



COLONOSCOPY AND M R COLONOGRAPHY-A COMPARATIVE STUDY

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ABSTRACT

Aim: The study was conducted to find out the merits and demerits of standard tool colonoscopy and newer modality Magnetic Resonance Colonography (MRC) in assessing the various colonic pathologies. To find out the role of MRC in patients with obstructive type of colonic lesion were further scope passage was not possible.

Material and Methods: Patients who were attending Medical Gastroenterology Department with clinical diagnosis highly suspicious of colorectal pathology were included in this study. Sixty patients were taken up for study and out of sixty patients thirty patients underwent colonoscopy first then subjected to MR Colonography and another thirty patients were subjected for MR Colonography first then followed by Colonoscopy. Comparative analysis done in assessing various colonic pathology.

Results: Out of sixty patient's colonoscopy passed up to cecum/ileum in 42 cases (70%). In the remaining 18 (30%) scope not passed up to cecum due to various reasons. MRC revealed additional colonic findings compared to colonoscopy in 5 cases (8.1%). MRC helped in extra colonic findings in 7 cases (11.67%). Comparing MRC with gold standard colonoscopy, both sensitivity (53%) and specificity (67%) is not significantly high for MRC. Both colonoscopy and MRC detects lesion with same accuracy in thirty four patients (57%), colonoscopy detects lesions missed by MRC in twenty one patients (35%) and MRC detects the lesion in five patients (8%), missed by Colonoscopy because of incomplete procedure.

Conclusion: The study suggests MRC is an alternate modality only if colonoscopy is not possible as tissue diagnosis is possible in the later only. The identification of additional lesion at MR colonography signifies the requirement for a second diagnostic approach in the setting of incomplete routine colonoscopy.

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INTRODUCTION

Colonoscopy is the gold-standard for evaluation of colonic pathology^{1,2}, but in certain situations colonoscopy is not possible or incomplete due to procedural pain, colonic stenosis and elongated colon. Colonoscopy is the gold-standard for evaluation of colonic pathology 1, 2, but in certain situation colonoscopy is not possible or incomplete due to procedural pain, colonic stenosis and elongated colon. Thus there has been a need to develop alternative diagnostic procedure to visualize large bowel.^{3,4,5}

Currently available modalities like Barium enema, which has following drawbacks like highly subjective, bowel loops superimposed with one another without cross sectional image to see the small lesions and risk of ionizing radiation.

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CT Colonography is another alternative but it carries the risk of excessive ionizing radiation and contrast exposure. MR Colonography (MRC) is technically similar to CT Colonography with few more advantages. In recent years major technologic advances in diagnostic MRI have led to improved image quality particularly with the use of fast sequence and surface coil. Positive contrast like water/saline can be used to distend the colonic lumen; hence without radiation and contrast material we can study the colon using this technique.^{6,7}

MR Colonography was first described in 1997 by Luboldt *et al.*⁸ Currently two technique are being evaluated for MR colonography. Based on the signal within the colonic lumen, they can be differentiated as "Bright lumen and "dark lumen" MRC.^{9,10,11,12}

With "bright lumen" MRC colorectal lesions are visualized as dark filling defects within the bright colonic lumen. This can be achieved by administering a rectal enema containing paramagnetic contrast. On 3D gradient echo sets only the

contrast-containing colonic lumen is bright whereas the surrounding tissues including colonic wall and polyps and growth remain low in signal intensity. A new approach for “bright lumen” MRC is based on the acquisition of True FISP sequences¹³.

“Dark lumen” MRC focuses on the colonic wall. It is based on the contrast generated between a brightly enhancing colonic wall and a homogeneously dark colonic lumen. The technique differs from “bright lumen” MRC because gadolinium containing tap water enema only is rectally applied rendering low signal on heavily T1 weighted 3D GRE acquisitions.^{14,15}

Luboldt *et al.*, showed MRC was highly dependent on polyp size: although most polyps smaller than five mm were not detected by MRC, the sensitivity for the detection of polyps larger than 10 mm was greater than 90%⁸. Lauenstein TC *et al.*, introduced fecal tagging method in 2002. MR colonography with barium-based fecal tagging initial experience was favorable to differentiate polyp from fecal material. Fecal tagging avoid the need of tedious colonic preparation.¹⁶

