Current Status of Magnetic Resonance Colonography for Screening and Diagnosis of Colorectal Cancer

Marije P. van der Paardt, MD, PhD[a,b,*],
Jaap Stoker, MD, PhD[b]

KEYWORDS

• Magnetic resonance colonography • Colonography • MRI • Colorectal cancer screening
• Virtual colonoscopy • Magnetic resonance colonoscopy • Screening • Colorectal cancer

KEY POINTS

- MR colonography lacks the need for ionizing radiation and is therefore a potential screening tool for CRC.
- Few MR colonography studies evaluated its potential for colorectal cancer screening, because there is wide availability of and experience with other screening tools.
- Data on diagnostic performance and patient burden of MR colonography in colorectal cancer screening and future preference of MR colonography as a screening tool are promising, but still heterogeneous.
- MR colonography is a cost-effective screening tool compared with no screening, but to be cost-effective, MR colonography should have higher participation rates than CT colonography.
- MR colonography in its current state is not suitable for CRC screening.

INTRODUCTION

Magnetic resonance (MR) colonography was introduced in the 1990s, just after the widespread introduction of computed tomography (CT) colonography. Both techniques were explored for minimally invasive assessment (or virtual colonoscopy) of the complete colon and especially in the setting of screening for colorectal cancer (CRC) and its precursors.[1,2] Fecal occult blood tests (FOBT), barium contrast enema, sigmoidoscopy, and colonoscopy have been evaluated for CRC screening, with optical colonoscopy being the most accurate, with high sensitivity and specificity regarding the detection of CRC and its precursors. Major drawback of this technique is the cathartic bowel preparation; patient sedation for procedural discomfort; and, although small, risk of procedural complications.[3] Luboldt and colleagues[4] presented preliminary results on colonic polyp detection with MR colonography in a small group of 23 persons. Initial results were promising, but poor spatial resolution and the lack of adequate post-processing were hurdles to overcome. Since then, the technique of MR colonography has improved.

Disclosure Statement: Dr M.P. van der Paardt has nothing to disclose. Dr J. Stoker is a research consultant for Robarts Clinical Trials concerning MRI in Crohn's disease.
[a] Department of Radiology, Albert Schweitzer Ziekenhuis, Postbus 444, Dordrecht 3300 AK, The Netherlands; [b] Department of Radiology and Nuclear Medicine, Academic Medical Center, University of Amsterdam, Meibergdreef 9, Amsterdam 1105 AZ, The Netherlands
* Corresponding author. Postbus 444, Dordrecht 3300 AK, The Netherlands.
E-mail address: m.p.vanderpaardt@asz.nl

Radiol Clin N Am 56 (2018) 737–749
https://doi.org/10.1016/j.rcl.2018.04.007

In this paper, we provide an overview on the status and potential of MR colonography in the setting of detection and screening of CRC and its precursors. This article is an update of the paper: Magnetic Resonance Colonography for Screening and Diagnosis of Colorectal Cancer.[1]

COLORECTAL CANCER

Over the past decades CRC morbidity and mortality rates have declined in the United States because of screening and surveillance, improved treatment strategies, and lifestyle changes (reduction in smoking and consumption of meat). Yet, CRC is the third most common diagnosed malignancy in the United States. For 2017 it is estimated that more than 135,000 individuals will be diagnosed with CRC and more than 50,000 deaths from CRC.[5] Early detection of CRC is vital because survival rates rapidly decline after spread of the disease to regional surroundings or distant organs. The 5-year survival rate of localized tumor is 90% compared with 71% and 14% for regional and distant disease, respectively.[5] The development of CRC is believed to follow a certain pathway in which malignant degeneration of an adenomatous polyp advances in an invasive carcinoma: the adenoma-carcinoma sequence. Size is a major prognostic factor for malignant transformation of a polyp, with lesions greater than 10 mm harboring most malignant potential. Yet, size is not the only prognostic factor for malignant transformation of the polyp. Polyps that show high-grade dysplasia and/or a villous component after histologic evaluation, also display increased risk of malignant degeneration. Therefore, polyps larger than 10 mm or with high-grade dysplasia or a villous component have been defined as advanced.

Important evidence now shows that approximately 70% of CRC develop from advanced adenomas, the traditional adenoma-carcinoma pathway. The other 30% are believed to arise via the serrated neoplastic pathway.[6] The traditional serrated polyps used to be classified as harboring no malignant potential. Over time this view changed as molecular analysis of CRC showed that some tumors had similarities with the molecular basis of the sessile serrated adenomas, which were not shown in CRC that originated from advanced adenomas.[7] Clinical implications of this pathway are still being determined.[8] Treatment and surveillance strategies might differ from those of the traditional pathway. Also screening strategies might change because serrated polyps are less likely to bleed, so FOBT might be challenging.[7] Although most MR colonography studies have not yet included the serrated pathway in the evaluation of the technique, a recent study showed that inclusion of the serrated pathway hardly affected long-term predictions on mortality and incidence of the screening program, when serrated lesions were removed.[8]

From the 1970s to recent time periods, the 5-year relative survival rate for all CRC stages combined increased 10%, because of improvements in treatment and earlier detection.[5] Current guidelines for CRC screening include FOBT, colonoscopy, and radiologic imaging tests that enable evaluation of the entire colon. Most research has focused on CT colonography and therefore most data on diagnostic accuracy are available for CT colonography. CT colonography proved to be highly accurate in CRC detection and precursor lesions of 10 mm and larger and therefore CT colonography is implemented as a screening tool for CRC by the US Multi-Society Task Force on Colorectal Cancer.[9] MR colonography, however, is not part of the screening tool recommendation of this guideline, probably because heterogeneity in MR colonography data acquisition, patient preparation techniques, and accuracy data still exist. During the considerable progress over the years in optimizing the CT colonography technique, major steps were also made in CT colonography dose reduction, making it acceptable for screening purposes. Yet the advantage of MR colonography over CT colonography is the lack of ionizing radiation and the excellent soft tissue contrast.

MAGNETIC RESONANCE COLONOGRAPHY

The evaluation of the colon with colonography techniques is based on detection of intraluminal mucosal protrusions and, in the setting of CRC screening, protrusions caused by polyps or mass lesions (**Figs. 1** and **2**). As in colonoscopy, polys are morphologically subdivided into sessile lesions, pedunculated lesions, and flat lesions. Sessile polyps are defined as mucosal protrusions of more than 3 mm elevation, without a mucosal stalk. When a protuberance with a stalk is present, the polyp is defined as a pedunculated polyp. Different definitions are used for flat lesions. Flat lesions can either be slightly elevated, truly flat, or even depressed. The definition for a slightly elevated flat lesion is no more than 2 to 3 mm in intraluminal height or no more than half of its greatest diameter.[10]

Because the histologic component is not demonstrable with MR colonography, size is the major criterion. Generally, three polyp size categories are recognized: (1) diminutive (<6 mm), (2) small (6–9 mm), and (3) large (10 mm) polyps. Another criterion is the presence of fat that is readily demonstrated at either CT colonography or MR