Depth of Endotracheal Tubes in Thai Adult Patients

Anchalee Techanivate, MD*, Oraluxana Rodanant, MD*,
Pornarun Charoenraj, MD*, Kunya Kumwilaisak, MD*

* Department of Anesthesiology, Faculty of Medicine, Chulalongkorn University

Objective: To predict the proper depth of placement of endotracheal tubes, oral and nasal.

Material and Method: This was a prospective study of 100 patients who underwent general anesthesia with oral endotracheal intubation. The cuff of the endotracheal tube was placed 2 cm below the vocal cords. The positions of the endotracheal tube tip and the airway distances of the patients were measured by fiberoptic bronchoscope; OC = the distance from the right upper canine to the vocal cords, NC = the distance from the right external naris to the vocal cords and T = the distance from the vocal cords to the carina. The correlation between the airway distances and patient's factors were analyzed. The proper depth of placement of the endotracheal tube was calculated with the formula OTT = OC+T-2, nasal endotracheal tube NTT = NC+T-2.

Results: The mean distance from the endotracheal tube tip to the carina was 3.0 ± 1.48 cm (ranged 0.7-7.5 cm). The distance from the endotracheal tube tip to the carina of 86 from 100 patients was more than 2 cm. The mean OC was 9.79 ± 1.27 cm. The mean NC was 15.00 ± 0.84 cm. The mean T were 13.03 ± 1.48 cm in males and 11.63 ± 1.25 cm in females and it also related to the height of the person (Pearson correlation = 0.557, p value < 0.05). These distances did not relate to gender.

Conclusion: The predicted formula of the depth of the endotracheal tube as "Chula formula";

OTT = 4 + (Ht/10) cm (The distance from the right upper canine to the point which is 2 cm above the carina)
NTT = 9 + (Ht/10) cm (The distance from the right external naris to the point which is 2 cm above the carina)

Keywords: Depth, Endotracheal tube, Thai patient

Endotracheal tube (ETT) intubation is one of the most important procedures performed by emergency physicians. Improper placement of the ETT, that is either too shallow or too deep, can lead to serious complications. It has been shown that in a patient whose right mainstem brochus was intubated, the incidence of hypoventilation, pneumothorax and atelectasis was increased[1-3]. The proper position of the ETT is commonly confirmed by the auscultation of bilateral breath sounds. However, Brunel et al[4] reported that 60% of intubations into the mainstem bronchus occurred despite the presence of equal breath sounds. Kazuna et al[5] suggested that the fiberoptic bronchoscope (FOB) is more reliable than chest auscultation in confirming endotracheal tube position. However, FOB is not available in an emer-

gency situation. Accordingly, the authors measured the airway distances by FOB and predicted the depth of ETT placement.

The position of ETT depends on the distance from the mouth to the vocal cords and the tracheal length for oral ETT and the distance from the nose to the vocal cords and the tracheal length for nasal ETT. The proper placement of ETT must be placed sufficiently below the laryngeal structures to permit ETT cuff inflation and minimize the risk of unexpected extubation or mainstem bronchial intubation with the patient's head movement. Conrardy et al[6] demonstrated flexion and extension of the neck resulted in mean endotracheal tube tip movement of 1.9 cm toward and away from the carina respectively. Therefore, the proximal end of the cuff of the ETT must be placed at least 2 cm below the vocal cords to reduce impingement on the vocal cords when the patient moves his/her neck. The tip of the ETT should be placed at

Correspondence to : Anchalee T,Department of Anesthesiology, Faculty of Medicine, Chulalongkorn University, Bangkok 10330

least 2 cm cephalad to the carina to reduce the risk of mainstem bronchial intubation with the patient's head movement. In the present study, the proper depth of ETT placement was calculated that the tip of the ETT should be placed at 2 cm cephalad to the carina.

