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Potassium-Titanyl-Phosphate (KTP) Laser Photocoagulation Combined with Resection Using an Ultrasonic Scalpel for Pharyngolaryngeal Hemangioma via a Transoral Approach: Case Report and Literature Review

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Conflict of interest: None declared

Patient: Male, 61-year-old
Final Diagnosis: Hemangioma
Symptoms: Foreign body sensation in the throat • throat clearing
Medication: —
Clinical Procedure: KTP laser photocoagulation combined with resection using an ultrasonic scalpel for pharyngolaryngeal hemangioma via a transoral approach
Specialty: Otolaryngology

Objective: Unusual clinical course

Background: Hemangiomas are relatively rare, slow-growing, benign neoplasms that can cause necrosis, ulceration, and infection leading to airway obstruction or intractable hemorrhage. Controversy persists regarding the treatment options for these tumors, which include active observation, corticosteroids, sclerotherapy, laser treatment, and surgical resection.

Case Report: A 61-year-old man presented with a 6-month history of persistent throat clearing and foreign body sensation in the throat. He was receiving medical treatment and psychotherapy for major depressive disorder and anxiety disorder. Laryngoscopy and computed tomography revealed a large, irregular, lobulated mass covered by bluish mucosa in the hypopharynx and larynx on the right without involvement of the true vocal fold or subglottis. Orotracheal intubation was performed under general anesthesia. The hemangioma abutting the epiglottis and arytenoid was dissected by CO_2 laser. The hemangioma in the pharyngoepiglottic fold and aryepiglottic fold was resected using an ultrasonic scalpel. The hemangioma in the ventricle, false vocal fold, and paraglottic space was treated by potassium-titanyl-phosphate (KTP) laser photocoagulation. Pathological examination confirmed hemangioma. There has been no recurrence during 18 months of follow-up.

Conclusions: The treatment of pharyngolaryngeal hemangiomas is challenging. It is important to select treatment options considering the characteristics of the treatments and the anatomical and functional relationship between the hemangioma and the surrounding structures. Single-session KTP laser photocoagulation combined with surgical resection using an ultrasonic scalpel via a transoral approach according to anatomic site could be an effective treatment for pharyngolaryngeal hemangioma.

Keywords: Hemangioma • Lasers, Gas • Lasers, Solid-State • Ultrasonic Surgical Procedures

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Background

Hemangiomas are relatively rare and slow-growing benign neoplasms of vascular origin [1-4]. Although these tumors can occur anywhere in the body, about 60% are located in the head and neck [1-7]. The pharynx and larynx are narrow complex anatomic structures that contain important blood vessels and nerves and have a close functional relationship with respiration, swallowing, and phonation. Hemangiomas have a vascular stroma with a thin and friable overlying mucosa [5,8] and can result in necrosis, ulceration, inflammation, and infection in involved structures, resulting in airway obstruction or severe intractable hemorrhage if the larynx and trachea are affected [1,7].

Most hemangiomas are asymptomatic in the early stage, and close regular follow-up can be considered for small asymptomatic lesions because of their slow-growing vascular benign nature [1-4,7,9]. However, as these neoplasms progress, they can cause various symptoms depending on their extent and location, including foreign body sensation in the pharynx or larynx, voice changes, dysphagia, blood-tinged sputum, hemoptysis, and dyspnea [1-3,6,7,10,11]. Treatment for symptomatic hemangioma should be selected based on the age of the patient and the size, extent, and primary site of the lesion [1,4,7-10], but remains controversial, mainly due to the rarity of this tumor. Furthermore, there have been no randomized comparisons of the various treatment options that have been reported, including active observation, corticosteroids, beta-blockers, intralesional sutures, sclerotherapy, embolization, cryosurgery, laser treatment, surgical resection via a transcervical or transoral approach, and radiotherapy [1-10]. Treatment of pharyngolaryngeal hemangioma is challenging because of the complexity of the anatomic structures involved, the limited treatment options available, the potential for severe complications after surgery, including life-threatening hemorrhage and airway obstruction, and a high recurrence rate [5,11,12]. Therefore, the aim of treatment is not only complete resection of the hemangioma but also preservation of anatomic structures and function [1,6,9,13]. Extensive, diffuse, or multifocal hemangiomas affecting the pharynx and larynx remain particularly difficult to treat. Symptomatic pharyngolayryngeal hemangiomas may require combination therapy, staged treatment, and a multidisciplinary approach. In this report, we describe a pharyngolaryngeal hemangioma that was treated successfully by a combination of potassium-titanyl-phosphate (KTP) laser photocoagulation and surgical resection using an ultrasonic device via a transoral approach without complications.

Case Report

A 61-year-old man presented with a 6-month history of persistent throat clearing and foreign body sensation in the throat. He had been referred to our hospital by a local clinic for evaluation and management of a suspected mass in the larynx. He did not complain of change in voice, hemoptysis, or dyspnea. There was no history of smoking or alcohol consumption. He had major depressive disorder, nonorganic insomnia, tension-type headache, and unspecified anxiety disorder for which he was receiving psychotherapy. He had been taking several psychiatric medications, including lorazepam, flunitrazepam, zolpidem, and propranolol, for more than 10 years and required regular psychiatric follow-up.

