The Effect of Lumbar Disc Hernia Operations in Prone Position on Endotracheal Cuff Pressure and Tracheal Morbidity

Yusuf İpek[1], Zeynep Baysal Yıldırım[2], Enes Çelik[3*], Hakan Akelma[3]

1. Mardin Training and Research Hospital, Anesthesiology Clinic ,Mardin, Turkey.
2. Dicle University, Faculty of Medicine, Departments of Anesthesiology and Reanimation, Diyarbakır, Turkey.
3. Artuklu University, Faculty of Medicine, Departments of Anesthesiology and Reanimation, Mardin, Turkey.

***Corresponding author:** Çelik E., MSc. PhD, Departments of Anesthesiology and Reanimation, Faculty of Medicine, Artuklu University, Mardin, Turkey.
E-mail : anestezistenescelik@gmail.com

Abstract

Background: When the cuffs of endotracheal tubes are inflated with high pressure, serious morbidities are encountered. The aim of our study is to monitor the values of endotracheal tube cuff pressure, which can change in different positions, during the operation and to investigate its effects on tracheal morbidity.
Materials and Methods: Prospective observational study. The age at which general anesthesia with endotracheal intubation was applied to the study; Sixty randomly selected patients in the ASA 1-2 group, 18-80 years old, and Mallampati class 1-2 were included between July 2016 and July 2017. Thirty patients with lumbar disc herniation surgery were divided into 2 groups as group 1 in the prone position, and group 2 in the supine position of 30 patients with lower or upper extremity surgery. After the patients in both groups were intubated in the supine position, the pilot balloon was inflated with an endotracheal cuff manometer between 28-30 cmH2O. Endotracheal tube cuff pressure was continuously monitored throughout the entire operation and recorded every 5 minutes. The patients were evaluated in terms of cough, dysphonia and sore throat at 1, 8 and 24 hours postoperatively.
Results: Hemodynamic and respiratory parameters and temperature values of the groups were recorded during the operation. Cuff pressures, postoperative cough, hoarseness and sore throat were statistically significantly higher in group 1 (p:0.0001).
Conclusion: In order to minimize tracheal morbidity and related complications that may develop due to endotracheal intubation, it was concluded that cuff pressure monitoring should become standard and continuous measurement is required, especially in operations in the prone position.

Research Article (HRU Int J Dent Oral Res 2023; 3(1): 40-45)

Keywords: Endotracheal intubation, Lumbar disc herniation, Prone position, Sore throat.

Introduction

Inflating endotracheal tube cuffs with inappropriate pressure; It can cause various complications ranging from tracheal mucosal damage to tracheal rupture (1, 2). Although the necessity of adjusting the cuff pressures after intubation with pressure gauges produced for this purpose has been reported in the anesthesia practice guidelines, the balloon palpation or "inflating until there is no air leak" method is often used in routine applications (3,4). However, it is stated that the cuffs adjusted in this way may not be at the appropriate

pressure (5). As a result of the studies to find the ideal cuff pressure, it was stated that the endotracheal cuff pressure should be kept between 20-30 cmH2O. Because if the cuff pressure is kept below 20 cmH2O, the secretions in the mouth around the intubation tube cuff may be aspirated into the lower respiratory tract and cause complications. If the pressure is kept higher than 30 cmH2O, complications such as loss of mucosal cilia, ulceration, bleeding, tracheal stenosis and tracheoesophageal fistula may occur, since the perfusion pressure of the tracheal mucosal will deteriorate (6,7).

Factors affecting the cuff pressure are the amount of air applied, the relationship between tracheal diameter and cuff size, the compliance of the trachea and cuff, and intrathoracic pressure changes. Measurement of pressure with a manometer can prevent overinflation of the cuff and possible complications can be avoided (4).

In this study, it was aimed to monitor the endotracheal tube cuff pressure changes during the operation and to investigate the effects of postoperative patients on tracheal morbidity such as sore throat, hoarseness and cough, especially in cases operated in the prone position such as lumbar disc herniation.

