South Australian Paediatric Practice Guidelines

management of paediatric empyema excluding neonates

Note

This guideline provides advice of a general nature. This statewide guideline has been prepared to promote and facilitate standardisation and consistency of practice, using a multidisciplinary approach. The guideline is based on a review of published evidence and expert opinion.

Information in this statewide guideline is current at the time of publication.

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Health practitioners in the South Australian public health sector are expected to review specific details of each patient and professionally assess the applicability of the relevant guideline to that clinical situation.

If for good clinical reasons, a decision is made to depart from the guideline, the responsible clinician must document in the patient's medical record, the decision made, by whom, and detailed reasons for the departure from the guideline.

This statewide guideline does not address all the elements of clinical practice and assumes that the individual clinicians are responsible for discussing care with consumers in an environment that is culturally appropriate and which enables respectful confidential discussion. This includes:

- The use of interpreter services where necessary,
- Advising consumers of their choice and ensuring informed consent is obtained,
- Providing care within scope of practice, meeting all legislative requirements and maintaining standards of professional conduct, and
- Documenting all care in accordance with mandatory and local requirements

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Key Priorities

- Empyema should be suspected in patients who do not respond to standard antibiotic therapy after 48-72 hours.
- Empyemas should usually be drained either surgically or via interventional radiology

Preamble

Empyema refers to the presence of pus within the pleural space, most often in association with an underlying pneumonia, and may result in sepsis and impaired respiratory function. Compared with uncomplicated community acquired pneumonia, empyema is associated with higher morbidity, longer hospitalisation, longer duration of antibiotic therapy, and often requires invasive intervention. While the prognosis in appropriately treated children is very good, with complete recovery and restoration of normal lung function, care is potentially complex and requires close attention to detail.

Empyema develops in a continuum, however three stages are described:

- Exudative – a simple parapneumonic effusion arising from inflamed pleura.
- Fibrinopurulent – frank pus and fibrin deposition within the pleural space leads to septation and loculation (complicated parapneumonic effusion / empyema).
- Organised – fibroblast infiltration leads to the formation of a thick non-elastic peel.

Causative Organisms

Streptococcus pneumoniae, Staphylococcus aureus (often PVL strain in SA isolates) and Streptococcus pyogenes are the most common pathogens but it is important to consider other organisms especially Mycoplasma pneumoniae, Mycobacterium tuberculosis, anaerobes in those who aspirate and MRSA if the child has risk factors or doesn't respond to empiric therapy.

While this guideline focuses on management of the empyema, the underlying pneumonia may be the most concerning component of the child's illness. (link to Pneumonia Guideline) Where progress is poor, fever persists or respiratory function is severely compromised, consider the role of the pneumonia as well as the empyema.

Definitions

- PHDU / PICU – Paediatric High Dependency Unit / Paediatric Intensive Care Unit
- WCH – Women's and Children's Hospital

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Assessment

Clinical Features

Children with empyema present in a similar fashion to those with pneumonia but may:

- be more unwell than expected
- have pleuritic chest pain and/or prefer to lie on the affected side.

Pleural effusion is suggested on examination by:

- unilaterally decreased breath sounds and chest expansion
- dullness to percussion
- functional scoliosis (concave towards affected side)

It may evolve after treatment for pneumonia has commenced and should be suspected in any child with persistent or recurrent fever or failure to improve.

Children with suspected parapneumonic effusion or those with pneumonia who have persistent (>48-72hr) fever on IV antibiotics should have a chest x-ray.

Management of children with parapneumonic effusions or empyema:

- All should be admitted to hospital for intravenous antibiotics and appropriate supportive care.
- Further management will depend on the size of effusion, response to antibiotics and degree of respiratory compromise.

General goals of therapy are to:

- Control sepsis
- Restore normal respiratory function
- Minimise morbidity, mortality and long term complications
- Minimise invasive interventions

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Admitting team:

- Those with small parapneumonic effusions responding well to antibiotics should be managed in a centre with Paediatric specialists. These patients will generally be managed by General Medicine
- Most children with symptomatic parapneumonic collections should be transferred to the WCH for further evaluation and management.
- Patients with known or suspected complicating underlying lung disease (e.g. bronchiectasis) or significant co-morbidities (e.g. primary immunodeficiency) may be admitted under the WCH Respiratory Team.
- All patients at the WCH should be referred to the Respiratory and Paediatric Surgery teams for review. The admitting team is responsible for day to day care, communication and referrals.

