Evaluation of tracheal stenosis with MDCT and broncoscopy.

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Learning objectives

- Review the physiopathology of tracheal stenosis.
- To evaluate comparatively the tracheal stenosis between the image by multidetector tomography and by bronchoscopy.
- Present a protocol for evaluation of benign tracheal stenosis using a MDCT system with multiplanar and three-dimensional reconstructions.
Background

- In 1886, Colles described 4 cases of tracheal stenosis as a cause of airway obstruction in 57 survivors who had undergone tracheostomy for treatment of diphtheria.
- Tracheal stenosis is defined as a decrease in lumen of 10% or greater, evidenced by imaging methods or direct visualization by conventional bronchoscopy.
- Tracheal stenosis due to traumatic origin is a common iatrogenic disease after tracheal intubation and is classified as a focal tracheal affection that generates fixed stenosis.
- Tracheal stenosis can be local or diffuse and has different etiologies: congenital; consequence of tracheostomy / intubation; inflammatory reactions after viral, bacterial and fungal infections; neoplasms and tumor resection and post radiation therapy in the cervical region.
- Tracheal stenosis is an increasingly important clinical and surgical entity due to the increase in intensive care unit admissions associated with prolonged orotracheal intubation or tracheostomy.
- Prospective studies indicate a 10 to 20% incidence of tracheal stenosis in post-intubation patients, being significantly significant in 1% of these cases. Time is an important factor for stenosis occurring in up to 6% of patients undergoing tracheal intubation greater than 8 days.

Physiopathology

- The physiopathology of stenosis by the aggressive traumatic agent occurs due to posttraumatic hyperemia and edema, followed by a repairing inflammatory process that subsequently causes a cicatricial narrowing of the tracheal lumen.
- Hyperemia and edema occur after changes in the perfusion of the tracheal mucosa that may progress to mucosal ulcerations. Ulcerations can coalesce, resulting in deep stromal necrosis and perichondritis approximately 96 hours after the onset of onset of the lesion. Chondritis leads to cartilage necrosis.
- Mild or moderate ulcerations may produce squamous metaplasia of the normal ciliated epithelium. When extensive, there is formation of fibrous tissue due to second intention scarring and granulation formations.
- The most common traumatic agents in ventilatory therapy are the laryngotracheal tube and the tracheostomy tube, which attack the mucosa by several factors: the site of contact between the tip of the tube and the wall of the trachea and the location of the cuff of both devices.
There are three anatomical regions where the laryngotracheal tube exerts pressure at rest and may trigger aggression to the mucosa: arytenoid cartilage, posterior glottis and cricoid cartilage.

- The lesion of the mucosa at the cricoid level is predisposed by:
  1. Number of intubation attempts.
  2. Prolonged intubation time
  3. Type of material used.
  4. Piston effect (characterized by improper cannula fixation and patient movements).
  5. Location of the tube in an inadequate position in the upper third of the trachea.
  6. Infection of the upper respiratory tract and inadequate handling of nursing.

- The operative wound of the tracheostomy insertion is also a potentially stenosing site.

**MULTIDETECTOR COMPUTED TOMOGRAPHY**

- The evaluation with Multidetector Computed Tomography (MDCT) is shown as an essential evaluation method in tracheal stenosis.
- MDCT equipments provides excellent accuracy in the diagnosis of tracheal stenosis and airway condition distal to the lesion, being especially useful in cases where there are difficulties of passage of the bronchoscope through the stenosis.
- It is important to know the disadvantages of bronchoscopy: may fail to provide information when the lesion is completely blocking the trachea; loss of information by presence of bleeding; uncomfortable and poorly tolerated procedure; sedation is required; is also associated with low morbidity rates.
- The multidetector CT plays an important role in the evaluation of injury, including anatomic location, number of lesions present and condition of distal airway to the lesion.
- Viewing lesions is best in the coronal and sagittal planes. Axial images have certain limitations to demonstrate craniocaudal extent of the disease, for detecting subtle lesions or stenoses and to show relations between the airway and mediastinal structures and lymph nodes in three dimensions.
- From the images obtained, we have a better evaluation for planning a treatment, either with stenting airway or surgical resection. The 3D reconstructions also help anesthesiologists to select the most appropriate tracheal tube to the procedure.
- In addition the multiplanar reconstruction MDCT allows reconstructions MIP and three-dimensional, including virtual bronchoscopy, which is one more resource available today, before submitting the patient bronchoscopy (FIGs 2-5).
Fig. 1: Areas of formation of tracheostomy and laryngotracheal tube stenosis

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**Fig. 2:** Multidetector Computed Tomography demonstrating Normal Trachea and Three Dimensional Reconstructions


**Fig. 3:** Tracheal stenosis: coronal and 3D reconstructions

Fig. 4: Virtual bronchoscopy


Neurofibromatosis

Fig. 5: Example of virtual bronchoscopy in tracheal stenosis due to polypoid images resulting from neurofibromatosis

Findings and procedure details

- Retrospective and observational study in which were reviewed the examinations of 20 patients with tracheal stenosis assessed by CT 64-channel (PHILIPS Brilliance)® and who underwent bronchoscopy later at the University Hospital Antônio Pedro, Universidade Federal Fluminense, Niterói, State of Rio de Janeiro, Brazil.
- All examinations were reviewed by two independent radiologists and discordant results were reviewed by consensus.
- We evaluated the anatomical location of the tracheal stenosis, number of lesions present and state of the airway distal to the lesion. A new protocol was proposed using multiplanar and three-dimensional reconstructions to facilitate the measurement of tracheal stenosis.

