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Research Article

The Frequency of Acquired and Age-Related Tracheal Deformations: a Retrospective Study of CT Scan Findings

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Abstract

Background: Changes of the anatomy of the trachea occur during aging and as a result of a large goiter, cardiac or pulmonary diseases and smoking. These changes may cause difficulties in endotracheal intubation.

Methods: In this retrospective study, we analyzed the frequency of acquired deformations, as seen in chest CT scan of 200 adult patients. The radiographic findings were studied, as well as the patients' demographic variables and co-morbidities.

Results: Acquired deformation of the trachea was found only in patients that were older than 50 years. In 117 patients 50 to 90 year-old three types of deformations were found: "S-shape" trachea in 83 patients (71%), horizontal left main bronchus with wide angle main carina in 24 patients (20.5%) and saber-sheath trachea in 10 patients (8.5%).

Conclusions: Acquired deformation of the trachea is frequent in patients older than 50. Studying the patient's chest CT scan may assist the physician in performing endotracheal intubation cautiously and safely.

Keywords: Trachea; Endotracheal intubation; Acquired tracheal deformation; Double lumen tube

1. Introduction

The anatomy of the trachea may be anomalous due to congenital, physiologic or pathologic reasons [1-3]. The diseases affecting the trachea can be categorized into focal or diffuse diseases. Tracheobronchial strictures, such as post-intubation stenosis and tracheobronchial neoplasms are regarded as focal diseases, whereas tracheobronchomegaly, tracheomalacia, are examples of diffuse diseases. Cardiac and pulmonary diseases may cause changes in tracheal anatomy, as well as goiter, smoking and aging [1, 3]. In addition to anatomical changes, there are dynamic changes of the tracheal following anesthesia and relaxation [4]. Tracheal anatomy has great importance in procedures as tracheal intubation and ventilation [5, 6]. Casual, thoughtless intubation of anomalous trachea may result in tracheal tear and mortality, especially when introducing large devices as the double-lumen endotracheal tube [7, 8].

Computed tomography (CT) is the best non-invasive method for evaluation of tracheal lesions [9, 10]. In this study, we retrospectively analyzed chest CT scan of adult patients, in order to find the frequency of acquired tracheal anomalies in our population and its correlation with demographic variables and co-morbidities.

2. Patients and Methods

This study was conducted in Bnai-Zion Hospital, Haifa, after acquiring the institution's Ethic Committee approval. It is a retrospective study of 200 adult patients, aged 40-90 years, who underwent chest CT scan in our hospital. Data that was analyzed: patient's age, gender, main disease, co-morbidity, smoking, geometric parameters of trachea and its main bifurcation and bronchi and other pulmonary findings.

2.1 Statistical analysis

Comparison of quantity characteristics between possible reasons for deformation were performed by Anova, Kruskal Wallis test, independent sample t-test, Wilcoxon rank sum test. The decision of choosing among those tests were done according to the number of the groups which was compared, group size and shape of the data distribution. For qualitative data correlation, Chi square test or Fisher's exact test were used. The choice between those tests was done according to pre-assumptions of these tests. P value less 5% was considered significant.

3. Results

Two hundred patients were included in this study, 105 female and 95 male patients. Among 83 patients 40-49 year old no tracheal deformation was detected. This group was not included in the data analysis. In 117 patients 50 to 90 year-old three types of tracheal and main bronchi deformations were found: "S-shape" trachea in 83 patients (71%) (Figure 1), horizontal left main bronchus with wide angle main carina in 24 patients (20.5%) (Figure 2) and saber-sheath trachea in 10 patients (8.5%) (Figure 3).

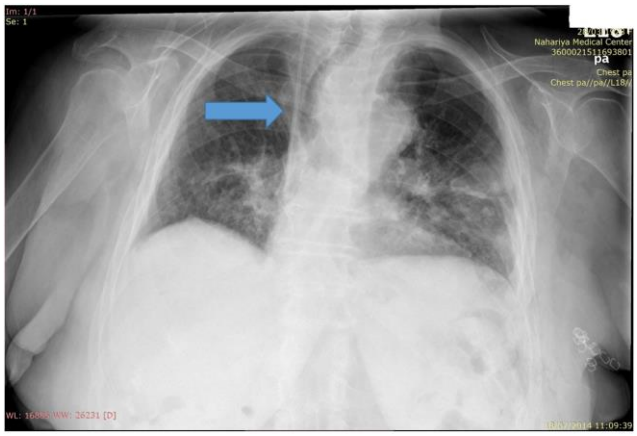

Figure 1: Chest x-ray of a patient with S-shape trachea (blue arrow shows the trachea).

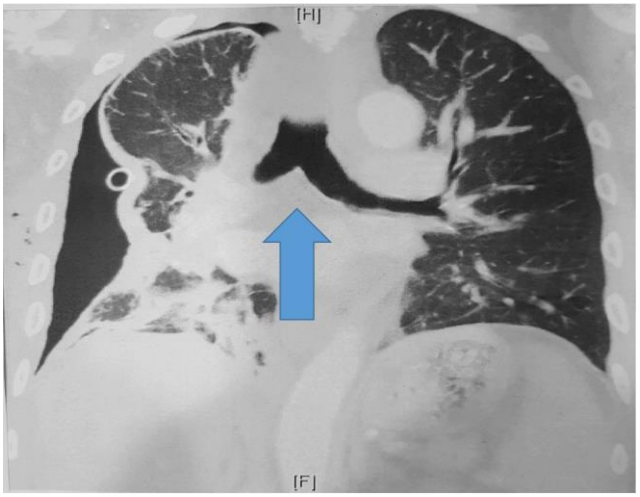

Figure 2: Chest CT scan of horizontal left main bronchus with wide angle main carina (blue arrow at the carina angle).

