Severe post-burn contracture (PBC) of the neck represents a challenge to the plastic surgeon as well as the anaesthesiologist. A burn scar contracture causes insufficient neck extension, resulting in difficult intubation that can be life-threatening.

Surgeons operating on patients with severe PBC of the neck should be aware of the airway obstruction during induction of anaesthesia and its appropriate treatment. These patients must therefore have the PBC scar released before other procedures are performed, in order to ensure airway control.

Direct laryngoscopy may be hampered by the presence of limited cervical extension. However, in patients with extreme deformity, the functional and anatomical distortion may be such that all attempts at intubation may fail. Concomitant microstomia due to facial burn further distorts the local anatomy.

Performing the surgical procedure demands release of the PBC of the neck, initially under ketamine, in order to allow sufficient extension of the atlanto-occipital joint. Then follows the safe insertion of the orotracheal (OT) tube, and surgery is continued by grafting under general anaesthesia. The interval between the incision and insertion of the OT tube can be crucial.

This paper describes our experience with safe and quick surgical neck release to facilitate OT intubation in such cases.

**Patients and methods**

Between January 2003 and December 2007 the Burns Unit of Mosul Teaching Hospital in Mosul, Iraq, admitted 75 patients with PBC of the neck. Twelve of the patients, considered to be suffering from severe PBC of the neck, had the contracture released under ketamine after one failed attempt at OTI.

In this study, all the patients were suffering from a severe post-burn neck contracture, a condition in which the neck is contracted in the flexed position and the chin is occasionally restrained down to the anterior trunk, restricting neck motility and preventing extension of the atlanto-occipital joint (Fig. 1). In these cases, the neck and thigh were prepared and draped.

**Fig. 1a, 1b** - Patient with severe PBC of the neck.
Following intravenous induction of anaesthesia by ketamine, 1-2 mg/kg body weight, anaesthesia was deepened by administering oxygen and halothane via a mask to the spontaneously breathing patient. Direct laryngoscopy and OTI were then tried and, if unsuccessful, a transverse incision over the entire scar was made by a scalpel into the skin and the platysma (Fig. 2). Manual separation of the two sides of the wound was performed forcefully and bluntly in order to open it, until cervical extension was possible (Fig. 3). The wound was then covered with sterile gauze and direct laryngoscopy and OTI were performed successfully, after which general anaesthesia was maintained using inhalational anaesthesia with long-acting muscle relaxant and intermittent positive pressure ventilation (Fig. 4). Intubation was established at the first attempt in all patients. The created defect was then grafted with a split-skin graft. At the end of the procedure, halothane was suspended and the muscle relaxant was reversed using neostimine and atropine. Extubation was performed when the patient was awake. Pulse oximetry, ECG, and non-invasive blood pressure monitoring were used during the operation. All the patients were monitored 24 h a day for any complications and they were allowed to take oral fluid on the first post-operative day. The patients were kept in a supine position with neck hyperextension by placing pillows under the shoulder. Post-operative splinting and physiotherapy were instituted to prevent recurrence of the contracture.

Results

The group of patients comprised 3 male and 9 female patients (age range, 7 to 37 yr; mean age, 20 yr). The time lapse between initial injury and neck release ranged from 1 month to 8 yr (mean, 4 months) (Table I).

Table 1 - Data of 12 patients with severe PBC of the neck released under Ketamine, followed by skin graft

<table>
<thead>
<tr>
<th>No.</th>
<th>Age (yr)</th>
<th>Sex</th>
<th>Cause</th>
<th>Time between initial burn and operation</th>
<th>Associated anterior chest wall burn</th>
<th>Complication</th>
<th>Follow-up (months)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>F</td>
<td>Flame</td>
<td>7 months</td>
<td>+</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>22</td>
<td>F</td>
<td>Flame</td>
<td>1 month</td>
<td>-</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>37</td>
<td>F</td>
<td>Flame</td>
<td>4 months</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>F</td>
<td>Hot water</td>
<td>6 months</td>
<td>+</td>
<td>Haematoma</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
<td>F</td>
<td>Flame</td>
<td>3 months</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>F</td>
<td>Flame</td>
<td>8 years</td>
<td>+</td>
<td>Infection</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>27</td>
<td>F</td>
<td>Flame</td>
<td>5 months</td>
<td>+</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>M</td>
<td>Hot oil</td>
<td>6 months</td>
<td>-</td>
<td>Infection</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
<td>M</td>
<td>Hot water</td>
<td>4 months</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
<td>M</td>
<td>Flame</td>
<td>6 months</td>
<td>+</td>
<td>-</td>
<td>24</td>
</tr>
<tr>
<td>11</td>
<td>8</td>
<td>F</td>
<td>Flame</td>
<td>2 years</td>
<td>-</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td>17</td>
<td>F</td>
<td>Flame</td>
<td>4 months</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

None of the twelve patients treated with this operative technique showed any complications attributed to the anaesthesiological technique. There were no reports of tracheomalacia or collapse of the trachea in the post-operative period in any of our patients, even in cases of long-standing
neck contracture, and no patient needed to be ventilated after extubation. There was no graft loss and blood loss was minimal (average blood loss, 150-400 ml). Total operative time ranged from 40 to 80 min.

