Ultasonography and CT Evaluation of Neck Masses

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ABSTRACT

Introduction: A neck mass in an adult patient is a frequently encountered entity in clinical practice. Imaging studies form an integral part of the diagnostic workup of neck masses. The present study was undertaken to evaluate the role of High resolution ultrasonography and Computed tomography imaging in evaluating neck masses.

Material and methods: This study was conducted in the Department of Radio diagnosis in co-ordination with the Departments of E.N.T, Surgery, Department of Oncology and Pathology at NSCB medical college and hospital. A total of 50 patients with palpable neck masses were included in our study.

Result: Of the 50 cases included in the study, masses were nodal in 19 cases (38.0%) and non nodal in 31 cases(62.0%).Out of 19 nodal masses 16 were malignant (84.21%) and 3 was benign (15.78%).Out of 31 non nodal masses 3 cases were malignant (9.6%) and 28 were benign (90.32%).In total, 31 cases (62%) had benign lesions and 19 (38%) cases had malignant lesions.

Conclusion: High resolution sonography and color Doppler is a useful modality for diagnostic evaluation of neck masses in every age group. It is simple, non-invasive and inexpensive diagnostic tool. It provides accurate and reproducible results. CT ensures accurate anatomical localization and lesion characterization in benign lesions. In malignant tumors, it is useful for staging and provides essential information about the tumor extent that directly affects the surgical approach necessary for curative resection.

Keywords: Ultasonography, CT Evaluation, Neck Masses

INTRODUCTION

A neck mass is a frequently encountered entity in clinical practice. Because of its complex anatomy and physiology, neck diseases manifesting as neck swelling can vary from etiological, pathological and prognostic points of view. Despite a vast array of etiologies, the most common neck masses are congenital lesions, lymphadenopathy and neoplasias, both benign and malignant.

Imaging studies form an integral part of the diagnostic workup of neck masses.

Ultrasound is a useful screening modality because of the lack of ionizing radiation and is non-invasive. USG can define the location, size and extent of the mass, relation to surrounding normal structures and the internal characteristics of the mass. But, sonography of neck lacks specificity in certain instances. The differentiation between inflammatory and malignant lymphadenopathy cannot always be made.[1]

The advent of color doppler sonography has added a new dimension to diagnostic sonography. It can be extremely valuable in demonstrating the vascular nature of the neck masses.

The development of cross-sectional imaging techniques has substantially altered the treatment and management of neck masses.

Computed tomography (CT) is now readily available in most of the health institutions and is currently the imaging modality most commonly used for head and neck masses. CT is extremely useful in defining both the osseous and soft-tissue extent of the lesion. With the advent of new generation Multi Detector CT Scanners (MDCT) there have been tremendous improvements in scanning time, tissue resolution and quality of three dimensional (3D) reconstructions.[2]

Owing to the complex anatomy of the neck a comprehensive knowledge of regional anatomy and recognition of the patterns of disease presentation are vital to arriving at a meaningful differential diagnosis. To permit early recognition of neck pathology, detailed anatomic correlation is mandatory. Current imaging permits a detailed analysis of the complex anatomy in this region and is the key to understanding many of its disorders including mass lesions.[3] The present study was undertaken to evaluate the role of High resolution ultrasonography and Computed tomography imaging in evaluating neck masses.

MATERIAL AND METHODS

This study was conducted in the Department of Radio diagnosis in co-ordination with the Departments of E.N.T, Surgery, Department of Oncology and Pathology at NSCB medical college and hospital after ethical approval. A total of 50 patients with palpable neck masses were included in our study after informed consent.

Inclusion Criteria

Patients who presented with a clinically palpable neck mass and underwent CT Scan, Ultrasonography and FNAC.

Exclusion Criteria

The following patients were excluded from the study:

1. Post operative patients.
2. Patients with contraindications to intravenous administration to contrast medium.
3. Pregnant females
4. Patient who did not not underwent all the three investigation (Ultrasonography, CT scan, FNAC or biopsy).

Methodology

Clinical Evaluation

A detailed history and complete general physical, systemic Local examination of the swelling was done.

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Relevant laboratory investigations, ESR, thyroid function tests, Mantoux test were also done.

