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Review Article

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Cystic Adenoid Carcinoma of the Airway: Multimodal Radiological Approach

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Abstract

Cystic adenoid carcinoma (ACC) is the second most frequent tumor of the pathway. The diagnosis is generally late when the patient is taken to tomography studies; however, in retrospective analysis, the patient often presents findings on the chest radiograph, which were generally omitted. For the radiologist, the diagnostic approach to the airway from radiography to tomography continues to be a challenge, therefore, the objective of the article is to carry out a complete systematic approach to the disease with emphasis on important normal and abnormal imaging findings on radiography and thorax tomography.

Keywords: Airway Tumors, Toracic Lines, Cystic Adenoid Carcinoma

Introduction

Neoplasms of the trachea are infrequent, of primary origin the majority [1,2]. Approximately 90% of adult tracheal tumors are malignant, compared to children, which range from 10% to 30%. The incidence of malignant lesions is approximately 0.1 in every 100,000 people / year, according to the Dutch Cancer Registry, which corresponds to 0.2% of all tumors of the respiratory tract [3]. These tumor lesions cause 0.1% of cancer deaths worldwide. Squamous cell carcinoma is the most common tumor in airway, followed by ACC [2]. The latter rarely affects the trachea, but it is the most common of the minor salivary tissue carcinomas [2,4]. In the largest epidemiological study in the United States, which evaluated patients between 1973 and 2004 (578 cases of tracheal tumors), it was shown that squamous cell carcinoma is the predominant type (44.8%), followed by ACC (16.3%) [1].

ACC was first described as a Clindroma in 1859 by Billroth. It has been found mainly in patients between the 3rd and 9th decades of life, with a predilection for the 5th decade without showing gender or race preference or relationship with cigarettes. The 5-year survival rate is 27% for all primary tracheal tumors, which increases to 46% when the disease is localized [1]. However, in the case of ACC, survival can reach up to 74%.

There is no consensus about the predilection for any segment, but what is clear is that it involves large segments at the time of its presentation; and although it is a little more frequent in the proximal segments, it can occur in the more distal segments [6,7].

Pathophysiology

Histologically, ACC originates from the salivary glands, however, other locations such as trachea, tongue, bronchi, lungs, and ear canals have been described. It is considered a slow growing, painless tumor. The most common location site in the trachea is the posterolateral wall, but it is also frequent to find it in the anterolateral wall, near the junction of the cartilage and the soft membranous areas of the trachea where the mucous glands are more abundant [8]. Honings and collaborators found in a retrospective study that the extramural invasion could be up to 20% of adjacent structures, 15% esophagus, 9% thyroid, 6% to the recurrent laryngeal nerve, 4% infrahyoid muscles and 1% to the pericardium [9]. Due to the above, the great importance of the exhaustive mediastinal evaluation of the adjacent structures in the diagnostic images.

On macroscopic evaluation, ACC appears as a grayish solid mass, with diffuse and infiltrating edges, often polypoid or protruding cannula in the light of the trachea. Microscopically, an infiltrative pattern is observed from the submucosa to the mucosa and organized in cords and nests. There are 3 defined histological types: cribriform (better prognosis), trabecular, and solid (worse prognosis). Szanto and collaborators created in 1984 a classification system in 3 grades: Grade I that does not have a solid component, Grade II with less than 30% of solid component and Grade III with more than 30% of the solid component [10]. Da cruz and collaborators found that a solid pattern with p53 expression correspond to the best prognostic factors [11].

Glandular and pseudoglandular spaces filled with positive eosinophilic material are found between the cribriform structures. As a characteristic finding, there is perineural invasion [12].

Immunohistochemical studies and techniques play a very important role to complement histological studies. Myoepithelial basal and duct cell markers such as SMA, calponin, CAM, CK7 and p63 are expressed. Furthermore, when cells with a high degree of malignant transformation appear, the expression of p53 and Ki-67 increases.