Ajaj *et al.* compared dark lumen magnetic resonance colonography with conventional colonoscopy for the detection of colorectal pathology. Dark lumen MRC was as sensitive and specific as colonoscopy in polyp deduction. Using gadolinium contrast polyp seen brightly and extraluminal pathology were well made out¹⁷. Extraluminal pathology is well demonstrated by dark lumen MRC which is not possible by colonoscopy¹⁸. In Kinner S *et al.*, Compared MR colonography versus optical colonoscopy on the basis of patient acceptance, the results concluded that of MR colonography is equally acceptable to colonoscopy in screening population^{19,20}

Indications for MRC are incomplete colonoscopy because of an obstructing mass or stricture, colonic tortuosity, adhesions, severe diverticular disease, patient intolerance of colonoscopy or inability to perform colonoscopy because of a strong requirement for anticoagulant therapy or risks of sedation and patients not willing for colonoscopy.

Table 1 Colonoscopy and Other Imagng Modalities - Advantages and Disadvantages

Parameters	Colonoscopy	DCBE	CTC	MRC
Intervention possible	Yes	No	No	No
Portion of colon examine	80-95%	80-95%	100%	100%
Mucosal abnormality detection	Yes	No	?	>
Sensitivity of polyp detection size < 1 cm	75%	50-80%	33-70%	61%
Sensitivity of polyp detection size > 1 cm	90%	75-95%	90-97%	99%
Sensitivity of polyp & cancer	100%	95%	90-97%	99%
Distinction of fecal residue from polyp	Yes	No	Yes with contrast	Yes with contrast
Operator dependent	Yes	Yes	No	No
Sedation req.	Yes	Yes	No	No
Patient preference	Low	Low	High	Undetermined
Risk of perforation	1 in 1000	1 in 25000	undetermined	Undetermined
Cost	High	Low	High	High

DCBE=Double contrast Barium Enema; CTC-CT Colonography; MRC-MR Colonography

Sixty patients with suspected colonic pathology were evaluated, thirty patients underwent colonoscopy first then MRC, another thirty patients underwent MRC first which was followed by colonoscopy. Findings in both modalities were compared to know the merits and demerits of each modality.

MATERIALS AND METHODS

This comparative study between Colonoscopy and MR Colonography was carried out in the Institute of medical Gastroenterology and Radiology Department of Madras Medical College, Chennai. The study period was February 2015 to January 2017 in patients who were attending Medical Gastroenterology Department with clinical diagnosis highly suspicious of colorectal pathology.

Inclusion Criteria included bleeding per rectum suggestive of colonic lesion rather than perianal problems, significant weight loss, change in bowel habits, positive FOBT, abnormal finding during rectal examination and patients with family history of colorectal cancer/polyposis with symptoms of bowel disease. Patients who were having contraindications for MR scans and not willing for the study were excluded

Most of the patients were prepared by giving Polyethylene Glycol colonic Lavage. Equipments used were Video Colonoscope – Pentax EC 3830/EC 3801L, 168 cm in length with light source and image processor – EPM-3300 and 1.5 Tesla MRI Technique.

After preparing the patient adequately thirty patients were taken up for colonoscopy first then MRC and the other thirty patients were taken up for MRC first then colonoscopy.

Before starting the MRC procedure, 20mg of hyoscine was given IV to reduce peristalsis/spasm. After positioning the patient in lithotomy position, Foleys catheter was introduced into the rectum. 1.5 to 2.0 liter of plain water introduced into the rectum at the rate of 120ml/min with IV administrative of paramagnetic contrast gadolinium for enhancement of colonic lesions in case of dark lumen MRC. The lesion appears as hyperintense in dark lumen MRC. Diluted gadolinium is instilled into the rectum in case of bright lumen MRC.

Statistical Analysis

The statistical analyses were performed using SPSS vs. 14.0 (SPSS, Chicago, IL) and SAS vs. 9.2 (SAS, Cary, NC). All continuous variables were compared using a two tailed Student’s *t* test. All categorical variables were compared using Fisher’s exact test. Multivariate analysis was conducted by logistic regression. A *p* value of <0.05 was used as the cutoff for statistical significance.

RESULTS

Baseline characteristics were sixty patients who fulfilled the study criteria were included in the present study. The mean age was 47 years and the male female ratio of (M: F) 37:23 (2:1)

Patients with clinical history and examination highly suggestive of organic lesions like bleeding PR, motion for occult blood positive and mass palpable per abdomen or growth rectum in PR examination only were included. Patients with history suggestive of functional bowel disorders were not included in this study.

