Argon Plasma Coagulation in Treatment of Post Intubation Tracheal Stenosis

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Abstract:

Introduction: Acquired tracheal stenosis can be created by various malignant or benign causes. The most common cause of acquired non-malignant tracheal stenosis is endotracheal intubation, even for a short period. Argon plasma coagulation is a non-contact method of thermal hemostasis. Argon plasma coagulation can be used easily and fast and has low depth of penetration.

Methods: This study is single blinded. Subjects are patients with tracheal stenosis after endotracheal intubation that were selected by non probability sampling and were studied from March 2007 to November 2009 in bronchoscopy and laser center of Masih Daneshvari hospital. First, for each patient, a diagnostic flexible bronchoscopy was performed to identify the type, location, and severity of the stenosis. Then under general anesthesia patients underwent rigid bronchoscopy. Then, with Argon plasma coagulation device (ERBE VIO 200D) the stenosis was removed as possible. After two weeks, a new PFT (pulmonary function test) was done for checking the obstructive signs.

Results: Of these 34 patients, 24 were asymptomatic for more than 1 year and responded to treatment (70.6%), 5 were asymptomatic for more than 10 months and less than 12 months (14.7%) and 5 did not have asymptomatic periods more than 10 months and did not respond to treatment. In follow-up PFTs, FEV1 in all patients who were asymptomatic for more than 10 months had significant progress; therefore, in 27 out of 29 patients at the end of the study, FEV1 was more than 90% and 2 patients had FEV1 of 70-90%.

Conclusion: In fact, although the surgical treatment remains the main treatment of tracheal stenosis after intubation (PITS), if this method is not possible for any reason, APC is very useful as a safe and effective method.

Keywords: argon plasma coagulation, bronchoscopy, post intubation tracheal stenosis
Argon plasma coagulation is a non-contact method of thermal hemostasis and can be used easily and fast and has low depth of penetration. This technology uses argon gas to produce thermal energy around the probe. A high voltage spark at the tip of the probe causes the argon gas to ionize. The ionized gas goes to the closest tissue and provides thermal energy. This temperature evaporates the liquid inside and outside the cell and breaks cellular proteins, which cause destructive and coagulative effects on the tissue. Depth and rate of the tissue destruction depends on the voltage of the device and duration of treatment. With power of 40-120W and duration below 2 seconds, the penetration depth will be less than 5 mm. Argon plasma coagulation is applied for periods of one to three seconds. If the voltage of the device or duration rises, the penetration and tissue damage will be greater.

The probe diameter is 1/5-2/3 mm and its length is 220 cm. The tip should be at a proper distance from the end of the bronchoscope; thus, the first black line on the probe can be seen during the procedure, otherwise it causes damage to the bronchoscope.

**Methods**

Subjects are patients with tracheal stenosis after endotracheal intubation that were selected by non-probability sampling and were studied from March 2007 to November 2009 in bronchoscopy and laser center of Masih Daneshvar hospital. Inclusion criteria were symptomatic tracheal stenosis after intubation. Patients with contraindications for bronchoscopy or high risk cardiac condition or history of radiotherapy in recent month were excluded.

Patients’ information were collected and investigated. All patients underwent preoperative investigation including physical exam, chest X-ray, CT-scan, 6-minute walk, and PFT (pulmonary function test).

First, for each patient a diagnostic flexible
bronchoscopy was performed to identify the type, location, and severity of the stenosis. Then, under general anesthesia, patients underwent rigid bronchoscopy. Argon plasma coagulation device (ERBE VIO 200D) was then used to remove the stenosis as possible. After two weeks, a new PFT was done for checking the obstructive signs. If the individuals were asymptomatic for one year, they were considered cured and if showed symptoms, they were retreated by argon plasma coagulation.

Before argon plasma coagulation, all potential risks were explained for the patients and enough information about this method was available for them. Collected data were analyzed using statistical software SPSS17.

Results

A total of 34 patients were evaluated. Their mean age was 30.52± 14.84 (range, 12 to 74) years. Eight were female (23.5%) and 26 (76.5%) were male. Types of stenosis observed by flexible bronchoscopy are included in Table 1.

The most common site for stenosis was upper trachea in 13 (38.2%) patients. Other places included subglottic (12 patients, 35.3%), mid trachea (7 patients, 20.6%) and distal trachea (2 patients, 5.9%). There was no statistical association between location of stenosis and response to the treatment (P>0.05). Number of the treatment sessions ranged between 1-8 and most patients were under treatment for 1-4 sessions.

