

INTRODUCTION

Low back pain is the second most common symptomatic reason for physician office visits, and the associated health care costs are rapidly rising. One reason for this increase is the inappropriate use of advanced imaging, particularly magnetic resonance imaging (MRI), for uncomplicated non-specific low back pain. Routine use of MRIs in low back pain cases is common, with 16 to 21% of low back pain patients in commercial health care plans and 12% of Medicare patients receiving an MRI. Clinical guidelines recommend that new episodes of non-specific low back pain not complicated by red flag conditions should be treated with conservative therapy and that MRI is not indicated in the first 6 weeks of onset. However, studies have found that 26 to 44% of spine MRIs are not guideline-concordant.

There is growing evidence that the consequences of inappropriate imaging for uncomplicated non-specific low back pain extend beyond the direct costs of an MRI. Potential downstream consequences include subsequent referrals and interventions performed as a result of imaging. Rates of lumbar spine procedures, including surgery, epidural steroid injections, and facet joint injections, are also increasing and are part of the higher costs associated with inappropriate imaging. There is no evidence that these additional procedures lead to better outcomes, and they may even result in more harm than benefit. The downstream effects of early MRI of the lumbar spine on procedures and opioid use remain underexplored in the literature.

METHODS

We conducted a retrospective cohort study of new episodes of uncomplicated non-specific low back pain. We used data from the U.S. Department of Veterans Affairs (VA) Corporate Data Warehouse, a national repository of extracts of electronic health records.

Cohort

Individuals were eligible for inclusion if they had a visit for uncomplicated low back pain in a VA primary care clinic between June 1, 2015, and June 30, 2016. Uncomplicated low back pain visits were characterized with a diagnosis of non-specific pain of the lower back: lumbar sprain, strain, spondylosis, or disk degeneration.

Visits were excluded if there was a “red flag” condition, as defined by the Medicare performance measure for appropriateness of lumbar spine MRI (LS-MRI), present in VA hospital and outpatient data. These conditions included trauma in the prior 45 days; lumbar spine surgery in the past 90 days; cancer, neurologic impairment, infections, or injection drug use in the past year; or autoimmune, inflammatory, conditions, neoplastic abnormalities, radiation therapy, or congenital malformation in the last 5 years.

Early MRI Scan

Scans were identified using Current Procedure Terminology codes for LS-MRI (72148, 72158). Scans provided within 6 weeks of the index visit were deemed “early,” which is consistent with guidelines for treatment of low back pain.

Outcome Measures

Time Horizon

Outcomes were measured from 43 to 365 days post-index visit, and costs were also measured for the first 42 days. We excluded the 42-day post-index visit, as this was the time period used to assess whether an individual received an early MRI scan.

Probability of Lumbar Surgery

Lumbar-related spinal surgeries included surgical procedures conducted on the lumbar, lumbosacral, and thoracolumbar regions in an inpatient or outpatient setting. Surgeries provided in the hospital were identified with procedure codes. Surgeries provided in outpatient settings were identified using CPT codes when the encounter included a diagnosis code for low back pain.

Opioid Use

Opioid prescriptions were defined as long-acting opioids, short-acting opioids, and tramadol, with doses converted to morphine equivalents using Centers for Disease Control conversion factors.

Statistical Analyses

Baseline characteristics of patients with early MRI were compared with those of patients without early MRI by calculating the standardized difference of the means using pooled variance.

The association between early MRI and each outcome was determined by multivariable regressions controlling for baseline covariates: demographics (age and sex); primary care provider characteristics (whether the patient was assigned to a provider, whether the assigned provider was seen on the index visit, provider’s panel size, and type of clinic visited at the index visit); case-mix (pain score at the index visit, history of opioid use in the prior year, time between the index visit and the last low back pain visit, and total VA costs in the prior year); and indicators for chronic conditions, mental health diagnoses, and pain conditions. Poisson regressions were used to estimate relative risks.

RESULTS

There were 1.17 million VA primary care visits for non-specific low back pain in the year ending June 30, 2016. Applying our exclusion criteria resulted in a cohort of 442,284 observations. Another 22,465 persons were excluded because of missing pain and clinic information from their index visit. This left 405,965 observations for study.

There were 9977 individuals (2.46%) who received a LS-MRI within 6 weeks of their index visit. Table 1 compares patients with non-specific low back pain who received an early scan with those who did not and summarizes the standardized difference in the means for each variable of interest. Patients with an early scan were younger, were less likely to have an assigned primary care provider, were less likely to have seen their assigned primary care provider, had higher baseline pain, were less likely to have had a back pain episode in the previous 24 months, had fewer chronic conditions, and were less likely to have a diagnosis of hypertension or ischemic heart disease in the prior year.

Table 2 summarizes unadjusted means and proportions of the outcome variables during the follow-up period. Compared with patients who did not receive an early scan, patients with an early MRI had more lumbar surgery (1.49% vs. 0.09%) and were more likely to receive a prescription for opioids (36.7% vs. 28.5%).

Table 3 presents analyses with adjustment for baseline covariates. Covariate adjustment resulted in a small attenuation of the estimated association between early scans and outcomes. Using the Poisson model, receipt of an early scan was associated with a higher risk of lumbar surgery (adjusted relative risk 12.7 [95% CI 10.3–15.5]). Early MRI was also associated with a greater likelihood of receiving a prescription for opioids (adjusted relative risk 1.23 [95% CI 1.20–1.27]).

