ORIGINAL RESEARCH

Improved Diagnostic Accuracy of Multi-Slice Spiral CT Combined with MRI in Colon Cancer Patients with Ileus: A Comparative Study

Qiurong Li, MBBS; Peipei Dai, MBBS; Wen Zhang, MBBS; Mei Jing, MBBS; Qian Chen, MBBS

ABSTRACT

Background • Colon cancer is a common malignant tumor that often leads to intestinal obstruction, resulting in significant morbidity and mortality. Early and accurate diagnosis of colon cancer and associated ileus is crucial for timely treatment and improved patient outcomes. Various diagnostic methods, including MSCT and MRI, are currently used in clinical practice. However, the optimal imaging approach for accurate diagnosis remains uncertain.

Objective • To study the value and accuracy of multi-slice spiral CT (MSCT) combined with magnetic resonance imaging (MRI) in diagnosing colon cancer obstruction.

Methods • A retrospective analysis was performed on 100 cases of colon cancer and ileus patients admitted to the Hai'an Hospital of Chinese Medicine from January 2019 to July 2020. The cases were randomly divided into control and experimental groups, with 50 cases in each. The control group was diagnosed with MSCT, and the experimental group was diagnosed with MRI based on the control group. The positive and negative detection rates, test accuracy, sensitivity, and specificity were compared between the 2 groups. The area under the curve (AUC), quality of life (QOL) score, and mental status scale in non-psychiatric settings (MSSNS) score were calculated with the receiver operator characteristic curve (ROC) and compared between the 2 groups.

Results • The test accuracy, positive detection rate, negative detection rate, test specificity, sensitivity, and AUC of the experimental group were significantly higher than those of the control group, and the results were statistically significant ($P < .05$). There was no significant difference in the QOL and the MSSNS scores between the 2 groups ($P > .05$).

Conclusion • MSCT combined with MRI has a high application value in diagnosing colon cancer obstruction patients, and can significantly improve the test's accuracy, specificity and sensitivity. (*Altern Ther Health Med.* 2024;30(12):170-175).

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INTRODUCTION

Colon cancer is a prevalent malignancy of the digestive system, with substantial clinical implications and significant morbidity and mortality rates worldwide. It typically arises from the colon's epithelial cells and can progress over time, leading to various complications.[1] One such complication is the development of intestinal obstruction, which occurs when the tumor obstructs the typical passage of stool and gas through the colon. The resulting condition, ileus, is characterized by impaired bowel motility and can have severe clinical consequences.

Colon cancer poses a significant global health challenge, as millions of individuals are diagnosed with the disease annually. According to the World Health Organization (WHO), colon cancer is the third most common cancer worldwide, accounting for approximately 1.8 million new cases and 881 000 deaths in 2020 alone.[2,3] The incidence of colon cancer varies geographically, with higher rates observed in developed countries such as the United States, Canada, Australia, and Western European nations.

Colon cancer not only has a high incidence but also has a significant clinical impact. It ranks among the leading causes of cancer-related deaths globally, accounting for approximately 10% of all cancer deaths.[4] The prognosis for colon cancer depends on several factors, including the stage of the disease at diagnosis, the presence of lymph node involvement, and the presence of distant metastases. Early detection and treatment are crucial in improving survival rates and reducing the burden of the disease.

Ileus, specifically associated with colon cancer, contributes to the clinical complexity and challenges in managing affected patients. While there is limited data on the prevalence of ileus solely attributed to colon cancer, it is estimated that up to 30% of patients with colon cancer may present with some degree of bowel obstruction.[5] Ileus not only causes distressing symptoms for patients, such as abdominal distention, pain, and constipation, but it can also lead to complications such as bowel perforation, peritonitis, and sepsis, further exacerbating the clinical impact of the disease.

