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Performance of NI-RADS on CECT Alone to Predict Recurrent Head and Neck Squamous Cell Carcinoma after Chemoradiotherapy: Added Value of RECIST 1.1.

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Abstract

Background The Head and Neck Imaging Reporting and Data System (NI-RADS) is a standardized reporting format for the categorization of the degree of suspicion for recurrent head and neck malignancies on positron emission tomography/computed tomography.

Purpose The purpose of our study was to analyze the efficacy of the NI-RADS rating scale and criteria for contrast-enhanced computed tomography (CECT) alone in predicting the local and regional recurrence of malignancies after chemoradiotherapy.

Material and Methods CECT of the patients with head and neck cancers receiving radiotherapy and concurrent chemotherapy as a primary treatment was obtained 3 months after the completion of radiotherapy and NI-RADS scoring was done using components of Response Evaluation Criteria in Solid Tumors (RECIST 1.1) criteria. Their management was guided according to the recommendations based on their NI-RADS score.

Results Thirty patients with squamous cell carcinoma of the neck were included in this study. The positive or negative status of the recurrent disease was based on biopsy results or follow-up protocol as recommended in NI-RADS rating scale. Fifteen patients had path proven recurrence at the primary tumor site. For primary tumor site, disease persistence rates of 4% for NI-RADS 1, 24% for NI-RADS 2, and 80% for NI-RADS 3 scores were seen. Five patients had recurrent lymph nodal disease. For lymph nodal assessment, NI-RADS categories 1, 2, and 3 revealed nodal disease recurrence rates of 5.3, 25, and 66.7%, respectively.

Conclusion CECT alone may be used to assign the NI-RADS rating scale using RECIST 1.1 criteria to predict the presence or absence of recurrent tumor in patients with neck malignancies.

Keywords
- head/neck
- CT
- larynx
- adults
- neoplasms-primary

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Introduction

Head and neck cancers are among the most common cancers in developing countries, especially in Southeast Asia. Overall, 57.5% of global head and neck cancers occur in Asian countries and India.[1] Radiation therapy alone or combined with chemotherapy, surgery, or both is a mainstay for the treatment of head and neck cancers. Advances in three-dimensional (3D) radiation planning and computer-controlled delivery have resulted in 3D conformal radiation therapy and intensity-modulated radiation therapy (IMRT).[2] These therapies allow delivery of a therapeutic dose to the tumor while reducing the dose to the surrounding tissues and thus minimizing unwanted side effects.[3] Radiation-induced tissue damage and death occur from the destruction of endothelial cells lining small blood vessels[4] This results in ischemia, edema, and inflammation and then delayed fibrosis of adjacent tissues. Radiation-induced changes may decrease the conspicuity of residual tumors or may be mistaken for residual or recurrent disease.[5]

Radiology plays an important role in the identification of treatment failure and recurrent disease after radiotherapy. Computed tomography (CT) scan is the most commonly used modality used to assess postradiotherapy changes in neck malignancies and response is assessed using a quantitative tool called Response Evaluation Criteria in Solid Tumors (RECIST 1.1). In the past two decades, positron emission tomography (PET) scan has been increasingly used in combination with CT to harness the metabolic capability of PET along with the anatomical information of CT. Response assessment using PET scan is done using Hopkins criteria or the PET Response Criteria in Solid Tumors (PERCIST).[6] Neck Imaging-Reporting and Data System (NI-RADS) is a standardized report format with a linked follow-up recommendation for patient management describing a template for both contrast-enhanced CT (CECT) scan and for CECT combined with PET scan.[7,8] Utilization of fluorodeoxyglucose-positron emission tomography (FDG-PET) with CT allows the assessment of metabolic activity along with the anatomical characteristic of the tumor site. It also helps to reduce ambiguity and variability of narrative interpretation by the use of numerical categories to convey levels of suspicion of disease recurrence. FDG-PET CT scan as a modality is not commonly available and is an expensive investigation, especially in developing countries where the burden of head and neck malignancies is high; our focus is to study the sensitivity of the more common and easily available CECT in predicting the local and regional residual malignancies in routine follow-up scans. It is important to develop a cost-effective approach to provide adequate care and management for malignancies with a high burden in developing countries. The purpose of our study was to analyze the efficacy of the NI-RADS rating scale and criteria for CECT alone in predicting the local and regional disease recurrence. We hypothesized that postcontrast enhancement characteristics and use of RECIST 1.1 criteria to refine the assignment of NI-RADS rating can yield a satisfactory diagnostic accuracy in the prediction of recurrent tumor after radiotherapy.

