

PARAPNEUMONIC EFFUSION AND EMPYEMA

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Pleural infection (parapneumonic effusion and empyema) has an annual incidence of 3.3 per 100 000 children. The incidence of childhood empyema may be increasing in the UK. If so, it is not clear whether this is related to different referral patterns, changes of antibiotic usage in primary care, or whether there is a genuine increase in disease incidence. Parapneumonic effusions and empyema are more common in boys, in infants and young children, and in winter and spring, presumably because of their infective origin. *Streptococcus pneumoniae* is currently the most common pathogen in the UK, but a number of other pathogens can also be implicated.

Empyema is a significant cause of morbidity, but fortunately not mortality, in children, and at times can be a therapeutic challenge. It is rare for children to have an underlying lung disease, and the final outcome is almost always excellent. There are important differences between adult and paediatric pleural infections. In adults empyema is a cause of significant morbidity with 40% of patients requiring pleural surgery because of failed catheter drainage, and a mortality rate of 20%, which is related to co-morbidity (for example, malignancy, immunodeficiency). Evidence from paediatric therapeutic trials is lacking, and it is inappropriate simply to extrapolate adult data to children. There is little consensus over management among respiratory paediatricians and thoracic surgeons in the UK.

An evidence based guideline has been developed under the auspices of the British Thoracic Society.¹ This covers the recognition, diagnosis, investigation, and alternative treatment options, including intrapleural fibrinolytics. Detailed guidance on chest drain management is included. Audit criteria and research priorities are suggested.

KEY PRACTICE RECOMMENDATIONS

- ▶ All children with parapneumonic effusion or empyema should be admitted to hospital [grade D]
- ▶ If a child remains pyrexial or unwell 48 hours after admission for pneumonia, parapneumonic effusion/empyema must be excluded [grade D]

Diagnostic imaging

- ▶ Postero-anterior or antero-posterior radiographs should be taken; there is no role for a routine lateral radiograph [grade D]
- ▶ Ultrasound must be used to confirm the presence of a pleural fluid collection [grade D]
- ▶ Ultrasound should be used to guide thoracocentesis or drain placement [grade C]
- ▶ Chest computed tomographic (CT) scan should not be performed routinely [grade D]

Diagnostic microbiology

- ▶ Blood cultures should be performed in all patients with parapneumonic effusion [grade D]
- ▶ When available, sputum should be sent for bacterial culture [grade D]

Diagnostic analysis of pleural fluid

- ▶ Pleural fluid must be sent for microbiological analysis including Gram stain and bacterial culture [grade C]
- ▶ Aspirated pleural fluid should be sent for differential cell count [grade D]
- ▶ Tuberculosis and malignancy must be excluded in the presence of pleural lymphocytosis [grade C]
- ▶ If there is any indication the effusion is not secondary to infection, consider an initial small volume diagnostic tap for cytological analysis, avoiding general anaesthesia/sedation whenever possible [grade D]
- ▶ Biochemical analysis of pleural fluid is unnecessary in the management of uncomplicated parapneumonic effusions/empyema [grade D]

Diagnostic bronchoscopy

- ▶ There is no indication for flexible bronchoscopy and it is not routinely recommended [grade D]

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Referral to tertiary centre

- ▶ A respiratory paediatrician should be involved early in the care of all patients requiring chest tube drainage for a pleural infection [grade D]

Conservative management (antibiotics ± simple drainage)

- ▶ Effusions which are enlarging and/or compromising respiratory function should not be managed by antibiotics alone [grade D]
- ▶ Give consideration to early active treatment as conservative treatment results in prolonged duration of illness and hospital stay [grade D]

Repeated thoracentesis

- ▶ If a child has significant pleural infection then a drain should be inserted at the outset, and repeated taps are not recommended [grade D]

Antibiotics

- ▶ All cases should be treated with intravenous antibiotics and must include cover for *Streptococcus pneumoniae* [grade D]
- ▶ Broader spectrum cover is required for hospital acquired infections, as well as those secondary to surgery, trauma, and aspiration [grade D]
- ▶ Where possible, antibiotic choice should be guided by microbiology results [grade B]
- ▶ Oral antibiotics should be given at discharge for 1–4 weeks, but longer if there is residual disease [grade D]

