To evaluation of contrast-enhanced computed tomography-indeterminate lung lesions using diffusion weighted magnetic resonance imaging and apparent diffusion coefficient measurement

Dr. Nikhil Deshneni
Assistant Professor, Department of Radiodiagnosis, Dr. Patnam Mahender Reddy, Institute of Medical Sciences, Chevella, Hyderabad, India

***Corresponding Author**
Dr. Nikhil Deshneni
Assistant Professor, Department of Radiodiagnosis, Dr. Patnam Mahender Reddy, Institute of Medical Sciences, Chevella, Hyderabad, India

ABSTRACT

Background and objectives: Diffusion weighted imaging and the assessment of apparent diffusion coefficient are used to evaluate lung lesions that were previously ambiguous on contrast-enhanced computed tomography.

Materials and methods: This study was conducted at the Department of Radiodiagnosis, Dr. Patnam Mahender Reddy Institute of Medical Sciences, Chevella, Hyderabad, India between May 2022 to April 2023. Magnetic resonance imaging using T2 weighted and diffusion weighted imaging techniques were performed on 40 consecutive people who had indeterminate pulmonary lesions on contrast-enhanced CT scans of the thorax and met the specified criteria for inclusion in the study. After that, the ADC values of the lesion's solid and necrotic parts were evaluated.

Results: Histopathology was used to diagnose half of the 40 patients in the study, while sputum culture and follow-up exams following antibiotic treatment were used to diagnose the other half. Both benign and malignant lesions showed hyperintensity on DWI, as determined by a qualitative study comparing the lesion's signal intensity to that of the thoracic skeletal muscle. Signal intensities on b=500 s/mm2 photos were not significantly different from those on b=1000 s/mm2 images, statistically speaking.

Conclusion: When evaluating lung lesions with ambiguous characteristics on computed tomography scans, Diffusion weighted imaging has proven to be an effective and safe alternative. MRI performed by using diffusion-weighted (DW) can offer both qualitative and quantitative information that can be helpful for tumour assessment. Moreover, lesion- to-spinal cord signal intensity ratio (LSR) has also been shown to be useful for the differentiation of lung lesions. Quantitative tumour assessment is possible by the calculation of ADC.
In terms of diagnostic accuracy, there is little to no difference between the two approaches.

Keywords: Lesion to spinal cord ratio, diffusion weighted, b factor, absolute signal intensity

INTRODUCTION

Patients getting thoracic CT scans for reasons unrelated to the thorax are now more likely to have pulmonary abnormalities detected thanks to the widespread use of computed tomography (CT) [1, 2]. Patients who appear with a pulmonary lesion require a definitive diagnosis before any treatment may begin. In comparison to traditional chest radiography, the use of contrast-enhanced computed tomography (CECT) for thoracic imaging has substantially improved the ability to properly identify and define pulmonary abnormalities. Combining the results of the CT scan with the patient's symptoms often yields a definitive diagnosis. However, there are situations in which further categorization of the lesions is difficult, and the differential diagnosis may include infectious, inflammatory, and malignant etiologies [3-5].

On CT scans of the lungs, lesions can be categorized as nodules, masses, cavities, consolidations, or ground glass opacities. Nodules, masses, cavities, consolidations, and ground glass opacities are all common cancer and infection symptoms. Imaging data, backed up by pertinent clinical features and laboratory tests, may guide the empirical treatment of viral and inflammatory lesions [6]. But a tissue diagnosis is essential before beginning treatment for cancer. In order to pick the most effective combination of surgery, chemotherapy, and radiation therapy, a definitive diagnosis must be made after identifying the histological subtype using immunohistochemistry and genetic investigations. Because of the importance of early detection, industrialized countries have implemented screening methods for people at high risk of developing lung cancer [7, 8]. The signal intensity ratios (SIRs) of the lesion divided by the rhomboid muscle on T2WI and T1WI are significantly different between benign pulmonary lesion and lung cancer.

Building on its successful application in differentiating malignant and benign lesions in the brain and prostate, diffusion weighted imaging (DWI) is currently being examined for its potential utility in the assessment of pulmonary lesions. Several recent studies have looked at the differences between DWI and ADC readings in biopsied benign and malignant tumors, and the results have been positive. Despite the potential benefits of diffusion-weighted imaging (DWI) in

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 08, 2023

determining the malignancy or benignity of lung lesions that are indeterminate on computed tomography (CT) scans. The ADC and T2 contrast ratio (T2 CR) of lung cancers are significantly lower than that of benign pulmonary lesions[33]. When computed tomography (CT) data are inconclusive, new imaging techniques can help determine if a lung biopsy would be beneficial despite the hazards involved [9, 10].