Materials and Methods

Subjects

This was a prospective observational study and was performed from June 2017 to June 2019 in a university-based tertiary-care Hospital. At the outset, approval from the institutional ethical committee was obtained and patients were enrolled in this study after obtaining informed consent. In this study, we included patients with primary head and neck squamous cell carcinoma treated with radiotherapy. All the patients had undergone a pretreatment baseline CT scan and completed radiotherapy at the hospital. Concurrent chemotherapy was administered with cisplatin 40 mg/m^2 once a week. At the time of recruitment, all the data regarding the clinical details, investigation reports, histopathological reports, and treatment details were gathered. A repeat CECT of the involved area was obtained 3 months after completion of radiotherapy and NI-RADS scoring was done and their management was guided according to the recommendations based on their NI-RADS score. The patients with recommendations for follow-up were subsequently followed up for 3 to 6 months. Tumor recurrence was considered if the patients had a biopsy positive for squamous cell carcinoma, or there was evidence of disease progression on subsequent imaging, or if there was an obvious tumor on physical examination. For declaring lack of tumor recurrence, we assessed the following: (1) follow-up imaging at least 90 days after the index scan, (2) clinical follow-up for at least 6 months without evidence of recurrent disease, or (3) biopsy of an abnormality detected on the index scan with pathology results negative for tumor. Patients were excluded from this study if they were lost to follow-up or if they underwent surgical treatment. Further, patients with NI-RADS category X (primary image not available) or category 4 (known recurrence) were excluded.

Image Acquisition

CT was performed using 64-row multi-detector CT scanner (Light speed, General Electric Medical Systems, Milwaukee, Wisconsin, United States). Scans were obtained after injection of 80 to 100 mL nonionic iodinated contrast media iohexol 300 mg I/mL (Omnipaque 300, GE Healthcare, Princeton, New Jersey, United States) using a double head automated pressure injector followed by 30 to 50 mL saline chaser at 2 to 3 mL/s.

Following volume acquisition (at 120kv, 320 mAs, pitch 1.375:1, rotation 55, detector coverage 40mm, slice thickness during acquisition 5mm) during one breath-hold, 0.625mm slices were reconstructed from the level of frontal sinus to T4 vertebra.

Image Analysis

The images were analyzed on an offline workstation (Advantage Windows; General Electric Medical Systems), postprocessing to generate thin/thick, multiplanar reformation images. All the posttreatment scans were analyzed with pretreatment scans by two radiologists together, with 8 and 17 years of experience, respectively, and the final report

was based on consensus between the two. First, the scans were analyzed for expected postradiation changes such as thickening of skin and platysma, reticulation of subcutaneous fat, edema and/or minimal fluid in the retropharyngeal space, diffuse thickening and increased enhancement of the pharyngeal walls, laryngeal structures, increased density of fat in preepiglottic space, and paralaryngeal spaces (►**Fig. 1**). Next, the primary tumor site was analyzed for the presence of focal mucosal enhancement, presence of soft tissue, or enhancing nodular tissue. A note was made of the degree of enhancement (comparing the HU difference from baseline scan), size of enhancing lesion, and definition of margin of the lesion. Categorization of the lesions into NI-RADS rating was assigned as described in ►**Table 1**. The nodal sites were analyzed in tandem with the pretreatment images. The definition of the NI-RADS score was assigned similar to RECIST 1.1 criteria[9] as described in ►**Table 1**. For more than one lymph node, NI-RADS categorization of all the malignant lymph nodes was done and the one with the highest score was finally taken as the lymph nodal NI-RADS score of the patient.

The template-driven surveillance protocol and linked management options laid by NI-RADS criteria were followed in all of the patients. NI-RADS 1 lesions were subjected to routine 6 months follow-up. NI-RADS 2a lesions required direct clinical or laryngoscopic inspection. If the inspection did not reveal malignancy, the patients were subjected to 3 months follow-up. NI-RADS 2b lesions underwent short-term follow-up by CT scan. NI-RADS 3 lesions were biopsied. The rate of recurrent disease in each NI-RADS category and sensitivity of NI-RADS low-suspicion and high-suspicion categories in predicting the absence/presence of disease recurrence was analyzed.

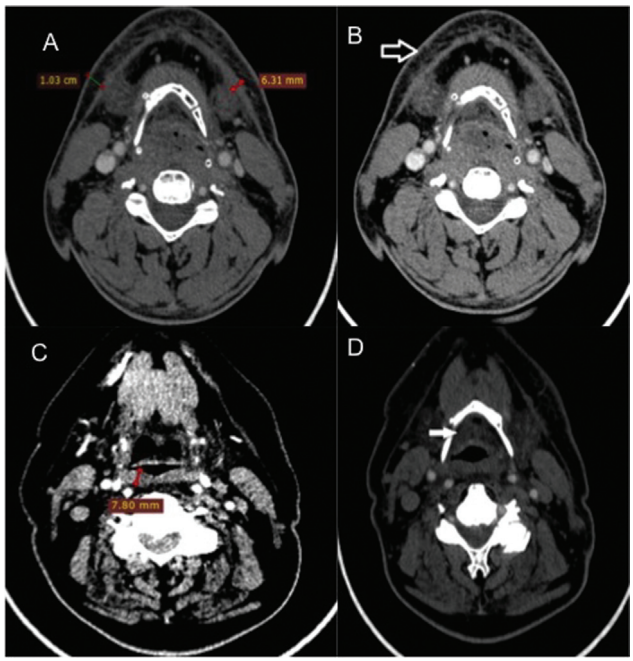

Fig. 1 Expected postradiation changes. Axial sections of follow-up computed tomographic scan of patients at 3 months after completion of radiotherapy showing (**A**) thickening of skin and platysma, (**B**) reticulation of subcutaneous fat (*arrow*), (**C**) thickening (*calipers*) of pharyngeal wall, and (**D**) increased preepiglottic fat (*arrow*).