Clinical presentation

Presenting symptoms can be varied, but generally include dyspnea, cough, stridor, and hemoptysis [2]. Due to the anatomy of the trachea, dyspnea appears when the obstruction exceeds 50% of the transverse diameter. Obstruction of less than 8 mm can present

dyspnea with exercise that advances to resting dyspnea when the patent diameter is less than 5 mm [5]. Occasionally it may debut with angina-like chest pain [13]. Dysphagia, hoarseness, and diaphragmatic elevation are less common [14]. The patients presented in the diagnostic images (Figure 2-5, see below) debuted with exertional dyspnea that progressed to dyspnea at rest.

Given the nonspecificity of the symptoms, a late diagnosis is generated. It has been found that the interval between the onset of symptoms and the diagnostic procedure is long, being on average 18.3 months in patients with resectable lesions and 23.7 months for inoperable lesions [15].

The prevalence of positive nodal disease in resection is 13% to 26%, although the presence of the nodes does not significantly impact survival. Metastatic disease generally involves the lung and esophagus, but can spread to extrathoracic sites [16].

Regarding spirometry, flow-volume curves can show different patterns of airway obstruction [14]. Some patients may debut with respiratory failure and critical airway obstruction.

Bronchoscopy is a very useful diagnostic test, since it allows us to evaluate macroscopic characteristics, take samples for histological study, evaluate the nature of the tumor and its extension. On the other hand, it allows us to establish limits with respect to anatomical repairs such as carina, cricoids, and compromise of the trachea.

Radiological approach

Chest x-ray

The airway can be located in different compartments of the mediastinum according to the classification used. The Japenese Association for research on the Thymus (JART 2014) uses the traditional four-compartment configuration, where the trachea before its bifurcation in the carina is located in the upper mediastinum. On the other hand, The International Thymic Malignancy Interest Group (ITMIG), proposes to use three compartments, where the trachea and source bronchi belong to the group of the middle mediastinum (17). 72% of chest groups prefer the ITMIG classification, 23% prefer JART, and 5% do not care. The reason for preference is due to an optimal distinction in 67%, its anatomy in 53%, and in 48% because it is easier to use and simpler (17). However, a recommendation is to have a multidisciplinary consensus for the use of one classification or the other (Diagram).

Diagram: JART vs ITMIG classification of the mediastinum.

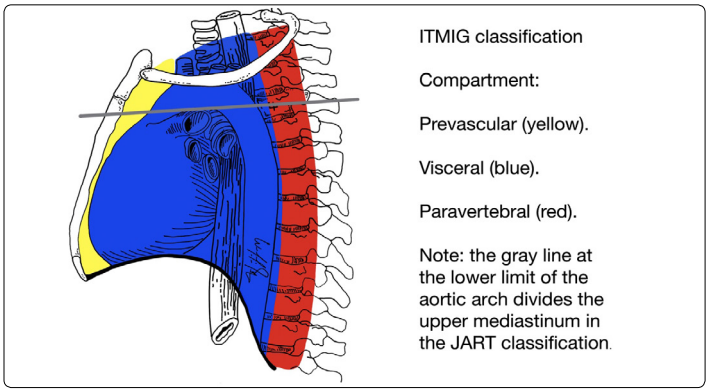


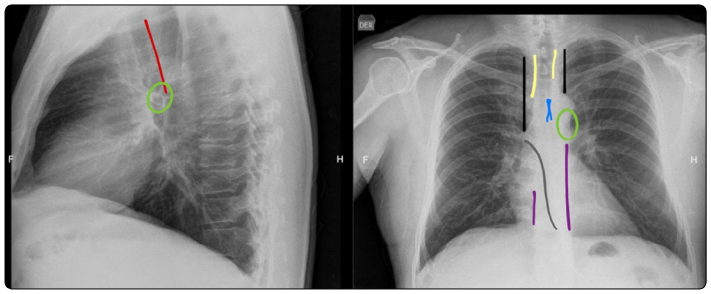
Diagram made by Dr. William A. Prada M. modified from [17].