Of these 34 patients, 24 were asymptomatic for more than 1 year and responded to treatment (70.6%), 5 were asymptomatic for more than 10 months and less than 12 months (14.7%), and 5 did not have asymptomatic periods more than 10 months and did not response to the treatment (Table 2).

In the initial PFTs, in 22 patients (64.7%) FEV1 was between 50-70% and 12 patients had FEV1 less than 50%. The initial FEV1 had no correlation with other factors examined in this study including the location of stenosis or type of narrowing (P>0.05).

In the follow-up PFTs, FEV1 in all patients who were asymptomatic for more than 10 months had significant progress; thus, in 27 out of 29 patients, FEV1 was more than 90% and 2 patients had FEV1 70-90% at the end of the study. The rate of change in FEV1 had no statistically significant correlation with the type of stenosis, or its location or demographic factors (p>0.05).

Discussion

In this study, the effect of argon plasma coagulation as a treatment method for tracheal stenosis has been studied. A total of 83% of the patients responded to this method and were therefore asymptomatic for more than 10 months. Also, patients showed obvious improvement and increase in PFT and FEV1. Thus, it is concluded that argon plasma coagulation is a safe method with few side effects for the treatment of tracheal stenosis in patients who are not surgical candidates.

Tracheal stenosis is an important complication of tracheal intubation, because it can easily end in the patient’s death (11). To date, this complication has been treated by surgical resection and anastomosis (8).

In a study by Simpson et al, 60 patients with tracheal stenosis were treated by bronchoscopic methods. This study concluded that bronchoscopic techniques alone, are not useful in severe tracheal stenosis especially in case of wide tracheal stenosis or tracheal cartilage damage; so, surgical resection of damaged area in extensive stenosis seems more useful (12). But in some patients, surgical treatment is not possible or acceptable. Several bronchoscopic methods are performed to treat and control the symptoms and signs of these patients.

In 1999, Brichet and colleagues suggested that Nd YAG laser and stent can be used as the first step of treatment (13). In other studies, methods

<table>
<thead>
<tr>
<th>Type of stenosis</th>
<th>Frequency</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Fib</td>
<td>13</td>
<td>38.2</td>
</tr>
<tr>
<td>Web</td>
<td>16</td>
<td>47.1</td>
</tr>
<tr>
<td>Fib+Web</td>
<td>2</td>
<td>5.9</td>
</tr>
<tr>
<td>Granulation</td>
<td>3</td>
<td>8.8</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 1. type of stenosis

<table>
<thead>
<tr>
<th>Response to treatment</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>24</td>
<td>70.6</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>14.7</td>
</tr>
<tr>
<td>&gt;10 m, &lt;12 m</td>
<td>5</td>
<td>14.7</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 2. response to the treatment
like balloon dilatation, stent and argon plasma coagulation had been reported to be useful, as well (14,15).

Recently, argon plasma coagulation as a method for treatment of benign tracheal stenosis is frequently used (14,17,18).

Morice and colleagues announced that the argon plasma coagulation causes heat and tissue destruction. When the level of electrical conductivity of the tissue is low, argon looks for a tissue with less electrical resistance, so it reduces the penetration depth. Thus, this method causes uniform coagulation and prevent airway perforation (19).

In our study performed in a 32-month period, patients with tracheal stenosis after intubation underwent fiberoptic bronchoscopy and dilatation by argon plasma coagulation. Argon plasma coagulation helps us to treat tracheal stenosis with contraindications for surgery with a low potency of side effects (19).

In a study by Wang and colleagues, argon plasma coagulation was performed in 32 patients with tracheal stenosis and showed a significant improvement in stenosis severity. This article concluded that accompaniment of argon plasma coagulation and stent in useful for controlling complex stenosis in carina (16).

Our patients were controlled by symptoms and PFT (FEV1). Argon plasma coagulation was used for dilatation of tracheal stenosis. There was no significant relationship between the risk factor evaluated such as age, sex, site and type of stenosis, and response to the treatment. Among the patients, 5 had not responded to treatment during the study time and were candidates for other bronchoscopic or surgical treatments. These patients had no special risk factors against patients with good response.

Argon plasma coagulation can be used in many aspects. Even it can be used for evacuation of foreign bodies from the bronchial tracts (20). Argon plasma coagulation was also helpful in tracheal stenosis caused by tumoral tissues (21). In a study by Yang and colleagues, argon plasma coagulation was 100% successful in treatment of the bronchial carcinoma (22).

**Conclusion**

In fact, although the surgical treatment remains the main treatment of tracheal stenosis after intubation (PITS), if this method is not possible for any reason, argon plasma coagulation as a safe and effective method is very useful.

**References**

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