Table 1 NI-RADS descriptors based on CECT for primary tumoral site and lymph nodal assessment. For lymph nodal assessment, RECIST 1.1 criteria were used for NI-RADS categorization

Primary tumor site	
NI-RADS 1	➢ Nonmass-like distortion of soft tissues ➢ Low-density nonenhancing submucosal or mucosal edema ➢ Diffuse mucosal enhancement without deep extension ➢ Expected postradiation changes such as thickening of skin and platysma, reticulation of subcutaneous fat, retropharyngeal space edema, thickening of the pharyngeal walls, increased density of fat in preepiglottic space, and paralaryngeal space
NI-RADS 2a	➢ Focal mucosal enhancement ➢ Enhancement deep to ulceration
NI-RADS 2b	➢ Ill-defined nonmass-like deep tissue with only mild contrast enhancement
NI-RADS 3	➢ Discrete enhancing nodules/ lesions with a mass-like appearance with intense or moderate enhancement
Lymph nodal assessment	
NI-RADS 1	➢ Lymph nodes that shrunk to size <1 cm in the short axis ➢ Lymph nodes showing at least a 30% decrease in short axis diameter ➢ Lymph nodes showing significant hypo-enhancement compared with previous image
NI-RADS 2	➢ Lymph nodes showing neither adequate shrinkage nor progression to qualify for NI-RADS 1 or NI-RADS 3
NI-RADS 3	➢ Presence of new enlarged malignant appearing lymph nodes ➢ For nodes >15 mm in pretreatment scan • If the diameter showed an increase in 20% short-axis diameter • Attained new morphologically abnormal features such as necrosis or extranodal extension ➢ For lymph nodes measuring 10–15 mm in pretreatment scan, unequivocal progression was decided based on the judgment of the two radiologists and was not based on a modest increase in size

Abbreviations: CECT, contrast-enhanced computed tomography; NI-RADS, Neck Imaging-Reporting and Data System; RECIST 1.1, Response Evaluation Criteria in Solid Tumors.

