CLINICAL ARTICLE

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Postoperative Tracheal Mucosa Ischemia by Endotracheal Tube Cuff Pressure Change During the Anterior Cervical Spine Surgery

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Objective : Endotracheal tube cuff-pressure(ETCP) increases significantly during anterior cervical spine surgery with neck retraction. Clinically, postoperative hoarseness with sore throat is correlated with vocal cord edema due to longer intubation time and higher ETCP during neck retraction.

Methods : Fifty patients of anterior cervical spine surgery were randomized to a control (no adjustment, 25 cases) and a treatment group (ETCP adjusted to 20mmHg, 25 cases). Patients were blinded to their group assignments. They were questioned about the presence of ischemic symptoms (sore throat, dysphagia, hoarseness) postoperatively at different time points; 4 hours, 24 hours, and 1 week postoperatively.

Results : No differences between groups at 4 hours and 1 week postoperatively were demonstrated. At 24 hours, 36% of patients in the treatment group complained of sore throat while 56% of control group patients did ($p < 0.05$). Female patients correlated with development of all ischemic discomfort ($p < 0.05$: sore throat, hoarseness, dysphagia).

Conclusion : Our results suggest that postoperative ischemic symptom following anterior cervical spine surgery may be associated with the two predictors; increased ETCP during neck retraction and female. The simple procedure of maintaining ETCP to 20mmHg can prevent postoperative tracheal ischemic symptom.

KEY WORDS : Anterior cervical spine surgery · Endotracheal tube cuff-pressure(ETCP) · Sore throat · Dysphagia · Hoarseness.

Introduction

The role of the endotracheal tube cuff in general anesthesia is to maintain the appropriate position of the tube inserted to the trachea, and to prevent aspiration of gastric contents caused by the regurgitation of the stomach. However, the cuff pressure during the endotracheal intubation, particularly, the increase of capillary pressure, or during hypotensive anesthesia, ischemia may be induced in the tracheal mucosa, and clinically, postsurgical sore throat, hoarseness, dysphagia, etc. may be developed. In studies reported in the literature, after the cervical retraction during the anterior cervical spine surgery, the incidence of such ischemia has been reported to be 2~44%[1,3-5], and it has been suggested that the endotracheal tube cuff pressure should be maintained at 20~22mmHg to prevent the ischemia in the tracheal mucosa[6,8]. In addition, according to recent reports, it has been reported that in the cases with the cuff pressure higher than 35mmHg and the cervical retraction time longer than 207±20 minutes, postsurgical ischemic symptoms were developed[5].

Therefore, the aim of this study is to investigate whether the incidence of postoperative discomfort(sore throat, dysphagia, hoarseness) is reduced by maintaining ETCP at 20mmHg during neck retraction in anterior cervical spine surgery.

Materials and Methods

The study population was 50 adult patients with one level disc herniation who underwent the cervical spinal surgery of discetomy and interbody fusion with autologous iliac bone using Solis^R device by anterior approach. The control group selected randomly and the treatment group were adjusted to

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Table 1. Summary of demographic data

	Control group			Treatment group		
	Age (years)	Height (cm)	Weight (kg)	Age (years)	Height (cm)	Weight (kg)
Male(12)	54.3	168.4	63.6	57.4	167.1	66.2
Female(13)	47.7	156.6	51.4	50.3	158.7	52.2
Mean	50.0	161.0	57.5	53.9	160.9	58.7

be 25 patients each, and the gender distribution in both groups was also adjusted to be 12 male and 13 female patients. At the time of surgery, a statistical significance difference of the age, height, and weight between these two groups was not detected (Table 1).

