Investigating the child with dyspnoea

Each month we present authoritative advice on the investigation of a common clinical problem, specially written for family doctors by the Board of Continuing Education of the Royal Australasian College of Physicians.

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Age influences diagnosis in paediatric medicine, and different conditions may present with identical symptoms and signs. The distinction is important because management strategies may differ. For example, in bronchiolitis and asthma, the common presenting features for both of these conditions are cough, tachypnoea, chest wall recession and wheeze. However, in acute asthma, treatment is centred upon bronchodilators and systemic corticosteroids, whereas in bronchiolitis, treatment is centred upon supportive hydration and oxygenation without bronchodilators and corticosteroids. The Table on page 103 outlines an approach to diagnosis in children presenting with dyspnoea, relating symptoms and signs of breathing difficulty to age.

Initial investigation

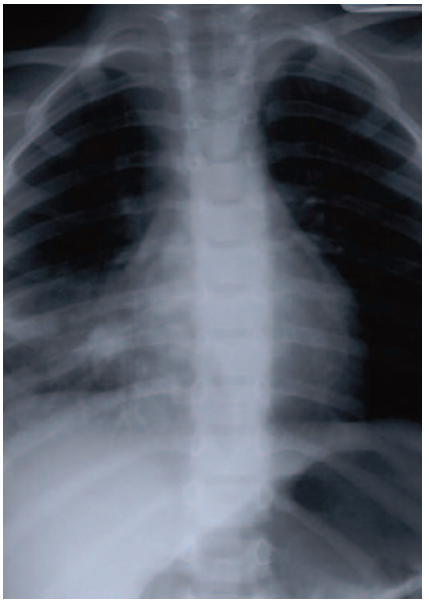
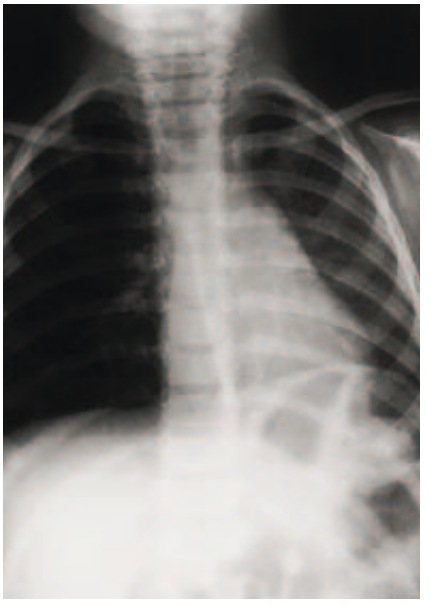
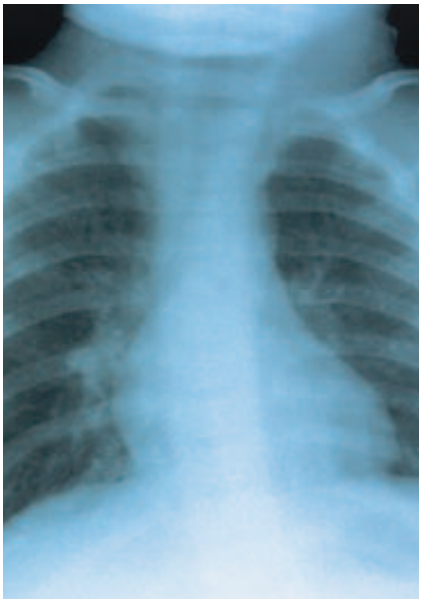
Chest x-ray

The most common investigation in a child with dyspnoea is the chest x-ray (Figures 1a to c). In attempting to combine the mechanisms of dyspnoea with the findings on the chest x-ray, one can consider the likely pathology in relation to its effect on airways of differing calibre:[1]

- increased radiolucency – consistent with widespread abnormalities of small airways giving rise to symmetrical hyperinflation as seen in bronchiolitis (infants) or asthma (older children)
- localised areas of radiodensity – signify fluid filled airways or lung parenchyma, may be seen in pneumonia, pulmonary oedema or near drowning and may be complicated by a pleural effusion (Figure 1a)
- ball-valve effect with distal hyperinflation (partial obstruction) or collapse/consolidation (total bronchial obstruction) – consistent with foreign body inhalation, primarily seen in the toddler years, i.e. 1 to 3 years of age (Figure 1b)
- a hyperlucent appearance between chest wall and compressed lung – consistent with a sudden decrease in vital capacity and lung volume due to pneumothorax (i.e. air in the pleural space compressing the lung). This may occur spontaneously in a tall thin adolescent following rupture of an apical pleural bleb or