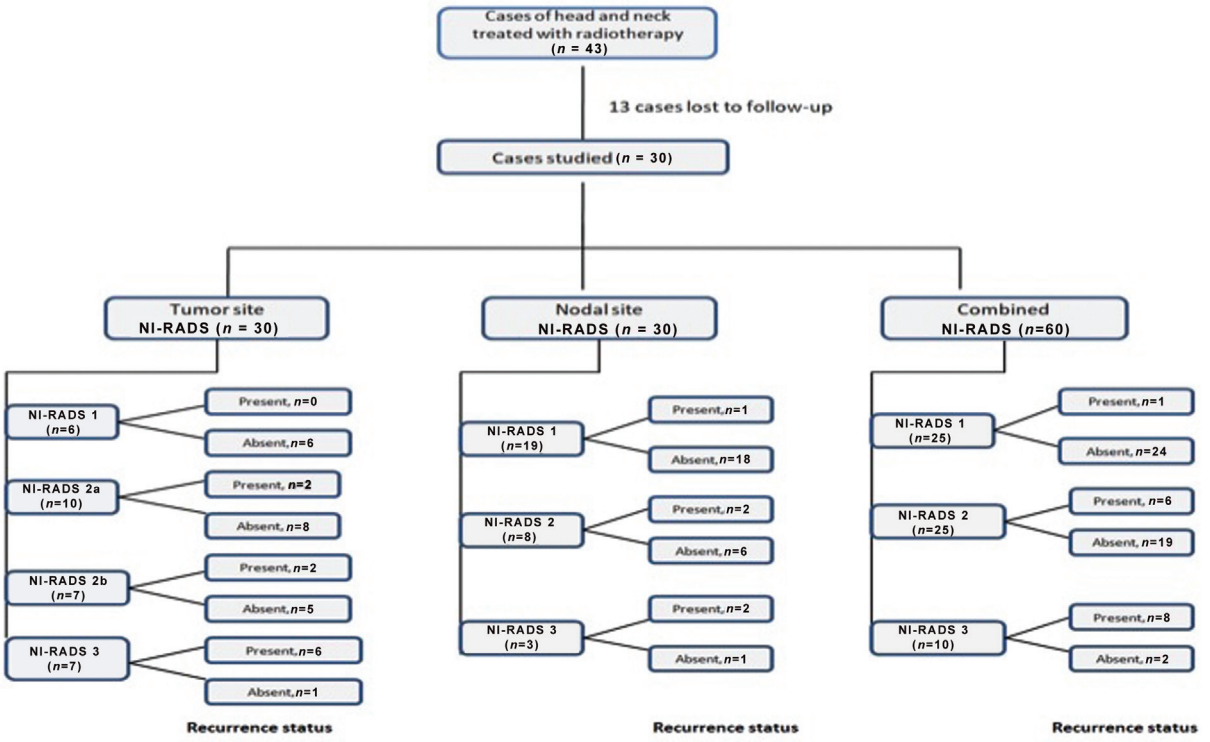

Fig. 2 Flowchart summarizing the inclusion of the patients and their Neck Imaging-Reporting and Data System (NI-RADS) categorization.

Results

Initially, 43 patients were present in our study, out of which 13 were lost to follow-up (►**Fig. 2**). The rest 30 patients completely matched our inclusion criteria with adequate follow-up and were included in our study. The mean age of the patients was 49 years with a male to female ratio of 14:1. Out of 30 patients, we included carcinoma of the pyriform fossa ($n = 5$), base of tongue ($n = 7$), supraglottic region ($n = 8$), and glottis ($n = 10$). In our study, the highest number of patients were of glottic carcinoma (33.3%). Recurrent disease was detected in 10 of the patients who were all males. All 10 of these patients showed recurrent disease at primary tumor that included, 6 lesions of the laryngeal region (3 glottic carcinoma and 3 supraglottic carcinoma), 2 lesions of pyriform fossa, and the rest of the 2 lesions were of carcinoma of the base of tongue. Five of these patients also showed lymph nodal recurrence where primary sites of tumors were base of tongue ($n = 2$), supraglottic larynx ($n = 1$), glottis carcinoma ($n = 1$), and pyriform fossa ($n = 1$). The summary of NI-RADS scores in our patients and final outcome has been presented in ►**Fig. 1**.

Site-Specific Analysis

►**Table 2** summarizes the site-specific categorization of postradiotherapy scans into NI-RADS scores along with their corresponding numbers of recurrent disease. Seven patients in our study had the base of tongue as the primary site (►**Fig. 3**) of which two showed recurrent disease at the tumor site and nodal site. In one of the patients, a lymph node was labeled as NI-RADS III owing to the mildly increased size (20% increase in short axis diameter) and increased necrosis that showed no subsequent disease recurrence. In another case, a submandibular lymph node was designated as NI-RADS I because of reduction in size less than 1 cm, while the follow-up showed nodal recurrent disease and subsequent increase in nodal size. Five patients had pyriform fossa as the primary site of the tumor of which recurrent disease was noted in two patients (►**Fig. 4**) rated as NI-RADS 3 and 2b categories, respectively. Eight patients had supraglottic laryngeal carcinoma as the primary site (►**Fig. 5**). Tumor site recurrent malignancy was present in three of the eight supraglottic carcinoma patients (37.5%). Two of these patients were assigned into category NI-RADS 3 for tumor site and one was assigned NI-RADS 2b for tumor site. One of the patients in NI-RADS 3 category for the nodal site showed evidence of nodal disease recurrence. Ten patients in our study had glottis as the primary tumor site, of which three showed recurrent disease (►**Fig. 6**). Two of these patients were assigned NI-RADS 3 category for tumor site, while one patient was assigned 2a category. One of the patients in the NI-RADS 2 category for the nodal site also showed nodal disease recurrence.

Tumor Site NI-RADS

►**Table 3** summarizes the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of individual NI-RADS scores at primary tumor site in our study. Six of the patients were assigned NI-RADS 1 for primary site, of which none showed signs of recurrence on

Table 2 Site-specific categorization of postradiotherapy scans into NI-RADS scores along with their corresponding numbers of recurrent diseases

NI-RADS	Base of tongue carcinoma ($n=7$)		Pyriform fossa carcinoma ($n=5$)		Supraglottic larynx carcinoma ($n=8$)		Glottic carcinoma ($n=10$)	
	No of patients	Recurrent disease present	No of patients	Recurrent disease present	No of patients	Recurrent disease present	No of patients	Recurrent disease present
Primary tumor site								
1	2	0	1	0	0	0	3	0
2a	2	1	2	0	2	0	4	1
2b	1	0	1	1	4	1	1	0
3	2	1	1	1	2	2	2	2
Lymph nodes								
1	3	1	3	0	4	0	9	0
2	2	0	2	1	3	0	1	1
3	2	1	0	0	1	1	0	0

Abbreviation: NI-RADS, Neck Imaging-Reporting and Data System.

