A HAZARD OF THE POLLARD ENDOTRACHEAL TUBE

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SUMMARY

Two patients are described in whom failure of the Pollard endotracheal tube produced complete respiratory obstruction. Comparisons are made of external diameters, resistance to gas flow and resistance to compression between Pollard tubes and several conventional tubes. It is concluded that the Pollard tube is not satisfactory for microlaryngoscopy.

The Pollard nylon reinforced endotracheal tube was introduced to facilitate microlaryngoscopy in the intubated patient (Pollard, 1968). The latex wall is supported by a nylon coil to prevent kinking and, in order to minimize interference with the operative field, there is a shoulder at which the diameter of the tube is reduced. The nylon support was introduced to reduce the risk, reported previously, of separation of the layers of latex from the metal coil used in other, earlier armoured tubes with consequent obstruction of the lumen (Forrester, 1959; Robbie and Pearce, 1959; Kohli and Manku, 1966; Catane and Davidson, 1969).

We wish to report two incidents which demonstrate a complication of the use of the Pollard tube.

CASE REPORTS

Case no. 1

A healthy, 48-year-old woman presented for microlaryngoscopy for hoarseness of voice. After premedication with papaveretum 10 mg and hyoscine 0.2 mg, anaesthesia was induced with Althesin 3 ml followed by suxamethonium 50 mg. Following manual ventilation with oxygen, a 5.0-mm Pollard endotracheal tube (packed and sterilized by autoclaving in our own hospital) was passed using a lubricated introducer. The cuff was inflated with 5 ml of air, this being the volume required to prevent gas leakage.

It was immediately obvious that there was almost complete resistance to inflation of the lungs and the tube was promptly removed and ventilation via a face mask substituted. The wall, lumen and cuff of the tube appeared undamaged and it was reinserted, but with the same result. A new tube was substituted and the operation proceeded uneventfully.

Examination of the lumen of the suspect tube with the cuff inflated revealed that separation of the latex had occurred at the level of the shoulder, air having entered via a communication with the pilot tube (fig. 1).

Case no. 2

A male patient, aged 60 yr, with benign vocal nodules, was anaesthetized for microlaryngoscopy and biopsy. After premedication with pethidine 100 mg and atropine 0.6 mg, anaesthesia was induced with thiopentone 250 mg followed by suxamethonium 50 mg. After inflation of the lungs with oxygen, a 5.0-mm Pollard tube was passed with a lubricated introducer and the cuff was inflated sufficient to prevent leakage. This was a new tube, fresh from the manufacturer's package, and had been examined carefully with the experience of the previous case in mind. The position of the tube was checked by auscultation over both lung fields. Anaesthesia was maintained with intermittent suxamethonium, nitrous oxide and oxygen with manual ventilation.

After an uneventful period of about 20 min, inflation of the lungs suddenly became impossible. The cuff was deflated and anaesthesia continued with a high fresh gas flow to compensate for the leak. Subsequent examination of the tube revealed the same fault as described in case 1 (fig. 2).

Following this second occurrence, all Pollard tubes in use in our hospitals were examined. Of 24 tubes in use at the time six, including the two described here, were found to exhibit the same fault, namely partial obstruction of the lumen, at the level of the shoulder when the cuff was inflated.

RESULTS OF LABORATORY TESTS AND DISCUSSION

Failure of this type, involving separation of the wall in flexometallic endotracheal tubes, has been reported many times (Forrester, 1959; Robbie and Pearce, 1959; Kohli and Manku, 1966; Catane and Davidson, 1969). The newer nylon supported tube is believed to reduce the risk of this complication because of better adhesion between the nylon and latex.

It would appear that the incorporation of a sharp reduction of lumen size introduces an inherent weakness, permitting separation of the latex layers by air from the pilot tube, a supposition supported by the fact that 25% of tubes examined exhibit the same fault. The second case reported was the more disturbing of the two. Here the fault developed, after 20 min use, in a new tube which had been neither boiled nor autoclaved. This suggests that not even the most careful preliminary examination can exclude the possibility of failure during operation.

