ACUTE LARYNGOTRACHEOBRONCHITIS AND EPIGLOTTITIS*

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RESPIRATORY OBSTRUCTION is one of the most serious problems in infants and children. Laryngotracheobronchitis and epiglottitis may cause acute respiratory obstruction. Epiglottitis alone can be one of the causes of sudden death in childhood.^{1,11,12} Unless we are familiar with the clinical features of these conditions, proper treatment may not be instituted in time to prevent death.

During the past twenty years, a number of papers on acute laryngotracheobronchitis and epiglottitis have appeared in the literature,¹⁻⁸ but few have dealt with the associated anaesthetic problems.

In this paper, the conditions are considered together in view of the similarity of the onset, although the clinical course can be different. Also the cause for alarm is the same in each disease; the anaesthetist is called for one reason, namely relief of acute respiratory obstruction.

CLINICAL FEATURES

Acute Laryngotracheobronchitis

The term laryngotracheobronchitis is preferred to the term "Croup" with which it is synonymous. The latter was formerly used for diphtheritic inflammation of the larynx and upper trachea.

The condition is usually preceded by an acute upper respiratory infection. The symptomatology is uniform, but variations in severity occur as the disease progresses.⁶ The onset may be sudden with dyspnoea, prostration, and high fever, or it may be insidious. The clinical picture includes features characteristic of both laryngeal and bronchial obstruction. Inspiratory stridor and expiratory wheeze may both be present.

As the name implies, the pathological condition is extensive as proved by endoscopic and post-mortem examination.⁶ Commonly the area immediately below the cords is the principal site of inflammation. The supraglottic area is usually normal. The cause of death may be either asphyxia, exhaustion with cardiac and respiratory failure, extensive atelectasis, pneumonia, or septicaemia.

Acute Epiglottitis (Supraglottitis, supraglottic laryngitis, and acute epiglottic oedema)

Sinclair⁸ in 1941 described a syndrome with acute respiratory obstruction produced by epiglottitis. The typical picture has since been described by others.^{3,4,5} It is characterized by an acute inflammatory oedema of the epiglottis and

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aryepiglottic folds causing laryngeal obstruction.^{11,12} The onset may be deceptively mild with slight sore throat, cough, and fever being the only complaints. In the younger age group, the only indication of illness may be the inability to swallow, resulting in an accumulation of secretions. The disease course usually is rapidly progressive. Symptoms of acute respiratory obstruction may suddenly appear. At this stage restlessness, air hunger, and prostration occur. The child may assume a characteristic posture in an attempt to improve his airway. He prefers to sit with chin thrust out, neck hyperextended, and tongue protruding; and there is much drooling of saliva.^{9,10}

The red swollen epiglottis projecting from the hypopharynx may be seen on examination. Direct or indirect laryngoscopy must be conducted gently and rapidly, and the tongue must not be pushed back.⁹ It has been said that placing the child in the supine position may cause sudden death because the swollen epiglottis is "sucked" into the larynx.¹¹ Dunbar¹³ believes that this is unlikely as the aryepiglottic folds and epiglottis are too swollen and rigid to allow any such movement. Aspiration of collected secretions may be a more likely cause of sudden death. If diagnosis is in doubt, radiological examination of the neck is valuable.¹³

REVIEW OF PATIENTS

All the records of patients admitted to the Montreal Children's Hospital with a diagnosis of acute laryngotracheobronchitis and acute epiglottitis from 1956 to 1961, inclusive, were reviewed. The relative incidence of the two conditions is shown in Figure 1.

FIGURE 1. Total admissions, Montreal Children's Hospital, 1956-61.

FIGURE 2 Sex incidence.

As in previous reports,²⁻⁶ there was no significant sex difference in acute epiglottitis. Acute laryngotracheobronchitis, however, was more frequent in the male (Fig. 2).

The two conditions have a definite predilection for certain age groups (Fig. 3). The greatest incidence of acute laryngotracheobronchitis was below the age of four years. Acute epiglottitis was most frequent between the ages of two and six years.

FIGURE 3. Age incidence.

FIGURE 4. Seasonal incidence.

The seasonal incidence in acute laryngotracheobronchitis is similar to that of respiratory infections in general, being greatest during winter and spring. In acute epiglottitis, the greatest incidence was in the spring (Fig. 4) and the yearly incidence appears to have shown an increase during the last three years (Fig. 5).

As judged by the time interval between the onset of respiratory difficulty and hospital admission, acute laryngotracheobronchitis was found to be the more insidious (Fig. 6).

