Anaesth Intensive Care 2000; **28:** 666-668

Can Insertion Length for a Double-Lumen Endobronchial Tube be Predicted?

R. A. DYER*, S. A. M. HEIJKE†, W. J. RUSSELL‡, M. B. BLOCH§, M. F. M. JAMES**

Department of Anaesthesia, Faculty of Health Sciences, University of Cape Town, Observatory, Cape Town, South Africa

SUMMARY

It has been suggested that the appropriate length of insertion for double-lumen tubes can be estimated by external measurement. This study examined the accuracy of external measurement in estimating the actual length of insertion required in 130 patients. It also examined the relationship between the length inserted and the patient's height in 126 patients and their weight in 125 patients.

Although there was a fair correlation between the measured external length and the final inserted length (r=0.61), the 95% confidence intervals of slope and intercept allowed a large variation and the prediction was too wide to be clinically useful. Height was reasonably well correlated with the final length (r=0.51) but an equally wide 95% confidence interval rendered it of little clinical value. There was no correlation between weight and final tube length.

It is concluded that external measurement alone is not adequate to predict a clinically acceptable position of the double-lumen tube.

INTUBATION, ENDOBRONCHIAL: double-lumen tubes

The accurate placement of a double-lumen tube is difficult for many anaesthetists. Some experts have stated that all double-lumen tubes must be checked by fibreoptic examination, and suggested that a large proportion of blindly inserted double-lumen tubes require re-positioning with respect to insertion length[1]. Others have argued that expert blind insertion can give satisfactory position in almost all cases, and routine fibreoptic checking is unnecessary[2]. All of these conclusions have been based upon a technique of uncontrolled insertion followed by checking the position. The correct depth of double-lumen tube insertion has been reported to be correlated with patient height[3], and neck length may also be a physical factor with some predictive value for correct insertion length[4]. None of these investigators advised any pre-intubation external measurement which might give a guide to the length to be inserted.

A new technique for blind insertion of double-lumen tubes was described in 1992. This used inflation of the bronchial cuff in the trachea and advancement with each breath until bilateral chest movement changed to a single-sided ventilation[5]. As part of this technique, a preliminary estimation of the required insertion length by external measurement on the patient was suggested (see Methods). The validity of this estimate by external measurement has not been assessed previously.

METHODS

Before commencement of the study, approval was obtained from the University of Cape Town Ethics Committee.

Patients who required a double-lumen tube for management of their surgery had the required insertion length of the tube to be inserted estimated by the following method.

Since an accepted surface marking of the carina in the supine patient is the manubrio-sternal angle[6], the double-lumen tube was placed on the patient so that the upper edge of the bronchial cuff was 1 cm below the manubrio-sternal angle. With the head in the

*F.C.A.(S.A.) Senior Specialist, Department of Anaesthesia, Faculty of Health Sciences, University of Cape Town, Observatory, Cape Town, South Africa.

†F.C.A.(S.A.), Senior Specialist, Department of Anaesthesia, Faculty of Health Sciences, University of Cape Town, Observatory, Cape Town, South Africa.

‡F.R.C.A., F.A.N.Z.C.A., Ph.D., D.I.C., Director, Research and Development, Department of Anaesthesia and Intensive Care, Royal Adelaide Hospital, Adelaide, South Australia.

§F.C.A.(S.A.), Specialist, Department of Anaesthesia, Faculty of Health Sciences, University of Cape Town, Observatory, Cape Town, South Africa.

**Ph.D., F.F.A.R.C.S., F.C.A.(S.A.), Professor and Head, Department of Anaesthesia, Faculty of Health Sciences, University of Cape Town, Observatory, Cape Town, South Africa.

Address for Reprints: Dr R. A. Dyer, Department of Anaesthesia, Faculty of Health Sciences, University of Cape Town, Observatory, Cape Town, South Africa 7925.

Accepted for publication on August 21, 2000.

normal intubating position, the tube was directed upward to the upper anterior dental or gingival margin, and thence curved posteriorly until it crossed anterior to the lobe of the ear. The insertion length was indicated by the point where the tube reached the anterior border of the lobe of the ear. In addition the weight and height of each patient was recorded. Required tube size was estimated from a measurement of the diameter of the bronchus to be intubated, 1 cm distal to the carina on the PA chest radiograph. Where this measurement could not be made reliably on the radiograph, tube selection was based on patient height and sex. Normal females received a size 37 Bronchocath™ double-lumen tube (Mallinckrodt®, Athlone, Ireland) and normal males a size 39, with this size being adjusted up or down in accordance with patient height.