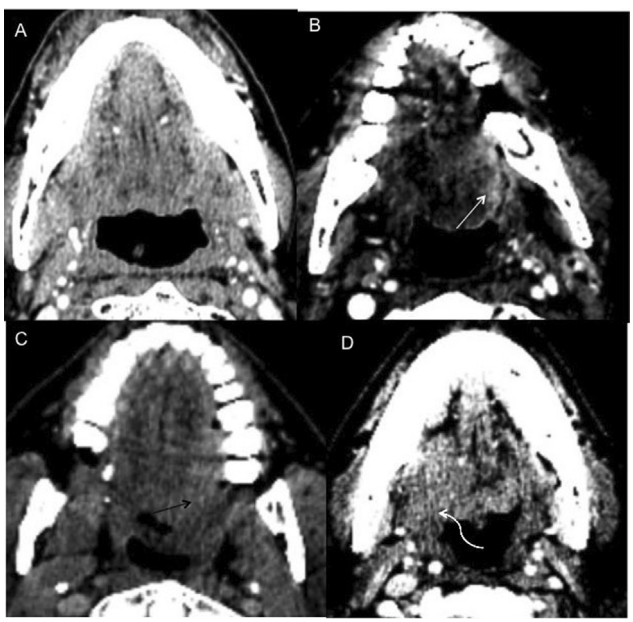

Fig. 3 Follow-up computed tomographic scans of postradiotherapy carcinoma of base of tongue. (**A**) Neck Imaging-Reporting and Data System (NI-RADS) 1. (**B**) NI-RADS 2a—Asymmetrical mucosal enhancement on left side (*white arrow*). (**C**) NI-RADS 2b—nonenhancing soft tissue lesion on left side (*black arrow*). (**D**) NI-RADS 3—moderately enhancing mass lesion on right side (*curved white arrow*).

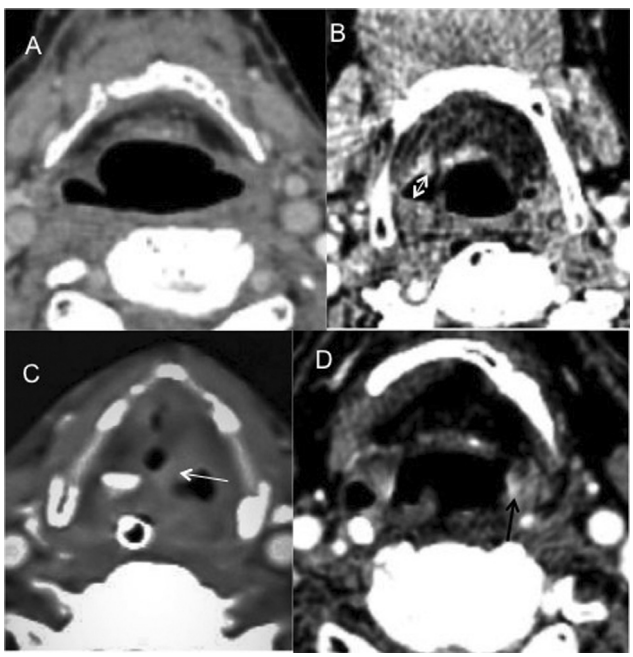

Fig. 4 Follow-up computed tomographic scans of postradiotherapy carcinoma of pyriform sinus. (**A**) Neck Imaging-Reporting and Data System (NI-RADS 1). (**B**). NI-RADS 2a—asymmetrical mucosal enhancement on right side (*white double arrow*). (**C**) NI-RADS 2b—minimally enhancing soft tissue lesion on left side (*white arrow*), subsequently positive for recurrent disease. (**D**) NI-RADS 3—frankly enhancing soft tissue lesion on left side (*black arrow*).

follow-up for 6 months. A NI-RADS score of 2 or higher had a high sensitivity (100%) and low specificity (30%) in prediction of recurrent disease. NI-RADS score of 2b or higher had a high specificity (70% respectively) compared with score of 2a that had a low specificity (30%). Ten of the patients were assigned NI-RADS 2a category and were referred for direct visual inspection based on the American College of Radiology recommendations of which two patients revealed recurrent disease. Two of the seven category 2b patients showed recurrent malignancy. In both these patients, the largest dimension of enhancing component measured more than 1cm (11 mm and 15 mm respectively), while in the other patients with NI-RADS 2b lesions and absent recurrent malignancy, the largest dimension was 9mm or lower. A NI-RADS score of 3 had a high specificity (95%) but a lower sensitivity (60%) in prediction of recurrent malignancy.