Prompt and accurate diagnosis of colon cancer obstruction with ileus is crucial for initiating appropriate therapeutic interventions, optimizing patient management, and improving survival rates. Imaging techniques play a pivotal role in the diagnosis and staging of colon cancer, allowing for precise localization of the tumor and assessment of its extent. Multi-slice spiral CT (MSCT) has gained widespread use due to its ability to visualize the location and characteristics of the lesion.[6] Magnetic resonance imaging (MRI) has also emerged as a valuable diagnostic tool, providing detailed anatomical imaging with excellent soft tissue contrast.[7-9]

The optimal imaging approach for accurate diagnosis and management of colon cancer obstruction with ileus remains a topic of ongoing research and debate. This study aims to explore the clinical value and diagnostic accuracy of using a combination of MSCT and MRI to evaluate colon cancer obstruction in patients with ileus. The present study aims to investigate the clinical value and diagnostic accuracy of combining MSCT and MRI in evaluating colon cancer obstruction in patients with ileus. By assessing the performance of this combined imaging approach, the researchers can provide valuable insights into its efficacy and potential benefits in clinical practice. Such findings can contribute to developing evidence-based diagnostic algorithms and facilitate more precise and timely management of colon cancer patients with ileus, ultimately leading to improved treatment outcomes and enhanced patient care.

MATERIALS AND METHODS

Participants

The researchers conducted a retrospective, controlled, and randomized study involving 100 cases of colon cancer and ileus patients who were admitted to Hai'an Hospital of Chinese Medicine from January 2019 to July 2020. These patients were randomly divided into control and experimental groups, each consisting of 50 cases. The experimental group had patients between 32 and 69, while the control group had patients aged between 35 and 71. The baseline information regarding gender, age, and disease duration was similar in both groups (Table 1).

Inclusion/Exclusion Criteria

Inclusion Criteria. Patients who met the following criteria were included in the study: (a) displaying clinical symptoms consistent with intestinal obstruction caused by colon cancer; (b) over 18 years of age; (c) having no history of drug allergy, drug abuse, or harmful habits; and (d) having no complications of other organic diseases.

Exclusion Criteria. Potential participants in the study were specifically excluded if they (a) had impaired consciousness disorder, (b) had other digestive system diseases, or (c) failed to meet the MRI diagnosis criteria.

Ethical Issues

Ethical clearance for the conduct of this study was obtained from the Health Research Ethics Committee of Hai'an Hospital of Chinese Medicine . The study strictly adhered to Good Clinical Practice (GCP), including compliance with the Helsinki Declaration on biomedical research and human rights. Participants who met the qualifications were provided with sufficient details regarding the research. Only after obtaining signed informed consent agreements were the participants enrolled in the study, which the researchers' hospital ethics committee had approved.

Methods

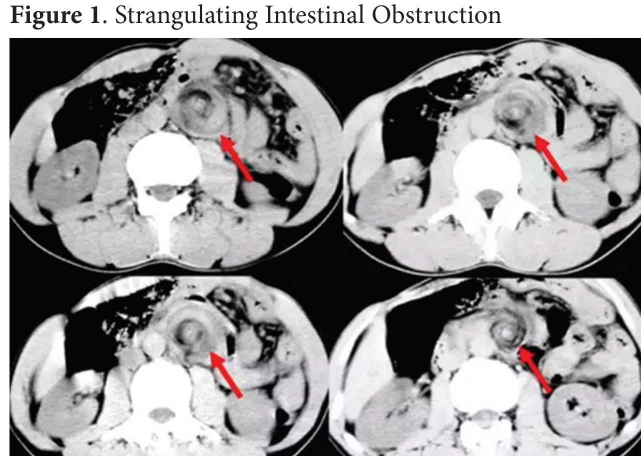
Participants in the study were assigned to either the control group or the experimental group based on a computer-generated randomization sequence. This sequence assigned a random number or identifier to each patient. The random numbers were associated with patients' medical records. The randomization information was placed in sealed envelopes and assigned to patients by personnel independent of the study.

