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ORIGINAL ARTICLE

Symptoms and signs differentiating croup and epiglottitis

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Aim: To determine differentiating symptoms and signs of epiglottitis and laryngotracheobronchitis (croup).

Methods: Contemporaneous interview of parents and clinical examination of children with acute upper airway obstruction presenting to the intensive care unit of a paediatric hospital.

Results: Two hundred and three children were examined over a 40-month period. One hundred and two had croup, of whom 49 had the diagnosis confirmed at intubation and another six by direct laryngeal inspection without intubation. One hundred and one had epiglottitis of whom 95 were diagnosed by direct inspection of the larynx at intubation, five by a lateral X-ray of the neck and one on direct inspection without intubation. One child with epiglottitis died. Although both illnesses presented with stridor, the additional presence of drooling had a high sensitivity (0.79, 95% CI 0.70–0.86) and specificity (0.94, 95% CI 0.88–0.97) for epiglottitis while coughing had a high sensitivity (1.00, 95% CI 0.96–1.00) and high specificity (0.98, 95% CI 0.93–0.99) for croup. Coughing predicted croup but drooling predicted epiglottitis. Additional reliable signs of epiglottitis were a preference to sit, refusal to swallow and dysphagia. Thirty-seven percent of children with epiglottitis and 16% with croup were treated as having another respiratory illness at least once before definitive diagnosis.

Conclusions: Epiglottitis and croup are often confused because they share symptoms and signs including stridor. However, differentiation in early illness is possible by additional observation of coughing and absence of drooling in croup and by the additional observation of drooling with absence of coughing in epiglottitis.

Key words: croup; diagnosis; epiglottitis.

What is already known on this topic

1 Croup and epiglottitis share symptoms and signs including stridor, fever and respiratory distress.
2 Croup uncommonly causes severe airway obstruction and has a slow course, whereas untreated epiglottitis rapidly culminates in complete obstruction, shock and may be fatal.
3 Hib vaccination has markedly decreased the incidence of epiglottitis, accentuating the difficulty in differentiating the two illnesses.

What this paper adds

1 Acute stridor in combination with coughing and the lack of drooling reliably diagnoses croup.
2 Acute stridor in combination with drooling and the lack of coughing reliably diagnoses epiglottitis.

Introduction

The diagnoses of bacterial epiglottitis and viral laryngotracheobronchitis (croup) in infants and children may be confused.[1] In the early phases of illnesses, some symptoms and signs are shared but their subsequent clinical courses and necessary treatments are very different. Early recognition of epiglottitis is vital to avoid misdiagnosis and life-threatening acute airway obstruction and peripheral circulatory failure. Although a dramatic reduction in the incidence of epiglottitis has been observed in response to widespread immunisation using conjugate vaccine against *Haemophilus influenza* type b (Hib), epiglottitis still occurs occasionally and it may be difficult to differentiate it from croup.

The symptoms and signs on presentation of children with acute upper airway obstruction were recorded with the aim of establishing the reliability of clinical signs to enable differentiation of the two illnesses.

Methods

Over the period 1980–2009, we recorded the annual incidence of infants and children presenting with croup or epiglottitis to the paediatric intensive care unit (PICU) of the Royal Children's

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Hospital (RCH), Melbourne. RCH is a tertiary hospital serving a population of approximately six million of whom approximately one million are children.

Over a period of 40 months (March 1990 to June 1993), when one of the two investigators was on duty, children presenting with acute upper airway obstruction to PICU were examined carefully and signs recorded on a prepared form. Recorded were details of cough, stridor, chest wall retraction, tracheal tug, temperature, drooling, preference to sit, colour, tone, consciousness, pattern of breathing and pulse. In cases of severe airway obstruction due to suspected epiglottitis, intubation was performed under general inhalational anaesthesia. If epiglottitis was suspected but immediate intubation was not indicated, a lateral X-ray of the neck was performed. Blood cultures and a urine Hib antigen test were performed. If intubation was required, a throat swab was also taken. Children considered to have epiglottitis were treated with chloramphenicol or a third generation cephalosporin. The pharynges of children with suspected croup were examined. These children were treated with inhaled adrenaline and steroids, but not with antibiotics. Diagnoses made at any previous medical consultations for the present illness were recorded. The numbers of children with acute airway obstruction due to other causes were recorded, but not analysed further. Children with airway obstruction due to anatomical or functional syndromic causes were excluded from the study.