Chest drains

- ▶ Chest drains should be inserted by adequately trained personnel to reduce the risk of complications [grade C]
- ▶ A suitable assistant and trained nurse must be available [grade D]
- ▶ Routine measurement of the platelet count and clotting studies are only recommended in patients with known risk factors [grade D]
- ▶ Where possible, any coagulopathy or platelet defect should be corrected before chest drain insertion [grade D]
- ▶ Ultrasound should be used to guide thoracentesis or drain placement [grade C]
- ▶ If general anaesthesia is not being used, intravenous sedation should only be given by those trained in the use of conscious sedation, airway management, and resuscitation of children, using full monitoring equipment [grade D]
- ▶ Small bore percutaneous drains should be inserted at the optimum site suggested by chest ultrasound [grade C]
- ▶ Large bore surgical drains should also be inserted at the optimum site suggested by ultrasound, but preferentially placed in the mid-axillary line through the “safe triangle” [grade D]
- ▶ Since there is no evidence that large bore chest drains confer any advantage, small drains (including pigtail catheters) should be used whenever possible to minimise patient discomfort [grade C]
- ▶ Neither substantial force nor a trocar should ever be used to insert a drain [grade D]
- ▶ A chest radiograph should be performed after insertion of a chest drain [grade D]
- ▶ All chest tubes should be connected to a unidirectional flow drainage system (for example, an underwater seal bottle) which must be kept below the level of the patient’s chest at all times [grade D]

- ▶ Appropriately trained nursing staff must supervise the use of chest drain suction [grade D]
- ▶ A bubbling chest drain should never be clamped [grade D]
- ▶ A clamped drain should be immediately unclamped and medical advice sought if a patient complains of breathlessness or chest pain [grade D]
- ▶ The drain should be clamped for one hour once 10 ml/kg are initially removed [grade D]
- ▶ Patients with chest drains should be managed on specialist wards by staff trained in chest drain management [grade D]
- ▶ When there is a sudden cessation of fluid draining, the drain must be checked for obstruction (blockage or kinking) by flushing [grade D]
- ▶ The drain should be removed once there is clinical resolution [grade D]
- ▶ A drain that cannot be unblocked should be removed and replaced if significant pleural fluid remains [grade D]

Intrapleural fibrinolytics

- ▶ Intrapleural fibrinolytics shorten hospital stay and are recommended for any complicated parapneumonic effusion (thick fluid with loculations) or empyema (overt pus) [grade B]
- ▶ There is no evidence that any of the three fibrinolytics are more effective than the others, but only urokinase has been studied in a randomised controlled trial in children so is recommended [grade B]
- ▶ Urokinase should be given twice daily for three days (six doses in total) using 40 000 units in 40 ml 0.9% saline for children weighing 10 kg or above, and 10 000 units in 10 ml 0.9% saline for children weighing under 10 kg [grade B]

Surgery

- ▶ Failure of chest tube drainage, antibiotics, and fibrinolytics should prompt early discussion with a thoracic surgeon [grade D]
- ▶ Patients should be considered for surgical treatment if they have persisting sepsis in association with a persistent pleural collection, despite chest tube drainage and antibiotics [grade D]
- ▶ Organised empyema in a symptomatic child requires formal thoracotomy and decortication [grade D]
- ▶ A lung abscess coexisting with an empyema should not normally be surgically drained [grade D]

Other management

- ▶ Antipyretics should be given [grade D]
- ▶ Analgesia is important to keep the child comfortable, particularly in the presence of a chest drain [grade D]
- ▶ Chest physiotherapy is not beneficial and should not be performed in children with empyema [grade D]
- ▶ Early mobilisation and exercise is recommended [grade D]
- ▶ Secondary thrombocytosis (platelet count $> 500 \times 10^9/l$) is common but benign; antiplatelet treatment is not necessary [grade D]
- ▶ Secondary scoliosis noted on chest radiograph is common but transient; no specific treatment is required but resolution must be confirmed [grade D]

Follow up

- ▶ Children should be followed up after discharge until they have recovered completely and their chest radiograph has returned to near normal [grade D]

