

# Value of Shoulder MRI in Cancer Patients Presenting with Shoulder Related Symptoms

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**Abstract:** Nonspecific shoulder pain is common presentation among elderly patients and patients with a history of cancer. The major concern of shoulder pain in cancer patients is the development of metastases. MRI of the shoulder is the most commonly used imaging modality for assessment of suspected soft tissue pathologies associated with the shoulder pain. In this study, we try to examine the role of shoulder MRI in elderly patients with a history of cancer presenting with nonspecific shoulder complaints for assessment of metastases.

**Key words:** Shoulder, MRI, malignancy, retrospective analysis.

## 1. Introduction

Nonspecific atraumatic shoulder pain is a common presentation among older adults, constituting approximately 15% of all musculoskeletal complaints [1]. It is the second most common reason for seeking medical attention after back pain, and contributes to a large quality of life burden, especially in terms of performing occupational or household tasks [2, 3]. The shoulder is a complex joint comprised of the scapula, humerus, and clavicle and has two functional joints, the glenohumeral joint and the acromioclavicular joint. Shoulder pain has many etiologies, among the most common are rotator cuff pathology (such as impingement, tendinosis, or tears), adhesive capsulitis, and bursitis [4, 5]. In patients with a previous history of cancer, a commonly feared etiology of non-specific shoulder pain is metastatic disease [6].

Imaging studies are widely used to evaluate shoulder complaints. Most authors conclude that a radiograph should be the initial imaging for chronic shoulder pain [5, 7-10]. However, the subsequent imaging work-up when the radiograph is non-disclosing is often ambiguous. Magnetic resonance imaging (MRI) of the

shoulder is currently the most commonly used modality for suspected soft tissue pathologies associated with shoulder pain [11, 12]. MRI is able to provide good resolution and standardize imaging planes, while offering a high degree of accuracy in terms of visualizing rotator cuff tears, muscle atrophy, and cartilaginous pathology in both the glenohumeral and acromioclavicular joints [13].

However, rising healthcare costs is a worrisome issue that continues to plague United States policy. Advanced diagnostic techniques such as MRI constitute a significant portion of the cost burden [14]. More than 100 MRIs are ordered per 1,000 inhabitants in the United States, surpassing almost every other country [14]. In a survey conducted across 71 hospitals and 26 independent imaging centers in Iowa, it was discovered that the mean technical cost to consumers (excluding the radiologist's reading fee) per MRI was  $\$1,874 \pm \$694$  [14].

The American College of Radiology Appropriateness Criteria© has a well-established guideline for the work-up of acute shoulder pain [15], but to our knowledge there is no guideline specifically for cancer patients with shoulder-related complaints. Clinicians often use MRI to detect *de novo* metastasis, but the diagnostic yield in patients with a history of

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cancer is not known. Therefore our paper will attempt to evaluate the utility in requesting an MRI for cancer patients more than 65 years old who presented with shoulder-related complaints.

## 2. Methods

From January 2014 to March 2016, 306 consecutive MRI scans that were performed at our institution for cancer patients who were greater than 65 years of age and presented with shoulder-related symptoms were retrospectively analyzed. Patients' primary diagnosis, presenting symptoms, presence of known metastasis, and findings that contributed to the shoulder complaint were collected. Patients who had known primary shoulder tumors were excluded.

## 3. Results

Out of the total 306 patients, 20 were excluded due to the presence of a primary tumor of the shoulder. Out of the remaining 286 patients included in the analysis, there were 34 cases of primary breast cancer, 1 carcinoma of unknown origin, 7 female genital tract cancers, 10 gastrointestinal cancers, 81 hematological malignancies, 30 lung cancers, 6 papillary thyroid cancers, and 24 other cancer types. MRI was able to show derangement in 162 patients (57%). Forty-six (46) patients had metastatic disease to the shoulder (16%) and 116 (41%) had other MRI derangements that contributed to their shoulder complaint. Of the patients with metastasis to the shoulder, 29 patients were initially suspected of metastatic disease on other imaging modalities (63%), and 17 had *de novo* metastasis to the shoulder first found on MRI. Of the 17, 13 patients had additional metastasis in other locations, and 4 had newly detected shoulder metastasis that was the cause of their shoulder-related complaint. This constitutes approximately 2% of the starting 286 patients studied (Fig. 1).

## 4. Discussion

Since metastatic disease often presents with

non-specific complaints, many clinicians elect to order MRI for shoulder pain due to fear of undiagnosed metastatic disease. We show that MRI of the shoulder has a low diagnostic yield for the initial detection of *de novo* shoulder metastasis in cancer patients greater than 65 years old. Of the 286 patients that were included in our analysis, shoulder MRI was of direct value in 4 patients (2%) that had a new metastasis to the shoulder as cause of their complaint. Among all the patients who had metastasis to the shoulder on MRI, the majority had metastasis demonstrated on other imaging modalities including ultrasound (US) and computed tomography (CT), and MRI did not contribute to affecting the course of their care. The threshold of suspicion to request MR studies, therefore, seems inappropriately low for this specific patient population.