Objectives

1. To measure the airway distances and calculate the proper depth of endotracheal intubation.

2. To analyze the patient factors which influence the endotracheal tube position.

3. To assess the success rate of proper position of ETT when the cuff of the ETT passes 2 cm below the vocal cords.

Material and Method

A prospective observational descriptive study design was used in the present study. 100 surgical adult Thai patients, who were scheduled for general anesthesia were studied. 50 patients were males and 50 patients were females. Their written and informed consent forms were obtained before they were recruited into the program. All patients in the present study were above 18 years old with their ASA physical status I and II. The patients who had a bleeding tendency and respiratory tract abnormality or pulmonary disease that are unable to tolerate hypo-xia and had no right upper canine were excluded.

Age, gender, weight and height were recorded. After induction, the ETT (Curity) number 7.0 for female and 8.0 for male were orally intubated into the trachea by the anesthesiologists. They placed the proximal end of the cuff of the ETT at 2-cm below the vocal cords ("C" or line marker placed at the vocal cords). All patients' heads were at neutral position. Before the FOB was inserted, the connector of the ETT connected the 2 opened-ends connector: one was connected to the ventilator and the other was the tract for the FOB. Then the fiberoptic bronchoscope (FOB) was inserted into the ETT. The distances at points on Fig. 1 were measured. Then the fiberoptic broncho-scope (FOB) was inserted into the right external naris and the distance from the external naris to the vocal cords was measured.

The distances were measured and calculated:

1. The distance from the right upper canine to the vocal cords (OC).

2. The distance from the right external naris to the vocal cords (NC).

3. The distance from the vocal cords to the carina is tracheal length (T).

4. The distance from the right upper canine to the carina (O) (OC + T = O).

5. The distance from the right external naris to the carina (N) (NC + T = N).

6. The distance from the tip of the ETT to the carina.

Statistical analysis

Data were analyzed by descriptive statistic SPSS program version 10.0. The numerical data were presented by mean $\pm$ SD The correlation between the patients' factors and the airway distances were analyzed by correlation coefficient and regression analysis. The Pearson correlation value between the patients' factors and the airway distances accepted
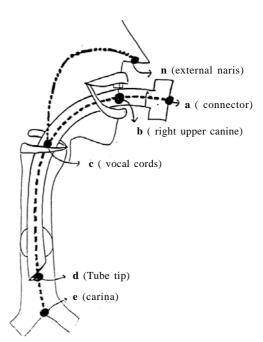

Fig. 1 The points of measurement

1. The distance from the right upper canine to the vocal cords (OC) was measured and calculated (ac-ab = OC).
2. The distance from the right external naris to the vocal cords (NC) was measured (nc = NC).
3. The distance from the vocal cords to the carina which is tracheal length (T) was measured and calculated (ae-ac = T).
4. The distance from the right upper canine to the carina (O) was calculated (OC + T = O).
5. The distance from the right external naris to the carina (N) was calculated (NC + T = N)
6. The distance from the tip of ETT to the carina (ae-ad) was measured

more than 0.500. All data accepted p value < 0.05 was clinically significant.

Results

The demographic data of the subjects, 50 males and females, are exhibited in Table 1. The different value the between genders was height.

1. The airway distances and their correlation

The airway distances are shown in Table 2. The distances from the right upper canine to the vocal cords (OC) were 10.08 ± 1.34 cm in males and 9.50 ± 1.45 cm in females. The distances from the right external naris to the vocal cords (NC) were 15.62 ± 0.81 cm in males and 14.98 ± 0.74 cm in females. There was no correlation between OC and the patient's height (Pearson correlation = 0.016) and poor correlation between NC and the patient's height (Pearson correlation = 0.448).

The tracheal lengths were 13.03 ± 1.48 cm in males and 11.63 ± 1.25 cm in females. The shortest trachea was 9.20 cm. There was moderate correlation between the tracheal length and the patient's height (Pearson correlation 0.577, p < 0.01).