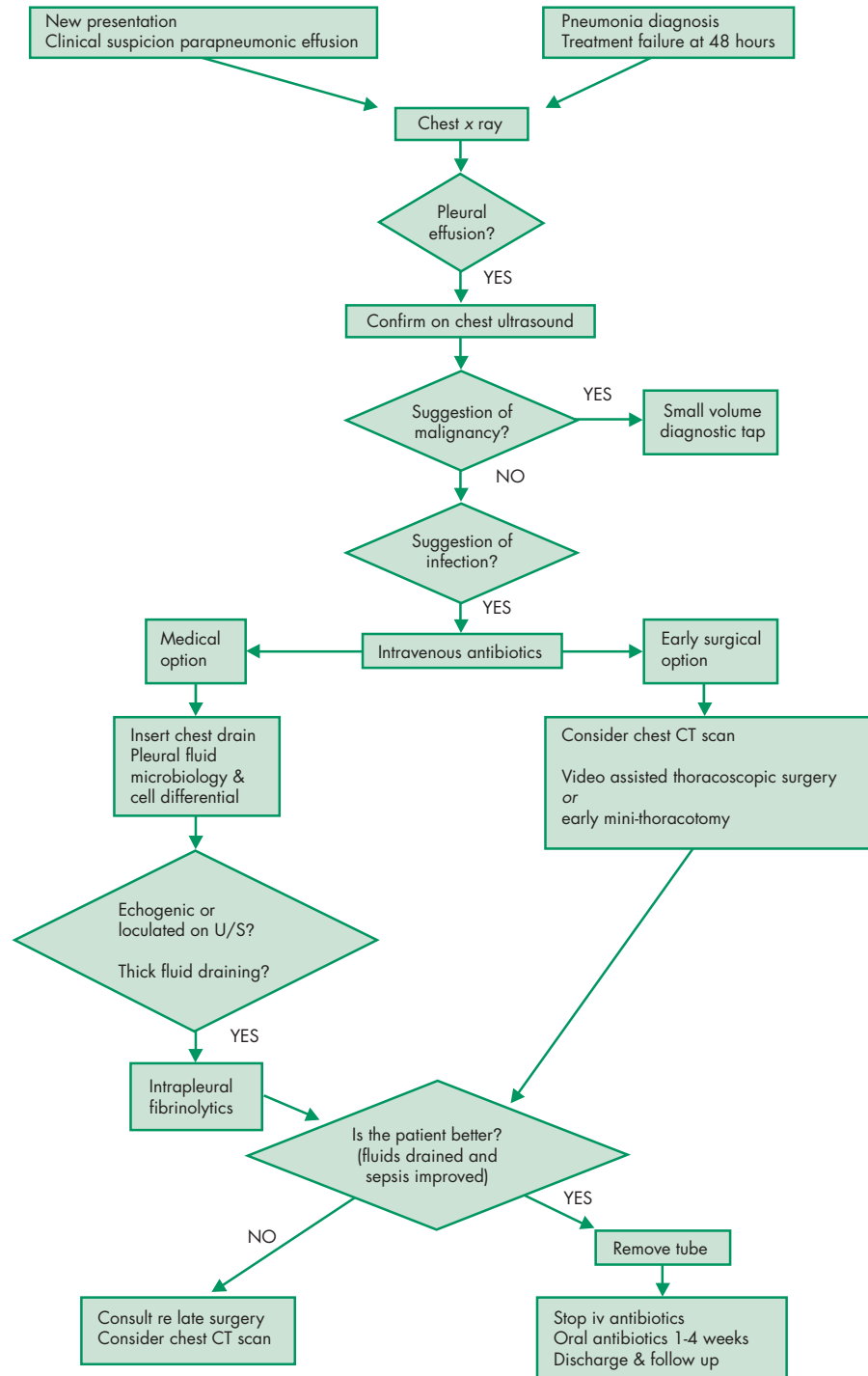


Figure 1 Algorithm for the management of pleural effusion in children. CT, computed tomography; U/S, ultrasound. Adapted from Balfour-Lynn I, *et al*,¹ with permission of the publisher.

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- Underlying diagnoses—for example, immunodeficiency, cystic fibrosis—may need to be considered [grade D]

COMMENTARY

The guideline provides two alternative treatment strategies, one medical and one surgical, backed up by a flow chart (fig 1). It was developed according to accepted guideline methodology, underpinned by a rigorous and well documented literature review. The lack of paediatric data in randomised controlled trials is reflected in the grading of most recommendations.