Materıal And Method

Local Ethics Committee approval was obtained for the study. (30.07.2015 and numbered 325) The study was planned in accordance with the Declaration of Helsinki. Informed consent was obtained from the patients. The age at which general anesthesia with endotracheal intubation was applied to the study; Sixty randomly selected patients, aged between 18 and 80, in ASA 1-2 group and Mallampati class 1-2 were included. Thirty patients with lumbar disc herniation surgery were divided into 2 groups as group 1 in the prone position, and as a control group, group 2 in the supine position of 30 patients with lower or upper extremity surgery. Patients with surgery on oropharyngeal, laryngotracheal regions, esophageal operations, chronic laryngo-pharyngitis, patients with severe asthma and chronic obstructive pulmonary disease (COPD), patients with upper respiratory tract infections, patients with pre-existing hoarseness, patients with chronic cough (post nasal discharge), laryngospasm or patients who developed bronchospasm, patients with difficult intubation or suspected difficult intubation, patients with multiple intubation attempts, patients with diabetic and connective tissue diseases, those with a history of excessive smoking and steroid users were excluded from the study.

In our study, Kaishou® (Made in China) high-volume, low-pressure cuffed endotracheal tubes were used in the operating rooms of our hospital. Macintosh laryngoscope was used for intubation procedure. Intubation was performed by experienced assistants in the same year.

Anesthesia was induced in all patients with 0.05 mg/kg midazolam (Zolamid 5 mg/ml ampoule, VEM Pharmaceuticals, Turkey), 2 mg/kg propofol (Propofol-PF %1 200 mg/ 20ml, Polifarma İlaç San. ve Tic. Inc, Turkey), 2 mcg/kg fentanyl (Fentanyl Citrate 50 μg/mL 10 mL ampoule, Abbott Laboratories, IL, USA) and 0.6 mg/kg rocuronium (Muscuron 50 mg/ 10 ml vials for enjection, Koçak Farma Pharmaceuticals and Chemicals Industry inc. Turkey) after 3 minutes of preoxygenation. In the maintenance of anesthesia, 50% oxygen, 50% air and 2% Sevoflurane (Sevorane % 100 inhalation solution, Abbvie medical pharmaceuticals Ind, USA) were used. Volume-controlled mechanical ventilation was used in all patients. Tidal volumes of the patients were adjusted to be 8-10 ml/kg according to ideal body weight, and respiratory frequencies were adjusted to be between 35-40 mmHg for end tidal carbon dioxide. ECG, peripheral oxygen saturation (SpO2), non-invasive blood pressure, ETCO2 and temperature monitoring were performed on all patients. Intubation tube ID:7.5 for women and ID:8.0 for men was used.

After the patients in both groups were intubated in the supine position, the endotracheal cuff was inflated between 28-30 cmH2O with a manometer. Endotracheal tube cuff pressure was continuously monitored throughout the entire operation and recorded every 5 minutes. Patients who will undergo LDH operation were placed in the prone position at the 5th minute for the surgical procedure after intubation in the supine position. Cuff pressure was continuously monitored during this procedure and changes were recorded. When the cuff pressure exceeded the limits of 20-30 cmH2O, which is accepted as the safe limit, it was brought back to the safe range and recorded. The patients were awakened by decurarization. Tramadol 1 mg/kg (Contramal 100 mg / 2 ml, Abdi İbrahim ilaç San. Turkey) and paracetamol 10-15 mg/kg (Parol 10 mg / ml vial for infusion, Atabay chemical Industry, Turkey) were given to all patients as postoperative analgesia. The patients were evaluated in terms of cough, dysphonia and sore throat at 1, 8 and 24 hours postoperatively. Sore throat was evaluated with the visual analog scale (VAS). VAS 0: no pain, VAS: 10 Numerical and visual classification from 0 to 10 was used so that I have very severe pain. Cough and dysphonia were evaluated as present or absent.

Statistical Analysis: SPSS 16.0 package program was used for statistical analysis of this study. All data were expressed as mean ± standard deviation and percentages. Categorical and non-numerical data were analyzed with Chi-square and parametric data were analyzed with Student's t test. $p<0.05$ was considered statistically significant.

Results

The demographic data of the patients are shown in Table 1.