The distances from the right upper canine to the carina (O) were 23.01 ± 1.06 cm in males and 21.13 ± 0.88 cm in females. The mean distances from

the right external naris to the carina (N) were 28.65 ± 1.80 cm in males and 26.61 ± 1.32 cm in females. There was a moderate correlation between O and the patients' gender, the height and the tracheal length (Pearson correlation 0.700, 0.707 and 0.611 respectively, p < 0.01) and between N and the patients' height and the tracheal length (Pearson correlation 0.654 and 0.899 respectively, p < 0.01).

2. The linear regression and estimated formula of airway distances

There was high correlation between the patients' height and their gender. The patients' gender is a constant variable that can be excluded in a linear regression analysis. The R square change was only 7% when this variable was excluded. T, O and N were plotted against the patients' height in centimeter, as shown in Fig. 2-4 respectively. The formulas of linear regression were:

- $T = -5.88 + 0.114Ht$
- $O = 1.62 + 0.1281Ht$
- $N = 1.43 + 0.1641Ht$

The tip of the ETT placed at 2 cm above the carina is the proper depth of the ETT. Oral intubation position was calculated by subtracting 2 cm from the distance from the right upper canine to the carina (O-2) which is shown in Fig. 3. Similarly the nasal

Table 1. The demographic data

	Male	Female	Total
AGE (yr)	42.24 ± 11.84 (18-62)	45.71 ± 11.94 (18-65)	43.96 ± 11.96 (18-65)
WT (kg)	59.19 ± 10.20 (41-85)	53.99 ± 8.76 (36-71)	56.59 ± 9.82 (36-85)
HT (cm)	165.12 ± 4.82 (155-175)	154.23 ± 5.43 (144-166)	159.68 ± 7.48 (144-175)

Value present mean $\pm$ SD, (minimum-maximum)

Table 2. The airway distances

	Male (n = 50)	Female (n = 50)	Total (n = 100)
OC (cm)	10.08 ± 1.34 (7.0-12.7)	9.50 ± 1.45 (6.5-11.5)	9.79 ± 1.27 (6.50-12.7)
NC (cm)	15.62 ± 0.81 (14.0-17.4)	14.98 ± 0.74 (13.5-16.6)	15.30 ± 0.84 (13.5-17.4)
T (cm)	13.03 ± 1.48 (10.70-17.0)	11.63 ± 1.25 (9.20-15.0)	12.33 ± 1.53 (9.20-17.0)
O (cm)	23.01 ± 1.06 (21.5-27.0)	21.13 ± 0.88 (19.0-22.5)	22.07 ± 1.36 (19.0-27.0)
N (cm)	28.65 ± 1.80 (26.1-33.0)	26.61 ± 1.32 (23.5-29.0)	27.63 ± 1.88 (23.5-33.0)

Value present mean $\pm$ SD, (minimum-maximum)

OC: The distance from the right upper canine to the vocal cords
NC: The distance from the right external naris to the vocal cords
T: The distance from the vocal cords to the carina is tracheal length
O: The distance from the right upper canine to the carina
N: The distance from the right external naris to the carina

Fig. 2 The distance from the vocal cords to carina (T) in cm (Y axis) is plotted against height in cm (X axis)
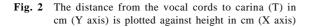
Fig. 2 shows the dots which plot the tracheal length against the height of each patient. And the line show the linear colleration between the tracheal length and the patients' height. The regression line: y = -5.88 + 0.114 x (T = -5.88 + 0.114 Ht).

intubation position was calculated: subtracting 2 cm from the distance from the right external naris to the carina (N-2) (Fig. 4).
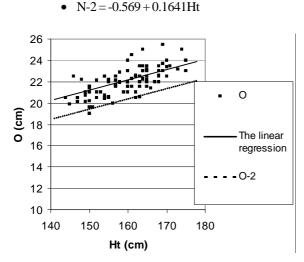
- O-2 = -0.379 + 0.1281Ht
- N-2 = -0.569 + 0.1641Ht

Fig. 3 The distance from the right upper canine to the carina (O) in cm (Y axis) is plotted against height in cm (X axis)

Fig. 3 shows the dots which are plotted O, the distance from the right upper canine to the carina, against the height of each patient