Conservative management (antibiotics with or without chest drain placement) has been reported to be successful in

Table 1 Available surgical procedures

Video assisted thoracoscopic surgery (VATS)	Achieves debridement of fibrinous pyogenic material, break down of loculations, and drainage of pus from the pleural cavity under direct vision. Leaves three small scars
Mini-thoracotomy	Achieves debridement and evacuation in a similar manner to VATS but it is an open procedure leaving a small linear scar
Decortication	Involves an open thoracotomy and excision of the thick fibrous pleural rind with evacuation of pyogenic material. It is a longer and more complicated procedure

60–80% of cases, but the duration of hospital admission may be long: mean lengths of stay of two weeks or longer have been reported. Intrapleural fibrinolytics are recommended for thick fluid with loculations, readily recognised on ultrasound imaging, as they shorten hospital stay.

There is no evidence to guide when to refer children for thoracic surgery, and little consensus on the merits of medical versus surgical management. Three surgical procedures are potentially available (table 1). Although there has been no randomised controlled trial comparing video assisted thoroscopic surgery (VATS) with the longer established procedures, a number of case series suggest that VATS is effective and safe, with less postoperative pain, shorter hospital stay, and a better cosmetic result. The relative merits of the different surgical approaches are described in the guideline. The guideline recommends early involvement of thoracic surgeons (especially where conservative management has failed to produce clinical and radiological improvement within seven days), but advises that there is a lack of evidence and consensus on timing and indications.

There was no involvement of parents or children. Given the option of two different treatments and the recommendation that carers and children are involved in decision making, it would have been helpful if the guideline had included good quality patient information, and if they had sought consumers' views on the two alternatives.

The guideline development group included three tertiary paediatricians (including a trainee), a general/emergency paediatrician, a paediatric and thoracic surgeon, a microbiologist, and a radiologist. No formal consensus method was used in the context of little available relevant research evidence.

Although the guideline includes a recommendation that children who require chest tube drainage are transferred to a tertiary paediatric respiratory unit (rather than directly to paediatric or thoracic surgeons), this is moderated by a statement that some secondary care centres are capable of inserting chest drains. Decisions about the need for tertiary care do depend on the available local expertise.

Recommendation grades and levels of evidence

Grade	Evidence
A	At least one high quality meta-analysis, systematic review, or RCT with a very low risk of bias, and directly applicable to the target population; or a systematic review of RCTs or a body of evidence consisting principally of studies with a low risk of bias, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including high quality systematic reviews of case-control or cohort studies, or high quality case-control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal, directly applicable to the target population, and demonstrating overall consistency of results; or extrapolated evidence from at least one high quality meta-analysis, systematic review, or RCT with a very low risk of bias, or from a systematic review of RCTs or a body of evidence consisting principally of studies with a low risk of bias, and demonstrating overall consistency of results
C	A body of evidence including well conducted case-control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal, directly applicable to the target population and demonstrating overall consistency of results; or extrapolated evidence from high quality systematic reviews of case-control or cohort studies, or high quality case-control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal
D	Non-analytic studies—for example, case reports, case series—or expert opinion; or extrapolated evidence from well conducted case-control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal

RCT, randomised controlled trial.

This is a detailed and helpful guideline covering all relevant aspects of management of pleural infection in children.

ACKNOWLEDGEMENTS

Figure 1 is adapted with kind permission from the BMJ Publishing Group.

REFERENCE

- 1 Balfour-Lynn I, Abrahamson E, Cohen G, *et al*. BTS guidelines for the management of pleural infection in children. *Thorax* 2005;**60**(suppl 1):i1–i21. Also available at www.brit-thoracic.org.uk.

CROSSWORD.....

Answers

ACROSS

- 1) Cold agglutinins, 5) CLD, 6) Amoxycillin, 8) Viruses, 9) Zinc, 11) Ixodes, 17) Kawasaki, 18) Pasteurisation, 19) Tacrolimus, 20) June

DOWN

- 1) Charlotte's, 2) Doxycycline, 3) Guideline, 4) Scarlet, 5) Consolidation, 7) Winter, 10) Chizukit, 12) Koplík, 13) Grade A, 14) Bartter, 15) Migrans, 16) Aspirin