When the mean cuff pressures between the groups were compared, there was no significant difference between the baseline cuff pressure measurements between the two groups, but the cuff pressures measured in group 1 were found to be significantly higher at all times, although it was obvious between the groups, especially at the 5th minute, which is the transition period to the prone position (p :0.0001) (Graph 1).

Direct laryngoscopy images performed by an otolaryngology specialist after induction of anesthesia, before intubation (Figure 1 A-B) and after intubation (Figure 2 A-B) were given from randomly selected patients operated in the prone position. Edema and mucosal hyperemic appearance are remarkable in postoperative images.

The clinical effects of the groups such as sore throat, hoarseness and cough in the postoperative period were compared in Table 2 and Graph 2.

In the evaluation of sore throat using a visual analog scale, significant elevation was observed in group 1 at all times (Graph 3) (p< 0.0001).

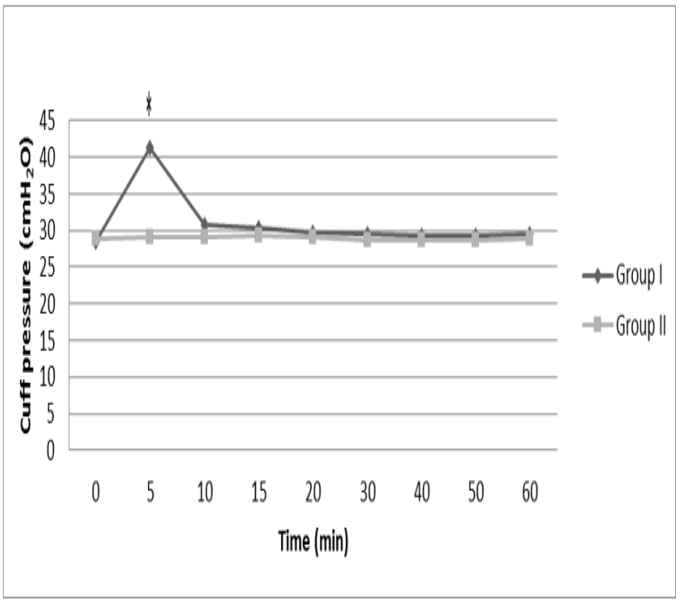
Table 1: Demographic characteristics of the patients.

	Group 1 (n=30)	Group 2 (n=30)	*p*
Gender (F/M)	10/20	14/16	0,2
Age (years)	47,8±12,8	43,6±13,6	0,2
Height (cm)	170±8,5	169±7,6	0,5
Weight (kg)	80,1±16,8	74,7±11,3	0,1
Surgical time (min)	74,7±24,5	76,7±26,4	0,7
Anesthesia time (min)	88,3±23,7	89,6±25,5	0,8
A p-value of <0.05 was considered significant (*), Mann Whitney U test, Chi-square test.			

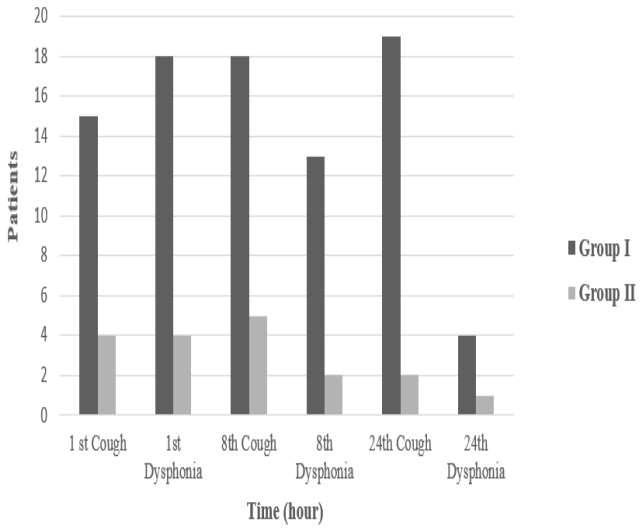
F:Female, M:Male

Table 2. Comparison of Tracheal Morbidity Between Groups.