The trachea presents a central location as an anatomical reference center. It is closely related to structures such as the esophagus, which is located posteriorly and generally to the left. The large vessels that emerge from the aorta and brachiocephalic veins are also closely related structures in the anterior aspect of the trachea. Other structures such as the upper tracheal ganglia, nerves (cranial nerve X), and the thoracic duct are related; most of them valuable in chest radiography, especially when there are pathological findings [18].

The evaluation of chest radiography, ideally in posteroanterior and lateral views, is crucial for the management of patients with pathology of the trachea, since the early diagnosis, especially in cancer patients, allows early and timely treatment. However, the findings are often recognized retrospectively after performing the appropriate analysis on computed tomography or chest MRI [19].

Due to all the structures in relation to the trachea, radiographic findings have been described that allow the alarms to be turned on when they are altered and the patient can be taken to a diagnostic modality with higher diagnostic performance as soon as possible. Among the most widely used are the anterior and posterior junction lines, which are given by the close relationship of the four pleural layers of both lungs, retrosternal (anterior) and retroesophageal (posterior), which are altered when the neoplastic tracheal compromise presents advanced concentric thickening. Tracheal stripes are also of great importance in airway pathology. They are presented by the relation of the pulmonary pleurae to the lateral walls of the trachea; the right superior to the arch of the azygos vein, while the left superior to the aortic arch (Figure 1). These stripes will be altered in patients with neoplastic disease who have concentric thickening of the trachea. In the case of the patient in Figure 2 and 3, they are altered by the tumor progression of a cystic adenoid tumor and the distortion due to postoperative changes.

Figure 1: Normal mediastinal lines.



Chest radiograph, lateral (left) view, posteroanterior (right). Light blue (anterior junction line), red (posterior tracheal band or stripe), yellow (paratracheal stripes), light Green circle (aortopulmonary window), black (vascular pedicle), gray (azygoesophageal recess), purple (paravertebral stripes).

Several structures can also be analyzed in the lower hemithorax. The posterior stripe describes the interface of the posterior wall of the trachea to its bifurcation with the anterior wall of the esophagus (Figure 1). This band is much easier to assess in lateral projection and is altered in patients with tumor infiltration. Figure 4 describes the radiograph of a patient with a cystic adenoid tumor of the trachea with alteration of the posterior tracheal band due to esophageal invasion of the tumor. The azygoesophageal recess is a portion of the retrocardiac mediastinum, which is closely related to the bifurcation of the trachea, esophagus, azygos vein, and thoracic duct (Figure 1). Figure 5b and 5c describe the tomography

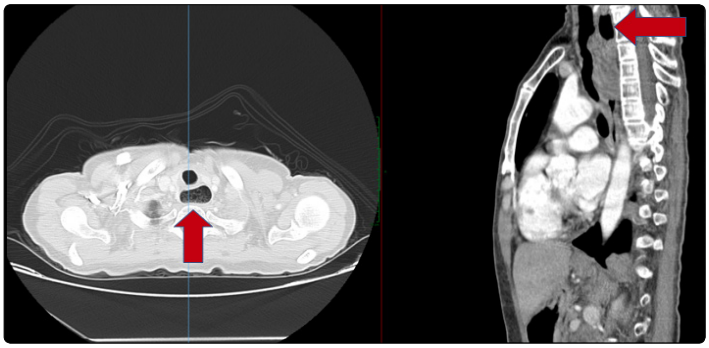
of the previous patient (figure 4) with alteration of the recess due to concentric thickening at the bifurcation of the trachea. The vertebral lines that describe the contact of the pleurae of the lower lobes are generally not altered in tracheal tumors because their bifurcation is superior to these interfaces (Figure 1).