**PROTOCOL USED FOR EVALUATION OF TRACHEAL STENOSIS:**

Radiological measurements were standardized in length in millimeters and divided into 4 measurements on the craniocaudal axis and 9 on the transverse axis:

- **In the craniocaudal axis:**
  a) Tracheal extension of the true vocal cord at the beginning of stenosis
  b) Extension of tracheal stenosis
  c) Extension between the end of stenosis and carina
  d) Extension between cricoid cartilage and carina
  e) Extension between the tracheostomy ostium and the final extension of the stenosis

- **On the transverse axis:**
  a) Measurement of the smallest diameter of the trachea above the stenosis area
  b) Measurement of the smallest diameter of the trachea in the stenosis area
  c) Measurement of the smallest diameter of the trachea below the stenosis area
  d) Measurement of the smallest area of the trachea above the stenosis
  e) Measurement of the smallest area of stenosis
  f) Measurement of the smallest area of the trachea below the stenosis
g) Measurement of the percentage of the area of stenosis in relation to the area above the stenosis

h) Measurement of the percentage of the area of the stenosis in relation to the area below the stenosis

i) Position of tracheostoma in relation to ostium stenosis

- In all cases MDCT was able to show the exact location of tracheal stenosis, as well as the state of the distal airway from injury.
- In all cases measures were taken in accordance with the proposed protocol by the Departments of Thoracic Surgery and Radiology of the University Hospital Antônio Pedro, in which contained not only the caliber of stenosis, such as pre and post stenotic, using the multiplanar and three-dimensional reconstructions.
- In cases where the patient was using metal tracheostomy, it was removed at the time of obtaining the images in order to improve the quality of the examination without generating artifacts.
- The evaluation with MDCT helped to visualize the distal airway tracheal stenosis, while the endoscope had difficulty and could not get through.
- They will be presented some cases for iconographic documentation of the findings (FIGs 6-14).
Figures A-F: Patient with dyspnea at rest and past of endotracheal tube. Reduction of tracheal gauge in the cervico-thoracic transition (arrows) distant about 8.7 cm from the carina. Figures A-D axial sequence. Figure E and sagittal image. Figure F coronal image demonstrating the transition.

Fig. 6

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Figures A-D: Tracheal stenosis secondary to lung cancer. In A-C there is a reduction in the diameter of the trachea. In D, after treatment, the normal gauge, at the same level as in Fig. A
Figures A-D: Stenosis in the cricotracheal transition with an estimated area of 10mm², with a tracheal metal cannula below.
Figures A-D: Trachea centered, with normal trajectory, presenting a reduction of the caliber in its upper segment with a longitudinal extension of 2.7 cm and transverse diameters of 2.6 x 0.5 cm (APxT), 7 cm apart from the carina.
Fig. 10: Male patient, 34 years. Tracheal stenosis associated with pseudodiverticulum left (arrow)

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Figures A-C: Subglottic tracheal stenosis at the C7-D1 level.
Figures A-B: Parietal thickening of the middle third of the trachea, causing irregularities and reduction of its caliber, especially of the transverse diameter.

Fig. 12

Figures A-B: Heterogeneous mass in LSD invading the lateral wall of the trachea, reducing its light, and the right bronchus, which is obliterated by the mass, causing subtotal atelectasis of the ipsilateral lung with a deviation of the mediastinum to this side. Subpleural blisters in the left lung.

Fig. 13
Fig. 14: Tracheal occlusion by tissue with soft tissue density at the cricoid cartilage (red arrow), with a longitudinal extension of 0.8 cm and stenosis behind the trachea, with a caliber of 1.5 x 0.7 x 0.5 cm. Tracheostomy path (blue arrow).
Conclusion

• MDCT should precede respiratory endoscopy to guide its performance, contributing to the decision of surgical planning and to the diagnosis of lesions that are sometimes difficult to have bronchoscopy approach, such as the presence of malacia.
• Thus, in addition to being less invasive and allowing it to be performed without general anesthesia.
• The conventional bronchoscopy with histopathological study remains the method of choice for the definitive diagnosis of the lesions.
• Imaging studies should precede respiratory endoscopy, to guide its implementation, as well as decision interventional planning.
• Thus, in addition to being less invasive and allow performing without general anesthesia, tracheal stenosis evaluation from the multidetector computed tomography proves advantageous since it allows assessment of the anatomical location, number of lesions present and state of distal airway to injury.
17. P, M. B.; CHUA, F. Multidetector CT and Postpro- cessing in Planning and Assisting in Minimally Invasive Broncho, 2012