After intravenous induction of anaesthesia and three minutes after neuromuscular blockade employing either pancuronium or vecuronium 0.1 mg/kg, (assessed by a peripheral nerve stimulator), the double-lumen tube was inserted employing the usual clinical endpoints of auscultation, observation of chest movement and resistance to advancing the tube. Once the anaesthetist was satisfied with the insertion, the position of the tube was examined with a 4 mm diameter fibreoptic bronchoscope (Olympus Optical, Tokyo, Japan), introduced via the tracheal lumen. A correct position required that the upper edge of the bronchial cuff was approximately 0.5 to 1.0 cm beyond the carina as judged either by direct observation of the cuff margin (101 patients), or by estimation of the cuff position from observation of the distance from the end of the tracheal lumen of the double-lumen tube to the carina, in cases where the bronchial cuff could not be directly seen (29 patients). If the tube was not correctly positioned, it was either advanced or withdrawn until the cuff position was correct. The final length of insertion from the upper incisors or gingival margin was then noted.

Statistical analysis was done using the regression module of Statview 5.0 (SAS Institute Inc.). Statistical significance was accepted at $P=0.05$ level (two-tail).

RESULTS

One hundred and forty adult patients were examined, 90 males and 50 females. The mean age was 45.6 years (range 16 to 83). The mean height was 165.5 cm (range 144 to 186). The mean weight was 61.7 kg (range 38 to 105). Eight double-lumen tubes were right-sided, 132 were left. Tube sizes used were as follows: 3 size 28, 25 size 35, 41 size 37, 52 size 39 and 19 size 41.

(a) *External Measurement*

One hundred and thirty patients had an external measurement performed and a final length of insertion determined by fibreoptic examination. The correlation between the two was moderate (r=0.61, $P<0.0001$) (Figure.1).

The standard error of the slope is 0.0911 (95% confidence interval (CI) 0.469-0.831) and that of the intercept is 2.768. Thus the 95% confidence interval of the regression is very wide. For example, an external measurement of 30 cm has a 95% probability that the final length of insertion will be between 19 and 41 cm.

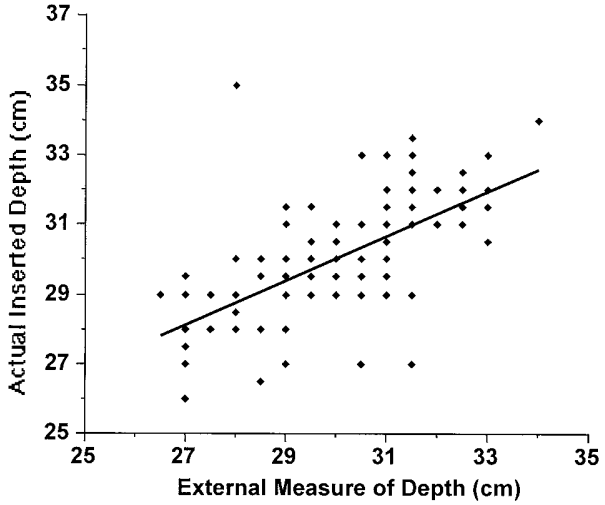

FIGURE 1: Scattergram of the relationship between the external measurement of the length for a double-lumen tube and the actual length inserted under fibreoptic control. The best fit line has a slope of 0.64 and an offset of 10.9 cm (r=0.61, $P<0.0001$).

(b) *Height*

One hundred and twenty-six patients had their height and final length of insertion measured. There was modest correlation (r=0.52, $P<0.0001$) (Figure 2). The 95% CI for the slope is 0.0645 to 0.1202 and for the intercept 10.28 to 19.51. Thus the 95% CI for the tube length of insertion for a patient of 170 cm height is from 21.2 to 39.9 cm. This again is too wide to be clinically useful.

(c) *Weight*

One hundred and twenty-five patients had their weight and final inserted length measured. There was no correlation between patient weight and the final inserted length (r= –0.017, $P=0.85$) (Figure 3).