IN SUMMARY

- **Dyspnoea refers to the feeling of difficult or laboured breathing, which an older child may describe as being 'short of breath'.**
- **Age and clinical features influence investigation and diagnosis in the child with dyspnoea.**
- **The chest x-ray is the most common investigation in the child with dyspnoea.**
- **Other useful initial investigations, where appropriate, include a lateral airways x-ray, a barium swallow and meal, pulmonary function tests and laboratory testing.**
- **In complex presentations, more sophisticated imaging, endoscopy and polysomnography may be useful.**

Figures 1a to c. Chest x-rays. a (left). Supine film showing right middle lobe pneumonia in a previously well child. This child responded rapidly to intravenous penicillin, suggesting *Streptococcus pneumoniae* was the most likely pathogen. b (middle). An expiratory chest x-ray demonstrating air-trapping (ball-valve effect) in the right lung, suggesting an inhaled foreign body is in the right main bronchus. c (right). An infant with cystic fibrosis. This child was missed by the newborn screening program and presented with recurrent chest infections, persisting tachypnoea and failure to thrive. The chest x-ray demonstrates bilateral upper lobe early bronchiectasis following pulmonary infection with *Staphylococcus aureus* and *Pseudomonas aeruginosa* (organisms isolated at bronchoscopy).

may complicate diffuse small airway pathology as in asthma or cystic fibrosis
- a radiodense appearance between chest wall and lung – consistent with a fluid filled pleural cavity that may indicate a pleural effusion complicating pneumonia (usually) or a haemothorax precipitated by trauma. In the latter, one would anticipate signs of tachycardia from intravascular depletion as well as dyspnoea
- extrinsic compression of large airways – by a rapidly enlarging posterior mediastinal mass, typically lymphoma, and possibly accompanied by clinical signs of superior vena caval obstruction, such as prominent neck veins as well as facial suffusion.

Lateral airways x-ray

Radiography of the lateral airways is performed to assess adenoid and tonsil size in children with snoring and apnoea who are being considered for adenotonsillectomy. A lateral airways x-ray also provides information on the size and shape of the epiglottis, retropharyngeal space and subglottic regions (Figures 2a and b).

Barium swallow and meal

A barium swallow can assess the co-ordination of swallowing. It may be used for this purpose by speech pathologists, using liquids and solids of various consistencies, when assessing children with suspected pulmonary aspiration.

A barium swallow is often continued as a barium meal in order to assess the possibility that gastro-oesophageal reflux is contributing to pulmonary aspiration.

A barium swallow is also used to assess the possibility of a vascular ring indentation on the anterior oesophageal wall, giving rise to localised tracheomalacia and resulting in stridor and a brassy cough.

Pulmonary function tests

Pulmonary function testing is important in assessing children over the age of 6 years in whom respiratory pathology is suspected.

Spirometry should be an integral part of the management of children with:
- persistent asthma (spirometry should be performed annually in these children)
- shortness of breath without wheeze
- exercise limitation
- pulmonary infiltrates on chest x-ray.

Lung diseases are classified as being obstructive, restrictive or mixed. The most common indication for spirometry is for the assessment of asthma and it is important to realise that most children with asthma will have normal lung function between exacerbations.

A good review of spirometry, spon-

sored by the National Asthma Campaign, is available to general practitioners.[2]

Laboratory testing

Full blood count

The full blood count is probably the most common pathology test ordered. It is useful when attempting to distinguish viral from bacterial lower respiratory tract infections, the latter characterised by neutrophilia.

Further, the full blood count may be able to rapidly confirm a clinical diagnosis. For example, in a young infant with a paroxysmal cough, an absolute lymphocytosis (more than 20,000 x 10^9/L lymphocytes) is pathognomonic of pertussis (whooping cough).

Serology

Serology is more useful in testing for whooping cough (IgA assay) in children over 12 months of age in whom lymphocytosis is seldom seen.

Serology may be performed as a single test for a variety of respiratory pathogens, – for example, mycoplasma IgM – or as paired titres over two or more weeks, as occurs in adenoviral infections.