FIGURE 5. Yearly incidence.

FIGURE 6. Duration of illness to hospital admission.

An analysis of all tracheotomies done at our hospital during this six-year period showed that about half of them were for acute laryngotracheobronchitis and acute epiglottitis (Fig. 7). The incidence of tracheotomy in the two conditions is interesting. Only 13 per cent of patients with acute laryngotracheobronchitis had a tracheotomy, and approximately 90 per cent of patients with acute

FIGURE 7. Tracheotomy.

epiglottitis. Age was not a definite factor in the incidence of tracheotomy in these conditions, although in acute laryngotracheobronchitis there was probably a greater tendency to perform a tracheotomy in the very young (Fig. 8).

Patients with acute laryngotracheobronchitis appeared to have a shorter stay in hospital than those with epiglottitis (Fig. 9). This may be primarily due to the tracheotomy, since it prolongs hospitalization.

MEDICAL MANAGEMENT

Acute laryngotracheobronchitis can be handled conservatively,¹⁴ but since the disease may progress rapidly, constant observation is necessary. Patients are placed in a cool atmosphere of high humidity and oxygen. Antibiotics are

FIGURE 8. Age incidence requiring tracheotomy.

FIGURE 9. Duration of hospital stay (all cases).

started. Sedatives are usually avoided to prevent respiratory depression. Any sign of increasing respiratory difficulty requires consideration of tracheotomy. We have attempted to use some criteria as a guide to indications for tracheotomy. It is suggested that a pulse rate of 140 or over and respiratory rate of 40 or over are reliable indications for tracheotomy.

Because sudden complete obstruction in epiglottitis can occur at any time, it is our present policy to do a tracheotomy once the condition is diagnosed. Those patients who are severely obstructed on admission are either immediately intubated in the emergency ward, or rushed to the operating room for surgical intervention.

ANAESTHETIC MANAGEMENT

Preoperative Considerations

These patients are seen by the anaesthetist just before the tracheotomy. They then have varying degrees of respiratory obstruction.

No preoperative medication is ordered for fear of depressing respiration, producing oversedation, or drying out the secretions. In some patients the obstruction is so great that they make constant strenuous efforts to ventilate in order to survive. On losing consciousness, efforts to ventilate would cease, and obstruction would be complete.¹⁷

Anaesthetic Considerations

It is generally agreed that upper airway obstruction calls for immediate relief, but the old method of emergency tracheotomy, without anaesthesia, is seldom indicated.¹⁵ The safest method is to overcome the obstruction before

anaesthesia. Our method in most of these patients is to give pure oxygen by mask in the lateral, head-down position for a few minutes before intubation. The lateral position is found helpful for drainage of secretions and the prevention of complete obstruction, which might occur in the supine position. The conscious patient is then turned supine and an oral endotracheal tube passed rapidly. For intubation the patient is "mummified" by wrapping him tightly in a sheet and held by assistants. A pillow doughnut head support may be used, and a mouth gag inserted. Trauma is avoided if possible; yet the anaesthetist must realize that even trauma is preferable to losing a patient from respiratory obstruction.²⁰ The psychic trauma of such a procedure is a secondary consideration compared with the physical risk involved.

In acute laryngotracheobronchitis, visualization of the cords is easy and the view comparatively normal if the subglottic constriction cannot be seen. In passing the obstruction below the larynx there may be some difficulty. Also it may be difficult to clear the lower tract of debris immediately after intubation.¹⁸ In most instances a pliable woven gum elastic catheter will pass the obstruction, but if this is not possible, a bronchoscope may have to be utilized and one should always be available.

FIGURE 10. Typical epiglottitis (laryngoscopic view).

In severe epiglottitis, visualization of the cords is often impossible. The lower passages may be freely entered if a small semi-stiff tube with an acute curve at its extremity is directed below the central epiglottic raphe; this raphe usually persists despite the swelling. Figure 10 is a picture of a typical epiglottitis. This has been described as cherry red in appearance. Once intubation has been accomplished, light anaesthesia with any inhalation agent will be adequate for performance of tracheotomy.

Conscious intubation has been found satisfactory in patients severely obstructed, and in the very young. Intubations have also been accomplished without much difficulty in the conscious older child who co-operated adequately. However, un-co-operative children, between the ages of two and five years, who are not in extremis may be difficult to manage by this method. The method we have found satisfactory in these patients is to anaesthetize them lightly by inhalation and to intubate as soon as consciousness is lost. Muscle relaxants should never be used in these conditions for reasons we believe to be obvious. After the tracheotomy, routine post-tracheotomy care is followed.

