Elevated 18F-NaF uptake in cricoid cartilage in a patient with laryngeal carcinoma
A case report and literature review

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Abstract

**Rationale:** Laryngeal cancer is an aggressive tumor that arises from the tissues of the larynx. Although any bone can be affected, involvement of cricoid cartilage was reported very rarely, and there has been no report of 18F-sodium fluoride positron emission tomography-computed tomography (18F-NaF PET-CT) and 3D PET-CT for the evaluation of cricoid cartilage invasion.

**Patient concerns:** A 54-year-old male discovered a protruding mass in the right anterior neck, which had rapidly increased in size over a period of 2 months. Subsequently, hoarseness, dysphagia, and dyspnea were gradually developed.

**Diagnoses:** 18F-FDG PET-CT demonstrated that the abnormal activity was located in a soft tissue mass, which was about 4.2 cm × 3.8 cm × 3.6 cm in largest dimension in the laryngeal cavity of supraglottic portion (SUVmax: 23.6). A swollen lymph node was revealed in the right submandibular region, which had intense FDG activity with a SUVmax of 18.4. However, there is a high uptake of 18F-FDG in the region near the bone, which is uncertain whether there is any skeletal invasion. NaF PET-CT and 3D PET-CT demonstrated increased uptake in the right side of cricoid cartilage (SUVmax: 13.2). The histopathologic examination confirmed squamous cell carcinoma of larynx.

**Interventions:** The patient underwent tracheotomy and received anti-infective treatment to relieve symptoms of dyspnea and prevent asphyxia.

**Outcomes:** Clinical follow up of the patient revealed that dyspnea was significantly relieved.

**Lessons:** The case report shows the imaging features of cricoid cartilage invasion, including 18F-FDG PET/CT, 18F-sodium fluoride positron emission tomography-computed tomography (18F-NaF PET-CT), and 3D PET-CT. Precise understanding of the invasion scope, accurately staging of laryngeal carcinoma, and choosing of the most suitable surgical scheme are the factors that lead to the optimal treatment of laryngeal neoplasms.

**Abbreviations:** 18F-FDG PET-CT = 18F-fluorodeoxyglucose positron emission tomography-computed tomography, 18F-NaF PET-CT = 18F-sodium fluoride positron emission tomography-computed tomography, CT = computerized tomography, ENT = Ear-Nose-Throat Department, SUVmax = maximum standardized uptake value.

**Keywords:** 3D PET-CT, cricoid cartilage, laryngeal carcinoma, NaF PET-CT

1. Introduction

Laryngeal cancer is a malignant tumor occurring in the larynx, accounting for 65% to 70% of respiratory tumors. It is the third most common malignancy in the Department of ENT and the second highest cancer in the respiratory tract, behind lung cancer.[1] The disease usually begins between the ages of 50 and 70 years, and its common symptoms are progressive hoarseness, dysphagia, and dyspnea. Use of tobacco products and drinking too much alcohol can affect the risk of laryngeal cancer.

18F-sodium fluoride (18F-NaF) was the first widely used agent for skeletal scintigraphy and 18F-sodium fluoride positron emission tomography-computed tomography (18F-NaF PET-CT) has an excellent diagnostic capacity for the detection of bone metastasis.[2–4] There has been no report of 18F-NaF PET-CT for the evaluation of cricoid cartilage invasion. Here, we report a case that a patient was referred for 18F-NaF PET-CT and 3D PET-CT to evaluate a protruding mass in the right anterior neck.

2. Case report

A 54-year-old male discovered a protruding mass in the right anterior neck, which had rapidly increased in size over a period of 2 months. Subsequently, hoarseness, dysphagia, and dyspnea were gradually developed. Blood routine examination analysis revealed no abnormality. The patient was subjected to 18F-FDG PET-CT scan to estimate patient’s condition in time. Maximum intensity projection image (Fig. 1A1) showed increased FDG uptake in the neck (big arrow). On the axial images of the PET-CT images (Fig. 1B–D), the abnormal activity was located in a soft tissue mass (long arrows), which was about 4.2 cm × 3.8 cm × 3.6 cm in largest dimension in the laryngeal cavity of supraglottic portion. The soft tissue mass had a maximum...
A 54-year-old male with a mass in the right anterior neck was diagnosed with laryngeal carcinoma on 18F-FDG PET-CT scan. Maximum intensity projection image (A1: anterior view) showed increased FDG uptake in the neck (big arrow). On the axial images of the PET-CT images (B, PET; C, CT; D, fusion), increased FDG uptake located in a soft tissue mass (long arrows) in the laryngeal cavity of supraglottic portion and the right submandibular node (short arrows).

Figure 1. A 54-year-old male with a mass in the right anterior neck was diagnosed with laryngeal carcinoma on 18F-FDG PET-CT scan. Maximum intensity projection image (A1: anterior view) showed increased FDG uptake in the neck (big arrow). On the axial images of the PET-CT images (B, PET; C, CT; D, fusion), increased FDG uptake located in a soft tissue mass (long arrows) in the laryngeal cavity of supraglottic portion and the right submandibular node (short arrows).

