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Research Article

Economic Burden of Unnecessary Magnetic Resonance Imaging of Knees in Elderly Patients with Advanced Osteoarthritis

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ABSTRACT

Purpose: Although proven unnecessary, MRIs continue to be used by primary care physicians (PCPs) for routine diagnostic purposes in symptomatic knee pain in the elderly with clear radiographic evidence of osteoarthritis. This study aims to show the financial burden these MRIs pose on the healthcare system.

Methods: A retrospective analysis of medical records and plain radiographs was performed on elderly patients (age ≥ 60 years) who were referred by their PCPs to our practice, with a chief complaint of knee pain. Demographic and clinical variables were gathered to elucidate any factors that might correlate with receiving MRIs. Radiographs were evaluated using the Kellgren-Lawrence (K-L) score. Calculated costs were based on low-end and high-end estimates of MRI cost for 2014.

Results: Overall, 767 patients who presented to our clinic met the inclusion criteria and were evaluated for this study. Two hundred twenty-five (29.3%) of the patients received plain radiographs from their PCPs without additional imaging. Seventy-seven (10%) of patients received MRIs for diagnostic purposes by their PCP. Demographic variables did not correlate with a patient receiving MRI ($p>0.05$). Patients who presented with unilateral knee pain were more likely to receive an MRI ($p=0.008$).

Conclusion: PCPs continue to underutilize plain radiographs and over utilize MRIs for diagnostic purposes in patients with clear evidence of osteoarthritis. If the rate of 19.25 unnecessary MRIs per orthopedic surgeon is projected to a national scale, the projected wasted finances are estimated to be between $349.2 million and $922.9 million.

Keywords: Osteoarthritis; MRI; Cost-effectiveness

Introduction

Osteoarthritis (OA) is one of the most prevalent conditions in the United States, affecting 52.5 million people (22% of the adult population), with knee osteoarthritis being the most common [1]. In the last couple of years, the prevalence of OA has risen rapidly and the trend is expected to continue as the overall population ages [2]. The associated cost to patients and the healthcare system is alarmingly high and has been rising. In 2007 alone, the out-of-pocket expense to patients for osteoarthritis in the United States was $36.1 billion. Including the cost to insurance carriers, the total expenditure of OA was $185.5 billion, which accounted for 8% of the overall healthcare expenditure [3,4]. Since OA makes up a significant portion of the overall national healthcare spending in the United States, which is the highest in the world in terms of percentage of the nation's gross domestic product (GDP) [5], and considering that the national healthcare expenditure is rising rapidly, physicians must play an active role in reducing the cost of care for OA.

One area that can potentially be evaluated for cost reduction is in the diagnosis of OA. In regards to knee pain, most patients tend to visit their primary care physician (PCP) before getting referred to an orthopedic physician. The current standard of care in primary care for diagnosing knee osteoarthritis, as outlined by American Academy of Orthopaedic Surgeons (AAOS), includes a thorough history and physical examination coupled with plain radiographs that includes bilateral anteroposterior weight-bearing, 45-degree flexion posteroanterior (Rosenberg view), lateral and patellofemoral (Merchant view). MRIs were deemed unnecessary unless other clinically significant pathology was suspected [6]. This standard of care was proven to be the most cost-effective method in diagnosing OA with degenerative meniscal tears compared to any other treatment plans, including the use of MRIs. [7].

Multiple studies have shown that there is a high incidence of meniscal tears in patients with severe osteoarthritis, proving that plain radiographs were sufficient for diagnosis and that MRIs were unnecessary in this population [8-10]. Additional studies have shown that the surgical treatment of meniscal tears in this subset of patients were of no benefit with both the Arthroscopy Association of North America (AANA) and AAOS recommending against arthroscopy in patients with primary diagnosis of symptomatic osteoarthritis of the knee [11]. Further cementing the fact that using an MRI to diagnose a possible

meniscal tear is unnecessary in this population. However, a study by Petron et al. showed that a significant number of PCPs continued to rely heavily on MRIs for evaluation and that very few had ordered weight bearing radiographs before the MRI if at all [12]. This practice pattern results in a significant amount of inefficiency and waste since MRI costs are far above those of standard plain knee radiographs.