Out of sixty patients nineteen patients presented with bleeding per rectum, thirteen patients presented with growth rectum on rectal examination and significant overlap of bleeding PR and growth rectum was seen. Six patients were diagnosed as IBD-UC, Seven patients diagnosed as TB abdomen, two patients diagnosed as rectal polyp, five patients with secondaries liver to rule out colonic lesions and FOBT positive in fifteen patients.

Based on the above clinical/examination findings patients were subjected for Colonoscopy and MRC. Thirty patients were subjected first to colonoscopy followed by MRC and another thirty patients were subjected for MRC first then colonoscopy, after adequate bowel preparation.

Table 2 Colonoscope Passed Up To

Ileum/Cecum	42 Patients
Ascending colon	05 Patients (5 Obstructing growth)
Hepatic flexure	01 Patients (1 Obstructing growth)
Transverse colon	01 Patients (1 Intussuscepting growth)
Splenic flexure	01 Patients (1 Poor patient tolerance)
Descending colon	01 Patients (1 Obstructing growth)
Sigmoid	03 Patients (1 stricture + 1 obstructing growth + 1 poor tolerance)
Rectum	06 Patients (6 Obstructing growth)

Out of sixty patient's colonoscopy passed up to cecum/ileum in forty-two patients, which accounts for 70%. In the remaining eighteen patients (30%) scope not passed up to cecum due to reasons as tabulated (TABLE -2).

Among ten patients with growth rectum, scope negotiation beyond the lesion was not possible in six patients due to obstructing growth.

On the same day after colonoscopy MRC done in radiology department and in those patient subjected for MRC first, they underwent colonoscopy on next day. Both the findings are tabulated and compared to find out the merits and demerits of each modality.

Table 3 Interpretations of Colonoscopy and MR Colonography

No	Type of lesion	By colonoscopy	By MRC
1	Growth rectum	10	10
2	Growth Rectosigmoid	03	03
3	Growth Descending colon	01	01
4	Growth transverse colon	02	02
5	Growth ascending colon	04	05
6	Proctitis	03	0
7	Proctosigmoiditis	04	2 normal and 2 thickened rectum
8	Left sided colitis	01	0
9	Rad.Proctosigmoiditis + stricture	01	Sigmo narrowing
10	Pancolitis	03	2 thicken RS & 1 normal
11	Ileocecal TB	04	3 thicken cecum & 1 normal
12	Ileocecal Crohn's	02	0
13	Colonic polyps including FAP(2) & Solitary polyp	8 polyp + 2 FAP	10 with additional findings
14	Solitary rectal ulcer	01	0
15	Sig diverticulosis with fistula	01	Only diverticulosis
16	Normal study	10	10

Diagnostic Accuracy of Colonoscopy and MRC

From the above Table-3 by comparing colonoscopy and MRC, diagnostic accuracy for the growth arising from rectum, rectosigmoid, descending colon, transverse colon and

ascending colon is same. However one patient with obstructing growth rectum showed thickened ascending colon suggestive of synchronous lesion in ascending colon by MRC. One patient with post radiation proctosigmoiditis and stricture in sigmoid colon by colonoscopy were reported as only narrowing of sigmoid stricture by MRC. Four cases of suspected Ileocecal TB by colonoscopy were reported as thickened wall of cecum in three patients and normal study in one patient by MRC.

One patient with sigmoid diverticulosis and low rectal fistula by colonoscopy were reported as diverticulosis by MRC and the fistula was not demonstrable. Three cases of proctitis, one left sided colitis and two ileocecal crohn's and one solitary rectal ulcer diagnosed by colonoscopy were reported as normal by MRC.

Among four cases of proctosigmoiditis by colonoscopy two were reported as normal and the other two cases were reported as thickened wall of rectum by MRC.

