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**The predictor role of FEV1 in airway management of patients under laryngeal tumor surgery.**

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**Abstract:**

**Background and objective:** Because of fixed airway obstruction in patients with laryngeal tumors, measurement of FEV1 can help in predicting the degree of airway obstruction and deciding the safe plan for anesthesia.

**Materials and methods:** 154 patients, 40-80 years old, with ASA class II-III who were scheduled for elective surgery enrolled in this study. Pulmonary function tests (PFT) was done before surgery for all patients. They were divided into three groups based on the result of PFT: Group 1: FEV1 > 2.5 L which received standard anesthesia induction. Group 2: FEV1 = 1.5-2.5 L, induction was performed by keeping spontaneous breathing and Group 3: FEV1 < 1.5 L: which awake intubation was performed with topical anesthesia.

**Results:** there was significant difference in intubation time and attempts among 3 groups (8.91.8, 10.7±1.7, 15.6±6.3 sec. p=.000; 1.2±0.5, 1.4±0.6, 1.7±0.8, p=.002 respectively). Failed intubations were 3, 4, 9 in three groups respectively, which was not statistically different (P=0.1).

**Conclusion:** Due to fixed airway obstruction in patients with laryngeal tumors, FEV1 can be used as a predictor for classification and choosing a safe method for induction of anesthesia.

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**Keywords:** FEV1, Laryngeal tumor, Airway management, Anesthesia induction.

## Introduction:

Difficult airway management has always been a challenge even to the expert anesthesiologists. This becomes more prominent in patients with the pharyngeal and/or laryngeal lesions.<sup>(1, 2, 3)</sup> For the airway management, there are many helpful indicators, usually used by the anesthesiologists.<sup>(4)</sup> However, in patients with laryngeal lesions, airway will be more difficult to handle.<sup>(5)</sup> Most of anesthesiologists choose the anesthesia pattern, based on their experience for handling of such patients; ranging from regional block, light anesthesia by inhalation, to usage of neuromuscular relaxants.<sup>(6, 7, 8)</sup> As the degree of obstruction caused by laryngeal tumors is fixed and can be evaluated during inspiration and/or expiration, we decided to use it as an indicator for deciding the safe way of induction in such patients.<sup>(9, 10, 11, 12)</sup> There are some methods for measurement of airway obstruction as followings: Airway resistance, Flow-volume loops and Forced expiratory maneuvers (Peak flow, FEV1, FEF 25%-75%, Maximal expiratory flow volume). An extensively used indirect measure of airway dimensions is the FEV1. During the first 25% of FVC maneuver, flow reflects dimensions of the airways between the alveoli and the mouth and is effort dependent. FEV1 is a simple and reproducible and is thus a useful index of airway function. In severe obstruction, it becomes less than 0.8-1 liter; on the other hand, when it is more than 2.5 liter, ventilation in large airways is normal.<sup>(13, 14, 15)</sup> Because induction of anesthesia in some patients in our study are under spontaneous ventilation and FEV1 is an effort dependent and very

simple test, we suggest to use it as an indicator for planning of airway management in patients with laryngeal tumors.

## Materials and Methods:

After obtaining informed consent and approval of "medical ethics committee", 154 patients with laryngeal tumor, aging 40-80 years and ASA II-III, were selected to undergo elective surgery and biopsy using bronchoscope, enrolled in this study.

They were clinically examined, and pulmonary function test was done for them, just on the day before operation. Those with extra laryngeal space-occupying lesions were excluded. All patients received 0.02 mg/kg IV midazolam as pre-medication and were ventilated by 100% oxygen for 3 minutes. They were divided into three groups for induction and intubation, based on the result of the test:

- 1- Group 1, FEV1 > 2.5 L, IV anesthesia induction with muscle relaxant.
- 2-Group 2, FEV1=1.5-2.5 L, inhalation induction by keeping spontaneous breathing.
- 3- Group 3, FEV1 < 1.5 L, awake intubation with topical anesthesia and regional block.

The first group (n=50), received 4 mg/kg sodium thiopental for induction, followed by 2 mg/kg succinylcholine, before intubation. The second group (n=51) were ventilated by halothane 1% until loss of consciousness and unresponsiveness to the painful stimuli (deep anesthesia), then halothane was decreased to 0.7%.