The darker line shows the linear colleration between the distance from the right upper canine to the carina and the patient's height. The regression line: y = 1.62 + 0.1281 x (O = 1.62 + 0.1281 Ht)

The dotted line (O-2 line) is calculated by subtracting 2 cm from the darker line. The O-2 line equal the formula O-2 = -0.38 + 0.1281 Ht

The formulas for the composite regression lines are not suitable for clinical use. However, they can replaced by easily remembering the formula was Ht/10. The Fig. 5 shows dotted lines OTT, NTT and Tn that approximated in the lines O-2, N-2 and T respectively. All dotted lines are based on the calculation of Ht/10 instead of their formulas.

Line O-2 is the distance from the right upper canine to 2 cm cephalad to the carina. This is very close to line OTT which is described by the formula:

OTT = Height of subject (cm)/10 + 4

Line N-2 is the distance from the right external naris to 2 cm cephalad to carina. This is very close to line NTT, according to the following formula:
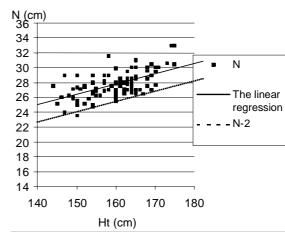
NTT = Height of subject (cm)/10 + 9

Line T is the distance from the vocal cords to the carina. This is very close to line Tn which according to the following formula:

Tn = Height of subject (cm)/10 - 4

3. The distance from the tip of the ETT to the carina

Fig. 6 shows the distance from the tip of the ETT to the carina, ranged 0.7-7.5 cm and mean was 3.0 ± 1.4 cm. The distance from the tip of the ETT to
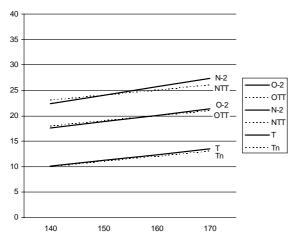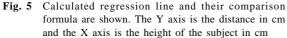

Fig. 4 The distance from external naris to the carina (N) and the subtracting 2 cm from this distance in cm (Y axis) is plotted against height in cm (X axis).

Fig. 4 shows the dots which are plotted N, the distance from the right external naris to the carina, against the height of each patient

The darker line shows the linear colleration between the distance from the right external naris to the carina and the patient's height. The colleration line equal the formula y = 1.43 + 0.1641 x (N = 1.43 + 0.1641 Ht)

The dotted line (N-2 line) is calculated by subtracting 2 cm from the darker line. The N-2 line equal the formula N-2 = -0.57 + 0.1641 Ht

Fig. 5 Calculated regression line and their comparison formula are shown. The Y axis is the distance in cm and the X axis is the height of the subject in cm

Each dark line equal linear equation that shows the linear colleration between each distance and the patient's height

    The "N-2 line" equal -0.57 + 0.1641 Ht
    The "O-2 line" equal -0.379 + 0.1281 Ht
    The "T line" equal -5.88 + 0.114 Ht

Each dotted line shows the closed line of the darker line
    The "NTT line" equal 9 + (Ht/10).
    The "OTT line" equal 4 + (Ht/10).
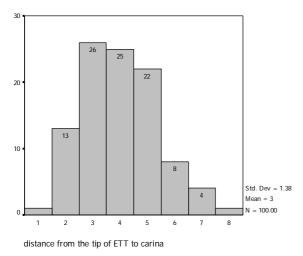   The "T line" equal -4 + (Ht/10)

distance from the tip of ETT to carina

Fig. 6 Show the frequency (n) of distances between the tip of the ETT and carina (cm)

the carina of 86 from 100 patients were more than 2 cm. Therefore, the success rate of the placing ETT to its proper depth is 86% when the cuff of ETT was passed 2 cm below vocal cords.

Discussion

    The proper depth of the ETT was confirmed by several methods. First, auscultation of bilateral equal breath sounds is a common technique but 60% of this technique presented bronchial intubation[4].