High resolution ultrasonography and color doppler Imaging:
Patient preparation: Informed written consent was taken prior to the procedure.
Patient position: Supine
Machines used: Phillips HD 7XE and Siemens acuson X300
Procedure: The sonographic examination of the neck was performed in supine position, with the neck of the patient hyper-extended with a pad or pillow under the shoulders to provide optimum exposure of the neck.
Examination was done in longitudinal and transverse planes of the mass in order to evaluate the mass for size, shape, consistency and echogenicity. Its internal architecture, presence of septae, calcification or necrosis was also noted.
The scanning was done using slow frame rate, low pulse repetition frequency, a narrow gate, low wall filter setting and high doppler gain setting in order to maximise Doppler sensitivity.

Computed Tomography
Patient preparation: Prior kidney function tests were performed. The patient was kept on empty stomach for 4-6 hours prior to performing the scan. Informed written consent was taken.
Patient position: Supine with the neck mildly hyper extended so that the hard palate was roughly perpendicular to the table top. When possible patient was scanned with quiet breathing and swallowing suspended.

Machine used: GE Optima 660 Dual Energy CT 128 SLICE

Procedure: Non enhanced and contrast-enhanced scans using non ionic contrast media were performed sequentially. Scanning covered the region from the base of the skull to the lung apices using 5-mm collimation. Multi-planar reconstructions were created in both coronal and sagittal planes using 1-mm axial sections. All images were reconstructed with bone algorithm to detect bone and cartilage invasion.

RESULTS

Results of the 50 cases included in the study, masses were nodal in 19 cases (38.0%) and non nodal in 31cases(62.0%).

Final diagnosis	Number of cases	Percentage
Nodal masses	19	38.0%
Salivary gland lesions	12	24.0%
Thyroid masses	10	20.0%
Masses of Developmental origin	4	8.0%
Masses of neurogenic origin	1	2.0%
Masses of vascular origin	1	2.0%
Masses of mesenchymal origin	1	2.0%
Inflammatory masses	2	4.0%

Table-1: Final diagnosis

Final diagnosis (n=50)	Non nodal masses (n= 31)	Nodal masses (n=19)	Total
Benign lesions	28	3	31
Malignant lesions	3	16	19

Table-2: Benign vs malignant lesions

Nodal masses constituted approximately 38.0% which included metastasis from aero digestive tract primary malignancies (14%), nodal metastases with unknown primary (14%), lymphomas (4%) and tubercular adenopathy (6%) (table-1). Non nodal masses constituted approximately 62.0% and included salivary gland lesions (24.0%), thyroid masses (20.0%), masses of developmental origin (8.0%), masses of neurogenic (2.0%),vascular (2.0), mesenchymal origin (2.8%), and inflammatory masses (4.0%). Malignancies (14%), nodal metastases with unknown primary (14%), lymphomas (4%) and tubercular adenopathy (6%). Non nodal masses constituted approximately 62.0% and included salivary gland lesions (24.0%), thyroid masses (20.0%), masses of developmental origin (8.0%), masses of neurogenic (2.0%),vascular (2.0), mesenchymal origin (2.8%), and inflammatory masses (4.0%).
Out of 19 nodal masses 16 were malignant (84.21%) and 3 was benign (15.78%). Out of 31 non nodal masses 3 cases were malignant (9.6%) and 28 were benign (90.32%). In total, 31 cases (62%) had benign lesions and 19 (38%) cases had malignant lesions (table-2).
Ultrasound made a correct diagnosis in 38 out of 50 cases, having a diagnostic accuracy of 76.0%. CT made a correct diagnosis in 47 out of 50 cases, having a diagnostic accuracy of 94.0% (table-3).
Ultrasound and CT together made a correct diagnosis in 47 out of 50 cases, having combined diagnostic accuracy of 94%.

DISCUSSION

50 patients with clinically palpable neck masses were evaluated using Ultrasonography and CECT and the masses were characterized based on location, morphological characteristics and enhancement pattern. The extent was outlined in terms of involvement of adjacent structures, vessels and lymphadenopathy. Cytological, histopathological and/or surgical details were noted to achieve the final diagnosis.
Age of the patients included in the present study ranged from 01-76 years. Maximum numbers of patients were in the age group 21-30years. The overall male to female ratio was 1.7:1 (figure-1).
The study comprised of nodal and non nodal masses Out of 50 cases studied, 31 cases (62%) had benign lesions and 19 (38%) cases had malignant lesions. Ultrasound made a correct diagnosis in 38 out of 50 cases, having a diagnostic accuracy of 76.0%.
CT made a correct diagnosis in 47 out of 50 cases, having a diagnostic accuracy of 94.0%.Ultrasound and CT together made a correct diagnosis in 47 out of 50 cases, having a diagnostic accuracy of 94.0%.