Three cases of IBD – UC Pancolitis by colonoscopy were reported by MRC as normal study in one patient and thickened wall of rectosigmoid in two patient. (Table-4)

Table 4 Colonoscopy and MRC IN IBD

No	Colonoscopy Findings	MRC Findings
1	Proctitis in 3 patients	Normal study in 3 patients
2	Proctosigmoiditis in 4 patients	2 normal and 2 thickened rectum
3	Left sided colitis in 1 patients	Normal in that 1 patient
4	Pancolitis in 3 patients	2 Thickened rectosigmoid & 1 normal
5	Ileocecal crohn's in 2 patients	Normal study of 2 patients

Colonoscopy and Biopsy

Biopsy was done for all patients with lesion (growth/inflammation) during colonoscopy examination. Out of thirteen patients with growth rectum biopsy showed adenocarcinoma in all of them. Biopsy taken from five patients with growth ascending colon revealed adenocarcinoma in three patients and non specific inflammatory infiltrate in two patients, but the repeat biopsy was positive for malignancy. Two patients with growth transverse colon revealed adenocarcinoma in both patients. Biopsy taken from eight patients with colorectal polyp showed hyperplastic polyp in two patients adenomatous polyp in three patients and inflammatory cell infiltrate in three patients. Two patients diagnosed as Familial Adenomatous Polyposis (FAP) showed adenomatous polyp (one patient tubular adenoma and other one tubulovillous) in biopsy.

Twelve patients with inflammatory disorder of the colon like proctitis, proctosigmoiditis, Left sided colitis and pancolitis showed varying inflammatory cell infiltrate (No evidence of dysplasia in all patients). Biopsy done in four patients with suspected Ileocecal TB revealed non-specific inflammation in two patients and caseating granulomas in two patients. Biopsy taken from suspected Ileocecal Crohn's showed non-specific inflammation in one patient and non-caseating granulomas in one patient.

Additional Findings by MRC When Compared To Colonoscopy

In one patient with growth mid-descending colon with luminal narrowing, scope not passable beyond the obstructing lesion, the MRC showed a polypoid lesion in splenic flexure In addition to growth. (table-5) In another patient

colonoscopy passed only up to splenic flexure due to poor patient tolerance, showed a polyp in sigmoid colon; however MRC showed another polypoid lesion in ascending colon. Three patients with obstructing growth rectum where scope not passable beyond the lesion subjected for MRC showed thickened wall of ascending colon in one patient and thickened wall of descending colon in one patient suggestive of Synchronous lesions and polypoid lesion in descending colon in another patient.

Table 5 Additional Findings with MRC

No	Type of lesion	Colonoscopy	MRC
1	Growth descending colon	Growth mid descending colon	Growth mid descending colon with polypoid lesion in splenic flexure
2	Sigmoid polyp	Sigmoid polyp	Sigmoid polyp with another polyp in ascending colon
3	Growth rectum	Growth rectum	Growth rectum with thickened wall of ascending colon-? synchronous lesion
4	Growth rectum	Growth rectum	Growth rectum with thickened wall of descending colon-? Synchronous lesion
5	Growth rectum	Growth rectum	Growth rectum with polypoid lesion in descending colon

Extracolonic Finding on MR Colonography

Among ten patients with Growth rectum diagnosed by MRC, three patients showed pelvic nodal involvement and one patient showed liver metastasis. Among two patients with growth transverse colon (growth transverse colon + growth proximal transverse colon and hepatic flexure) and five patients with growth ascending colon one patient in each showed liver metastasis. In addition to liver metastasis one patient with ascending colon growth also showed cholelithiasis. One patient with proctitis showed left renal calculi with cholelithiasis but normal study of colonic lumen by MRC. One patient with radiation proctosigmoiditis with stricture showed sigmoid narrowing with left sided hydroureteronephrosis by MRC. (Table-6)

Table 6 Extracolonic Findings on Mr Colonography

No	Colonoscopy	MRC-colon findings	Extracolonic findings
1	Growth rectum (n-10)	Growth rectum	Pelvic nodes with liver mets
2	Growth rectum (n-10)	Growth rectum	Pelvic nodes
3	Growth rectosigmoid (n-3)	Growth rectum	Pelvic nodes
4	Growth Transverse colon(n-2)	Growth Transverse colon	Liver mets
5	Growth ascending colon(n-5)	Growth ascending colon	Liver mets with Gallstones
6	Proctitis(n-1)	Normal study	Left renal calculi with Gallstones
7	Radiation proctosigmoiditis with stricture at sigmoid (n-1)	Sigmoid narrowing	Left Hydroureteronephrosis