Laryngoscopic examination revealed a large, lobulated mass with an overlying bluish mucosa in the hypopharynx and larynx on the right side (**Figure 1**). The mass involved the arytenoid, aryepiglottic fold, pharyngoepiglottic fold, pre-epiglottic space, laryngeal surface of epiglottis, and false vocal fold on

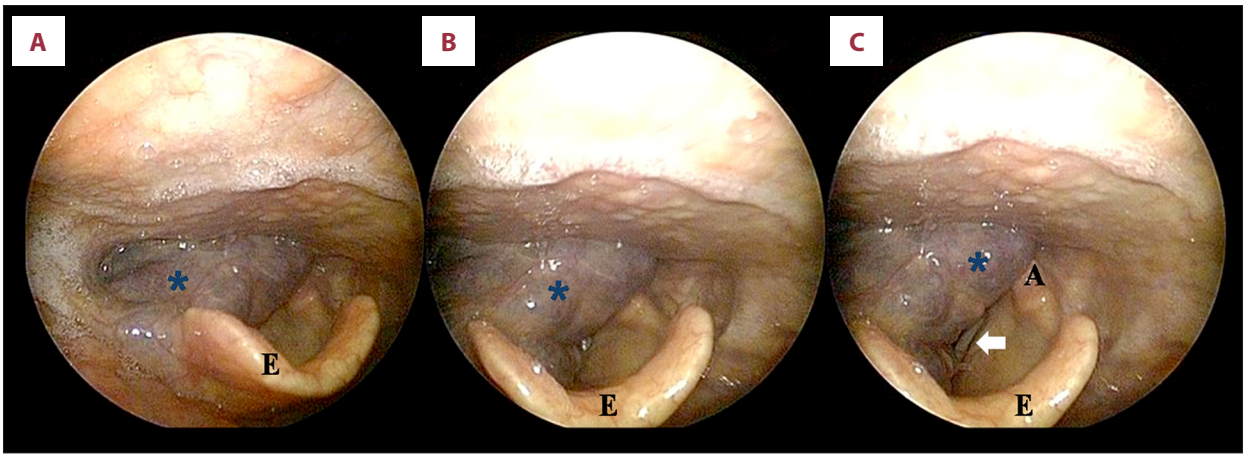

Figure 1. Representative preoperative laryngoscopic image. (**A, B**) A lobulated bluish mass (asterisk) was detected in the hypopharynx and larynx on the right side. (**C**) The left true vocal fold (white arrow) was partially observed to have an intact mucosa and a narrowed glottic space on abduction. A – arytenoid; E – epiglottis.

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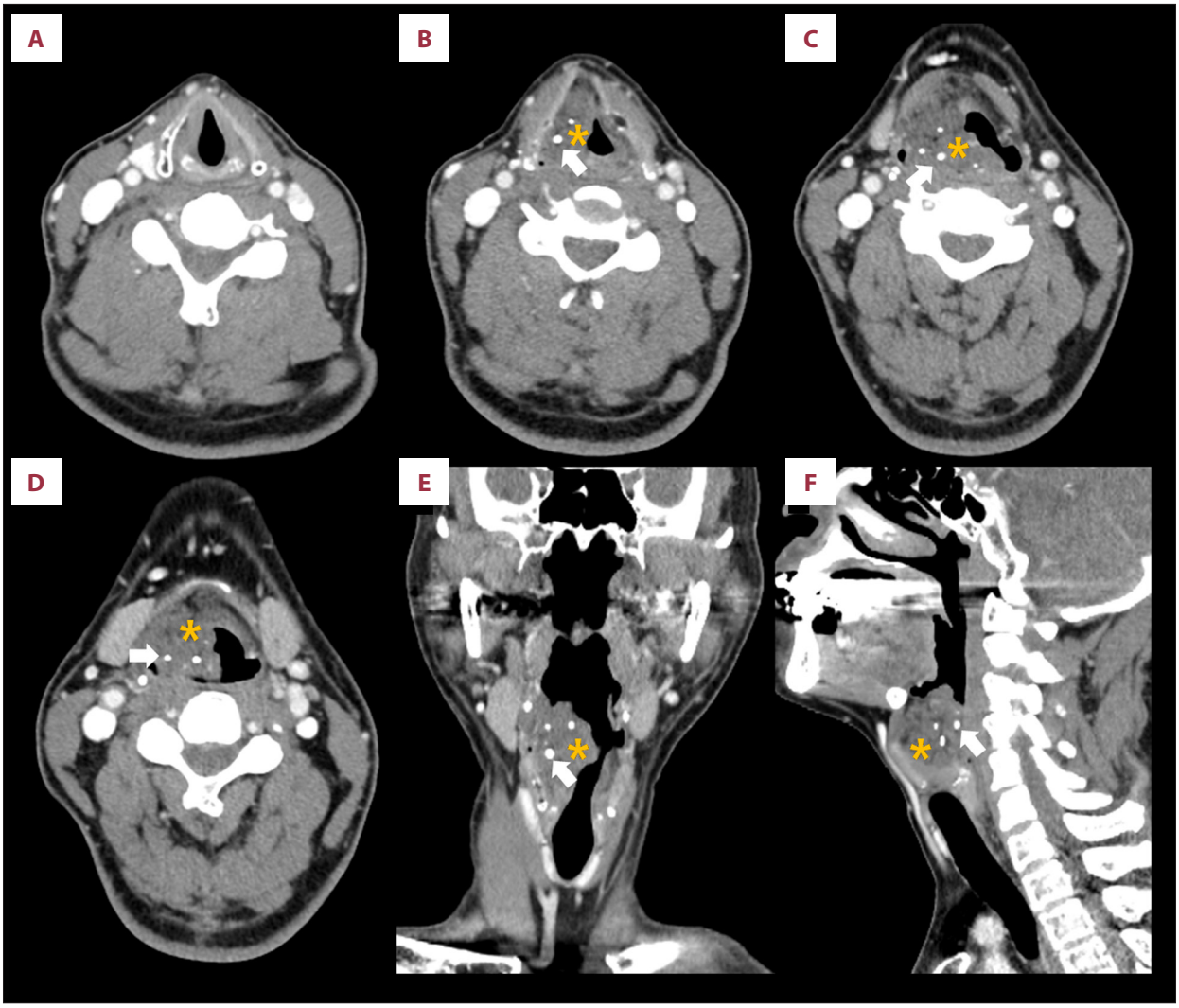