COMPLICATIONS

In our patients there was no serious complication directly attributable to anaesthesia. There were some complications which were attributable to the disease itself and some to the tracheotomy.

1. *Complications Due to the Disease*

There was one death in the group of patients with acute laryngotracheobronchitis with a final diagnosis of severe pneumonia and septicaemia. Pneumonia is frequently associated with this condition and results in stormier course in the hospital. In the group with acute epiglottitis one patient arrived at the emergency ward severely obstructed and with marked bradycardia. External cardiac massage and intubation were performed, followed by tracheotomy. Except for some drowsiness lasting a few days, the patient recovered completely. Another patient, while waiting in the recovery room for tracheotomy, had a cardiac arrest and was resuscitated, but had a very stormy recovery period.

2. *Complications Due to Tracheotomy*

All the common complications reported as secondary to tracheotomy were seen in some of our patients.²¹ One death occurred, which was due to post-operative obstruction and development of bilateral pneumothorax as shown at post mortem.

DISCUSSION

The scarcity of papers in the anaesthetic literature dealing specifically with these conditions is interesting. It may be that they are not being recognized early, and that only terminal resuscitation measures are performed; or that tracheotomies are still done without an anaesthetic.

In acute laryngotracheobronchitis, unless obstruction is severe, conservative treatment is first attempted. The patient is constantly watched for signs of increased respiratory insufficiency. Deming recently reported the usefulness of steroid and anti-histaminic drugs for post-intubation subglottic oedema.²² This might also be of value in acute laryngotracheobronchitis. A slow pulse may be an indication of severe hypoxia. Increased chest retraction and rapid respiratory rates are other ominous signs. Although pulse rate and respiratory rate may have some significance, using them alone may be indefinite. Pro-

gressive restlessness, cyanosis, and pallor are other signs of hypoxia. The patient with acute epiglottitis is admitted to the recovery room and an anaesthetist is on hand while preparations for operation are being made. If severely obstructed, the patient is immediately intubated. Each patient must be considered separately and all of these suggested signs must be correlated. When in doubt the safer course is to perform a tracheotomy.

Obstruction must be relieved prior to anaesthesia. Urgent tracheotomy may be the only way of relieving respiratory obstruction, but more often than not it is both possible and desirable to improve the airway before the operation is begun. Anoxia is thereby avoided, and the operation carried on unhurriedly and without the embarrassment of venous congestion. Passing a bronchoscope has been advised,^{14,15,16,19} but we have preferred to use the more familiar laryngoscope. Using a semi-stiff tube we have been able to intubate all these patients without great difficulty. We keep such tubes of all sizes in our emergency equipment. There has been a gradual increase in the use of light inhalation anaesthesia before intubation in our patients. It may be that the patients are arriving at the operating room with less respiratory obstruction than in previous years, because of closer observation for signs of increasing respiratory distress.

Helium has been used for respiratory obstruction, although there is some doubt as to its usefulness. We have used it rarely in these two conditions and with no obvious advantage.

The possibility of producing apnoea when pure oxygen is given to any patient with severe respiratory obstruction must be borne in mind. However, this danger should not deter one from oxygenating such patients well before intubation, as of course artificial ventilation can then be immediately instituted. It has been stated that death may occur after tracheotomy, and that this is due to a rapid reversal of the pre-existing respiratory acidosis with cardiovascular collapse and respiratory failure being secondary to inadequate medullary blood flow.²³ We have not seen this in any of our patients.

There were two deaths in 194 patients with acute laryngotracheobronchitis. This is low when compared with a previous report,⁶ which was made before the era of antibiotics, in which the mortality rate was over 50 per cent. The mortality from epiglottitis has been high in almost all reported series. In 1957, Jones and Camps¹¹ reported 26 out of 29 cases coming to coroner's post mortem examination. In a review of 42 patients, three were dead on arrival at the Children's Medical Centre in Boston, and two died in the hospital.² Thus it is frequently a fatal disease. We have had no patients with acute epiglottitis that died after admission to hospital.

SUMMARY

The clinical features of acute laryngotracheobronchitis and acute epiglottitis are presented as anaesthetists may help considerably in the care of patients with these conditions, and often assist in the correct diagnosis by laryngoscopy.

We have reviewed 245 patients treated at The Montreal Children's Hospital in the last six years. There have been two deaths, one from the primary infection,

and one from a tracheotomy complication, in the larger group of acute laryngotracheobronchitis. Not one of 51 patients with acute epiglottitis died, but nearly all had a tracheotomy.