Tomographic Findings

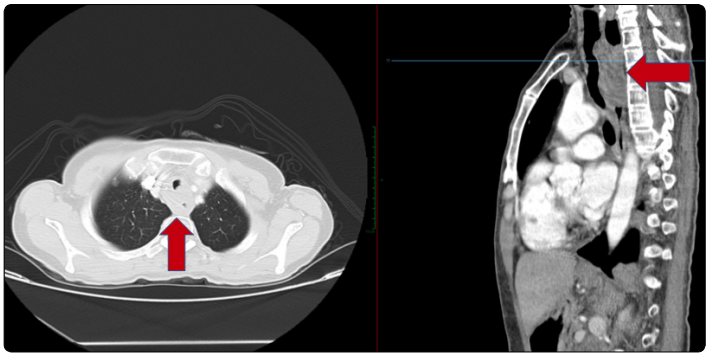
Multidetector tomography is the diagnostic modality of choice for the study of airway pathology, due to its rapid and non-invasive evaluation of the tracheobronchial anatomy. Among the advantages it offers is spatial resolution and the ability to generate multiplanar and three-dimensional reconstructions. In addition, it provides information on local airway compromise and distant disease, evaluating secondary involvement [20,21]. Likewise, virtual bronchoscopy based on reconstructions from images obtained by computed tomography is a non-invasive alternative in the evaluation of the tracheobronchial tree and the recurrence of tracheal tumors.

In ACC of the trachea, the tomographic evaluation evidences a homogeneous, broad-based, intraluminal polypoid mass with attenuation of the soft tissues, but we can also find a lesion with a smooth appearance, an infiltrating pattern and an extension towards the tracheal wall associated with circumferential thickening, which conditions narrowing of the tracheal lumen [22]. In general, the longitudinal extension of the tumor is greater than the extension in the axial plane (Figures 2 and 3) [23].

Figure 2: Chest computed tomography.

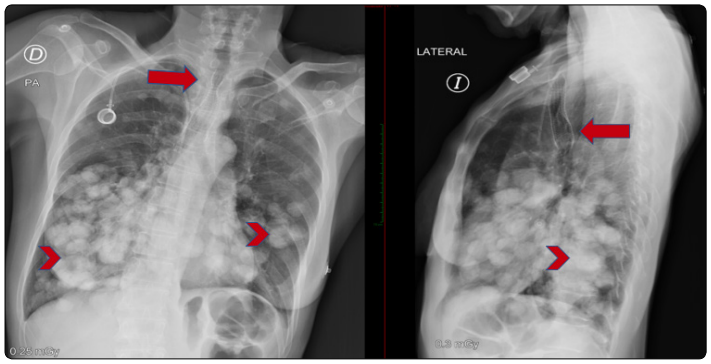


2a. Axial section in lung window (left) and sagittal reconstruction in mediastinum window (right), with the presence of an adequate interface between the trachea and esophagus in the upper segment without tumor involvement, with significant esophageal dilation due to distal obstruction and presence of food content. (arrow).

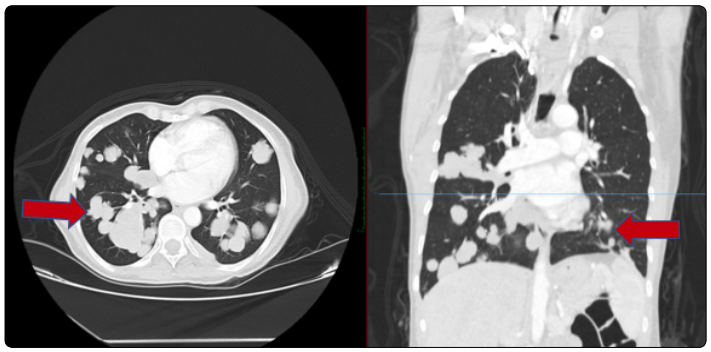


2b. Axial section in lung window (left) and sagittal reconstruction in mediastinum window (right), with the presence of circumferential thickening of the tracheal wall, presence of a sessile lesion dependent on the left submucosa, and concentric thickening of the adventitia that generates loss of plane cleavage with the anterior wall of the esophagus. (arrow).

