International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 2 ǁ February 2023 ǁ PP. 252-256

Prognostic methods for colorectal cancer detection and classification: A Review

Sachin B Borse
Research Scholar
ECE
SAGE,University Indore

Dr.Sudhir Agrawal
Professor.
SAGE,University Indore

Abstract—*Colorectal cancer (CRC) is a common health problem, representing the third most commonly diagnosed cancer worldwide and causing a significant burden in terms of morbidity and mortality, with annual deaths estimated at 700000. The western way of life that is being rapidly adopted in many regions of the world is a well discussed risk factor for CRC and could be targeted in terms of primary prevention. Furthermore, the relatively slow development of this cancer permits drastic reduction of incidence and mortality through secondary prevention. These facts underlie primary care physicians (PCPs) being assigned a key role in health strategies that enhance prevention and prompt diagnosis. Herein, we review the main topics of CRC in the current literature, in order to better understand its pathogenesis, detection and prediction techniques are discussed.*

Keywords*—Colon, rectum, cancer, early detection.*

Date of Submission: 10-02-2023 Date of acceptance: 22-02-2023

I. INTRODUCTION

Cancer is now one of the most prevalent diseases affecting human health, with a high mortality rate. Cancer is a disease in which cells in the body grow out of control. The accelerated proliferation of aberrant cells outside of their normal bounds, which can then penetrate and proliferate to adjacent organs and areas of the body. Recent statistics suggest that cancer is the second most fatal disease worldwide and the leading cause of nearly 1 in 6 deaths globally, accounting for approximately 8.8 million deaths [1]. Colorectal cancer (CRC) is a type of cancer that begins in the colon or rectum, which is located inside the large intestine. Based on where they begin, these malignancies are often known to as colon cancer or rectal cancer. Colon cancer is one of the world's third most dangerous and lethal cancers.

CRC is the world's third most common cancer in terms of prevalence (6.1%) but second in terms of mortality (9.2%) [2]. By 2030, the worldwide burden of CRC is estimated to rise by 60% in respect of new cases and fatalities [3]. To enhance therapeutic efficiency and survival, reliable and timely identification of CRC is critical. The modern CRC diagnosis necessitates a comprehensive visualization by highly trained pathologists. Colonoscopy seems to be the most trustworthy early detection method. The most crucial part in the treatment of any cancer is early detection. For clinicians and scientists interested in this field, detection of cancer in the initial stage is a major challenge.

Early cancer detection extends human life and aids in the fight against the disease [4]. Medical imaging is a useful tool for detecting cancer early on and plays an important part in cancer treatment [5]. Despite the growth in medical imaging data, interpreting the data in connection to illness progression speed is time-consuming and challenging. This highlights the critical need for an automated colon cancer screening technology that can be used to identify colon cancer more reliably while also lowering process time.

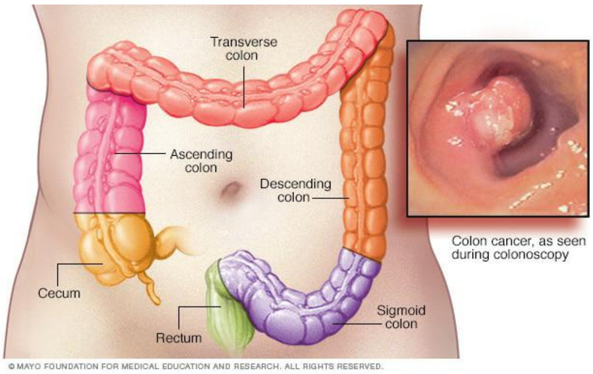

Fig. 1Large Intestine and Colonoscopy view of Colon Cancer

II. RESEARCH BACKGROUND

Colon cancer is typically detected by microscopic examination of histological colon tissues. Under a microscope, histopathologists examine the samples and determine whether or not the tissue is normal. In addition, histopathologists give statistical cancer grading to malignant colon biopsies. There are a few limits to this physical inspection. To begin with, it is subjective since quantitative indicators such as cancer grades/stages rely heavily on pathologists' visual judgment. Second, there is grading variance between and among observers [6-9].

Such flaws in the manual procedure necessitate the development of automatic colon cancer diagnostic procedures [10], [11], which might give pathologists with a second opinion and act as an individual, reliable method for cancer identification. As a result, a reliable computer-aided methodology is needed to automatically categorize normal and cancerous colon samples, as well as identify malignant sample grades.

