Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 06, 2024

CECT evaluation of neck masses with histopathology correlation

Dr Maram.Suneetha[1], Dr Rayavarapu.Sukumar[2*], Dr Bendalam.Srikanth[3]
[1]Assistant professor ,Department of radiodiagnosis,
Andhra medical college,vishakapatnam
[2]Assistant professor ,Department of radiodiagnosisAndhra medical college,vishakapatnam
[3]Assistant professor ,Department of radiodiagnosis,Andhra medical college,vishakapatnam

Corresponding author: Dr Rayavarapu.Sukumar

Introduction:

The neck is a region with complex anatomy, housing numerous small and closely spaced anatomical structures. Accurate diagnosis of neck lesions requires a thorough understanding of normal spatial relations and anatomical variations. Computed Tomography (CT) imaging offers enhanced visualization, providing crucial information for better patient management.[1]
The suprahyoid and infrahyoid portions of the neck are separated at the level of the hyoid bone. The deep cervical fascia, comprising superficial, middle, and deep layers, divides the suprahyoid neck region into distinct spaces, acting as vital anatomical markers for evaluating pathological changes and their spread. Notable spaces in this region include the parotid space, retropharyngeal space, pharyngeal mucosal space, masticator space, pre-styloid parapharyngeal space, post-styloid parapharyngeal space (carotid space), and prevertebral space. Lesions originating in these spaces initially expand and distort their respective surroundings, providing valuable evidence for their origin.[2,3]
Neck masses are commonly encountered in clinical practice, and their etiology, pathology, and prognosis can vary significantly. The most prevalent neck masses include congenital lesions, lymphadenopathy, and both benign and malignant neoplasms.[4]
Imaging plays a pivotal role in the diagnostic work-up of neck masses. Ultrasound is a non-invasive and radiation-free screening modality that provides information on the mass's location, size, extent, and internal characteristics. However, it may lack specificity in certain cases, particularly in distinguishing between inflammatory and malignant lymphadenopathy.[5]
In contrast, Computed Tomography (CT) has become the imaging method of choice for evaluating head and neck masses in most healthcare facilities. CT excels at delineating bone and soft tissue extent of lesions. Advancements in Multi-Detector CT Scanners (MCTs) have significantly improved scanning speed, tissue resolution, and 3D reconstruction quality.[6]
Neck has complex anatomy, comprehensive knowledge of regional anatomy, and recognition of disease patterns are vital for a meaningful differential diagnosis. Detailed anatomical correlation is mandatory to allow early recognition of the neck pathology. Current imaging allows a thorough analysis of the complex anatomy in this region and is a key to understand many of its disorders, including mass lesions.[7]

In addition to a routine CT, using a contrast media enhancement may be helpful in identifying malignant lymph nodes which are not enlarged and to distinguish vessels from lymph nodes. But, few exceptions with using a contrast are that they can obscure visualization of sialoliths. Iodine-based contrast media must be avoided in patients with a history of thyroid disease or when a metastatic thyroid cancer is a concern. Though positron emission tomography (PET) with CT may be used to distinguish between a malignant tumour and un-affected tissues, its use in the preliminary diagnosis is not as effective and shall be limited to definitive management of malignancy.[8]

Talukdar et al[9] in their study included 60 cases where, 27 (45%) were benign and 33 (55%) were malignant neck lesions. Overall there was a male preponderance with 35 (60%) males and 25 (40%) females, male to female ratio of 3:2. Among the neck lesions the most common was metastatic lymph-node mass (24%) followed by laryngeal carcinoma (13.3%) and oral cavity malignancy. Most of the infection (66.66%) of neck were below the age group of 40 years. Benign lesion was common in the age group of 21-30 with a female to male ratio of 1.4:1. Malignant lesions were more common in the elderly age group of 61-70 years with a male to female ratio of 3:1. The most common space involvement was parapharyngeal space (28.3%) followed by visceral space (23%). Most of the malignant lesions showed heterogeneous contrast enhancement (73%), necrosis (70.6%), bone involvement (20%), vascular involvement IJV thrombosis (7%) and extension into adjacent spaces 27 %. CT has 96 % accuracy in diagnosing neck lesions. CT has 100 % accuracy in predicting bony involvement in head and neck cancers. Advantages of MDCT includes ability to perform thin slices, short scan time, reconstruction and ability to perform MIP, SSD, MPR and curved reformatted images.

sachin et al[7] in their study reported that Multi-detector row computed tomography is a sensitive diagnostic technique for diagnosing the mass of the neck and distinguishing between benign and malignant lesions with high precision. The degree of pathology with local/continuous spread predicted by the CT examination was definitive.

Pushpa Raj et al[11] in their study reported that Of the 36 subjects evaluated for head and neck malignancy, USG had a high sensitivity of 96 per cent, a specificity of 49 per cent, a positive predictive value of 87 percent and also a negative predictive value of 66 per cent with an accuracy of 86 per cent, CT had a high sensitivity of 96 per cent, a specificity of 56 per cent, a positive predictive value of 90 per cent and also a negative predictive value of 96 per cent. The above table has a p value of 0.001, which is considered to be very significant. Kappa Statistics have been measured and found to be 0.712, which is considered to be a strong agreement.

This study aims to investigate the role of Contrast Enhanced Computed Tomography (CECT) in evaluating neck masses, specifically in characterizing them as benign or malignant based on their location, morphology, enhancement pattern, lymph node involvement, and the presence of calcifications. Additionally, the study seeks to assess the operability of neck masses and correlate CECT findings with histopathological examination to determine its diagnostic accuracy.

Materials and Methods:

Study Design: This observational prospective study aimed to evaluate patients with clinically suspected neck lesions or those diagnosed with neck lesions on ultrasound, referred to the Department of Radiology, Andhra Medical College, for Computed Tomography (CT) examination. The study was conducted between August 2023 and February 2024. A convenient sampling method was employed, and a total of 50 patients with clinically suspected neck masses, aged between 18 and 65 years, were included in the study. Pregnant females, patients with a history of trauma, those having contraindications to contrast, and individuals unwilling to provide informed consent were excluded from the study.

CT Imaging Protocol: All enrolled patients underwent Contrast-Enhanced Computed Tomography (CECT) after obtaining informed consent. Prior to the CT examination, laboratory investigations were performed. Patients were administered intravenous (IV) contrast at a rate of 2 to 3 ml/sec of non-ionic contrast agent. To ensure optimal imaging results, patients were required to fast for 4 to 5 hours before the CT scan. The CT scans were performed using a helical technique with a single breath-holding method. Scans were acquired in a cranio-caudal direction, covering axial sections from the skull to the suprasternal notch. Suitable sagittal and coronal reconstructions were generated from the acquired data to enhance visualization. Patient safety was a top priority during the study. All patients were carefully monitored for any adverse reactions following the administration of contrast material.

Evaluation Parameters: The CT images were used to make a provisional diagnosis, and these findings were subsequently correlated with histopathological examination results. The following parameters were evaluated:

1. Location of the lesion: neck space involved.
2. Morphology and component of the lesion: solid / cystic.
3. Pattern of enhancement: homogenous / heterogeneous.
4. Lymph Node (LN) involvement: present/absent.
5. Presence of fat planes with adjacent structures: present/absent.
6. Presence of calcifications: present/absent.
7. Bony involvement.

By analysing these parameters, the study aimed to characterize neck masses and determine their benign or malignant nature based on CT findings, subsequently correlating the results with histopathological examination for accurate diagnosis and assessment of operability.

Results:

The study included a total of 50 participants with a mean age of 47.0 ± 12.10 years. The majority of participants (56%) belonged to the age group of 40-60 years, while 30% were in the age group of 20-40 years, and 14% were in the age group of 61-65 years. Among the participants, 52% were male, and 48% were female.

Regarding the location of neck masses, the majority (62%) of cases involved visceral spaces, followed by 14% with pharyngeal spaces, 12% with carotid spaces, and 6% each with post cricoid spaces (PCS) and sternomastoid spaces (SMS). In terms of the lesion's characterization, 82% of cases had well-defined margins (WD), while 18% had ill-defined margins (ID). Lymph node involvement was observed in 30% of the participants, while the majority (70%) did not show any lymph node involvement. Mass effect, indicating compression or displacement of nearby structures, was present in only 8% of the cases, while the remaining 92% did not exhibit any mass effect. Calcifications were detected in the CT findings of 8% of the study participants, and bone and vascular involvement were observed in 4% of the cases.

Contrast Enhancement – Figure1 and CT diagnosis – figure2.

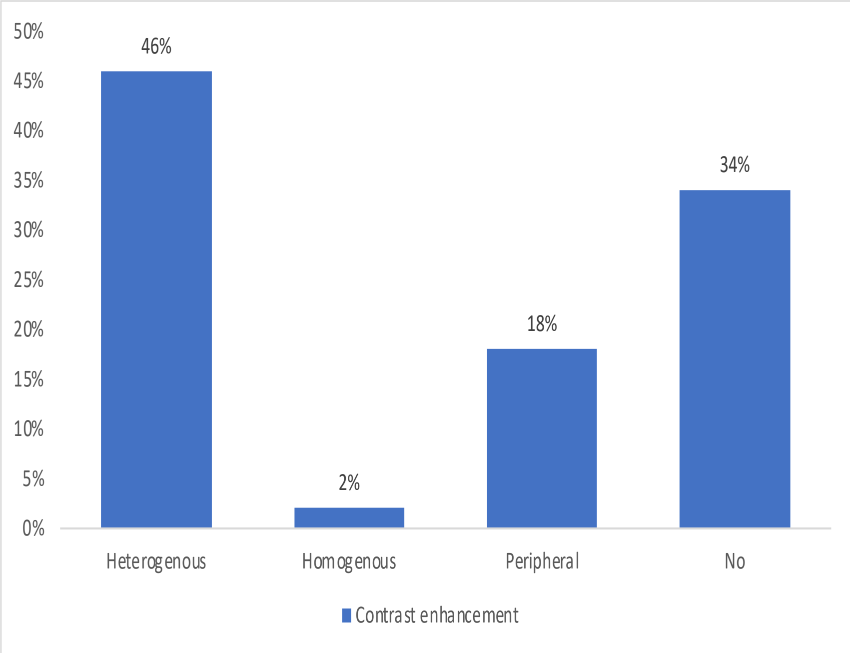

Figure 1: Contrast Enhancement

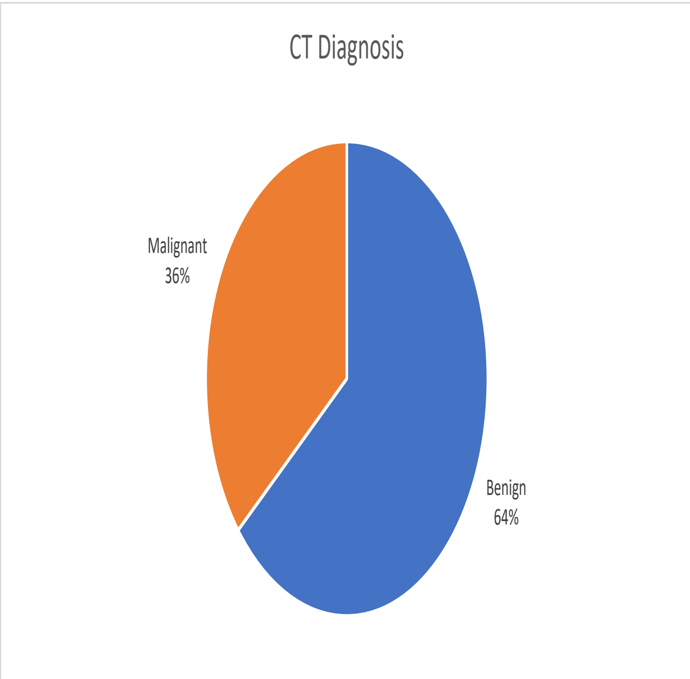

Figure 2: CT Diagnosis

Number of cases based on various diagnoses:

There were a total of 50 cases observed. Among them, the most common diagnoses were Papillary Carcinoma Thyroid with 6 cases, followed by Multinodular Goitre with 5 cases, and CA Hypopharynx, Colloid Cyst / Nodule / Goitre, and Abscess, each with 4 cases. The diagnoses with 3 cases each were Abscess and Squamous Cell Carcinoma of the Larynx. FCT

(Follicular Carcinoma of Thyroid), Hashimoto's Thyroiditis, Lipoma, Parotid Tumour, Parotiditis, and TB Lymphadenitis each had 2 cases. The remaining diagnoses, including Branchial Cleft Cyst, Lymphoma, Non-specific Lymphadenitis, Pleomorphic Adenoma, Mucoepidermoid Carcinoma, Schwannoma, Solitary Thyroid Nodule, Thyroid Adenoma, and Tubercular Abscess, had 1 case each. The distribution highlights the varying prevalence of different diagnoses within the total cases observed

CT and Histopathology Correlation:

The study compared CT (Computed Tomography) findings with histopathology results to assess its accuracy in diagnosing benign and malignant conditions. Among the 50 cases analysed, 32 were classified as benign based on histopathology, with CT correctly identifying 30 of them as benign (true positives) and misdiagnosing 2 as malignant (false positives). There were 18 cases classified as malignant by histopathology, and CT accurately identified all of them as malignant (true positives) while correctly ruling out malignancy in the remaining cases (true negatives). Therefore, CT showed a sensitivity and specificity of 100% for ruling out benign lesions and a sensitivity of 90% and specificity of 100% for identifying malignant conditions when histopathology was considered the gold standard. These results indicate that CT is highly reliable in excluding benign conditions but may have a slight limitation in differentiating certain malignant lesions.

Discussion:

Mean age of the study participants has found to be 47.0 ± 12.10 years. Majority of the study participants (56%) belonged to the age groups of 40-60 years, 30% belonged to the age groups of 20-40 years and 14% belonged to the age group of 61-65 years. Mean age group in the majority of the studies is found to be in concordance with the present study. The majority of the participants were in the age groups of 20-40 in most of the studies, which shows that majority of cases of neck masses fall in this age group. Mean age of the study participants has found to be 44.5 ± 1.9years by Charan I et al[12], 46.08±20.45years by Siddiqua et al[13] and 44.5years by Desai S et al[14].

Among the study participants, 52% were male and 48% were female. Male-female ratio observed in the study is found to be in near concordance with the findings of many other studies. A male predominance in malignancies was seen in many of the studies, which was attributed to the cases of oral cancer, which was probably due to tobacco abuse being more common in males. The ratio of male to female in this study is 1:0.9 while in the study done by Siddiqua et al[13] it is 1.9:1, charan I et al[12] it is 2.1:1, Kaur et al[1] it is 2:1, Ajay et al[4] it is 1.7:1 and Desai S et al[14] it is 2.1:1.

Involvement of Neck Spaces:

The involvement of neck spaces in neck masses was investigated in our study, and the results were compared with findings from other research works. The table 1 below presents the distribution of neck spaces involved in the participants:

Study	Visceral Spaces (VS)	Pharyngeal Spaces (PS)	Carotid Spaces (CS)	Post Cricoid Spaces (PCS)	Sternomastoid Spaces (SMS)
Present Study	62%	14%	12%	6%	6%
Charan I et al[12]	49%	26%	8%	34%	8%

Study	Visceral Spaces (VS)	Pharyngeal Spaces (PS)	Carotid Spaces (CS)	Post Cricoid Spaces (PCS)	Sternomastoid Spaces (SMS)
Siddiqua et al[13]	46%	28%	20.3%	26%	7.7%
Desai S et al[14]	49%	26%	8%	8%	8%

Table 1.

In our study, the majority of participants (62%) had neck masses involving visceral spaces (VS), followed by 14% with pharyngeal spaces (PS) involvement, and 12% with carotid spaces (CS) involvement. Additionally, 6% of the subjects showed involvement in both post cricoid spaces (PCS) and sternomastoid spaces (SMS). These findings were consistent with those reported in the literature, as demonstrated by the studies conducted by Charan I et al., Siddiqua et al., and Desai S et al. The knowledge of the distribution of neck spaces involved in neck masses can aid clinicians in the accurate assessment and effective management of these conditions, guiding appropriate treatment strategies. Understanding the anatomical distribution of neck masses is essential for providing optimal patient care and improving outcomes

CT findings in relation to masses

In the study we observed that, well defined margins are seen in 82% of the participants and 18% had ill-defined margins. In the study, lymph nodes are involved in 30% of the participants, and in a majority of 70% neck nodes are not involved. In the majority (92%) of the study participants, mass effect is not seen, whereas mass effect is seen in a meagre 8% of the study participants. Changes of bone and vascular involvement are seen in 4% of the study participants.

Bagale S et al[10]made an observation that the Enhancement patterns and the presence or absence of bone invasion were found to be more specific in differentiating benign/malignant nature. A variety of cases ranging from the thyroglossal duct cyst to the florid recurrent oral carcinoma cases were observed.

In the study done by **Desai S et al**[14]Necrotic changes were present in 30% of the malignant lesions.19% (n=14) of malignant lesions and 22% of benign lesions have shown calcifications. of malignant lesions calcification was seen in thyroid malignancies (8%) followed by malignant bone tumor (6%). Most common benign lesions that showed calcification are haemangiomas (7%) among the benign lesions, attributing to the presence of phleboliths. Bony changes in 15% of benign lesions and 19% of malignant lesions. It was observed that the lymph nodes were found to be the most common malignant neck lesions in the study. Many of the changes observed in this study are in concordance with the present study.

Charan I et al[12] made an observation that necrosis was the most common feature in malignant lesions. The solid nature of the lesion was most common in malignant lesions (88%), followed by the solid cystic type, which is seen in thyroid gland lesions and salivary gland tumours (7%) and lytic sclerotic type (7%), which was also seen in bone tumours. Benign lesions also revealed solid lesions most commonly (44%), followed by cystic (19%) lesions. Calcification was found among 22% of benign and 19% of the malignant lesions.

Necrosis was the most common feature in the malignant lesions, 30% of malignant lesions showed necrosis, and 7% of malignant lesions shows cystic areas. Cystic areas are most commonly seen in benign lesions, 33% of the benign lesions demonstrated cystic areas. Bone erosion was seen in 19%, and cartilage erosion is seen in 7% of the malignant lesions. 15% of benign lesions showed bone erosions.

In the study done by **Siddiqua et al**[13]ill-defined margins were found in 94% of the malignant lesions, whereas 80% of the benign tumors showed wellfined margins. Most of the malignant tumors were cystic, whereas benign tumors were mostly solid tumors.

Enhancement pattern in CT:

The enhancement patterns of neck masses in CT imaging were investigated in our study and compared with the results from other research studies. The table 2 below summarizes the distribution of enhancement patterns observed in the participants:

Study	No Enhancement	Homogeneous Enhancement	Heterogeneous Enhancement	Peripheral Enhancement
Present Study	34%	2%	46%	18%
Charan et al[7]	12%	14%	81%	18%
Kaur et al[1]	9%	8%	31%	12%

Table 2.

In our study, 46% of the participants exhibited a heterogeneous contrast enhancement pattern, 18% showed peripheral enhancement, and only 2% demonstrated homogenous contrast enhancement. Additionally, 34% of the participants did not display any contrast enhancement. These findings were found to be in close concordance with those reported in the other studies conducted by Charan et al. and Kaur et al. It was observed that benign tumors typically exhibited well-defined and homogenous enhancement, whereas malignant tumors displayed heterogeneous enhancement with infiltration towards the peripheries and manifested as having ill-defined margins. Understanding the distinct enhancement patterns observed in CT scans can aid in differentiating between benign and malignant neck masses, enabling more accurate diagnoses and informed treatment decisions for improved patient outcomes.

CT diagnosis of the lesions

The CT diagnosis of neck lesions was studied, and the results were compared with findings from other research studies. The table 3 below presents the distribution of CT diagnoses in terms of benign and malignant lesions among the study participants:

Study	Benign (%)	Malignant (%)
Present Study	64%	36%
Charan I et al[12]	31%	69%
Siddiqua et al[13]	35.1%	64.9%

Study	Benign (%)	Malignant (%)
Ajay et al[4]	62%	38%
Desai S et al[14]	27%	73%

Table 3

In the present study, CT diagnoses revealed that 36% of the study participants had malignant lesions, while the majority, 64%, were diagnosed with benign conditions. Our study findings were consistent with the results reported by Ajay et al., where benign cases were more prevalent than malignant ones. However, it is worth noting that in the studies conducted by Charan I et al. and Siddiqua et al., the proportion of malignant cases was higher in comparison to benign cases. The radiological evaluation based on CT scans plays a pivotal role in accurately diagnosing neck lesions, enabling healthcare professionals to differentiate between benign and malignant conditions, thus guiding appropriate treatment strategies for optimal patient care. The varying proportions of benign and malignant cases across different studies underscore the importance of comprehensive evaluations and individualized management approaches for patients with neck lesions

Diagnostic Accuracy of CT in comparison with HPE:

In our study, we assessed the diagnostic accuracy of CT (Computed Tomography) in comparison with Histopathological Examination (HPE) for identifying benign and malignant conditions in neck masses. The results revealed that CT exhibited excellent performance with 100% sensitivity and specificity for diagnosing benign lesions, meaning it correctly identified all cases of benign conditions and accurately ruled out malignancy in others. However, in diagnosing malignant conditions, CT showed a slightly lower sensitivity of 90%, indicating that it correctly identified most malignant cases, but there were a few instances where malignancy might have been missed.

When comparing our findings with previous studies, some studies reported even higher sensitivity and specificity rates for CT in diagnosing neck masses. For instance, Kaur et al. reported a sensitivity of 96.4% and specificity of 100%, while Siddiqua et al[13] found sensitivity and specificity values of 94.6% and 95%, respectively. Additionally, Charan I et al[12] and Desai S et al[14] showed similar sensitivity rates at 95.7%, but their specificity values were lower at 77.5%. Considering the clinical implications of accurate diagnosis, CT can serve as a valuable modality for identifying neck masses and formulating appropriate surgical plans. The high sensitivity and specificity observed in our study suggest that CT is a reliable tool for distinguishing benign from malignant conditions. While there are variations in specificity among different studies, CT remains a valuable tool for guiding treatment decisions and surgical interventions, enabling clinicians to manage neck masses effectively and plan appropriate treatment strategies.

Conclusion: CECT is a valuable imaging modality for evaluating neck masses, providing important information for accurate diagnosis and treatment planning. It showed high sensitivity and specificity for diagnosing both benign and malignant lesions. The findings of this study contribute to the understanding of the role of CECT in the assessment of neck masses and its correlation with histopathology.

References

1. Kaur R, Singh P, Kaur N, Bhatnagar S, Dahuja A. Role of Computed Tomography (CT) in Localisation and Characterisation of Suprahyoid Neck Masses. Pol J Radiol. 2017 May 13;82:263–70.
2. Gamss C, Gupta A, Chazen JL, Phillips CD. Imaging evaluation of the suprahyoid neck. Radiol Clin North Am. 2015;53:133–44.
3. Harnsberger HR, Osborn AG. Differential diagnosis of head and neck lesions based on their space of origin. The suprahyoid part of the neck. Am J Roentgenol. 1991;157:147–54.
4. Goutam AK, Kushwah APS, Pande S. Ultrasonography and CT evaluation of neck masses. Int J Contemp Med Res. 2017;4(6):1392-1397.
5. Koischwitz D, Gritzmann N. Ultrasound of the neck. Radiol Clin North Am. 2000;38:1029-104.
6. Miller EM, Norman D. The Role of Computed Tomography in the Evaluation of Neck Masses. Radiology. 1979;133:145-149.
7. Williams DW. An imager’s guide to normal neck anatomy. Semin Ultrasound CT MR. 1997;18:157-181.
8. Haynes J, Arnold KR, Aguirre-Oskins C, Chandra S. Evaluation of Neck Masses in Adults. AFP. 2015 May 15;91(10):698–706.
9. Talukdar R. CT Evaluation of Neck Masses .IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) 2015;14(12):39-49.
10. Bagale D, Agarwal V, Dethe V, Resident S, Professor A. Multi Detector Computed Tomography Evaluation of Neck Masses in Adults. 2017 Jan 1;127–32.
11. Dr. Pushpraj Naik, Dr. G Gurushankar. Comparison and evaluation by USG and CT with histological findings of cervical lymphadenopathy in head and neck malignancies. Int J Radiol Diagn Imaging 2020;3(1):265-269.
12. Charan I, Kapoor A, Kumar N, Jagawat N, Singhal MK, Kumar HS. Evaluation of Neck Mass with Computed Tomography: An Observational Study. Int J Sci Stud. 2014;2(7):118-122.
13. Siddiqua U, Halder B, Hossain R, Roy S, Al-Amin A, Sultana S. Evaluation of Neck Mass by Multidetector Computed Tomography and Histopathological Comparison. Bangladesh Med Res Counc Bull. 2018 Apr 16;43:115.
14. Desai SC. CT Evaluation of Neck Masses - A Retrospective Study of 100 Cases. 2019;8(7):42-45.