DISCUSSION

This study found that an MRI of the lumbar spine provided early in episodes of non-specific low back pain was associated with more surgery and greater prescription opioid use. Lumbar surgery was 13 times more likely in the group with early MRI compared with that in those without an early scan (1.48% vs. 0.09%). This is consistent with other observational studies, where surgery was 5 to 20 times more likely among those receiving an early MRI. Absolute rates of surgery in this study were much lower than in these other studies, however. In those studies, lumbar surgery was provided in 14–22% of those with an early scan and in 1–3% without an early scan. These studies had approximately 10 times that rate of lumbar surgery that we observed in VA.

The finding that early MRI was associated with greater use of opioids over the follow-up period appears to be a unique contribution of this study—one that is especially important given concerns over hazards resulting from over-prescription of opioids for pain. We found only one clinical trial that considered this outcome, and it found no significant association between early MRI and prescription opioid use. Other studies did not consider this outcome.

Early MRI was provided to 2.46% of this cohort. This is a lower rate than in other studies. It may also be lower than expected because VA providers are salaried and not affected by financial incentives present in fee-for-service settings. Self-referral drives some of the high use of LS-MRI in patients sponsored by Medicare, although Federal statutes on self-referral may have reduced this practice. In addition, it is possible that VA providers are less likely to

practice “defensive medicine,” as malpractice liability in the VA system is the responsibility of the Federal government.

This study used electronic health records to assemble the largest cohort used to estimate the downstream consequences of early MRI. The size of this cohort ($N = 405,965$) was more than 10 times the size of other observational studies and more than 400 times the size of clinical trials that addressed this issue. While large cohort studies have the advantage of gathering evidence from generalized, real-world experience, they must address the problem of selection bias: patients were not randomized to receive an early scan.

We rely on the untestable assumption that observable characteristics explained the exposure of interest. As such, we cannot be certain that downstream surgeries and opioid use directly resulted from early MRIs. Our measures of the potential benefit of early MRI were limited.

This study confirms that early LS-MRI is associated with increased surgery. It expands upon prior studies by finding that early MRI is associated with greater use of prescription opioids. An MRI provided early in episodes of uncomplicated non-specific low back pain not only is, therefore, an unnecessary expense, but also is associated with the potential harms of prescription opioids: their side effects, risk of abuse, and potential for overdose.

Table 1

Patient characteristic	With early MRI ($N = 9,977$)	Without early MRI ($N = 395,718$)	Standardized difference in means
Patient age (mean, in years)	52.2	56.5	– 0.277
< 40 years (%)	24.9	18.4	0.159
40–50 years (%)	19	15.3	0.098
51–60 years (%)	21.2	20.4	0.019
61–70 years (%)	25.7	29.4	– 0.084
71+ years (%)	9.2	16.4	– 0.218
Female gender (%)	7.1	5.5	0.066
Travel distance to nearest VA clinic (miles)	16.5	16.2	0.018
Travel distance to nearest VA tertiary hospital (miles)	101.5	99.3	0.023
Travel distance to nearest VA tertiary hospital > 40 miles (%)	70.5	71.6	– 0.025
Patient had an assigned primary care provider (%)	90.3	93.3	– 0.110
Patient saw assigned primary care provider (%)	80.2	84.8	– 0.120
Index visit at satellite clinic	52.5	58.7	– 0.125
Baseline pain score (numeric)			

Baseline pain score 0 (%)	12.7	31.8	- 0.472
Baseline pain score 1 (%)	1.8	2.4	- 0.041
Baseline pain score 2 (%)	3.6	4.5	- 0.046
Baseline pain score 3 (%)	8.5	8.5	0
Baseline pain score 4 (%)	9.8	8.8	0.035
Baseline pain score 5 (%)	12.3	10.8	0.049
Baseline pain score 6 (%)	12.8	9.9	0.091
Baseline pain score 7 (%)	13.7	9.8	0.121
Baseline pain score 8 (%)	13.9	8.6	0.167
Baseline pain score 9 (%)	5.6	2.7	0.142
Baseline pain score 10 (%)	5.4	2.3	0.165
Back pain visit in prior 6–12 months (%)	37.6	39.4	- 0.037
Back pain visit in prior 12–24 months (%)	23.4	26.7	- 0.076
No visit for back pain in last 24 months (%)	39	33.9	0.106
Total cost in the year prior to the index visit (mean \$US)	4482	3802	0.084
History of any opioid prescription in prior year (%)	19.7	20	- 0.006
Number of chronic health conditions in prior year (mean)	1.51	1.73	- 0.153
Mental health diagnosis in prior year (%)	42.2	39	0.067
Diagnosis of painful condition in prior year (%)	66.5	63.4	0.066

Table 2

Outcome	With early MRI (N = 9977)	Without early MRI (N = 395,718)	<i>p</i>
Lumbar surgery (%)	1.49	0.09	< 0.001
Prescription opioid use (%)	36.7	28.5	< 0.001

Table 3

Outcome	Adjusted mean		<i>p</i>	Relative risk [95% CI]
	With early MRI (<i>N</i> = 9977)	Without early MRI (<i>N</i> = 395,718)		
Lumbar surgery (%)	1.48	0.12	< 0.001	12.7 [10.3–15.5]
Prescription opioid use (%)	35.1	28.6	< 0.001	1.23 [1.20–1.27]