III. METHODOLOGY

Colonoscopy is the gold standard procedure for diagnosis and removal of colorectal lesions with potential to evolve into cancer. Computer-aided detection systems can help gastroenterologists to increase the colon detection rate. Current techniques use manual, invasive procedures that are slow and inaccurate. Previous approaches have tried to automate this task with satisfactory results. The overall flow of proposed system will be consisting of various steps as illustrated in figure 2.

Pre-processing improves the quality of the image by reducing artifacts. Feature extraction and selection provides the measurement vectors on which the image segmentation is based. Segmentation groups pixels into regions, and hence defines the boundaries of the tissue regions. Segmentation is followed by classification or labelling of the regions into the tissue types.

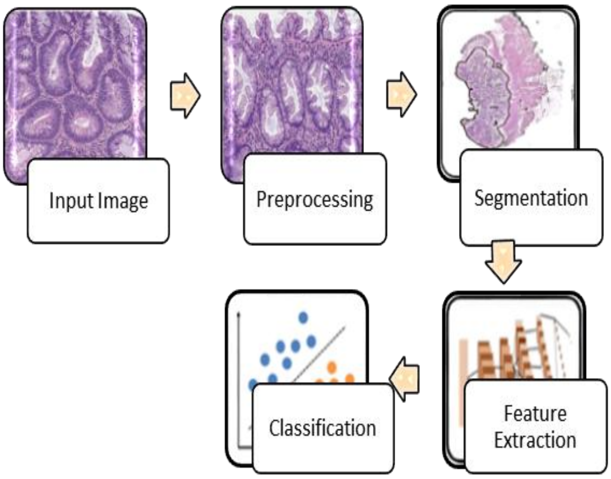

Fig. 2 Automated Colon Cancer detection system

Deep learning techniques are gaining popularity in many areas of medical image analysis, such as computer-aided detection and diagnosis of breast lesions, pulmonary nodules and histopathological diagnosis. Deep learning techniques may enable identification of new useful imaging features for quantitative analysis of colon cancer. As the deep learning architectures are becoming more mature, they gradually outperform state-of-the-art classical machine learning algorithms. The two main avenues for automatic detection of colon cancer are segmentation and classification. Due to a variety of characteristics, including similar hues in various biological elements, automatic categorization of the colon into normal and malignant classifications is difficult.

IV. LITERATURE REVIEW

Several approaches for detecting colon cancer have also been presented in this context. Depending on the actual dataset and approach used, there are five primary kinds of colon cancer detection techniques. These categories include Texture, hyperspectral and OO texture analysis based techniques.

A. Texture Analysis based Techniques

Texture is a collection of regular and irregularly repeating patterns [12]. Normal and cancerous colon tissues have a considerable difference in texture. In their different investigations, a few researchers have taken advantage of this variance and obtained successful classification on colon biopsy datasets. Texture has traditionally been quantified using entropy and correlation.

TABLE I. TEXTURE ANALYSIS BASED TECHNIQUES

Author/s	Proposed
Esgiar et al [13]	GLCM of the image is used to compute texture properties.
Kalkan et al [14]	textural and anatomical features to divide colon samples into three categories.
Jiao et al [15]	The images are used to compute statistical characteristics.
Ng et al [16]	The standard deviation, entropy, homogeneity, kurtosis, and skewness of pixel distribution histograms were retrieved.

B. OO Texture Analysis Based techniques

These technologies use baseline information on colon tissue segmentation and categorization of colon biopsy pictures on their size and geographical distribution. These approaches were further separated into techniques of segmentation and classification.

TABLE II. OO TEXTURE ANALYSIS BASED TECHNIQUES

Author/s	Proposed
Sokmensuer et al [17]	OOSEG encompasses three stages, namely object definition, texture definition and segmentation.
Tosun et al [18]	A group of 12 features as utilized in are computed for each item.
Demir et al [19]	The procedure of circular fitting is proposed instead of OOSEG.
Altunbay et al [20]	The methods of circular and graph creation are utilized.
Ozdemir et al [21]	Introduced another method of detection of colon cancer using object-graphs.

