Relative Comparison on invasive and non-invasive diagnostic methods for detection of colorectal cancer.

Introduction:

As the second-most-common cause of cancer death, colorectal cancer (CRC) has been recognized as one of the biggest health concerns in advanced countries. The 5-year survival rate for patients with early-stage CRC is significantly better than that for patients with CRC detected at a late stage. It is, therefore, necessary to develop more efficient detection methods to enable earlier detection and therefore better prognosis. Although a number of CRC diagnostic methods are currently used for early detection, including stool-based tests, traditional colonoscopy, etc., they have not shown optimal results due to several limitations. Hence, development of more reliable screening methods is required in order to detect the disease at an early stage. New screening tools also need to be able to accurately diagnose CRC and advanced adenoma, help guide treatment, and predict the prognosis along with being relatively simple and non-invasive. As part of such efforts, many proposals for the early detection of colorectal neoplasms have been introduced. For example, metabolomics, referring to the scientific study of the metabolism of living organisms, has been shown to be a possible approach for discovering CRC-related biomarkers. In addition, a growing number of high-performance screening methodologies could facilitate biomarker identification.

Comparative Study of diagnostic Methods:

Colorectal cancer early detection plays an important role in the treatment of colorectal cancer. Here in this study I reviewed all the exciting diagnostic methods from and represented in a tabular form and listed the advantages & disadvantages of methods.

	Category	Advantages	Disadvantages
Invasive	Colonoscopy	1.Offer direct visualization and detection of a colonic polyp. [1] 2.The gold standard tool for screening CRC and adenoma.[1 22] 3.High sensitivity and specificity.[1] 4.It is relatively safe with recent data suggesting.[1] 5.It being readily available.[1]	1.It is not cheap. [1] 2. It is not easily affordable to the general population.[2 3] 3.Its application difficult on mass screening basis. [2 3 9 10] 4.Requires full bowel preparation and sedation.[4 5]
	The flexible sigmoidoscopy (FS)	1.Decrease disease the disease-specific mortality when used as screening tool. [6 7] 2.Limited bowel preparation compared to colonoscopy.[1]	1.Benefit of sigmoidoscopy is limited to cancer in the distal colon (rectum, sigmoid, and descending colon),for which the reduction in mortality was reported to be 46%.[8]
	Endocopy	1.Esssential in both initial & follow up of disease activity.[11]	1.High Burden for patients.[11] 2.Performed under anaesthesia anr required hospital admission for Children.[11]
	Methylated SEPT9 (Epi procolon)	1. Overall sensitivity for CRC detection of Septin9 may be superior to gFOBT with a sensitivity of about 70% and specificity of 90% for CRC detection. [13 14] 2. High patient interest. [15] 3. Relatively cost effective. [16] 4. May have solid future.[1]	1. A second intervention is needed if the test was positive. [17] 2. Raising concerns for potential abuse leading to inadequate screening.[1 17]
Non-Invasive	GC-MS	1.Identifies each chemicals.[22 31 32 33] 2.Gold standard in reproducibly identifying specific VOCs.[18]	1.Expensive.[1 11 18 19 22] 2.Time Consuming. [11 22] 3.Required highly trained personal.[11 18 19] 4.Offline sampling. [22 18] 5.It is relatively slow and immobile .[18] 6.Complex.[12 18 19]
	PTR-MS (Proton transfer reaction-MS)	1.Do not require pre-concentration and seperation of target gas. [20] 2.Do not affeced by high concertration of N_2, CO_2, or H_2O. [20]	1.Remain relatively expensive.[29] 2.Often sacrifice precision in VOC profiling as a trade-off for online operability.[29]
	SIFT-MS (Selected ion flow tube MS)	1.Provides rapid identification of volatiles within seconds of analysis. [24] 2. Particularly suited for real-time breath analysis.[24]	
	IMR-MS (ion-molecule reaction spectrometry)	1.Reduces sample fragmentation.[18 21]	
	ion mobility spectrometry (IMS)	1.Can be used with SESI and MS and Separates gases based on travel time within a drift tube.[18]	
	SESI-MS (secondary electrospray ionization MS)	1.Soft ionization mass spectrometry technique used with a non-radioactive source.[25]	
	FAIMS (field-asymmetric ion mobility spectrometry)	1.Allows for ambient analysis of volatiles.[26 27] 2.Capability of handheld or portable application.[26] 3. Offers an alternative and less instructive option, such as urine rather than faeces, far more acceptable to patients.[27]	
	E-Nose	1.Cost effective. [11 12 18] 2.Allow portable analysis.[18 28] 3.Nonspecifically capture and characterize VOCs in patterns.[34] 4.Patient Friendly.[11] 5.Point-of-care, hand-held.[12 18] 6.Provide a real-time breath analysis in 10 minute's time.(Aenose) [18 23] 7.Wireless connectivity via Bluetooth [18 28]	1. Risk for variances in sensor performance or even manufacture or calibration. [18 29] 2.Numerous sensor types, and thus different signal responses per type of device, findings from one electronic nose are not comparable to that of a different device or sensor type. [18 29] 3.Questions about reliability even among devices of the same sensor type and model have been raised (i.e., variances in operating or testing conditions, sensor drift).[30]
	guaiac-based fecal occult blood test (gFOBT)	1.It is an inexpensive [1] 2. simple[1] 3. widely available test.[1]	1.It is not analytically very sensitive to the presence of blood [35] once only the test sensitivity is approximately 50% .[36] 2. An inherently non-specific test with a very low PPV of 3%-10% [37 38] 3. Any dietary peroxidases effects on the test. [1]
	FIT (Fecal Immunochemical test)	1.Does not cross react with dietary meats.[1] 2. The FIT sampling technique is simple easy to collect with fewer fecal samples required compared to FOBT.[1] 4.FIT has a greater sensitivity for detecting advanced adenomas and CRC than gFOBT. Overall accuracy of FIT for CRC is 95% with 79% sensitivity and 94% specificity.[39]	1.FIT is its low sensitivity for detecting colon polyps. [40]
	Fecal DNA testing	1.Fecal DNA test had a higher sensitivity than FIT for detecting CRC (92% vs 74%).[1]	1. Less effective and more costly.[1] 2. Fecal DNA test had lower specificity at 87%-90% compared to FIT (95%-96%) [41]
	Computed tomographic colonography (CTC)	1.Lower procedural risks compared to colonoscopy. [42-44] 2.It carries the advantage of extra colonic evaluation. [45-48] 3. Overall detection of CRC, the pooled sensitivity of CT colonography (96%) was not statistically significant from that of colonoscopy (91%) [51]	1.Patient discomfort during procedure insufflation.[1] 2. Contrast allergy, radiation exposure and need for colonoscopy if positive findings are considered additional disadvantages of CTC.[49] 3.Perforation risk is an existing drawback.[50]

Conclusion:

From the above study, it is prominent that e-nose a solution for early detection of colorectal cancer as it is patient friendly and cost effective. Although, the performance of e-nose might varies by the performance of sensors. As there is advancement in sensor technology e-nose can be an effective solution in the future.

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