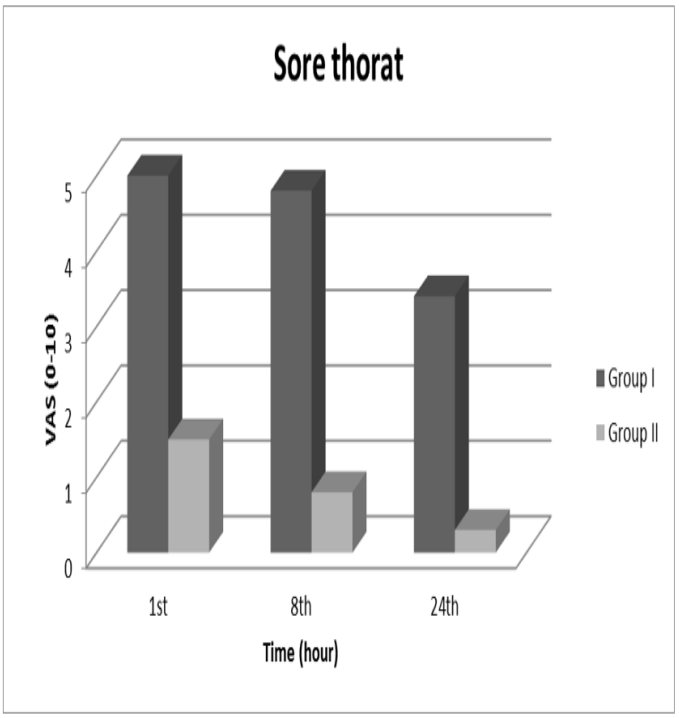
TIME	MORBIDITY	GROUP 1	GROUP 2	P
POSTOP 1HOUR	COUGH	15	4	0,002*
	DYSPHONIA	18	4	0,0001*
	THROAT ACHE	5±2,3	1,5±2	0,0001*
POSTOP 8 HOUR	COUGH	18	5	0,001*
	DYSPHONIA	13	2	0,001*
	THROAT ACHE	4,8±2,4	0,8±1,1	0,0001*
POSTOP 24 HOUR	COUGH	19	2	0,0001*
	DYSPHONIA	4	1	0,1
	THROAT ACHE	3,4±2,2	0,3±1,1	0,0001*
A p-value of <0.05 was considered significant (*), Mann Whitney U test, Chi-square test.				



Graph 1. Comparison of the cuff pressure values of the groups according to the groups.



Graph 3. Cough-Dysphonia Comparison Between Groups.



Graph 2. Comparison of sore throat between groups.

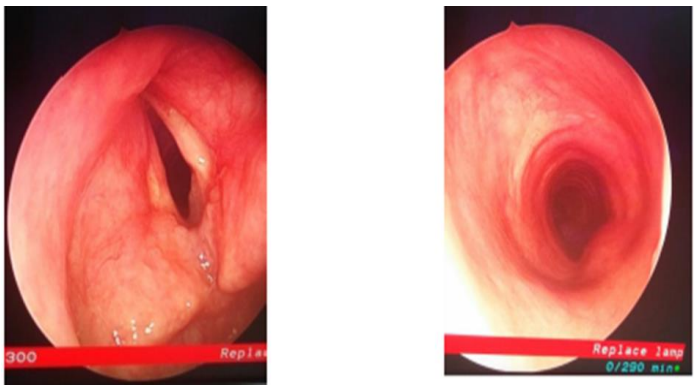


Figure 1 A-B. Direct laryngoscopy images before intubation

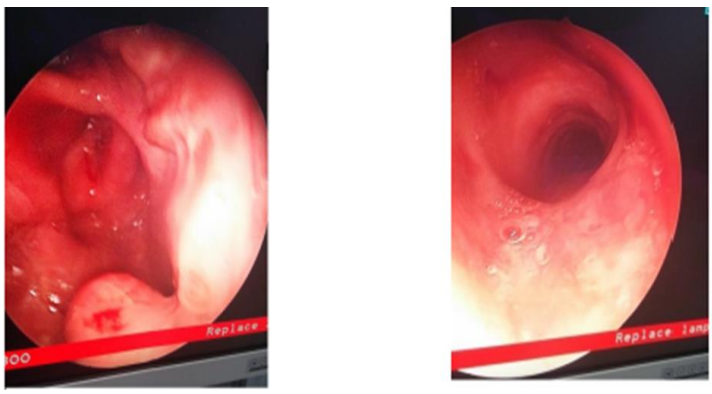


Figure 2 A-B. Postoperative direct laryngoscopy images.

