Post intubation laryngeal sequelae in an intensive care unit

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Abstract

The incidence, severity and pattern of post-intubation laryngotracheal sequelae in a 12 bed multidisciplinary intensive care unit (ICU) were assessed in this prospective study. One-hundred and fifty consecutive patients requiring intubation for more than 24 hours for various indications were studied. Evaluation of the larynx and trachea was done using a fibreoptic bronchoscope introduced through the endotracheal tube prior to elective extubation. Rigid bronchoscopy and direct laryngoscopy were performed in very small children and adults requiring tracheostomy. One-hundred and thirty-one (87.6 per cent) patients had visible laryngeal pathology in the immediate post-extubation period. Thirteen (8.6 per cent) had long term sequelae. A high incidence of long term sequelae was noted in patients with seizures (25 per cent) followed by patients with head injury (19 per cent). Steroid therapy failed to offer any significant protection but resulted in doubling of pulmonary sepsis. A grading system was adopted to classify acute laryngotracheal injury and a significant correlation was found between the presence of slough in the immediate post-extubation period and subsequent development of long term sequelae. There was also a significant correlation between a deeper insertion of the endotracheal tube and development subsequently of long term sequelae. The significance of these findings is discussed.

Key words: Intubation, intratracheal, complications

Introduction

Endotracheal intubation (ETI) is perhaps the commonest invasive procedure undertaken in any intensive care unit. Though often life saving, the procedure is not without complications. Formation of granulations, infection, glottic and subglottic oedema and stenosis have all been reported (Lewis *et al.*, 1978; Morriss, 1984). With the introduction of low pressure high volume cuffs the incidence of complications came down but frequent reports of disabling and sometimes life threatening complications continued to appear in the literature (Lewis *et al.*, 1978; Gaynor *et al.*, 1985).

Several papers have looked into the relative importance of the factors which contribute to the development of laryngotracheal stenosis (Lewis *et al.*, 1978; Dunham and La Monica, 1984; Gaynor *et al.*, 1985; Barbet *et al.*, 1988; Squire *et al.*, 1990). In a retrospective study of all patients intubated in the ICU in our hospital over a period of three years (unpublished data), ten patients developed subglottic stenosis although one of them, a child, had been intubated for only three days.

This study is a further attempt at identifying the factors leading to long term sequelae following ETI. In particular, we document and grade, by endoscopic examination, the degrees of acute mucosal injury following intubation. This can be useful in identifying those patients at greater risk of developing laryngotracheal stenosis.

Materials and methods

The study was a prospective one of all ICU admissions requiring intubation for more than 24 hours. It was based in a 12 bed multidisciplinary ICU at the Asir Central Hospital, a 570 bed tertiary referral teaching facility in Southern Saudi Arabia and it extended over a period of 18 months from October 1991.

Patient selection criteria

The study included all patients who were admitted to the ICU and required intubation for more than 24 hours. Patients who were transferred or died before extubation were excluded from the study. Similarly patients with prior tracheostomy or known laryngotracheal pathology were excluded. Overall 150 patients fulfilled the criteria for inclusion in the study and represented all age groups.

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Parameters used in the study

(1) The indications for intubation were divided into four groups: (a) Control of intracranial pressure; (b) Ventilatory support; (c) Airway support and (d) Post-operative. (2) The endotracheal tube was either orotracheal or nasotracheal. When a cuffed tube was used, it was of a high volume, low pressure type. The cuff was inflated using a minimum inflation technique to just prevent leak and the pressure was recorded using a manometer connected to the pilot cuff. (3) The site of the cuff and the tube tip were noted from the chest X-ray performed soon after intubation. (4) The seniority of the intubator was noted namely 1. consultant, 2. resident. Those patients who came referred from other hospitals with an endotracheal tube were labelled as 3. 'outside'. (5) The duration of intubation was noted in days in each patient. (6) Endotracheal secretions and blood samples were sent for culture and antibiotic sensitivity on the 2nd day and every two days thereafter for the duration of intubation. (7) The presence or absence of shock and its nature and duration were noted whilst the patient was with the endotracheal tube. (8) The administration or not of steroids was noted. (9) The co-existence of any diabetes, hypertension, obesity, cirrhosis, epilepsy or any other metabolic diseases was noted. (10) The assessment of the trachea and the larynx was carried out in adult patients by using a fibre-optic broncho-scope introduced through the endotracheal tube at the time of extubation. In patients undergoing tracheostomy, direct laryngoscopy and conventional rigid bronchoscopy were carried out simultaneously and the findings recorded. (11) A clinical system of grading was devised by us (Table I) to grade the acute changes noted in the larynx and the trachea and was applied strictly to all patients. (12) All intubated patients were followed up until their discharge from hospital and any evidence of chronic sequelae were noted. (13) All patients were examined at the time of their admission to rule out any local pathology in the neck. In particular any evidence to suggest local trauma to the neck was noted. All the results were entered into a SPSS/PC programme and analyzed.