Nodal masses
Nodal masses were the most common masses encountered and constituted 38.0% of the total number of cases. These included nodal metastases from aero digestive malignancies (36.8%), nodal metastases with unknown primary (36.8%), lymphoma (10.6%) and tubercular adenopathy (15.8%). Out of 19 nodal masses, 16 were malignant (84.2%) and 3 was benign (15.8%).

Metastatic adenopathy
We observed 14 cases of metastatic lymphadenopathy. All the nodal masses were histopathologically proven to be cases of squamous cell carcinoma of different grades.In 7 cases the

Findings	No. of patients (n=50)	CT				USG			
		TP	FP	FN	TN	TP	FP	FN	TN
Multinodular goiter	8	8	2	0	0	8	2	0	0
Squamous cell carcinoma with unknown primary	7	7	0	0	0	1	0	6	0
Pharyngeal squamous cell carcinoma with nodal metastases	4	4	0	0	0	3	0	1	0
Pleomorphic adenoma of parotid	3	3	0	1	0	3	0	1	0
Tubercular adenopathy	3	3	0	0	0	3	0	0	0
Transglottic squamous cell carcinoma with nodal metastases	3	3	0	0	0	3	0	0	0
Abscess	2	2	0	0	0	2	0	0	0
Medullary carcinoma thyroid	1	0	0	1	0	0	0	1	0
Papillary carcinoma thyroid	1	0	0	1	0	0	0	1	0
Lymphoma	2	2	0	0	0	2	0	0	0
Parotid abscess	2	2	1	0	0	2	1	0	0
Thyroglossal duct cyst	2	2	0	0	0	2	0	0	0
Mucoepidermoid carcinoma of parotid	1	1	0	0	0	0	0	1	0
Hemangioma	1	1	0	0	0	1	0	0	0
Second branchial cyst	1	1	0	0	0	1	0	0	0
Lipoma	1	1	0	0	0	1	0	0	0
Lymphangioma	1	1	0	0	0	1	0	0	0
Parotid lipoma	1	1	0	0	0	1	0	0	0
Parotid tuberculosis	1	0	0	1	0	0	0	1	0
Pleomorphic adenoma of right submandibular glands	1	1	0	0	0	1	0	0	0
Ranula	1	1	0	0	0	1	0	0	0
Cervical sympathetic chain schwannoma	1	1	0	0	0	0	0	1	0
Warthins tumor	2	2	0	0	0	2	0	0	0
TP: true positive, FP; False Positive, FN: False Negative TN: True Negative									

Table-3: Final diagnosis vs CT and USG diagnosis (FNAC findings vs CT and USG: An observation)

