Effect of increased MRI and CT scan utilization on clinical decision-making in patients referred to a surgical clinic for back pain

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Background: We sought to determine the association between radiologic and clinical diagnoses and to measure the impact of more magnetic resonance imaging (MRI) and computed tomography (CT) scans on clinical decision-making in patients referred to a surgical clinic for back pain.

Methods: We conducted a 7-week prospective study of patients referred for back pain to spine surgeons in 1 health care centre. Patients were included if they had not previously been seen by a surgeon for their back problems and if their back pain was related to the thoracic or lumbar spine. We collected demographic data, imaging findings, clinical diagnoses as determined by the surgeons and visit outcomes and compared our results with those of a similar study conducted in 1996.

Results: Of 160 patients, 8 (5%) were no-shows and excluded from further analysis owing to incomplete data. There were more MRI scans and fewer plain radiographs ordered in 2009 compared with 1996 (73% v. 11% and 39% v. 68%, respectively). Degenerative disc disease was a more common radiologic diagnosis (n = 78, 63%) than clinical diagnosis (n = 41, 27%). Disc herniation was a more common radiologic diagnosis (n = 69, 56%) than clinical diagnosis (n = 25, 16%). With regards to visit outcomes, there were fewer second opinions sought in 2009 compared with 1996 (3% v. 11%). Although not statistically significant, the number of surgical candidates remained relatively stable (19% in 1996 v. 16% in 2009, p = 0.44).

Conclusion: The clinical diagnosis had a poor association with radiologic abnormalities. Despite an increase in the number of MRI and CT scans, the number of patients deemed surgical candidates has not changed.

Contexte : Nous avons cherché à déterminer le lien entre les diagnostics radiologiques et cliniques et à mesurer l'effet d'un plus grand nombre d'imageries par résonance magnétique (IRM) et de tomodensitométries (TDM) sur la prise de décisions cliniques au sujet de patients référés à une clinique chirurgicale à cause de douleurs au dos.

Méthodes : Nous avons procédé à une étude prospective d'une durée de 7 semaines portant sur des patients référés à cause d'une douleur au dos à des chirurgiens de la colonne dans 1 centre de soins de santé. Les patients ont été inclus s'ils n'avaient pas été vus auparavant par le chirurgien pour leurs problèmes de dos et si leur douleur au dos était reliée à la colonne thoracique ou lombaire. Nous avons réuni des données démographiques, des données sur les résultats d'imagerie, des diagnostics cliniques établis par les chirurgiens et des résultats de consultations, et nous avons comparé nos résultats à ceux d'une étude semblable réalisée en 1996.

Résultats : Sur 160 patients, 8 (5 %) ne se sont pas présentés et ont été exclus de l'analyse à cause de données incomplètes. Il y a eu plus d'examens d'IRM et moins de radiographies ordinaires prescrits en 2009 qu'en 1996 (73 % c. 11 % et 39 % c. 68 % respectivement). La discopathie dégénérative a constitué un diagnostic radiologique plus fréquent (n = 78, 63 %) que le diagnostic clinique (n = 41, 27 %). La hernie discale a constitué aussi un diagnostic radiologique plus fréquent (n = 69, 56 %) que le diagnostic clinique (n = 25, 16 %). En ce qui a trait aux résultats des consultations, on a demandé un deuxième avis moins souvent en 2009 qu'en 1996 (3 % c. 11 %). Même si ce n'est pas statistiquement significatif, le nombre de candidats à l'intervention chirurgicale est demeuré relativement stable (19 % en 1996 c. 16 % en 2009, p = 0,44).

Conclusion : Il y avait un lien faible entre le diagnostic clinique et les anomalies radiologiques. Même si le nombre d'examens par IRM et TDM a augmenté, celui des patients considérés comme candidats à une intervention chirurgicale n'a pas changé.

