


ORIGINAL  
ARTICLEIncidence of anesthetic and surgical complications in  
laryngeal laser surgeriesMohammad Hossein Taziki<sup>1</sup> , Arazberdi Ghorchaei<sup>2</sup> ✉, SediqehDaneshmand<sup>3</sup> , Kazem Kazem Nezhad<sup>2</sup> <sup>1</sup>General Surgeon, Faculty of Medicine, Golestan University of Medical Sciences, Gorgan, Iran<sup>2</sup>Anesthesiologist, Faculty of Medicine, Golestan University of Medical Sciences, Gorgan, Iran<sup>3</sup>General Practitioner, Faculty of Medicine, Golestan University of Medical Sciences, Gorgan, Iran

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## Abstract

**Introduction:** Carbon dioxide (CO<sub>2</sub>) laser is an available technological tool for laryngeal surgeons. Given the importance of laser outcomes and complications, this research was conducted to identify the complications associated with laser surgery in the patients referring to the 5th Azar Medical-Educational Center in Gorgan, Iran, from 2013 to 2017.

**Methods:** This descriptive cross-sectional study was conducted on 85 patients with laryngeal lesions who underwent microscopic surgery with CO<sub>2</sub> laser at the 5th Azar Medical Educational Center in Gorgan, Iran, from 2013 to 2017. The patients were examined for the associated short-term complications 1, 7, and 21 days after the operation. They were also examined after 3 months to determine the long-term complications and patient satisfaction with sound quality. The data were analyzed in SPSS software (version 16). A p-value less than 0.05 was considered statistically significant.

**Results:** Out of the 85 patients undergoing laser surgery, 60 (70.6%) cases were male. None of the patients experienced short-term complications. In terms of long-term complications, 2 (2.35%) cases, who had failed to perform the follow-up, had recurrent lesions after 3 months of surgery. In addition, 18 (21.8%) subjects had recurrent hoarseness, 18.8% (n=16) and 2.35% (n=2) of whom were detected with laryngeal carcinoma and recurrence, respectively. However, a total of 67 (78.91%) cases did not suffer from long-term complications. In this study, out of 85 patients undergoing larynx surgery, 69 (81.2%) cases had benign pathology, while the rest (n=16, 18.8%) had malignant pathology.

**Conclusions:** It seems that a CO<sub>2</sub> laser surgery that follows scientific principles can produce good outcomes.

**Key words:** Larynx, Laser, Surgical complications

## Introduction

The larynx can be inflicted by a variety of diseases. Symptoms of the laryngeal disease include a change in voice quality, shortness of breath, and inspiratory stridor (1). Diseases that cause dysphonia due to structural reasons can include laryngomalacia, congenital laryngeal paralysis, laryngeal cysts, cysts of vocal folds and vocal fold fissures, laryngeal papilloma, laryngeal

carcinoma, amyloidosis, laryngeal nodules, vocal fold polyps, chronic hyperkinetic laryngitis, laryngeal contact ulcer, and laryngeal granuloma (1). In many diseases, lesion removal through surgery will have indications, which will be regarded as both biopsy taking and lesion treatment. Microsurgical removal of the laryngeal lesion is a routine practice due to facilitating good vision and reducing the damage to the adjacent tissues (2).

Since 1960, carbon dioxide (CO<sub>2</sub>) laser has been

available to laryngeal surgeons as a technological tool. However, given the knowledge gained from the microstructure of the vocal cords and the thermal distribution in the surrounding tissue, there have been questions about the use of CO<sub>2</sub> laser for the removal of benign lesions in the larynx, and this issue has been researched (3). The CO<sub>2</sub> laser has an infrared wavelength of 10.6  $\mu\text{m}$ , which can be absorbed by the body tissues. Since 80% of the tissues are composed of water, the absorbed heat evaporates the intracellular water. The extent to which the tissue is affected depends on the laser power and exposure time. Heat transfer to adjacent structures is very low because of the low conductivity and evaporation of water (4). Laser complications include bleeding, hematoma, emphysema, airway fire, postoperative mucosal edema and its subsequent respiratory distress, aspiration, damage to the eyes of the patient and staff, and damage to the teeth, skin, and adjacent organs due to the reflection of laser energy (5, 6).