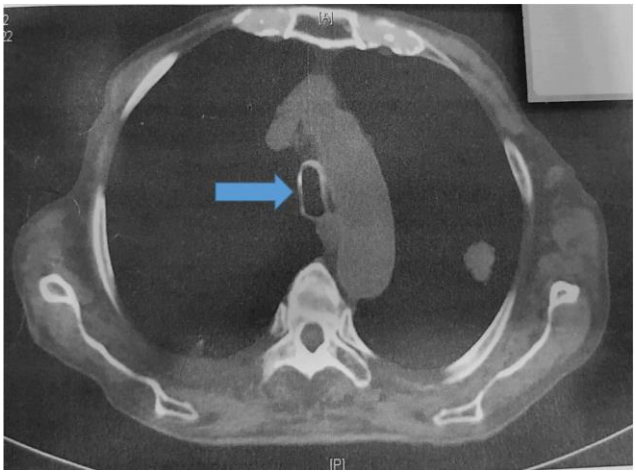

Figure 3: Chest CT scan of a saber sheath trachea (blue arrow shows the trachea).

Saber sheath trachea was detected in male patients only, while S-shape trachea was predominantly female (Figure 4).

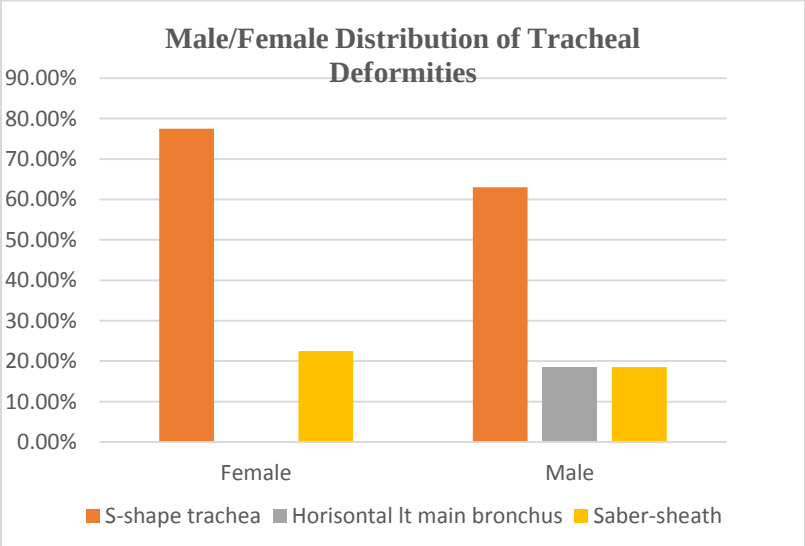

Figure 4: The distribution of acquired tracheal deformity between male and female patients.

No significant correlation was found between the patient's age and deformity (p=0.92). Regarding co-morbidities: all the patients with saber sheath trachea had COPD, 54 of the patients with S-shape trachea (74%) had cardiovascular disease. Horizontal left main bronchus with wide angle main carina was not correlated to co-morbidities.

4. Discussion

The main result of this study was the finding of frequent acquired tracheal malformation in patients 50 year old and older. While S-shape trachea and wide main carina are detectable on standard chest x-ray exam, the saber sheath malformation is not, and chest CT scan is required for its diagnosis. The patients with saber sheath trachea were found to have COPD, while S-shape trachea was found in patients with cardio-vascular disease. Acknowledging the possibility of tracheal anomaly is significant if tracheal intubation is planned, especially in case the endotracheal tube is massive and long as the double-lumen tube.

The procedure of endotracheal intubation is extremely frequent. However, it may carry the risk of tracheal trauma, such as tear or rupture [11-13]. Post-intubation tracheal injury is a potentially fatal complication. Several factors may increase the risk for complication: repetitive attempts of intubation, emergency situations, intubation of a neonate, patient with a tracheal pathology, or when using large endotracheal tubes, as the double lumen tube [7, 8, 12-14]. The double-lumen tube is to be placed in the left main bronchus, thus the intubator has to rotate the tube to the left [15, 16]. In case of S-shape trachea, where the trachea curve is to the right, a rotation to the left may tear it. By being familiar with the tracheal anatomy, the injury may be prevented.

An important weakness of this study relies on its design as a retrospective study. Indeed, a prospective study may have a more robust result. Another problem was the study population that was younger than 50 years, where no tracheal deformity was found and was not included in the data analysis. However, this finding teaches us that patients younger than 50 are at lower risk for acquired tracheal deformity and intubation may be with reduced risk of complications. In the group of patients 50 year old and more, no significant correlation was found between patient's age and deformity. This finding may be different in a larger group of patients.

5. Conclusions

Patient 50 year-old or older may have a required tracheal deformity. In patients with a non-linear trachea, intubation carries a risk of injuring the trachea. When planning to intubate such a patient, it is advised to become familiar with the tracheal anatomy, for a safe and cautious endotracheal intubation.

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Ethics Approval and Consent to Participate

The study was approved by the institutional local Ethic Committee.

Competing Interest

The authors declare that they have no competing interests.

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