Immunofluorescence

Nasopharyngeal aspirates are used for immunofluorescence testing for respiratory syncytial virus (cause of bronchiolitis and croup), parainfluenza (cause

Table. Breathing difficulty: clinical features and diagnosis in relation to age

Clinical features	Diagnosis		
	Infant (<1 year)	Toddler (1 to 3 years)	Child (>3 years)
Cough, tachypnoea, chest wall recession, wheeze	Bronchiolitis	Viral-induced wheeze	Asthma
Cough, tachypnoea, chest wall recession, fever	Pneumonia	Pneumonia	Pneumonia
Cough, tachypnoea, localised crackles or wheeze	Inhaled foreign body	Inhaled foreign body	Inhaled foreign body
Tachypnoea, chest wall recession and clear chest	Diabetic ketoacidosis Poisoning*	Diabetic ketoacidosis Poisoning*	Diabetic ketoacidosis Poisoning*
Tachypnoea, chest wall recession, widespread crackles and finger clubbing	Interstitial lung disease Suppurative lung disease†	Interstitial lung disease Suppurative lung disease† Immunoglobulin deficiency	Interstitial lung disease Suppurative lung disease† Immunoglobulin deficiency
Stridor, cough, tracheal tug and fever	Croup Supra- and/or epiglottitis¶	Croup Supra- and/or epiglottitis¶	Croup‡ Supra- and/or epiglottitis¶
Stridor, brassy cough, chest recession but afebrile	Tracheomalacia	Tracheomalacia	Tracheomalacia
Stridor (intermittent), tracheal tug, chest recession but afebrile	Laryngomalacia Foreign body in larynx Haemangioma in proximal airway	Laryngomalacia Foreign body in larynx	–

* For example, with salicylates or antifreeze.
† For example, cystic fibrosis, primary ciliary dyskinesia or immunoglobulin deficiency.
‡Croup occurs mainly in children younger than 3 years of age, but can occur up to 10 years of age.
¶Epiglottitis is rare since the advent of Hib immunisation.

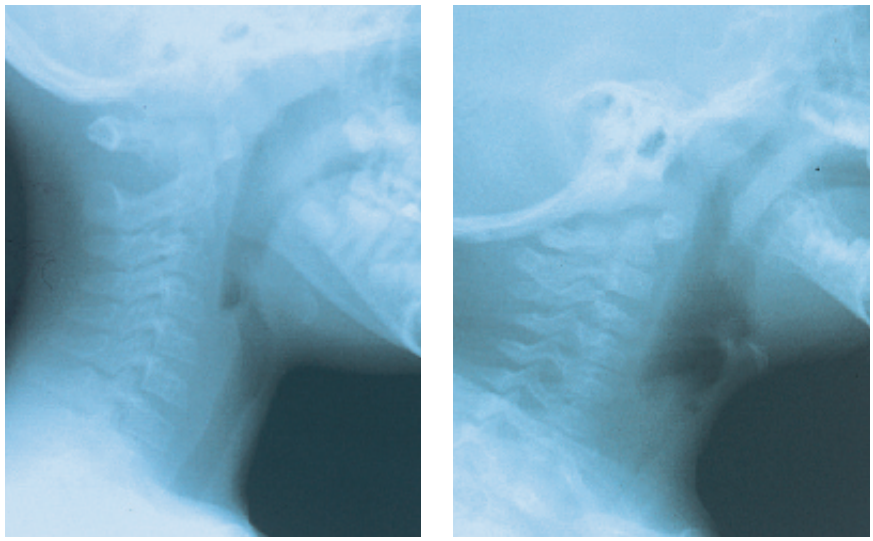


Figure 2. Lateral airways x-ray. a (left). A normal study. b (right). Viral croup. Note the ballooning of the hypopharynx and the thin tracheal air column in the patient with croup.

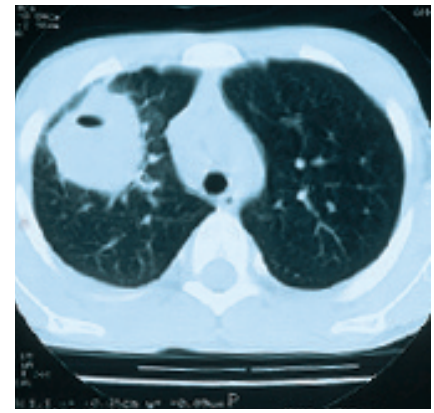


Figure 3. Computed tomography. A lung abscess in the right upper lobe. Group A streptococcus was cultured from 15 mL of pus aspirated via percutaneous drainage of the abscess. The child received six weeks of antibiotics. A Mantoux test was negative.

of croup), adenoviruses and influenza, especially in winter months.