Patients in the control group were diagnosed using a 16-slice spiral CT (manufactured by Shenzhen Anke Hi-Tech Co., Ltd; lot number: 20183060562) to scan their abdomen. The

Table 1. Baseline Information

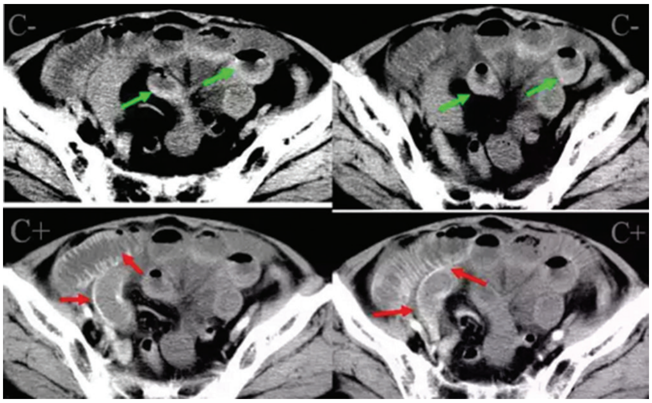
Group	Experimental group	Control group	χ^2/t	*P* value
Gender (Male/Female)	25/25	26/24	0.36	.55
Age (years)	57.62±4.33	58.31±4.50	0.78	.44
Height (cm)	167.52±9.86	166.80±10.26	0.36	.72
Weight (kg)	75.59±6.02	75.00±5.96	0.49	.62
Course (Month)	3.68±0.69	3.72±0.73	0.28	.78
Smoking history (year)	6.61±1.33	6.57±1.38	0.15	.88
Drinking history (year)	9.96±1.38	9.88±1.65	0.26	.79
Hypertension (case)	13	15	0.20	.66
Diabetes (case)	8	7	0.08	.78
Hyperlipidemia (case)	4	6	0.44	.51

Figure 1. Strangulating Intestinal Obstruction



Note: The root of the small mesentery is twisted by 1080 degrees in the direction of the arrow.

Figure 2. Formation of a Band from the Transverse Colon to the Root of the Mesentery Leads to Hernia Formation in the Small Intestine



slice thickness was 5mm. Figure 1 illustrates a case of intestinal obstruction in a colon cancer patient from the control group who was diagnosed with strangulated intestinal obstruction.

An MRI diagnosis was performed for the experimental group based on the control group's findings. After undergoing a 16-slice spiral CT in a supine position, the patients were instructed to insert cotton balls or earplugs in their ears and remove any potential sources of interference, such as mobile phones, accessories, earrings, magnetic cards, or other materials. They were scanned by a 1.5T MRI scanner (manufactured by Hangwei General Electric Medical System Co., Ltd; lot number: 2003 No. 3280043) with a slice thickness of 3mm. Gadopentetic acid was injected as a contrast agent at a rate of 2.0ml/s

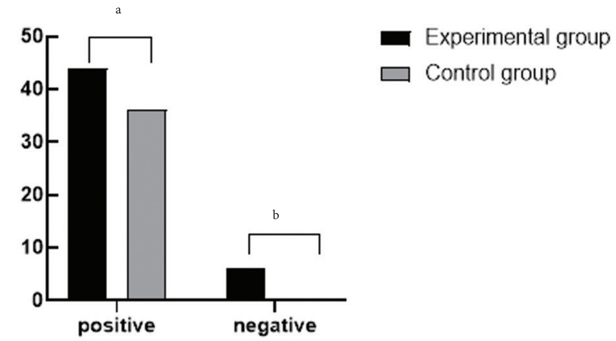
The characteristics and extent of colon tumors were evaluated using T2-weighted sequences, which offer excellent soft tissue contrast. These sequences were acquired in both axial and coronal planes. Gadolinium-based contrast agents were used during the MRI examination to improve the detection of abnormal tissue and enhance lesion visualization.

The criteria for diagnosing colon cancer obstruction using an MRI include the tumor morphology, such as the thickening of the colon wall and the presence of a mass or tumor, as well as identifying the location of the lesion in the ascending colon, transverse colon, descending colon, or rectum. Figure 2 shows an ileus examination of a patient in the experimental group. It displays an internal hernia in the small intestine resulting from a cluster extending from the transverse colon to the root of the mesentery.