The major goal of this prospective study is to better define the features of lung lesions that are ambiguous on CT scans. This will be accomplished by inspecting diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) maps both visually and quantitatively. The purpose of this research is to learn how these methods aid in distinguishing between malignant and infectious lesions. Biopsy, histological analysis, clinical follow-up, and corroborating tests [9, 11] were all used to arrive at the definitive diagnoses for our patients. The primary goal of this research was to assess the value of diffusion weighted magnetic resonance imaging (DW-MRI) and apparent diffusion coefficient (ADC) quantification in the evaluation of pulmonary lesions with equivocal features on contrast-enhanced computed tomography (CT) scans.

Materials and Methods:

This study was conducted at the Department of Radiodiagnosis, Dr. Patnam Mahender Reddy, Institute of Medical Sciences, Chevella, Hyderabad, India between May 2022 to April 2023. Magnetic resonance imaging (MRI) with T2 weighted and diffusion weighted imaging (DWI) was performed on 40 consecutive people with indeterminate pulmonary lesions on contrast-enhanced CT scans of the thorax who met the inclusion criteria. After that, the ADC values of the lesion's solid and necrotic parts were evaluated.

Methodology:

In this investigation, we included 40 consecutive patients who presented with unexplained pulmonary lesions on contrast-enhanced computed tomography of the thorax and who met the predetermined inclusion criteria. After obtaining their consent, these individuals received T2-weighted MRI, diffusion-weighted imaging, and apparent diffusion coefficient (ADC) assessment.

Inclusion Criteria:

- Patients >18 years old with ambiguous pulmonary lesions after thoracic CECT.
- Possible infection or cancer.

Exclusion Criteria:

- Patients with prior lesion biopsy may have altered MRI signal intensity.
- Patients contraindicated for MR imaging E.g. pacemakers, metallic implants, severe claustrophobia.
- Pregnancy.
- Patients with motion artefacts impairing image interpretation

Statistical methods:

All continuous variables at baseline were expressed as means standard deviations, and all categorical variables were reported as frequencies and percentages. Mean LSR and ADC values were compared between benign and malignant lesions and their subgroups using the independent samples T-test. It was determined that there was a statistically significant difference between the groups. After that, a ROC curve was made and used to determine the best possible threshold value. The clinical follow-up data was also incorporated because it was deemed important.

RESULTS

Forty patients with pulmonary lesions detected on contrast-enhanced computed tomography (CECT) of the chest were included in the study. The ages of the people who took part in this study ranged from 24 to 79, with 50 being the median. Patients aged 50–59 made up the largest age group. Thirty of the forty people in the cohort were classified as male, while ten were classified as female. Referrals from the divisions of General medicine, Pulmonary medicine, and medical oncology provided the study's participants.

Table 1 displays information about patients who have been referred to specific departments.

Table 1: Study patient enrollment distribution

Sr. No.	Department of Referral	Patients	%
1.	General Medicine	5	12.50
2.	Pulmonary Medicine	30	75.00
3.	Medical Oncology	5	12.50
	Total	40	100.00

Out of the total cohort of 40 patients, 29 individuals opted for CT guided biopsy, 10 individuals chose transbronchial biopsy, and 1 individual received thoracoscopic guided biopsy.

The study population consisted of 20 individuals who were diagnosed with malignant lesions. The various types of

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 08, 2023

malignant lesions observed in these patients are presented in Table 2.

Table 2: Biopsy distribution of malignant pulmonary lesions

Sr. No.	Type of malignancy	Patients	%
1.	Adenocarcinoma	6	30
2.	Squamous cell carcinoma	4	20
3.	Undifferentiated carcinoma	2	10
4.	Lymphoma	6	30
5.	Large cell carcinoma	2	10
	Total	20	100

In a cohort of 6 individuals diagnosed with biopsy-confirmed adenocarcinoma of the lung, a subset of 4 patients underwent testing to identify mutations in the EGFR gene. Of these 4 patients, one exhibited a positive result for EGFR mutations, while the remaining 3 patients tested negative.

