MRI COLONNOGRAPHY VERSES CONVENTIONAL COLONOSCOPY IN DETECTION OF COLONIC POLYPOSIS

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Abstract- AIM:
1. To evaluate the specificity of employing MRI colonography as a minimally invasive screening test in assessment of colonic polyps
2. To compare, positive predictive value and efficacy of MRI colonography with that of conventional colonoscopy in assessment of colonic polyps

SUBJECTS AND METHODS:
35 consecutive patients with suspected colonic polyps underwent standard MR imaging (bright lumen technique). The images were assessed independently by two viewers who unaware of patient identities and clinical histories. Number, size and site of polyps measurement was made on the bright lumen technique images. Results are compared with conventional colonoscopy. Pathological confirmation obtained in 20 patients

RESULTS:
MR colonography is a new diagnostic procedure that makes it possible to noninvasively visualize the entire large intestine without exposure to radiation. MR colonography-bright lumen method not useful for screening of colonic polyps. The objective would not satisfy be to compete with colonoscopy as the diagnostic gold standard, but rather to offer patients another screening option. MR colonography is a vital tool in assessing the colon in case of incomplete colonoscopy and for extraluminal pathology.

CONCLUSION:
Bright lumen MR colonography is not as effectively as colonoscopy for colonic polyp screening but more useful to find out extraluminal pathology

Key words: Bowel preparation, Brightlumen, colonoscopy, Magnetic resonance Imaging (MRI), Polyp, T2 weighted True FISP.

I. INTRODUCTION
In the mid 1970s, approximately 60 cases of colorectal cancer were diagnosed per 100000 people in the united states and approximately 51% of those diagnosed survived their disease at least five years. Over the last two decades, incidence rates have fallen by nearly 26% between 1984 and 2004. This decline is likely due to increased colorectal cancer screening, which allows physicians to detect and remove colorectal polyps before they progress to cancer. Yet, incidence is still high: colorectal cancer is the third most commonly diagnosed cancer for both men and women. As of 2004, approximately 48 cases of colorectal cancer were diagnosed per 100000 people in the United States. About 65% of men and women diagnosed with colorectal cancer now survive their disease at least five years.

Definition of polyp:
A polyp is defined as a fibro-vascular structure arising from the mucosa either flat or protruding into the lumen of a hollow organ, protruding polyp with or without a pedicle

Etiology:
An assessment of causative factors have shown that

Hyperplastic - Minimal cancer potential

Adenomatous - Approximately 90% of colon and rectal cancers arise from adenomas

Benefits of screening:
Cancer prevention - Removal of precancerous polyps prevent cancer (unique aspect of colon cancer screening)

Improved survival: Early detection markedly improves chances of long term survival. Currently available procedures each with its drawbacks include Barium enema: is highly subjective and expose patient to ionizing radiation. Conventional colonoscopy: This is invasive. CT colonography: Expose patient to ionizing radiation and contrast medium. Of the techniques conventional colonoscopy has been commonly used. In recent years major technologic advances in diagnostic MRI have led to improve image quality particularly with the use of Fast sequences and surface coil. Positive contrast like water / saline can be used to distend the colonic lumen

II. AIMS & OBJECTIVES
1. To evaluate the specificity of employing MRI colonography as a minimally invasive screening test in assessment of colonic polyps
2. To compare positive predictive value and efficacy of MRI colonography with that of conventional colonoscopy in assessment of colonic polyps

NORMAL ANATOMY

COLON

The large bowel comprises the colon, rectum and anus. Its length is about 100cm. The ascending, descending colon and part of rectum are retroperitoneal. The transverse and sigmoid colon have a mesentry formed from a double layer of visceral peritoneum sandwiching connective and adipose tissue with vessels, nerves and lymphatic's. The caecum, hepatic and splenic flexures may also have short mesenteries. The caecum is the first part of the large intestine and continues with ascending colon. The caecum usually lies within one inch of the inguinal ligament. Commonly bound to lateral abdominal wall by one or more caecal folds of peritoneum. Caecum continues as ascending colon up to hepatic flexure. Transverse colon most mobile part of colon, crosses abdomen from right colic flexure to the left colic flexure where it continues as descending colon. The sigmoid colon links descending colon and rectum, extends from the ileac fossa to S3 vertebral level. The termination of teniae colica approximately 15cm from the anus, indicates the rectosigmoid junction. The rectum continues inferiorly as anus. Blood supply- Caecum, ascending colon, hepatic flexure right two third of transverse colon supplied by superior mesenteric artery branches. Left one third of transverse colon, left colic flexure, descending colon, sigmoid and rectum supplied by inferior mesenteric artery branches. Venous drainage to respective veins. Lymphatic to respective group of lymphnodes via epicolic, paracolic and intermediate colic lymphnodes. Nerves upto left colic flexure parasympathetic via vagal and distal to that via pelvic splanchnic nerves.