Figure 3: Chest radiograph and chest computed tomography. Control study.



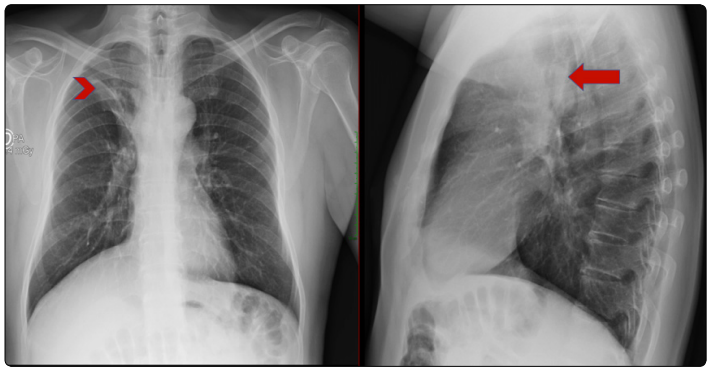
3a. Chest x-ray, posteroanterior view (left), lateral (right); with tracheal endoprosthesis present, with distortion of the upper tracheal bands (arrow), loss of the esophageal tracheal band with invasion of the distal prosthesis (lateral view. Arrow). Multiple metastases in the lung parenchyma predominantly in both lung bases (arrowheads).



3b. Axial slice (left) and coronal reconstruction (right) in lung window, with the presence of multiple lung metastases in a shotgun barrel configuration (arrows).

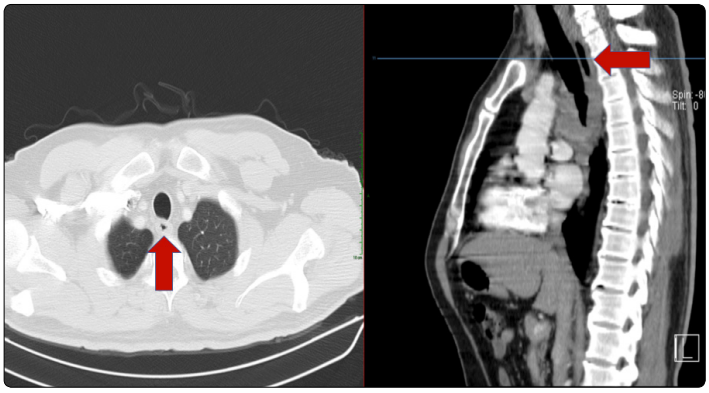
Lesion margins can be smooth, lobed, or irregular. Intralesional calcifications are not frequent. The presence of atelectasis distal to the site of obstruction due to endoluminal involvement of the tumor is a frequent finding in this pathology, and air trapping can be identified from this situation (Figures 4 and 5) [24-27].

Figure 4: Chest radiograph. Tracheo-esophageal band alteration.

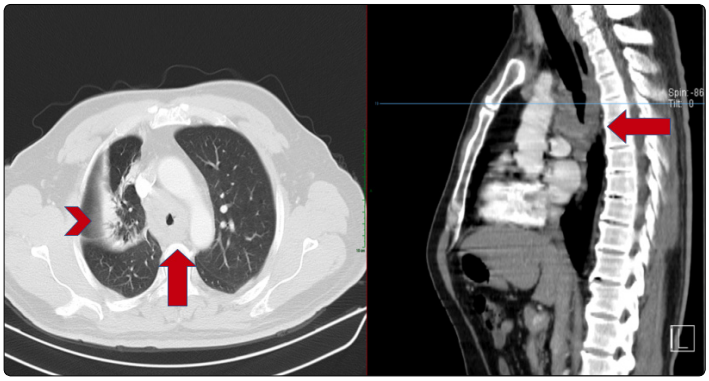


4a. Posteroanterior view, with the presence of right apical opacity by subsegmental atelectasis due to compression of the bronchus for the upper lobe (arrowhead). 4b. Lateral view, with the presence of an alteration of the tracheo-esophageal band with a silhouette sign between the posterior aspect of the trachea and the anterior aspect of the esophagus due to tumor involvement (arrow).