Low-back pain is the second most common chronic condition in Canada,[1] with over two-thirds of all adults experiencing back pain at some point in their lives.[2] It is consistently one of the leading reasons for primary care physician visits.[2–4] Furthermore, low-back pain is a important cause of work-related disability in terms of workers' compensation, medical expenses and work absences.[2,5]

Magnetic resonance imaging (MRI) and computed tomography (CT) scans are often ordered to help in the assessment of low-back pain.[6–9] You and colleagues[10] reported that over 90% of the MRI scans of the spine for back pain that they studied were abnormal, but the clinical significance of the abnormalities was unclear. Since Ontario's Wait Time Strategy was launched in November 2004, the provincial government has invested in more MRI and CT scanners, with about $118 million in capital and operational funding in place for MRI services through March 2008.[11] It is important to assess how these scanners have been used, with skeptics worrying that more scans will be performed for indications that are already low-yield.[10]

In 1996, the visit outcomes of patients referred for surgical consultation for back pain at our centre were reported.[12] The current investigation involved repeating the previous study and comparing results with respect to the number of MRI and CT scans accompanying the patients to the consultation visit and the outcome of the visit. The purpose of this study was to determine the association between the radiologic and clinical diagnoses as well as the impact of more MRI and CT scans on clinical decision-making in patients referred to a surgical clinic for low-back pain.

Methods

As a quality assurance assessment, this prospective study was conducted between Apr. 29 and June 17, 2009. The study was multidisciplinary, involving 3 neurosurgeons and 1 orthopedic surgeon, all based in 1 health science centre that provides secondary and tertiary care to the region (Kingston, Ont.). Patients were included if they had not previously been seen by a surgeon for their back problems and if their back pain was related to the thoracic or lumbar spine. Patients with conditions, such as fractures or progressive neurologic deficits, that required immediate assessment were seen in the emergency department and were excluded from the study.

Data collected included patient demographics, imaging findings, diagnoses and visit outcomes. Only imaging studies related to the thoracic or lumbar spine were considered. Radiologic findings were taken from the radiology report. The surgeon determined the diagnosis and visit outcome, whereas a researcher completed the data sheet at the time of the clinic visit. Clinic visit outcomes were divided into the following categories of patients:

- those with chronic pain not amenable to surgery,
- surgical candidates who were offered an operation,
- those who symptomatically improved to the point of not wanting an operation,
- those who wanted a second opinion only,
- those with mechanical back pain appropriate for referral for physiotherapy,
- those who had an inadequate trial of nonoperative treatment when seen in the clinic and were given a follow-up appointment,
- those who did not show up for the appointment,
- those who wanted a medico-legal assessment,
- those who wanted confirmation from a specialist that surgery was not required, and
- those who sought the cause for symptoms related to a body system other than the spine.

We determined the baseline characteristics of participants and descriptive statistics for all variables, including frequencies, means, standard deviations (SDs) and ranges. Differences in proportions between 1996 and 2009, and between radiologic and clinical diagnoses, were assessed using the Pearson χ^2 test. The Fisher exact test was used when there was an expected cell count less than 5. We considered results to be significant at $p < 0.05$, 2-tailed.

Results

Over our 7-week study period, 160 patients presented with back problems, compared with 142 who presented from Apr. 14 to May 30, 1996. Patients were excluded if they were assessed for orthopedic or neurosurgical problems unrelated to the thoracic or lumbar spine. Patients who were no-shows were excluded from further analysis owing to incomplete data.

All patients referred for consultation were seen by a spine surgeon. Most patients were referred by family physicians (n = 130, 83%). One clinic required imaging, whereas the others did not in both 1996 and 2009. In 1996, 16 (11%) patients were seen in this clinic; in 2009, 23 (15%) were seen. Based on their referral letters, the spine surgeon triaged patients to a time for their surgical clinic visit. There was no standardized referral letter or triage process. The mean wait time was 12.58 (SD 11.74) weeks.

Table 1. Investigations ordered before a surgical clinic visit in patients referred for back pain

	Year; no. (%)		
Investigation	1996	2009	p value*
MRI	15 (11)	111 (73)	< 0.001
CT	50 (37)	62 (41)	0.52
Radiograph	92 (68)	60 (39)	< 0.001
Bone scan	9 (7)	6 (4)	0.43
Nerve conduction study	3 (2)	5 (3)	0.73
Myelogram	5 (4)	1 (1)	0.11
None	8 (6)	1 (1)	0.014

CT = computed tomography; MRI = magnetic resonance imaging.
*Based on the Pearson χ^2 or Fisher exact test, as appropriate.