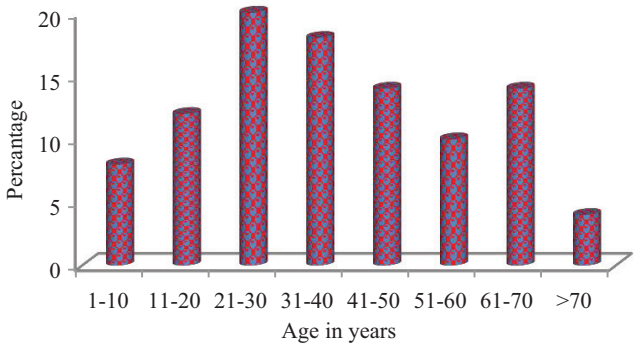

Figure-1: Age distribution

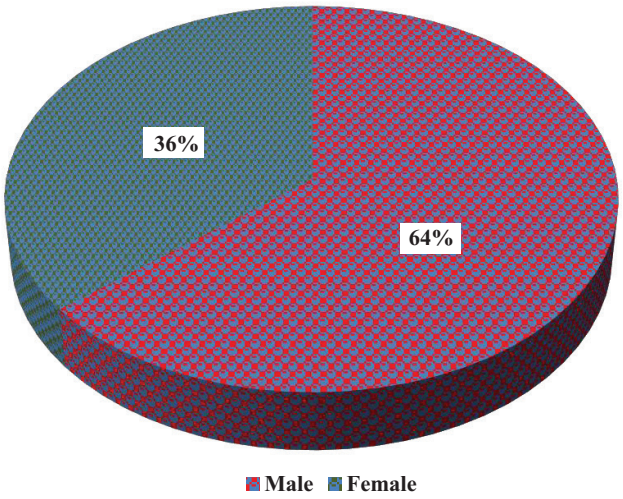

Figure-2: Sex distribution

primary site was the aerodigestive tract. Out of these 7, 4 cases had oropharyngeal carcinoma and in 3 cases larynx was the primary site. 7 cases were labelled as nodal metastases from unknown primary as the primary site could not be delineated even after detailed clinical examination and investigations.

Nodal size

In our study metastasis was suspected when a lymph node was greater than 1.5 cm in maximum diameter either in the jugulodigastric region (level II) or in the submandibular triangle (level I) or, when a node was greater than 10 mm (1 cm) in greatest diameter elsewhere in the neck.

Central nodal necrosis

On USG metastatic node is seen as hypoechoic, round and without echogenic hilus. Intranodal necrosis appears as demarcated echogenic focus and is not continuous with adjacent soft tissues. According to King Ad et al[4] necrosis on CT was defined as a focal area of low attenuation with or without a surrounding rim of enhancement.Necrosis was seen on both USG and CT in 6 cases.

Extranodal spread

The presence of extra nodal tumour extension was identified as an irregular nodal margin with infiltration around and obliteration of the adjacent fat planes in our study. We detected extra nodal tumour extension spread in 10 cases both on both USG and CT. King AD et al[5] in their study concluded that sensitivity and specificity of CT 65% and 93% respectively. There is no significant difference between CT and Ultrasound for either sensitivity or specificity for the detection of ENS.

Arterial invasion

Vessel wall invasion was suggested when more than 180 degree

of the arterial circumference was surrounded by the node length of contact more than 3.5 and was seen in 7 cases.

Evaluation of primary lesion

In 4 out of the 14 cases oropharynx was the primary site. All 4 cases were tonsillar fossa masses with tongue base invasion. The extent of the lesions was defined and any additional findings like bone erosion, prevertebral muscle invasion and involvement of adjacent spaces were noted. In 3 cases of larynx was the primary site. Both the lesions show transglottic spread with invasion of the thyroid cartilage. In 7 cases the primary site could not be delineated even after detailed clinical examination and imaging evaluation.

Lymphoma

1 case was diagnosed as Non Hodgkins lymphoma and 1 case as Hodgkins lymphoma. All cases showed multiple lymph nodes involving multiple levels on USG and CT and on CT the lymph nodes were homogenously enhancing. 1 cases with non hodgkins lymphoma had associated mediastinal lymphadenopathy. One case of Non Hodgkins lymphoma showed marrow signal intensity changes in multiple cervical and thoracic vertebrae suggestive of lymphomatous involvement. Lee YY et al[6] described neck nodal involvement in Hodgkin's and Non Hodgkin's lymphoma, as involvement of multiple deep chain lymph nodes which can be unilateral or bilateral and of varying sizes. Nodal necrosis was found in 5% with Hodgkin's disease and 13% with non-Hodgkin's lymphoma, even with extensive disease in their study.

Tubercular adenopathy

3 cases of tubercular adenopathy were noted with bilateral cervical lymphadenopathy and parenchymal lesion on Chest X ray and reactive Mantoux. On USG and CT, the tubercular lymph nodes had the appearance of bilateral conglomerate nodal mass with rim enhancement (on CT) and preservation of fascial planes around them. These findings were in accordance with those described by Vaid S et al[7]

Non nodal masses

Non nodal masses constituted approximately 62.0% of the lesions and included salivary gland lesions (24.0%), thyroid masses (20.0%), masses of developmental origin (8.0%), masses of neurogenic (2.0%),vascular (2.0%), mesenchymal origin (2.0%), and inflammatory masses (4.0%). Out of 31 non nodal masses 3 cases were malignant (9.6%) and 28 were benign (90.3%).