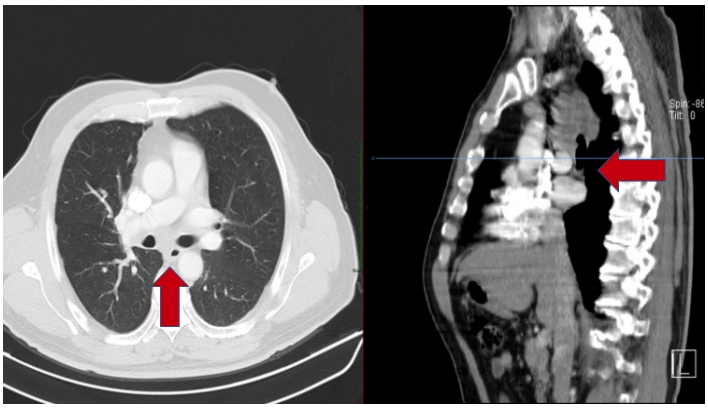
Figure 5: Chest computed tomography.



5a. Axial slice in lung window (left) and sagittal reconstruction in mediastinal window (right) with the presence of an adequate interface between the trachea and the esophagus in the upper segment without tumor involvement (arrow).



5b. Axial slice in lung window (left) and sagittal reconstruction in mediastinum window (right) with the presence of circumferential thickening of the tracheal wall and concentric thickening of the adventitia that generates loss of the cleavage plane with the anterior wall of the esophagus. (arrow). Subsegmental atelectasis due to compression of the bronchus for the right upper lobe (arrowhead).



5c. Axial slice in lung window (left) and sagittal reconstruction in mediastinal window (right) with the presence of an adequate interface between the left source bronchus and the distal esophagus without tumor involvement (arrow).

Treatment

The main objectives of the treatment are to reestablish the airway and the management of the underlying pathology. Furthermore, it is important to define if the treatment is emergency due to the risk of compromising the respiratory pattern or if, on the contrary, it allows the study and joint management of the pathology [28].

Primary resection with end-to-end anastomosis is the choice in localized disease, but it depends on many patient-related factors such as age, weight, comorbidities, and neck mobility [29,30]. This last factor is very important, since young patients with long and mobile necks can have resection of up to 6 cm and have a successful reconstruction [28]. There are also factors related to the disease that can influence the surgical procedure such as the presence or absence of a tracheal wall, the total length of the trachea compromise and metastases; which must be studied and included in the tomographic report.

Many authors recommend adjuvant radiotherapy to surgical treatment (45-65 Gy), which improves 5-year survival by 88% [31]. In cases of advanced disease, mainly with commitment greater than 50% of the length or location close to the carina, invasion of neighboring tissues, metastatic disease, decompensated comorbidities (mainly diabetes) and excessive use of corticosteroids, surgery is contraindicated and advises radiation therapy in conjunction with chemotherapy, but has little success compared to the surgical procedure [31,32]. The addition of Brachytherapy evidences long-term local improvement and improves survival. It is important to clarify that chemotherapy has a more limited role in ACC, and in retrospective studies it has been observed that it has no additional benefit [33].