Histology - four layers 1. Mucosa columnar in type with goblet and enterochromaffin cells arrange in the crypts. The lamina propria contains lymphoid follicles. 2. Submucosa adipose tissue with neural elements, blood vessels and lymphatics. 3. Muscularis mucosa shows inner circular and outer longitudinal layers with myenteric plexus inbetween. Outer layer thickened and forms band of taeniae coli made of collagen and elastic tissue. 4. Serosa-Intraperitoneal colon covered by mesenteric serosa, fromepiploic appendages. Retroperitoneal colon has an adventitial layer.

COLONIC FUNCTIONS

The main function of the colon is absorption of water, Na+ and other minerals. The movements of the colon include segmentation, contractions and peristaltic waves like those occurring in small intestine. Mass action contraction move material from one portion of the colon to another.

DIAGNOSIS OF COLONIC POLYPOSIS

1. Double contrast Barium enema
2. Conventional colonoscopy-Direct visualization of polyp, Possibility of biopsy, polypectomy or treatment during examination
3. CT-colonography- have short history and still being developed and have radiation risk. No possibility of biopsy, polypectomy or treatment during examination
4. MRcolonography was described in 1997 by Luboldt et al.

Currently two techniques 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

MRI APPEARANCE OF NORMAL COLON

Bright lumen- Colonic lumen appears hyperintense/bright and wall appears hypointense/Dark. Fecal matter and air appears as filling defects.

Dark lumen - Colonic lumen appears hypointense/Dark

CLASSIFICATION OF COLONIC POLYPS

I. Nonneoplastic polyps
   a. Hyperplastic polyp - represents 90%, due to decreased epithelial turnover
   b. Inflammatory polyps/pseudopolyps-IBD
   c. Submucosal-Lymphoid, lipoma, fibroma, hemangioma
   d. Hamartomatous - i) Sporadic
      ii) Familial Juvenile polyposis
      iii) Peutz-Jeghers polyps

II. Neoplastic polyps (adenoma/Carcinoma)
   a. Conventional
      i) Tubular >75% tubular
      ii) Villous >75% villous
      iii) Tubulovillous
   b. Serrated adenoma
      i) Simple serrated
      ii) Traditional serrated
      iii) Serrated unclassified
   c. Hyperplastic polyposis syndrome

Depends on shape
   Type I Pedunculated, subpedunculated, sessile
   Type II Flat and depressed

Depends on size
   Diminutive 1 to 5mm
   Small 6 to 9mm
   Large ≥10mm

Non neoplastic polyps

Hyperplastic polyps
   Represent 90% of all polyps in the large intestine. Do not exhibit dysplasia. They may arise at any age but usually are discovered incidentally in the sixth and seventh decades. It is believed that the hyperplastic polyt results from decreased epithelial turnover and accumulation of mature cells on the surface. Usually <5mm in size

Inflammatory pseudopolyps
   Is an island of normal colonic mucosa which only appears raised because it is surrounded by atrophic tissue (Ulcer)-In long standing ulcerative colitis benign with no malignant potential

Submucosal polyps
   Lymphoid aggregates, lipomas, leiomyomas, hemangiomas, fibromas, metastatic lesion. They may be either neoplastic/non neoplastic with smooth overlying mucosa
Hamartomatous Polyps
Results of faulty development, made up of a mixture of tissues. a. Juvenile polyps—Consists of lamina propria and dilated cystic glands than increased number of epithelial cells. They are more common in child hood. Removed because of high risk of bleeding.
b. Peutz-Jeghers polyps— glandular epithelium supported by smooth muscle cells that is contiguous with the muscularis mucosa. Polyps are benign but may undergo malignant transformation.

