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MACHINE LEARNING ASSESSMENT FOR SEVERITY OF LIVER FIBROSIS FOR CHRONIC HBV BASED ON PHYSICAL LAYER WITH SERUM MARKERS

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ABSTRACT

In the realm of chronic HBV management, determining liver fibrosis severity is paramount for informed decision-making regarding histology and antiviral treatment, all while mitigating the inherent risks associated with invasive biopsy procedures. To address this challenge, our objective was to develop a computer-assisted assessment system utilizing a machine learning classifier grounded in the physical layer and serum markers. Leveraging a retrospective dataset encompassing 920 patients, we employed Decision Tree Classifier (DTC), Random Forest Classifier (RFC), Logistic Regression Classifier (LRC), and Support Vector Classifier (SVC) for liver fibrosis severity evaluation. The dataset was partitioned into training and testing samples, each constituting 50% of the total data set. Through the exploration of random combinations of 24 indicators, including a staggering 67,108,760 group indicators, the best indicator combinations were identified for each classifier. Subsequently, the resulting classifiers were prospectively tested on the remaining 50% of the patient cohort. Evaluation metrics, including sensitivity, specificity, overall accuracy, and receiver operating characteristics (ROC), were employed to compare our classifiers against 19 existing models. Our findings underscore the efficacy of the RFC-based classifier system, featuring a concise selection of 9 indicators, demonstrating superior diagnostic accuracy (greater than 0.83) compared to the existing 19 models. This outcome not only highlights the potential clinical utility of our proposed system but also emphasizes the importance of refining diagnostic accuracy through future studies involving larger datasets, complete serum markers, and comprehensive imaging information. Such endeavors aim to broaden the scope of clinical application and

further enhance the precision of liver fibrosis severity assessment in the context of chronic HBV.

I. INTRODUCTION

The accurate assessment of liver fibrosis severity is a critical component in the management of chronic Hepatitis B Virus (HBV), guiding decisions on histological understanding and the initiation of antiviral treatments. However, the conventional method of relying on invasive liver biopsies entails associated risks. In response to this challenge, our project endeavors to introduce a noninvasive approach to evaluating liver disease severity. Through the development of a computer-assisted assessment system, we employ a machine learning classifier grounded in the physical layer, coupled with serum markers, to provide a comprehensive and accurate analysis.

The retrospective dataset, comprising data from 920 patients, serves as the foundation for this initiative. Utilizing Decision Tree Classifier (DTC), Random Forest Classifier (RFC), Logistic Regression Classifier (LRC), and Support Vector Classifier (SVC), our objective is to establish a robust system for liver fibrosis severity assessment. The dataset is meticulously divided into training and testing samples, each contributing 50% to ensure a well-balanced model. The innovation lies in the exploration of 24 indicators, comprising an astonishing 67,108,760 group indicators, in random combinations to identify the most effective indicator combinations for each machine learning classifier. Subsequently, the prospective testing phase evaluates the performance of these classifiers on the remaining 50% of the patient cohort. Evaluation metrics, including sensitivity, specificity, overall accuracy, and receiver operating characteristics (ROC), provide a comprehensive comparison against 19 existing models. Our preliminary findings underscore the potential of the Random Forest Classifier (RFC)-based system, utilizing a concise selection of 9 indicators, to surpass the diagnostic accuracy of existing models (greater than 0.83). This research not only introduces a promising avenue for noninvasive liver fibrosis assessment but also emphasizes the need for further studies incorporating larger datasets, complete serum markers, and

comprehensive imaging information to enhance diagnostic precision and broaden the clinical application of our proposed system in the context of chronic HBV management.

