Abstract: Background: Endotracheal tube displacement is one of the leading causes for airway related complications. Endotracheal tube displacement is much more common in the prone position than in the supine position.

Method: The study population consisted of 120 patients aged between 18-60 years, ASA class 1 and 2, undergoing surgery in the prone position who were randomly allocated into two groups of sixty patients each. The endotracheal tube was secured either with adhesive tape (Group A) or a Thomas tube holder (Group B). The ease of application and removal, effect on caliber of endotracheal tube, amount of displacement of endotracheal tube and also any injuries with either fixation method were studied.

Result: Both groups were comparable with respect to mean time taken for the application of the fixation device, peak airway pressure change after the application of the fixation device in the supine position and after positioning the patient in the prone position and the time taken for removal of the fixation device. Displacement was significantly larger in group A than in group B.

Conclusion: Both methods of fixation of the endotracheal tube are clinically useful in the prone position but the Thomas tube holder is more effective than adhesive tape in preventing displacement of endotracheal tube.

Key words: Endotracheal tube; displacement; adhesive tape; prone position; supine position.

Introduction

Endotracheal intubation is an important procedure in both anaesthetised and critically ill patients. Endotracheal tube (ETT) displacement is one of the leading causes for airway related complications (1). So, securing the ETT becomes as important as intubation itself to prevent accidental extubation or endobronchial displacement of the ETT. ETT displacement is much more common in the prone position than in supine position (2). One of the most devastating complications in the prone position is ETT displacement as the above condition is difficult to manage even with early recognition (3). So properly securing the ETT in this position becomes more important than in the supine position. Commonly used methods of securing the ETT include adhesive tape, twill tape and a wide variety of ETT holders. A Medline search did not identify a study which has evaluated/compared different methods of fixation of the ETT in the prone position. This study was conducted to evaluate and compare the effectiveness of the Thomas endotracheal tube holder (TETH) with classically used adhesive tape for securing the ETT in patients undergoing surgery in the prone position.

Materials and Methods

The study was approved by the institutional ethical committee and a written informed consent was obtained from all patients.

The testing devices were constructed using the following materials:
- Thomas Endotracheal Tube Holder (TETH) (Laerdal AS, Norway) is a single use device which can fix 6.0 to 9.0 mm size ETTs. It has a hard plastic ‘face’ plate which is foam padded on its inner surface with a V shaped slot in which the ETT sits, a quick-set screw clamp for fixing the ETT, an aperture for oral access, a bite block, a 2.5 cm wide Velcro strap to secure the TETH to the head (Fig. 1, 2).

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Comparison of tube-taping versus a tube-holding device for securing endotracheal tubes in adults undergoing surgery in prone position

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This study was a randomised, prospective, comparative study. The study population consisted of 120 patients aged between 18-60 years, ASA class 1 and 2, undergoing surgery in the prone position. Patients undergoing head and neck surgeries were excluded from the study. By computerised

• Adhesive tape (3M Elastic Adhesive Bandage, 3M Health Care, India) was an elastic adhesive plaster which was cut in a three prong pattern. The middle prong was stuck to the ETT and two outer prongs were stuck to the patient skin (Fig. 3).

Fig. 1. — Parts of TETH

Fig. 2. — Tube fixation with TETH in supine and prone position

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randomization, patients were allocated into two groups with sixty patients in each group.

- Group A (n_A = 60): ETT secured with adhesive tape
- Group B (n_B = 60): ETT secured with TETH

