USE OF TRIPHASIC CT LI-RADS V 2018 IN PATIENTS UNDERGOING DYNAMIC CONTRAST-ENHANCED CT LIVER FOR HEPATIC LESION CHARACTERIZATION

Humaira Anjum[1], Samia Iftikhar[2]

How to cite this article

Anjum H, Iftikhar S. Use of Triphasic CT LI-RADS V 2018 in Patients Undergoing Dynamic Contrast-Ehanced CT Liver for Hepatic Lesion Characterization. J Gandhara Med Dent Sci.2026;13(1):18-22. https://doi.org/10.37762/jgmds.13-1.767

Date of Submission: 16-10-2025
Date Revised: 15-12-2025
Date Acceptance: 16-12-2025

[1]Assistant Professor, Department of Radiology, Hayatabad Medical Complex, Peshawar

Correspondence

Samia Iftikhar, Specialist Registrar, Department of Radiology, Hayatabad Medical Complex, Peshawar
✆: +92-333-9459513
✉: samiaifthikhar.123@gmail.com

ABSTRACT

OBJECTIVES

This study aimed to characterize hepatic observations and evaluate the frequency of LI-RADS v2018 categories in a high-risk Pakistani population using triphasic CT.

METHODOLOGY

A retrospective cross-sectional observational study was conducted at the Radiology Department of Khyber Teaching Hospital in Peshawar from March 2021 to September 2022. Fifty-five high-risk patients (cirrhosis/chronic hepatitis B) underwent triphasic CT, and 80 Observations were independently categorized by two radiologists using LI-RADS v2018 major features. Histopathological correlation was assessed where available.

RESULTS

Out of 55 patients (80 observations) in our study, the LI-RADS distribution was: LR-5 in 61 (76.25%), LR-4 in 4 (5%), LR-M in 3 (3.75%), LR-TIV in 7 (8.75%), LR-1/2/3 in 5 (6.25%). Non-rem arterial phase hyperenhancement was the most frequent feature (81.3%). All LR-5 lesions showed non-rim APHE and washout. In the subset with histopathology (n=12), LR-5 showed 100% concordance with HCC (7/7), and LR-M showed 100% concordance with cholangiocarcinoma (3/3).

CONCLUSION

Triphasic CT LI-RADS v2018 effectively categorized hepatic findings in high-risk Pakistani patients, with LR-5 being the most frequent category and demonstrating strong histopathological correlation; however, the high LR-5 prevalence suggests potential selection bias inherent to the referral-based setting. The system provides a standardized reporting framework suitable for local clinical practice.

KEYWORDS: *Hepatocellular Carcinoma, Liver Imaging Reporting and Data System (LI-RADS), Dynamic Contrast-Enhanced CT, Triphasic CT, Pakistan*

INTRODUCTION

Hepatocellular carcinoma (HCC) is a prevalent form of hepatic cancer and ranks fourth among deaths from cancer globally. Cross-sectional imaging plays a vital role in HCC diagnosis and management, obviating the need for invasive biopsy procedures.[1,2] Ultrasound surveillance is performed regularly in patients with chronic liver disease for HCC screening. Although HCC is more common in cirrhosis patients, a wide range of lesions, ranging from benign regenerative nodules to malignant lesions, can occur.[3] These non-malignant entities can exhibit similar imaging characteristics to HCC, resulting in diagnostic ambiguity and potentially incorrect treatment decisions.[4] Tri-phasic CT and MR Imaging is used in this situation to distinguish HCC from other malignancies and benign lesions in cirrhotic liver.[3] The American College of Radiology (ACR) introduced the Liver Imaging Reporting and Data System (LI-RADS) to facilitate the diagnosis and management of HCC in high-risk patients. The system comprises a diagnostic algorithm, a lexicon, and recommendations for standardized interpretation, reporting, data collection, and imaging techniques. It categorizes liver observations on CT and MRI in patients with cirrhosis, chronic hepatitis B infection (even in the absence of cirrhosis), or a prior history of HCC by analyzing primary and ancillary imaging features to indicate the likelihood of malignancy.[1,2,5,6] The 2018 update introduced new criteria, classifying small liver lesions (10-19 mm) that show arterial phase hyperenhancement (APHE) and washout as LR-5.[7,8] LI-RADS classifies liver observations based on primary and ancillary imaging characteristics to determine the relative likelihood of HCC, non-HCC malignancy, and benign. These categories include LR-1, which indicates that the observation is definitely benign, LR-2, which suggests a high probability of benignity, LR-3, which represents an intermediate probability of HCC, LR-4, which indicates a high probability of HCC, LR-5, which