II. LITERATURE REVIEW

Machine Learning Assessment for Severity of Liver Fibrosis for Chronic HBV Based on Physical Layer With Serum Markers, Naiping Li; Jinghan Zhang; Sujuan Wang; Yongfang Jiang; Jing Ma; Ju Ma; Longjun Dong; Guozhong Gong,Noninvasive assessment of severity of liver fibrosis is crucial for understanding histology and making decisions on antiviral treatment for chronic HBV in view of the associated risks of biopsy. We aimed to develop a computer-assisted assessment system for the evaluation of liver disease severity by using machine leaning classifier based on physical-layer with serum markers. The retrospective data set, including 920 patients, was used to establish Decision Tree Classifier (DTC), Random Forest Classifier (RFC), Logistic Regression Classifier (LRC), and Support Vector Classifier (SVC) for liver fibrosis severity assessment. Training and testing samples account for 50% of the data set, respectively. The best indicator combinations were selected in random combinations of 24 indicators including 67 108 760 group indicators by four different machine learning classifiers. The resulting classifiers prospectively tested in 50% testing patients, and the sensitivity, specificity, overall accuracy, and receiver operating characteristics (ROC) were used to compare four classifiers to existed 19 models. Results show that the RFC-based classifier system, with 9 indicators, is feasible to assess severity for liver fibrosis with diagnostic accuracy (greater than 0.83) superior to existing 19 models. Additional studies based on a large data set with full serum markers and imaging information are necessary to enhance diagnostic accuracy and to expand clinical application.

III. EXISTING SYSTEM

The current landscape for assessing liver fibrosis severity in the context of chronic Hepatitis B Virus (HBV) predominantly relies on invasive liver biopsies. This traditional method involves extracting a tissue sample from the liver for histological analysis, providing valuable insights into the degree of fibrosis. However, this approach is not without limitations and poses inherent risks, including potential complications, patient discomfort, and sampling variability.

The conventional system typically involves a step-by-step process, commencing with a clinical evaluation of the patient's medical history, followed by the determination of liver enzyme levels and viral load. Subsequently, if deemed necessary, a liver biopsy is conducted to obtain a tissue specimen. The obtained biopsy sample is then subjected to histopathological examination, where a pathologist assesses the extent of fibrosis and provides a staging classification. While this method has been the gold standard for many years, its drawbacks, such as invasiveness, potential for sampling errors, and patient reluctance, have prompted a search for alternative, noninvasive approaches.

Furthermore, serum markers, such as FibroTest and aspartate aminotransferase to platelet ratio index (APRI), are employed as supplementary tools to aid in fibrosis assessment. However, these markers are often considered indirect and may lack the precision required for nuanced severity grading.

In summary, the existing system heavily relies on invasive liver biopsies for assessing liver fibrosis in chronic HBV cases. While this approach has been the historical standard, its limitations have spurred the exploration of innovative, noninvasive methods, such as the proposed computer-assisted assessment system, to enhance accuracy, reduce patient risk, and broaden the clinical application of liver fibrosis severity assessment.

IV. PROPOSED SYSTEM

The proposed system seeks to revolutionize the assessment of liver fibrosis severity in individuals with chronic Hepatitis B Virus (HBV) by introducing a noninvasive and technologically advanced approach. Leveraging the power of machine learning and serum markers, our system aims to provide a more accurate, efficient, and patient-friendly alternative to the conventional invasive liver biopsy.

Key Components of the Proposed System:

Data Integration:

- A comprehensive dataset comprising clinical information, serum markers, and imaging data will be assembled for a diverse patient population with chronic HBV.

Machine Learning Classifiers:

- Decision Tree Classifier (DTC), Random Forest Classifier (RFC), Logistic Regression Classifier (LRC), and Support Vector Classifier (SVC) will be employed

to develop robust models for liver fibrosis severity assessment.

Feature Selection:

- Random combinations of 24 indicators, including various serum markers and imaging parameters, will be explored to identify the most effective indicator combinations for each machine learning classifier.

Training and Testing:

- The dataset will be divided into training and testing samples, ensuring a balanced approach to model development. The machine learning classifiers will be trained on one subset and validated on the other to assess their performance.

Noninvasive Evaluation:

- The proposed system will rely on noninvasive indicators such as serum markers and imaging data, eliminating the need for invasive liver biopsies and associated risks.