Intubation in this group was performed by local anesthesia and without muscle relaxants, while the patients had spontaneous breathing. Finally, the third group of patients (n=53), were intubated, using regional block and topical anesthesia. All of intubations were done by an anesthesiologist who was blinded for study. In case of intubation failure, urgent tracheostomy was done after the 3rd attempt. Following data were noted for each patient : age, sex, intubation time, number of attempts, failure of intubation, size of the tracheal tube, urgent tracheostomy in case of failed intubation, regional block failure (in third group), complication happening during intubation (bleeding, trauma to teeth, tracheal injury). Data was analyzed with ANOVA statistical test for quantitative variable and Kruskal Wallis test for qualitative variable. P values lesser than 0.05, was considered significant.

### Results:

There was significant difference between the mean age, but not sex between three groups (P= 0.008, P=0.9, respectively) (Table 1). Mean FEV1/FVC was 61% in group 1, 55% in group 2 and 49% in group 3. This difference was between group 2 and 3. There was not significant difference between 1-2 and 1-3 groups [Post Hoc- Tukey HSD test; 1-2 groups: 95% CI= -1.94- 5.10, P=0.54; 1-3 groups: 95% CI= -6.46- 0.51, P=0.11; 2-3 groups: 95% CI= -8.02- (-1.08),

P=0.006]. The intubation time was significantly shorter in the first group compared to the other two groups (Mean  $\pm$  SD:  $8.9 \pm 1.8$ ,  $10.7 \pm 1.7$ ,  $15.6 \pm 6.3$ , respectively, 95% CI= 10.87- 12.46, P= 0.000; ANOVA analysis). In Post Hoc-Tukey HSD test, there was not significant difference between 1 and 2 group within intubation time (P= 0.53) (Table 2).

Mean intubation attempts was significantly higher in the third group compared to the other two (ANOVA test; 95% CI= 1.31- 1.53, P= 0.002), but in Post Hoc-Tukey HSD test, it was the same in group1 and 2(P= 0.58) (Table 2).

Intubation time, intubation attempts, and tracheal tube size had significant difference within 3 groups and also had indirect correlation with FEV1 amount (P<0.03) (Kappa's P=0.011), but have not been shown correlation between fail intubation, urgency tracheostomy, and rate of complication (bleeding, trauma to teeth, tracheal injury) with FEV1 amount (P>0.6) (Table 3).

Failure of intubation in three groups 1,2 and 3 was as follows: 3, 4, and 9 respectively which were the same in all of them (P= 0.15) (Kruskal Wallis test).

Complications during the procedure did not have significant difference among groups, and it happened in 3, 4, and 9 cases, respectively (P= 0.23) (Kruskal Wallis test).

Table 1: Demographic characteristics of patients.

Variable	Group	No	Mean/SD	P value*
age	1	50	57.4/9.1	0.008
	2	51	55.9/6.1	
	3	53	60.4/7	
	total	154	57.9/7.7	
Sex(M/F)	1	27/23	—	0.9
	2	28/23	—	
	3	30/23	—	
	total	154	—	
Complication	1	3	—	0.23
	2	4	—	
	3	9	—	
	total	16	—	
Underline disease (COPD,Asthma)	1	3	—	0.07
	2	5	—	
	3	8	—	
	total	16	—	

\* ANOVA test

Table 2: Comparison of group-between, based on classification of FEV1 amount.

Variable	Comparison of group-between	Mean difference	95% confidence interval	P value*
Intubation time (Second)	1-2	-1.85	-3.72- 0.02	0.53
	1-3	-6.72	-8.62- (-4.82)	0.000
	2-3	-4.87	-6.77 – (-2.97)	0.000
Intubation at- tempts	1-2	-0.13	-0.45- 0.18	0.58
	1-3	-0.46	-0.77- (-0.15)	0.002
	2-3	-0.33	-0.64- (-0.02)	0.037
Tracheal tube size	1-2	0.67	0.48- 0.86	0.000
	1-3	0.97	0.78- 1.16	0.000
	2-3	0.29	0.11- 0.49	0.001

\* Post Hoc- Tukey HSD test

Table 3: Correlation of variables and groups.

Variable	Standardized coefficient (β)	P value
Intubation time (Second)	0.33	0.000
Intubation attempts	0.11	0.037
Tracheal tube size	- 0.57	0.000
Intubation complications	0.02	0.92
Urgent tracheostomy	0.13	0.09
Fail of intubation	0.115	0.62

\*ANOVA test, Regression model.