The majority of the patients undergoing this type of surgery require general anesthesia. The standard method to induce anesthesia without airway obstruction is inhalation or intravenous injection (5). Some of the immediate complications of tracheal intubation during direct laryngoscopy for general anesthesia are dental trauma, soft tissue trauma, hypertension, tachycardia, direct damage to the upper airway due to excessive physical force during intubation, endotracheal tube cuff rupture, pneumothorax, and dysarthria (7). Moreover, the side effects of anesthetics administered during the surgery may be allergic reactions to the medication, changes in blood pressure and heart rate, cardiac dysrhythmia, and airway spasms (8).

Moustapha et al. (2014) investigated laser endoscopic microsurgery in laryngeal cancers. They demonstrated the benefits of endoscopic laser microsurgery in maintaining laryngeal function and local tissue control in early-stage laryngeal cancer (9). Ya et al. (10) also compared CO<sub>2</sub> laser and conventional laryngomicroscopic technique in the treatment of vocal fold polyps and leukoplakia, in three stages, namely immediately, one week, and 1-3 months after the surgery. They used GRABS and voice handicap index to perform the subjective evaluations. Their results revealed that both objective and subjective findings of the laser group were significantly better than those of the other group.

Benningr (2000) compared CO<sub>2</sub> laser and microdissection in superficial benign lesions limited to the free edge of the vocal fold. To this

end, they evaluated the audio and aerodynamic scales and videostroboscopic findings immediately, 2-3 weeks, and 5-12 weeks postoperatively, with no differences in clinical outcomes between the two groups. Given the significance mentioned above and the limited number of studies in this area, the present study was conducted to evaluate the surgical and anesthetic complications of laryngeal laser in the patients referring to the 5<sup>th</sup> Azar Medical Educational Center in Gorgan, Iran, from 2013 to 2017.

## Methods

This descriptive cross-sectional study was performed on all operable patients with laryngeal lesions who underwent CO<sub>2</sub> laser microscopy at the 5<sup>th</sup> Azar Medical Educational Center in Gorgan from 2013 to 2017. The patients who referred with a change in voice or shortness of breath without any known causes in physical examination (i.e., laryngoscopy) underwent stroboscopy after their history was taken. The patients who had an indication of surgical removal in terms of diagnostic or therapeutic reasons were hospitalized. In the operating room, they were directly re-examined under general anesthesia using a microscope, and the mass was evaluated carefully. Anesthesia was induced using thiopental and scholine and maintained by isoflurane and air. Moreover, atracurium was administered to relax the muscles. The patients were subjected to orotracheal intubation using the SUPA system (low volume-low pressure) filled with distilled water.

The CO<sub>2</sub> laser generating devices used in the current study were the Ultra Dream Pulse V (DS-40U) and UNI MAX 2000 micromanipulator (photomedex). Radiation and power were adjusted proportionately. Webril bandage impregnated with diluted epinephrine solution and sutured with silk thread was used to cover the subglottic trachea and tube cuffs, as well as adjacent tissues in the larynx. Intraoperative observations and information about anesthesia and recovery status in terms of such complications as dyspnea, hemorrhage, hematoma, and emphysema were recorded in the patients' files. The patients were examined 1, 7, and 21 days after the surgery. They were also re-evaluated after 3 months to determine the long-term complications, as well as satisfaction with surgery and sound quality.

The patients who did not attend at the pre-defined follow-up meeting were asked to answer our questions about the indicators (questionnaire) on the phone. The subjects were also asked to

refer to the medical educational center for re-examination if necessary. Complementary therapies were continued appropriately, and those with laryngeal cancers were managed according to the standard protocols. The exclusion criteria were: 1) death during the study period, 2) inaccessibility, and 3) unwillingness to participate in the study. The collected data were analyzed in SPSS software (version 16) and described as frequency and percentage. This research was approved with the Code of Ethics of IR.GOUMS.REC.1395.76.