Figure 2. Representative preoperative computed tomography (CT) of the neck with contrast enhancement. (**A**) The true vocal fold and subglottis were not involved by the tumor (axial image). A 38×22×32-mm irregular lobulated soft tissue density mass (asterisk) with multiple calcifications (white arrow, phleboliths) was detected on an axial image (**B-D**), coronal image (**E**), and sagittal image (**F**).

the right and contacted posterior pharyngeal wall, extending to the arytenoid on the left. The mobile true vocal fold on the left was partially observed and the mucosa was intact on abduction. However, since the true vocal fold and ventricle on the right were obscured by the large tumor, movement of the right vocal fold and its involvement in the tumor could not be observed (**Figure 1C**). Laryngoscopic examination also suggested that the tumor was obstructing the airway, although the patient did not complain of dyspnea. His vital signs, including oxygen saturation and respiratory rate, were normal. There were no abnormal findings in the oral cavity, nasopharynx, or oropharynx. Physical examination of the neck did not reveal symptomatic or enlarged lymph nodes. Laboratory blood tests were within normal limits. A computed tomography scan showed a 38×22×32-mm irregular lobulated lesion with soft tissue density on the right involving the arytenoid, aryepiglottic fold, pharyngoepiglottic fold, pre-epiglottic space, laryngeal surface of the epiglottis, false vocal fold, ventricle, and most of the paraglottic space. The true vocal fold and subglottis were not involved in the tumor. The mass contained multiple calcifications that appeared to be phleboliths. There was no pathologic enlargement of the lymph nodes in the neck (**Figure 2**). Based on the results of the laryngoscopic examination and computed tomography scan, the lesion was presumed to be a vascular anomaly in the hypopharynx and larynx.

Although the patient did not complain of dyspnea, he was considered to be at risk of airway obstruction because of the tumor. In view of the risk of complications, including bleeding from the tumor on intubation, we made a plan to perform a

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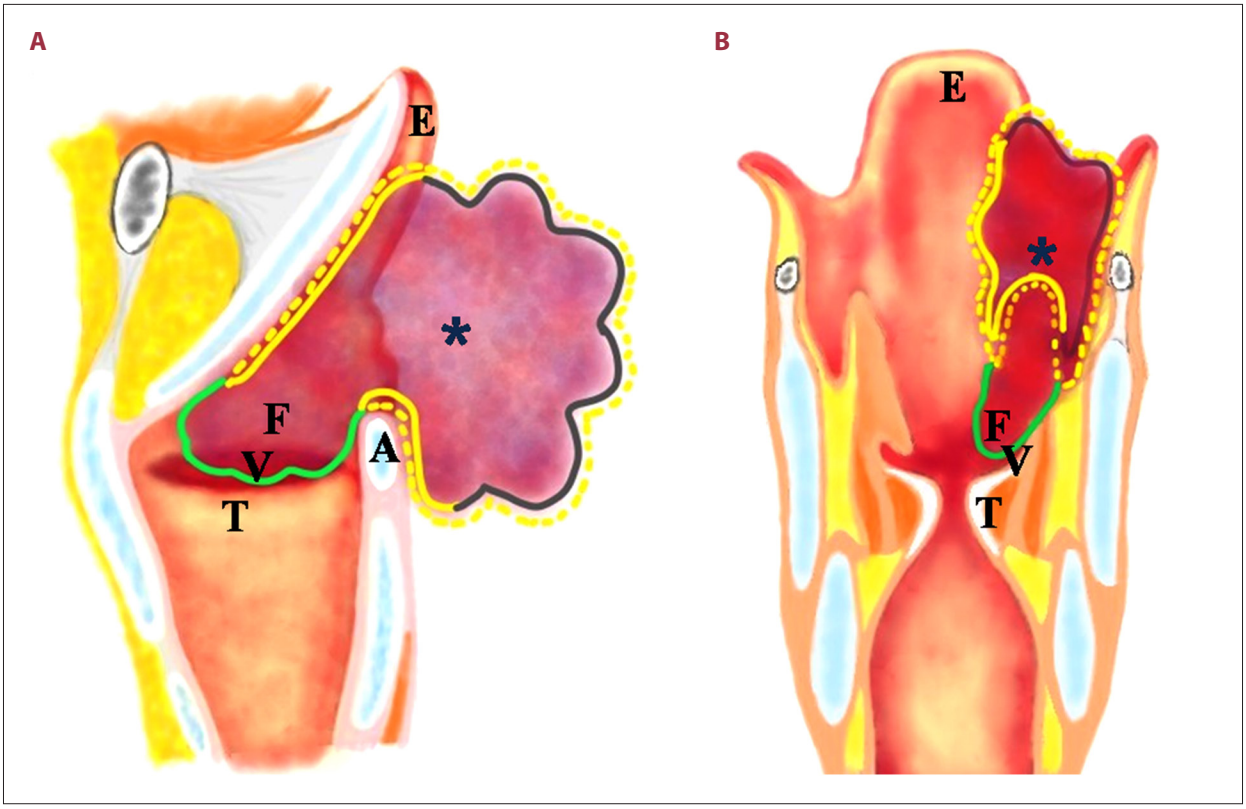