The aim of this study is to determine the incidence of unnecessary MRIs ordered by PCPs in patients referred to our clinic with advanced osteoarthritis and to estimate the financial cost of these MRIs. With initiatives such as Choosing Wisely by the American Board of Internal Medicine (ABIM) placing emphasis on reducing financial waste on unnecessary medical tests, treatments, and procedures, it is important to highlight the financial significance of relying on these unnecessary MRIs to prevent further waste from occurring [13]. Since the use of MRIs for diagnostic purposes continues to be prevalent despite multiples studies that have previously demonstrated that their use is not justified [8-10], our study aims to extrapolate the financial burden these MRIs create on our national healthcare system.

Methods

A retrospective analysis of medical records and plain radiographs was performed on patients over the age of 60 who presented to our clinic with a complaint of knee pain between January 1, 2014 and December 31, 2014. The subject population included patients who were referred to our practice from their primary care physicians for an evaluation of knee pain. All patients were evaluated by one of four physicians at our clinic (two fellowship trained sports medicine orthopedic surgeons and two fellowship trained arthroplasty orthopedic surgeons). Inclusion criteria for the study include symptomatic knee pain and radiographic evidence of severe osteoarthritis of the knee. The severity of osteoarthritis in all patients was evaluated through radiographic evaluation in our office using the Kellgren-Lawrence (KL) classification. Severe osteoarthritis was defined as 2+ grade or higher on a radiographic evaluation of plain film [14]. Exclusion criteria for the study include workman's compensation, legal cases, second opinion visits, prior visit to the emergency department (ED), referral from physicians other than PCPs, and prior visit to an orthopedic surgeon within the past 12 months. Additionally, patients with incomplete medical records and/or unattainable plain radiographs for the visit were excluded from the study.

Charts were reviewed on all patients to determine if an MRI had been ordered by the referring PCP. Only MRIs performed within the last 6 months of the patient's visit to our clinic were included in our study. Institutional Review Board approval of this research was obtained. Demographic and diagnostic variables were compared between patients with and without MRI using the chi-square test of association. A multiple logistic regression was used to determine if any correlation existed between any of the variables and a patient receiving MRI.

Despite exhaustive measures, the exact costs for the MRIs for our patients could not be obtained. Therefore, low-end and high-end estimates for the cost of MRIs for the 2014 fiscal year were used (CPT 73721). The total costs of the MRIs accrued were split per physician at our clinic to determine a range of spending on unnecessary MRIs per orthopedic surgeon. The financial burden on the national healthcare system was then estimated by multiplying this range by the number of practicing orthopedic surgeons that evaluate the knee in the United States.

Results

We identified a total of 1268 patients over the age of 60 that presented to our clinic from January 1, 2014 to December 31, 2014 with a chief complaint of knee pain. Of these, 28 patients were excluded due to incomplete patient charts and/or plain radiographs. Additional 134 patients were excluded due to presentation of non-severe osteoarthritis (KL<2) as evidenced by their plain radiograph. Finally, a further 339 patients were excluded due to referral from a physician other than a PCP, recent evaluation in the emergency department, or prior evaluation by another orthopedic surgeon. In total, 767 patients were included in the study.

The average age of the patients was 70.6 years old, ranging from 60 to 97 years old. Average BMI was 30.8 kg/m^2 with 1.2% of the patients (n=9) being morbidly obese (BMI>40). Only 30% of the patients were male (n=207) while 70% of the patients were female (n=483). Majority of the patients carried Medicare as either their primary or secondary insurance plan (n=507) and classified themselves as retired (n=457). Most did not have a prior history of surgery (n=619) nor injury to the affected knee (n=671). Regarding the location of their knee pain, 32.1% of the patient reported the pain being on the left knee (n=246) and 34.8% reported the pain being on the right knee pain (n=267) while 33.1% of the patients reported pain being on both knees (n=254).