In all patients, surgery was performed by a usual method and a same surgeon. In other words, in the supine position of patients, monitoring equipment that is required during general anesthesia was attached, anesthesia was induced, and subsequently, directly under laryngoscope, the endotracheal intubation (female : 7.0 Fr and male : 7.5 Fr) was maintained. During the end-expiration within the trachea, the cuff pressure was maintained at 20mmHg. Anesthesia was induced by propofol (2mg/kg), fentanyl (<2mg/kg), and rocuronium (1mg/kg). To facilitate the exposure after the completion of cervical retraction, in the treatment group, the cuff pressure was measured again and maintained at 20mmHg. Patients were blinded to their group assignments. In each patient group, development of postsurgical ischemic symptoms (sore throat, hoarseness, dysphagia) was assessed at 3 different times (4 hours after surgery : time of tube removal, 24 hours after surgery, and 1 week after surgery) through the inquiry by the same surgery team member. The complaint level was evaluated by the visual analog scale of 1 to 10, and the scores higher than 3 points were evaluated to be clinically significant discomfort. For statistical analysis, the populations statistics information of patients, the endotracheal cuff pressure, the cervical retraction time, etc. were applied as statistical variables, and additional analysis was performed by applying Fisher exact test (comparison of proportion) and of clinical outcome.

Results

The cuff pressure

During the cervical retraction, the endotracheal tube cuff pressure in both groups was increased evidently than the base condition (20mmHg prior to retraction). The control group was average 32mmHg, the treatment group was average 33mmHg, and such pressure increase between two groups was not statistically significant ($P>0.05$). In the treatment group, during decompression, average 1.1 ± 1.0ml air was removed, and after the retraction, the cuff pressure was adjusted to 20mmHg.

Table 2. Number of patients of postoperative discomfort

	Sore thorat			Dysphagia			Hoarseness		
	4hrs	24hrs	1wk	4hrs	24hrs	1wk	4hrs	24hrs	1wk
Control	15	14	1	8	9	3	8	8	1
(25cases)	(60%)	(56%)	(4%)	(32%)	(36%)	(12%)	(32%)	(32%)	(4%)
Treatment	16	9	1	7	8	3	6	7	0
(25cases)	(64%)	(36%)	(4%)	(28%)	(32%)	(12%)	(24%)	(28%)	(0%)

Table 3. The incidence of sore throat at 24 hours after operation according to gender

	Female		Male	
	Presence	Absence	Presence	Absence
No. of patients	17	9	6	18
Initial ETCP(mmHg)	30±5	28±5	34±9	36±10
Operation time (min)	87±7	86±9	98±13	99±15

Discomfort data

Table 2 shows the pattern of the development of ischemic symptom 4 hours, 24 hours, and 1 week after surgery.

As factors for the logistical analysis, the effective pressure during retraction, total retraction time, and their gender were chosen.

Sore throat : 4 hours and 1 week after the surgery, none of factors between two groups was different, however, in regard to the complaint of sore throat 24 hours after surgery, the incidence in the treatment group (9 patients, 36%) was lower than the control group (14 patients, 56%), and it was statistically significant ($p<0.05$). In addition, in females, the incidence was shown to be two times higher than males, and it was not associated with the treatment group. Therefore, it was speculated that this due to the anatomically low threshold value of developing the ischemia by the cuff pressure ($p<0.05$) (Table 3).

Dysphagia : 4 hours and 24 hours after the operation, between two groups, none of factors was different. However 1 week after surgery, similarly to sore throat, unrelated to the treatment group, it was developed six patients and all was female sex ($p<0.05$).

Hoarseness : 4 hours and 1 week after surgery, between two groups, the effect was not noted, however, 24 hours after surgery, regardless of the treatment group and variables, it developed two times more in females ($p<0.05$). Therefore, the postsurgical tracheal distress developed after the perfusion impairment in the tracheal mucosa and ischemia showed a temporary clinical outcome that disappears with time. None of the pateints enrolled in this study suffered recurrent larynageal nerve palsy.

Discussion

After general anesthesia using an endotracheal tube, as complications associated with the trachea, sore throat, the edema and adhesion in the trachea, and recurrent laryngeal

injury may be developed, and during the neurosurgical area, particularly, the anterior cervical spine surgery, to secure a wide surgical view, by additionally using a cervical tract, the cervical area is extended maximally in many cases, and in such cases, the inserted cuff pressure is increased, and thus after surgery, the injury in the blood flow in the tracheal mucosa may be induced, and the secondary postsurgical symptoms sore throat, dysphagia, hoarseness may be developed by ischemia[6,8].