Results

Of the 150 patients who were included in this study, 119 were males. The mean age was 28.2 years (range 1 month–85 years). The average duration of intubation was 7.5 days (range 1–35 days). Ninety-seven patients (64.7 per cent) had cuffed endotra-

TABLE I
CLINICAL GRADING OF ACUTE CHANGES SEEN IN THE LARYNX AND
TRACHEA IMMEDIATELY AFTER EXTUBATION

Grade 0	No change
Grade 1	Erythema and/or oedema but no ulceration
Grade 2	Ulceration and/or slough but no narrowing of airway
Grade 3	Glottic or subglottic narrowing due to oedema and/or slough
Grade 4	Vocal fold paralysis

cheal tubes and 53 (35.3 per cent) had non-cuffed tubes. The route of intubation was oral in 145 (96.7 per cent) and nasal in five (3.3 per cent). Sixty-six of these patients underwent tracheostomy (44 per cent).

The admission diagnosis was as follows:

Head injury:	44	Sepsis:	10
Polytrauma:	43	Respiratory failure:	8
Post-operative:	18	Others:	18
CVA:	11		

The indication for intubation was as follows: (a) control of intracranial pressure 83 (55.3 per cent); (b) ventilatory support 33 (22 per cent); (c) airway support 28 (18.7 per cent); (d) post-operative six (four per cent).

The acute laryngotracheal pathology was graded as per the schema in Table I: (a) Grade 0 (no changes) 19 (12.6 per cent); (b) Grade 1 (erythema, oedema) 37 (24.6 per cent); (c) Grade 2 (slough) 87 (58 per cent); (d) Grade 3 (glottic and subglottic narrowing) three (two per cent); (e) Grade 4 (vocal cord paralysis) four (2.6 per cent). One-hundred and four male and 27 female patients had evidence of acute laryngeal pathology whereas 15 males and four females showed no changes. Chronic sequelae were noted in 13 subjects namely: (a) subglottic stenosis five (3.3 per cent); (b) unilateral complete vocal cord palsy three (two per cent); (c) tracheomalacia three (two per cent); (d) bilateral partial vocal cord palsy one (0.7 per cent) and (e) tracheo-oesophageal fistula one (0.7 per cent).

There was no significant correlation between the sequelae and the sex or the ethnicity of the patients. Somewhat surprisingly, neither the duration of intubation, the seniority of the intubator nor the number of times the endotracheal tube was changed had any significant correlation with either the acute or the chronic sequelae in this study. The presence or absence of shock or the nature of the shock had no correlation with the development of sequelae. Similarly the presence of local or systemic sepsis or the presence of local neck trauma not involving the larynx, had no significant correlation with the subsequent development of sequelae.

However in all 13 patients who developed long term sequelae, it was noted that the endotracheal tube was located deeper i.e., between T1 and T4. In fact the deeper the insertion the greater the propensity noticed for complications. The highest incidence of sequelae was noticed in patients who presented with seizure disorders (25 per cent) and patients presenting with serious head injuries (19 per cent) and to a lesser extent in patients presenting to the ICU with pre-existing respiratory problems (17 per cent).

Steroids did not seem to influence the incidence of laryngotracheal sequelae in this study. They, however, doubled the incidence of pulmonary sepsis.

Discussion

Endotracheal intubation is perhaps the commonest invasive procedure carried out in an ICU. It is

normally associated with varying degrees of damage to the laryngotracheal mucosa ranging from oedema, erythema, necrosis to slough formation (Morriss, 1984). In some patients these changes may proceed to eventual laryngotracheal stenosis or tracheo-oesophageal fistula with life threatening complications (Lewis et al., 1978; Gaynor et al., 1985). Although several risk factors in the causation of laryngotracheal stenosis have been identified, the relative importance of these factors is far from clear, different studies emphasizing different risk factors (Lewis et al., 1978; Stauffer et al., 1981; Barbet et al., 1988; Zalzal and Luyten, 1992). The classification presented in this study (Table I) has the advantage of simplicity and ease of application as it is based entirely on endoscopic findings. Barbet et al. in 1988, emphasized the importance of humidity in the pathogenesis of mucosal damage in the tracheobronchial tree. In our study all the patients received humidified air thus eliminating the influence of this important factor.