Outcome Measures

The positive detection, negative detection, test accuracy, sensitivity, and specificity of the 2 groups were compared. Additionally, the groups were evaluated based on AUC, QOL, and MSSNS scores. Test accuracy was determined by dividing the number of detected cases by the number of confirmed cases and multiplying by 100%. A cut-off value of 60 points was used for the MSSNS score, with scores below this indicating a normal mental state, scores between 60-70 showing mild abnormalities, and scores over 70 indicating abnormalities. The QOL scoring dimensions included daily activities, work and life, interpersonal relationships, and others, with a maximum score of 10 points for each dimension. A higher score suggests a better quality of life.

Figure 3. Comparison of Positive Detection and Negative Detection



[a]There were 44 positive cases in the experimental group and 36 positive cases in the control group (χ^2=4.00, P = .046);
[b]There were 6 negative cases in the experimental group, while 0 cases were in the control group (χ^2=6.38, P = .012).

Note: The abscissa from left to right indicates the positive and negative detection, and the ordinate indicates the number of cases.

Table 2. Comparison of Test Accuracy and AUC ($\bar{x} \pm s$)

Group	Test accuracy (%)	AUC
Experimental group	100%	0.83±0.07
Control group	72%	0.61±0.06
χ^2/t	16.28	16.87
P value	<.001	<.001

Table 3. Comparison of QOL and MSSNS Scores ($\bar{x} \pm s$, points)

Group	QOL score	MSSNS score
Experimental group	86.35±7.66	53.37±4.22
Control group	85.93±7.82	53.08±4.29
t	0.27	0.34
P value	.79	.73

Statistical Analysis

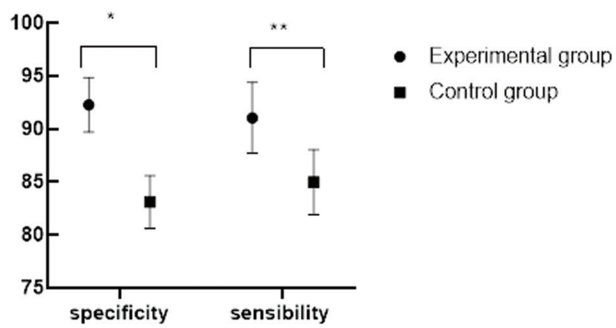
All statistical analysis was carried out by using SPSS20.0 software and GraphPad Prism 7 (GraphPad Software, San Diego, USA) for graphing purposes. Measurement data was presented as (±s) and analyzed using a *t* test while counting data was presented as [n(%)] and analyzed using a chi-square test. Results were considered significant at a $P < .05$.

RESULTS

Comparison of Positive Detection and Negative Detection

The experimental group showed remarkably high numbers in both positive and negative detection compared to the control group ($P < .05$). See Figure 3. Table 2 details that the experimental group was superior to the control group in test accuracy and AUC ($P < .05$). The experimental group scored markedly higher specificity and sensitivity than the control group ($P < .05$). See Figure 4 & 5. No marked difference was observed in the QOL score and MSSNS score between the 2 groups ($P > .05$). See Table 3.

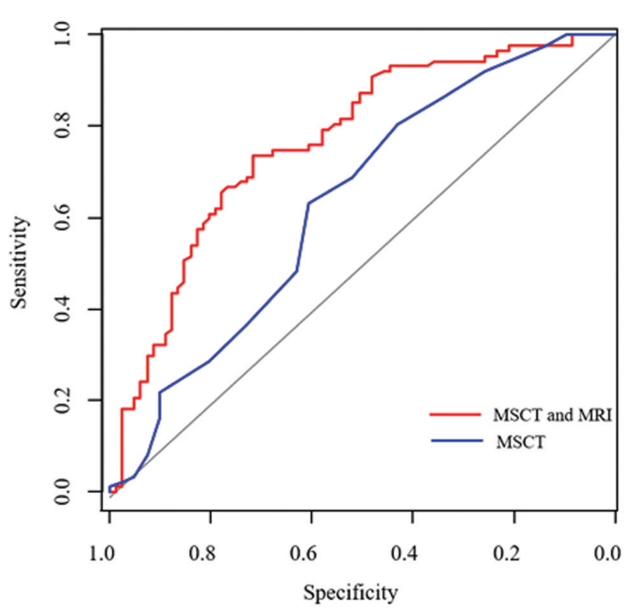
Figure 4. Comparison of Test Specificity and Sensitivity