Clinically, Jellish et al. have reported that longer was the intubation time and higher was the tube cuff pressure during the cervical retraction, higher was the frequency of the development of postsurgical sore throat, hoarseness, and other symptoms[1,4,5,7], and similarly, in our results, it was noted that the development of ischemic symptoms was able to be decreased by maintaining the actual cuff pressure at 20mmHg after the retraction during surgery in the treatment group. The result at 4 hours after surgery (time of tube removal) between two groups was not different, which was because patients had a pain relief equipment in many cases, and in addition, it was understood due to the residual anesthetics.

In our study, 24 hours after surgery, the incidence of sore throat was significantly decreased in the treatment group ($p < 0.05$). The cuff pressure of the base state (prior to cervical retraction) was standardized as 20mmHg, and the pressure was increased to 32~33mmHg after the cervical retraction, and it was adjusted to 20mmHg in the treatment group. In other words, the actual target pressure was set at 20mmHg, and thus the ischemia in the tracheal mucosa during the cervical retraction was prevented, however, Sperry et al. set the pressure at 15mmHg, etc. and in some cases, it was adjusted to relatively lower levels than our study[10].

Hoarseness as a complication of anterior cervical spine surgery is well known. It may be caused by recurrent laryngeal nerve palsy. The prevalence of recurrent laryngeal nerve injury associated with anterior cervical discectomy has been reported to be between 0.07% to 11%. But temporary vocal cord paralysis may be much higher. Kriskovich and associates reported a decreased prevalence of vocal cord paralysis in a consecutive series of 900 patients who underwent anterior cervical fusion and plating and those patients who had repositioning of their deflation and reinflation of the endotracheal tube cuff. The prevalence of temporary paralysis decreased from 6.4% to 1.69% after institution of this maneuver. They hypothesized that recurrent laryngeal nerve injury is due to displacement of larynx into the unyielding shaft of the endotracheal tube fixed distally by the balloon cuff and proximally by tape at the mouth. But none of the pateints enrolled in this study suffered recurrent larynageal nerve palsy[7].

In female cases, regardless of the adjustment of the cuff pressure, sore throat and hoarseness at 24 hours after surgery were two or three times more frequent. And dysphagia at 1 week after surgery was occurred in all female patients. Therefore, in the development of postsurgical ischemic symptoms, female has been recognized as a risk factor, and as its causality, Sheffield et al. have reported that to the same level of unpleasant stimulation, females are more sensitive than males and respond more strongly[9]. However, the ischemia in the mucosa by the cuff pressure could not be measured directly, therefore, the definite basis showing that the adjustment of the cuff pressure to 20mmHg may be a direct factor that prevents the postsurgical ischemic symptom could not be obtained, therefore, it is thought that in future, additional other objective diagnostic methods such as direct tracheal endoscopy are required.

Conclusion

Based on our results, we were able to speculate two variables that could cause discomfort after the anterior cervical spinal surgery by the cervical retraction. (1) increase of the tube cuff pressure during the cervical retraction (sore throat), and (2) female (sore throat, dysphagia hoarseness). Therefore, a simple manipulation of the adjustment of the endotracheal tube cuff pressure to 20mmHg during surgery may be of help to reduce the ischemic symptom after anterior cervical spine surgery.

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Commentary

In this article, Authors analyzed the pressure effect of tracheal mucosa by endotracheal tube cuff during neck retraction in anterior cervical surgery. They described that the adjustment of the cuff pressure to 20mmHg may prevents the post-surgical ischemic symptom of tracheal mucosa. It is worth consideration in this study, increased endotracheal tube cuff pressure and female are capable factors predicting ischemic damage on tracheal mucosa.

However, as authors commented, it is difficult to measure the ischemia in the mucosa by the cuff pressure directly and to correlate between clinical symptom and objective finding, especially female. Additionally, special attention should be paid that long-term outcome did not differ between two groups 1 week after surgery. This result suggest that the influence of raised pressure may be temporary and a part of definite cause of postoperative sore throat and hoarseness. Although larger number of cases and well control studies to consider other related factors are warranted to clarify the significance of cuff pressure in the development of postoperative ischemic symptom, I appreciate the author's honest analysis of their data in this article.

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