The interview with parents was conducted as soon as practicable after intubation (if performed) or the diagnosis suspected on clinical criteria. Symptoms and test results were added to the record form. The investigator specifically asked if their child had experienced any of the following symptoms: difficulty breathing, noisy breathing, cough, dysphonia, drooling, fever, preference to sit, refusal of food or fluid, difficulty in swallowing, coryzal symptoms, sore throat or vomiting.

The reliability of selected signs to diagnose croup and epiglottitis was determined by calculation of sensitivity (true positive/(true positive + false negative)), specificity (true negative/(true negative + false positive)), positive predictive value (PPV) (true positive/(true positive + false positive) and negative predictive value (true negative/(true negative + false negative)). Differences in the incidence of symptoms and signs were subjected to Fisher exact tests and differences in the annual incidence of the illnesses analysed with *t*-tests (Stata: StataCorp, College Station, TX, USA). The study was approved by our institution's Human Ethics Research Committee.

Results

In a 40-month period, 606 patients (without syndromic upper airway anomalies) presented with acute stridor. Of these, 374 were diagnosed with croup, 189 with epiglottitis and 43 with other conditions (Table 1). Endotracheal intubation was required for 134 (36%) of patients with croup and for 167 (88%) of patients with epiglottitis.

The mean (±SD) annual incidence of croup presenting to PICU from 1980–1993 was 89 ± 34 and from 1994–2009 was 34 ± 12 ($P < 0.001$). The mean annual incidence of epiglottitis was 56 ± 9 from 1980–1993 and 2 ± 2 from 1994–2009 ($P < 0.001$) with no cases over the recent 3 years. Vaccination was offered against Hib in 1993 and steroids[2] were routinely used at our institution for croup from 1992–1993 onwards.

Table 1 Causes of acute airway obstruction other than croup and epiglottitis

Diagnosis	Number
Bacterial tracheitis	7
Tonsillitis-pharyngitis	7
Sub-glottic stenosis	5
Post-extubation stridor	4
Vocal cord palsy	3
Tracheo/tracheo-bronchial stenosis	3
Vascular ring	2
Aspiration of foreign body	2
Mediastinal tumour	2
Subglottic haemangioma	2
Hysterical-anxiety cord adduction	2
Ingestion of caustic substance	1
Angioneurotic oedema	1
Goitre	1
Retropharyngeal abscess	1

Detailed symptoms and signs were recorded for 203 children. None of whom had been vaccinated against Hib. One hundred and two children (age: mean ± SD 35 ± 48, median 18 months) were considered to have croup. In 49 of these, the diagnosis was made on the basis of normal appearance of the epiglottis and supraglottic structures on direct inspection, a perceived constriction of the tracheal at intubation and lack of culture of tracheal bacteria. These children required intubation for 68 ± 79 h (range 3–484 h, median 48 h). In another six children, the diagnosis of croup was made on the basis of a normal epiglottis on direct inspection without intubation. Children considered to have croup but not intubated were treated with inhaled adrenaline and with systemic steroid. In 53 children not intubated, the diagnosis of croup was based on positive responses to inhaled adrenaline and systemic steroid and detection of viruses in naso-pharyngeal aspirates (22 children).

Of the 101 children (age: mean ± SD 37 ± 17, median 34 months) diagnosed with epiglottitis, 95 were intubated for which general anaesthesia was provided in 94. One child was intubated at home by ambulance officers after a cardiorespiratory arrest following misdiagnosis, and subsequently died in hospital. The mean duration of intubation was 18 ± 8 h, which was significantly shorter than for croup ($P < 0.001$). It is our practice to extubate when the child's temperature normalises and we do not inspect the epiglottis prior to extubation.[3] None required re-intubation after extubation. In the six children not intubated, the diagnosis was made in five by a lateral X-ray of the neck and in one by direct inspection of the larynx. In these six children not intubated, the degree of airway obstruction was not severe and quickly resolved with antibiotic therapy. Sixty-six (65%) were treated with chloramphenical and 35 (35%) with cefotriaxone or cefotaxime. Hib was cultured from blood samples of 87 (86%) children, another five had positive urine antigen tests, and another three positive epiglottic swabs for Hib.