Salivary gland lesions

12 cases (24.0%) of salivary gland pathology were observed in the present study which comprised of tumours (8 cases), infections (3 cases) and ranula (1 case). 8 cases were diagnosed as tumors. All cases were seen involving the major salivary glands.

7 of these were benign. 4 out of the 7 (57.7%) were diagnosed to be pleomorphic adenomas. Yousem et al[8] observed that nearly 80% of benign parotid neoplasms are pleomorphic adenomas. They also mentioned that pleomorphic adenomas occur most commonly in middle-aged women. However in our study all cases were males. This could be because of variation in demographic factors.

3 of the cases were seen involving the superficial lobe of the parotid gland which has been reported to be the most common site of involvement.

1 of the cases was diagnosed to have pleomorphic adenomas involving right submandibular glands. Koral K et al[9] in their study have reported that the tumour is almost always solitary and multiple or bilateral pleomorphic adenomas are rare. Cases appeared as heterogeneously/homogenous enhancing, well defined lobulated/smooth lesions on CT. On ultrasonography pleomorphic adenoma appear as well define, homogenous, regular sometime lobulated shape, with poor vascularity (Dumitriu D et al).[10]

2 cases of Warthin tumour were diagnosed in this study. One case was a 60 year old male with bilateral warthin tumours. The second case was a 45 year old male with unilateral warthin tumour of the parotid gland. Teymoortash A et al[11] in their study described a preponderance of these tumours in elderly males and observed bilateral tumours in 12.3% of the cases.

Only 1 malignant salivary gland tumour was diagnosed in our study i.e. mucoepidermoid carcinoma involving the left parotid gland. On ultrasound it appeared as a ill defined, heterogeneous, predominantly hypoechoic lesion with moderate vascularity. It was seen as a heterogeneously enhancing lesion with ill defined margins on CT. There was circumferential encasement of ramus and condyle of left mandible with erosion of ramus of left mandible. It was misdiagnosed on USG imaging as a pleomorphic adenoma.

It was not possible to distinguish between the benign and malignant nature of the tumours on both USG and CT. Kim KH et al[12] in their study concluded that both CT and USG showed a similar level of accuracy in evaluation of salivary gland tumours, and showed a considerable tendency of misdiagnosis. Also that imaging features of a salivary gland mass can support a clinical diagnosis but cannot alone make a definitive histological diagnosis.

3 cases were diagnosed to be infectious diseases involving the parotid gland.

2 cases were pyogenic parotid abscess. On CT the parotid gland was bulky with a rim enhancing abscess seen. The abscess was drained under ultrasound guidance and patient was given antibiotics.

The third case showed multiple abscesses in the parotid gland on imaging and was proven to be tuberculosis involving the parotid gland on cytological examination and staining for acid fast bacilli was positive. Patient was given anti tubercular therapy and responded with decreased lesion size. Alex L et al[13] described parotid tuberculosis as a rare lesion with nonspecific imaging findings.

1 case was diagnosed as a simple ranula and was seen on CT as a well defined cystic lesion in the sublingual space with thin non enhancing walls. While simple ranulas are confined to the sublingual space, plunging ranulas are centered on the submandibular space and tend to spill into one or more adjacent spaces.

Thyroid masses

In our study there were 10 cases which were considered originating from the thyroid gland. Subsequently 8 cases were diagnosed as multinodular colloid goiter and 2 case was proven to be malignant (papillary,medullary carcinoma) on FNAC. All patients were females in the age group 31-50 years.

As advocated by Laurie A Lovner et al[14], the main role of cross-sectional imaging in thyroid neoplasms is not in the characterization of an intrathyroid lesion, as there are no imaging findings that are histologically specific. The role of the radiologist is to assess the findings related to a thyroid mass which will influence treatment decisions, including invasion through thyroid capsule and infiltration of adjacent tissues and structures of neck and to identify presence of cervical lymph node metastasis.

Accordingly we assessed the following parameters in thyroid masses- size and location of the lesion, presence of calcification, hemorrhage, necrosis, thyroid capsule invasion, vascular invasion, involvement of trachea and oesophagus, mediastinal extension and adenopathy. All patients underwent total thyroidectomy and histopathological examination of the post operative specimen was done.