The distribution of causative bacteria among the 20 patients with lung lesions resulting from an infective etiology. The aforementioned instances were diagnosed as TB. Within the cohort of non-infectious benign pulmonary lesions, the observed instances included one case of pulmonary amyloidosis and one case of IgG4 illness, while the remaining cases were characterized as non-specific inflammatory lesions.

Table 3: Patient symptoms with benign and malignant pulmonary lesions

Sr. No.	Symptom profile	Benign	Malignant
1.	Cough	5	7
2.	Expectoration	2	3
3.	Chest pain	3	2
4.	Breathlessness	2	1
5.	Hemoptysis	3	2
6.	Fever	2	3
7.	Sig. weight loss	3	2
	Total	20	20

Symptoms were observed to last an average of 7.70 months for malignant lesions and 9.31 months for benign ones. The two groups did not differ significantly statistically. Smoking was a factor in the development of benign pulmonary lesions in 29.6% of patients and malignant pulmonary lesions in 40% of patients. There were 06 cases of adenocarcinoma, and 3 were linked to a smoking history; there were 4 cases of squamous cell carcinoma, and 3 were linked to smoking. Table 3 details the prevalence of each symptom among study participants, and table 4 shows how many people in each group smoke.

Table 4: Statistics on the Smoking and Nonsmoking Population

Sr. No.	Type	Benign	Malignant
1.	Non-smoker	15	10
2.	Smoker	5	10
	Total	20	20

CT Findings in Pulmonary Lesions and Their Characteristics

Lesions in the lower right lobe of the lungs were observed in the majority of the 40 individuals. The majority of wounds were concentrated on one side. The average diameter of the lesions was 5.28 millimeters. Necrosis was observed in 44.4% of instances across benign and malignant tumors. There was evidence of lymphadenopathy in the ipsilateral mediastinum in 30 of the 40 patients, in the ipsilateral hilar region in 34, in the contralateral mediastinum in 10, and in the contralateral hilar region in 2. Eleven patients were identified as having pleural effusion. The bulk of the 27 benign lesions in the lungs were nodules and consolidation areas. One case of an IgG4 sickness was among the few incidences of infection manifesting as a mass.

DISCUSSION

Nodules, masses, consolidations, and cavities are all possible CT findings associated with pulmonary lesions. The CT findings provide valuable insight into the underlying disease processes. By examining the morphology of the lesion and accompanying findings, contrast-enhanced computed tomography (CECT) is frequently instrumental in differentiating between benign and malignant lesions. On rare occasions, however, computed tomography (CT) scans reveal lesions with inconclusive features that defy categorization as either benign or malignant. Additional imaging modalities may be useful in better characterizing these patients [12-14].

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 08, 2023

Standard sequences, such as T1-weighted (T1W) and T2-weighted (T2W) pictures, can be examined qualitatively or visually to provide some insight into the cellular characteristics of a lesion. DWI and ADC maps may help in objectively distinguishing between benign and malignant tumors by shedding light on their cellular features. The treatment and prognosis of these lesions are greatly affected by this differentiation. Relaxation time on T2 weighted imaging and the corresponding apparent diffusion coefficient (ADC) value of the voxel determine the signal in diffusion-weighted imaging (DWI). Malignancies affecting the brain, liver, and prostate are only few of the organs for which this method has been studied and put to use in the identification and evaluation of cancer. Apparent diffusion coefficient mapping allows researchers to quantify how much water molecules diffuse throughout a tissue [15–17].

This research set out to determine if the use of diffusion weighted imaging (DWI) and apparent diffusion coefficient (ADC) measurement would improve the diagnostic accuracy of contrast-enhanced computed tomography (CECT) in the evaluation of lung lesions with equivocal characteristics. Using diffusion-weighted imaging (DWI), we compared the signal intensity of the lesion to that of the thoracic skeletal muscle. A three-point scale was used to make the comparison. Our results showed that hyperintensity was present in the majority of benign and malignant lesions. However, there was no discernible difference between the two groups statistically speaking. Liu *et al*. used a three-point scale that was also applied to skeletal muscle to evaluate a total of 62 people with 66 lung lesions. According to the findings, no discernible distinction could be seen between malignant and benign lesions. However, it was determined that hyperintensity is a hallmark of malignant lesions, while moderate intensity is more typical of benign ones [18, 19].