represents a definite diagnosis of HCC, LR-TIV, which is a definite diagnosis of HCC with the tumor in vein and does not require visualization of a parenchymal mass, and LR-M, which suggests malignancy but not specific for HCC and is indicative of non-HCC malignancy with rim arterial phase hyperenhancement. LR-3, LR-4, and LR-5 observations can be distinguished based on major imaging characteristics. These include non-rim arterial phase hyperenhancement (APHE), size and diameter (< 10 mm, 10-19 mm, ≥ 20 mm), washout appearance (attenuation loss in the venous and/or delayed phase), presence of enhancing capsule during the portal venous or delayed phase, and threshold growth rate (growth >50% in ≤6 months).[1,2] While MRI is often considered the preferred modality for LI-RADS application given its superior soft-tissue contrast, triphasic CT remains a widely available, faster, and more accessible first-line multiphasic imaging tool in many clinical settings, including resource-constrained environments. Moreover, there is a notable gap in the literature regarding the systematic application and performance of CT-based LI-RADS v2018 in specific populations, particularly in regions like Pakistan, where aetiology, stage at presentation, and healthcare infrastructure may differ from those in the populations in which the system was primarily validated. In Pakistan, HCC is prevalent and ranks high among cancers affecting the adult population, yet the utilization and impact of a standardized reporting system like LI-RADS in routine radiological practice remain poorly documented. Therefore, this study aims to evaluate the frequency distribution of LI-RADS categories and the diagnostic performance of major CT features in a high-risk Pakistani population undergoing triphasic CT. We seek to determine the feasibility and reliability of implementing this standardized framework to improve diagnostic consistency, enhance communication between radiologists and clinicians, and ultimately support optimized patient management pathways in our local context.

METHODOLOGY

A retrospective, observational study was conducted at the Radiology Department of Khyber Teaching Hospital, Peshawar, from March 2021 to September 2022. The study included 55 consecutive adult patients (>18 years) meeting the LI-RADS v2018 diagnostic population criteria: those with cirrhosis (any aetiology), chronic hepatitis B virus (HBV) infection (with or without cirrhosis), or a prior history of hepatocellular carcinoma (HCC) who underwent a triphasic CT abdomen for hepatic lesion evaluation.[9] Patients with cirrhosis due to congenital hepatic fibrosis, vascular disorders (e.g., hereditary haemorrhagic telangiectasia, Budd-Chiari syndrome), or diffuse infiltrative conditions that mimic HCC were excluded.[10] All examinations were performed using a Canon Aquilion Prime 160-slice multidetector CT scanner. The triple-phasal contrast-enhanced study includes the arterial phase (late arterial phase recommended), portal venous phase, and delayed phase. Unenhanced images if the patient has previous loco-regional treatment. CT images were independently reviewed on a PACS workstation by two radiologists with 5 years of experience in abdominal imaging. Each identified liver observation was evaluated for LI-RADS v2018 major features: size, non-rim arterial phase hyperenhancement (APHE), non-peripheral "washout" appearance, enhancing "capsule," and threshold growth. For this preliminary study, which focused on the core algorithm, ancillary features were not considered, and threshold growth was not assessed due to the frequent lack of prior or follow-up imaging. Each observation was assigned a final LI-RADS category (LR-1 to LR-5, LR-M, or LR-TIV) based strictly on the combination of major features present, following the LI-RADS v2018 diagnostic table. In cases of discrepancy, a consensus reading was obtained through joint review. Demographic data, clinical history (etiology of liver disease, cirrhosis status), were recorded from electronic medical records. Histopathological confirmation, when available, served as the reference standard and was obtained via percutaneous biopsy or surgical resection. For patients without histopathology, the assigned LI-RADS category itself was used as the imaging-based risk stratification endpoint, reflecting the system‘s intended clinical use. Categorical data are presented as frequencies and percentages. The positive predictive value (PPV) was calculated for LR-5 and LR-M categories based on histopathological confirmation. A p-value of <0.05 was considered statistically significant. All analyses were performed using IBM SPSS Statistics version 22.