[a]Indicates the comparison in test specificity of the 2 groups is statistically significant [(92.28±2.57)% vs. (83.11±2.49)%, (t =18.12, P < .001)].
[b]Indicates differences between 2 groups in test sensitivity are statistically significant [(91.05±3.34)% vs (84.99±3.07)%, (t =9.45, P < .001)].

Note: The abscissa from left to right indicates the specificity and sensitivity of the test, and the ordinate indicates the specificity and sensitivity data.

Figure 5 ROC curve of MSCT and MRI



DISCUSSION

Intestinal blockage is a common issue among those with colon cancer. Still, due to the unclear cause, patients often overlook typical digestive system symptoms such as indigestion and abdominal distention, resulting in misdiagnosis or missed diagnosis.[10-13] As the disease progresses and the tumor grows, it can spread to other areas and result in severe abdominal pain. Ileus is an obstructive disease with symptoms such as difficulty in aerofluxus and defecation, which can hinder the elimination of endotoxins and negatively affect intestinal function.[14-17]

Timely identification and treatment are crucial in preventing the spread of cancer cells, minimizing complications, and extending the life expectancy of patients. For individuals with ileus and colon cancer, the main methods of detection include ultrasound, CT scans, and MRI scans. Ultrasound is useful in monitoring the progression of tumors in the digestive system, while CT and MRI scans provide a clear view of the tumor's location, aiding in the determination of where to make the incision for tumor removal.[18-20] Studies have shown that combining CT and MRI tests offers higher accuracy and reduces the risk of misdiagnosis and missed diagnosis.[21-22] To evaluate further the effectiveness of using MSCT and MRI for diagnosing colon cancer with ileus, the researchers conducted separate diagnoses using MSCT and a combination of MSCT and MRI.

The findings of this study demonstrated the superior performance of the experimental group compared to the control group in terms of accuracy, positive and negative detection rates, and AUC (P < .05). These findings suggest that combining MSCT and MRI diagnosis can markedly improve test accuracy, specificity, and sensitivity, thus reducing misdiagnosis and missed diagnosis in colon cancer patients with ileus. As a result, it can yield a promising treatment outcome and considerably minimize patient suffering.

The explanation for the impressive performance of the combination of MSCT and MRI in diagnosing is that CT scans can provide a more apparent distinction between the composition of soft tissue and cell dispersion. Therefore, a more precise detection of patients' specific conditions can be detected more accurately.[23,24]

In terms of quality of life and mental state scale for patients, MSCT was found to be equivalent to the hybrid approach (P > .05), suggesting that both MSCT and the hybrid approach have minimal impact on patients' QOL and mental state. As both MSCT and MRI tests are non-invasive imaging methods, they are not likely to disrupt patients' daily routines or affect their lives and emotions. Previously, Lv et al.[25] performed MSCT and MRI detection on patients with colon cancer and ileus, demonstrating that the hybrid approach had higher accuracy than CT or MRI alone. The researchers' present study aligns with the previous research, further validating its reliability.

Implications

The implications of this study suggest a way to decrease the incidence of incorrect results. The increased level of accuracy in the experimental group indicates that an MRI has a lower likelihood of producing false positive results, thereby minimizing the need for unnecessary additional investigations or interventions. Additionally, the enhanced ability to detect actual positive cases indicates a lower likelihood of missing such cases, leading to more dependable and accurate diagnostic decision-making.