    Subhash C et al[7] described the cuff palpation technique for suitable depth of ETT intubation by palpating the cuff of the ETT at the jugular notch. The effectiveness of this method was confirmed by Richard J et al[8]. This method should not be used to verify the location of the ETT in the trachea. Injury to the vocal cords by the cuff cannot be ruled out in the cuff palpation technique.

    Confirmation of using a 21-cm tube mark for women and 23-cm tube mark for men by chest radiographies showed that the tip of the ETT was more than 2 cm cephalad to the carina[9]. Roberts JR et al[9] concluded these tube marks can be used for general oral intubation. However, these tube marks did not guarantee the cuff which impinged on the vocal cords.

    In outlining the procedure for oral intubation, standard emergency medicine texts generally described passing the tube such that the cuff just passes the vocal cords, or advancing the tube an additional 2-3 cm beyond the vocal cords[10]. A movement of the patients' head resulted in the movement of the ETT about 1.9 cm[6]. Therefore, the correct ETT position should be the placement of the tip at least 2 cm above the carina. In the present study, the proximal end of the cuff of the ETT be was placed 2 cm below the vocal cords in all patients. Then they would be safe from impingement of the cuff on their vocal cords if their heads were extended. The distance from the tip of the ETT to the carina in 86% of the present study was more than 2 cm. That meant 86% of the present study would be safe from bronchial intubation if their heads were flexed.

    The authors predicted the proper depth of the oral ETT by subtracting 2 cm from the distance which was measured from the right upper canine to the carina and the proper depth of the nasal ETT by subtracting 2 cm from the distance which was measured from the right external naris to the carina. The estimated formula of these distances is shown in Fig 3, 4. However, these formulas were difficult to remember. In 1969, Dr. Morgan[11] suggested a formula of the length of the oral endotracheal tube (cm) to be (Height of Patient (cm)/10) + 5. Fig. 5 shows the estimated lines of proper depth ETT (O-2 and N-2) and their closed lines (OTT and NTT) that used (Height of patient (cm)/10) to substitute the old formula. The

new formula for length of oral ETT (cm) = Ht/10 + 4 and nasal ETT (cm) = Ht/10 + 9. The authors name the new formula that was found to be "Chula formula".

By using the level of 2 cm above the carina to predict the proper depth of placement of the ETT, 12% of the male and 16% of the female subjects in the present study were exposed to an increased risk of laryngeal trauma, the cuff impinge on vocal cords, when their heads were in extension. The distances from the proximal end of the cuff to the tip of the ETT (Curity) were approximately 7.5 cm in ETT size 8.0-8.5(Fr) and 6.5 cm in ETT size 7.0-7.5(Fr). When the cuff of ETT was placed 2cm below the vocal cords, 9.5 cm from the tip of ETT size 8.0-8.5 (Fr) and 8.5 cm from the tip in ETT size 7.0-7.5 (Fr) were placed into the trachea. The risk of mainstem bronchus intubation increased when the length of the patient's trachea was shorter than 11.5 cm (12%) in males and 10.5 cm (16%) in females in the present study because the distance from the vocal cords to the proximal end of the cuff of the ETT was lower than 2 cm.

Because flexion and extension of the patient's head resulted in the movement of the ETT about 1.9 cm toward and away from the carina respectively[6], therefore, the proximal end of the cuff of the ETT should be placed 1.9 cm below the vocal cords and the tip of the ETT should be placed 1.9 cm above the carina. The proper placement of the ETT not only depends on the tracheal length but also the length of the cuff of the ETT or the distance from the proximal of the cuff to the tip of the ETT. The suitable length of the cuff of the ETT should reduce the risks of vocal cords injury and mainstem bronchial intubation when the patient moves his/her neck. The long cuff (or the long distance of proximal of the cuff to tip of the ETT) could not only injure the a vocal cords but could also lead to mainstem bronchial intubation in a patient who has a short trachea.

