ECRONICON OPEN ACCESS

EC EMERGENCY MEDICINE AND CRITICAL CARE

Research Article

Measurement of Flexion of a Tracheal Catheter after Intubation with X-Ray

Zhang Zhi-ming, Zeng Bin, Zhang An-sheng and Chen Xia*

Department of Anesthesiology, The First People's Hospital of Chenzhou City, Hunan, China

***Corresponding Author:** Chen Xia, Department of Anesthesiology, The First People's Hospital of Chenzhou City, Hunan, China.

Received: September 26, 2020; **Published:** November 07, 2020

DOI: 10.31080/ecec.2020.04.00383

Abstract

Objective: The shape of intubated tracheal tube will flex from its original shape from factory, few report focus on this kind of flexion. Our proposal of this study is to measure and analyze the flexion angle of armored tracheal tubes after oral intubated with X-ray imaging.

Methods: 31 adult patients scheduled for cerebral angiography or intracranial aneurysm packing underwent tracheal intubation with ASA status at II-III general anesthesia were selected to use armored tracheal tube, which is flexible, after anesthesia induction. After successful intubations, X-ray images were taken twice of the mouth and neck, which show shapes of intubated tracheal tubes in the normal supine position and the sniffing position of the head, respectively. Carol drawl 12 was used as Measure tools of tracheal tube curvature.

Results: In the normal position, the minimum angle was 91.12°, the maximum angle was 120.3°, the mean value was 106.8°, the standard deviation was 8.45°; in the sniffing position, the minimum angle was 95.36°, the maximum angle was 125.2°, the mean value was 111.9° and the standard deviation was 8.8°; the difference between the two was significant ($P < 0.001$).

Conclusion: The flexible armored tracheal tube showed a different shape after the head position was changed, the flexion angle in sniffing position was bigger, which was significantly different from that in supine position, showing the easier intubation and freer ventilation.

Keywords: *Armored Tracheal Tubes; X-Ray Imaging; Oral Intubation; Deformation*

Introduction

With the pressures of various organs and tissues in the mouth and the temperature (with which will soften the PVC (Polyvinyl chloride) tubes, the warmed up common PVC tracheal tube will be more soft [1] and show a certain deformation after being kept in the mouth for a period of time (> 45 minutes). In the previous study [2], although we take measures such as gentle extubation and cold salt water washing in practice to maintain the shape of the tracheal tube out of patients mouth, its shape may still have a certain change in the process of extubation. We suspect that even when the tracheal tube has a certain softening after warmed up in the mouth, it can still maintain a certain elasticity and toughness [3], which may have a certain impact on the measurement of curvature. Clinically, x-ray is used to detect the depth of intubation and the accuracy of intubation [4]. The armored tracheal tube can be made of silica gel and other soft materials because of the metal or nylon ring set inside the tube wall to prevent the tube wall from collapsing [5,6]. The tube can be very flexible. After the tube is placed through the oral cavity, it can produce a shape changes more fit to the oral anatomical structure under the action of various pressures of organs and tissues in the mouth. At the same time, the metal ring inside the wall of the armored tracheal tube is more suitable for X-ray imaging and can be viewed well in X-ray photos [4,7]. We assume that X-ray can be used to image the flexible armored tracheal tube through the oral cavity, and the analysis of the image can further accurately understand the changes of the tracheal tube after the oral intubation. In order to understand and confirm this assumption, we decided to use X-ray to make *in vivo* imaging after tracheal tube intubation orally. Through the analysis of X-ray image, we can accurately analyze the curvature after tracheal tube intubation and further understand the anatomical structure of up-airway.

Materials and Methods

With the approve of the hospital ethics committee (2018052), we decided to take X-ray photos of the mouth and neck of 33 adult patients who planned for cerebral angiography or intracranial aneurysm packing with general anesthesia and tracheal intubation. The inclusion conditions of the study are as follows: Patients need to operate under general anesthesia and tracheal intubation and use X-ray for diagnosis or localization during the operation. ASA II - III unlimited for men and women, with normal structure of oropharynx and neck flexibility. Exclusion conditions: the condition is urgent, patients do not need X-ray examination, the oropharyngeal tumors was found with x-ray.