The surgical technique consists of circumferential dissection of the trachea to allow its active mobilization, but taking care not to damage the lateral irrigation of the trachea wall, the recurrent laryngeal nerves and the esophagus. Then a distal dissection is performed, a distal endotracheal tube is inserted, a proximal dissection is performed, with repair of the proximal segment and over the tube, mobilization of the neck is performed to allow anastomosis without presenting forced tension or an abnormal cervical position (figure 3). Bronchoscopy has been used as a palliative method and symptomatic control of airway obstruction, in addition to performing microdebridements, thermal ablative therapy, and airway bridging. Complications of the surgical procedure include dehiscence of the anastomosis, mediastinitis, and airway stenosis. Patients present 70% survival at 5 years, mainly with tumor-free margins in microscopic findings [31]. However, despite the negative edges, late recurrence may occur (Figure 3). The impact of perineural invasion on survival has been considered, but there are no conclusive studies. There are many fields of study for the management of these lesions, mainly those that are currently considered inoperable, among which are the use of biocompatible tracheal models, allogeneic trachea, tracheal and aortic allografts, and autologous substitutes, but conclusive results are lacking. in these environments.

Conclusion

ACC is a rare neoplasm of the airway, which is generally late recognized. Carrying out a systematic analysis from the chest x-ray in the patient with dyspnea allows the early alarms to be activated and an earlier therapeutic approach with better long-term prognosis can be performed. Likewise, knowing the treatment and the points of tumor recurrence in the follow-up images allows optimal multidisciplinary management that allows greater knowledge of this pathology and that of many others of the mediastinum.