The practice of relieving respiratory obstruction whenever possible before an anaesthetic is given, and performing a tracheotomy if the progress of the disease is doubtful, seems justified.

RÉSUMÉ

Chez les petits et les grands enfants, la laryngotrachéobronchite et l'épiglottite aiguës sont des causes fréquentes d'obstruction respiratoire. Au cours de l'enfance, l'épiglottite aiguë peut être une des causes de mort subite. L'anesthésiste est habituellement appelé pour une seule raison: pour soulager une obstruction respiratoire aiguë.

Nous avons passé en revue les signes cliniques de ces deux états. Habituellement, ils ont un début semblable. Bien que la laryngotrachéobronchite aiguë possède une pathologie plus extensive, l'épiglottite aiguë peut être dangereuse parce que, soudainement, peut apparaître une obstruction respiratoire aiguë.

Nous avons repassé tous les dossiers des malades souffrant de ces maladies et qui ont été admis à l'hôpital Children's Memorial de Montréal au cours des années 1956 à 1961. Il y a eu au delà de 194 cas de laryngotrachéobronchite aiguë et 51 cas d'épiglottite aiguë dans cette série. Le sexe, l'âge, la fréquence saisonnière et annuelle apparaissent aux figures de 1 à 9.

Cinquante pour cent de toutes les trachéotomies pratiquées à l'hôpital Children's Memorial de Montréal l'ont été pour ces deux pathologies. Seulement 13 pour cent des cas de laryngotrachéobronchite aiguë ont nécessité une trachéotomie alors que 90 pour cent des cas d'épiglottite en ont nécessité une. L'âge n'a pas été un facteur déterminant dans la fréquence de la trachéotomie. Chez ces cas là, la trachéotomie a été faite au cours des six premières heures après l'admission. Toutefois, un plus grand nombre de cas d'épiglottite ont subi une trachéotomie en deçà d'une heure après leur admission. Quand la trachéotomie était pratiquée, l'hospitalisation était prolongée. A cause de la pathologie plus étendue de la laryngotrachéobronchite aiguë, les porteurs de cette maladie sont demeurés plus longtemps à l'hôpital, qu'ils aient subi ou non une trachéotomie.

On peut traiter de cas bénins de laryngotrachéobronchite aiguë de façon conservatrice. Il faut une surveillance constante par un personnel compétent. En présence d'épiglottite, il faut recourir à la trachéotomie aussitôt que le diagnostic est posé parce qu'une obstruction complète peut soudainement survenir en aucun temps.

A l'admission, les malades porteurs d'une obstruction marquée sont intubés rapidement dans la salle d'urgence ou ils sont dirigés d'urgence à la salle d'opération pour être opérés.

Nous avons décrit la conduite de l'anesthésie. Nous ne prescrivons pas de prémédication de crainte de déprimer la respiration, produisant une sédation excessive et augmentant la viscosité des sécrétions. Ce qui offre le plus de sécurité, c'est de dépasser l'obstruction avant l'anesthésie. Ce que nous préférons, c'est de poser un tube endotrachéal par la bouche chez le malade conscient.

Il peut être difficile d'employer cette méthode chez l'enfant qui ne collabore pas ou qui n'est pas *in extremis*. Chez ces derniers, la méthode qui nous a paru la plus satisfaisante a consisté à anesthésier les malades légèrement au masque et de les intuber aussitôt qu'ils sont devenus inconscients.

En présence de laryngotrachéobronchite aiguë, il est facile de visualiser les cordes vocales mais la grande difficulté consiste à dépasser l'obstruction subglottique et à débarrasser de ses débris la partie inférieure des voies respiratoires. En temps ordinaire, un tube flexible, tissé, en caoutchouc élastique, pourra dépasser l'obstruction, mais, si cela ne réussit pas, il faudra recourir au bronchoscope. En présence d'épiglottite marquée, il est souvent impossible de visualiser les cordes vocales, mais on peut réussir à intuber en employant un tube semirigide dont l'extrémité antérieure est recourbée à angle aiguë et en le dirigeant sous le raphe épiglottique central qui persiste habituellement.

Au cours de cette série, nous n'avons pas observé de complications sérieuses attribuables directement à l'anesthésie. Nous avons observé des complications dues à la maladie ou à la trachéotomie.

Ces deux maladies peuvent conduire à la mort si elles ne sont pas reconnues et traitées adéquatement.

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