Patients referred from out of region:
Patients receiving care in other hospitals may be referred for ongoing medical and/or surgical care at WCH. Care may shift directly back to the other hospital once the drains have been removed

Investigations

Baseline investigations in children with parapneumonic effusion/empyema:

- Full blood count (risk of anaemia, possibility of haemolytic uraemic syndrome)
- CRP
- Electrolytes and renal function (risk of SIADH, possibility of haemolytic uraemic syndrome). Recheck regularly if on IV fluids or abnormal.
- Albumin
- Blood culture
- NPA for viruses and mycoplasma
- Sputum culture (if possible)
- Coagulation studies (perform in patients with known risk factors or suggestive history)

Correct abnormalities, where possible, before any surgical intervention.

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Chest ultrasound
The need and timing of chest ultrasound will vary – it may be unnecessary if there is neither diagnostic uncertainty nor need for surgical intervention (e.g. small parapneumonic effusion responding well to intravenous antibiotics). Early ultrasound assists with decision making re early surgical intervention. It confirms, characterises and quantifies pleural effusions.

Routine bronchoscopy and/or CT are not recommended for parapneumonic empyema.

Children with apparent non-infective pleural effusions (e.g. malignancy) require different investigations and management and this guideline should not be used.

The decision re early thoracocentesis should be considered in conjunction with a paediatric thoracic surgeon/ physician but not mandatory.

Subsequent investigations

- Pleural fluid (if obtained):
  - cytology, microscopy for malignant cells.
  - M,C & S (including mycobacterial),
  - PCR for Streptococcus pneumoniae.
- CT chest is better able to define parenchymal lung abnormalities. While not routine, it may be appropriate pre-intervention in complex or atypical cases.

1. Supportive care:

- Oxygen to maintain SpO2 ≥93%
- Analgesia for comfortable respiration and mobilisation. Use paracetamol and opioids but avoid non-steroidal anti-inflammatories if surgery is contemplated. Consider referral to the Acute Pain Service.
- Antipyretics (paracetamol) if fever causes significant discomfort
- Fluid and nutritional management (beware dehydration, SIADH and catabolism)
- Mobilisation should be encouraged but there is otherwise no specific role for physiotherapy.

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2. Antibiotics:

Intravenous:

Initial empiric therapy:

Cefotaxime 25mg/kg up to 1g, 6hourly
PLUS
Vancomycin 30 mg/kg up to 1.5g 12-hourly

Consider adding Lincomycin (15 mg/kg/dose up to 1.2g, 8 hourly) if Staph Aurous considered possible/ likely because of high risk of PVL strains.

Consider Azithromycin (10 mg/kg/day up to max dose of 500mg) if Mycoplasma suspected.

Once the causative pathogen has been identified, therapy should be modified according to the susceptibility test results (known or presumed)

Cover for less common or multi-resistant organisms (including tuberculosis) should be considered depending on the child's history and subsequent clinical progress. In those cases, early consultation with the Infectious Diseases service is advised.

Consider inserting a PICC line early in treatment if a long course is envisaged.

Oral

- Children may be switched to oral antibiotics when all criteria below are met:
  - had any drains removed
  - been afebrile for ≥48 hours*,
  - are making good clinical progress ('well' looking, not requiring supplemental oxygen, mild work of breathing).
- Choice depends on identification of the causative pathogen
- If no pathogen identified
  - Amoxycillin-clavulanic acid 25mg/kg/dose (max 875mg) tds x 5 days

  *If penicillin allergy discuss with Infectious Diseases

- Oral therapy should be continued for a total antibiotic duration of 2-6 weeks depending on the severity of disease, length of stay in hospital, complications and causative organism

*Note: International guidelines recommend switching to orals when afebrile for 24 hours.