C. Hyperspectral Analysis Based Techniques

Hyperspectral analysis-based approaches detect normal and malignant tissues in colon biopsy images by analysing chosen spectral bands. A hyperspectral imaging system with a customized light source is used to obtain hyperspectral data from colon biopsy images.

TABLE III. HYPERSPECTRAL ANALYSIS BASED TECHNIQUES

Author/s	Proposed
Rajpoot et al[22]	Have classified colon biopsy images using multiple kernels of SVM
K. Masood, and N. Rajpoot, [23]	Circular local binary patterns are used to do spatial analysis on one spectral band of hyperspectral colon biopsy data.
Maggioni et al [24]	Established a method for the categorization of normal, pre-cancerous and malignant colon conditions.
Chadded et al [25]	The multi-spectral colon biopsy classifications were carried out.
Akbari et al.[26]	They used a wide band light source to illuminate the tissue slide and the camera.

V. CONCLUSION

1.93 million cases of CRC are reported in 2020.Due to CRC 935 000 deaths reported in 2020. CRC accounts for 10% of the world's new cases of cancer and is greater in developing countries [27]. CRC is the third most frequent malignancy and the second most prevalent cause of cancer death [28]. This scenario motivated us to explore the development of automated system for detection of colon cancer.The main focus of this research work lies on the automatic segmentation and classification of colon cancer from whole slide images. By analyzing the resulting measurements, clinical experts are aiming to achieve an early detection of colon cancer. Efficient and comprehensive pathological image analysis for colorectal cancer (CRC) diagnosis takes time and expertise, yet it is critical for CRC patients' treatment. Pathologists' present excessive workload in clinics/hospitals may easily lead to unintentional misinterpretation of CRC based on daily image analysis.

Hence proposed research work will focus on development of the computer assisted framework for early detection of precursor lesions.

In future work ,it can be studied with large data sets or re-trained by increasing the number of data with image augmentation techniques.Moreover,deep learning models can be created. By providing the classification of tissue types,support can be provided to pathologists. It will significantly contribute to an accurate and rapid diagnosis.It also saves time and thus all allowing pathologists to focus on important cases is another gain.

References

[1]. WHO, "World Health Organization: Cancer," 2018. [Online]. Available: http://www.who.int/en/news-room/factsheets/detail/cancer.

[2]. Ferlay JS, Ervik M, Dikshit R, Eser S, Mathers C, Rebelo M, Parkin DM, Forman D, Bray F: Cancer incidence and mortality worldwide: IARC CancerBase. In GLOBOCAN 2012 v10, Volume 11.

[3]. Lyon, France: International Agency for Research on Cancer; 2013. 2. Bingham S: The fibre-folate debate in colo-rectal cancer. Proc Nutr Soc 2006, 65:19–23.

[4]. J.D. Schiffman, P.G. Fisher, P. Gibbs, Early detection of cancer: past, present, and future, Am. Soc. Clin. Oncol. Educ. B (2015) 57–65, https://doi.org/10.14694/ edbook_am.2015.35.57.

[5]. M. Abd El-Salam, S. Reda, S. Lotfi, T. Refaat, E. El-Abd, Imaging Techniques in Cancer Diagnosis, Cancer Biomarkers Minimal Noninvasive Early Diagnosis Progn, 2014, pp. 19–38, https://doi.org/10.1201/b16389.

[6]. G.D. Thomas et al., "Observer Variation in the Histological Grading of Rectal Carcinoma," J. Clinical Pathology, vol. 36, pp. 385-391, 1983.

[7]. A. Andrion et al., "Malignant Mesothelioma of the Pleura: Inter Observer Variability," J. Clinical Pathology,, vol. 48, pp. 856-860, 1995.

[8]. A. Young, R. Hobbs, and D. Kerr, eds., ABC of Colorectal Cancer, second ed. Wiley-Blackwell, 2011.

[9]. J. Scholefield et al., eds., Challenges in Colorectal Cancer, second ed. Wiley-Blackwell, 2006.

[10]. P.W. Hamilton et al., "Automated Location of Dysplastic Fields in Colorectal Histology Using Image Texture Analysis," J. Pathology, vol. 182, pp. 68-75, 1997.

[11]. S.J. Keenan et al., "An Automated Machine Vision System for the Histological Grading of Cervical Intra Epithelial Neoplasia," J. Pathology, vol. 192, pp. 351-362, 2000

[12]. S. Rathore, M. A. Iftikhar, M. Hussain et al., "Texture Analysis for Liver Segmentation and Classification: A Survey," Proc. Frontiers of Information Technology, pp. 121-126, 2011.