RESULTS

A total of 55 patients (35 males, 20 females) with a mean age of 49 ± 10 years (range: 32-78 years) were included. All patients met LI-RADS v2018 diagnostic criteria: 42 (76.4%) had cirrhosis (primarily due to hepatitis C virus [HCV] and hepatitis B virus [HBV]), 10 (18.2%) had chronic HBV without cirrhosis, and 3 (5.5%) had a history of previously treated HCC. Eighty (80) distinct hepatic observations were identified and categorized using LI-RADS v2018 criteria. The distribution of LI-RADS categories is summarized in Table 1. Of the 55 patients, 3 (5.5%) had no detectable observations. Two patients (3.6%) had concurrent LR-5 and LR-4 lesions. All 61 LR-5 lesions (100%) exhibited

non-rim arterial phase hyperenhancement (APHE) and non-peripheral washout. An enhancing capsule was observed in 30 (49.2%) of LR-5 lesions. The frequency of significant features in LR-4 and LR-5 observations is detailed in Table 2. Overall, non-rim APHE was the most frequently observed central feature across all observations (65/80, 81.3%). All three LR-M observations (3.75%) exhibited rim APHE and were later confirmed as cholangiocarcinoma on histopathology. Histopathological confirmation was available for 12 of 55 patients (21.8%) through biopsy (n=9) or surgical resection (n=3). The correlation between LI-RADS categorization and final histopathological diagnosis is presented in Table 3.

Table 1: Distribution of LI-RADS Categories (n = 80 Observations)

LI-RADS Category	Number of Observations	%age	Interpretation
LR-1	03	3.75%	Definitely benign
LR-2	01	1.25%	Probably benign
LR-3	01	1.25%	Intermediate probability of HCC
LR-4	04	5.00%	Probably HCC
LR-5	61	76.25%	Definitely HCC
LR-M	03	3.75%	Probably malignant, not specific for HCC
LR-TIV	07	8.75%	Tumor in the vein

*Note: LR-TIV observations were concurrent with LR-5 observations in the same patients. *

Table 2: Major Imaging Features in LR-4 and LR-5 Observations (n = 65)

Major Feature	LR-4 (n=4)	LR-5 (n=61)	Total (n=65)
Non-rim APHE	04 (100%)	61 (100%)	65(100%)
Non-peripheral Washout	01 (25%)	61 (100%)	62(95.4%)
Enhancing Capsule	none	30 (49.2%)	30(49.2%)
Size ≥ 20 mm	01 (25%)	53 (85.2%)	54(83.1%)
Size 10–19 mm	03 (75%)	08 (14.8%)	11(16.9%)

Table 3: Histopathological Correlation and Diagnostic Performance of LI-RADS (n=12 patients)

LI-RADS Category	Observations with Pathology(n)	Confirmed diagnosis (n)	PPV (95% CI)*
LR-5	07	HCC (7)	100% (59.0% - 100%)
LR-4	02	HCC (1), Dysplastic Nodule (1)	50% (1.3% - 98.7%)
LR-M	03	Cholangiocarcinoma (3)	100% (29.2% - 100%)

*PPV = Positive Predictive Value; CI = Confidence Interval. Note: For patients with multiple observations, the highest LI-RADS category was used for correlation.

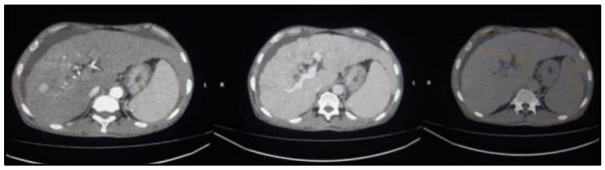

Figure 1: 40-year-old Male Patient with HBV Cirrhosis, LR-5. An Arterial Phase CT Demonstrates a 16.8x13.4x13.5 mm (APxTRxCC) Non-Rim APHE Lesion in Segment 5 (arrow), Which Shows Non-Peripheral Washout in Both b Venous and c Delayed Phases (Arrows). The Lesion Was Categorized as LR-5 (HCC).

