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Prediction of the Size of Double Lumen Endotracheal Intubation by Measuring the Diameter of the Trachea

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Abstract

Objective: To find the faster and easier way than the existing intubating technique for double-lumen tube. We prediction of required double lumen tube size by measure the X-ray trachea diameter size before surgery.

Methods: Randomly selected 100 cases of single lung ventilation in patients undergoing thoracic surgery. Measurement of tracheal diameter at the level of clavicle in X-ray. Choose the double-lumen size according to the measurement of tracheal diameter in X-ray. If the tracheal diameter greater than 16 mm, choose a 39 Fr double lumen tube, if the trachea diameter between 15-16 mm, used 37 Fr double lumen tube, with less than 15 mm, used 35 Fr double lumen tube. Record the number of intubation and whether there is difficulty for double lumen tube through the glottis.

Results: All patients' double lumen were selected according for the measurement of the diameter of the trachea, all successful intubation and accurate localization of bronchus.

Conclusion: There was no significant difference in the diameter of trachea with age, body weight and height, and the diameter of the female trachea was significantly narrower than that of the male. For vast majority of male Chinese, 39 Fr double lumen tube is suitable, and the height and weight is of small relation, female patients with large differences in the airway diameter, height, weight, gender cannot be the basis for the choice of double lumen tube.

Keywords Thoracic surgery; Single lung ventilation; Tracheal diameter measurement; Double lumen catheter

Introduction

There is no objective criteria for the selection of the size of a double lumen tube for patients undergoing thoracic surgery, inappropriate double lumen tube size may cause airway injury, edema, or would influence oxygenation during single lung ventilation [1].

Generally, for double lumen tube choose, On the one hand, if you choose a slender double lumen, during mechanical ventilation, it's easy to increase airway resistance, and also pulmonary secretion drainage is not sufficient [2], but in order to avoid airway flat, often need to increase the set of sac injection volume and high pressure within the set of capsule is easy cause airway mucosa damage; on the other hand, if you choose to a coarse double lumen endotracheal tube, to track when tracheal intubation and tracheal mucosa damage, even cause bronchial rupture, so it is particularly important to choose appropriate double lumen [3].

The purpose of this study is to predict the size of a double lumen tube needed by measure the patient's X-ray tracheal diameter size before operation.

Material and Methods

Materials

Randomly selected 100 cases of single lung ventilation in patients undergoing thoracic surgery, aged 24 to 75 years old. Measurement of tracheal diameter at the level of clavicle in X-ray. Double lumen tube diameter was shown in Table 1, select double lumen tube size according to measurement of trachea diameter, if trachea diameter is greater than 16 mm then select 39 Fr double lumen tube, if trachea diameter is between 15-16 mm then select 37 Fr double lumen tube, if trachea diameter is less than 15 mm, with 35 Fr double lumen tube.

Tracheal diameter	Double lumen tube diameter	
≥16	39 Fr	14 mm
≥15	37 Fr	13 mm
<15	35 Fr	12 mm

Table 1: Choose double lumen standard and the inner diameter of the double lumen (mm).

Methods

After induction of general anesthesia, the double lumen tube was inserted according to the normal procedure, and the air was filled with

sufficient amount of air to prevent positive airway pressure. Record the number of intubation and whether there is a difficulty for the double lumen tube through the glottis.

Statistical analysis

Linear regression analysis was used to assess the relationship between airway diameter, height, weight and age. The relationship between gender and airway diameter was assessed by ANOVA and $P<0.05$ was significantly different.

Results

There were 100 cases in this group, 54 males and 46 females, age, height and body weight were found in Table 2. Male airway diameter (17.9 ± 0.32) mm, female (14.9 ± 0.25) mm (Table 3). The patient used double lumen in Table 4.

Gender	Male	Female
Age (Year)	63 ± 12	65 ± 13
Height (cm)	170 ± 7	165 ± 9
Weight (kg)	73 ± 14	61 ± 10

Table 2: Demographic characteristics of patients.

Airway diameter (mm)	13	14	15	16	17	18	19	20	21	≥ 22
Female (n)	6	16	18	3	1	1	1	0	0	0
Male (n)	0	1	5	10	17	11	4	2	2	2

Table 3: Airway diameter.