Figure 3. The schematic representations of the treatment options for pharyngolaryngeal hemangioma. (**A**) Sagittal image and (**B**) Coronal image. The mucosa at the margin of the hemangioma in the pre-epiglottic space, laryngeal surface of the epiglottis, pharyngoepiglottic fold, aryepiglottic fold, and arytenoid was incised (yellow dotted line). Next, the margin and hemangioma abutting epiglottis and arytenoid was dissected using the CO_2 laser (yellow solid line). The hemangioma in the pharyngoepiglottic fold and aryepiglottic fold was excised using an ultrasonic scalpel (black solid line). The hemangioma in the ventricle, false vocal fold, and paraglottic space was treated by KTP laser photocoagulation until it was no longer visible under the microscope (green solid line). A – arytenoid; E – epiglottis; F – false vocal fold; T – true vocal fold; V – ventricle.

tracheostomy under local anesthesia followed by tumor resection under general anesthesia. Although informed consent was obtained to perform tracheostomy for airway management, the prospect of this procedure caused the patient's major depressive disorder and anxiety to worsen. Therefore, we opted to resect the tumor via a transoral approach rather than a transcervical approach in order to avoid tracheostomy if possible. A CO_2 laser (Acupulse DUO, Lumenis, Yokneam, Israel), KTP laser (Quanta System S.p.A., Samarate, Italy), and an ultrasonic scalpel (Harmonic ACE, Ethicon, Johnson & Johnson, Bridgewater, NJ, USA) were used to excise the hemangioma and minimize bleeding (**Figure 3**). Orotracheal intubation was performed under general anesthesia using a laser-protected intubation tube. Use of a Feyh-Kastenbauer oral retractor (Gyrus AMI, Southborough, MA, USA) was planned for adequate exposure of the pharynx and larynx but was replaced by a suspension laryngoscopy due to severe dental caries and poor dentition. The tumor in the hypopharynx and larynx was accessible under suspension laryngoscopy (Weerda laryngoscope). The large lobulated mass was found to be occupying the arytenoid, aryepiglottic fold, pharyngoepiglottic fold, pre-epiglottic space, laryngeal surface of the epiglottis, false vocal fold, ventricle, and most of the paraglottic space on the right side with preservation of the right true vocal fold and subglottis (**Figure 4**). The tumor bled easily on touch. An incision was made between the normal mucosa and the margin of the hemangioma in the pre-epiglottic space, laryngeal surface of the epiglottis, pharyngoepiglottic fold, aryepiglottic fold, and arytenoid using the CO_2 laser. The margin and hemangioma abutting epiglottis and arytenoid were then dissected using the CO_2 laser (2 W of energy delivery, superpulse, continuous mode) while preserving the cartilage. However, the CO_2 laser alone could not achieve effective hemostasis or dissect the tumor successfully in the pharyngoepiglottic fold and aryepiglottic fold, which are rich in blood vessels and soft tissue. At these sites, the hemangioma was exposed using forceps, coagulated, and cut using an ultrasonic scalpel in hemostasis mode with a power setting of 3 W. Bleeding from the tumor was controlled by monopolar electrocauterization with a mode for coagulation setting of 20 W. The base of the hemangioma

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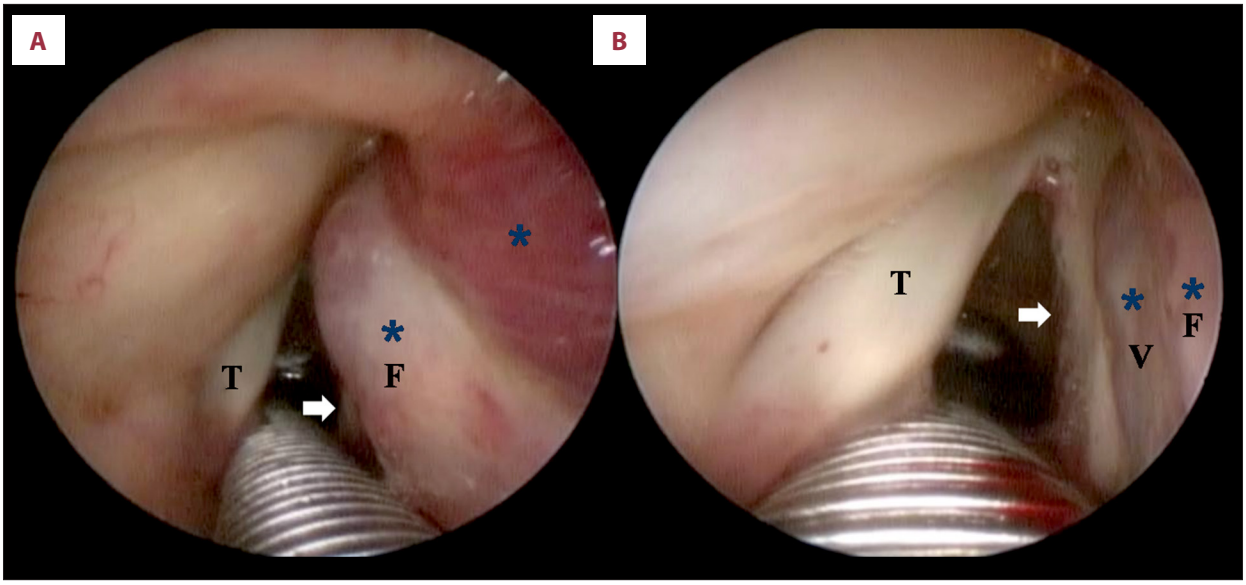

Figure 4. Representative intraoperative view via a suspension laryngoscopy. (**A, B**) The hemangioma (asterisk) was found to be occupying the false vocal fold, ventricle, and the paraglottic space on the right side, with preservation of the right true vocal fold (white arrow) and subglottis. F – false vocal fold; T – true vocal fold; V – ventricle.

