



## Original Contribution

## Chest radiography after endotracheal tube placement: is it necessary or not? ☆

Hooman Hossein-Nejad MD <sup>a,\*</sup>, Pooya Payandemehr MD <sup>a</sup>,  
Seyed Ali Bashiri MD <sup>a</sup>, Hamid Hossein-Nejad Nedai MD <sup>b</sup>

<sup>a</sup> Imam Hospital, Tehran University of Medical Sciences, Tehran, Iran

<sup>b</sup> Tohide Jam Hospital, Jam, Bushehr, Iran

## ARTICLE INFO

## Article history:

Received 2 August 2012

Received in revised form 13 April 2013

Accepted 23 April 2013

## ABSTRACT

**Purpose:** The aim of this study was to evaluate the necessity of chest x-ray (CXR) in detecting the endotracheal tube (ETT) misplacement after the intubation.

**Basic procedures:** In this cross-sectional study, we took a CXR after confirming the ETT placement by physical examination. The distance between the tip of the ETT and carina was then evaluated and graded as satisfactory if it was more than 2 cm.

**Main findings:** During the study period, 381 patients were intubated in the emergency department (ED). According to the CXR findings, the distance between the ETT and carina was more than 2 cm in 336 patients (88.2%), whereas it was less than 2 cm in 45 patients (11.8%). Fourteen ETTs (3.6%) were judged to be too low with 6 (1.5%) of these being right bronchus intubations. One patient had a CXR confirming left bronchial intubation.

**Principal conclusions:** Although ED intubations have high success rate, the complications of inappropriate intubations are highly remarkable that postintubation CXR remains a necessary step to minimize the misplacement of the tube.

© 2013 Elsevier Inc. All rights reserved.

## 1. Introduction

It is one of the most important duties of emergency physicians to provide a secure airway for critically ill patients. Endotracheal tube (ETT) placement is currently the definitive way of securing airway [1]. Although it can be life saving, the complications due to ETT misplacement can cause serious problems for patients. Esophageal intubation can be fatal. Likewise, bronchial intubation or insufficient depth of the tube can result in hypoxia, pneumothorax, and accidental extubation [2].

There are several methods to verify ETT placement including direct observation of vocal cords during laryngoscopy, observation of symmetrical chest expansion, auscultation, capnography, and using a postintubation chest x-ray (CXR). Although none of those methods, except for direct visualization, can confirm a nonesophageal intubation, they are recommended nonetheless [3,4]. Only observation of symmetrical chest expansion, auscultation, and a postintubation CXR can verify correct ETT depth. Although clinical methods are routinely used to verify ETT depth by emergency physicians, obtaining a CXR after intubation is not a common practice in many emergency departments (EDs). This may be the result of the belief that clinical methods are adequate for confirmation of ETT depth [5].

The aim of our study was to determine whether the physical examination is adequate for the verification of ETT placement and if a postintubation CXR is necessary in the emergency care or not.

## 2. Methods

## 2.1. Patients

This cross-sectional study was performed at the ED of Imam Khomeini Hospital (Tehran, Iran), which is a tertiary referral center with approximately 20 000 emergency admissions per year.

Eligible patients for the study were adults (age >18 years) who were intubated by emergency medicine service for any indications of orotracheal intubations. Patients in whom bilateral pulmonary examination was impossible (unilateral pleural effusion, hemothorax or pneumothorax, or previous pneumonectomy) were excluded. We also excluded the patients who died immediately after intubation or in less than 30 minutes due to ethical issues of doing chest radiographs for dead patients.

The study was approved by ethics committee of Tehran University of Medical Sciences.

## 2.2. Study design

For each intubated patient, physical examination for confirmation of ETT placement was performed immediately after intubation by

☆ This study was funded and supported by Tehran University of Medical Sciences grant number 53.

\* Corresponding author. Department of Emergency Medicine, Imam Khomeini Hospital, Keshavarz Blvd, Vali-asr Sq., Tehran, Iran. Tel.: +98 21 66904848; fax: +98 21 66904848.

E-mail address: [hosseinnejad@TUMS.ac.ir](mailto:hosseinnejad@TUMS.ac.ir) (H. Hossein-Nejad).

observation of symmetrical chest expansion and bilateral auscultation of breath sounds in 5 foci (axilla, fifth intercostal spaces, and epigastrium). After confirmation, the ETT was fixed, and the number on the tube, which was near the corner of the mouth, was recorded. Then, within 30 minutes, a portable CXR (AD125P-MUXH; Shimadzu, Co. Kyoto, Japan) at a distance of 1 m from the patient bed and 90° angle was obtained, and the distance between the carina and the tip of the tube was measured by a ruler. A distance of more than 2 cm from the carina was reported as appropriate placement, and other tubes were relocated to reach the desirable depth.

All the procedures, including the intubation and CXR interpretation, were performed by emergency medicine residents under direct supervision of faculties of the emergency medicine in the working shifts.

### 2.3. Statistical analysis

Descriptive statistics were used, and 95% confidence interval was reported as appropriate. Data are presented as mean  $\pm$  SD. Significant differences in general characteristics were determined by  $\chi^2$  and Student *t* test, and  $P < .05$  was considered statistically significant. SPSS for Windows (Version 17; SPSS, Inc, Chicago, IL) was used for data analyses.