Methods

All the selected patients were prepared according to the general anesthesia routine protocol. Before operation, 1.0g of phenobarbital sodium and 0.6 mg of penehyclidine were injected intramuscularly into the buttock muscle 30 minutes before operation. After the patient entered the operating room, ECG, noninvasive blood pressure (NIBP) and pulse oxygen saturation were monitored. After a placement the forearm vein channel, the patient was told to hold the mask by himself (Adjusting the angle of the mask, so that the patient does not need to spend too much effort when holding the mask) inhales oxygen (the concentration of inhaled oxygen (FiO_2) is 100%) and instructs of take a deep breath was given when they were inhaling oxygen. The induction started 3 minutes later. All anesthesia induction is carried out according to the following scheme: Midazolam 0.04 mg/kg, sufentanil 0.6 UG/kg, propofol 2 mg/kg, rocuronium 0.6 - 0.8 mg/kg. when the unconscious was confirmed the patient's mandible joint was fully relaxed and the glottis were exposed with a video laryngoscope, an armored tracheal tube was inserted, the tube was properly placed, the air bag was inflated and properly fixed and then the anesthesia machine was connected to control breathing (IPPV, VT = 6 - 8 ml/kg, f = 12 bpm). Propofol 400 mg + remifentanil 1 mg compound solution was continuously pumped into the vein for 20 - 40 ml/h to maintain anesthesia and atracurium 25 - 35 mg/h was pumped to maintain muscle relaxation.

We maintained the normal supine position of the patient's head and neck, adjusted the C-arm X-ray machine, aligned the C-arm plane with the patient's head and neck and put the patient's head and neck in the middle of the C-arm. Fine adjust the position of X-ray, so that the patients' oral cavity and pharyngeal cavity can be better developed. After obtaining satisfactory pictures, the patient's head and neck was adjusted to maintain the position of "sniffing" when the head was tilted backward and another picture was taken.

Marking the pictures obtained with ordinal number each patient according to the sequence. Marking "a" in normal supine position, "b" in "sniffing" position of head back on the picture and then measured the angle with a software CorelDRAW 12 (Corel, Ottawa, Canada). The measurement method was the same as that of previous study: Two axis lines were drawled, Line A is the axis of the oral segment of the tracheal tube, line B is the axis of the pharyngeal segment of the tracheal tube. During the angle analysis, due to the influence of the throat on the tracheal tube, we located the starting point of the pharyngeal cavity segment at the intersection of the tracheal tube and the glottis, as shown in point C in figure 1.

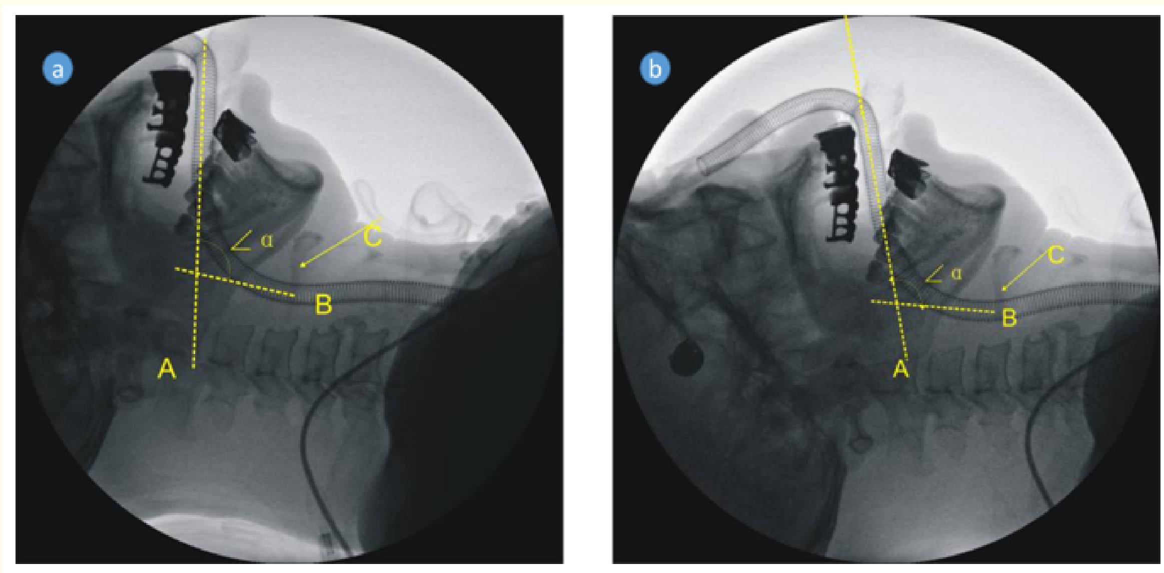

Figure 1: *X-ray imaging after oral intubation armored tracheal tubes in two head positions picture a: in supine position; Picture b, in sniffing position. Line A is the axis of the oral segment of the tracheal tube, line B is the axis of the pharyngeal segment of the tracheal tube, C is the glottic cartilage, and α is the angle between the line A and line B.*

During the operation, the patient's heart rate and blood pressure were kept stable and enough sedation and analgesia were maintained. After the operation, patients were transferred to PACU or ward.

Statistical treatment

SPSS 22.0 was used for statistical analysis. The angles measured in the two positions were descriptive statistics with mean ± sd (standard deviation), maximum and minimum values respectively and the differences were compared with paired t-test, $P < 0.05$ was regarded as statistically significant.