Of the 160 patients, 8 were no-shows, leaving 152 patients with a mean age of 53.83 (SD 16.45) years for inclusion in our analysis. Seventy-nine (52%) were women, and 73 (48%) were men. Eighteen (11%) patients were pursuing workers' compensation, and all but 2 patients had undergone imaging before the surgical clinic visit (n = 150, 99%). These baseline characteristics are similar to those in other epidemiologic studies on back pain.[2–4]

Table 2. Magnetic resonance imaging and computed tomography scans conducted in patients referred to a surgery clinic for back pain in 2009

Imaging study	No. (%)
Only MRI	80 (53)
Only CT	31 (20)
Both MRI and CT	31 (20)
Either/both MRI and CT	142 (93)
MRI	
1	99 (65)
2	11 (7)
3	1 (1)
CT	
1	58 (38)
2	4 (3)

CT = computed tomography; MRI = magnetic resonance imaging.

The most common investigation ordered before our clinic visit was MRI (n = 111, 73%), followed by CT (n = 62, 41%), then plain radiographs (n = 60, 39%; Table 1). Twelve patients had more than 1 MRI (8%), and 31 patients had both an MRI and a CT scan (20%; Table 2). In contrast, in 1996, plain radiographs were most common (n = 92, 68%; $p < 0.001$), followed by CT (n = 50, 37%; $p = 0.515$), then MRI (n = 15, 11%; $p < 0.001$). As well, there were fewer patients who presented without having undergone imaging before their surgical clinic visit in 2009 (n = 1, 1%) compared with 1996 (n = 8, 6%; $p = 0.014$).

In our study, the most common radiologic diagnosis was degenerative disc disease (n = 78, 63%); however, it was diagnosed clinically as arthritic back pain in 41 patients (27%, $p < 0.001$). Disc herniation was a more common radiologic diagnosis than the clinical diagnosis of radiculopathy ($p < 0.001$; Table 3).

The visit outcomes are shown in Table 4. There were fewer second opinions sought in 2009 (n = 5, 3%) than in 1996 (n = 16, 11%; $p = 0.005$). Otherwise, there were no significant differences in visit outcomes, including the number of patients deemed to be surgical candidates (2009: n = 25, 16% v. 1996: n = 27, 19%; $p = 0.44$).

Table 3. Radiologic and clinical diagnoses of patients referred to a surgical clinic for back pain*

Diagnosis; no. (%)				
Radiologic		Clinical		p value†
Spinal stenosis	31 (25)	Neurogenic claudication	27 (18)	0.16
Disc herniation	69 (56)	Radiculopathy	25 (16)	< 0.001
Degenerative disc disease	78 (63)	Arthritic back pain	41 (27)	< 0.001
Facet joint degeneration	21 (17)	Chronic pain syndrome	33 (22)	NA
Spondylolisthesis	11 (9)	Mechanical back pain	11 (7)	NA
Annular tear	3 (2)	Other	23 (15)	NA
Normal	3 (2)			NA

NA = not applicable.
*Diagnoses were not mutually exclusive.
†Based on the Pearson χ^2 test.

Table 4. Outcomes of surgical clinic visits of patients referred for back pain

Outcome	Year, no. (%)		p value*
	1996	2009	
Chronic pain not amenable to surgery	36 (25)	54 (34)	0.11
Surgical candidates offered an operation	27 (19)	25 (16)	0.44
Symptomatically improved to the point of not wanting an operation	19 (13)	16 (10)	0.36
Second opinion only	16 (11)	5 (3)	0.005
Mechanical back pain appropriate for referral to physiotherapy	14 (10)	14 (9)	0.74
Inadequate trial of nonoperative treatment when seen in clinic, given a follow-up appointment	12 (9)	13 (8)	0.92
No-show	7 (5)	8 (5)	0.98
Medico-legal assessment	5 (4)	5 (3)	0.85
Confirmation from a specialist that surgery was not required	5 (4)	13 (8)	0.09
Seeking the cause for symptoms related to a body system other than the spine	1 (1)	7 (4)	0.07

*Based on the Pearson χ^2 or Fisher exact test, as appropriate.