Neoplastic polyps

Adenomas-
Conventional adenomas—Tubular, Tubulovillous and villous. Villous adenomas are most malignant type.

Inherited polyps—Familial adenomatous polyposis syndrome

MRI SEQUENCES

Bright lumen—TruFISP / HASTE/3D T1 W GRE

III. REVIEW OF LITERATURE
In 2007 Kinner S, Kuehle CA, Langhorst J, et al shows MR colonography is equally acceptable to colonoscopy in screening population.

IV. MATERIAL AND METHODS:

Study design: prospective study

Study period: 3 years

Subjects: 35 patients for whom a colonoscopy had been indicated. Magnetic resonance imaging and conventional colonoscopy are performed in all patients after appropriate bowel cleansing. The primary objective of the study was to run a prospective comparison between MR colonography and colonoscopy in the detection of colorectal polyps. The goal here was to determine whether MR colonography bright lumen technology available today reaches the gold standard of conventional colonoscopy in the diagnosis of colorectal polyps. Other objectives were to compare both methods in terms of patient’s acceptance and satisfaction. Before colonoscopy, the patient undergoes MR colonography after written informed consent. The two examinations are performed and diagnostically evaluated independently of each other by experienced radiologist and gastroenterologists.

Inclusion criteria:
Patients over 10 years
Colonoscopy indicated
Good health
Written declaration of consent from patient

Exclusion criteria:
Patient under 10 years
Known patient with anal incontinence
Known MR contraindication: Cardiac pace makers,
Aneurysmal clip, Cochlear implants, Recent implants.
Implants in dorsolumbar spine, Hip prostheses Claustrophobia

Assessment
Detailed history and after brief clinical evaluation of patients, every patient was subjected to a colonic preparation.

Patient preparation:
Bowel preparation and cleansing process should be started the evening before the MR colonography scan with peglec purgative. Before the patient put into the MRI bore must be screened for general contraindications. The patient is conveyed to a diagnostic system in supine position. Inj scopalamine 20 mg given intravenously to reduce peristalsis. Bowl filled with 1.5 to 1 litre of lukewarm water through indwelling rectal catheter. Filling screened with MRI.

Scan technique

MR Imaging protocol:
True FISP dataset of the abdomen covering entire colon is collected in coronal and axial sections of both prone and supine position with following parameters.

1.5 tesla MRI machine with surface coils
TR: 4.45 ms,
TE: 2.23 ms,
Flip angle 70 degree
FOV: 400 x 400 mm,
Voxel size 1 mm x 1 mm x 1.6 mm,
Slice thickness 3 mm
Acquisition time 21 sec.
Total scan time 20 minutes

ADVANTAGES

MR Colonography
Bright lumbar technique bowel wall appears dark. Fluid filled lumen appears bright. Polyp appears as dark filling defect within fluid filled bright colonic lumen. Extension of lesion along the length of lumen and extraluminal extension appears dark and loss of fat plane gives clue to diagnosis. Other abdominal organs can be evaluated at same time.

Conventional colonoscopy
Direct visualization of polyp as mucosal projection and also biopsy can be taken
LIMITATIONS OF THE STUDY
Bowel preparation could not be avoided. Small size polyps <8mm were less sensitive to detect. Fecal material may mislead for polyps. Not able to biopsy. No possibility of intervention

OBSERVATION & RESULTS:

ANALYSIS BASED ON TYPE OF POLYPOSIS

<table>
<thead>
<tr>
<th>Type of polyposis</th>
<th>No. of cases</th>
<th>%</th>
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<tbody>
<tr>
<td>Family history</td>
<td></td>
<td></td>
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<tr>
<td>Present</td>
<td>18</td>
<td>51.44</td>
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<tr>
<td>Absent</td>
<td>17</td>
<td>48.56</td>
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SITE OF COLON PREDOMINANTLY INVOLVED

<table>
<thead>
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<th>Site</th>
<th>Cases</th>
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</tr>
<tr>
<td>Left colon</td>
<td>23</td>
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COLONIC POLYS –DIAGNOSED BY MR COLONOGRAPHY