Result

The collection of 31 patients' photos took 33 days from May to August 2019 and 60 X-ray photos of head and neck were collected.

The age and weight of 31 patients were (46 ± 8) years and (62 ± 13) kg respectively. In normal position, the minimum angle is 91.12°, the maximum angle is 120.6°, the mean value is 106.8°, and the standard deviation is 8.45°; in sniffing position, the minimum angle is 95.36°, the maximum angle is 125.18°, the mean value is 111.9°, and the standard deviation is 8.8°. The maximum difference between the two is 4.88°, the minimum difference is 2.94°, the mean value is 5.1°, and the standard deviation is 1.8°. There was a significant difference between the two groups ($P < 0.001$). Showing in figure 2.

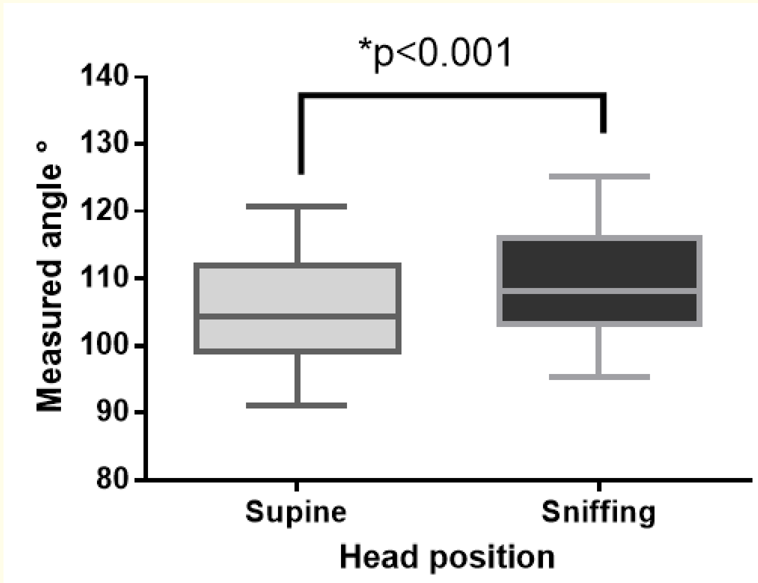

Figure 2: *Measured angle of shared tracheal tube in two head position. Paired t-test shows a significantly difference.*