This high failure rate prompted us to assess the Pollard tube to determine what advantage, if any, it has over more conventional equipment.

The factor determining the degree of obstruction to vision is the external diameter. Accordingly, we measured this in a variety of tubes using an engineer’s micrometer. The results are given in table I.

Internal diameters were measured also and found to correspond exactly with the stated sizes in each case.

In terms of external diameter, the Pollard 6.0 mm and 5.0 mm are similar to the Portex 7.0 mm and 6.5 mm respectively. Therefore, we decided to measure and compare the resistance to the flow of air through these tubes.

A vacuum cleaner motor, controlled by a Variac, was used to produce a range of flow rates through an appropriate rotameter on the way to an outlet incorporating a side-arm to a water manometer. The tubes were attached directly to this outlet and the pressure decrease across the tube at various flow rates was measured (fig. 3). Each point represents the mean of three measurements and, as no deviation was found, no confidence limits are given. The range of flows was chosen to correspond to flows found in clinical practice.

Pollard tubes are shown to have higher resistance to gas flow than conventional tubes of similar external diameter. In the Pollard tube, the thick wall needed to incorporate the nylon coil eliminates most

<table>
<thead>
<tr>
<th>Tube type:</th>
<th>Pollard</th>
<th>Pollard</th>
<th>Portex</th>
<th>Portex</th>
<th>Portex</th>
<th>Portex</th>
<th>Red rubber</th>
<th>Red rubber</th>
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<tbody>
<tr>
<td>I.d. (mm)</td>
<td>6.0</td>
<td>5.0</td>
<td>7.0</td>
<td>6.5</td>
<td>6.0</td>
<td>9.0</td>
<td>9.0</td>
<td>6.5</td>
</tr>
<tr>
<td>O.d. (mm)</td>
<td>9.5</td>
<td>9.0</td>
<td>9.8</td>
<td>9.1</td>
<td>8.25</td>
<td>12.35</td>
<td>9.0</td>
<td></td>
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</tbody>
</table>
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<table>
<thead>
<tr>
<th>Tube type</th>
<th>Pollard</th>
<th>Pollard</th>
<th>Pollard</th>
<th>Portex</th>
<th>Red rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.d. (mm)</td>
<td>10 (narrow section)</td>
<td>6 (narrow section)</td>
<td>5 (narrow section)</td>
<td>6.5</td>
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<tr>
<td>Occluding force at 20 °C (kg)</td>
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<td>4.5</td>
<td>4.0</td>
<td>5.85</td>
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<tr>
<td>Occluding force at 37 °C (kg)</td>
<td>1.35</td>
<td>3.1</td>
<td>2.7</td>
<td>4.27</td>
<td>2.02</td>
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</table>

Fig. 3. Flow–pressure curves of the tubes under test. On the x axis, flow (litre/min). On the y axis, the pressure decrease across the tube (cm H₂O).

Table II. A comparison of the force (kg) required to exclude the lumen of the tubes at 20 °C and 37 °C

REFERENCES


DANGERS DU TUBE ENDOTRACHEAL DE POLLARD

RESUME

On décrit dans cet article le cas de deux malades sur lesquels un défaut du tube endotrachéal de Pollard a causé une obstruction respiratoire complète. On y procède aussi à une comparaison des diamètres extérieurs, de la résistance au débit de gaz et de la résistance à la compression entre les tubes de Pollard et plusieurs autres tubes ordinaires. On conclut en disant que le tube de Pollard n'est pas satisfaisant pour la microlaryngoscopie.

EINE GEFAHR DER ENDOTRACHEALEN POLLARD-RÖHRE

ZUSAMMENFASSUNG


UN RIESGO DE LA SONDA ENDOTRAQUEAL POLLARD

SUMARIO

Se describe el caso de dos pacientes en los que un fallo de la sonda endotraqueal Pollard produjo completa obstrucción respiratoria. Se efectuán comparaciones de diámetros externos, resistencia al flujo del gas y resistencia a la compresión, entre las sondas Pollard y varias otras convencionales. Se concluye que la sonda Pollard no es satisfactoria para la microlaringoscopia.