Discussion

Clinical guidelines recommend that in the absence of historical or clinical features suggestive of a serious underlying condition, such as a tumour, infection or cauda equina syndrome, early imaging for low-back pain does not improve clinical outcomes.[6–9] This study illustrates that increasing the number of MRI and CT scans did not affect the number of patients offered surgery. We did not collect data to determine whether MRI and/or CT studies help the referring physicians screen out patients who do not need to see a surgeon. However, we suspect that scans are not solely used in this way because 3 of the 152 referred patients (2%) whom we saw had a scan that was reported as being normal. Furthermore, of the 184 MRI and CT scans accompanied by a referral letter, 23 were obtained after the referral letter (12.5%). This indicates that these imaging results were not used in the decision to refer the patient to a spine surgeon.

You and colleagues[10] determined that 90.1% of their MRIs of the spine had abnormal findings. Similarly, we found that only a few MRIs in our study were reported as being normal (n = 3, 2%). The most common MRI abnormalities were degenerative disc disease (n = 78, 63%), followed by herniated or bulging disc (n = 69, 56%), spinal stenosis (n = 31, 25%) and intervertebral foraminal stenosis (n = 27, 22%). In contrast, the most common clinical diagnoses were arthritic back pain (n = 41, 27%; $p < 0.001$), followed by chronic pain syndrome (n = 33, 22%), neurogenic claudication (n = 27, 18%; $p = 0.158$) and radiculopathy (n = 25, 16%; $p < 0.001$; Table 3). Therefore, we did not find a strong association between clinical diagnoses and specific radiologic abnormalities.

The direct and indirect costs of imaging resources not used efficaciously are considerable. Not only is there a lack of clinical benefit[7] and detrimental effects of radiation exposure from CT scans,[13] but there are also substantial associated costs to the health care system. With a national median wait for MRI and CT scans of 9.7 and 4.9 weeks, respectively,[14] imaging that does not influence clinical management delays MRI and CT scans for other patients. Furthermore, a diagnosis on the basis of imaging studies alone can become a psychologic burden for patients, unnecessarily emphasizing the importance of nonspecific findings and convincing patients that they have a disease and require further investigations and/or treatment.[15]

There are several reasons for the increase in MRI and CT scans. In addition to increased availability of the technologies, there are many reasons for ordering a scan, including diagnosis, reassurance for patients, determining the extent of disease and monitoring the progression of disease.[16] However, Laupacis and Evans[16] argue that the increasing power of new technologies has led to an inappropriate de-emphasis on clinical skills and a greater dependence on sophisticated tests. Ordering imaging can often mistakenly be construed by the physician and/or patient to be part of a complete work-up.

Limitations

This study has several limitations. First, while this study was prospective in nature and multidisciplinary, involving neurosurgery and orthopedic surgery, patients seen at a private orthopedic clinic were not included in the study. Second, one clinic required imaging before consultation. In 1996, 16 of the 142 (11%) patients were seen in this clinic, while in 2009, it was 23 of 152 (15%) patients. The 4% increase in the proportion of patients seen in this clinic may have contributed to the increase in MRI and CT scans, but cannot entirely account for it. It should be noted that the requirement of scans at this clinic may have caused referring physicians to believe that scans would be necessary elsewhere as well. Finally, conclusions concerning scans and outcome of consultation apply only to the spine surgeons. Treatment by family physicians and other types of specialists may have been more influenced by having more scans. Patient symptoms often fluctuate over time, and whereas the study demonstrates that the increase in MRI and CT scans does not help select surgical candidates, the determination of the appropriateness of the imaging was based on an initial specialist review and not on the clinical picture articulated by the physician who requested the radiologic investigation.

Conclusion

In summary, there was a poor association between radiologic and clinical diagnoses of patients referred to a surgical clinic for low-back pain. Despite the increase in MRI (from 11% to 73%) and CT (from 37% to 41%) scans, the number of patients deemed surgical candidates did not change from 1996 to 2009. We believe that requiring an MRI and CT scan as a prerequisite to being seen at a surgical clinic is not an effective use of resources. The referring physician needs to consider the clinical diagnosis in deciding who should be sent to a surgical clinic. To justify allocation of more resources to MRI and CT scanning to meet the government's wait time strategy, further study to determine the ordering physicians' purpose in asking for the imaging and whether the results helped them treat their patients is necessary.

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