## 3. Results

### 3.1. Characteristics of the patients

Between March 2008 and October 2009, 381 intubated patients were evaluated. A total of 192 patients (50.4%) were male with a mean age of  $62.9 \pm 16.8$  years, and 189 patients (49.6%) were female with a mean age of  $64.8 \pm 16.0$ . The most frequent sizes of the ETT were 7.5, 8, and 7 applied for 60.1%, 29.7%, and 10.2% of the patients, respectively. According to the number on the ETT near the corner of the mouth, the mean depth of the ETT was  $22.4 \pm 1.5$  cm for men and  $22.6 \pm 1.3$  cm for women.

### 3.2. CXR assessment

According to the CXR findings, the distance between tip of the ETT and carina was more than 2 cm in 336 patients (88.2%), whereas it was less than 2 cm in 45 patients (11.8%). In the latter group, the tip of the tube was located at carina in 8 patients (2.1% of all patients); in 6 patients, it was in the right bronchus (1.6%), and there was 1 left bronchial intubation (0.03%). There was no esophageal intubation diagnosed by CXR.

### 3.3. Appropriate intubations

Because a distance of more than 2 cm from the carina was considered as appropriate, 336 patients (87.5% of men and 88.9% of women) had appropriate intubation. The mean depth of the ETT based on the number near the corner of the mouth was  $22.38 \pm 1.36$  in this group ( $22.57 \pm 1.32$  for women and  $22.19 \pm 1.37$  for men) and was significantly less than the depth in the other group ( $23.86 \pm 1.53$ ,  $P < .001$ ).

The correct intubations were not significantly different between sexes. In addition, significant sex differences were not shown regarding tube size and mean age.

## 4. Discussion

Intubation with an ETT is one of the most important parts of airway management and can be life saving in emergency situations. On the other hand, the misplacement of ETT can cause significant morbidity and mortality in critically ill patients.

There are a few studies that have investigated the intubation success rate in emergency physicians [6–8]. Bissinger et al found that up to 7% of intubations in the field by emergency physicians were bronchial and the distance between the tube tip and carina was less than 2 cm in the other 13% of the whole cases [6]. Geisser et al [8] reported that up to 20.5% of ETTs in a major trauma center in Germany were not in appropriate place. In addition, 14.7% of the tubes were in less than 2 cm from the carina, and 5.7% of them were in main bronchus. Fewer inappropriate intubations were found in our study (11.8% of the patients). This higher success rate may be due to the exclusion of the patients who had limitations in pulmonary auscultation (unilateral hemothorax and pneumothorax and pleural effusion), which made the physical examination more accurate.

Although we found no sex difference in wrong intubations, several studies have reported that female patients are at a higher risk for inappropriate intubation probably due to anatomical differences [3,9].

Our results showed that the number near the corner of the mouth was significantly higher in inappropriately intubated patients, but we could not specify a number at which a tube can be considered safely placed. Mean depths in our study were  $22.57 \pm 1.32$  for women and  $22.19 \pm 1.37$  for men in appropriately intubated patients. This result is inconsistent with previous data that were reported as margins for safe intubation [2]. This shows the unreliability of these findings for confirmation of ETT placement.

Intubation guidelines recommend obtaining a CXR after intubation, but there is still a controversy whether physical examination alone can confirm the appropriate placement of the ETT [5]. Our study indicates that there is still a significant proportion of the patients in whom the ETT placement is inappropriate even with use of all physical examination tools. There are several methods to verify ETT placement including laryngoscopy, capnography, CXR, and sonography, but CXR is more feasible in emergent status. Although getting a chest radiograph in the department of emergency medicine takes time and the risk of exposure to x-rays and cost of treatment increases, the complications due to ETT misplacement can cause serious problems for patients. These results show the necessity of obtaining a postintubation CXR to verify the ETT placement in EDs.

## 5. Limitations

Pediatric patients were not included in our study; subsequently, the results cannot be applied to them. We did not include the patients who were intubated out of hospital or by paramedics; hence, the results are merely for emergency physicians and for in-hospital intubations.

## References

- [1] Rosen P, Ban KM, Pini R. Airway management: the sine qua non of emergency medicine. *Intern Emerg Med* 2006;1(2):137–8.
- [2] Owen RL, Cheney FW. Endobronchial intubation: a preventable complication. *Anesthesiology* 1987;67(2):255–7.
- [3] Brunel W, Coleman DL, Schwartz DE, et al. Assessment of routine chest roentgenograms and the physical examination to confirm endotracheal tube position. *Chest* 1989;96(5):1043–5.
- [4] Salem MR. Verification of endotracheal tube position. *Anesthesiol Clin North America* 2001;19(4):813–39.
- [5] Sanchez LD, Di Martino P, Babineau M, et al. Intubation practice patterns in Tuscan emergency departments. *Int J Emerg Med* 2008;1(2):127–9.
- [6] Bissinger U, Lenz G, Kuhn W. Unrecognized endobronchial intubation of emergency patients. *Ann Emerg Med* 1989;18(8):853–5.
- [7] Bushra JS, McNeil B, Wald DA, et al. A comparison of trauma intubations managed by anesthesiologists and emergency physicians. *Acad Emerg Med* 2004;11(1):66–70.
- [8] Geisser W, Maybauer DM, Wolff H, et al. Radiological validation of tracheal tube insertion depth in out-of-hospital and in-hospital emergency patients. *Anaesthesia* 2009;64(9):973–7.
- [9] Schwartz DE, Lieberman JA, Cohen NH. Women are at greater risk than men for malpositioning of the endotracheal tube after emergent intubation. *Crit Care Med* 1994;22(7):1127–31.