## Results

Out of 85 patients, 60 (70.6%) cases were male. The mean age of the patients was  $46.23 \pm 1.7$  years (age range: 9-79 years). The primary symptoms included hoarseness and shortness of breath observed in 85 and 4 cases, respectively (Table 1). The follow-up periods were 1, 2, and > 2 years in 8 (9.5%), 38 (44.8%), and 39 (45.88%) cases, respectively. In terms of short-term complications, the patients were examined in the operating room, recovery room, and surgery ward, as well as 1, 7,

**Table1: Primary symptoms at the time of referral**

Type of complication	Number	Percent
Shortness of breath	4	4.5
Hoarseness	85	95.5
Total	89	100

and 21 weeks after the operation. The majority of the patients (n=81) did not have such complications as bleeding, hematoma, emphysema, airway fire, aspiration, and damage to the tooth, skin, and eyes. However, four cases with laryngeal carcinoma had respiratory distress, resulting in tracheostomy (Table 2).

In terms of long-term complications, 2 (2.35%)

**Table2: Frequency of short-term complications in patients undergoing laryngeal laser surgery**

Type of complication	Number	Percent
Shortness of breath	4	4.5
Edema	0	0.0
Bleeding	0	0.0
Damage to adjacent organs	0	0.0
Airway fire	0	0.0
Total	4	4.5

**Table 3: Long-term complications in patients undergoing laser surgery**

Type of complication	Number	Percent	Pathology
Inability to speak	4	4.71	Cancer - Tracheostomy
Dissatisfaction with voice in benign lesions	2	2.35	Benign mass
Dissatisfaction with voice in malignant lesions	12	14.12	Cancer
Complete satisfaction with respiration and voice	67	78.82	Benign mass
Total	85	100	

cases had recurrent lesions after 3 months. In addition, 16 (18.8%) patients had hoarseness with laryngeal carcinoma as their pathology. No long-term complications, including lesion recurrence, hoarseness, or respiratory distress, were found in 67 (78.8%) cases (Table 3).

## Discussion

This study involved the investigation of 60 (70.6%) males and 25 (29.4%) females. In the same study performed by Yazdani et al., 57.5% of the patients were male, while 46.23% of them were female (5). In our study, the patients had the mean age of  $44.5 \pm 1.7$  years and age range of 9-79 years. In the study by Yazdani et al., the mean age and age range of the subjects were 27.6 and 3-64 years, respectively. In the current study, 85 patients underwent CO<sub>2</sub> laser surgery. Accordingly, in the studies carried out by Yazdani et al. (5), Hui-chilai et al. (2002) (11), and Herford et al. (2000), CO<sub>2</sub> laser was used for laryngeal

lesions.

In our study, 81 (95.3%) patients had no complications (e.g., hemorrhage, hematoma, subcutaneous emphysema, airway fire, aspiration, and damage to the teeth and eyes) either in the operating room or 1, 7, and 21 days after the operation. However, 4 (4.71%) subjects presented with dyspnea as the main symptom before the surgery; therefore, they underwent tracheostomy. Accordingly, dyspnea was not a surgical complication. Yazdani et al. reported bleeding (1.3%), respiratory distress (1.3%), and airway fire (1.3%), (5).

Prgomet et al. (2009), investigating CO<sub>2</sub> laser surgery among patients with laryngeal cancer, reported a complication rate of 12.7%. These complications included bleeding, emphysema, and mucosal edema requiring tracheostomy (6). In another study performed by Hui-chilai et al. (2002) on patients undergoing laryngeal laser surgery, airway fire was reported as a complication with the prevalence of 0.14-1.5% (11). However, this

dangerous complication was reported to have the incidence rate of 0.5%-1.5% in a study conducted by Miller (15).