Discussion

In our study, we found that the endotracheal cuff pressure was statistically significantly higher in patients in group 1, especially during the transition to the prone position. We observed acutely edematous mucosal hyperemia in the vocal cords and posterior pharyngeal wall due to elevated cuff pressure in the direct laryngoscopy image in randomly selected patients from group 1.

Some investigators have reported that changes in the position of the head and neck affect the pressure of the endotracheal tube cuff and concluded that there is an increase in pressure applied to the tracheal mucosa with the transition to the prone position (4, 5, 8, 9). Godoy et al. examined the changes in the cuff pressure after the change in the positions of 70 patients who underwent mechanical ventilation in their study and concluded that there was a significant change in the cuff pressure with the change of patient positions, after 280 cuff pressure measurements of the patients included in the study measured in different positions (10). In our study, it was observed that the cuff pressures increased above 30 cm H_2O when the patients in group 1 were taken from the supine position to the prone position. This is in parallel with the Brimacombe and Godoy studies.

Endotracheal tube cuff pressure measurement has not yet been standardized in orotracheal intubated patients undergoing general anesthesia in the operating room. Inflation of the endotracheal tube cuff with inappropriate pressure can cause various complications, ranging from tracheal mucosal damage in the postoperative period, and as a result, tracheal rupture in the long term (1,2). In a study conducted with clinical evaluation and radiological examination, it was reported that ischemia did not develop in the tracheal wall against the ETT cuff adjusted with 30 cmH2O pressure (11). As a result of these studies, it was recommended to keep the cuff pressure low and monitor it during the operation in order to prevent the development of side effects related to ETT cuff pressure in the respiratory system (12).

Continuous monitoring of the cuff pressure at the bedside can be done safely with the cuff manometer and instant changes can be observed. With close follow-up, it can easily return to safe limits when it is out of safe limits after changing position. Sengupta et al. in their study where they tested the hypotheses that the endotracheal tube cuff could not be inflated adequately without the use of a manometer; They measured the cuff pressures with a manometer 60 minutes after induction and showed that only 27% of the patients had cuff pressures between 20-30 cmH2O at the end of the measurement, and above 40 cmH2O in 27% (13). As a result of their studies, they said that the endotracheal tube cuff pressure should be monitored with a manometer. Stewart et al. inflated the endotracheal tube cuff with the traditional method in 40 people who administered anesthesia in their study, and then revealed that the ETT cuff pressure values controlled by manometer were at an ideal rate in less than one-third (14). In our study, in which we evaluated the cuff pressure in different positions, we found the ETT cuff pressure to be significantly higher in the prone position at all times compared to the control group, although it was very significant especially in the first transition to the prone position.

Postoperative sore throat is one of the most common complications in general anesthesia patients undergoing endotracheal intubation.(15-18) Jain et al. found a 20% higher rate of sore throat in the group in which the endotracheal tube cuff was inflated with an injector in their study on neurosurgery intensive care patients (19). Baysal Yıldırım et al. found that both ETT cuff pressure and postoperative sore throat were at higher rates in the group of patients who underwent laparoscopic cholecystectomy surgery compared to the control group (20). In the literature review, many studies were found on the prevention and treatment of postoperative sore throat (21-26). Considering these studies, the incidence of cough and hoarseness after ET ranges from 40% to 96%.

Postoperative cough can cause unwanted side effects. These; hypertension, tachycardia, other arrhythmias, increased intraocular pressure, increased intracranial pressure, pain in the upper-lower abdomen surgery area and suture separations. Many drug studies have been conducted in the literature to prevent cough (21,23,24,26-29). In our study, in the patient group operated in the prone position; In the postoperative evaluation, the frequency of cough at all times was found to be higher than the control group. The reason for this is the patient's position, the associated high cuff pressure, and in addition, long-term scoliosis, spinal tumor, etc., where the average time of our anesthesia is approximately 90 minutes. We think that the surgeries are effective. We believe that continuous cuff monitoring and measures to prevent tracheal morbidity can be made routine in operations performed in the prone position.