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3. Pleural Drainage:

- Antibiotics and supportive therapy are often all that is required for small parapneumonic effusions and where children are making good clinical progress.
- In more severe cases, drainage of the pleural cavity hastens recovery and may reduce long term complications (lung entrapment). The decision to intervene will be based on the child's condition, any co-morbidities and their initial response to therapy.
- Indications for intervention include:
    - Large effusion / empyema with significant respiratory impairment (respiratory distress, hypoxia, etc) and / or
    - Persistent fevers after 48hrs of IV antibiotics
- SA experience suggests that drainage before 48 hrs markedly increases chance of isolation of pathogen.

- Where further intervention is indicated, a review should be requested from the on call general surgical team or the surgical team who have already reviewed the patient.
- The surgical team will take responsibility for deciding which method of pleural drainage is appropriate and will instil the Alteplase if used.

- **Recommended pleural drainage options include**

- Chest drain with fibrinolytics (Alteplase) and negative pressure drainage.
- Video-assisted Thoracoscopic Surgery (VATS)
- Open thoracotomy

The choice of intervention is determined case by case depending on the child, complexity of empyema, and availability of appropriate surgical support.

- Most cases will be treated with either a chest drain & fibrinolytics or with VATS. Chest drains may be inserted by either percutaneous (Seldinger pigtail catheters inserted in radiology) or open technique.
- Where the fluid is non-echogenic, non-loculated (ultrasound finding) and thin (gross sample) a simple drain and negative pressure drainage may be appropriate.
- When using fibrinolytics, small bore (8-12Fr) drains are recommended (more comfortable and fibrinolytic agent prevents blockage).
- Open thoracotomy / decortication may be necessary in advanced or long-standing cases.
- In cases requiring surgical intervention, care will be shared between the home and surgical teams from the point they are accepted for surgery until the last drain is removed, at which time they will be passed back to the primary medical team. While they have drains in situ, they will generally be cared for in PICU/PHDU.

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Drain management

Drain set-up:

1. All chest drains require a unidirectional drainage system. At WCH this will generally be an Atrium system. Children <10kg should only be connected to a Paediatric Atrium System. (http://www.atriummed.com/en/chest_drainage/default.asp)
2. The drain should be clamped for 1 hour once 10 ml/kg are initially removed
3. Chest x-ray must be done following insertion to ensure appropriate placement.
4. Drains should usually be placed on controlled suction at the surgeon / intensivist's discretion.

Drain Maintenance:

1. An accurate record of the drain's status must be kept including whether it is static, swinging or bubbling and how much fluid is draining (usually an hourly record with tallies each morning).
2. Bubbling drains should never be clamped (or removed) and any clamped drain should be immediately unclamped if the patient develops breathlessness or signs of worsening respiration.
3. If a drain suddenly stops swinging or draining fluid the medical staff should be notified as it may be obstructed. The patient may need to be re-positioned, the drain unkinked or the drain flushed (10-20ml 0.9% sodium chloride) to return it to patency. Once patency and position have been checked, non-functioning drains (neither swinging nor draining fluid) should be removed. Depending on the clinical setting the drain may need to be replaced or Alteplase instilled (see contraindications below). Discuss with the surgical team before removal.
4. For Alteplase instillation, see Appendix.

Drain Removal:

1. The last drain should be removed when less than 2ml/kg/day of fluid is draining (regardless of effusion size or clinical status). NB: A bubbling drain should not be removed.
2. See Appendix for drain removal procedure.
3. Clamping of drains prior to removal is not routinely recommended.
4. A chest x-ray should be performed within 4 hours of drain removal to check for pneumothorax. A small pneumothorax is not uncommon and will usually spontaneously reabsorb.

Alteplase

See appendix for Alteplase instillation protocol
Alteplase contraindications:

1. ongoing air leak
2. active pleural bleeding
3. known Alteplase hypersensitivity
4. Necrotising pneumonia
5. Bleeding disorder
6. Air in the pleural space
7. age < 6 months (relative contraindication)
8. recent major surgery including open thoracotomy (relative contraindication)
9. Alteplase is not routinely given post VATS procedure but may be considered.

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Treatment failure and Complications

- Persistent fever and/or persistently raised inflammatory markers may be an indication of:
    - organism resistant to current antibiotic
    - poor antibiotic penetration
    - severe inflammation
    - lung necrosis or abscess
- In many cases, persevering with antibiotics may be the best course, especially if fever or inflammatory markers appear to be settling.
- Consider chest x-ray, ultrasound and CT scan if progress is not as expected.
- Persistent lobar collapse may be a sign of foreign body and bronchoscopy should be considered.
- Secondary scoliosis is common and usually transient. No specific treatment or investigation is necessary but resolution should be confirmed.
- Hypoalbuminaemia and/or thrombocytosis are common and require no specific therapy.
- Anaemia. Transfusion should be considered as per current guidelines.

