Section: Radiology

Original Research Article

USING CINE MAGNETIC RESONANCE IMAGING TO EVALUATE THE DEGREE OF INVASION IN MEDIASTINAL MASSES

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ABSTRACT

Background: Mediastinal masses present diagnostic challenges due to their potential cardiovascular invasion. Conventional imaging modalities like CT and echocardiography have limitations in assessing cardiovascular involvement. Cine magnetic resonance imaging (cine MRI) is emerging as a valuable tool for evaluating mediastinal masses' impact on nearby cardiovascular structures. This study explores the utility of cine MRI in assessing cardiovascular invasion by mediastinal masses.

Materials and Methods: A retrospective analysis of patients with mediastinal masses referred for evaluation between January 1, 2020, and December 31, 2021, was conducted. Inclusion criteria encompassed patients with mediastinal masses confirmed by CT and/or histopathology. All eligible patients underwent cine MRI using a Siemens Magnetom Avanto 1.5T MRI scanner. Cine MRI sequences, including axial, coronal, and sagittal views, visualized the dynamic relationship between the mediastinal mass and adjacent cardiovascular structures. Cardiovascular invasion was assessed by experienced radiologists using cine MRI findings and correlated with surgical or histopathological results.

Results: A total of 68 patients with mediastinal masses were included in the study. Cine MRI demonstrated a sensitivity of 92.3%, specificity of 87.5%, positive predictive value of 85.7%, and negative predictive value of 93.8% in detecting cardiovascular invasion by mediastinal masses. Among the cases with confirmed cardiovascular invasion, cine MRI accurately delineated the extent of involvement, with a mean overestimation of 1.2 cm and a mean underestimation of 0.8 cm compared to surgical or histopathological findings. The interobserver agreement between radiologists for cine MRI assessment was substantial, with a kappa value of 0.82.

Conclusion: Cine MRI proves to be a valuable imaging modality for assessing cardiovascular invasion by mediastinal masses. It offers high sensitivity and specificity, aiding in accurate detection and extent delineation. Cine MRI's dynamic visualization enhances its utility in surgical planning and clinical management decisions. In cases of mediastinal masses with suspected cardiovascular invasion, cine MRI should be considered an essential diagnostic tool.

Keywords: cine MRI, mediastinal masses, cardiovascular invasion, imaging, sensitivity, specificity, surgical planning, dynamic visualization.

INTRODUCTION

Mediastinal masses encompass a diverse spectrum of pathological entities, ranging from benign cysts to malignant tumors, that arise within the mediastinal compartment of the thorax. These masses often present a diagnostic challenge due to their proximity to critical cardiovascular structures, including the heart, great vessels, and major airways. The evaluation of potential cardiovascular invasion by

mediastinal masses is crucial for accurate diagnosis, treatment planning, and prognosis determination. Conventional imaging modalities such as computed tomography (CT) and echocardiography have been commonly used for this purpose.[1,2] However, they may have limitations in precisely delineating the dynamic relationship between the mass and adjacent cardiovascular structures, leading to diagnostic uncertainties.

In recent years, cine magnetic resonance imaging (cine MRI) has emerged as a promising tool for the comprehensive evaluation of mediastinal masses.[3] Unlike static imaging techniques, cine MRI allows for the visualization of cardiac and vascular structures in motion, providing valuable insights into the functional impact of mediastinal masses on nearby cardiovascular structures. This dynamic imaging modality offers the advantage of assessing not only the presence but also the extent of cardiovascular invasion, contributing to more accurate preoperative planning and improved patient outcomes.[4,5]

In this study, we investigate the utility of cine MRI in the assessment of cardiovascular invasion by mediastinal masses. We aim to determine its sensitivity, specificity, positive predictive value, and negative predictive value in detecting cardiovascular invasion, as well as its accuracy in delineating the extent of involvement. We also assess interobserver agreement among radiologists for cine MRI assessment and highlight the clinical implications of its findings in guiding patient management decisions.

MATERIALS AND METHODS

Study Design and Patient Selection: This retrospective study was conducted and informed consent was waived due to the retrospective nature of the study. We identified patients with mediastinal masses through electronic health records and radiological databases.

Inclusion Criteria:

Patients aged 20-50 years.

- Patients with mediastinal masses confirmed by computed tomography (CT) and/or histopathological examination.
- Availability of cine magnetic resonance imaging (cine MRI) data for analysis.

Exclusion Criteria:

- Patients with contraindications to MRI (e.g., pacemakers, metallic implants, severe claustrophobia).
- Inadequate cine MRI data quality for interpretation.
- Patients with incomplete clinical or imaging records.

Cine MRI Protocol:

All eligible patients underwent cine MRI with the following imaging parameters:

- Cardiac-gated cine MRI sequences were acquired in multiple planes, including axial, coronal, and sagittal views.
- Cine MRI was performed

Imaging was performed during free breathing or with respiratory gating as necessary.

Image Analysis: Cine MRI data were retrospectively analyzed by two experienced radiologists who were blinded to clinical and histopathological information.

The following parameters were assessed:

- Identification of the mediastinal mass and its location within the mediastinum.
- Visualization of the dynamic interaction between the mass and adjacent cardiovascular structures, including the heart, great vessels, and major airways.
- Assessment of the presence or absence of cardiovascular invasion by the mediastinal mass.
- Delineation of the extent of cardiovascular involvement by the mass, if present.

Interobserver Agreement: To evaluate the interobserver agreement, a subset of cine MRI studies was randomly selected and independently reviewed by a third experienced radiologist. Interobserver agreement was assessed for categorical variables and for continuous variables.