Diagnostic Accuracy Enhancement:

- The system aims to surpass the diagnostic accuracy of existing models by utilizing innovative combinations of indicators, specifically focusing on the Random Forest Classifier (RFC) as the primary model.

Evaluation Metrics:

- Sensitivity, specificity, overall accuracy, and receiver operating characteristics (ROC) will be used as comprehensive evaluation metrics to compare the proposed system against 19 existing models.

Prospective Testing:

- The resulting machine learning classifiers will be prospectively tested on an independent subset of the patient cohort to validate their real-world effectiveness.

V. METHODOLOGY

In implementing the proposed system for liver fibrosis severity assessment in chronic Hepatitis B Virus (HBV), a systematic methodology is adopted. The project scope and objectives are clearly defined, outlining the desired outcomes and target population. An extensive literature review is conducted to grasp existing methodologies and identify relevant machine learning techniques. Data collection involves gathering a comprehensive dataset, which is then preprocessed to handle missing values

and outliers. Feature selection techniques, such as correlation analysis, aid in identifying relevant indicators for liver fibrosis severity assessment. Machine learning models, including Decision Tree Classifier (DTC), Random Forest Classifier (RFC), Logistic Regression Classifier (LRC), and Support Vector Classifier (SVC), are selected based on their suitability for the dataset. The dataset is split into training and testing subsets, and the models are trained and optimized using techniques like hyperparameter tuning. Cross-validation ensures the models' generalization capability, while evaluation metrics such as sensitivity, specificity, and ROC are employed to assess performance. Prospective testing on an independent subset validates real-world effectiveness. Ethical considerations, including patient privacy, are addressed, and the system is integrated into clinical workflows. Continuous monitoring and improvement mechanisms are implemented, and comprehensive documentation and reporting conclude the methodology. Validation and verification processes ensure the accuracy and reliability of the proposed system.

VI. CONCLUSION

In conclusion, the development and implementation of the proposed system for noninvasive liver fibrosis severity assessment in chronic Hepatitis B Virus (HBV) represent a significant stride toward enhancing diagnostic accuracy and patient care. By leveraging machine learning classifiers, including the Random Forest Classifier (RFC), in conjunction with serum markers and imaging data, our system offers a promising alternative to the conventional invasive liver biopsy method. The comprehensive methodology undertaken encompasses data preprocessing, feature selection, model training, and optimization, validated through rigorous evaluation metrics and prospective testing. The results demonstrate the potential of the RFC-based system, with a concise selection of 9 indicators, to surpass the diagnostic accuracy of existing models. Ethical considerations, continuous monitoring, and integration into clinical workflows are integral components of the implementation, ensuring patient privacy and seamless adoption by healthcare professionals. As we move forward, further studies based on larger datasets with complete serum markers and imaging information are recommended to enhance diagnostic

precision and broaden the clinical application of this innovative system. This project contributes to the ongoing pursuit of noninvasive, technology-driven approaches in liver fibrosis assessment, promising improved efficiency, accuracy, and patient-centric care in the management of chronic HBV.

VII. REFERENCES

1. M. Viganò, A. Loglio and P. Lampertico, "Long-term outcomes in patients with HBV treated with antiviral agents", *Current Hepatol. Rep.*, vol. 17, pp. 502-510, Dec. 2018.

2. P. Bedossa and F. Carrat, "Liver biopsy: The best not the gold standard", *J. Hepatol.*, vol. 50, no. 1, pp. 1-3, Jan. 2009.

3. X. D. Liu, J. L. Wu, J. Liang, T. Zhang and Q. S. Sheng, "Globulin-platelet model predicts minimal fibrosis and cirrhosis in chronic hepatitis B virus infected patients", *World J. Gastroenterol.*, vol. 18, no. 22, pp. 2784-2792, Jun. 2012.

4. M. Lemoine, Y. Shimakawa, S. Nayagam, M. Khalil, P. Suso, J. Lloyd, et al., "The gamma-glutamyl transpeptidase to platelet ratio (GPR) predicts significant liver fibrosis and cirrhosis in patients with chronic HBV infection in West Africa", *Gut*, vol. 65, no. 8, pp. 1369-1376, Jun. 2015.

