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ROLE OF POSITRON EMISSION TOMOGRAPHY-COMPUTED TOMOGRAPHY IN RECURRENCE POSTOPERATIVE LARYNGEAL MALIGNANCY

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ABSTRACT

Background: The leading factors associated with mortality in laryngeal malignancy are the recurrence of pathology and spread of the disease. Anatomical and histological changes induced by surgery with or without complementary radiation therapy for the initial laryngeal malignancy may make it more difficult to confirm recurrence or remnant pathology. Increased precision in the confirmation of recurrence in head and neck malignancy can be achieved using various therapeutic methods, such as fluorodeoxyglucose-positron emission tomography-computed tomography. **Goal:** To assess the confirmation precision of fluorodeoxyglucose-positron emission tomography-computed tomography in cases of possible postoperative recurrence of laryngeal malignancy treated with or without complementary radiotherapy. **Methods:** Our retrospective investigation included 104 participants, who were assigned to various operative procedures with or without complementary radiotherapy for the initial laryngeal malignancy. Confirmation of possible recurrence was undertaken using fluorodeoxyglucose-positron emission tomography-computed tomography after clinical computed tomography and magnetic resonance imaging between January 2010 and January 2020, at the nuclear medicine department, King Hussein medical center, Jordanian Royal medical services, Amman, Jordan. The inclusion criteria assumed that subjects were assigned to fluorodeoxyglucose-positron emission tomography-computed tomography imaging because of inability to determine recurrence using clinical and computed tomography or magnetic resonance imaging. The disease stage was clinically evaluated in terms of the 7th TNM staging (AJCC). Positron subjects were intravenously administered 18F-FDG (37 MBq/10 kg body weight) (EANM) (8). The investigation extended from the skull to the middle of the thigh [scan at 10 mA, CT scan (120 kVp, 50–120 mA) and a 3D whole-body PET scan (2 min) (OSEM)]. Emission tomography-computed tomography was classified as true positive and true negative, and sensitivity and specificity were determined. **Results**: Fifty-nine subjects were included and 45 subjects were excluded. In 32 subjects (54.2%), there was a possible recurrence of T (15 of SCL, 5 of SGL and 12 of TL) and in 27 subjects (45.8%), there was a possible N. In 15 out of 32 subjects, PET/CT was positive. In the other 17 subjects, PET/CT and biopsy were negative with no recurrence at the initial location. Specificity and sensitivity of positron emission tomography-computed tomography were 86.8% and 98.8%, respectively. Regarding the possible recurrence in the initial location; sensitivity and specificity of positron emission tomography-computed tomography were 98.8% and 86.3%, respectively. In possible spread of neck pathology, positron emission tomography-computed tomography had a sensitivity and specificity of 98.8% and 88.8%. **Conclusion**: Positron emission tomography-computed tomography in laryngeal cancer is helpful in cases of possible recurrence where traditional computed tomography or magnetic resonance cannot confirm the diagnosis.

KEYWORDS: Laryngeal: Malignancy, Recurrence, PET/CT; Sensitivity, Specificity.

INTRODUCTION

Following oral cavity malignancy, laryngeal malignancy has the highest incidence of malignancies of the head and neck. Globally, laryngeal malignancy is the 6th most frequent malignancy.[1] Management of the development of malignancy has enhanced the lives of patients via new operative procedures and multimodal management.[2] Unfortunately, the life span of subjects with advanced pathology has not improved. The leading factors associated with mortality are the recurrence of pathology and spread of the disease.[3] Anatomical and histological changes caused by operation, with or without complementary radiotherapy, in laryngeal malignancy may make it more difficult to confirm recurrence or remnant pathology using physical examination, computed tomography or magnetic resonance imaging.[3] Post initial management, precise confirmation of early

recurrence is mandatory, as salvage management is less beneficial when the disease is advanced.[3]

Positron emission tomography has been shown to be important in pre-management staging, complementary radiotherapy, and assessment of the reaction to chemotherapy or radiotherapy of head and neck malignancies.[4,5] Increased confirmation precision of malignancy recurrence following various management methods has been achieved with fluorodeoxyglucose (FDG)-PET/CT.[3] Various methods of management for various sites have encountered clinical issues in confirmation of recurrent pathology. In laryngeal malignancy, attention has been focused on the confirmation precision of PET/ CT and pre-management staging. PET for the confirmation of recurrent laryngeal malignancy has been limited, as PET has not been used in follow up imaging protocols.[6]

The objective of our investigation was to assess the confirmation precision of FDG-PET/CT in possible recurrence of laryngeal malignancy with or without complementary treatment using ionizing radiation.

METHODOLOGY

Our retrospective investigation enrolled 104 subjects who were exposed to different operative management schemes with or without complementary radiotherapy for initial laryngeal malignancy with FDG-PET/CT imaging, between January 2010 and January 2020, at the nuclear medicine department, King Hussein medical center, Jordanian Royal medical services, Amman, Jordan. Written informed consent was obtained from all subjects. Inclusion criteria assumed that subjects were assigned to FDG-PET/CT imaging due to possible recurrence or subjects with minimal 180 days' observation following PET/CT.

The disease stage was clinically evaluated using the 7th TNM staging (AJCC).[7] One month postoperatively, clinical assessment was undertaken and participants were monitored at 90-day intervals. True-positives were classified based on a malignant PET/CT with recurrence or spreading pathology according to surgical or pathological findings. True-negatives were classified based on a PET/CT negative for malignancy and with negative histopathology or a stable clinical picture for duration of 180 days. The sensitivity and specificity of PET/CT for detecting recurrence was investigated.