The the relationship between the distance from the proximal end of the cuff to the tip of the ETT and the tracheal length, the distance from the vocal cords to the carina, effects to the safe placement of the ETT. The trachea length must be longer than the distance from the proximal end of the cuff to the tip of the ETT approximately 3.8 cm, laryngeal trauma and mainstem bronchial intubation would disappear when the patient's head was moved. For example, if the trachea length is 10 cm, the distance from the proximal end of the cuff to the tip of the ETT will be shorter than 6.2 cm (10-3.8 cm). But in fact the distances from the proximal end of the cuff to the tip of

the ETT (Curity) were 7.5 cm in ETT size 8.0-8.5(Fr) and 6.5 cm in ETT size 7.0-7.5(Fr).

From the formula of tracheal length (cm) = height of subject (cm)/10-4, that meant the tracheal length varied according to the subject's height. The subjects who were short had a short trachea and should be intubated by the shorter distance from the proximal end of the cuff to the tip of the ETT which decreases the risk of brochial intubation. The distance from the proximal end of the cuff to the tip of the ETT varies according to the ETT size and brand such as the distance from the proximal end of the cuff to the tip of the ETT (Mallinckrodt) is approximately 5.7 cm. Therefore, the shorter distance from the proximal end of the cuff to the tip of the ETT appropriates with patients who are short.

Conclusion

The mean tracheal lengths in Thai patients are 13 ± 1.48 cm in males and 11.63 ± 1.25 cm in females. Tracheal length varies according to the patient's height.

The patient's height influences the proper depth of oral and nasal endotracheal intubation. Therefore the estimated "Chula formula" of oral endotracheal intubation is (Ht/10) + 4 cm and nasal endotracheal intubation is (Ht/10) + 9 cm.

The success rate of proper positioning of the ETT is achieved when the cuff of the ETT passes 2 cm below the vocal cords, which accouted for 86% in the present study.

References

1. Blanc VF, Tremblay NA. The complications of tracheal intubation: a new classification with review of the literature. Anesth Analg 1974; 53: 202-13.
2. Zwillich CW, Pierson DJ, Creagh CE, Sutton FD, Schatz E, Petty TL. Complication of assisted ventilation. Am J Med 1974; 57: 161-9.
3. Breivik H, Grenvik A, Millen E, Safar P. Normalizing low arterial CO2 tension during mechanical ventilation. Chest 1973; 63: 523-31.
4. Brunel W, Coleman DL, Schwartz DE, Peper E, Cohen NH. Assessment of routine chest roentgenograms and the physical examination to confirm endotracheal tube position. Chest 1989; 96: 1043-5.
5. Kazuna S, Kozo Y. Reliability of auscultation of bilateral breath sounds in confirming endotracheal tube position. (Letter) Anesthesiology 1995; 83: 1373.
6. Conrardy PA, Goodman LR, Lainge F, Singer MM. Alteration of endotracheal tube position. Crit Care Med 1976; 4: 8-12.

7. Subhash C, Emanuel F. Correct placement of endo-tracheal tubes. N Y State J Med 1979; 79: 1843-4.
8. Richard JP, Emilio BL. Endotracheal tube location verified reliably by cuff palpation. Anesth Analg 1995; 81: 135-8.
9. Roberts JR, Spadafora M, Cone DC. Proper depth of oral endotracheal tubes in adults prior to radiographic confirmation. Acad Emerg Med 1995; 2: 20-4.
10. Clinton JE, Rutz E. Respiratory procedures. In: Roberts JR, Nedges JR, eds. Clinical procedures in emergency medicine, 2nd ed. Philadelphia: WB Saunders, 1991: 8-18.
11. Morgan GA. An orotracheal tube with laryngeal hooks. (Letter) Anaesthesia 1989; 44: 82.