Table 7 Statistical Analysis

MRC	COLONOSCOPY			
		POSITIVE	NEGATIVE	TOTAL
POSITIVE	COUNT	24	5	29
	%	40.0%	8.3%	48.3%
NEGATIVE	COUNT	21	10	31
	%	35.0%	16.7%	51.7%
TOTAL	COUNT	45	15	60
	%	75.0%	25.0%	100.0%

Based on the above findings when comparing MRC with gold standard Colonoscopy:

Table 8

NO	Parameters	Percentage %
1	Sensitivity	53%
2	Specificity	67%
3	Positive predictive value	83%
4	Negative predictive value	32%
5	Pearson chi-square (p)	>0.05(NS)

ROC is 0.6 in this study, if ROC is more than 0.8-0.9 then the sensitivity and specificity is better and we can recommend that modality, but not in this case.

DISCUSSION

Colonoscopy is the gold standard for evaluation of colonic lesions and also to take biopsy and for various therapeutic purposes, however we see lot of obstructing type of recto sigmoid growth where passage of scope beyond the lesion is not possible, hence we planned to do alternative investigation, that is MR colonoscopy. The diagnostic accuracy of both colonoscopy and MRC in this study is same in 34 patients, however biopsy and polypectomy was possible only with colonoscopy.

The diagnostic accuracy of colonoscopy scores over MRC in twenty one patients in determining various lesions like IBD-proctitis, proctosigmoiditis, left sided colitis and pancolitis, solitary rectal ulcer, ileocecal TB, Crohn’s disease and sigmoid diverticulosis with fistula. In all conditions metioned above in addition to diagnosis, biopsy was taken from suspected lesion for HPE confirmation.

The diagnostic accuracy of MRC scores over colonoscopy in five patients. In one patient growth mid descending colon scope passage was not possible beyond the lesion due to obstructing growth, but MRC showed a polypoid growth in splenic flexure in addition to growth mid descending colon. The staging accuracy of growth rectum with MRC and MRI abdomen is better than CT Abdomen, we did staging with 1.5 Telsa MRI available in our institution, the staging accuracy is comparable or even superior to CT Abdomen and pelvis, especially to find out the nodal and mesorectal fat involvement. (3 Tesla MRI is superior and very accurate for staging growth rectum).

The diagnostic accuracy of detecting polyp with MRC is more than 90% if the polyp size is more than 5mm. Colonic wall thickening brought out well with MRC if the lesion size is more than 5mm. Several studies showed poor sensitivity of MRC in detecting polyp of size less than 5 mm, however in condition like FAP, in which colon is studded with polyps, it is easy to diagnose polyps even though the size is less than 5mm.

Overall accuracy of Colonoscopy in our study is 92% (both modality same accuracy in thirty four patients + colonoscopy scores over MRC in twenty one patients) in assessing colonic lesion. Overall accuracy of MRC is 65% (both modality same accuracy in thirty four patients + MRC scores over colonoscopy in five patients) in assessing colonic lesion

Extra colonic findings were detected by MRC in seven patients in addition to colonic lesions viz. pelvic, liver metastasis, gall stones, left renal calculi and left sided hydroureteronephrosis.

Apart from inherent noninvasiveness, lack of exposure to ionizing radiation, and excellent diagnostic performance in assessing the colon, MR colonography delivers extra relevant data pertaining to parenchymal organs^{21,22}. These data are of particular importance in the presurgical assessment of cases suspected of having tumor-related stenosis. Within same examination, the colon can be also assessed for the metachronous lesions and the liver assessed for the presence of metastases.

The study establishes that in patients with an incomplete colonoscopy, MR colonography could confirm the disease found at routine colonoscopy and provide additional information. The identification of additional disease at MR colonography in segments not reached at conventional colonoscopy signifies the need for a second diagnostic approach in the setting of incomplete conventional colonoscopy.

CONCLUSION

From the study, statistically while comparing the MRC with standard tool colonoscopy the values are sensitivity-53%, specificity-67%, positive predictive value – 83%, negative predictive value-32% and the p-value is also not significant (>0.05). In future higher Tesla MRI with advanced software may play an important role in evaluation of colonic lesions especially for screening polyposis and colorectal cancer but still colonoscopy will be needed for tissue diagnosis. MRC has its own advantages that it is non invasive, does not require anesthesia, visualizes the entire bowel and extra colonic findings, but can either be advised only as a complementing tool or in cases where full length colonoscopy is not possible.

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