The percentages of children having symptoms and signs, and the significance of differences, are given in Figures 1 and 2. The annual incidence of both illnesses is shown in Figure 3. Concerning symptoms, children with epiglottitis had significantly greater incidence of drooling ($P < 0.001$), dysphonia ($P < 0.001$), fever ($P = 0.012$), preference to sit ($P < 0.001$), refusal of food ($P < 0.001$), dysphagia ($P < 0.001$), sore throat ($P < 0.001$) and vomiting ($P < 0.001$). Children with croup had significantly greater incidence of cough ($P < 0.001$), breathing difficulty ($P = 0.029$), noisy breathing ($P = 0.018$) and coryzal symptoms ($P < 0.001$). Although eight children with epiglottitis were said by their parents to have a cough, on our observation of these children, six of these were not actually coughing but rather expectorating saliva from their mouths. Concerning signs, all but five children (with epiglottitis) had stridor on presentation. Children with epiglottitis had a greater incidence of drooling ($P < 0.0001$), preference to sit ($P < 0.001$) and a temperature above 38°C ($P < 0.001$), whereas children with croup had a greater incidence of cough ($P < 0.001$) and retraction ($P < 0.001$). There was no difference in the incidence of stridor, tracheal tug, pallor or cyanosis, hypotonia or obtundation.

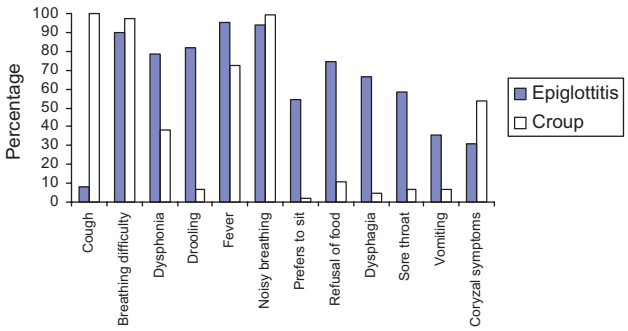

Fig. 1 Symptoms of epiglottitis and croup. Differences in incidence: cough $P < 0.001$, breathing difficulty $P = 0.029$, dysphonia $P < 0.001$, drooling $P < 0.001$, fever $P = 0.012$, noisy breathing $P = 0.018$, prefers to sit $P < 0.001$, refuses food $P < 0.001$, dysphagia $P < 0.001$, sore throat $P < 0.001$, vomiting $P < 0.001$, coryzal symptoms $P < 0.001$.

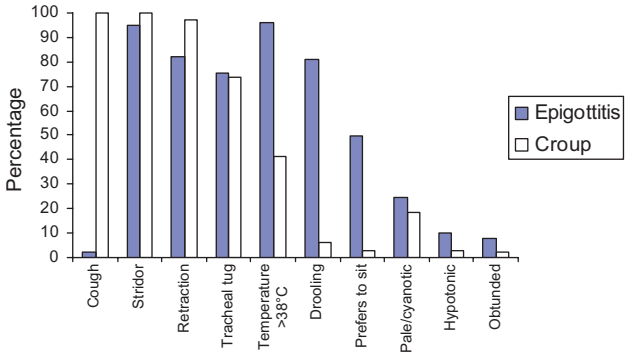

Fig. 2 Signs of epiglottitis and croup. Differences in incidence: cough $P < 0.001$, stridor NS, retraction $P < 0.001$, tracheal tug NS, temperature >38°C $P < 0.001$, drooling $P < 0.001$, prefers to sit $P < 0.001$, pale/cyanotic NS, hypotonic NS, obtunded NS. NS, not significant.

Of 198 children presenting with stridor, 96 had epiglottitis (of whom two had coughing and 76 had drooling) while 102 had croup (of whom 102 had coughing and 6 had drooling). With this data, the sensitivity and specificity of coughing for croup is 1.00 and 0.98, respectively, while the sensitivity and specificity of drooling for epiglottitis is 0.79 and 0.94, respectively. Alternatively viewed, the sensitivity and specificity of the *absence of coughing* for epiglottitis is 0.98 and 1.00, while the *absence of drooling* has a sensitivity and specificity for croup of 0.94 and 0.79, and a sensitivity and specificity for epiglottitis of 0.21 and 0.94, respectively. While croup is highly predicted by coughing (PPV 1.00) and the absence of drooling (PPV 0.83), epiglottitis is highly predicted by drooling (PPV 0.93) and the absence of coughing (PPV 1.00). Confidence intervals (95%) are given in Table 2.