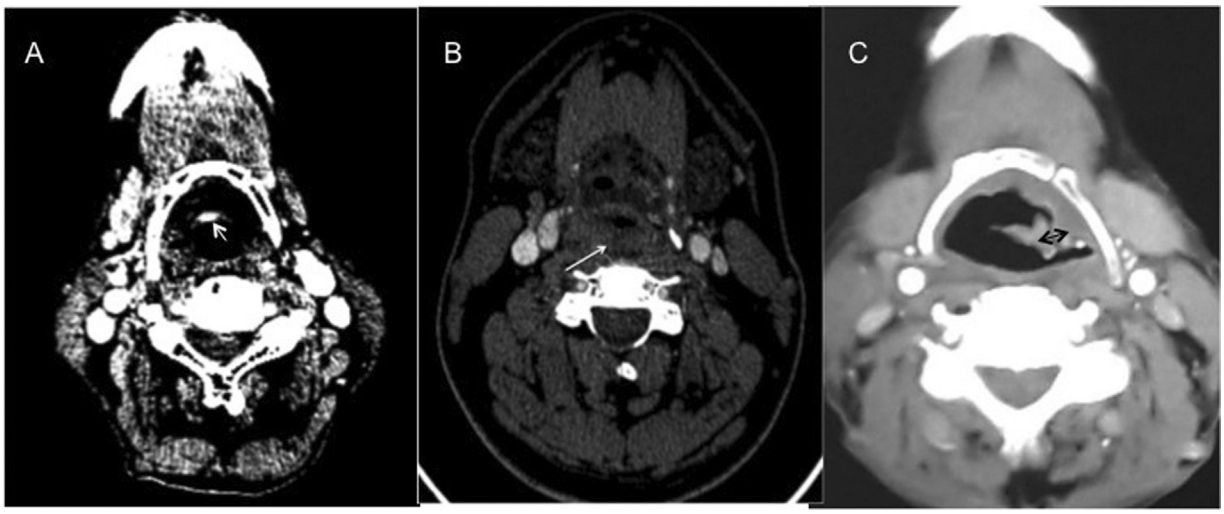

Fig. 5 Follow-up computed tomographic scans of postradiotherapy supraglottic carcinoma. (**A**) Neck Imaging-Reporting and Data System (NI-RADS) 2a—anterior focal mucosal enhancement (*short arrow*), negative for recurrent disease. (**B**) NI-RADS 2b—nonenhancing increased soft tissue bulk (*white arrow*). (**C**) NI-RADS 3—irregularly thickened epiglottis and supraglottic mucosa on the left side (*double black arrow*).

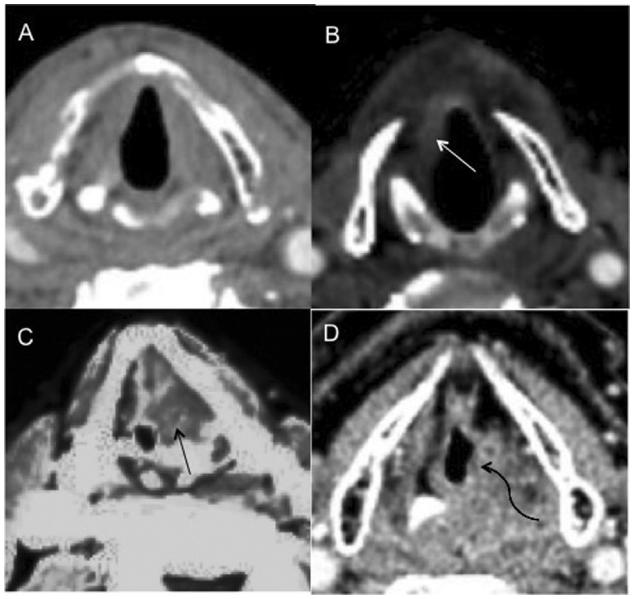

Fig. 6 Follow-up computed tomographic scans of postradiotherapy glottic carcinoma. (**A**) Neck Imaging-Reporting and Data System (NI-RADS 1). (**B**) NI-RADS 2a—asymmetrical mucosal enhancement on right side anteriorly (*white arrow*). (**C**) NI-RADS 2b—nonenhancing left-sided soft tissue (*black arrow*). (**D**) NI-RADS 3—enhancing lesion on left side posteriorly (*curved black arrow*).

Table 3 Sensitivity, specificity, PPV, and NPV of individual NI-RADS score at primary site of malignancy

NI-RADS score	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)
≥1	100	0	33	–	33.33
≥2a	100	30	42	100	53.33
≥2b	80	70	57	87	73.33
≥2	100	30	42	100	53.33
≥3	60	95	86	83	83.33

Abbreviation: NI-RADS, Neck Imaging-Reporting and Data System.

Neck NI-RADS Analysis

The majority of the patients (19 out of 30) were assigned NI-RADS 1 category (►**Fig. 7A**) for the nodal site due to the presence of residual nodal tissue less than 1 cm in the short axis or disappearance of the nodes leaving some strand of residual tissue. One of these patients showed recurrent disease at the nodal site. Eight of the patients were assigned NI-RADS 2 (►**Fig. 7B**) due to the presence of mildly enlarging

Table 4 Tumor recurrence rate in different NI-RADS categories

Tumor site NI-RADS	Percentage of patients with recurrent disease	Nodal site NI-RADS	Percentage of patients with recurrent disease	Combined NI-RADS	Tumor recurrence rate
NI-RADS 1	0%	NI-RADS 1	5.3%	NI-RADS 1	4%
NI-RADS 2a	20%	NI-RADS 2	25%	NI-RADS 2	24%
NI-RADS 2b	28.5%				
NI-RADS 3	85.7%	NI-RADS 3	66.7%	NI-RADS 3	80%

Abbreviations: NI-RADS, Neck Imaging-Reporting and Data System; NPV, negative predictive value; PPV, positive predictive value.