Using diffusion-weighted imaging (DWI) with a b-value of 1000, Satoh *et al*. compared the signal intensity of injuries to the spinal cord using a 5-point rank scale. The purpose of the research was to identify benign pulmonary nodules. With an AUC of 0.796 for the receiver operating characteristic, the results showed a clear separation. Results showed that a cutoff score of 3 had 88.9% sensitivity and 79.6% specificity. The study found that the severity of several types of metastatic nodules and adenocarcinoma decreased, whereas the severity of other granulomas and other inflammatory nodules increased. Cakir *et al*. ran an experiment where they compared outcomes on a 5-point scale. Forty-eight single pulmonary nodules were examined, and thirty were found to be malignant, while the remaining eighteen were deemed to be benign.

In addition to ADC value, lesion-to-spinal cord signal intensity ratio (LSR) has been proposed to be more accurate than mean ADC values on DWI. Moreover, LSR has also been shown to be useful for the differentiation of lung lesions and prediction of tumor invasiveness. When looking at an LSR score of 3 or higher, their research showed a slightly increased level of sensitivity and specificity, namely 93.3% and 88.9% respectively [20-22].

Out of a total of 20 malignant lesions, we found that necrosis was present in half of them. The necrosis rate was also high; it was seen in 10 of the 20 benign lesions studied. Within the necrotic portion of malignant lesions, the average apparent diffusion coefficient (ADC) value was much higher than in benign lesions. However, no significant difference was seen statistically. Research shows that pyogenic abscess necrotic cores had lower apparent diffusion coefficient (ADC) values than necrotic tumors. Pus' high cellularity, viscosity, and fibrinogen content all play a role in this process by greatly impeding the flow of water molecules. Our study's sample size may have been too small to detect a statistically significant association between necrosis and any given factor [23-25].

The use of diffusion weighted imaging (DWI) in the assessment of pulmonary lesions was the subject of a meta-analysis by Chen *et al*., which included data from 11 separate investigations. This meta-analysis found that the average sensitivity and specificity were 82.8% and 80.1%, respectively. This led the scientists to the conclusion that DWI is a non-invasive, reasonably accurate approach for distinguishing benign from malignant tumors. Shen *et al*. performed another meta-analysis, this time included 31 trials and 2368 pulmonary lesions. The results showed that when both LSR and ADC were combined, the sensitivity was 80% and the specificity was 85%, whereas the sensitivity and specificity for ADC were both 84%. Our research found higher values of sensitivity and specificity than those seen in the literature. The sensitivity and specificity for LSR were 70% and 85.2%, respectively [24-26], whereas those for ADC were 80% and 74.1%.

Positron emission tomography-computed tomography (PET-CT) and perfusion studies are two more imaging techniques that can help doctors tell benign from malignant tumors. Ohno *et al*. compared the diagnostic value of PET CT to that of CT perfusion for the assessment of 76 pulmonary nodules. The findings showed that a SUV max threshold value of 2 yielded a sensitivity of 91% and a specificity of 52%. Similarly, a BVPP threshold value of 2 was associated with a sensitivity of 86% and a specificity of 54% [27-29]. Although PET CT has a high sensitivity for cancer detection, its specificity is diminished by the presence of false positive results. False positives in PET CT imaging detection have been reported for a number of diseases, including tuberculosis and granulomas. Furthermore, PET CT is not widely accessible, and it requires the use of radioisotopes and contrast media in order to function. When

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 08, 2023

compared to the PET-CT and dynamic first pass CECT perfusion studies by Ohno *et al*., our examination showed higher specificity while keeping similar sensitivity. Unlike prior studies, ours focuses on lesions that contrast-enhanced computed tomography (CECT) cannot definitively classify as benign or malignant, rather than lesions that can be diagnosed as either benign or malignant with 100% certainty. Diffusion-weighted imaging (DWI) is a fast MRI technique that does not call for the use of contrast agents, making it a desirable option for diagnostic purposes. Our results show that diffusion-weighted imaging (DWI) is an effective adjunct to contrast-enhanced computed tomography (CECT) of the chest for the detection and characterization of pulmonary lesions with equivocal appearances on CECT. Those who are especially vulnerable to the side effects of a biopsy operation should pay special attention to this [30-32].

CONCLUSIONS:

The utilization of Diffusion weighted imaging, commonly referred to as DWI, has proven to be a valuable and secure method for assessing pulmonary abnormalities that exhibit uncertain characteristics on computed tomography scans. The utilization of LSR and ADC in the assessment of solid components has proven to be valuable in distinguishing between benign and malignant lesions. Notably, there is no substantial disparity in the diagnostic efficacy exhibited by these two techniques. If a lesion demonstrates a positive result for malignancy in either of the tests, it is possible to enhance the overall sensitivity to a maximum of 94%. In individuals who are at a heightened risk for lung biopsy, the utilization of diffusion-weighted imaging and apparent diffusion coefficient maps, in conjunction with contrast-enhanced computed tomography, can provide additional evaluation of the probability of malignancy and aid in guiding subsequent medical interventions.