**Discussion:**

Patients with laryngeal tumor are difficult cases of airway management, because of the partial obstruction in the airway, and upper respiratory tract deviation as well.<sup>(16)</sup>

Choosing the suitable anesthesia method in these patients has always been a major concern of anesthesiologists, each one deciding just based on the personal experience and skill. The usual methods are general anesthesia and/or muscle relaxants, local anesthesia with neuromuscular blockade (such as laryngeal nerve block), or deep sedation, while the patient is awake. This has lead to more stress in patients with serious comorbidities, or limits in using usual anesthetic drugs. It is important, we can predict rate of intubation success, in order to safe induction of anesthesia and airway management, particularly in awake patient, because the patient is stressful in this situation.<sup>(17)</sup>

In this study, we used FEV1, as an indicator for the degree of involvement of the major airways (bronchi and larynx), could be of great help in deciding about the method of anesthesia in such patients. In patients with FEV1>2.5 liter (group 1), the upper airway evaluation was done as the normal population; intubation under general anesthesia, and using muscle relaxants helped easing up the intubation procedure. Two of our cases in this group (two 60 and 51 year – old female, with hypo pharyngeal mass) made bias; however more precise evaluation revealed that the cause of this was just the pressure applied by the tumor and closure of the airway, further on. So, they were excluded from the

study due to the presence of extra laryngeal, space occupying lesion. Three patients with FEV1>2.5 showed to be a difficult case of intubation, therefore the intubation was failed. Nevertheless less fail of intubation in 1 group, it was not significant in compared with other 2 groups. FEV1 amount was significant predictor in time and attempts of intubation but it was not mind with fail of intubation. This found may be help for better ready in airway management and avoiding of adverse effects. Not a significant standard deviation (SD) and bias, happened in our study, as these patients were ASA II-III cases, including those with pulmonary diseases -even the obstructive (COPD) types. Considering the critical state of the airways to be managed, the skill of the person doing the intubation was considered as a parameter as well. It was reflected by the intubation attempts, with repetitive attempts recorded as two. Keeping in mind that the goal of such procedures, is just exploring the involved area and making biopsies of the larynx and/or the upper airways, one can assume the reason for using small size tubes such as ID.(5-6) It will be even smaller in the third group, due to the higher degree of the obstruction.<sup>(18-27)</sup>

As it was mentioned before, the amount of air flow during expiration and inspiration is fixed in time, in patients having laryngeal tumor, due to the nature of the disease.

This results in FEV1 being a valuable indicator of the degree of ventilation-competency of the upper airways. Few cases that led to urgent tracheostomy,

were those in whom, airways obstruction accompanied by the extensive involvement of the area by tumor, would not make an effective neuro-muscular blockade possible. So, considering the severe stenosis, the patient would undergo the tracheostomy, in case the awake intubation failed in the first attempt.<sup>(28-33)</sup>

As mentioned before, the underlying pathology and pulmonary diseases present in patients did not make any bias in the study.

Another point in applying this classification to intubation and airway management of such patients, is taking advantage of the benefits of sedative /short acting narcotic drugs. In other words, one can use these drugs with more confidence in these cases with co-morbid diseases such as cardio-pulmonary problems. Muscle relaxant usage limits, in those with laryngeal cancer, make obstacles in intubation /airway management of them, unavoidable. So, by applying this method, one can use short-acting muscle relaxants safely in majority of these cases.<sup>(34-38)</sup>

Few anesthesiologists do the induction by inhalation, avoiding any other IV drug unless the patient is in deep anesthesia stage. However, this method demands not only a higher dosage of inhalations, but also a great deal of time ( $8.9 \pm 1.8$  vs.  $10.7 \pm 1.7$ ). Moreover, there are other things to be considered, such as the side effects of the drugs, happening more often in higher dosages, leading to dysrhythmias, and you have to keep in mind that the patients undergoing surgery are more prone to developing ad-

verse effects of the drugs, due to the decreased blood pressure and depressed cardiac function.<sup>(39-40)</sup>

In one word, this is to say by being precise in clinical assessments, taking x-rays, and doing pulmonary function test before the surgery, the anesthesiologist will be saved a great deal of time and stress in managing the difficult cases, as proved by this clinical trial.<sup>(41-42)</sup>

### Conclusion:

FEV1 can be a valuable indicator in evaluating the upper airways. This clinical trial lasting 1.5 years, can enable the one in charge of anesthesia procedure to manage the airway more easily, by classifying the patients into different groups, each of which are suitable candidates for a certain method of induction/intubation. As a result, he can use a wider range of anesthetic drugs- analgesics, sedatives and muscle relaxants included- and avoid adverse drug reactions happening by high dosage of such drugs.

Even in those anesthesiologists who use neuro-muscular blockade technique, this classification can help choose an acceptable dosage of IV drugs/Inhalators.

However, this pattern is not applicable to those cases that have extra laryngeal lesions.

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