Figure 2. A 54-year-old male with a mass in the right anterior neck was diagnosed with laryngeal carcinoma on 18F-NaF PET-CT scan. An increased NaF uptake located in the bones of the neck (short arrows) was shown in the coronal images (E1: PET, E2: CT, and E3: fusion) and the sagittal images (F1: PET, F2: CT, and F3: fusion).

standardized uptake value (SUVmax) of 23.6. A swollen lymph node (short arrows) was revealed in the right submandibular region, which had an intense FDG activity with a SUVmax of 18.4 (Fig. 1B, D). According to the imaging data, we diagnosed laryngeal carcinoma with lymph node metastasis. However, the high uptake of FDG cannot evaluate whether the cartilage has been invaded. Subsequently, 18F-NaF PET-CT scan, 3D reconstruction, and 3D PET-CT were performed to determine whether the bone was invaded or not. Uptake of 18F-NaF is increased (Fig. 2) in the bones of the neck (short arrows). Bone
Changes were not seen in the 3D images (Fig. 3G), but 3D PET-CT images (Fig. 3H) demonstrated that there was a focus of tracer activity (arrows) only in the right side of cricoid cartilage (SUVmax: 13.2). As PET/CT scan raised the possibility of malignant laryngeal tumor, the patient was admitted to our hospital. Physical examination found a swollen lymph node in the right anterior neck, which was similar in size to a grape. An ultrasound-guided lymph node puncture biopsy was implemented to confirm the nature of the mass, which confirmed squamous cell carcinomas. Therapeutic approaches[5] are as follows: 1. Chemotherapy and radiation therapy given together. Laryngectomy may be done if cancer remains. 2. Surgery followed by chemotherapy and radiation therapy given together. Partial laryngectomy is almost impossible because of the wide range of tumor invasion and the involvement of cricoid cartilage. The patient cannot reserve phonetic function after the surgery. 3. Palliative treatment. Unfortunately, the patient ultimately chose the last option, palliative care. The patient underwent tracheotomy and received anti-infective treatment to relieve symptoms of dyspnea and prevent asphyxia before discharge. Clinical follow-up of the patient revealed that dyspnea was significantly relieved.

3. Discussion

Laryngeal neoplasms form in the tissues of the larynx (area of the throat that contains the vocal cords),[5] of which squamous cell carcinoma is the most, and accounts for 85% to 95%. The most common clinical symptoms of laryngeal neoplasms are hoarseness, dysphagia, and dyspnea. These specific clinical presentations make laryngeal neoplasms easy to be diagnosed. However, due to the complex anatomical structure of the neck, conventional imaging is difficult to locate the invasive lesions and observe the invasion range accurately. Recent comparative studies have demonstrated that 18F-NaF PET-CT is more accurate than 99mTc-diphosphonate single-photon emission computed tomography for identifying both malignant and benign lesions of the skeleton and offers shorter study times (typically less than 1 hour), resulting in a more efficient workflow, improved patient convenience, and faster turnarounds of reports to the referring physicians.[6]

The treatment of laryngeal cancer includes surgery, chemotherapy, and new types of treatment, which are being tested in clinical trials, such as targeted therapy and radiosensitizers.[5] In 1863, H.B Sands performed the first partial laryngectomy for a patient with laryngeal cancer in the world. After that, laryngeal cancer surgical procedures underwent a historical process from partial laryngectomy to total laryngectomy, and the transition from total laryngectomy to partial laryngectomy. At present, surgery is supplemented by radiotherapy and chemotherapy, which is the cornerstone of the treatment of laryngeal cancer, and the 5-year survival rate is 79%.[7] After laryngectomy, a series of changes in physiology, psychology, and society are caused by the
loss of laryngeal function. With the continuous improvement of treatment methods and the paradigm shift of the medical model, people began to pay more attention to the quality of life, not only the survival rate. There was no significant difference in the treatment effect of partial laryngectomy and total laryngectomy, but the partial laryngectomy was able to retain the laryngeal function and improve the quality of the patients’ survival. For example, partial laryngectomy with either cricohyoidoepiglottopexy (CHEP) is mainly used to treat glottic cancers because they ensure a satisfactory preservation of physiological functions and satisfactory local carcinologic control.

In order to choose the most suitable surgical scheme, the radiologist is required to have a precise understanding of the invasion scope of laryngeal carcinoma to surrounding tissues and to accurately stage laryngeal carcinoma.

4. Conclusion

Our case illustrates that there is a high uptake of $^{18}$F-FDG in the region near the bone, which is uncertain whether there is any skeletal invasion, so $^{18}$F-NaF PET/CT is critical for the diagnosis of skeletal invasion and 3D PET-CT images are helpful in locating invasion lesions and observing the scope of invasion visually at complex anatomic sites, resulting in further appropriate management and that $^{18}$F-NaF PET-CT and 3D PET-CT fusion may be useful to detect occult lesions, such as bone metastases, which have no bone changes. Therefore, $^{18}$F-NaF PET-CT and 3D PET-CT fusion should be kept in mind for differential diagnosis of skeletal invasion.

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