Misdiagnoses

Among the 101 children with epiglottitis, 38 (38%) had been previously assigned another diagnosis before the definitive diagnosis. In eight of these, a second misdiagnosis was made and in one each a third and fourth misdiagnosis was made before the definitive diagnosis. First misdiagnoses were pharyngitis or

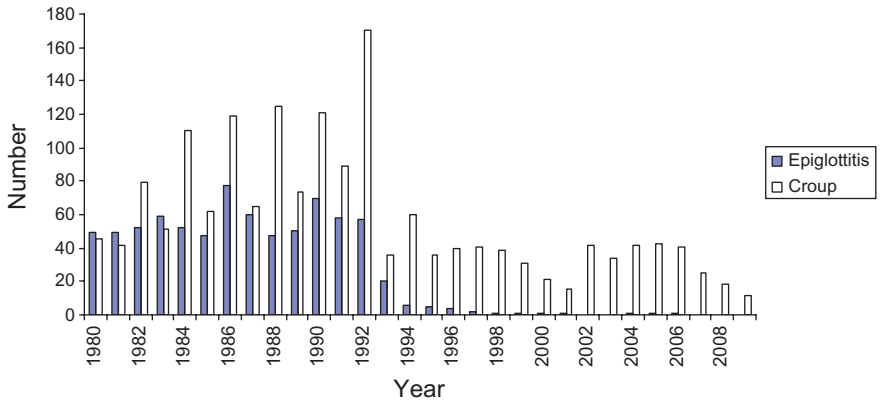

Fig. 3 Annual incidence of epiglottitis and croup presenting to ICU.

Table 2 Reliability of signs to diagnose croup and epiglottitis in children with stridor

	Cough	Absence of cough	Drooling	Absence of drooling
Croup				
Sensitivity	1.00 (0.96–1.00)	–	0.06 (0.03–0.12)	0.94 (0.88–0.97)
Specificity	0.98 (0.93–0.99)	0.02 (0.01–0.07)	0.21 (0.14–0.30)	0.79 (0.70–0.86)
Positive predictive value	0.98 (0.93–0.99)	–	0.07 (0.03–0.15)	0.83 (0.75–0.89)
Negative predictive value	1.00 (0.96–1.00)	0.02 (0.01–0.07)	0.17 (0.11–0.25)	0.93 (0.85–0.97)
Epiglottitis				
Sensitivity	0.02 (0.01–0.07)	0.98 (0.93–1.00)	0.79 (0.70–0.86)	0.21 (0.14–0.30)
Specificity	–	1.00 (0.96–1.00)	0.94 (0.88–0.97)	0.94 (0.88–0.97)
Positive predictive value	0.02 (0.01–0.07)	1.00 (0.96–1.00)	0.93 (0.85–0.97)	0.77 (0.58–0.89)
Negative predictive value	–	0.98 (0.93–0.99)	0.83 (0.74–0.89)	0.56 (0.48–0.63)

tonsillitis 14, viral upper respiratory tract infection nine, croup eight, asthma four, influenza two and bronchiolitis one. Four children had respiratory arrests and were resuscitated. One child with epiglottitis had a cardiorespiratory arrest at home and died in hospital after being sent home with a misdiagnosis of pharyngitis at a general practitioner's surgery.

Among the 102 children with croup, 16 (16%) had had another diagnosis made once before the definitive diagnosis. Misdiagnoses were asthma nine, epiglottitis nine and pharyngitis one.

Discussion

This study, performed in an era when epiglottitis was at its height of incidence, shows that more than one third of children with epiglottitis and approximately one sixth of children with croup were misdiagnosed. This illustrates the difficulty in differentiating epiglottitis and croup in the early phases of illness. Misdiagnosis of one case of epiglottitis ended in a fatal outcome. Now that the incidence of epiglottitis has diminished markedly, young physicians may never have seen a case thus accentuating the difficulty distinguishing the two illnesses.

Difficulty in differentiating the two illnesses exists because both epiglottitis and croup occur in children of the same age group and cause upper airway obstruction. They often share symptoms of fever, noisy breathing and difficulty in breathing. Although coughing is a hallmark of croup, the presence or absence of coughing in epiglottitis has been uncertain.