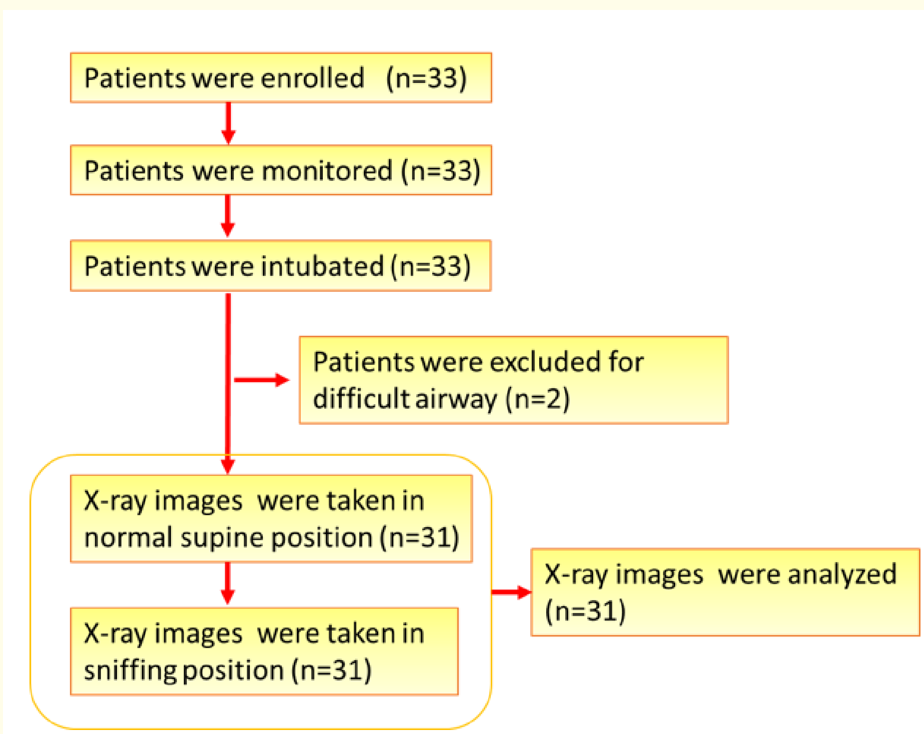

Figure 3: *Flow chart of research.*

Discussion

In our study, we used the C-arm X-ray machine to take X-ray image of the angle change of the armored tracheal tube after the oral intubation, because armored tracheal tubes were clearly developed under x-ray [4] and then measured the angle of the crooked tube in photos. Compared with the common PVC tracheal tube, the armored tracheal tube is provided with a metal/nylon support ring inside the tube wall, which can be imaged well under X-ray. At the same time, due to the role of metal/nylon support ring, the collapse or kinking of tracheal tube cavity can be avoided [6] and more the armored tracheal tube was usually softer than that of ordinary PVC tracheal tube. In this case, the shaping effect of airway tissue in the mouth on the tracheal tube can be more accurate, while compared with extubated PVC tracheal tube. An X-ray imaging of *vivo* body and the use of flexible enhanced tracheal tube, can well reflect the actual curvature change of the tracheal tube in the human body.

Our previous study showed that the average bending angle of the common PVC tracheal tube was (108.4 ± 8.5)° slightly higher than that of the conventional position (106.8 ± 8.45)° and less than that of the sniffing position (111.9 ± 8.8)° when the tracheal tube was taken out from the mouth. From the data point of view, due to the use of large samples in the early research, the results are more representative; this study uses *vivo* X-ray images, and the results are more accurate.

In general, for normal airway patients, when the patient's head was fully tilted back, which means 'sniffing' and tongue was well pressed, the oral axis, pharyngeal axis and laryngeal axis could be as close as possible, and vocal cord can are more visible than supine position [8]. In this study, when the head and neck of the patients were adjusted from the conventional supine position to the supine "sniffing" position, the bending angle of the tracheal tube increased, and the difference between the two positions was significant ($P < 0.001$), which confirmed this view. However, in this study, the difference between the mean values of the two is not large (4.8%), which might be due to the fact that we did not use enough force to make the head and neck fully starched during the research process, or there might be some errors in the measurement itself.

Conclusion

In conclusion, through the angle measurement and analysis of the armored tracheal tube in the patient's mouth, we believe that the tracheal tube will change according to the corresponding curvature after the oral intubation. The flexion angle was related to the characteristics of the tongue, mouth, pharyngeal cavity and other respiratory pathways. The change of the head and neck position had a significant impact on the flexion of the tracheal tube When using sniffer position, the degree of flexion was lower and the airway was easier to keep unobstructed. This study provides strong imaging evidence for the advantage of sniffing posture in airway opening.

Limitation of the Study

The biggest limitation in this study was that the obviously difficult airways were not included, mainly due to the following reasons: 1. The patients with difficult airways have complicated conditions and have more changes; 2. The difficult airways may be treated during treatment. Various methods have been used, and the photos obtained may be more disturbed, and the collection of data on difficult airways can be continued in later studies. Another limitation of this study is that we did not use 3D imaging of CT or MRI to analyze tracheal catheters, they may be more accurate.

Acknowledgment

This research was supported by the following funding: Chenzhou Science and Technology Innovation Project: yfzx201805: Hunan Science and Technology Plan Project: 2019JJ40010: Chenzhou Science and Technology Plan Project: ZDYF2020012.

Conflicts of Interest

No conflicts of interest need to be declared.

Bibliography

1. Agarwal A and Gupta D. "Warming the tracheal tube and kinking". *The Canadian Journal of Anesthesia* 1 (2004): 96.
2. Zhiming Zhiming JW., *et al*. "Deformation of endotracheal tube in oropharyngeal airway anatomy after extubation". *Hainan Medical Journal* 26.3 (2015): 360-362.
3. Hosseinzadeh H., *et al*. "Warming Endotracheal Tube in Blind Nasotracheal Intubation throughout Maxillofacial Surgeries". *Journal of Cardiovascular and Thoracic Research* 5.4 (2013): 147-151.
4. Zaytseva A., *et al*. "Determination of optimal endotracheal tube tip depth from the gum in neonates by X-ray and ultrasound". *Journal of Maternal-Fetal and Neonatal Medicine* (2019): 1-6.
5. Shimoda O., *et al*. "A tracheal tube protector to prevent kinking". *British Journal of Anaesthesia* 71.2 (1993): 326.
6. Dubey PK and Kumar N. "External reinforcement for extraoral kinking of tracheal tube during pediatric anesthesia". *Paediatric Anaesthesia* 24.3 (2014): 354-356.
7. Hossein-Nejad H. "Chest x-ray or fiber optic bronchoscopy for confirmation of endotracheal tube depth". *American Journal of Emergency Medicine* 32.6 (2014): 678-679.
8. Prakash S., *et al*. "Comparative evaluation of the sniffing position with simple head extension for laryngoscopic view and intubation difficulty in adults undergoing elective surgery". *Anesthesiology Research and Practice* (2011): 297913.

Volume 4 Issue 12 December 2020