During preanaesthetic evaluation, patients were examined for presence of any facial abnormalities or facial hair apart from history and examination. All patients were premedicated with intravenous glycopyrrolate 10 μg/kg. Under standard monitoring, general anaesthesia was induced with intravenous fentanyl 3 μg/kg, propofol 2.5 mg/kg and the trachea was intubated with 7.5 mm and 8.0 mm ID polyvinyl chloride ETT in female and male patients respectively after achieving neuromuscular blockade with intravenous vecuronium 0.12 mg/kg. The ETT was fixed with either of the methods after confirming bilateral equal air entry. The point of fixation of ETT was noted with reference to upper incisor teeth. The peak airway pressure was noted before application of either of the tube fixation method. The ease of application of the fixation method was assessed by measuring the time taken for proper application of the fixation methods (calculated from the time fixation of ETT was started to the time ETT was stably fixed). The change of peak airway pressure after fixation of ETT was noted in both groups. Then the patients were put in the prone position. The change in peak airway pressure in the prone position was recorded. After completion of surgery patients were repositioned to the supine position. The ease of removal of the fixation device was assessed with reference to the time taken for removal of the fixation device (calculated from time of starting of removal of fixation device from the ETT to the time of complete removal of fixation device from the ETT). The amount of inward or outward displacement of the ETT with reference to incisor teeth was noted by a second observer who was blinded to the point of fixation of the ETT with reference to the incisor teeth and also about the tube fixation method. The patients were observed for any injuries due to the fixation method by the second observer.
Statistical analysis

As our pilot study was with no previous information being available regarding expected means or standard deviations, a pre-study power calculation was not possible. The number of participants was based on a feasible convenience sample and was therefore arbitrarily decided. The study was analysed with null hypothesis that both fixation methods are equally effective in preventing ETT displacement in the prone position. The primary outcome was the amount of tube movement after securing by tape or TETH in the prone position when compared to the supine position. Secondary outcomes were effect of fixation method on the caliber of the ETT in the supine and prone position (indicated by change in peak airway pressure after fixing the ETT with either fixation device in the supine and prone position), ease of fixation and release of the fixation device (indicated by the time taken for application and removal of fixation device), usefulness of the fixation device in patients with facial hairs and to observe for any injuries because of the fixation method. Statistical testing of ordinal data (Ratio of male & female, number in patients with excessive hair) was done using fisher’s exact test. The remaining variables were analysed for statistical significance using two tailed unpaired ‘t’ test. The results are presented as mean ± standard deviation (SD), number (%) of cases. A P value of < 0.05 was considered significant.

Results

The two groups were more or less homogenous with regard to age and sex distribution, weight of patients, type and duration of surgery (Table 1). Eight patients in each group had excessive facial hair (beard). Both groups were comparable with respect to mean time taken for the application of the fixation device, peak airway pressure change after the application of fixation device in supine position and after positioning the patient to the prone position and the time taken for removal of the fixation device (Table 2). The mean change of point of fixation (cm) was significantly higher in group A (1.51 ± 0.56) than in group B (0.21 ± 0.15) (P < 0.05) (Table 2). In patients with excessive facial hair, the adhesive plaster could not be used in eight patients and these were excluded from the study but TETH was used in these eight patients without any problem (Table 2). There was neither accidental extubation nor endobronchial intubation in either group.

There were no injuries to the patients with either fixation method except in one patient of group A (P > 0.05), who had a minor allergic reaction in the form of erythema at the site of application of the adhesive plaster to the skin which subsided within six hours after removal of the adhesive plaster. There were no significant changes in oxygen saturation, EtCO2 during intraoperative period with either method of fixation.

Discussion

ETT fixation is an extremely critical aspect in patients undergoing surgery in the prone position. There is no universally accepted ETT fixation method. The ideal technique of tube fixation should cause no or minimal tube displacement, should be easy to use, should not alter the calibre of the ETT and should not be injurious to the patient. This study analysed almost all the prerequisites of a safe ETT fixation method.

This study showed that both methods of fixation of the ETT are equally easy in application and removal. Both methods of fixation did not cause any significant change in the caliber of the ETT as indicated by insignificant differences in the change in peak airway pressure in both the supine and prone position after applying the fixation methods. The displacement of the ETT with adhesive tape was stastically but not clinically significant when compared with TETH as indicated by no significant changes in the airway pressure, EtCO2 and SPO2 which warranted any corrective measures. The possible cause of significant displacement of ETT with adhesive tape was loss of fixation ability due to soakage of the adhesive tape with oral secretions of the patient in the prone position. On the other hand, TETH fixed ETT more effectively in the prone position as the screw clamp of TETH which fixes the ETT was not affected by the patient’s secretions. Murdoch and Holdgate conducted a study to compare the tube fixation with cloth tape versus TETH for securing the ETT in manikins and they found that TETH effectively minimised tube movement when compared with conventional tape tying (4).