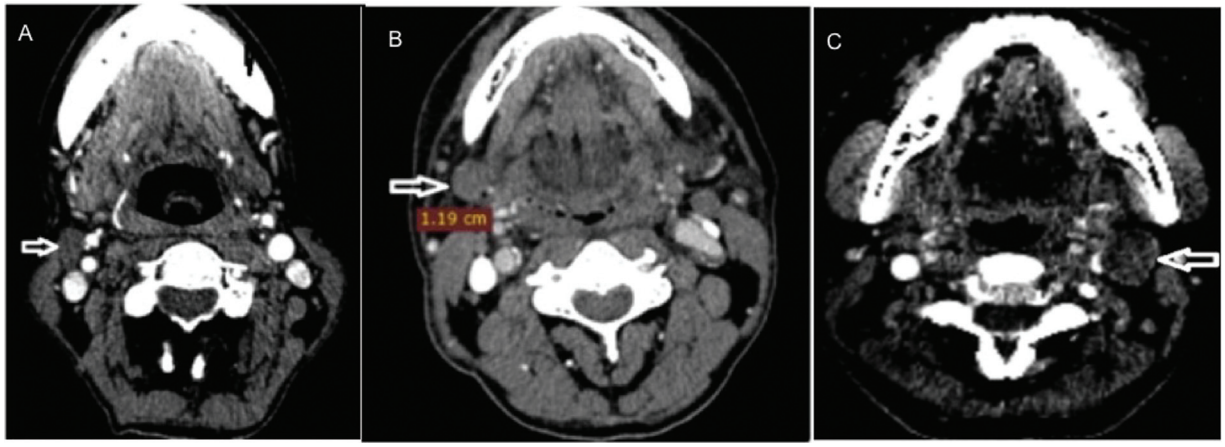

Fig. 7 Neck Imaging-Reporting and Data System (NI-RADS). Follow-up computed tomographic scans of patients at 3 months after completion of radiotherapy showing (**A**) small less than 1 cm lymph node (NI-RADS 1) (*arrow*), negative for nodal recurrent disease; (**B**) marginally enlarging lymph node (*arrow*) without significant postcontrast enhancement (NI-RADS 2), negative for nodal recurrent disease; and (**C**) significantly enlarging lymph node (*arrow*) with central necrosis (NI-RADS 3), positive for nodal recurrent disease.

size (<20% increase in short axis diameter) or less than 30% reduction in short axis diameter. Two of these patients showed nodal recurrence. Three of the patients were assigned NI-RADS 3 (►**Fig. 7C**) category due to the presence of new or enlarging lymph node (more than 20% increase in short axis diameter) with abnormal morphologic features (necrosis or extranodal extension). Two of these patients were positive for nodal recurrence on biopsy (66.7%). However, one of the three patients, which showed mildly increased size as well as increased necrotic component, was negative for disease recurrence on lymph nodal biopsy and subsequent follow-up. A NI-RADS score of 3 had a high specificity (96%) and NPV (86%) but a low sensitivity (40%) and PPV (66.7%). NI-RADS score of 2 or higher had a high sensitivity (80%) and NPV (94.7%) and a low specificity (72%) and PPV (36%).

►**Table 4** summarizes the tumor recurrence rate in different NI-RADS categories at primary tumor site and lymph nodal site.

Discussion

The NI-RADS was developed for surveillance of CECT with or without positron-emission tomography in patients with treated head and neck cancers. Both the primary tumor site and neck are assessed for recurrence/residual disease and assigned a category of 1 to 4 based on the level of suspicion with linked management recommendations.[10] Imaging with combined use of PET and CT at 3 months after the completion of treatment is currently considered as the best approach for posttreatment imaging.[11,12] While CT provides a reasonably accurate anatomical survey of the postradiation neck, FDG-PET complements the information by providing functional interrogation of the radiated tissue. The ability of PET to upgrade or downgrade the level of suspicion provided by CECT has enabled the combined usage of PET and CT as a preferable approach for NI-RADS scoring. Nevertheless, PET is an expensive investigation and is not universally available in all the centers providing oncological care. Occasionally PET scans can result in false-positive results due to postsurgical changes, tongue fasciculations, radiation-induced injury to bones, and soft tissue. CT can offer rapid imaging solutions for the follow-up of these patients and our study shows that CT alone can be adequately utilized for NI-RADS categorization with comparable accuracy to the combined usage of PET and CT.