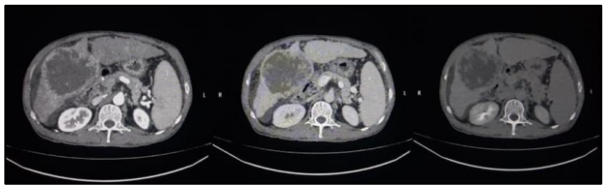

Figure 2: 40-year-old Male Patient with Cirrhosis, LR M. An Arterial Phase CT Demonstrates 8.8x10.4x9.4 cm (APxTRxCC) Rim APHE Lesion Segment 5 and 6, Which Shows Peripheral Washout in both *b* Venous and *c* Delayed Phases (Arrows), No Other Feature. LR-M (Biopsy-Proven Cholangiocarcinoma)

DISCUSSION

This study evaluated the application of LI-RADS v2018 in a Pakistani cohort undergoing triphasic CT for hepatic lesion characterization. This study evaluated the initial application of the CT LI-RADS v2018 algorithm in a high-risk Pakistani population, demonstrating its feasibility as a standardized diagnostic framework in a setting where triphasic CT is the first-line multiphasic imaging modality. The majority of observations (76.25%) were categorized as LR-5, indicating a definite diagnosis of HCC, which aligns with the high-risk profile of our study population. This proportion is notably higher than that reported in a study by Tang ES et al, which typically reports LR-5 rates of 31.4% in surveillance cohorts.[11] This discrepancy likely does not reflect a failure of the algorithm. Instead, it underscores a critical characteristic of our study population: selection bias inherent to a tertiary care, referral-based setting, a known challenge in resource-limited environments where surveillance programs are underutilized. Our cohort comprised patients already suspected of having focal liver disease based on symptoms, abnormal surveillance ultrasound, thereby enriching the sample with advanced, imaging-overlapping malignancies. Consequently, our results validate LI-RADS for diagnosis and staging in symptomatic patients, while its performance in a proper screening context within our region requires further

study. In this study, APHE was the predominant feature (present in 81.3% of all observations and 100% of LR-5 lesions), consistent with prior studies highlighting its critical role in HCC diagnosis.[12,13,14] All LR-5 lesions demonstrated both non-rim APHE and washout, reinforcing the high specificity of this combination for HCC.[10,13] The frequency of enhancing capsules (49.2%) in our LR-5 observation was slightly higher than that reported by Granata V et al. (37.2%).[12] This variance may be attributed to the larger average size of LR-5 lesions in our cohort (85.2% were ≥20 mm), as capsule visualization is positively correlated with lesion size and may also be influenced by delayed phase timing. The algorithm also demonstrated high utility in suggesting non-HCC malignancies. We found that rim APHE was the most characteristic feature of LR-M, and all three were subsequently confirmed as cholangiocarcinoma on histopathology, yielding a PPV of 100% in this small subset. Our results align with the established LI-RADS literature, in which rim APHE is recognized as one of the most specific LR-M features. Chernyak V et al reported that rim APHE is conceivably the most prevalent LR-M characteristic.[13] Furthermore, in our study, LR-TIV was seen in 7 patients who had LR-5 observations. This result was consistent with observations in a study by Khanna et al which revealed that all lesions classified as LR-TIV were HCC.[15] The presence of LR-TIV in association with LR-5 lesions further supports the system‘s ability to identify aggressive tumor behaviour, consistent with established literature.[15] Robust external validators supported the LI-RADS categorization. Histopathological correlation, available in a subset of patients (21.8%), demonstrated strong diagnostic performance of LI-RADS categorization. All LR-5 lesions (7/7) with available histopathology were confirmed as HCC, yielding a 100% positive predictive value (PPV) for this category. Our results are consistent with those of a previous study, which reported 100% (9/9) of LR5 observations confirmed as HCCs.[16] Similarly, all 3 LR-M observations were confirmed as cholangiocarcinoma, validating the system's utility in suggesting non-HCC malignancies. Of the two LR-4 lesions with histopathological correlation, one was an HCC and a dysplastic nodule. Our finding that one of two LR-4 lesions was HCC (50%) aligns with the core premise of the LI-RADS category, reinforcing that LR-4 observations signify a high probability of malignancy, as supported by a prior study in which 65.6% were HCC.[17] In contrast, our small sample showed a higher rate of dysplastic nodules (50% vs. 6.3%) and no instances of a non-correlating benign finding (compared to 28.1% in the prior study, discrepancies are most reasonably attributed to the profound limitation of our minimal cohort size (n=2), which is highly susceptible to sampling variation, coupled with the methodological difference of targeted histopathological correlation rather than whole-liver explant analysis, the latter being the gold standard for identifying imaging false positive.[17] Despite the numerical variances, the key clinical implication is consistent: LR-4 observations require prompt diagnostic or therapeutic management. In line with LI-RADS guidance, LR-3 observations may benefit from short-term follow-up or further evaluation with MRI, while LR-4 and LR-5 observations should be managed within a multidisciplinary team framework. In settings where uncertainty persists-particularly for LR-3 and LR-4 lesions-biopsy may be considered on a case-by-case basis.