Discharge and follow up

- Children may be discharged when:
    - they have minimal respiratory distress,
    - they are eating, drinking and mobilising freely,
    - they have a SpO2 consistently ≥93%,
    - they are afebrile for ≥48 hours,
    - they had their last drain removed ≥12 hours ago, and
    - clinical staff are confident child is improving and that family are competent with child's ongoing care and have access to emergency services should symptoms reoccur.
- If the child needs to fly, this should be discussed with the surgeon and / or Respiratory team.
- Most of these criteria will be met at the point of changing to oral therapy.
- Radiological resolution is not required (or anticipated) prior to discharge.
- Patients should be advised about completing their course of oral antibiotics, reasons for return including fever and increased respiratory symptoms/signs and what follow up plans have been made.
- Outpatient review should continue until the child has made a complete clinical recovery and has a near normal chest x-ray. Often clinic review 6 weeks post discharge with a repeat chest x-ray will satisfy these criteria. Children with more severe disease will likely require longer follow up but nearly all chest x-rays are normal by 3-6 months.
- Check that scoliosis (if present) has resolved.
- Children with persistent signs, symptoms, radiological abnormalities should be discussed early with the Respiratory team.

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This guideline is based on the guideline from Starship Children's Hospital, Auckland, NZ. The references from that guideline are below.

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Appendix 1: Alteplase instillation protocol

See contraindications above.
This is generally well tolerated though sometimes discomfort is experienced duringinstillation and pleural fluid may be transiently blood stained.

Dose: Alteplase 0.1 mg/kg (maximum of 6mg) diluted in 40-100mL of 0.9% sodium chloride.
Repeat every 12 to 24 hours (maximum of 6 doses)

Required equipment
Syringe with Alteplase with small bore needle
Alcohol wipes
Two chest drain clamps
Gloves

Procedure

> Note baseline observations
> IV fluids should be running
> Explain what you are doing to patient / family as appropriate
> Consider Midazolam
> Check that the drain is in good condition and properly sited within pleural cavity.
> Position patient supine.
> Instillation can be uncomfortable – a small morphine dose or lignocaine in the Alteplase may be helpful.
> Clamp the distal drain
> Slowly instil Alteplase over 5 minutes (using a 3 way tap helps avoid breaching the system)
> Flush the drain with 0.9% sodium chloride (10ml if <10kg, 40ml if >10kg)
> Replace clamp and leave for 4 hours.
> Encourage the child to mobilise
> Allow free drainage for 30 minutes
> Return to suction
> If ≥10ml/kg drains, reclamp drain for 60 minutes followed by 30 minutes free drainage and then return to suction.
> Remove clamp if the child develops sudden respiratory distress.
> Monitor fluid balance and drain output. Replace drain losses 1:1 with normal saline if large losses.

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Appendix 2: Chest drain removal protocol

In brief:
1. Explain the procedure.
2. Ensure adequate analgesia is given.
3. A medical officer (or MET nurse) will remove the drain with nursing assistance
a. Position child as appropriate to provide good access to the drain
b. Stop suction and clamp drain
c. Instruct child (where possible) to take a deep breath in and push or blow out slowly (Valsalva) during the drain removal. If this isn't possible, ideally the drain should be removed during expiration.
d. While one person cuts the anchoring suture and pulls the drain out (brisk smooth motion), the second person presses (seals) the wound edges together, or a single person can withdraw the drain with one hand whilst sealing the edges with the other.
e. If there is a closing suture pulls and knot this (not so tight as to pucker the edges).
f. Apply Steristrips as necessary to seal the wound
g. Apply an occlusive transparent sterile dressing
4. Ensure the child is comfortable and positioned for good chest expansion.
5. Ensure a chest x-ray is arranged and reviewed following removal.
6. Nursing staff should assess respiratory status immediately following drain removal, hourly for four hours and four hourly thereafter.

Version control and change history

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