<table>
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<tr>
<th>Results</th>
<th>No. of polyps</th>
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<tr>
<td></td>
<td>Right</td>
<td>Left</td>
<td></td>
</tr>
<tr>
<td>&lt;8mm</td>
<td>3</td>
<td>2</td>
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<tr>
<td>&gt;8mm</td>
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<td>19</td>
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COLONIC POLYS –DIAGNOSED BY COLONOSCOPY

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COMPARISON OF MR COLONOGRAPHY & COLONOSCOPY LESS THAN 8MM POLYP

<table>
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<th>Procedure/ &lt;8mm polyp</th>
<th>DETECTED</th>
<th>NOT DETECTED</th>
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<tr>
<td>MRC</td>
<td>3</td>
<td>28</td>
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<tr>
<td>CC</td>
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COMPARISON OF MR COLONOGRAPHY & COLONOSCOPY MORE THAN 8MM POLYP

<table>
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<td>7</td>
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<tr>
<td>CC</td>
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STATISTICAL TABLE

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<th>Procedure</th>
<th>Polyp detected &gt;8mm</th>
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<tr>
<td>MRC</td>
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<tr>
<td>Total</td>
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Bright lumen MR colonography sensitivity is found to be 78.12% while specificity is 81.25%
Accuracy is 79.16% while positive predictive value is 89.28% and negative predictive value is 65%.

REPRESENTATIVE CASES WITH IMAGES:

Figure 1. Patient positioned in 1.5 tesla MRI
Figure 2. Set for bowel preparation
Figure 3. Bright lumen supine
DISCUSSION:
A study involving 50 patients with personal and family history of colonic symptoms to investigated MR colonography versus colonoscopy as standard. Two patients were excluded due to technical reasons 48 patients were underwent MR colonography. Out of 48 cases 13 were negative for polyp in both MRC and CC. Thirty five cases taken for discussion.
Out of 35 cases 17 cases were family histories positive. Male patients were 19. Left side colon involved in 23 and right side colon 12. Mean age of familial and nonfamilial colonic polyps was 22 and 38 years respectively. On analysis, conventional colonoscopy 32/48 cases were found to have polyps and 16/48 cases were of not having polyp. MR colonography 28/48 cases were detected as polyp and 7 cases read as negative for polyp. MRC true positive cases are 25 and false positive are 3. Fecal material detected as polyp. Seven cases were not detected by MRC. MR colonography detected polyp > 8 mm size.
With above data Bright Lumen MR colonography sensitivity is found to be 78.12% while specificity is 81.25%. Accuracy is 79.16% while positive predictive value is 89.28% and negative predictive value is 65%. Extraluminal pathology cholelithiasis, ovarian cyst, fibroid, renal calculi, liver cyst were detected by MR colonography which is not detected by colonoscopy. Colonoscopy is used to biopsy of polyp at the time of examination which is disadvantage of MR colonography.

Cost Impact: No cost effectiveness information was found regarding MR colonography.
Ethical, cultural or religious considerations: No issues were identified/raised in the sources examined.

Comparison was made with previous studies conducted in evaluation of MRC and colonoscopy.

<table>
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<tr>
<th>Author</th>
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<th>Sensitivity per patients</th>
<th>Specificity per patients</th>
<th>Positive predictive value</th>
<th>Negative predictive value</th>
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<td>Saar et al.</td>
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<td>Lauenstein et al.</td>
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CONCLUSION:
MR colonography-bright lumen, when compared to colonoscopy has moderate sensitivity and specificity. Patient acceptance of MR colonography is at least as good as acceptance of colonoscopy. MR colonography is a new diagnostic procedure that makes it possible to noninvasively visualize the entire large intestine without exposure to radiation. MR colonography-bright lumen method not useful for screening of colonic polyps. The objective would not satisfy be to compete with colonoscopy as the diagnostic gold standard, but rather to offer patients another screening option. Given that only a few patients avail themselves of colonoscopy screening, MR colonography might play an important role in the preventive screening concept for colorectal carcinoma alongside the test for occult blood, clinical and digital rectal examination, and endoscopic procedures if included newer technique. MR colonography is a vital tool in assessing the colon in case of incomplete colonoscopy and for extraluminal pathology. Better resolution of colon.

REFERENCES
1. National Institutes of Health colorectal cancer-1 September 2007