In an early article on the management of epiglottits in 1979,[4] it was stated that a 'croupy cough' is often noted, and in a textbook published the same year it was stated that that a 'brassy cough' is present.[5] That textbook observation became modified with time such that by 2000, it stated the symptoms included 'brassy cough (less commonly)'.[6] In a study of 97 children with the disease, approximately one third were said to have coughing but most children were studied retrospectively.[7] We speculate that coughing in that study may have been mistaken for expectoration of saliva, as we observed. In a recent edition of the textbook,[8] it is stated that in epiglottitis: 'The barking cough typical of croup is rare', but no evidence is advanced. In contrast, this study shows that coughing in epiglottitis although uncommon, is not rare even when expectoration of saliva is recognised. Of more importance perhaps, are the signs of upper airway obstruction without coughing which along with drooling, reliably differentiates epiglottitis from croup. Additional but less reliable hallmarks of epiglottitis are preference to assume a sitting position, refusal of food or drink, inability to swallow, a complaint of sore throat and vomiting. An altered voice is not discriminating. Both conditions are accompanied by fever but in epiglottitis it is usually above 38°C.

It is possible that our observations were confounded by the stage of disease at which the children presented, especially of epiglottitis that is a rapidly progressive illness culminating in both airway obstruction and peripheral circulatory failure. We did not study the development of symptoms and signs and may have encountered the children at different stages of illness. Similarly, the histories given by parents may have been influenced by their observation of our treatment and being informed of their child's diagnosis.

Apart from discriminating clinical signs, a lateral neck X-ray[9] or sonographic investigation[10] may identify the 'thumb sign' of epiglottitis whereas an antero-posterior neck film may identify the 'steeple sign' of croup.[1] However, the reliability of radiologic study for these illnesses is poor-moderate.[11,12] Occasionally, resort to direct inspection of the epiglottis may be necessary to confirm or exclude the condition. If the index of suspicion is high for epiglottitis, direct inspection should only be performed under anaesthesia with the intention of intubation. If the index of suspicion for epiglottitis is very low and the intention is to exclude the condition, direct inspection is not totally contraindicated but should only be done where facilities and personnel are on hand to intubate, should sudden obstruction be precipitated. In this latter circumstance, it may be preferable to perform a lateral neck X-ray to exclude the condition.

The marked decrease in the incidence of epiglottitis presenting to our PICU after availability of vaccination against Hib is commensurate with the reduction noted among young children in United States,[13,14] Europe,[15] England,[16] elsewhere in Australia,[17,18] New Zealand,[19] France[20] and Sweden.[21] However, there has been a resurgence in some countries, for example in England[22] and in Holland[23] although not at rates similar to the pre-vaccination era. The most likely reason has been suggested as secondary vaccine failure whereby Hib carriership is

decreased by mass vaccination leading to decreased natural boosting, decreased immunity and increased susceptibility.[23]

An individual case of bacterial epiglottitis may be due to a number of possibilities including Hib vaccination failure,[14,24–26] lack of vaccination[19] (e.g. in immigrants from countries with no vaccination programmes), infection with bacterial species other than Hib or an underlying immunological illness. A wide variety of species of bacteria other than Hib may cause epiglottitis including non-type b *Haemophilus influenzae* strains,[25] *Streptococcus mitis*,[27] group B *Streptococcus*,[28] group F and group A *Streptococci*,[29] group G beta-hemolytic *Streptococcus*,[30] *Pneumococcus*,[31] *Staphylococcus aureus*[32] and *Pasteurella mulocida*.[33] Non-bacterial epiglottitis may be due to chemical or thermal burn[34] or simulated by hereditary angioedema[35] or haemophagocytic lymphohistiocytosis.[36]

Although it is unlikely that the incidence of croup has diminished over the past two decades, there has been a significant reduction in the annual incidence of croup presenting to our PICU. This coincides with adoption of routine steroid therapy for this disease. Other investigators have also determined that steroids used for croup relieve symptoms, reduce admissions,[37] shorten duration of intubation and reduce length of hospital stay.[38]

In conclusion, this study shows that epiglottitis and croup are easily confused but they may be reliably distinguished by discriminating signs. If a stridulous child has a cough and not drooling the diagnosis is likely to be croup and unlikely to be epiglottitis, but if he/she has drooling and no coughing the diagnosis is likely to be epiglottitis and unlikely to be croup.

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