PET/CT without contrast was performed. Participants were nil by mouth for 6 h before PET/ CT, and were administered 18F-FDG (EANM).[8] The investigation extended from the skull to the middle of the thigh. The CT volume included 512 × 512 voxels of 1.36 × 1.36 × 3.75 mm^3.

PET/CT was considered positive for malignancy if: 1) the node's longest axial diameter was more than 15 mm for stages I and II, or more than 10 mm for III–V[9,10]; and 2) lesions or lymph nodes had increased FDG avidity higher than mediastinal blood pool activity.

RESULTS

Fifty-nine patients were investigated: 55 men and four women, with a median age of 61.5 years. (Range: 40–74 years.). Forty-five subjects were excluded (those patients were not included in our study due to ether inadequate follow up or missed clinical or pathological data), we included patients known case of laryngeal Ca who had previous laryngectomy with or without neck dissection and with or without radiotherapy referred for PET-CT suspicious of recurrence. Fourteen participants were diagnosed with squamous cell supra-glottic carcinoma, 23 with squamous cell glottic carcinoma and 22 with squamous cell transglottic carcinoma. Based on TNM score, five subjects were scored as T1b, 18 as T2, 21 as T3 and 15 as T4. At the same time point, 32 subjects were scored as N0, 17 as N1 and ten as N2.

Twenty-one patients had supracricoid laryngectomy (SCL), eight had supraglottic laryngectomy (SGL) and 30 had total laryngectomy (TL). Thirty-two subjects (54.2%) had unilateral SCL (16) or bilateral SCL (16) neck dissection (Table I). The median period between the last therapy and PET/CT was 11 m (8–23 m). Thirty-two subjects (54.2%) had a possible recurrence of T (15 of SCL, five of SGL and 12 of TL) and 27 subjects (45.8%) had a possible N.

In 15 out of 32 subjects, PET/CT was positive and carcinoma was detected on biopsy. In the other 17 subjects, PET/CT and biopsy were negative with no recurrence at the initial location. Complementary radiotherapy was performed in 20 subjects out of 59.

In 27 subjects with possible neck tumor spread pathology, 19 had neck dissection (bilateral in ten subjects and unilateral in nine subjects), of which seven had complementary radiotherapy. Twelve subjects with no findings on PET/CT had been monitored for more than 180 days without progressive neck pathology. Within the 59 participants, PET/CT had a specificity and sensitivity of 86.8% and 98.8%, respectively. For possible recurrence at the initial location, PET/CT had a sensitivity and specificity of 98.8% and 86.3%. For possible spread neck pathology, PET/ CT had a sensitivity and specificity of 98.8% and 88.8% (Table II). This study revealed that the measurement of the area under the curve (AUC) for MRI and PET/CT are 0.776 and 0.864 respectively.

Table I: Patient characteristics.

Item	Value
Number of patients	59
Gender	
M	55
F	4
Age (years; median; range)	61.5 (40–74)
T staging (no.)	
T1b	5
T2	18
T3	21
T4	15
N staging (no.)	
0	32
1	17
2	10

Table II: Positron emission tomography-computed tomography diagnostic outcome.

Recurrence location	Sensitivity	Specificity
All	98.8%	86.8%
Possible malignancy recurrence at the **initial location**	98.8%	86.3%
Possible spread of neck **nodal pathology**	98.8%	88.8%

DISCUSSION

PET/CT in laryngeal masses includes pre-therapy confirmation of lymph nodes in order to enhance neck surgery [(11)] and the assessment of reaction to complementary radiotherapy or pathology recurrence after complementary radiotherapy or chemo radiation therapy.[12] The importance of PET/CT during possible reoccurrence or lymph node confirmation in laryngeal malignancy managed by open operation was investigated. The anatomical and structural change was greater than in endoscopic operation, complementary therapy using ionizing radiation, or chemo/radiotherapy. Fibrosis, oedema, and asymmetry of the soft tissues and remnant anatomical items make it harder to confirm recurrence. In our investigation, PET/CT had a sensitivity and specificity of 98.8% and 86.8%, respectively.

Sensitivity and specificity of the confirmation of reoccurrence was 93.75% and 91.67%, respectively, after various management methods for laryngeal malignancy.[13] Sensitivity and specificity were 96% and 87% in subjects with laryngeal malignancy after various management methods, with PET/CT being done 180 days between.[14] PET/CT sensitivity and specificity were 100% in laryngeal malignancy.[15] PET/CT is more important in the confirmation of reoccurrence in laryngeal carcinomas. In our investigation, based on the location of possible recurrence and the evaluation of recurrence (T), sensitivity and specificity were 98.8% and 86.3%. In possible spread pathology (N), PET/CT sensitivity and specificity were 98.8% and 88.8%.

PET/CT for confirmation of reoccurrence of spread pathology laryngeal malignancy had very varied findings in terms of sensitivity and specificity.[15,16] The high importance of PET/ CT in the assessment of spread pathology based on recurrence is explainable, as in 71.4% of patients; the location of lymph node spread in the neck was not dissected. In open operation, confirmation is increasingly hampered by character and irregularities post therapy. Use of PET/CT in the protocol for monitoring of laryngeal malignancy in asymptomatic patients did not result in benefits regarding lifespan[17], but is beneficial in patients with signs of relapse during monitoring.

CONCLUSION

PET/CT in laryngeal malignancy is useful in cases of possible recurrence where traditional imaging (CT and MRI) are unable to confirm the diagnosis.

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