In a case control study involving 11 general practices in Devon, UK, 162 patients with metastatic disease (breast, colorectal, prostate) were compared to 152 patients with cancer without metastatic disease and 145 healthy controls [6]. The authors found that 17% of metastatic cases compared to 5% of non-metastatic cancer controls presented with shoulder pain (OR 5.3, 95% CI 1.6 to 18,  $p = 0.007$ ). This may indicate that shoulder pain could be a red flag symptom for a patient suspect of metastatic disease. However, the authors also demonstrated that patients with metastatic disease also tend to present with other symptoms compared to the controls, such as vomiting (25% of cases and 9% of cancer controls), low back pain (24% of cases and 11% of controls), as well as loss of appetite (20% of cases and 6% of controls) [6]. While a patient with a history of cancer presenting with new-onset shoulder pain is concerning, this study seems to suggest that additional clinical findings should be used in conjunction to determine the appropriateness of requesting an MRI.

In the general population, there is a myriad of etiologies for shoulder pain. From the most common, they include rotator cuff pathology (impingement, tendinosis, tears), adhesive capsulitis, bursitis, calcific tendinosis, osteoarthritis, biceps pathology (tendinosis,



**Fig. 1** Retrospective analysis of patients presenting with nonspecific shoulder pain.

tears, dislocation), labral tears/instability, cysts, clavicular osteolysis, internal impingement, rheumatological causes, tumors, stress fractures, and pathology of the cervical spine [16]. The imaging modality following shoulder radiographs depends on the suspected pathology from the history and physical, as discussed in the previously reviewed literature. For suspected

rotator cuff disorders, the American College of Radiology Appropriateness Criteria© states that MRI may be appropriate [17]. However, in 3 reviews with meta-analysis comparing MRI versus ultrasound, it was discovered that there were no statistically significant differences in terms of accuracy between the two modalities [7, 18, 19]. The Society of

Radiologists in Ultrasound Consensus Conference Statement recommends ultrasound because of its lower cost and less disruptive nature despite comparable accuracy [20]. With impingement, dynamic ultrasound can show compressed structures with arm elevation, and with bursitis, it can visualize the bursa and guide steroid injection [21, 22]. In suspected labral tear and instability, a meta-analysis shows that magnetic resonance (MR) arthrography is superior to MRI for the detection of glenohumeral labral tears [23]. In suspected biceps tendinopathy, CT arthrography may be more accurate than MRI, which has similar accuracy when compared to ultrasound [24]. In suspected adhesive capsulitis, imaging modalities are controversial and the diagnosis is largely made clinically since no widely accepted guideline exists [3, 25-27].

Imaging pathology commonly presents in asymptomatic older populations [28]. In a randomly selected population-based cohort study of 30 patients with current shoulder pain, past shoulder pain, or no history of shoulder pain, Gill et al. [28] concluded that there was little association between the presence of clinical pain and radiological findings. This suggests that the value of MRI as a clinically useful diagnostic tool is questionable, and not just in patients with a history of cancer [28]. Furthermore, incidental findings on MRI with no clinical significance could complicate patient care and incur more costs to the consumer. The authors suggest restricting MRI studies to patients for whom shoulder surgery is being seriously contemplated [28].

Previous literature on the appropriateness of shoulder MRI among the general population reports high number of inappropriately ordered MRI. In a study of 237 consecutive patients at a tertiary hospital in 2013, it was found that 45% of the tests were inappropriately requested, mostly due to the lack of a preceding radiograph [29]. Furthermore, in 66% of the patients for whom an MRI was requested, it was determined that ultrasound would have been

appropriate [29]. In another study looking at 100 consecutive MRI shoulder scan requests in the UK, 56% of the requests were deemed inappropriate [30]. While our study focuses on patients with a history of cancer, previous data show that the inappropriate use of MRI for the shoulder is a salient issue in the general patient population.

We acknowledge several important limitations to our study. The retrospective nature of the data analysis to determine outcomes may have missed important clinical context when determining the utility of ordering MRI studies. Additionally, we do not have data on whether any of the metastasis diagnosed on MRI was biopsy-proven. There is also the variability in the likelihood of shoulder metastasis and shoulder complaints between different initial malignancies. For example, a patient with a history of Pancoast tumor may be more likely to present with a shoulder-related complaint. Additionally, our data-set contained metrics from one site and was limited to patients over 65 years of age. Future studies can expand the population size to encompass multi-center patient populations.

## 5. Conclusion

Shoulder pain is a common complaint among the general population, and may be of special concern in a patient with a history of cancer. MRI is commonly included as part of the initial diagnostic work-up, but is associated with a high cost burden. Our study shows that MRI of the shoulder has a low diagnostic yield for the initial detection of *de novo* shoulder metastasis in cancer patients greater than 65 years old with shoulder complaints, and may not be cost-effective as part of the initial work-up. Our study can potentially contribute to the American Board of Internal Medicine Foundation's Choosing Wisely program to reduce unnecessary medical tests.

## Conflict of Interest

The authors declare no conflict of interest.

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