Sputum culture

Sputum culture in patients with suppurative lung disease, such as cystic fibrosis, is a useful investigation that may influence antibiotic choice.

Further investigations

In more complex presentations, further investigations are usually arranged after review by a general or a respiratory paediatrician.

Imaging

Fluoroscopy

Airway screening (also known as fluoroscopy) allows a two-dimensional view of the tracheal diameter and allows a subjective assessment of its degree of collapse in relation to the phase of respiration – for example, in tracheomalacia. It is also used to assess movement of the diaphragm in relation to the phase of respiration – for example, in diaphragmatic palsy or following inhalation of a foreign body, where unilateral paradoxical diaphragm movement may be seen following air-trapping.

Computerised tomography

Computerised tomography (CT) of the chest is used in the acute situation for:

- delineating effects of trauma – pulmonary contusions, haemothorax, pericardial fluid
- delineating pneumonias complicated by pneumatoceles
- delineating lung abscesses, pleural effusions and pleural empyemas (Figure 3)
- identifying pleural blebs as a cause of recurring pneumothoraces
- assessing interstitial lung diseases.

In addition, CT scans are useful for delineating structural abnormalities such as congenital cyst–adenomatoid malformations, mediastinal masses and lymphadenopathy, and rare lung tumours.

Magnetic resonance imaging

Magnetic resonance imaging (MRI) is important in investigating vascular abnormalities. By using MRI with reconstructions – for example, in the case of complicated vascular rings compressing the trachea or of pulmonary sequestered lobes with aberrant blood supply – one can delineate anatomy preoperatively. MRI is also useful for imaging posterior mediastinal masses, especially those potentially communicating with the spinal cord, such as thoracic neuroblastomas.

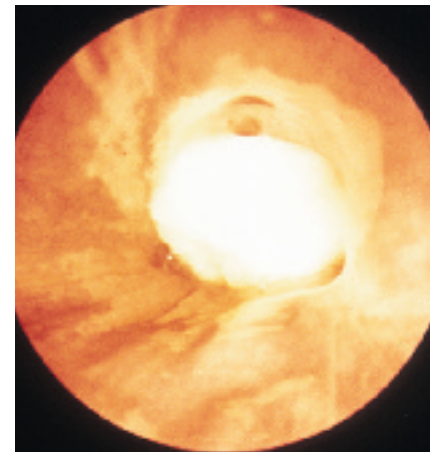


Figure 4. Bronchoscopy. An almond in the right main bronchus.

Endoscopy

Bronchoscopy

Bronchoscopy is less commonly performed in children than in adults, principally because of the need for general anaesthesia in children. Rigid bronchoscopy is needed to retrieve inhaled foreign bodies and delineate structural

problems in the trachea (Figure 4). Flexible bronchoscopy is used for bronchoalveolar lavage:

- in the setting of interstitial lung diseases
- when pulmonary infiltrates develop in febrile, neutropaenic oncology patients
- on occasions for surveillance in children with chronic suppurative lung disease (e.g. in cystic fibrosis).

Nasendoscopy and laryngoscopy

In co-operative children, assessment of adenoid hypertrophy and vocal cord function can be obtained by nasendoscopy and laryngoscopy (usually performed by otolaryngologists) under topical anaesthesia in the consulting rooms.

Nasendoscopy has the advantage of providing a dynamic, functional assessment of proximal airway crowding in children being considered for adenotonsillectomy.

Polysomnography

Overnight polysomnography provides information regarding the physiological consequences of upper airway obstruction with measures of sleep architecture (such as REM sleep fragmentation and apnoea indices), falls in oxygenation, degree of carbon dioxide retention and arousal frequency.

Children with Down syndrome, generalised hypotonia, former preterm infants (especially those born before 28 weeks' gestation) and other children with midface hypoplasia have a high risk of obstructive sleep apnoea and should be assessed clinically from this viewpoint regularly.[3]

Conclusion

Investigations should be guided by the clinical signs and the age of the patient.

When faced with a perplexing respiratory problem in general practice, consider referring the child to a general or respiratory paediatrician rather than to undertake investigations that may turn out to be unnecessary. MT

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