[13]. A. N. Esgiar, R. N. G. Naguib, M. K. Bennett et al., "Automated Feature Extraction and Identification of Colon Carcinoma," Analytical and Quantitative Cytology and Histology, vol. 20, pp. 297-301, 1998.

[14]. H. Kalkan, M. N. R. Duin, and M. Loog, "Automated Classification of Local Patches in Colon Histopathology," Proc. 21st International Conference on Pattern Recognition, pp. 61-64, 2012.

[15]. L. Jiao, Q. Chen, S. Li et al., "Colon Cancer Detection Using Whole Slide Histopathological Images," Proc. World Congress on Medical Physics and Biomedical Engineering, pp. 1283-1286, 2013.

[16]. F. Ng, B. Ganeshan, R. Kozarski et al., "Assessment of Primary Colorectal Cancer Heterogeneity by Using Whole-Tumor Texture Analysis: Contrast-Enhanced CT Texture as a Biomarker of 5-Year Survival," Radiology, vol. 266, no. 1, pp. 177-184, 2013.

[17]. A. B. Tosun, M. Kandemir, C. Sokmensuer et al., "Object-Oriented Texture Analysis for the Unsupervised Segmentation of Biopsy Images," Journal of Pattern Recognition, vol. 42, pp. 1104-1112, 2009.

[18]. A. B. Tosun, C. Sokmensuer, and C. G. Demir, "Unsupervised Tissue Image Segmentation through Object-Oriented Texture," Proc. 20th International Conference on Pattern Recognition, pp. 2516-2519, 2010.

[19]. C. G. Demir, M. Kandemir, A. B. Tosun et al., "Automatic Segmentation of Colon Glands Using Object-Graphs," Medical Image Analysis, vol. 14, pp. 01-12, 2010.

[20]. D. Altunbay, C. Cigir, C. Sokmensuer et al., "Color Graphs for Automated Cancer Diagnosis and Grading," IEEE Transactions on Biomedical Engineering, vol. 57, pp. 665–674, 2010.

[21]. E. Ozdemir, C. Sokmensuer, and C. G. Demir, "A Resampling-Based Markovian Model for Automated Colon Cancer Diagnosis," IEEE Transactions on Biomedical Engineering, vol. 59, no. 1, pp. 281-289, 2012.

[22]. K. M. Rajpoot, and N. M. Rajpoot, "SVM Optimization for Hyperspectral Colon Tissue Cell Classification," Proc. Medical Image Computing and Computer Assisted Intervention (MICCAI), Lecture Notes in Computer Science, 3217, pp. 829-837, 2004.

[23]. K. Masood, and N. Rajpoot, "Texture Based Classification of Hyperspectral Colon Biopsy Samples Using CLBP," Proc. IEEE International Symposium on Biomedical Imaging: From Nano to Macro, pp. 1011-1014, 2009.

[24]. M. Maggioni, G. I. Davis, F. J. Warmer et al., "Hyperspectral Microscopic Analysis of Noral, Benign Adn Carcinoma Microarray Tissue Sections," Proc. SPIE 6091, Optical Biopsy IV, 609101, 2006.

[25]. A. Chaddad, C. Tanougast, A. Dandache et al., "Improving of Colon Cancer Cells Detection Based on Haralick's Features on Segmented Histopathological Images," Proc. International Conference on Computer Applications and Industrial Electronics, pp. 87-90, 2011.

[26]. H. Akbari, L. V. Halig, H. Zhang et al., "Detection of Cancer Metastasis Using a Novel Macroscopic Hyperspectral Method," Proc. SPIE, 2012.

[27]. International Agency for Research on Cancer, Colorectal cancer factsheet. Tech. rep. (2018) http://gco.iarc.fr/today/data/factsheets/cancers/10_8_9-Colorectum-fact-sheet.pdf

[28]. J. Ferlay, M. Colombet, I. Soerjomataram, T. Dyba, G. Randi, M. Bettio, et al., “Cancer incidence and mortality patterns in Europe: estimates for 40 countries and 25 major cancers in 2018” Eur J Cancer, pp. 356-387, 103 (2018).