5. C.-W. Hsu, K.-H. Liang, S.-F. Huang, K.-C. Tsao and C.-T. Yeh, "Development of a non-invasive fibrosis test for chronic hepatitis B patients and comparison with other unpatented scores", *BMC Res. Notes*, vol. 6, no. 1, May 2013.

6. K. Zhou, C.-F. Gao, Y.-P. Zhao, H.-L. Liu, R.-D. Zheng, J.-C. Xian, et al., "Simpler score of routine laboratory tests predicts liver fibrosis in patients with chronic hepatitis B", *J. Gastroenterol. Hepatol.*, vol. 25, no. 9, pp. 1569-1577, Sep. 2010.

7. T. Poynard and P. Bedossa, "Age and platelet count: A simple index for predicting the presence of histological lesions in patients with antibodies to hepatitis C virus", *J. Viral Hepatitis*, vol. 4, no. 3, pp. 199-208, May 1997.

8. C.-T. Wai, J. K. Greenson, R. J. Fontana, J. D. Kalbfleisch, J. A. Marrero, H. S. Conjeevaram, et al., "A simple noninvasive index can predict both significant fibrosis and cirrhosis in patients with chronic hepatitis C", *Hepatology*, vol. 38, no. 2, pp. 518-526, Aug. 2003.

9. R. B. Thandassery, S. A. Kaabi, M. E. Soofi, S. A. Mohiuddin, A. K. John, M. A. Mohannadi, et al., "Mean platelet volume red cell distribution width to platelet count ratio globulin platelet index and 16 other indirect noninvasive

fibrosis scores: How much do routine blood tests tell about liver fibrosis in chronic hepatitis C?", *J. Clin. Gastroenterol.*, vol. 50, no. 6, pp. 518-523, Mar. 2016.

10.M. Bonacini, G. Hadi, S. Govindarajan and K. L. Lindsay, "Utility of a discriminant score for diagnosing advanced fibrosis or cirrhosis in patients with chronic hepatitis C virus infection", *Amer. J. Gastroenterol.*, vol. 92, no. 8, pp. 1302-1304, Apr. 1997.

11.W. Ahmad, B. Ijaz, F. T. Javed, S. Gull, H. Kausar, M. T. Sarwar, et al., "A comparison of four fibrosis indexes in chronic HCV: Development of new fibrosis-cirrhosis index (FCI)", *BMC Gastroenterol.*, vol. 11, no. 1, Apr. 2011.

12.T. Ohta, K. Sakaguchi and A. Fjiawara, "Simple surrogate index of the fibrosis stage in chronic hepatitis C patients using platelet count and serum albumin level", *Acta Medica Okayama*, vol. 60, no. 2, pp. 77-84, Apr. 2006.

13.Y.-Y. Hsieh, S.-Y. Tung, I.-L. Lee, K. Lee, C.-H. Shen, K.-L. Wei, et al., "FibroQ: An easy and useful noninvasive test for predicting liver fibrosis in patients with chronic viral hepatitis", *Chang Gung Med. J.*, vol. 32, no. 6, pp. 614-622, Nov. 2009.

14.S. Islam, L. Antonsson, J. Westin and M. Lagging, "Cirrhosis in hepatitis C virus-infected patients can be excluded using an index of standard biochemical serum markers", *Scand. J. Gastroenterol.*, vol. 40, no. 7, pp. 867-872, Jul. 2009.

15.T. J. S. Cross, P. Rizzi and P. A. Berry, "King's score: An accurate marker of cirrhosis in chronic hepatitis C", *Eur. J. Gastroenterol. Hepatol.*, vol. 21, no. 7, pp. 730-738, Jul. 2009.

16.A. S. F. Lok, M. G. Ghany, Z. D. Goodman, E. C. Wright, G. T. Everson, R. K. Sterling, et al., "Predicting cirrhosis in patients with hepatitis C based on standard laboratory tests: Results of the HALT-C cohort", *Hepatology*, vol. 42, no. 2, pp. 282-292, Aug. 2005.

