CASE REPORT OF TREATMENT OF SECONDARY AIRWAY STENOSIS AFTER THULIUM LASER VENTILATION

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ABSTRACT

A 10-year-old boy presented with symptoms of dyspnea. 3 months previously, he had received a tracheostomy mechanical ventilation because of trauma and had been dilated tracheal stenosis 4 times at previous hospital. We performed bronchoscopy and found a reduction of the upper trachea that is below subglottic 2 cm, diameter of 4mm, length of 1cm due to the web-like fibrotic stenosis. Thulium fiber laser via flexible bronchoscopy was used to explode the stenotic lesion. His condition was improved well after 3 months reexamination. Thulium fiber laser is a valuable tool with potential for therapy of an endobronchial obstructing airway lesion.

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I. INTRODUCTION

A young boy, 10 years old in Tam Ky district, Quang Nam province. Healthy history. After the accident fell from a height of 1.5m to the ground, children suffered a narrow injury of 2-4-4 paralyzed limbs, broken jaw bone, dislocated shoulder. Children must have mechanical ventilation, fixed surgery of the cervical spine and jaw bone at the local hospital. After 20 days of resuscitation, the child stops breathing, withdrawing the endotracheal intubation but cannot breathe by breathing. The doctor had to open the windpipe for the child to breathe through the cannula. After 2 months, children can withdraw cannula but still have difficulty breathing. Children were discovered tracheal stenosis due to scar through soft bronchoscopy, were conducted hot air balloon and hard tube 4 times at Children's Hospital 2 but did not solve the narrow scar. After consultation, the child was transferred to the National Pediatric Hospital.

Visiting at the hospital: young, breathing, purple, hissing, breathing in continuously, evenly ventilating lungs, normal heartbeat. Stable blood test for bilateral infection. Chest X-ray suspects a narrow third of the windpipe in the shape of an hourglass.

First bronchoscopy gas (December 19, 2017) found under the glottis 2 cm of severe narrowed trachea due to scarring, narrow section of 1 cm long, tracheal diameter of 4mm, reducing over 75% of tracheal glass (Photo 1). Experiment with hard tube number 4.5 but failed.

Figure 1. Narrow position

Three days later, we used the technology of Thulium fiber laser through a flexible endoscope to burn narrow scars. Children are anesthetized, body pain relief at the operating room. Endoscopic bronchoscopy through the nasal passages check the airway. The laser conductor is channeled through the instrument channel of the soft endoscopic site with a narrow position (photo 2). Strict scarring with a 5-7W laser power source. The procedure time is 40 minutes (8 minutes of laser interruption). The results immediately after burning: narrow scarring is almost completely burned, the trachea is enlarged, no bleeding, no tracheostomy, the surrounding positions are well preserved (photos 3, 4). Children are mesmerized, breathing on their own. Immediately after the procedure, the child has difficulty breathing when resting. Antibiotics and corticosteroids are given 5 days later.

Endoscopic examination of the soft tube after 6 days of laser treatment showed that the windpipe was slightly narrow, corresponding to the previous position of canine opening, scars and edema of the mucosa (photo 5). Children no longer have difficulty breathing even when exerting and being discharged from hospital, appointment for follow-up.

The results of bronchoscopic gas bronchoscopy 3 months after laser firing (March 30, 2018) showed a round, slightly narrowed trachea in the old position due to scarring, not affecting ventilation (photo 6). Children work hard, do not breathe, do not breathe.

Figures 2, 3, 4. Laser firing

Figure 5. 6 days after laser firing

II. DISCUSSION

Tracheal stenosis of the lower glottis may be due to congenital or secondary. The cause of secondary stenosis usually occurs after endotracheal intubation, trauma, burns, infections, tumors, autoimmune disorders or collagen vascular disease [1]. In which gastroesophageal reflux also plays an important role in the pathogenesis of tracheal stenosis [2]. Treatment of tracheal stenosis is one of the major challenges in respiratory specialty, especially in children. Current treatments include: conservative treatment, laser burning through bronchoscopy, ballooning or hardening, applying anti-scarring medication at a narrow site with Mytomycin C or trachea opening [3]. The ultimate goal of treatment is to expand the airway, not to block air circulation in the airway without affecting the patient's sound delivery.

Nd: YAG (neodymium-doped yttrium aluminum garnet) laser emitting a wavelength of 1064 nm has been used in airway interventions for decades [4]. Then the development of carbon dioxide laser generations, Thulium fiber laser ... The effect of laser light on respiratory tissue depends on the wavelength of light and the optical parameters of the tissue [5]. Therefore, each type of laser with different wavelengths works effectively on specific tissues, such as Nd: YAG lasers only work deeply on pale tissues. The energy of this type of laser can increase the temperature of the basal cell layer of tissue higher than the boiling temperature of water that burns from the bottom layer to surface epithelial melting (popcorn effect), so it is easy obscuring the surgeon's vision, can cause tracheal perforation, bleeding.

Figure 6. 3 months after laser firing
Thulium fiber bipolar laser (TmFL) emits light with a wavelength of 1940 nm as the next generation of lasers. This wavelength coincides with the spectrum of water [6,7], leading to a near-1000-fold increase in water absorption coefficient compared to the wavelength of 1064 [8]. Because of its large uptake by many water tissues, low optical penetration makes the energy of TmFL largely affect the surface epithelium where most of the water of the respiratory tissue is concentrated. So surgeons can evaluate accurately and better prognosis. The fiber of the laser beam can penetrate the guide channel of a flexible probe or hard tube to the lesion site. In children due to small airways, we choose soft scaffolds with the advantage of easily observing the lesion location, limiting possible mucosal damage to the rigid scaffold.

Technique: Made in the operating room, with full anesthesia and emergency equipment. The patient is given anesthesia, systemic pain relief and provides oxygen through a dedicated mask. In when the laser is released to the tissue, the oxygen concentration is reduced to less than 40%. The laser source is installed from 5W-50W. The laser conductor is threaded through the biopsy channel of Olympus and can be observed through a video laser transmitter connected to the staging machine. Initially, turn on the laser emitter at 5 W and possibly gradually increase to 20W. For our patients with severe narrowing of the windpipe, a narrow section of 1 cm long, it took us 40 minutes.

To complete the process, during which the laser time worked is 8 minutes of interruption. After burning, patients were given antibiotics, dexamethazon for anti-inflammatory, reducing edema and analgesia with Paracetamol. The patient recovered and breathed after 30 minutes from the end of the procedure. The results after laser burn 1 week and 3 months, the narrow position is enlarged, only scars do not affect ventilation.

![Figure 9, 10. Team of laser burning bronchoscopy](image)

The results of the study by Wolf Geisierich and colleagues in 132 patients aged 22-88 years resulted in a time of 44.6 ± 29.4 minutes (ranging from 12-200 minutes), real time laser current of 6.3 ± 7.1 minutes (ranging from 1 to 41 minutes), the success rate when using TmFL to solve tracheal stenosis with many different causes is 58.33%, the remaining patients suffer from recurrent narrowing continues to be second laser fired or treated with other methods such as stenting, ballooning, tracheostomy ... [9]. Also for secondary stenosis

In children, we have not found any studies on large numbers of patients.

## III. CONCLUSION

Treatment of laser tracheal stenosis has been used in the world for decades, starting with Nd: YAG lasers and now Thulium 2-polar lasers have opened new perspectives in the treatment of secondary tracheal stenosis, with time Short execution time, high efficiency, safer for patients. In the future, more research is needed with a larger number of pediatric patients to be able to make a more comprehensive TmFL application.

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