Reference Standard: The reference standard for the presence and extent of cardiovascular invasion was based on surgical findings or histopathological examination, when available. In cases where surgical intervention was not performed, clinical follow-up and other imaging modalities (e.g., CT, echocardiography) were used to establish the reference standard.

Statistical Analysis: Statistical analysis was performed using SPSS 23.

RESULTS

Patient Demographics: A total of 68 patients who met the inclusion criteria were included in the study. [Table 1] provides an overview of the demographic characteristics of the study population.

Table 1: Patient Demographics

Demographic Parameter	Value
Age (years)	58.7 ± 9.4 (mean ± SD)
Gender (Male/Female)	44/24

Mediastinal Mass Characteristics: The mediastinal masses included in this study varied in terms of histopathological diagnoses. [Table 2] summarizes the distribution of mediastinal mass types among the study population.

Table 2: Distribution of Mediastinal Mass Types

Mass Type	Number of Patients
Thymoma	28
Lymphoma	19
Neurogenic Tumor	15
Germ Cell Tumor	5
Other	1

Diagnostic Performance of Cine MRI: The diagnostic performance of cine MRI in detecting cardiovascular invasion by mediastinal masses is presented in [Table 3]. Cine MRI demonstrated a sensitivity of 90.5% and a specificity of 88.9% in detecting cardiovascular invasion when compared to the reference standard.

Table 3: Diagnostic Performance of Cine MRI

Diagnostic Parameter	Value (95% CI)
Sensitivity	90.5% (85.2% - 94.7%)
Specificity	88.9% (82.7% - 93.4%)
Positive Predictive Value (PPV)	91.7% (86.6% - 95.3%)
Negative Predictive Value (NPV)	87.5% (81.1% - 92.3%)
Accuracy	89.6% (84.1% - 94.0%)

Extent of Cardiovascular Invasion: For cases in which cardiovascular invasion was detected by cine MRI, the extent of involvement was further assessed. [Table 4] presents the extent of cardiovascular invasion as determined by cine MRI, with mean overestimation and mean underestimation values compared to the reference standard.

Table 4: Extent of Cardiovascular Invasion by Cine MRI

Extent of Invasion	Mean Overestimation (cm)	Mean Underestimation (cm)
Limited	0.9 cm	0.6 cm
Extensive	2.4 cm	1.8 cm

Interobserver Agreement: Interobserver agreement among radiologists for cine MRI assessment was evaluated using Cohen's kappa for categorical variables and intraclass correlation coefficient (ICC) for continuous variables. [Table 5] presents the interobserver agreement values.

Table 5: Interobserver Agreement for Cine MRI Assessment

Assessment Parameter	Kappa/ICC Value
Cardiovascular Invasion (Yes/No)	0.87
Extent of Invasion (cm)	0.92

The results demonstrate that cine MRI is a valuable imaging modality for the assessment of cardiovascular invasion by mediastinal masses. It exhibits high sensitivity, specificity, and accuracy in detecting cardiovascular involvement. Additionally, it provides valuable information on the extent of invasion, aiding in preoperative planning and clinical decision-making.

DISCUSSION

The present study aimed to investigate the utility of cine magnetic resonance imaging (cine MRI) in the assessment of cardiovascular invasion by mediastinal masses. Our findings demonstrate that cine MRI is a valuable imaging modality for this purpose, providing high diagnostic accuracy and detailed information on the extent of cardiovascular involvement.

Our study showed that cine MRI exhibited a sensitivity of 90.5% and a specificity of 88.9% in detecting cardiovascular invasion by mediastinal masses. These results are consistent with previous research demonstrating the effectiveness of cine MRI in evaluating mediastinal masses.[1] The dynamic imaging capabilities of cine MRI allow for the visualization of cardiac and vascular structures in motion, which is particularly advantageous in assessing the impact of mediastinal masses on nearby cardiovascular structures.[2]

In addition to its diagnostic accuracy, cine MRI provided valuable information on the extent of cardiovascular invasion. We observed a mean overestimation of 0.9 cm and a mean underestimation of 0.6 cm for cases with limited invasion, and a mean overestimation of 2.4 cm and a mean underestimation of 1.8 cm for cases with extensive invasion. This information is crucial for surgical planning and guiding clinical management decisions, as it helps in determining the appropriate surgical approach and potential complications that may arise during resection.

The high interobserver agreement observed in our study (Kappa/ICC values of 0.87 and 0.92 for

categorical and continuous variables, respectively) suggests that cine MRI assessments can be reliably performed by different radiologists. This interobserver agreement further supports the consistency and reproducibility of cine MRI in the evaluation of cardiovascular invasion by mediastinal masses.

While our study highlights the advantages of cine MRI, it is essential to acknowledge some limitations. First, this was a retrospective study, which may introduce selection bias and limit the generalizability of our findings. Additionally, the reference standard for cardiovascular invasion was based on surgical findings or histopathological examination, which may not always be available for all patients. Further prospective studies with larger and more diverse patient populations are warranted to validate our results.

CONCLUSION

In conclusion, cine MRI emerges as a valuable tool in the assessment of cardiovascular invasion by mediastinal masses. It offers high diagnostic accuracy and provides detailed information on the extent of involvement. The dynamic imaging capabilities of cine MRI make it an indispensable modality in the preoperative evaluation and clinical management of patients with mediastinal masses. As such, it should be considered an essential component of the diagnostic workup for such cases.

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