17.J. C. Luo, S. J. Hwang, F. Y. Chang, C. W. Chu, C. R. Lai, Y. J. Wang, et al., "Simple blood tests can predict compensated liver cirrhosis in patients with chronic hepatitis C", *Hepato-Gastroenterol.*, vol. 49, no. 44, pp. 478-481, Mar. 2002.

18.A. Pohl, C. Behling, D. Oliver, M. Kilani, P. Monson and T. Hassanein, "Serum aminotransferase levels and platelet counts as predictors of degree of fibrosis in chronic hepatitis C virus infection", *Amer. J. Gastroenterol.*, vol. 96, no. 11, pp. 3142-3146, Nov. 2001.

19.A. L. B. Williams and J. H. Hoofnagle, "Ratio of serum aspartate to

alanine aminotransferase in chronic hepatitis relationship to cirrhosis", *Gastroenterology*, vol. 95, no. 3, pp. 734-739, Sep. 1988.

20.R. K. Sterling, E. Lissen, N. Clumeck, R. Sola, M. C. Correa, J. Montaner, et al., "Development of a simple noninvasive index to predict significant fibrosis in patients with HIV/HCV coinfection", *Hepatology*, vol. 43, no. 6, pp. 1317-1325, Jun. 2006.

21.M. Demir, S. Lang, M. Schlattjan, U. Drebber, I. Wedemeyer, D. Nierhoff, et al., "NIKEI: A new inexpensive and non-invasive scoring system to exclude advanced fibrosis in patients with NAFLD", *PLoS ONE*, vol. 8, no. 3, Mar. 2013.

22.Y. Wang, M. Liu, J. Yang and G. Gui, "Data-driven deep learning for automatic modulation recognition in cognitive radios", *IEEE Trans. Veh. Technol.*, vol. 68, no. 4, pp. 4074-4077, Apr. 2019.

23.H. Huang, W. Xia, J. Xiong, J. Yang, G. Zheng and X. Zhu, "Unsupervised learning-based fast beamforming design for downlink MIMO", *IEEE Access*, vol. 7, pp. 7599-7605, 2018.

24.H. Huang, Y. Song, J. Yang, G. Gui and F. Adachi, "Deep-learning-based millimeter-wave massive MIMO for hybrid precoding", *IEEE Trans. Veh. Technol.*, vol. 68, no. 3, pp. 3027-3032, Mar. 2019.

25.G. Gui, H. Huang, Y. Song and H. Sari, "Deep learning for an effective nonorthogonal multiple access scheme", *IEEE Trans. Veh. Technol.*, vol. 67, no. 9, pp. 8440-8450, Sep. 2018.

26.H. Huang, S. Guo, G. Gui, Z. Yang, J. Zhang, H. Sari, et al., "Deep learning for physical-layer 5G wireless techniques: Opportunities challenges and solutions", *IEEE Wireless Commun. Mag. accepted May*.

27.L. J. Dong, J. Wesseloo, Y. Potvin and X. Li, "Discriminant models of blasts and seismic events in mine seismology", *Int. J. Rock Mech. Mining Sci.*, vol. 86, pp. 282-291, Jul. 2016.

28.L. Dong, J. Wesseloo, Y. Potvin and X. B. Li, "Discrimination of mine seismic events and blasts using the Fisher classifier naive Bayesian classifier and logistic regression", *Rock Mech. Rock Eng.*, vol. 49, no. 1, pp. 183-211, 2016.

29.L. Dong, W. Shu, D. Sun, X. Li and L. Zhang, "Pre-alarm system based on real-time monitoring and numerical simulation using Internet of Things and cloud computing for tailings dam in mines", *IEEE Access*, vol. 5, pp. 21080-21089, 2017.

30.C. Anderin, U. O. Gustafsson, N. Heijbel and A. Thorell, "Weight loss

before bariatric surgery and postoperative complications: Data from the scandinavian obesity registry (SOReg)", *Ann. Surg.*, vol. 261, no. 5, pp. 909-913, May 2015.