This guideline represents the views of STRS and was produced after careful consideration of available evidence in conjunction with clinical expertise and experience. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.

Glossary: *WCC- white cell count, FBC- full blood cell, PCR- polymerase chain reaction- virology test, NPA- nasopharyngeal aspirate, BAL- bronchoalveolar lavage, CVS- cardiovascular, RBC- red blood cells, HFOV High frequency oscillation ventilation*

Change History		
Date	Change details, since approval	Approved by
Aug '15	Health Protection Agency changed to Public Health. Advice on ECMO and Leucofilter changed.	Evelina CGG
Dec '22	Addition of ECMO MDT discussion. Addition of 'main considerations'. Paediatric ARDS guideline hyperlink	ELCGC, Dec 2022

Paediatric Critical Care

Pertussis infection

South Thames RETRIEVAL SERVICE

Pertussis = "Whooping Cough"

Broad spectrum of disease severity. Highly contagious, with significant morbidity and mortality in infancy

Main considerations:

- Can cause significant lymphocytosis with hyperviscosity
- Risk of multi-organ impairment with significant potential for neurological sequelae & death.
- Vaccination in 3rd trimester of pregnancy from 2012 has ↓cases

Causative organism = Bordetella Pertussis:

- Gram-negative coccobacillus producing potent endotoxins.
- Endotoxin-mediated vascular endothelial damage, lymphocyte deformity with abnormal rolling, toxin-mediated lymphocytosis & hyperviscosity syndrome.
- Consequent microvascular thrombosis with pulmonary hypertension, necrotising bronchiolitis/pneumonia, myocardial dysfunction and encephalitis.

Clinical presentation

Infants: respiratory illness, apnoeas, seizures
Highest risk for severe disease: < 3 months/ unimmunised
Reducing risk with repeat immunisation
Early recognition, aggressive management and early referral of infants is essential

Older children: respiratory illness with inspiratory 'whoop', post-tussive vomiting, prolonged spasmodic cough

Suspect in respiratory illness with:

- leukocytosis with lymphocytosis (WCC ≥20 with ≥ 50% lymphocytes) or isolated lymphocytosis
- known/suspected contact with carrier of pertussis

Differential diagnoses:
Bronchiolitis, pneumonia, para-pertussis, encephalitis, sepsis.

NB: Co-infection with respiratory virus is commonly seen (16-23% of cases)

Initial management at local hospital

Admit all infants <3 months with suspected pertussis (symptoms + lymphocytosis) for observation & repeat FBC

- Early symptoms may be mild.
- This group frequently develop severe disease

All suspected cases:

- **Isolation** until macrolide antibiotic treatment completed
- **Notify** local health protection team (HPT): see below
- **Staff:** consider their own immunisation status (see below)

Baseline investigations:

- ≤12 months: Pernasal swab for PCR
- >12 months: Pernasal swab for culture if < 2 wks since onset of symptoms OR bloods for serology if >2 wks since onset of symptoms (and > 1yr post pertussis immunisation)
- NPA and BAL for other respiratory pathogens
- FBC with differential: Repeat every 6 hours if WCC rising or deteriorating clinical condition
- Chest X-ray (pneumonic changes)
- ECG (ischaemia, pulmonary hypertension, right heart strain)

Treatment

- Azithromycin daily enterally for 3 days
- Clarithromycin IV If concerns about enteral absorption
- Co-amoxiclav empirically to cover other respiratory pathogens
- Consider broader cover for those presenting with apnoea/seizures

General management

- Fluid restrict to 2mL/kg/h; Enteral feeds preferable
- Close observation of respiratory and cardiovascular status

Indications for early PICU referral

- Infants ≤ 3 months with clinical or laboratory deterioration
- WCC ≥ 30 on admission or rapidly rising WCC (>10 /6h)
- Respiratory failure/frequent apnoea
- Pneumonic changes on CXR
- Persistent tachycardia/ cardiovascular instability
- Neurological symptoms including seizures

PICU management

Highest risk group are those with pneumonia

→ Ventilation strategy as for ARDS: **Paediatric ARDS**

Initial Investigations:

- ECHO – assess cardiac function and pulmonary artery pressures
- Monitor WCC 6 hourly
- Baseline head ultrasound (possibility of ECMO)

Urgent double volume exchange transfusion to reduce WCC if:

- WCC ≥ 30 and rapidly rising
- WCC ≥ 30 with pneumonia or cardiovascular instability
- WCC ≥ 50

Double volume exchange transfusion considerations:

- *ECMO centre should be fore-warned of child's condition*
- 200mL/kg in 20mL aliquots over 2 hrs
- Replace whole blood with packed RBCs + crystalloid fluid – target HCT of 0.4-0.45
- Target final WCC of < 20
- Repeat FBC 2 hours after completion, then 6 hourly

Success relies on procedure being carried out before the infant is severely compromised

If cardiorespiratory failure is refractory to above, urgent referral to an ECMO centre

- ECMO outcomes poor <6wks of age
- All cases warrant MDT meeting to discuss ECMO candidacy

Lack of evidence to support the following therapies:

- HFOV, Nitric oxide, Surfactant, Steroids, Immunoglobulins, Bronchodilators
  (Nitric oxide would be utilised if pulmonary hypertension)

Specialist interventions

ECMO:

- Case fatality rate 70% (84% if <6 weeks old).
- Consider adding leukocyte filter to circuit. (80% survival in small case series)

Leukapheresis:

- Effective at rapid white cell count reduction.
- Performed with ECMO support. Often need >1 leucofilter as clots with high WCC.

Public health

- Highly contagious. Incubation period 5-21 days.
- Notify local HPT of all *suspected* cases (S/E London 0203 764 0804)
- If onset of symptoms <21 days ago, all vulnerable close contacts require chemoprophylaxis (vulnerable = partially or unimmunized infants and children up to 10yrs; adults working in healthcare, social care, child care; immunocompromised individuals; women in last month of pregnancy).
- Prophylaxis: Azithromycin enterally for three days.
- Erythromycin is recommended macrolide in pregnancy
- For healthcare worker related exposure- contact occupational health

References: 1. Cherry et al. (2011) 2. Rowlands et al (2010) 3. Public Health England pertussis guideline (2014) 4. UK ECMO meeting (Jan 2015) 5 ELSO registry, 6. Decker et al. (2021) JID, 2021:224 (Suppl 4), 7.Esposito et al. Frontiers in immunology, July 2019, Vol 10 Art 1344.