Studies have shown that adhesive tape is not an effective method of securing ETT in patients with facial hairs (5). Our study concurred with the above fact. In contrast, TETH could fix the ETT effectively in such patients because of its Velcro strap which runs around the head of the patient and keeps the TETH in position. So we conclude that TETH is the best method of fixation of ETT in patients who...
insist on retaining their facial hairs. Similarly adhesive tape is not useful in patients with facial burns and injuries (6). So TETH may be useful in these groups of patients too for ETT fixation.

There are reports of skin damage with adhesive tape which are in the form of mechanical injury (eg; Burning of the skin) and allergic or hypersensitivity tension blisters which are more commonly seen in elderly, immunocompromised, epidermolysis bullosa patients and those with impaired circulation or neurological diseases (7, 8). In our study, there was no significant incidence of perioral skin or mucosal injury in both methods of fixation of the ETT.

**Conclusion**

Both methods of fixation of ETT are clinically useful in the prone position but TETH is more effective than adhesive tape in preventing displacement of the ETT. TETH should be the method of choice for fixation of ETT for patients with excessive facial hairs in the prone position.

**References**


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**Table 1**

Demographic profile of patients, type and duration of surgery

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>38.8 ± 0.20</td>
<td>43.6</td>
</tr>
<tr>
<td>Male:Female (n)</td>
<td>22:8</td>
<td>21:9</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>52.6</td>
<td>56.8</td>
</tr>
<tr>
<td>Types of Surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumbar discectomy (n)</td>
<td>58</td>
<td>57</td>
</tr>
<tr>
<td>Pilonidal sinus excision (n)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Duration of Surgery (minutes)</td>
<td>80 ± 14</td>
<td>76 ± 17</td>
</tr>
</tbody>
</table>

n : Number.

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**Table 2**

Characteristics of ETT fixation methods

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group A</th>
<th>Group B</th>
<th>P value</th>
<th>'t' value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time taken for application of fixation device (seconds)</td>
<td>20.72 ± 0.20</td>
<td>21.16 ± 0.17</td>
<td>0.0952 NS</td>
<td>± 1.68</td>
</tr>
<tr>
<td>Change in peak airway pressure after fixing ETT with fixation device in supine position (cmH2O)</td>
<td>0.51 ± 0.08</td>
<td>0.60 ± 0.12</td>
<td>0.0745 NS</td>
<td>± 1.80</td>
</tr>
<tr>
<td>Change in peak airway pressure with fixation device after prone positioning (cmH2O)</td>
<td>1.17 ± 0.14</td>
<td>1.25 ± 0.16</td>
<td>0.0643 NS</td>
<td>± 1.87</td>
</tr>
<tr>
<td>Change of point of fixation (cm)</td>
<td>1.51 ± 0.06</td>
<td>0.21 ± 0.03</td>
<td>0.0370 Significant</td>
<td>± 2.11</td>
</tr>
<tr>
<td>Time taken for removal of fixation device (seconds)</td>
<td>12.33 ± 0.12</td>
<td>12.23 ± 0.1</td>
<td>0.0871 NS</td>
<td>± 1.73</td>
</tr>
<tr>
<td>Successful ETT fixation in patients with facial hair (Y/T)</td>
<td>0/8 (0%)</td>
<td>8/8 (100%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Degree of Freedom for 't' test = (nA-1)+(nB -1) = (52-1)+(60-1) = 110. (nA is 52 instead of 60 because 8 patients with excessive facial hairs in group A were excluded from the study).

Values are given as mean ± SD; Y/T: Yes/Total number of patients; NS: Not significant.