As a result, we believe that cuff pressure monitoring should become a standard in order to minimize tracheal morbidity (cough, hoarseness, etc.) and related complications that may develop due to endotracheal intubation, and that it should be followed with continuous

measurement, especially in operations that require preoperative or intraoperative position change. We think that more comprehensive studies will contribute to the literature.

References

1. Mehta S, Mickiewicz M. Pressure in large volume, low pressure cuffs: its significance, measurement and regulation. IntensiveCareMed 1985; 11(5):267-72.
2. Combes X, Schauvliege F, Peyrouset O, Motamed C, Kirov K, Dhonneur G, et al. Intra cuff pressure and tracheal morbidity: influence of filling with saline during nitrous oxide anesthesia. Anesthesiology 2001; 95(5):1120-4.
3. Adnet F, Bally B, Pean D. Airway management in adult scheduled anaesthesia (difficult air way excepted)] AnnFrAnesth Reanim 2003;22 Suppl 1:60s-80s.
4. Galinski M, Treoux V, Garrigue B, Lapostolle F, Borron SW, Adnet F. Intra cuff pressures of endotracheal tubes in the management of airway emergencies: the need for pressure monitoring. AnnEmergMed 2006; 47(6):545-7.
5. Hoffman RJ, Parwani V, Hahn IH. Experienced emergency medicine physicians can not safely inflate or estimate endotracheal tube cuff pressure using Standard techniques.Am J EmergMed 2006; 24(2):139-43.
6. Relio J, Sonora R, Jubert P, Artigas A, Rué M, Valles J. Pneumonia in intubated patients: role of respiratory airway care. Am J RespirCritCareMed 1996; 154(1):111-115.
7. Braz J R C, Navarro L H C, Takata H I, Junior N P. Endotracheal tube cuff pressure: need for precise measurement. Sao PauloMed J 1999; 117(6):243-7.
8. Minonishi T, Kinoshita H, Hirayama M, Kawahito S, Azma T, Hatakeyama N, Fujiwara Y. The supine-to-prone position change induces modification of endotracheal tube cuff pressure accompanied by tube displacement. Journal of ClinicalAnesthesia 2013; 25:28–31.
9. Brimacombe J, Keller C, Giampalmo M, Sparr HJ, Berry A (1999) Direct measurement of mucosal pressures exerted by cuff and non-cuff portions of tracheal tubes with different cuff volumes and head and neck positions. Br J Anaesth 82:708–711
10. Godoy AC, Vieira RJ, Capitani EM. Endotracheal tube cuff pressure alteration after changes in position in patients under mechanical ventilation. J BrasPneumol 2008; 34(5):294-297.
11. Doyle A, Santhirapala R, Crowe M, Blunt M, Young P. The pressure exerted on the tracheal wall by two endotracheal tube cuffs: A prospective observational bench-top, clinical and radiological study. BMC Anesthesiol 2010; 9:10-21.
12. CurielGarcía JA, Guerrero-Romero F, Rodríguez-Morán M. Cuffpressure in endotracheal intubation: should it be routinely measured? GacMedMex 2001; 137: 179-182.
13. Sengupta P, Sessler DI, Maglinger P, Wells S, Vogt A, Durrani J, Wadhwa A. Endotracheal tube cuff pressure in three hospitals, and the volume required to produce an appropriate cuff pressure. AACN AdvCritCare 2008 Apr-Jun;19(2):235-43.
14. Stewart SL, Secrest JA, Norwood BR, Zachary. A comparison of endotracheal tube cuff pressures using estimation techniques and direct intracuff measurement. R.AANA J 2003 Dec;71(6):443-7.