Double lumen	35 Fr	37 Fr	39 Fr
Female (n)	22	18	6
Male (n)	1	5	48

Table 4: The size of double lumen tube used in patients (n=100).

No. of attempts	Classification	Comments
3	greater resistance	Successful tracheal intubation in 20 minutes on 3rd attempts
2	Small resistance	Successful tracheal intubation in 10 minutes on 2nd attempts
1	No resistance	Successful tracheal intubation in 5 minutes on 1st attempts

Table 5: Detailed description of the patients who failed the first intubation attempt.

All patients were selected double lumen tube according to the measurement of the airway diameter. All successful intubation, accurate localization of bronchus. There was no significant difference in tracheal diameter and age, body weight and height, and the female trachea diameter was significantly narrower than that of the male ($P<0.05$). 20 cases (20%) were encountered with small resistance in the intubation through the glottis, 19 cases (19%) with greater resistance, and 6 cases (6%) patients were inserted into the right bronchus. According to the criteria of Table 5, all patients did not have hypoxia during operation, single lung ventilation was good and there was no complication associated with single lung ventilation after operation.

Discussion

A double-lumen tube is more difficult to insert than a single-lumen tube mainly because of its wider external diameter [4], less compliant characteristics, straighter shape, although it has been generally accepted as a standard technique for lung isolation during thoracic surgery [5]. Basically, tracheal intubation is composed of three sequential steps: 1) the achievement of laryngeal view, 2) the delivery of tube to the glottis and 3) the advancement of tube into trachea. In the past, choose double lumen tube according to the patient's height and gender. In this study, we found 39 Fr double lumen tube is suitable for the vast majority of male Chinese, which has less relation with the height and weight [6]; However, in female patient, there is a significantly difference in tracheal diameter, height, weight, sex cannot become standard to choose double lumen catheter. In choosing the double lumen tube should consider two aspects: 1. the double lumen tube must be as far as possible to reduce the lung injury; 2. the bronchial tube part of the double lumen tube must be inserted into the bronchus [7].

Hannallah used to measure left bronchus in chest X-ray on the diameter, because only half of patients can be measured in chest X-ray, is limited in clinical use, and tracheal diameter easily measured in chest X-ray. According to the measurement of the diameter of the trachea, the choice of double lumen tube can reduce the damage as much as possible [8].

This study from the X-ray measurement and detection of cadaveric tracheal diameter consistent adult tracheal diameter, adult male corpse detection tracheal diameter average 20 mm (15 ~ 25 mm), female 15 mm (13 ~ 23 mm). The diameter of the left main bronchus was 15 mm (10 ~ 18 ram), and the female was 12 mm (9 ~ 15 mm). The researchers found that although there were individual differences in the diameter of the trachea and bronchus, the ratio of the diameter of the trachea and bronchus was a constant, about 0.68 [9]. Therefore, it is necessary to select the right double lumen tube as long as the measurement of the diameter of the trachea, without measuring the diameter of the bronchus.

In the past, the choice of 39 Fr tube for use in male patients, 37 Fr and 35 Fr tubes for female patient [10]. In this study, 6 cases of female patients with 39 Fr double lumen tube. There are many anesthesia doctors prefer to use a small double lumen tube, afraid of the double lumen tube is too thick, causing airway damage. We thinks that the vast majority of surgical position of double lumen tube was caused by double lumen tube is too thin, thin double lumen tube can be inserted into the bronchial too deep [11], thin double lumen tube cuff must end bronchial filling more air is easy to damage the tracheal cuff formation or hernia hinder ventilation in the carina on. If the cuff inflation caused by a lack of two lung lobes are not separated completely, do not collapse or the side of the lesion to the discharge side [12]. In addition, the diameter of the double lumen tube is smaller in the single lung ventilation resistance, easy to lead to inadequate ventilation; it is not

conducive to the positioning of the fiber bronchoscopy, sputum suction and so on.

For some cases, the ideal double lumen tube size should have a larger diameter, it is just fit the bronchial tube bronchial, when the bronchial tube is not inflated only a little leak. In the past, the use of the double lumen tube generally depends on the experience and preferences of the anesthesia doctor, lack of scientific basis [13-15]. Direct measurement of the diameter of the trachea by this study can provide a useful guide for selecting a double lumen catheter for each physician.

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