With regards to the evaluation of the patient's plain radiographs, 52% of the patients (n=396) received a grade of 4 on the K-L scale for at least one of their affected knees. The treatment plan resulted in 95.3% of the patients receiving conservative treatment (n=731) with 63.8% of the patients (n=490) receiving either oral anti-inflammatories or corticosteroid injection. The remaining 4.7% of the patients (n=36) scheduled total knee replacement after their evaluation at the clinic (Table 1). With regards to MRIs ordered by PCPs prior to presentation to our clinic, only one patient had an MRI that was considered helpful in managing patient care. Overall, 10% of the patients (n=77) came in with an MRI prior to the visit while 90% of the patients (n=690) did not. In patients that did not receive an MRI, 29.3% of the patients (n=225) received x-rays before their referral while 58.9% of the patients (n=452) did not receive any type of imaging (Table 2).

A logistic regression was performed to elucidate factors that might correlate with a patient receiving MRI for diagnostic purposes. No correlation existed between patients receiving MRI and their age (p=0.35), gender (p=0.71), BMI (p=0.78), occupation (p=0.15), history of surgery (p=0.77), history of injury (p=0.42), or extent of osteoarthritis as determined by KL score (p=0.62). However, patients with unilateral knee pain

Table 1: Logistic regression of variables measuring correlation with receiving MRI imaging.

	No MRI (n=690)	MRI (n=77)	p-value
Age, years*	70.7 ± 7.7	69.8 ± 7.8	0.35
Gender			
Male	254 (36.8%)	30 (39%)	0.71
Female	436 (63.2%)	47 (61%)	
BMI, kg/m²*	30.8 ± 5.8	30.6 ± 5.8	0.78
Insurance			
Medicare	455 (65.9%)	51 (66.2%)	0.96
Other	235 (34.1%)	26 (33.8%)	
Occupation			
Retired	417 (60.4%)	40 (51.9%)	0.15
Other	273 (39.6%)	37 (48.1%)	
Location			
Left	212 (30.7%)	34 (44.2%)	0.008
Right	239 (34.6%)	28 (36.4%)	
Both	239 (34.6%)	15 (19.4%)	
Previous Surgery	135 (19.6%)	14 (18.2%)	0.77
Previous Injury	85 (12.3%)	12 (15.6%)	0.42
KL score			
2	160 (23.2%)	10 (13%)	0.62
3	164 (23.8%)	37 (48%)	
4	366 (53%)	30 (39%)	
Treatment			
Anti-inflammatory			
Corticosteroid injection	72 (10.4%)	10 (13%)	
Total Knee	366 (53%)	42 (54.5%)	0.68
Arthroplasty	30 (4.3%)	6 (7.8%)	
Other	222 (32.2%)	19 (24.7%)	
*** Mean ± SD**			

Table 2: Type of imaging received for diagnostic purposes.

Imaging	Number of patients
None	452 (58.9%)
X-ray only	225 (29.3%)
MRI only	24 (3.1%)
X-ray+MRI	53 (6.9%)

were more likely to receive MRIs than patients with bilateral knee pain (p=0.008) (Table 1).

Since the exact cost of MRIs was unable to be determined, low-end and high-end estimates for the cost were used. The estimated cost of an MRI was found to be between $1400 to $3700. In our study, 77 patients among 4 orthopedic surgeons were found to have received inappropriate diagnostic MRIs, which results in a rate of 19.25 MRIs performed by PCPs per orthopedic surgeon per year. Overall, the aggregate projected cost of these MRIs for our clinic is estimated to be between $26,950 and $71,225 per orthopedic surgeon.