The enhanced precision, sensitivity, and specificity of an MRI in the diagnosis of ileus-related colon cancer can significantly influence decisions regarding patient management. Accurate and early detection of colon cancer can guide appropriate treatment strategies, including surgery, chemotherapy, or targeted therapies. It can also help determine the disease's extent, facilitating staging and prognosis assessment.

The potential to improve patient outcomes is evident in the improved diagnostic capabilities of an MRI observed in the experimental group. By integrating this imaging modality into routine clinical practice, there is a possibility of achieving better results for patients. Early and accurate diagnosis allows prompt initiation of treatment, increased survival rates, and an enhanced quality of life for patients.

To ensure thorough consideration, evaluating the potential advantages and limitations of combining MSCT and MRI on a case-by-case basis is crucial. Such assessment should consider various factors such as the clinical indication, availability of resources, patient-specific considerations, and the expertise of the interpreting radiologists.

Advantages

MSCT and MRI provide complementary information due to their different imaging capabilities. MSCT excels in visualizing bony structures and calcifications and detecting acute hemorrhage, making it valuable for evaluating traumatic injuries or assessing vascular abnormalities. On the other hand, an MRI offers superior soft tissue contrast, making it ideal for evaluating the brain, spinal cord, joints, and abdominal organs. Combining both modalities can comprehensively evaluate various anatomical structures and pathologies.

By combining MSCT and MRI, the diagnostic accuracy can be significantly enhanced. The strengths of each modality can compensate for the limitations of the other. For example, in oncology, MSCT can accurately detect metastatic lesions in the liver or lungs, while an MRI can provide detailed information about the extent of the tumor and its involvement with surrounding structures. This combined approach enables more precise staging and treatment planning.

Certain conditions require a comprehensive evaluation involving both morphological and functional data. The combination of MSCT and MRI allows for a comprehensive assessment of various pathologies. For instance, in stroke evaluation, MSCT can quickly identify hemorrhagic strokes, while an MRI can provide detailed information about ischemic strokes, including the extent of tissue damage and perfusion deficits.

Potential Disadvantages

One of the limitations of combining MSCT and MRI is the increased cost and time required for the diagnostic evaluation. The acquisition and interpretation of images from both imaging modalities may require additional resources such as specialized equipment and expertise. This can limit its widespread availability and utilization, particularly in resource-constrained settings.

Furthermore, there may be patient discomfort and safety concerns when performing both MSCT and MRI sequentially or within a short period. This can be particularly challenging for specific patient populations, such as those with claustrophobia or metallic implants, who may have difficulties with MRI. Moreover, contrast agents in both modalities carry a risk of adverse reactions, although these risks are generally low.

Another limitation is potential radiation exposure from MSCT, which can be a concern for repeated imaging or pediatric patients. The cumulative effects of radiation exposure should be considered when determining the appropriateness and frequency of MSCT examinations.

In addition, integrating and interpreting information from MSCT and MRI can be challenging due to differences in image acquisition, contrast, and artifacts. This requires radiologists to have expertise in both modalities to interpret accurately the combined images and provide a comprehensive clinical assessment.

Study Limitations

It is essential to acknowledge the limitations of the present study. One limitation is the small sample size, which may restrict the applicability of the results. A larger sample would be beneficial to improve the accuracy and consistency of the findings.

Another limitation is the potential for selection bias in the study population. The participants in the study might not be representative of the broader population, which could affect the external validity of the findings.

Additionally, conducting the study in a single center may introduce biases specific to the center and limit the diversity of patient populations and imaging protocols. Therefore, it is necessary to conduct multi-center studies to validate the results across different settings and populations.

CONCLUSION

In conclusion, the combination of MSCT and MRI provides additional diagnostic value in patients with colon cancer and ileus by improving test accuracy, specificity, and sensitivity. Therefore, the researchers recommend using MSCT and MRI together, which is a promising method for diagnosing colon cancer with ileus.

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No funds were received.

AUTHOR CONTRIBUTIONS

Rongli Qiu and Peipei Dai contributed equally to the project.

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