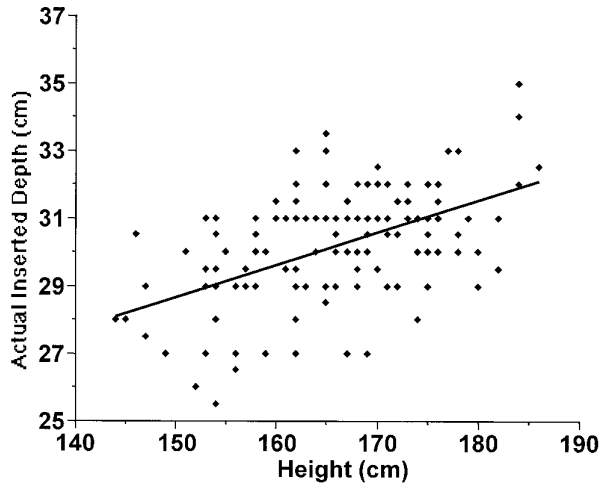

FIGURE 2: Scattergram of the relationship between the patient's height and the actual length of a double-lumen tube inserted under fibreoptic control. The best fit line has a slope of 0.0958 and an ofset of 14.3 cm (r=0.52. $P<0.0001$).

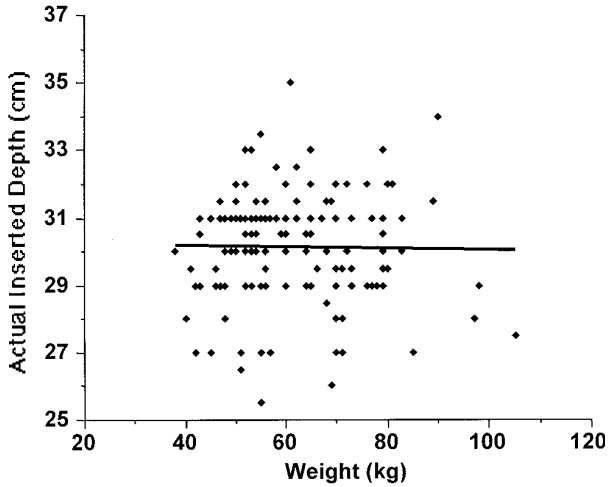

FIGURE 3: Scattergram of the relationship between the patient's weight and the actual length of a double-lumen tube inserted under fibreoptic control. The best fit shows no correlation between the two parameters (r=–0.017, $P=0.85$).

DISCUSSION

There have been few studies attempting to use patient characteristics to predict correct insertion length for double-lumen tubes. One previous study involving 101 thoracic surgical patients showed a significant correlation between depth of insertion and patient height[3]. In this study, the average depth of insertion was 29 cm for patients 170 cm tall and for each 10 cm increase or decrease in height, average placement depth was increased or decreased 1 cm. This corresponds closely to our findings of a regression slope of 0.096, i.e., a 10 cm change in height predicts a 9.6 mm change in inserted tube length (95% CI 6.5 to 12.0 mm). However, in their conclusion, these authors recommended that a technique be used to confirm the accuracy of the DLT placement, because of the wide variation.

In view of the difficulty of accurate placement of double-lumen tubes, it was thought that a simple external measurement, previously described as a potential aid to a new intubating method[5], could be of benefit as an adjunct to clinical endpoints. Although we have demonstrated a moderate correlation between the external measurement and the correct inserted length as determined by fibreoptic bronchoscopy, the 95% probability of a correct prediction had a very wide range. Because of the wide range, this external measurement cannot be recommended as a reliable predictor of the correct insertion length.

REFERENCES

1. Ehrenwerth J. Pro: proper positioning of a double-lumen endobronchial tube can only be accomplished with endoscopy. J Cardiothorac Anesth 1988; 2:101-104.
2. Brodsky JB. Con: proper positioning of a double-lumen endobronchial tube can only be accomplished with the use of endoscopy. J Cardiothorac Anesth 1988; 2:105-109.
3. Brodsky JB, Benumof JL, Ehrenwerth J et al. Depth of placement of double lumen endobronchial tubes. Anesth Analg 1991; 73:570-572.
4. Bahk J-H, Soh Y-S. Prediction of double-lumen tracheal tube depth. J Cardiothorac Vasc Anesth 1999; 13:370-371.
5. Russell WJ. A blind guided technique for placing double-lumen endobronchial tubes. Anaesth Intensive Care 1992; 20:71-74.
6. Ellis H, Feldman S. Anatomy for Anaesthetists. Oxford, Blackwell Scientific Publications, p. 46, 1993.