In three patients there were post-operative complications, including a haematoma which was drained and minor infection of the graft in two patients, controlled by dressing and antibiotics. Eight patients were followed up for 6-24 months. All grafts were successful and achieved good results (Figs. 5a, 5b) and none of the patients had any significant scar formation.

Discussion

PBC of the neck causes functional limitations and aesthetic disfigurations. Reconstruction of severe deformities and scars in the neck following healing from burns confronts the surgeon with the most challenging problems in reconstructive surgery. Severe anterior neck PBC causes serious functional embarrassment, requiring early neck reconstruction based on three principles: releasing the shrunken area, restoring the contour of the mento-collicial angle, and preventing recurrence. Performing the surgical procedure demands maintenance of the airway for a prolonged procedure by OT intubation, which is impossible to accomplish because of the chin’s adherence to the jugulum.

Patients who have suffered deep burns of the anterior thorax with ascending involvement of the neck and face are particularly likely to give rise to problems with OT intubation. Measurement of the thyromental distance, the Mallampati score, and the mouth opening (interdental) distance are important clinical assessment data helping to anticipate difficult intubation. Preparation for dealing with difficult intubation is indicated in all patients with scarring in the upper thorax, neck, and face. Concomitant microstomia due to facial burn may further distort the local anatomy. When difficult intubation is expected, a variety of other techniques and instruments can be utilized, such as the laryngeal mask, the oesophago-tracheal Combi tube, the fiberoptic bronchoscopy, and tracheostomy.

The accomplishment of safe anaesthesia is perhaps the most important problem to be resolved when there is a severe anterior neck contracture. Severe PBC of the neck poses the anaesthesiologist some difficult problems. The prediction of hazardous intubation requires a difficult decision based on the anaesthetist’s clinical judgement although in most cases difficulties with intubation are easy to predict. While a number of techniques are available to the anaesthetist when intubation by direct laryngoscopy is impossible, the method of choice in each case depends on the functional abnormality. The usual technique includes blind nasotracheal intubation or release of the contracture under local anaesthesia followed by intubation. Other methods involve the use of a fiberoptic bronchoscope and a laryngeal mask, but this equipment is expensive and not available in our hospital.

Blind nasal intubation may be successful, but the positioning of the head and neck may be severely limited and repeated attempts present the risk of nasal bleeding, which may further endanger the airway. Direct laryngoscopy may be hampered by the presence of limited cervical hyperextension and restricted mobility of the mandible, and bronchoscopy itself can be difficult if the anatomy of the airway is distorted owing to soft tissue contracture, especially when repeated attempts to intubate have resulted in the presence of blood and secretions in the oropharynx. As an aid to difficult OT intubation, fiberoptic bronchoscopy has become established as the safest and most effective alternative to direct laryngoscopy and has been described in patients with PBC of the neck.

Use of the laryngeal mask may be hampered by the anatomical abnormalities described, and airway maintenance may be jeopardized in operations which require turning of the patient. Translaryngeal techniques employing retrograde guidance with a catheter inserted through the cricothyroid membrane are similarly contraindicated because anatomical reference points are obscured.

The problem of tunescous anaesthesia is that the dose of the local anaesthetic agent used to achieve the clinical effect may easily exceed the maximum safe dose. Also, any injection through a thick scar is very painful, and the depth and plane of injection cannot be assessed because of the thickness of the contracture scar.

A combined anaesthetic technique using intravenous ketamine, with or without local infiltration of anterior neck scarring, and immediate cutting of the scar is highly recommended. Elective surgical release of neck contractures prior to intubation can be safely performed following induction of anaesthesia, with a spontaneously breathing patient directly after the first failed intubation attempt. The surgeon

Figs. 5a, 5b - Healed split-skin grafting of the neck post-operatively.
should always be aware of the possibility of difficult intubation and remain on hand to perform an emergency contracture release if necessary.

Contracture release of the neck prior to intubation was first described in 1964 by Tanzer et al., who suggested release of the inferior half of the neck under local anaesthesia when difficulties are anticipated. Further release can then follow successful intubation. Waymack et al. described 17 emergency neck release procedures in 13 patients. Failure to perform intubation following contracture release in four instances was resolved by emergency tracheostomy. In our study we had no OTI failure in any of our patients after the initial release of the PBC scar in the neck. The usual technique of intravenous induction and muscle relaxants would have been disastrous in our patients. We released the contracture under ketamine, achieving complete extension. It is important that a qualified anaesthetist should be present throughout the procedure to monitor the patient.

We found that it was easy to release the contracture by simple but firm traction of the edges of the incised wound apart. This has the advantages of being quick, with minimal blood loss due to blunt dissection and rupture, mainly of scar tissue, sparing the blood vessels which can be seen in the wound and cauterized. This technique also avoids injury to other structures in the neck, especially the major blood vessels and nerves.

One might expect a high risk of wound contamination to be a possible disadvantage of OTI after neck release, but we found this to be negligible in our patients’ wounds, mainly because during OTI we covered the incised wound in the neck with sterile gauze.

Conclusion

Surgical release of neck contracture after intravenous ketamine can be used safely and effectively prior to intubation in severe post-burn contracture of the neck whenever intubation is expected to be difficult.

BIBLIOGRAPHY