Variations in the cartilaginous wireframe of adult human trachea

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Introduction:
The cartilaginous structure of the trachea is highly variable. In the everyday practice of otorhinolaryngology this structure is exposed to various surgical procedures. However, the deviations from the regular schematic tracheal anatomy seem to be underestimated which may lead to intraoperative and postoperative complications. [1,2]

Our aim was to study the morphological alterations of the cartilaginous skeleton of the trachea in a population of adult individuals.

Materials and methods:

1. Cadavers
The variations of the cartilaginous wireframe in adult human trachea were evaluated in 18 cadaver tracheas (10 male, 8 female, mean age 69±8.9 y).

2. CT reconstructions
Studies on 14 adults (10 male and 4 female, mean age 63±8.4 y) using computed tomography (CT) reconstruction of the trachea were performed.

Detailed structural and quantitative characteristics of the cartilaginous wireframe were analyzed.

Results:

1. Cadavers
In 17/18 (94%) cadaver tracheas cartilages with a shape, different from the simple horseshoe one, were noted. Of them 44.3% were found in the cervical part and 55.7% in the intrathoracic part of the organ (Chart 1). In 2/18 cases (11%) there was subtot al welding between the cricoid and the first tracheal cartilage. A partial cartilaginous bridge between the cricoid and the first tracheal cartilage was observed in 2 cases. In 10 cases the first and second tracheal ring had the same variation. The type of variations we discovered and their predominant localization are depicted in Fig. 1.

2. CT reconstructions
In the neck region of 3/14 patients (27.2%) non-parallel cartilages were observed. Eight of them (57.1%) had up to 3 cartilages deviating from the normal horseshoe anatomy. In the thoracic area results were 11/14 (78.6%) and 10 (71.4%) (up to 5 deviations), respectively (Chart 2 and 3). The findings were similar to those observed in the cadaver group (Fig. 2).

Discussion:
Our study portrayed a considerable variety of shapes and contacts between the cartilaginous rings (Fig. 2 and 3). There were only two cases which were reported to have an unwavering distribution of similar rings – one from the cadaver and one from the CT group. The same finding is reported in the literature. [1,3] 44.3% of the variations were observed in the cervical part of the trachea which is subject to otorhinolaryngology practice. Their presence would scarcely hinder the work of an experienced surgeon, but if cartilage has to be cut through, it would remain unprotected. The following tissue scarring results in an uneven cicatrix that may perrade other rings and lead to stenosis. [4]

Performing a termino-terminal anastomosis and resection would be deterred.

The variant rings in the cervical part of the trachea are especially susceptible to injury during percutaneous dilatational tracheostomy. [5] Said procedure blindly attempts to cut between two neighboring rings, but that can harm their integrity or lead to their invagination into the lumen, increasing the risk of stenosis.

Conclusion:
The cartilaginous wireframe of the human trachea is characterized with a high degree of variability for both structural and quantitative parameters. Some of these anatomical variations could present a risk factor for early or postoperative complications.

References: