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Research Paper

Accuracy of Node-RADS 1.0 in the Detection of Lymph Node Metastasis in Primary Abdominopelvic Malignancies by Computed Tomography

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ABSTRACT:

BACKGROUND:

Careful assessment of abdominal and pelvic lymph nodes on computed tomography is a final job in radiological training particularly in oncological reporting. Node –RADS1.0 was used to form a steady construction for radiological reporting of lymph nodes.

OBJECTIVE:

Intended to assess lymph nodes metastasis among a sample of Iraqi patients with primary abdominopelvic tumors based on Node–RADS version 1.0 in comparison with histopathological results.

PATIENTS &METHODS:

This prospective comparative study was conducted at the CT unit of Oncology Teaching Hospital in Baghdad Medical City for period from March 2021 to December 2022. The study sample included (70) patients with abdomen/ pelvic malignancies, CT scan study was done, both unenhanced and contrast enhanced CT studies were included. The patients were followed up after surgery for the result of their histopathological examination to be compared with the Node-RADS score.

RESULTS:

The study shows that Node-RADS v 1.0 category 2 was the most one registered among 18 (25.7%) of the patients, followed by 4 among 15 (21.4%), category 3 among 13(18.6%) patients and category 1 and 5 among 12 (17.1%) of the patients respectively. Regarded histopathology there was equal percentage (50.0%) of the positive and negative result, there was a significant association between the histopathological finding with the Node-RADS results, 81.5% of positive histopathology had Node-RADS category (4 and 5) and this finding found to be significant as p value was less than 0.05. The sensitivity of the Node-RADS test compares with the gold standard test (Histopathology) found to be 81.5% and the specificity of the Node-RADS was 69.8%.

CONCLUSION:

The Node Reporting and Data System 1.0 regulates reporting of cancer nodal contribution on CT imaging. There is high sensitivity and good specificity of Node-RADS in comparison to histopathological study.

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Iraqi Postgraduate Medical Journal, 2024; Vol. 23(3): 26-34
DOI: 10.52573/ipmj.2025.144536 *Received: January 11 , 2024* *Accepted January 11, 2024*

INTRODUCTION:

Assessment of lymph nodes for the possibility of disease contribution is essential in the background of cancer staging because nodal affection is an undesirable prognostic sign that affect patient management, distinguishing surgical candidates from patients suitable for non-surgical treatment.[1-3] Node -RADS—the ordered reporting system for lymph nodes—to help patient treatment by physicians and get better contact between radiologists and physicians. A precise explanation of lymph nodal location is necessary for suitable staging and treatment of the disease.[4-6] Imaging estimation of lymph node metastasis can be difficult for the radiologist because there are numerous lymph node levels to evaluate and variable optional criteria for metastatic lymph nodes.[7,8]

CT scan: provides a brilliant spatial resolution for measuring nodes. The most dependable finding indicative effected lymph nodes is size.[9,10]

Node reporting and data system 1.0 (Node-RADS).

Node-RADS is an idea that aiming to improve the reporting of distant and regional lymph nodes in cancer patients, results in a groupings scored between 1 and 5, which reflects the level of suspicion for affection by malignancy: "1:very low"; "2:low"; "3:equivocal"; "4:high"; "5:very high.[11,12]

PATIENTS AND METHODS:

Patients: This prospective study was conducted at the CT unit of Oncology Teaching Hospital in the Baghdad Medical City for period from March 2021 to December 2022. The study sample included (70) patients with abdomen/ pelvic malignancies, (49) female and (21) male, with mean age was (53.3years). The smallest short axis diameter of lymph nodes included in this study was (7 mm) and the largest one was (40mm) in axial diameter. Ethical approval from Iraqi Board of Diagnostic Radiology Committee with verbal or written consents were obtained from all patients were included in the study.

The inclusion criteria were: The patients were referred to the CT unit on base of clinical suspicion and/or other imaging modalities findings (US, MRI) about presence of abdominal and /or pelvic tumor with nearby or faraway lymph nodes.

The exclusion criteria were: Patients less than 18 years old, Patients with: hematological malignancies, with known case of diagnosed malignancy and on treatment, with newly diagnosed malignancy which is beyond surgery (stage VI disease), with disease/ condition that made radiation &/or IV contrast is contraindicated & with the non nodal details histopathological reports (underestimate L.N involvement).

METHODS:

CT scan study was done and images were acquired by using uniform protocol for abdomen & pelvis on multi-detector CT scan system 64 slice (Siemens Somatom Definition AS, Siemens Medical Solutions, Erlangen, Germany). All the patients were examined at supine position with their arms above their head throughout whole the study, they were examined initially by unenhanced study with following scan parameters: (120 kV, manual mA (dose modulation) dose between 250-350mA was used accordingly, rotation time 0.5 sec, increment 1, collimation 24 mm x1.2 mm, pitch 0.65. Reconstructions were achieved in 1, 1.5 & 5 mm thickness of slice using three special kernels (B20f smooth, B30f medium smooth, B31f medium smooth +), matrix 64 x 0.6 mm, FOV depend on examined area length either 768 mm or 1024 mm accordingly, Display FOV 512 mm, no section gap. Scout view obtained then IV contrast (OMNIPAQUE 350 mg Iodine/ml - IOHEXOL 100 ml each 1 ml contain 755mg of Iohexol_ GE Healthcare Inc, Marlborough, MA 01752 U.S.A) were given by injector or manually by technician with volume of 100-120ml of nonionic contrast at 3-5mL/s at three phases: Arterial phase: at 15-30 seconds post bolus trigger (35-45s after injection), Portal venous phase: at 60 -75 seconds post injection, Delayed phase at 2-5minutes.The patients were followed up after surgery for the result of their histopathological examination.

Image analysis

All sections were reviewed; native study was useful as initial assessment. Contrast study was useful for qualitative assessment of lymph nodes. The number of the detected lymph nodes was calculated, after that each lymph node was assessed at delay phase for detection of the following parameters:

1) **Size:** which was obtained by measuring short axis axial diameter for two times to decrease interobserver error, the size interpretation was: Normal (short axis diameter less than 10 mm except for special groups e.g., inguinal, mesorectal), enlarged (short axis larger than normal but no bulky).Bulky (any axis which is equal or more than 30 mm).
2) **Configuration** which was assessed by observing the following:

a) **Texture:** Homogenous (given score 0), heterogeneous (given score 1). Focal necrosis (given score 2), gross or any new necrosis (given score 3). Cystic appearance, calcifications, mucinous texture (given score 3).

b) **Border:** Smooth (given score 0)**,** irregular or ill defined (given score 1).

c) **Shape:** Any shape with preserved fatty hilum (given score 0), oval or bean shape without hilum (given score 0), spherical without fatty hilum (given score 1). After that we calculate the score totally with correlation with measured size short axis axial diameter), each LN give the specific Node-RADS score

Statistical analysis

The data were coded, then entered into the computer by the researcher using statistical package for social sciences (SPSS) version26. Data were presented in simple measure of frequency, percentage, mean, standard deviation & range (minimum–maximum values). Statistical significance was tested by means of the Pearson Chi-square test and considered significant whenever the P-value was less than or

equal to 0.05. The sensitivity & specificity of using Node-RADS 1.0 was also measured.

RESULTS:

Of the 70 patients with different complaints referred to the Department of radiology-Oncology teaching hospital-Baghdad medical city, during the study period, noticed that there were 49 females (70.0%) and 21 males (30.0%), patients had different age groups, below 40 years old were 14 (20.0%), 41 to 60 years old were 32 (45.7%) and above 60 years old were 24 (34.3%), with a mean age was 53.3 years old and standard deviation of ± 14.9 years. Colorectal ca. was the most frequent primary tumor among participants (30/70) followed by ovarian ca. (9/70) .While endometrial ca. was the third one among (6/70) gastric ca. (4/70), cervical ca., gallbladder adenocarcinoma and SCCof vulva were (3/70) for each one respectively. Pancreatic ca., small bowel ca., metastatic ca. and seminoma was happened on 2/70 patients for each one. Finally, adrenal ca., cholangiocarcinoma, RCC and uterine leiomyosarcoma were happened in 1/70 participants respectively . Internal iliac was the most frequent lymph nodes group that recorded by radiological features among our participants (6/70), followed by (inf mesenteric, para-aortic, peri-colic, mesorecta, external iliac, inguinal, Right colic) the lymph node groups was (5, 5, 5, 4, 3,3 and 3) respectively, The mean size of the lymph nodes was 12.66 mm with a standard deviation of ±5.87 mm. According to the size of the largest lymph node (short axis), 11 mm was the most frequent size registered among (14/70) participants lymph node sample, followed by 8 mm (10/70) participants, 12 mm (9/70) participants and 9 mm, 13 mm was among (6/70) participants for each one respectively as shown in (Fig.1).

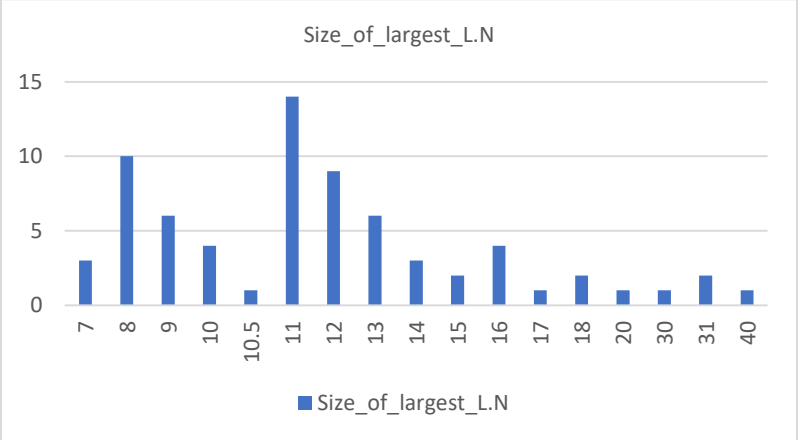

Fig.1: Bar chart of the lymph nodes size frequency among participants

Table 1 shows that Node-RADS category 2 was the most one registered among 18 (25.7%) of the participants, followed by category 4 among 15 (21.4%), category 3 among 13 (18.6%) participants and category 1 and 5 among 12 (17.1%) of the participants respectively. Regarded histopathology there was equal percentage (50.0%) of the positive and negative result as shown in (Table 1).

Table 1: The distribution of the Node-RADS radiological result and the histopathology finding of the participants (n=70).

Clinical presentation and examination		No	%
Node-RADS	1	12	17.1
	2	18	25.7
	3	13	18.6
	4	15	21.4
	5	12	17.1
histopathology	Negative	35	50.0
	Positive	35	50.0

There was no significant statistical association between the age , gender of the participants, lymph nodes groups &the primary tumor site with the results of Node-RADS (negative or positive) (P = 0.505) ,(p = 0.120) , (p =0.354) & (P =0.187) respectively, While there was significant association between the size of the lymph node with Node-RADS test as that the negative test found to be significantly smaller size compare to positive node-RADS test as (p value was less than 0.05).

Also significant association between the histopathological finding with the Node-RADS results, 81.5% of positive histopathology had Node-RADS category (4 and 5) and this finding found to significant as (p value was less than 0.05). The sensitivity of the Node-RADS test compare with the gold standard test (Histopathology) found to be 81.5% and the specificity of the Node-RADS was 69.8% as shown in (Table 2).

Table 2: The sensitivity and specificity of the Node-RADS test compare to the histopathological finding.

		Node-RADS		Total
		positive	negative	
histopathology	positive	**22 (81.5%)**	13 (30.2%)	35 (50.0%)
	negative	5 (18.5%)	**30 (69.8%)**	35 (50.0%)
Total		27 (100%)	43 (100%)	70 (100%)

Depending on the above Node-RADS radiological result among participants and to measure the significant of Node-RADS true and false result compare to histopathology using the ROC curve. The ROC curve shows that 3.5 may be the optimal cutoff value for differentiated significant positive (True result) Node-RADS RADS from not with a sensitivity of 93.2%, specificity of 42.3% as shown in (Fig.2).

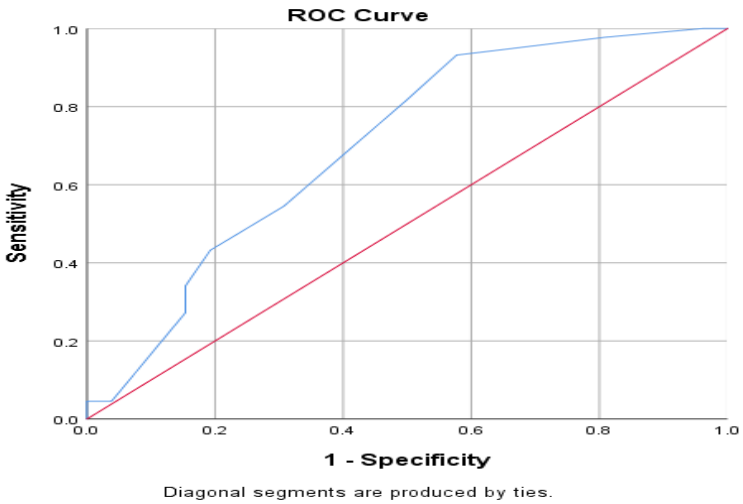

Fig 2: The ROC curve test of the Node-RADS cutoff value among participants.

According to the cutoff mentioned previously the Node-RADS more than 3 considered positive and the opposite considered negative, about (61.4%) (no.43)had negative result according to Node-RADS results and (38.6%)(no.27) had positive Node-RADS results as show in table 3 .

Table 3: The distribution of the Node-RADS result according to the cutoff value calculated by ROC Curve.

Node-RADS	N	%
Negative	43	61.4
Positive	27	38.6

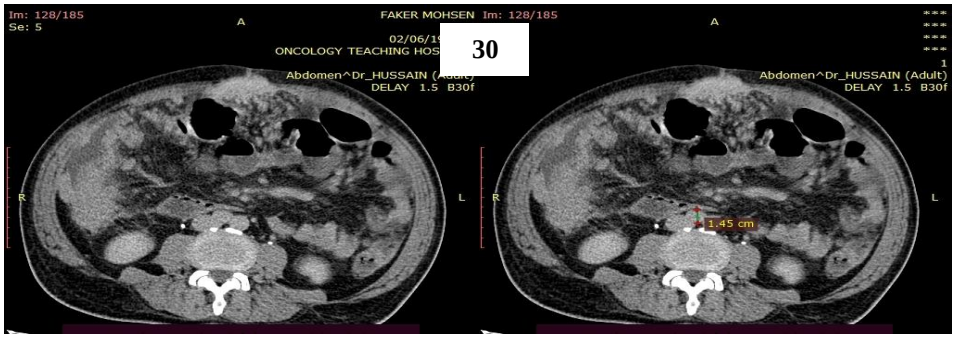

Fig 3: CT scan of 50 years old male patient with histopathological diagnosis of colonic adenocarcinoma with multiple lateroaortic&aortocaval L.N enlargement of benign histology. (Size:short axis axial diameter of largest L.N is 14.5mm(enlarged) , Texture: homogenous(0) , Border:smooth(0), shape:oval, loss of hilum(0) (L.N was Node-RADS2).

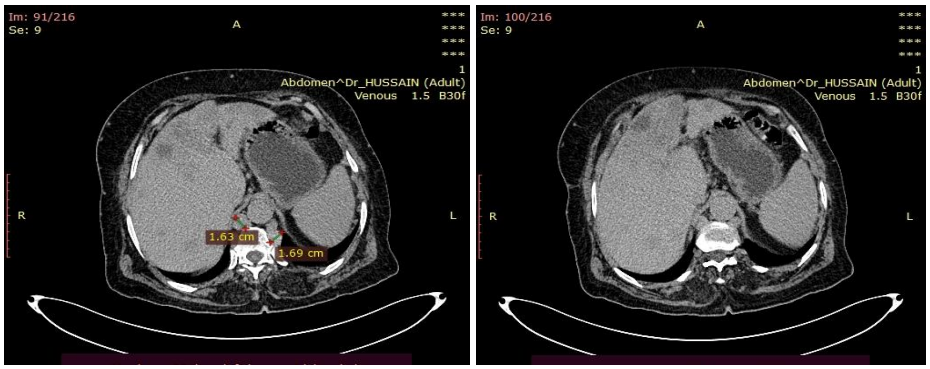

Fig 4: CT scan of 71 year old female with histopathological diagnosis of cholangiocarcinoma with multiple retrocrural & preaortic L.N enlargement with malignant invasion.(Size:short axis axial diameter of largest L.N is 17mm(enlarged) , Texture: homogenous(0) , Border: smooth(0), shape: rounded, loss of hilum(1). (L.N was given Node –RADS 3).

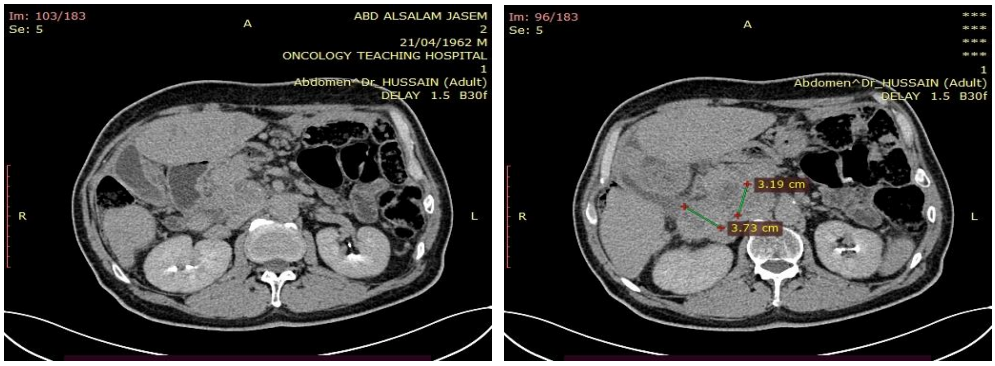

Fig 5: CT scan of 60 years old male with histopathological diagnosis of gastric adenocarcinoma with multiple lateroaortic L.N enlargement with malignant invasion. (Size:short axis axial diameter of largest L.N is 37.3mm(bulky) , Texture: heterogenous (1) , Border: irregular ,ill defined (0), shape: rounded, loss of hilum(1)+focal necrosis(2). (L.N was given Node –RADS5).

DISCUSSION:

Preoperative evaluation of lymph node condition in patients with abdomino- pelvic tumor is essential because the occurrence of tumor-associating lymph nodes increases the risk of recurrence. [13,14]This prospective study uses Node-RADS 1.0 as the basic reference for the estimation of lymph node status in patient with primary abdominal or pelvic malignancy, in correlation with histopathological examination after surgical excision. Abundant studies have assessed the precision and efficacy of CT scanning for diagnosing lymph node metastases. In overall, specificities and sensitivities fluctuated from the high of 94% low to a of 55%.[15] It has been exposed that the most consistent parameter of nodal size was short axis measurement of lymph node ,the comparison between these studies is problematic because of the different size criteria employed, the different type of measurements for abnormal nodes achieved, and different patient populations .[10] In this study, there was a significant association between the histopathological finding with the Node-RADS results, 81.5% of positive histopathology had Node-RADS category (4 and 5) and this finding found to significant as (p value was less than 0.05). Regarding the distribution of Node-RADS, shows that Node-RADS category 2 was the most one registered among 18 of the participants, followed by category 4 among 15, category 3 among 13 participants and category 1 and 5 among 12 of the participants respectively. According to Node-RADS1.0 scoring system lymph nodes that were scored as Node-RADS 1 & 2, they had very low & low possibility to have been invaded by malignancy, while LNs that were scored as Node 4 & 5, they had high &very high possibility to have been malignant nodes. The remaining Node-RADS 3 which was given equivocal possibility according to Node-RADS1.0 scoring system; however, its possibility was tested by ROC curve to measure the significant of Node-RADS true and false results compare to histopathology, The ROC curve shows that 3.5 may be the optimal cutoff value for differentiated significant positive (True result) node-RADS from not with a sensitivity of (93.2%), specificity of(42.3%).The sensitivity of the Node-RADS test compare with the gold standard test (Histopathology) found to be 81.5% and the specificity of the Node-RADS was (69.8%).The false negative results were 13 cases (30.2%) while false positive results were 5cases(18.5%), in comparison with the study that concern about the patients with optimal debulking surgery with advanced ovarian carcinoma(≥ IIB), were randomized for no removal of the lymph nodes versus whole pelvic and para-aortic lymphadenectomy, However, the main spot is that (55.7%) of patients in the lymphadenectomy group had lymph node contribution, even though they had been designated as normal in CT scan,[16] which is much higher than this study completed(30.2%). The causes of discordant results between Node-RADS scoring system of L.N evaluation by CE- CT scan & histopathological results were: First, the no. of LNs detected by CE-CT scan were much less than that removed after surgery & were examined histopathologically (rise the possibility of false negative result). Second, size of the LN; whenever, we using the size as the only reliable parameter for prediction of malignant LN the possibility of false positive result was higher(e.g.; patient with seminoma who had large (bulky more than 3cm) para aortic LN which was given Node-RADS 5, his pathological result was negative for invasion, one of the studies shows in the bulky nodal group only 42% of the nodes were positive, although these nodes were categorized as pathologic due to their size.[16] Third, presence of entity specific finding such as calcification ,leading to higher Node-RADS status of that node , the cause of this is not always malignancy (TB or treated lymphoma, sarcoma). Fourth, other processes including primary retroperitoneal tumors or retroperitoneal fibrosis may similar to/or cause lymphadenopathy. Fifth, there are several problems in expecting LN status on imaging, leading to the false-positive result. The reactive LN makes it difficult to be distinguished from concerned nodes. Furthermore, continuous (or may be discontinuous) tumor deposits could be similar to the concerned LN, leading to overestimation of positive LN. To keep away from this type of overestimation, direct connection with the main tumor should be cautiously evaluated on multiplane images. Sixth, discrimination between affected nodes and discontinuous extra-nodal tumor deposits without remaining nodal tissue have not been resolved yet on microscopy, much less on imaging. Seventh, the post-radiation effect makes it difficult in clarification of LN status at imaging. Edema of the perirectal fat tissue by post-radiation fibrosis around the LN & radiation effect and may result in false-

positive results of LN status (although the study's participants were not undergoing radiation).

Limitations of the study The study was limited by certain factors such as: Selection bias could have been submitted because the study was made with small number of the patients at single center. The study was conducted with only patients who had subsequent surgery (lower tumor stage) as correlated to the average patients who tolerate imaging for staging. The measurement of size of each LN to score it and then account the highest score as the LN status is time consuming & made obstacles in daily work practice. Each tissue specimen (include LN specimen) was cut for examination only once, additional positive node can be detected if the pathologist examines multiple sections or by immunological assessment. The number of excised & histopathologically examined lymph nodes much higher than these detected by CT scan imaging. The Node-RADS 1.0 which is the basic of the study is the recent scoring system, with no adequate studies to validate it.

CONCLUSION:

The Node Reporting and Data System 1.0 (Node-RADS) regulates reporting of cancer contribution of distant and regional lymph nodes on CT imaging, Node-RADS is suitable at any anatomical location, signifying the utilize in the scoring of the categories of "configuration" and "size" for designing the 5-point Node-RADS valuation category score. The likelihood of malignant LN involvement increase with increase Node-RADS score. There is high sensitivity & good specificity of Node-RADS in comparison to histopathological study.

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