15. Baran İ, Altınsoy S, Yamankılıç Mumcu Ö, Dönmez A. Endotrakeal Kaf İnflasyon Yöntemlerine Bağlı Yüksek İntraoperatif Kaf Basıncı İnsidansı ve Klinik Etkileri. JARSS 2019;27(3):217-223. doi: 10.5222/jarss.2019.41636
16. Çardaközü T, Çınar Köse EÖ, Yucal NN, Balcı S. Objective and Subjective Evaluation of Endotracheal Tube Cuff Pressure Between Different Levels of Anesthesia Experiences. KOU Sag Bil Derg. 2023;9(1):39-42. doi:10.30934/kusbed.1144138
17. Hung KC, Chang YJ, Chang YP, Ho CN, Lan KM, Chen JY, et al. The impact of esophageal device insertion on cuff pressure of endotracheal tube: a literature review and meta-analysis. Sci Rep 2022;12:18192. https://doi.org/10.1038/s41598-022-21980-0
18. Park JH, Lee HJ, Lee SH, Kim JS. Changes in tapered endotracheal tube cuff pressure after changing position to hyperextension of neck: a randomized clinical trial. Medicine 2021;100:29(e26633).
19. Jain MK, Tripathi CB. Endotracheal tube cuff pressure monitoring during neurosurgery- Manuel vs. automatic method. Journal of AnaesthesiologyClinicalPharmacology 2011/ vol 27/ıssue 3;358-361
20. Baysal Yıldırım Z,Uzunköy A, Cigdem A, Ganidagli S, Ozgonul A. Changes in cuff pressure of endotracheal tube during laparoscopic and open abdominal surgery. SurgEndosc 2012; 26:398–401
21. Agarwal A, Nath SS, Goswami D, Gupta D, Dhiraaj S, Singh PK. An evaluation of the efficacy of aspirin and benzydamine hydrochloride gargle for attenuating postoperative sore throat: a prospective, randomized, single-blindstudy. AnesthAnalg 2006; 103(4):1001–3.
22. Jaensson M, Gupta A, Nilsson UG. Risk factors for development of postoperative sore throat and hoarseness after endotracheal intubation in women: a secondary analysis. AANA J 2012; 80(4 Suppl): S67–73.
23. Tabari M, Soltani G, Zirak N, Alipour M, Khazaeni K. Comparison of Effectiveness of Betamethasone gel Applied to the Tracheal Tube and IV Dexamethasone on Postoperative Sore Throat: A RandomizedControlled Trial. Iran J Otorhinolaryngol 2013; 25(73):215–20.
24. Hung NK, Wu CT, Chan SM, Lu CH, Huang YS, Yeh CC, et al. Effect on postoperative sore throat of spraying the endotracheal tube cuff with benzydamine hydrochloride, 10% lidocaine, and 2% lidocaine. AnesthAnalg 2010; 111(4):882–6.
25. Jaensson M, Olowsson LL, Nilsson U. Endotracheal tube size and sore throat following surgery: a randomized-controlled study. ActaAnaesthesiolScand 2010; 54(2):147–53.
26. Rudra A, Ray S, Chatterjee S, Ahmed A, Ghosh S. Gargling with ketamine attenuates the postoperative sore throat. Indian J Anaesth 2009; 53(1):40–3.
27. Banihashem N, Alijanpour E, Hasannasab B, Zarei A. Prophylactic Effects of Lidocaine or Beclomethasone Spray on Post-Operative Sore Throat and Cough after Orotracheal Intubation. IranJ Otorhinolaryngology 2015 ;27(80):179-84. PMID: 26082898; PMCID: PMC4461840.
28. Mekhemara NA, El-agwanyb AS, Radi WK, El-Hady SM. Comparative study between benzydamine hydrochloride gel, lidocaine 5% gel andlidocaine 10% spray on endotracheal tube cuff as regards postoperative sore throat. RevBrasAnestesiol 2016; 66(3):242 - 48.
29. Souissi H, Fre´chette Y, Murza A, Masse MH, Marsault E, Sarret P, D'Aragon, F, Parent AJ, Sansoucy Y. Intracuff 160 mg alkalinized lidocaine reduces cough upon emergence from N2O-free general anesthesia: a randomized controlled trial. Can J Anesth 2016; 63(7):862-70. DOI 10.1007/s12630-016-0652-8.