was attached to the pharyngoepiglottic fold and aryepiglottic fold; however, the vascular pedicles were not clearly identified. The attached base was excised using the ultrasonic scalpel without extensive bleeding, after which the tumor was successfully resected. Subsequently, suspension laryngoscopy (Weerda laryngoscope) was replaced by a suspension laryngoscopy (Benjamin Lindholm laryngoscope) to obtain the adequate exposure of the false vocal fold and glottis. The hemangioma in the ventricle, false vocal fold, and paraglottic space adjacent to the true vocal fold was treated by KTP laser photocoagulation while preserving the true vocal fold. A 600-μm KTP laser optic fiber was inserted through the suspension laryngoscopy and a 532-nm KTP laser was used at an energy delivery setting of 2 W in continuous mode. After irradiation of the mucosal surface of the hemangioma by KTP laser, the lesion decreased in size and became covered with photocoagulated crusts, which were carefully removed. Next, the hemangioma was irradiated repeatedly until it was no longer visible under the microscope. Pathological examination confirmed hemangioma with vessels containing phleboliths.

The patient stayed in hospital after his surgery and was treated with antibiotics, reflux medication, and corticosteroids for 7 days to prevent airway edema and was maintained on a diet of cold liquids for 2 weeks. The patient complained of a painful throat and tongue with expectoration but not dyspnea or hemoptysis. Mild tongue edema and injury to the oropharyngeal mucosa caused by the suspension laryngoscopy was observed. Laboratory investigations on postoperative day 2, including a complete blood count, were within normal limits (hemoglobin 14.4 g/dL [normal range 14.0-18.0] and hematocrit 42.0% [normal range, 38.0-52.0]). Laryngoscopic examination on postoperative day 10 confirmed that the mass was completely excised and that the surgical site had recovered well with crusting but no evidence of hemorrhage (**Figure 5**). The patient was discharged on postoperative day 10 with no complications and good recovery at the operation site. Laryngoscopic imaging performed 1 month after surgery confirmed disappearance of the mass, preservation of vocal cord mobility, and no deformity (**Figure 6**). At the time of writing, the patient remains in very good condition without recurrence after 18 months of follow-up. However, given that the hemangioma had involved the ventricle, false vocal fold, and most of the paraglottic space adjacent to the true vocal fold, he is considered to be at high risk of recurrence and is being followed up at regular intervals.

Discussion

Vascular anomalies are commonly caused by congenital dysmorphogenesis but their exact pathogenesis is still not understood [1,2]. Vascular anomalies are classified into hemangiomas and vascular malformations according to their clinical behavior and histopathologic characteristics [1]. According to the histopathological findings, hemangioma is divided into capillary, cavernous, and mixed types, with the cavernous type being the most common [6]. Hemangiomas are also categorized into an infantile or adult form [2,3,6-10]. Infantile hemangiomas include distinct proliferative, involution, and involuted phases and are usually diagnosed during the first year of life. Furthermore, infantile hemangiomas have a female

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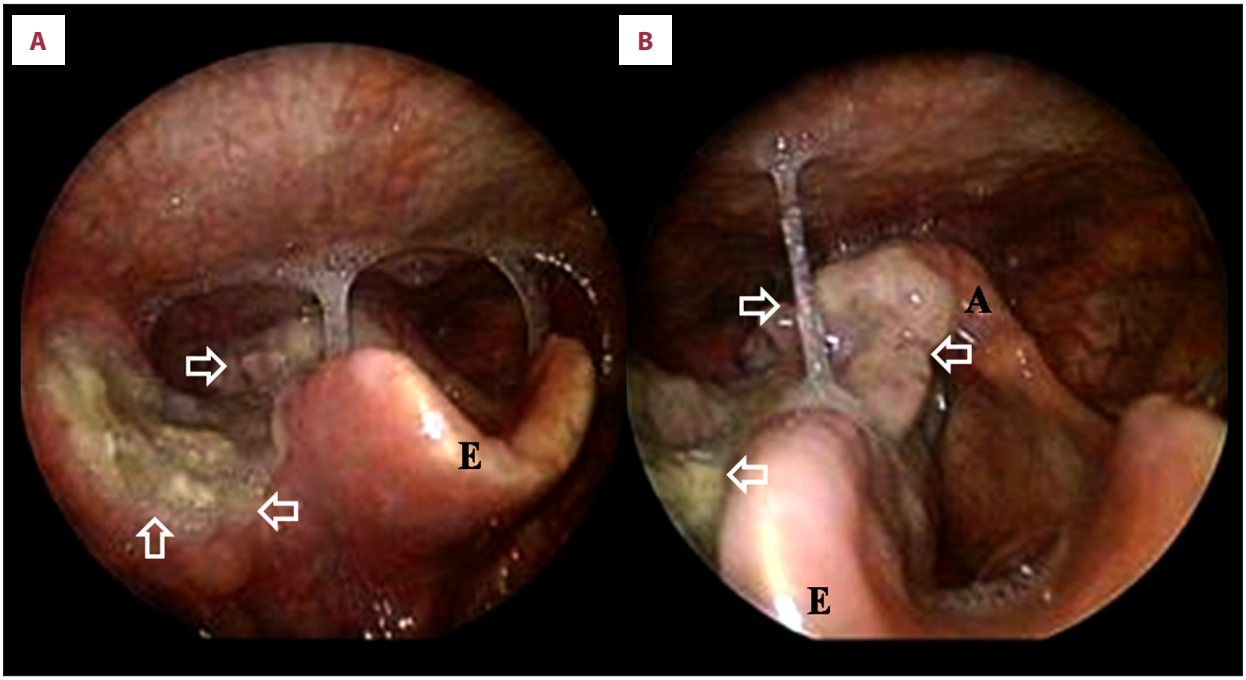

Figure 5. Representative postoperative laryngoscopic image 10 days after surgery. (**A, B**) The tumor had disappeared, crusting (open arrow) and blood clot on the lesion were observed, the mucosal edema was decreased, and there was no evidence of bleeding on postoperative day 10. A – arytenoid; E – epiglottis.