Funding None
Conflict of Interest None

REFERENCES

1. Silva CIS, Marchiori E, Souza Júnior AS, Müller NL, Comissão de Imagem da Sociedade Brasileira de Pneumologia e Tisiologia. Illustrated Brazilian consensus of terms and fundamental patterns in chest CT scans. J Bras Pneumol. 2010 Feb;36(1):99–123.
2. Walker CM, Abbott GF, Greene RE, Shepard J-AO, Vummidi D, Digumarthy SR. Imaging pulmonary infection: classic signs and patterns. AJR Am J Roentgenol. 2014 Mar;202(3):479–92.
3. Honda O, Tsubamoto M, Inoue A, Johkoh T, Tomiyama N, Hamada S, *et al*. Pulmonary cavitary nodules on computed tomography: differentiation of malignancy and benignancy. J Comput Assist Tomogr. 2007 Dec;31(6):943–9.
4. Shi C-Z, Zhao Q, Luo L-P, He J-X. Size of solitary pulmonary nodule was the risk factor of malignancy. J Thorac Dis. 2014 Jun;6(6):668–76.
5. O'donovan PB. The radiologic appearance of lung cancer. Oncology (Williston Park, NY). 1997 Sep;11(9):1387–402; discussion 1402-1404.
6. Jeong YJ, Lee KS, Jeong SY, Chung MJ, Shim SS, Kim H, *et al*. Solitary pulmonary nodule: characterization with combined wash-in and washout features at dynamic multi-detector rowCT. Radiology. 2005 Nov;237(2):675–83.
7. Shim SS, Lee KS, Kim B-T, Choi JY, Chung MJ, Lee EJ. Focal parenchymal lung lesions showing a potential of false-positive and false-negative interpretations on integrated PET/CT. AJR Am J Roentgenol. 2006 Mar;186(3):639–48.
8. Hansell DM, Bankier AA, MacMahon H, McLoud TC, Müller NL, Remy J. Fleischner Society: glossary of terms for thoracic imaging. Radiology. 2008 Mar;246(3):697–722.
9. Nachiappan AC, Rahbar K, Shi X, Guy ES, Mortani Barbosa EJ, Shroff GS, *et al*. PulmonaryTuberculosis: Role of Radiology in Diagnosis and Management. Radiographics. 2017 Feb;37(1):52–72.
10. Nemec SF, Eisenberg RL, Bankier AA. Noninfectious inflammatory lung disease: imaging considerations and clues to differential diagnosis. AJR Am J Roentgenol. 2013 Aug;201(2):278–94.
11. Chung MP, Yi CA, Lee HY, Han J, Lee KS. Imaging of Pulmonary Vasculitis. Radiology. 2010 May;255(2):322–41.
12. Sweidan AJ, Singh NK, Stein A, Tanios M. Nodular Sarcoidosis Masquerading as Cancer. Clin Med Insights Circ Respir Pulm Med [Internet]. 2017 Apr 12 [cited 2018 Oct 12];11.
13. Wong MCS, Lao XQ, Ho K-F, Goggins WB, Tse SLA. Incidence and mortality of lung cancer: global trends and association with socioeconomic status. Scientific Reports. 2017 Oct 30;7(1):14300.
14. Kaur H, Sehgal IS, Bal A, Gupta N, Behera D, Das A, *et al*. Evolving epidemiology of lung cancer in India: Reducing non-small cell lung cancer-not otherwise specified and quantifying tobacco smoke exposure are the key. Indian J Cancer. 2017 Mar;54(1):285–90.
15. Yang P, Cerhan JR, Vierkant RA, Olson JE, Vachon CM, Limburg PJ, *et al*. Adenocarcinoma of the lung is strongly associated with cigarette smoking: further evidence from a prospective study of women. Am J Epidemiol. 2002 Dec 15;156(12):1114–22.