The performance of NI-RADS in follow-up CECT scans to predict disease recurrence demonstrated significant discrimination between groups in our study, with disease recurrence rates of 4% for NI-RADS 1, 24% for NI-RADS 2, and 80% for NI-RADS 3. NI-RADS 1 category for the primary site is used for expected posttreatment changes. Diffuse mucosal enhancement without deep extension is more likely mucositis and should fall under NI-RADS 1. Our study showed a 0% residual disease on routine follow-up at 6 months in these patients. In a previous study by Krieger et al, NI-RADS 1 lesions showed a tumor recurrence rate of 3.5%.[10] Our results and the existing literature show that lesions scored as NI-RADS 1 can be safely subjected to routine 6 months follow-up without the need for PET scan.[8] NI-RADS 2 category is used for mildly suspicious lesions on imaging. The 2a category is used for low-suspicion superficial mucosal lesions with a linked recommendation of direct visual inspection. Focal asymmetric enhancement in posttreatment imaging could either represent benign mucositis or early recurrence of tumor. Two out of these 10 patients with2a lesions showed recurrent disease (20%). For the primary site, the 2b category is used for deep, ill-defined, nondiscrete, low-suspicion lesions. In practice, most category 2 lesions are managed with short-term follow-up rather than biopsy. Since these lesions are ill-defined and nonmass like, they are not good biopsy targets. In our study, seven patients were assigned NI-RADS 2b category, out of which two showed recurrent disease (28.5%). It was seen that NI-RADS 2b patients with size less than 1 cm showed no recurrent disease, while patients with size more than 1cm showed recurrent disease. Overall, 23.5% of the patients with NI-RADS 2 score, which was marginally higher than that of previous study utilizing PET/CT by Krieger et al who reported 18.4% recurrence.[10] NI-RADS 3 is

reserved for high-suspicion lesions including discrete, nodular, strongly enhancing lesions for which biopsy is recommended. Six out of seven patients (85.7%) in our study that were assigned NI-RADS 3 score showed disease recurrence, which is higher than 54.6% reported by a previous study utilizing PET and CECT.

For lymph nodal assessment, high FDG avidity is a strong indicator of recurrent disease and should be assigned NI-RADS 3 score. In the absence of PET scan, as per the recommendation of the existing literature, new or "definitely enlarging" lymph nodes should be assigned NI-RADS 3, whereas "mildly enlarging" lymph nodes are to be categorized as NI-RADS 2. However, there are no clear-cut objective criteria as to when the lymph nodes should be considered as definitely enlarging. In this regard, our study supports the usage of RECIST 1.1 criteria,[9,13] where a 20% increase in short-axis diameter of target lymph nodes (>15mm) should be considered as progressive disease (NI-RADS 3). For non-target lymph nodes (10–15mm), NI-RADS 3 was assigned in cases of "unequivocal progression" based on the judgment of two radiologists. It should be noted that the application of RECIST 1.1 to the lymph nodes is not currently a part of NI-RADS. Subcentimetric lymph nodes (<1cm in short axis) were considered nonpathological and were assigned NI-RADS 1 score. Only one lymph node in our study showed tumor recurrence after being assigned NI-RADS 1 because of its small size. For target lymph nodes, more than 30% reduction in short axis diameter was also considered a sign of overall response and was assigned NI-RADS 1 score. Lymph nodes showing neither adequate shrinkage nor progression to qualify for NI-RADS 1 or NI-RADS 3 were included in NI-RADS 2 category. In our experience, utilization of RECIST 1.1 measurements in assigning NI-RADS score of lymph nodes can add reasonable objectivity in posttreatment imaging assessment. For lymph nodal assessment, NI-RADS categories 1, 2, and 3 revealed nodal recurrent disease rates of 5.3, 25, and 66.7%, respectively. This was comparable to the previous study by Krieger et al who demonstrated 4, 15 and 70%, recurrent rate for NI-RADS 1, 2, and 3 lesions, respectively, using both CT and PET scans.[10]

We realize that our study had many limitations. First, the number of patients included in our analysis was too small to hold a statistical significance. Second, we did not assess interobserver variation in assigning NI-RADS scores as the scans were not interpreted by the two radiologists independently. Third, we did not make a direct comparison between the usage of CT alone and the usage of PET/CT due to the unavailability of PET scan in our institute. The prospective nature and adequate follow-up of all the patients were strengths of this study. To the best of our knowledge, this is the first prospective study to evaluate the utility of NI-RADS template using CECT alone.

In conclusion, this study shows that CECT alone may be used to assign the NI-RADS rating scale to predict the presence or absence of tumor recurrence in patients with neck malignancies, especially when PET/CT is not available. Moreover, utilization of measurements advocated by RECIST 1.1 criteria can aid in NI-RADS categorization of malignant neck lymph nodes. This was an initial study suggesting that CECT may be sufficient for NI-RADS categorization, especially when used in combination with the RECIST 1.1 criteria, if PET is not available. We recommend further large multicentric studies to compare the accuracy of CECT alone with that of PET CT in predicting tumor recurrence in neck malignancies based on NI-RADS rating scale.

Note
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Conflict of Interest
None.

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