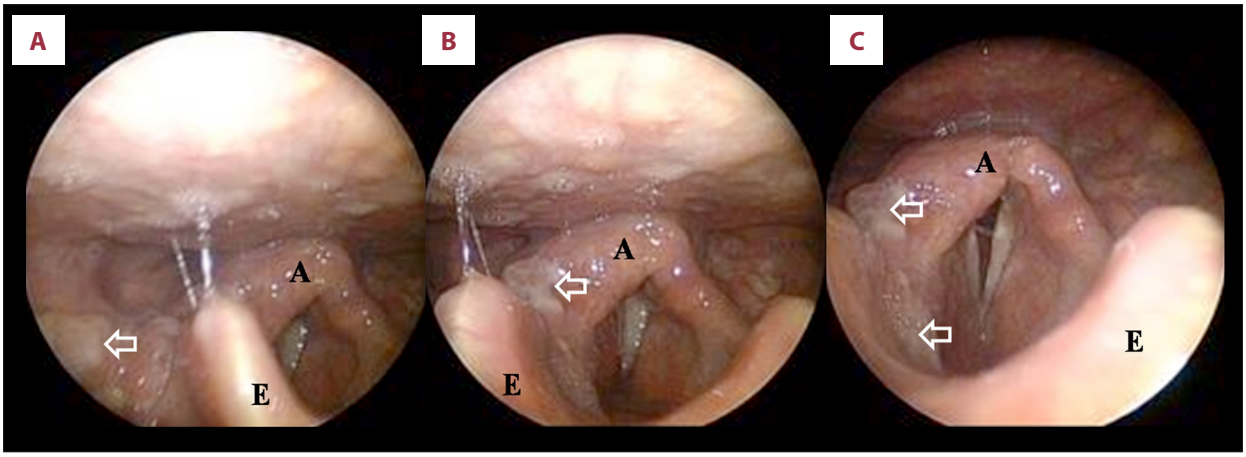

Figure 6. Representative postoperative laryngoscopic image 1 month after surgery. (**A**) A well-healed, smooth-surfaced mucosa was observed without deformity at 1 month after surgery. No recurrence of the lesion was visible. (**B, C**) The mobility of the vocal fold was preserved. A – arytenoid; E – epiglottis.

predominance, with most lesions arising from the subglottis and being histologically of the capillary type. In contrast, hemangiomas of the adult form progress slowly and rarely regress spontaneously. Adult hemangiomas have a male predominance, with almost all lesions arising from the glottis or supraglottis and histologically are usually of the cavernous type.

Hemangioma in the pharynx and larynx is identified endoscopically as a mass with overlying bluish mucosa [2,3,9]. Radiologic evaluation, computed tomography, and magnetic resonance imaging provide useful information, including the location, size, and extent of the hemangioma and its relationship with anatomic structures [2,4,6]. Angiography is not always performed. Although it was not performed in this case, preoperative angiographic study with embolization as a combination therapy might be helpful for diagnosis of the extent and vascular characteristics and the decrease of the intraoperative and postoperative morbidity for an extensive or multifocal hemangioma and treatment planning [2]. A biopsy is not recommended when hemangioma is suspected, in view

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of the risk of severe bleeding [2,11,13]. Appropriate management is mandatory for symptomatic hemangiomas [1,4,7-10]. However, there is still no consensus regarding the treatment of hemangioma involving the pharynx and larynx, and treatment of extensive hemangioma has been difficult. The treatment modality can be determined by the age of the patient, the size, extent, and characteristics of the lesion, and the primary site, in order to achieve a good outcome by complete resection as well as preservation of the normal structures and their function [1,2,6,9].

Medical treatment with corticosteroids or a beta-blocker may be preferable for symptomatic relief [1]. Corticosteroids was traditionally considered the first-line medical treatment for hemangiomas [1]. These agents induce tumor shrinkage, relieve symptoms, and have been reported to have a high response rate, with a particularly good outcome in pediatric patients with infantile hemangiomas [1,3,6,7,9]. Tumor rebound or relapse occurs in approximately 30% of patients after treatment with corticosteroids [1,3,6,7,9]. Vincristine might be considered for hemangiomas that are refractory and those that rebound after corticosteroids [1,14]. We predicted that the response to corticosteroids would be poor in our patient, given his age and the extent of the hemangioma, but used corticosteroids after surgery to prevent airway edema. Beta-blocker therapy has been reported to be effective for shrinking a hemangioma without a rebound effect [1], but was not considered in our patient because he was already taking one of these agents for his anxiety disorder.

Radiotherapy is one of the treatment options, but its use is limited to patients in whom other treatments have failed and those with intractable or life-threatening hemangiomas because of the risk of radiation-related malignancy and adverse effects [3,6,7,9]. Moreover, there have been occasional case reports of malignant transformation of hemangioma [2]. Hemangiomas in the pharynx and larynx have been treated with radiotherapy at a total dose of 3000-4000 cGy in 20 fractions to relieve the symptoms of a residual tumor in adult patients [7].