Several studies have emphasized the importance of the duration of intubation in the pathogenesis of laryngotracheal stenosis. Stauffer et al. (1981) demonstrated mucosal ulceration, inflammation, oedema and submucosal haemorrhage at autopsy after only seven hours intubation. Spruance et al. (1982) utilizing a dog model showed that the changes in the larynx and subglottic area were reversible when intubation lasted for less than seven days but when extended beyond 14 days most changes were irreversible with an average of 40–50 per cent reduction in the subglottic airway. Different authors have given different estimates of what they consider to be safe periods of endotracheal intubation. Geffin et al. (1971) recommended not more than six days; Pontoppidan et al. (1972) eight days; El Naggar et al. (1976) 11 days and Dunham and La Monica (1984) 10-14 days. Whited (1984) suggested that intubation beyond seven days and especially 10 days carried a significantly increased risk. O'Neill (1984) stated that ETI is safe in infants up to three to four weeks but no longer than seven days in patients over six-months of age. In our study all patients were evaluated at the end of the first week and where it was felt that prolonged intubation was necessary, a tracheostomy was performed. It is therefore not surprising that there was no correlation between the duration of intubation and the development of long term sequelae. What was surprising, however, was the lack of significant correlation between the number of times the endotracheal tube was changed and the subsequent development of long term sequelae. Numerous papers (Morriss, 1984; Gaynor et al., 1985) have emphasized the importance of this correlation.

The seniority of the intubator, the ethnicity of the patient and the sex of the patient did not seem to influence the development of long term sequelae in this study. This is contrary to the observation of Tonkin and Harrison and others who have reported a higher incidence in women (Tonkin and Harrison, 1967; Burns et al., 1979). This increased propensity in female patients has been variously attributed to

the relatively smaller dimensions in the female (Gaynor et al., 1985) as well as increased fragility of the lining mucosa (Balestrieri and Watson, 1982).

This study failed to establish any correlation between the presence of shock or its type with the development of long term sequelae. Squire et al. (1990) using a rabbit model showed a higher incidence of stenosis developing in association with respiratory infection. No such association was evident in this study. Gaynor et al. (1985) demonstrated a higher incidence of stenosis in female diabetics. Morriss, (1984) mentioned a number of debilitating conditions such as cancer, steroid therapy, chronic anaemia, malnutrition, respiratory tract infections and dehydration as predisposing a patient to a higher rate of complications. Our study looked into the significance of external neck trauma (not involving the larynx), diabetes and hypertension in relation to the later development of laryngotracheal stenosis and failed to show any significant correlation.

A significantly high incidence of laryngotracheal pathology has been previously demonstrated in head injury patients (Nowak et al., 1987) and patients with seizures (Morriss, 1984). In our series we found laryngotracheal pathology in 25 per cent of patients with seizures followed by 19 per cent in patients in coma following head injury.

The use of corticosteroids was not significantly associated with suppression of laryngotracheal injury but a trend in that direction was suggested by Stauffer et al. in 1981. In our study steroid therapy offered no protection and on the contrary, seemed to double the incidence of pulmonary sepsis.

Interestingly a significant correlation was demonstrable between the depth of the tube insertion and the incidence of laryngotracheal stenosis. The deeper the insertion the greater seemed the chance of developing laryngotracheal pathology. This fact has not been emphasized in previous papers and is perhaps a reflection of the increased propensity for tube movement with the increase in the length of the tube within the trachea.

Endotracheal intubation remains and will continue to remain, one of the most common procedures carried out in critically ill patients. Laryngotracheal stenosis is one of the most important complications of this procedure. Several papers have looked into the relative importance of the various factors which can contribute to the development of this complication (Lewis et al., 1978; Dunham and La Monica, 1984; Gaynor et al., 1985; Barbet et al., 1988; Squire et al., 1990). This study is yet another attempt in this direction. Based on this study we recommend that flexible endoscopy of the larynx and trachea at the time of extubation should be carried out wherever possible and patients showing the presence of slough should be followed up for prolonged periods of time, perhaps even after discharge from the hospital.

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