Compared to the results of the two aforementioned studies, our findings revealed the incidence of no complication in our patients in the short term, which could be due to accurate operation or small sample size. There were only four cases who referred with a complaint of severe respiratory distress and required tracheostomy. In our study, all patients underwent general anesthesia. Nevertheless, in the study by Yazdani et al., general anesthesia was used in 98.7% of the cases, and sedation was employed in 1.3% of the subjects (5). Cummings et al. (1998) reported that most of the patients requiring upper airway laser surgery would need general anesthesia. However, oral and oropharyngeal surgery could be performed with topical anesthesia with or without analgesics (12).

In the current study, thiopental sodium and scholine were used to induce anesthesia, and isoflurane, air, and atracurium were adopted to maintain it. Yazdani et al. utilized halothane and N<sub>2</sub>O, together with oxygen, for most of the patients. They also used halothane and oxygen or N<sub>2</sub>O and oxygen for some of the subjects (5). Cummings et al. (1998) recommend to use non-flammable drugs, such as halothane and isoflurane, and reduce oxygen concentration to about 40% (12).

In our study, muscle relaxants, such as atracurium, were used to maintain anesthesia. However, Yazdani et al. employed succinylcholine and atracurium for this purpose (5). Cummings et al. also recommended the use of muscle relaxants (12). In a study carried out by Nagelhout et al., muscle relaxants were employed during laryngeal laser surgery (13, 14). The use of muscle relaxants facilitates the immobilization of the larynx and maintenance of the airway in a wide-open state, thereby removing the probability of laser radiation contact with the operating site and preventing tissue damage.

In our study, all patients were treated with the SUPA tracheal tubes through the mouth during anesthesia. In the research by Yazdani et al., 55.2%, 26.9%, and 17.9% of the cases had Red Rubber tubes, tracheostomy, and metallic tubes, respectively, which were administered orally in 93.6% and nasally in 6.4% of the cases (5). According to Miller (2000), all endotracheal tubes are flammable, and PVC tubes are very sensitive to CO<sub>2</sub> laser (15). In another study, PVC endotracheal tubes and silicone tubes were reported to be dangerous due to ignition (11). Miller did not consider the use of metal tubes as a

definite method for fire prevention (15).

In our study, manual ventilation was used for all cases. Similarly, Yazdani et al. used a manual method (5). In our study, pathology was squamous cell carcinomas, which was benign in 69 (81.2%) cases and malignant in 16 (18.8%) cases. In the research by Yazdani et al., 5.2% of the patients undergoing CO<sub>2</sub> laser had malignant lesions, and the remaining were benign (5).

In terms of the long-term outcomes and complications, our finding revealed that 2 (2.35%) cases with recurrent benign lesions had no postoperative follow-up. It was also found that 16 (18.8%) cases had hoarseness with carcinoma pathology. However, no long-term complications, such as the recurrence of lesion, hoarseness, and respiratory distress, were observed in 67 (78.8%) cases. Moreover, 36 (81.8%) cases were completely satisfied with their voice and breathing. Nonetheless, 14 (16.47%) patients were dissatisfied with their voice, 2 cases of whom had unfollowed benign pathology. In the dissatisfied patients, 12 cases had laryngeal carcinoma and underwent radiotherapy, and 4 cases had laryngeal carcinoma and were subjected to tracheostomy.

Lewicz (2011), investigating the complications of CO<sub>2</sub> laser at the early stages of gluteal malignancy, indicated a better efficacy of CO<sub>2</sub> laser, compared to microsurgery, in terms of better postoperative acoustic function, lower edema, and faster and more cost-effective recovery (16). In addition, Moustapha et al. (2014), examining the treatment of laryngeal premalignancy using a CO<sub>2</sub> laser, reported satisfactory results (9).

## Conclusions

The CO<sub>2</sub> laser laryngeal surgery can both yield good therapeutic outcomes and have few side effects when using technical principles, taking safety considerations, and collaborating with an otolaryngologist and an anesthesiologist. However, further research with a larger sample size would be required.

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### Conflict of Interest

The authors of the article have no conflicts of interest to declare.

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