To estimate the number of practicing orthopedic surgeons in the United States that treat patients with knee pain, the 2014 AAOS Census of Orthopedic Surgeons was used. According to the census, 46.2% of the orthopedic surgeons that contributed to the census reported a primary specialty area that treated knee joints which includes sports medicine, general practice, total joint and adult knee [15]. When projected to the total number of orthopedic surgeons in the United States, that accounts for 12,958 orthopedic surgeons that regularly see patients with knee pain. Using the rate of unnecessary MRIs performed, the number of practicing orthopedic surgeons in the United States, and the estimated range of cost of the MRIs, the aggregated total cost spent on these MRIs in 2014 is estimated to be between $349.2 million and $922.9 million in the United States.

Discussion

In the setting of significant OA, MRIs have been shown to be unnecessary for diagnosis [6-10]. Our study confirmed that MRIs are still being performed for diagnostic purposes by PCPs on a consistent basis and plain radiographs are not being utilized enough. Only 29.3% of the patients received the recommended plain radiograph without other imaging tests. Of the patients that received MRIs, 39% of the patients had plain radiographs with severe OA (KL grade of 4), suggesting minimal reliance and utilization of plain radiographs by PCPs in patients with knee pain.

The similarity in the patient population receiving MRIs versus patients that did not receive MRIs suggest that demographic variables did not play a role in the physician opting to utilize the MRI (p>0.05). One factor that seemed to increase the likelihood of a physician ordering an MRI was presentation with unilateral knee pain versus bilateral knee pain (p=0.008). This may be due to physicians being overly concerned about specific anatomic pathology, such as meniscal pathology, rather than understanding the overall degenerative state of the knee.

Although the incidence of these MRI occurrences may seem low, the magnitude of patients affected by OA of the knee in the US compounds this waste resulting in a projected aggregate cost of $349.2 million to $922.9 million. Of those 77 MRIs ordered, only one was found to impact patient care and, if needed, could have been ordered by the orthopedic surgeon once the patient arrived in our office. The cost outweighs the benefit of PCPs ordering the imaging for diagnostic purposes in this patient population. If the patient population were expanded to include referrals from physicians other than PCPs, the projected aggregate cost could be even higher.

Since the majority of the patients who received the MRIs in our study were insured by federal insurance, the wasted financial resource of these MRIs has a significant impact on the state of Medicare itself. With the prevalence of osteoarthritis expected to increase every year, reducing the number of these unnecessary MRIs could help curb the current trend of increased expenditure for Medicare significantly.

Several limitations exist within our study. First, all of our financial calculations were determined using an estimate cost of the MRIs instead of the exact cost. Despite our efforts, the data remained unavailable as the contract between insurance companies and the respective healthcare providers was deemed confidential. However, we believe that by estimating the high

end and the low end of the cost, we have provided insight to the scope of the problem. This lack of transparency in healthcare costs is particularly concerning as we move forward to a more cost conscious healthcare system.

Second, the demographics of the patient population in our community, the practice patterns of PCPs in our area, type and volume of patients seen by our physicians, and costs of MRIs throughout the county may not accurately reflect the demographics nationwide [16]. In addition, Medicaid patients were likely underrepresented in our study. This may slightly inflate our findings since Medicaid patients in general are less likely to receive advance imaging such as MRIs [17,18]. These factors may limit the generalizability of the study and make our estimates less reliable.

Finally, the study was retrospective in nature and the data was limited to written records. Since 2.2% of the patients were excluded because incomplete medical records, there may be data that would change the results. Since only medical records from the orthopedic clinic were used, factors that led to the ordering of MRIs by the PCPs cannot be elucidated. Despite these limitations, we feel the results are sufficient in providing an estimate for the severity of the problem we intended to investigate.

Conclusion

In conclusion, our study shows the heavy financial burden that the inappropriate use of MRIs for diagnostic purposes in the setting of significant OA of the knee impose on our healthcare system. Further work should be done to make the financial impact of healthcare more transparent so that patients, healthcare providers, and researchers can better understand the costs associated with diagnosis and treatment. Education on effective utilization of MRIs for diagnostic purposes should be stressed to improve efficiency and minimize waste. Additional study of the financial impact of diagnostic testing in other medical conditions is warranted.

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