References

1. Urdaneta AI, Yu JB, Wilson LD (2011) Population based cancer registry analysis of primary tracheal carcinoma. Am J Clin Oncol 34: 32-37.
2. McCarthy MJ, Rosado-de-Christenson ML (1995) Tumors of the trachea. J Thorac Imaging 10: 180-198.
3. Honings J, Van Dijck JA, Verhagen AF, Van der Heijden HF, Marres HA (2007) Incidence and treatment of tracheal cancer: a nationwide study in the Netherlands. Ann Surg Oncol 14: 968-976.
4. Hyams V, Bastakis J, Michaels L (1988) Tumors of the upper respiratory tract and ear. In: Hartman WH, Sobin LH, eds. Atlas of tumor pathology, fasc 25, ser 2. Washington, DC: Armed Forces Institute of Pathology 92-94.
5. Sherani K, Vakil A, Dodhia C, Fein A (2015) Malignant tracheal tumors: a review of current diagnostic and management strategies. Curr Opin Pulm Med 2015; 21:322–326
6. Gelder CM, Hetzel MR. Primary tracheal tumours: a national survey. Thorax 48: 688- 692.
7. Azar T, Abdul-Karim FW, Tucker HM (1998) Adenoid cystic carcinoma of the trachea. Laryngoscope 108: 1297-1300.
8. Spizarny DL, Shepard JA, McLoud TC, Grillo HC, Dedrick CG (1986) CT of adenoid cystic carcinoma of the trachea. AJR 146: 1129-1132.
9. Honings J, Gaissert HA, Weinberg AC, Mark EJ, Wright CD, et al: (2010) Prognostic value of pathologic characteristics and resection margins in tracheal adenoid cystic carcinoma. Eur J Cardiothorac Surg 37: 1438-1444.
10. Szanto PA, Luna MA, Tortoledo ME, White RA (1984) Histologic grading of adenoid cystic carcinoma of the salivary glands. Cancer 54: 1062-1069.
11. da Cruz Perez DE, de Abreu Alves F, Nobuko Nishimoto I, de Almeida OP, Kowalski LP et al. (2006) Prognostic factors in head and neck adenoid cystic carcinoma. Oral Oncol 42: 139-146.
12. Rosai J (2004) Respiratory tract: nasal cavity, paranasal sinuses, and nasopharynx—larynx and trachea, lung and pleura. In: Rosai J, ed. Rosai and Ackerman's surgical pathology. 9th ed. New York, NY: Mosby 892-894.
13. Dean C, Speckman J, Russo J (2011) AIRP Best cases in Radiologic-Pathologic Correlation. Adenoid Cystic Carcinoma of the Trachea. Radiographics 31: 1443-1447.
14. Bauer TL, Berkheim DB (2016) Bronchoscopy: diagnostic and therapeutic for nonsmall cell lung cancer. Surg Oncol Clin N Am 25: 481-491.
15. Gaissert HA, Grillo HC, Shadmehr MB, Wright CD, Gokhale M, et al: (2004) Long-term survival after resection of primary adenoid cystic and squamous cell carcinoma of the trachea and carina. Ann Thorac Surg 78: 1889-1896.
16. Gaissert HA, Grillo HC, Shadmehr MB, Wright CD, Gokhale M, et al. (2004) Long-term survival after resection of primary adenoid cystic and squamous cell carcinoma of the trachea and carina. Ann Thorac Surg 78: 1889-1896; Discussion 1896-1897.
17. Carter BW, Benveniste MF, Madan R, Godoy MC, de Groot PM, et al. (2017) ITMIG Classification of Mediastinal Compartments and Multidisciplinary Approach to Mediastinal Masses. Radiographics 37: 413-436.
18. Hodler J, Kubik-Huch RA, von Schulthess GK (2019) Diseases of the Chest, Breast, Heart and Vessels 2019-2022: Diagnostic and Interventional Imaging. 2019.
19. Broncano J, Alvarado-Benavides AM, Bhalla S, Álvarez-Kindelan A, Raptis CA, et al. (2019) Role of advanced magnetic resonance imaging in the assessment of malignancies of the mediastinum. World J Radiol 11: 27-45.
20. Boiselle PM, Lee KS, Ernst A (2005) Multidetector ct of the central airways. *Journal of thoracic imaging* 20: 186-195.
21. Kang E-Y (2011) Large airway diseases. *Journal of thoracic imaging* 26: 249-262.
22. Kwak SH, Lee KS, Chung MJ, Jeong YJ, Kim GY, et al. (2004) Adenoid cystic carcinoma of the airways: Helical CT and histopathologic correlation. Am J Roentgenol 183: 277-281.
23. McCarthy MJ, Rosado-de-Christenson ML (1995) Tumors of the trachea. *J Thorac Imaging* 10: 180-198.
24. Maziak DE, Todd TR, Keshavjee SH, Winton TL, Van Nostrand P, et al. (1996) Adenoid cystic carcinoma of the airway: Thirty-two-year experience. *J Thorac Cardiovasc Surg* 112: 1522-1531.
25. Regnard JF, Fourquier P, Levasseur P (1996) Results and prognostic factors in resections of primary tracheal tumors: A multicenter retrospective study. The french society of cardiovascular surgery. *J Thorac Cardiovasc Surg* 111: 808-813; Discussion 813-814.
26. Dean CW, Speckman JM, Russo JJ (2011) Airp best cases in radiologic-pathologic correlation: Adenoid cystic carcinoma of the trachea. *Radiographics* 31: 1443-1447.
27. Qi D, Feng L, Li J, Bing Liu, Qingfu Zhang et al: (2016) Primary adenoid cystic carcinoma of the trachea with thyroid invasion: A case report and literature review. Onco Targets Ther 9: 6291-6296.
28. Díaz-Mendoza J, Debiana L, Rolando A, Simoff M (2019) Tracheal tumors 25.

29. Gaissert HA, Mark EJ (2006) Tracheobronchial gland tumors. Cancer Contr 13: 286-294.

30. Mathisen DJ (1996) Tracheal tumors. Chest Surg Clin N Am 6: 875-898.

31. Grillo HC, Mathisen DJ, Wain JC (1992) Management of tumors of the trachea. Oncology (Williston Park) 6: 61-67; Discussion 68, 70, 72.

32. Huston B, Froloff V, Mills K, McGee M (2017) Adenoid cystic carcinoma of the trachea resulting in fatal asphyxia. J Forensic Sci 62: 244-246.

33. Chen F, Huang M, Xu Y, Li T, Xie K, et al. (2015) Primary tracheal adenoid cystic carcinoma: adjuvant treatment outcome. Int J Clin Oncol 20: 686-692.