LIMITATIONS

This study has several important limitations. First, its retrospective design at a single center and modest sample size limit the generalizability of our findings. Second, our LI-RADS application was limited to major features; ancillary features were not evaluated, and threshold growth could not be assessed due to the lack of prior or follow-up imaging for many patients. This deviation from the complete LI-RADS algorithm may have influenced the categorization of indeterminate observations. Third, although it reflects real-world clinical practice, in which imaging often guides management, the limited availability of histopathological confirmation for all lesions limits definitive validation, particularly for LR-3 and LR-4 categories. Fourth, we did not formally assess inter-observer agreement among radiologists, a key metric for the reproducibility of any standardized reporting system. Finally, potential selection bias exists as our cohort comprised referred, high-risk patients, which may explain the high observed prevalence of LR-5 lesions and is an important consideration when interpreting our results. Despite these limitations, our findings suggest that triphasic CT LI-RADS v2018 is a clinically valuable tool for standardizing liver observation reporting in high-risk Pakistani patients, facilitating clear communication among specialists for timely management.

CONCLUSIONS

In this preliminary evaluation, CT LI-RADS v2018 provided a feasible and reliable framework for standardizing liver lesion reporting in our high-risk Pakistani population. The system effectively categorized the majority of observations, with LR-5 being the most frequent outcome, demonstrating strong histopathological correlation. The high positive

predictive value observed for LR-5 and LR-M categories supports its diagnostic utility in our clinical setting. However, the high prevalence of LR-5 lesions warrants consideration of potential selection bias. Non-rem arterial-phase hyperenhancement was the most sensitive central feature for HCC. To further validate and optimize LI-RADS performance in local and regional contexts, future prospective, multi-centre studies incorporating ancillary features, longitudinal imaging, inter-observer reliability assessment, and broader histopathological correlation are recommended.