Sclerotherapy has long been used as an alternative to surgical resection or in an adjunctive role to treat vascular anomalies [11,15]. Various sclerosing agents have been used, including anticancer drugs (eg, bleomycin), osmotic agents (hypertonic saline or salicylates), chemical agents (alcohol or iodine), and detergents (morrhuate sodium, polidocanol, sodium tetradecyl sulfate, and diatrizoate sodium) [1,11]. Sclerotherapy were shown to be more effective for small tumors, those with a slow blood flow rate, and those with low drainage from the lesion [15]. Office-based sclerotherapy is a potentially useful treatment for laryngeal lesions of small to medium size to avoid the need for general anesthesia [15]. Bleomycin is a cytotoxic anticancer agent that has a direct sclerosing effect on the vascular endothelium, resulting in an inflammatory response, thrombus formation, and fibrosis, which leads to obstruction of the vessels and shrinkage of the tumor [1,11]. When bleomycin 1-2 mg/mL was injected into the center of a hemangioma, the surface at the injection site was noted to become pale [1]. Multiple and repeated intralesional applications of bleomycin according to the extent of the tumor is possible but should not exceed a total dose of 8 mg [1]. Intralesional administration of bleomycin as sclerotherapy is feasible and has a high response rate (complete resolution in 49% of cases), especially for superficial or localized hemangiomas [1]. However, massive or deep-seated hemangiomas might respond poorly to sclerotherapy. Moreover, bleomycin is associated with fibrosis, and thus may be unsuitable for application to the adjacent true vocal fold, ventricle, and interarytenoid area [11]. Pulmonary fibrosis, immunosuppression, and myelosuppression, which are bleomycin-related adverse effects, are very rare after intralesional injection of bleomycin [11]. If large or multiple intralesional bleomycin injections are administered, periodic follow-up and evaluation for bleomycin-related adverse effects is recommended [11]. Patients who received sclerotherapy alone require regular long-term follow-up to detect recurrence [15]. In our patient, sclerotherapy with bleomycin was inappropriate because of his pharyngolaryngeal tumor and involvement of the ventricle and paraglottic space. Sclerotherapy with ethanol, a strong sclerotic agent, is effective in the management of venous malformation or extensive hemangiomas [1,3,16]. However, prophylactic tracheostomy is recommended for tumors in the head and neck area because of severe pain and edema in the surrounding soft tissues. Embolization is more effective than sclerotherapy for lesions with rapid blood flow or high-drainage vascular lesions [15]. Embolization can usually be performed preoperatively as a combination therapy to decrease the intraoperative and postoperative morbidity rather than as monotherapy [1,4].

Superficial hemangiomas of small to medium size have been treated effectively with endoscopic cryosurgery [17]; however, the therapeutic effect of cryosurgery for hemangioma of the pharynx and larynx is not well understood because of lack of recent studies. Moreover, cryosurgery, which is not readily accessible, has been replaced by laser treatment, which is less invasive.

Laser has the advantages of easy manipulation and being able to be applied repeatedly, allow effective integrated coagulation, and divide the tissue. Laser treatment is considered a less invasive and a safer and more feasible treatment modality in view of its short operating and recovery times and favorable results. The overall therapeutic response rate to laser treatment for hemangioma is in the range of 29-42%, depending on the extent and location of the tumor [4,11,18]. For small and superficial hemangiomas, laser treatment has achieved

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an excellent response rate of more than 77% [1,7]. Given that the therapeutic effects of laser are determined by its characteristics and the penetration depth, it is important to choose the appropriate type of laser treatment [1,4,9,11]. Delivery of high energy to the tumor and adjacent area could cause tissue damage, adhesions, and scarring. When treating a large, deep-seated tumor by laser, staged repeated applications or combination of laser with other therapy should be considered to decrease the amount of energy delivered.

CO_2 laser with a wavelength of 10 600 nm is absorbed by tissues with a high water content [5,8] and is most commonly used for precise excision of benign to early-stage malignant tumors of the pharynx and larynx [5,8,19]. However, the benefit of CO_2 laser excision is limited in patients with extensive pharyngolaryngeal hemangioma and large-sized vessels because of the limited hemostatic effect and the likelihood of extensive scar formation [2,5,6,8,9]. In our patient, the mucosa at the margin of the hemangioma in the pre-epiglottic space, laryngeal surface of the epiglottis, pharyngoepiglottic fold, aryepiglottic fold, and arytenoid was incised and then the margin and hemangioma abutting the epiglottis and arytenoid was dissected using CO_2 laser to minimize bleeding and preserve the normal tissue. Next, the tumor was excised using an ultrasonic scalpel.

Angiolytic laser, including pulsed dye laser and KTP laser, is preferentially absorbed by hemoglobin and has a photocoagulation effect on hemorrhagic lesions without bleeding [4,5]. Moreover, it causes secondary thermal damage to surrounding tissues, resulting in scar remodeling through changes in the extracellular matrix [20]. Therefore, angiolytic laser is a suitable treatment for vascular pathology, such as hemangioma, as well as glottoplasty for sulcus vocalis [4,5,20]. Pulsed dye laser with a wavelength of 580-595 nm selectively acts on blood vessels to induce photocoagulation despite having a limited penetration depth and is a useful treatment for superficial hemangioma [1,11].