1 case of medullary carcinoma and 1 of papillary carcinoma were misdiagnosed as multinodular goiter on USG and CT which later confirm on FNAC. However ultrasound and Doppler examination were suggestive of a potentially malignant lesion which was proven on FNAC. Shetty SK[15] in their study concluded that there is no CT feature that distinguishes benign from malignant lesions when correlated to sonographic appearance or histopathology

Masses of developmental origin

In our study 4 cases were diagnosed as masses of developmental origin which included lymphangiomas (1 cases), branchial cyst (1 case) and thyroglossal cyst (2 cases).

One cases was diagnosed to be lymphangiomas seen as a as a multilocular cystic lesion in the posterior cervical space deep to sternocleidomastoid muscle in a 10 year old female patient. On USG it appeared as a mixed echogenicity mass with septae of variable thickness with an average density of 25 HU (range 15-35 HU) on CT.

Kraus J et al[16] have reported that these lesions are usually discovered in infants or children younger than two years of age and occurrence in adults is uncommon. In adults, solitary cystic hygromas can occur in the posterior triangle of the neck and in the submandibular triangle as was seen in our study.

1 case of branchial cyst was diagnosed which was a second branchial cyst (type II cyst) in a 14 year old male patient which is the most common branchial anomaly (75%) described by Vazquez E et al.[17] It was seen as a cystic lesion posterior and lateral to the submandibular gland, anterior to the sternocleidomastoid muscle and lateral to the carotid space. The wall of the cyst does not show enhancement.

2 cases were diagnosed as a thyroglossal cyst in young male patients.

Masses of neurogenic origin

One case of neurogenic tumor was observed in our study, which was seen as an oval hypoechoic mass with posterior acoustic enhancement on ultrasound. On color flow analysis moderate vascularity was seen in the lesion.

The lesion appeared as a well defined heterogeneously enhancing lesion in the poststyloid parapharyngeal space on both CT. Kehagias et al[18] have described that schwannomas appear as well-defined masses, usually of higher attenuation than muscle on contrast-enhanced CT images. USG evaluation typically shows hypoechoic masses with mild posterior acoustic enhancement,and well define margin,few internal vessels seen colour Doppler examination.Mass shift the internal carotid artery and internal juglar anterolaterally.

According to Saito DM et al[19] anterior displacement of the common or internal carotid artery is a characteristic finding of parapharyngeal neurogenic tumours without splaying the internal and external carotid arteries. Vagal schwannomas separate the common or internal carotid artery from the jugular vein, whereas schwannomas of the cervical sympathetic chain do not. Similar pattern of vascular displacement was seen in our study. The neurogenic tumor was confirmed to be schwannoma arising from cervical sympathetic chain at surgery subsequently at histopathological examination.

Masses of vascular origin

One case was diagnosed to have a hemangioma in the neck. Lesion was heterogeneously enhancing with calcific foci suggestive of phleboliths on CT in the anterior triangle of necks. FNAC was done and aspirate contained blood. Patient was given sclerotherapy.

Inflammatory masses

In our study two cases of abscess in the perivertebral space were diagnosed in a patients presenting with painful swelling with fever, leucocytosis and neutrophilia. Abscess showed complete rim enhancement on CT. Few discrete level V lymph nodes were also noted. The abscess was drained and patient was given antibiotics. Freling N, Roele E et al[20]

In their study concluded that as adequate clinical assessment is possible in such cases; imaging is only needed to delineate the extent of the infective process.

Masses of mesenchymal origin

One case of lipoma in the submandibular space, with well defined margins showing uniform attenuation values of -110 to -50 HU, without any contrast uptake on CT was noted. FNAC was done which showed fat cells. The lipoma was excised. Monem M et al[21] described the posterior subcutaneous neck to be the most common site for lipomas in the head and neck.

CONCLUSION

Based on our results and review of literature, the following can be drawn:

High resolution sonography and color Doppler is a useful modality for diagnostic evaluation of neck masses in every age group. It is simple, non-invasive and inexpensive diagnostic tool. It provides accurate and reproducible results. In many clinical conditions it can be used as first line modality for evaluating cervical soft tissue masses especially in young and paediatric populations.

CT ensures accurate anatomical localization and lesion characterization in benign lesions. In malignant tumors, it is useful for staging and provides essential information about the tumor extent that directly affects the surgical approach necessary for curative resection.

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