CONFLICT OF INTEREST: None

FUNDING SOURCES: None

REFERENCES

1. Cunha GM, Fowler KJ, Roudenko A, Taouli B, Fung AW, Elsayes KM, et al. How to use LI-RADS to report liver CT and MRI observations. Radiographics. 2021 Sep- Oct;41(5):1352-67. https://doi.org/10.1148/rg.2021210003. PMID: 34432443
2. Cerny M, Bergeron C, Billiard JS, Murphy-Lavallée J, Olivié D, Bérubé J, et al. LI-RADS for MR imaging diagnosis of hepatocellular carcinoma: performance of major and ancillary features. Radiology. 2018 Jul;288(1):118-28. https://doi.org/10.1148/radiol.2018171920. PMID: 29624486
3. De Santis A, Gallusi G. Diagnostic imaging for hepatocellular carcinoma. Hepatoma Res. 2019;5:1. https://doi.org/10.20517/2394-5079.2018.97
4. Jha RC, Mitchell DG, Weinreb JC, Santillan CS, Yeh BM, Francois R, et al. LI-RADS categorization of benign and likely benign findings in patients at risk of hepatocellular carcinoma: a pictorial atlas. AJR Am J Roentgenol. 2014;203(1):W48–69. https://doi.org/10.2214/AJR.13.11530. PMID: 24951233
5. Elsayes KM, Hooker JC, Agrons MM, Kielar AZ, Tang A, Fowler KJ, et al. 2017 version of LI-RADS for CT and MR imaging: an update. Radiographics. 2017 Nov–Dec;37(7):1994–2017. https://doi.org/10.1148/rg.2017170099. PMID: 29131712
6. Santillan C. CT and MRI of the liver for hepatocellular carcinoma. Hepatoma Res. 2020;6:63. https://doi.org/10.20517/2394-5079.2020.60
7. American College of Radiology Committee on LI-RADS® (Liver). CT/MRI LI-RADS® PowerPoint Presentation. Reston, VA: American College of Radiology; 2022. Available from: https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/LI-RADS/Presentations
8. Chernyak V, Fowler KJ, Kamaya A, Kielar AZ, Elsayes KM, Bashir MR, et al. Liver Imaging Reporting and Data System (LI-RADS) version 2018: imaging of hepatocellular carcinoma in at-risk patients. Radiology. 2018 Dec;289(3):816–30. https://doi.org/10.1148/radiol.2018181494. PMID: 30403565
9. Bhatti ABH, Sheikh AAE, Mahmud US, Zeeshan S, Khan NY, Zia HH, et al. Clinical profile and treatment of hepatocellular carcinoma: a single-center experience. South Asian J Cancer. 2021 Apr;10(2):76-80. https://doi.org/10.1055/s-0041-1731101. PMID: 34230706
10. Parkash O, Hamid S. Next big threat for Pakistan: hepatocellular carcinoma (HCC). J Pak Med Assoc. 2016 Jun;66(6):735–9. PMID: 27339578
11. Tang ES, Hall G, Yu D, Menard A, Hopman W, Nanji S. Predictors and cumulative frequency of hepatocellular carcinoma in high and intermediate LI-RADS lesions: a cohort study from a Canadian academic institution. Ann Surg Oncol. 2019 Aug;26(8):2560–7. https://doi.org/10.1245/s10434-019-07386-9. PMID: 31025229
12. Granata V, Fusco R, Setola SV, Sandomenico F, Barretta ML, Belli A, et al. Major and ancillary features according to LI-RADS in the assessment of combined hepatocellular–cholangiocarcinoma. Radiol Oncol. 2020 May 28;54(2):149–58. https://doi.org/10.2478/raon-2020-0029. PMID: 32463393
13. van der Pol CB, McInnes MDF, Salameh JP, Levis B, Chernyak V, Sirlin C, et al. CT/MRI and CEUS LI-RADS major features association with hepatocellular carcinoma: individual patient data meta-analysis. Radiology. 2022 Feb;302(2):326-35. https://doi.org/10.1148/radiol.2021212493. PMID: 34734976
14. Cho MJ, An C, Aljoqiman KS, et al. Diagnostic performance of Liver Imaging Reporting and Data System in patients at risk of both hepatocellular carcinoma and metastasis. Abdom Radiol (NY). 2020;45(12):3789–99. https://doi.org/10.1007/s00261-020-02684-z. PMID: 32556789
15. Khanna G, Chavhan GB, Schooler GR, Fraum TJ, Alazraki AL, Squires JH, et al. Diagnostic performance of LI-RADS version 2018 for evaluation of pediatric hepatocellular carcinoma. Radiology. 2021 Apr;299(1):190–9. https://doi.org/10.1148/radiol.2021203138. PMID: 33382160
16. Kim H, Choi JI, Kim BH, Youn SY, Kim H, Kim DH, Rha SE. LI-RADS version 2018 in patients with prior history of hepatocellular carcinoma: are LR-4 observations enough for the diagnosis of recurrent HCC? Investig Magn Reson Imaging. 2021 Sep;25(3):172–82. https://doi.org/10.13104/imri.2021.25.3.172
17. Dunn C, Lin B, Rich NE, Patel MS, Gopal P, Singal AG. Correlation of LI-RADS 3 or 4 observations with histopathologic diagnosis in patients with cirrhosis. Clin Gastroenterol Hepatol. 2023 May;21(5):1351-3.e2. https://doi.org/10.1016/j.cgh.2022.03.009. PMID: 35307596
18. Cannella R, Matteini F, Dioguardi Burgio M, Sartoris R, Beaufrere A, Calderaro J, Mule S, Reizine E, Luciani A, Laurent A, Seror O. Association of LI-RADS and histopathologic features with survival in patients with solitary resected hepatocellular carcinoma. Radiology. 2024 Feb;310(2):e231160. https://doi.org/10.1148/radiol.231160. PMID: 38398656

AUTHORS CONTRIBUTION

Humaira Anjum – *Concept & Design; Data Acquisition; Drafting Manuscript; Supervision; Final Approval*
Samia Iftikhar – *Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Final Approval*

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.