ความลึกที่เหมาะสมของการใส่ท่อหายใจในผู้ป่วยไทย

อัญชลี เตชะนิเวศน์, อรลักษณ์ รอดอนันต์, พรอรุณ เจริญราช, กัญญา คำวิลัยศักดิ์

ทำการศึกษาในผู้ป่วย 100 คน เพื่อคาดคะเนความลึกของการใส่ท่อหายใจทางปากและจมูกในคนไทย และหาความสำเร็จ ของการใส่ท่อหายใจด้วยวิธีใส่ให้ cuff ของท่อหายใจผ่านสายเสียง 2 เซนติเมตร โดยทำการศึกษา ในผู้ป่วยที่มารับบริการระงับความรู้สึกที่ต้องใส่ท่อหายใจ ผู้ป่วยชายจะใส่ท่อหายใจเบอร์ 8.0 และ ผู้ป่วยหญิงจะใส่ท่อ หายใจเบอร์ 7.0 โดยทุกคนจะถูกใส่ให้ cuff ผ่านสายเสียง 2 เซนติเมตร แล้ววัดระยะต่าง ๆ ของทางเดินหายใจด้วย fiberoptic bronchoscope ดังนี้ ระยะ OC = ระยะจากฟันหน้าถึงสายเสียง , NC = ระยะจากจมูกถึงสายเสียง และ T = ระยะจากสายเสียงถึง carina หรือความยาวของหลอดคอ โดย ความลึกที่เหมาะสมของท่อหายใจทางปาก คิดจากระยะจากฟันหน้าถึง carina ลบด้วย 2 เซนติเมตร (OC + T-2 เซนติเมตร) และ ทางจมูกคิดจากระยะจาก จมูกถึง carina ลบด้วย 2 เซนติเมตร (NC+T-2 เซนติเมตร) และวิเคราะห์ความสัมพันธ์ของระยะต่าง ๆ ที่วัดกับ ข้อมูลพื้นฐานของผู้ป่วย

ความลึกของท่อหายใจที่เหมาะสมจะคิดจากระยะจากปลายท่อหายใจถึง carina มากกว่า 2 เซนติเมตร พบว่าการใส่ด้วยวิธีให้ cuff ของท่อหายใจผ่านสายเสียง 2 เซนติเมตร นั้นมีค่าเฉลี่ยของระยะจากปลายท่อหายใจถึง carinaเท่ากับ3.0 ± 1.4เซนติเมตรโดยมีผู้ป่วยร้อยละ86ที่มีระยะนี้มากกว่า2เซนติเมตร ระยะเฉลี่ย จากฟันหน้าถึง สายเสียง (OC) เท่ากับ9.79 ± 1.27เซนติเมตร, ระยะเฉลี่ยจากจมูกถึงสายเสียง (NC) เท่ากับ 15.30 ± 0.84 เซนติเมตร และ ระยะเฉลี่ยจากสายเสียงถึง carina หรือความยาวหลอดคอ (T) ในผู้ชายเท่ากับ 13.03 ± 1.48 เซนติเมตร และใน ผู้หญิงเท่ากับ 11.63 ± 1.25 เซนติเมตร โดยระยะจากสายเสียงถึง carina หรือความยาวหลอดคอ (T) มีความสัมพันธ์ กับความสูง (Pearson correlation = 0.557; p value < 0.05)เมื่อคิดความลึกที่เหมาะสมของท่อหายใจทางปากจากระยะ OC+T-2 และทางจมูกคิดจากระยะ NC+T-2เซนติเมตรพบว่าระยะทั้งสองมีความสัมพันธ์กับความสูง และสามารถ คาดคะเน ระยะ ทั้งสองจากความสูง ดังสูตรเรียกว่าสูตรจุฬา ได้ดังนี้

ความลึกที่เหมาะสมของท่อช่วยหายใจทางปาก = 4 + (ความสูง (ซม.)/10) เซนติเมตร
(ระยะจากฟันหน้าถึงตำแหน่ง 2 เซนติเมตรเหนือ carina)

ความลึกที่เหมาะสมของท่อช่วยหายใจทางจมูก = 9 + (ความสูง (ซม.)/10) เซนติเมตร
(ระยะจากจมูกถึงตำแหน่ง 2 เซนติเมตรเหนือ carina)