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 08, 2023

16. Gilham C, Rake C, Burdett G, Nicholson AG, Davison L, Franchini A, *et al*. Pleural mesotheliomaand lung cancer risks in relation to occupational history and asbestos lung burden. Occup Environ Med. 2016 May;73(5):290–9.
17. Kurishima K, Kagohashi K, Miyazaki K, Tamura T, Ohara G, Kawaguchi M, *et al*. Small cell lung cancer with endobronchial growth: A case report. Oncol Lett. 2013 Aug;6(2):553–5.
18. Kaifi JT, Kayser G, Ruf J, Passlick B. The Diagnosis and Treatment of Bronchopulmonary Carcinoid. Dtsch Arztebl Int. 2015 Jul;112(27–28):479–85.
19. Nawa T, Nakagawa T, Mizoue T, Kusano S, Chonan T, Hayashihara K, *et al*. A decrease in lungcancer mortality following the introduction of low-dose chest CT screening in Hitachi, Japan.Lung Cancer. 2012 Dec;78(3):225–8.
20. Le Bihan D. Diffusion MRI: what water tells us about the brain. EMBO Mol Med. 2014May;6(5):569–73.
21. Zhang X, Fu Z, Gong G, Wei H, Duan J, Chen Z, *et al*. Implementation of diffusion-weighted magnetic resonance imaging in target delineation of central lung cancer accompanied withatelectasis in precision radiotherapy. Oncol Lett. 2017 Sep;14(3):2677–82.
22. Satoh S, Kitazume Y, Ohdama S, Kimula Y, Taura S, Endo Y. Can malignant and benign pulmonary nodules be differentiated with diffusion-weighted MRI? AJR Am J Roentgenol. 2008Aug;191(2):464–70.
23. Thoeny HC, Forstner R, De Keyzer F. Genitourinary applications of diffusion-weighted MRimaging in the pelvis. Radiology. 2012 May;263(2):326–42.
24. Caravan I, Ciortea CA, Contis A, Lebovici A. Diagnostic value of apparent diffusion coefficient indifferentiating between high-grade gliomas and brain metastases. Acta Radiol. 2018 May;59(5):599–605.
25. Gümüştaş S, Inan N, Akansel G, Ciftçi E, Demirci A, Ozkara SK. Differentiation of malignant and benign lung lesions with diffusion-weighted MR imaging. Radiol Oncol. 2012 Jun;46(2):106–13.
26. Gümüştaş S, İnan N, Sarisoy HT, Anik Y, Arslan A, Çiftçi E, *et al*. Malignant versus benign mediastinal lesions: quantitative assessment with diffusion weighted MR imaging. Eur Radiol.2011 Nov 1;21(11):2255–60.
27. Karaman A, Durur-Subasi I, Alper F, Durur-Karakaya A, Subasi M, Akgun M. Is it better to include necrosis in apparent diffusion coefficient (ADC) measurements? The necrosis/wall ADCratio to differentiate malignant and benign necrotic lung lesions: Preliminary results. J Magn Reson Imaging. 2017 Oct;46(4):1001–6.
28. Purandare NC, Rangarajan V. Imaging of lung cancer: Implications on staging and management.Indian J Radiol Imaging. 2015;25(2):109–20.
29. Ofiara LM, Navasakulpong A, Ezer N, Gonzalez AV. The importance of a satisfactory biopsy forthe diagnosis of lung cancer in the era of personalized treatment. Curr Oncol. 2012 Jun;19(Suppl 1):S16–23.
30. Gupta RK, Prakash M, Mishra AM, Husain M, Prasad KN, Husain N. Role of diffusion weighted imaging in differentiation of intracranial tuberculoma and tuberculous abscess from cysticercusgranulomas-a report of more than 100 lesions. Eur J Radiol. 2005 Sep;55(3):384–92.
31. Chen L, Zhang J, Bao J, Zhang L, Hu X, Xia Y, *et al*. Meta-analysis of diffusion-weighted MRI inthe differential diagnosis of lung lesions. Journal of Magnetic Resonance Imaging. 2013 Jun 1;37(6):1351–8.
32. Shen G, Ma H, Liu B, Ren P, Kuang A. Diagnostic Performance of DWI With Multiple Parametersfor Assessment and Characterization of Pulmonary Lesions: A Meta-Analysis. AJR Am J Roentgenol. 2018 Jan;210(1):58–67.
33. Usuda K, Ishikawa M, Iwai S, Iijima Y, Motono N, Matoba M, Uramoto H (2021) Combination assessment of diffusion- weighted imaging and T2- weighted imaging is acceptable for the differential diagnosis of lung cancer from benign pulmonary nodules and masses. Cancers 13(7):1551