The KTP laser has a wavelength of 532 nm and is delivered through a 600-μm optic fiber that can be easily manipulated. Compared with the CO_2 laser, the KTP laser is capable of deeper penetration because of its good tissue absorption and more effective coagulation ability [4,5]. The risk of thermal damage to surrounding tissues is lower with the KTP laser than with the neodymium-doped yttrium aluminum garnet (Nd: YAG) laser [5]. Excellent therapeutic outcomes have been reported when the KTP laser is used for vascular lesions of the true vocal folds and glottoplasty for sulcus vocalis while maintaining the mucosal wave of the true vocal folds and phonation [5,20,21]. The photocoagulation effect of KTP laser has been reported to produce a better outcome with preservation of function and minimization of edematous change [5]. When the mucosa overlying the hemangioma was irradiated by the KTP laser, the energy delivered to the vessels and absorbed by hemoglobin resulted in shrinkage and photocoagulation of the underlying vessels in the hemangioma with no blood refilling. Even after careful removal of the crusts, there was no bleeding from the lesion. Irradiation was repeated until the hemangioma could no longer be observed. KTP laser irradiation with a low power setting of 1.5-2.0 W can provide effective photocoagulation with a reduction in the total amount of energy delivered and tissue damage [5]. Tracheostomy is not always necessary when treating hemangiomas in the pharynx and larynx with KTP laser but could be considered selectively depending on the extent and location of the tumor [5]. In our patient, the hemangioma in the ventricle, false vocal fold, and paraglottic space adjacent to the true vocal fold was managed by KTP laser photocoagulation with 2-W irradiation to preserve the function of the glottis until it was no longer visible under the microscope.

The Nd: YAG laser, which has a wavelength of 1064 nm and a penetration depth of 5 mm, is absorbed by blood and delivered to the tumor through an easily manipulated optic fiber [5]. Nd: YAG laser may be more suitable than other types of laser for large-sized tumors but should be used carefully because of the risk of thermal damage to the surrounding tissues and occasionally troublesome changes in scar tissue [1,5,8].

Surgical resection is not generally a first-line treatment for hemangioma [1], but is often considered in the following scenarios: (1) hemangioma that does not respond to medication or other conservative treatment; (2) hemangioma involving vital structures that might cause severe symptoms; (3) severe or repeated hemorrhage, infection, and necrosis of the hemangioma; and (4) surgical correction is required because of complications or deformity caused by previous treatment [1].

Hemangiomas in the pharynx and larynx are accessed via a conventional transcervical approach (open surgery through pharyngotomy or laryngofissure) [6], or a transoral approach (laryngomicrosurgery or endoscopic surgery) [2,5,8,10,11]. The transcervical approach requires a temporary tracheostomy, involves considerable intraoperative and postoperative morbidity, and has a relatively long recovery period [6,10]. Compared with the transcervical approach, the transoral approach has the drawbacks of a narrow operation field, difficulty in manipulating surgical instruments, and limited ability to control excessive bleeding, but has the advantages of being less invasive and requiring a shorter hospital stay [5]. With the advent of energy-based devices, such as the ultrasonic scalpel, the LigaSure Small Jaw instrument (Medtronic, Greenwood Village, CO, USA), and the Thunderbeat Open Fine Jaw device (Olympus, Tokyo, Japan), the safety and feasibility of the transoral approach have increased due to improved coagulation,

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hemostasis, sealing of vessels and lymphatics, cauterization, and dissection of the coagulated tissues with a shortened operating time [5,6]. The ultrasonic scalpel uses ultrasonic energy and is able to grasp the tissue and dissect it using a curved blade, allowing coagulation and division of the coagulated tissues simultaneously, thereby preventing massive hemorrhage. The ultrasonic scalpel is better used in hemostasis mode (power, 3 W) than in cutting mode (power, 5 W) when treating a hemangioma. Transoral robotic resection is another effective surgical treatment option for hemangioma in the pharynx and larynx but its use is limited because of the expensive equipment involved and restricted availability [2]. Therefore, the transoral approach is preferred when treating hemangioma because it is less invasive and has a short recovery time and good outcome [5]. However, if resection proves impossible or complications such as hemorrhage occur, the transoral approach should be converted to a transcervical approach [6].

Hemangiomas composed of vascular matrix with overlying thin and fragile mucosa can cause troublesome bleeding during surgery. Intraoperative bleeding should be prevented to allow a clear surgical field and obtain good surgical results. In our patient, the hemangioma involving the pharyngoepiglottic fold and aryepiglottic fold areas, which contain neurovascular bundles and are rich in soft tissues, was excised using coagulation and resection with an ultrasonic scalpel after mucosal incision using a CO_2 laser.

After treatment, close monitoring is mandatory to identify hemorrhage or airway obstruction. Tumor recurrence has remained a challenge after treatment, even though hemangiomas are benign neoplasms [12]. The risk of tumor recurrence is increased if excision is incomplete and if the tumor is large, diffuse, or multifocal [12]. In our patient, the large hemangioma had involved the ventricle, false vocal fold, and most of the paraglottic space adjacent to the true vocal fold which was not readily accessible, so he is considered to be at high risk of recurrence. Regular follow-up is required to detect recurrence.

Conclusions

Hemangiomas of the pharynx and larynx are slow-growing benign neoplasms that require appropriate treatment when symptomatic. Treatment of pharyngolaryngeal hemangioma is challenging because of its rarity, anatomical complexity, limited treatment options, risk of life-threatening hemorrhage and airway obstruction, and a high recurrence rate. Our experience in this patient was that KTP laser photocoagulation for hemangioma in the false vocal fold, ventricle, and true vocal fold achieved a good therapeutic outcome with preservation of function. Excision using energy-based devices is effective for minimizing bleeding when the hemangioma involves areas rich in blood vessels and soft tissue. When selecting the treatment strategy, it is important to consider and the characteristics of the treatment options and the anatomical and functional relationship between the hemangioma and the surrounding structures. Single-session combination therapy consisting of KTP laser photocoagulation and surgical resection with an ultrasonic scalpel via a transoral approach based on the anatomic site of the tumor can be an effective treatment for pharyngolaryngeal hemangioma, which preserves normal structures and their function.

Ethics Approval

The study was conducted in compliance with the Institutional Review Board (IRB) regulations (HPIRB 2019-09-004) and the Declaration of Helsinki. The IRB approved a request to waive the documentation of informed consent.

Conflict of Interest

None.

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