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Clinical Study

Value of repeat CT scans in low back pain and radiculopathy

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ABSTRACT

We assessed the clinical value of repeat spine CT scan in 108 patients aged 18–60 years who underwent repeat lumbar spine CT scan for low back pain or radiculopathy from January 2008 to December 2010. Patients with a neoplasm or symptoms suggesting underlying disease were excluded from the study. Clinical data was retrospectively reviewed. Index examinations and repeat CT scan performed at a mean of 24.3 ± 11.3 months later were compared by a senior musculoskeletal radiologist. Disc abnormalities (herniation, sequestration, bulge), spinal stenosis, disc space narrowing, and bony changes (osteophytes, fractures, other changes) were documented. Indications for CT scan were low back pain (60 patients, 55%), radiculopathy (46 patients, 43%), or nonspecific back pain (two patients, 2%). A total of 292 spine pathologies were identified in 98 patients (90.7%); in 10 patients (9.3%) no spine pathology was seen on index or repeat CT scan. At repeat CT scan, 269/292 pathologies were unchanged (92.1%); 10/292 improved (3.4%), 8/292 worsened (2.8%, disc herniation or spinal stenosis), and five new pathologies were identified. No substantial therapeutic change was required in patients with worsened or new pathology. Added diagnostic value from repeat CT scan performed within 2–3 years was rare in patients suffering chronic or recurrent low back pain or radiculopathy, suggesting that repeat CT scan should be considered only in patients with progressive neurologic deficits, new neurologic complaints, or signs implying serious underlying conditions.

1. Introduction

Low back pain and radicular pain are among the most common complaints of patients seeking medical care [1]. Second only to the common cold as the cause of lost work days, back pain presents a tremendous economic burden, estimated at over 100 billion dollars annually in the USA alone [2]. Although clinicians may be inclined to image the spine quickly in patients presenting with significant discomfort, most back-related pain subsides within several weeks.

CT scans are performed with increasing frequency. Nearly 75 million CT studies have been performed annually in the last decade [3], and CT scanning is thus responsible for nearly 50% of total patient radiation exposure [4]. Authors of several large studies have estimated that radiation exposure from CT scans may lead to a number of cancers [3,5].

Approximately 4% of CT examinations performed are of the lumbar spine, with an estimated risk of cancer for each 1 in 3,200 examinations [6]. The estimated dose for CT scan of the lumbar spine is similar to that of CT scan of the abdomen and pelvis, approximately 15 mSv (range 10–20 mSv), compared to a recommended maximum annual radiation exposure of 10 mSv for the general population.

The aim of this study was to investigate the merit of repeat CT scans, performed 2 years after the index study, for the investigation of spine-related pathologies in patients with low back pain, radicular pain, or a related spine complaint.

2. Material and methods

2.1. Patients

The prospective database of all patients undergoing CT examination from January 2008 to December 2010 in an academic medical center was retrospectively reviewed. Patients aged 18–60 years who underwent repeat lumbar spine CT examination during the study period were identified. Those who had undergone spine surgery, sustained a traumatic injury, or been diagnosed with a neoplasm, and those in whom the indications for study included

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"red flags" such as fever, unexplained weight loss, nocturnal back pain, night sweats, or symptoms suggestive of systemic disease, were excluded from the study. Data regarding patient age, sex, indication for the examination stated by the referring physician, interval between examinations, and findings at CT scan were documented.

The Medical Center Institutional Review Board approved the study design and waived the requirement for informed consent.

2.2. CT scan examination and interpretation

Examinations were performed with MDCT scanners (Brilliance 64-Slice, Philips Healthcare, Eindhoven, The Netherlands; or LightSpeed16-slice, GE Healthcare, Milwaukee, WI, USA). Scans were performed in the craniocaudal direction with 120 kVp, auto mAs (maximal 330 mAs), 1.25 mm slice thickness, a pitch of one, small field-of-view, standard filter, and a 512 × 512 matrix. Axial slices were reconstructed with a 2.5 mm slice thickness with focal 2.5 mm slice width reconstructions in the plane of each disc space, as well as sagittal, coronal, and three-dimensional reconstructions for each examination.

All examinations (index and repeat) were reviewed on a picture archiving and communication system (Centricity PACS, GE Healthcare) in conventional bone and spine windows by a single musculoskeletal radiologist with over 15 years of experience.

The lumbar spine was assessed from the T12–L1 disc space to the S1 vertebral body. Each motion segment was evaluated separately in cases where any findings were seen. Findings at index CT scan were documented, with pathologies listed according to lesion type as well as disc space and vertebral level. A visual assessment of the difference between the two CT examinations was made using great care to assess comparable anatomical sections of the pathological level. Findings at repeat CT scan were classified as no change, improvement, worsening, or new pathology.

2.3. Classification of pathology

Disc abnormalities were classified as herniation, sequestration, or bulge, using generally accepted criteria [7]. Spinal stenosis, disc space narrowing, and the presence of osteophytes, fractures, or other bony changes, were documented. Patients with other spine pathologies, for example primary or metastatic neoplasms, traumatic injuries, or infections, were excluded from the study.

2.4. Statistical analysis

The two-tailed Student's *t*-test and chi-squared test were used to compare findings on the original and repeat CT scan. Statistical significance was set at $p < 0.05$.

3. Results

3.1. Patients and CT scan examinations

From January 2008 to December 2010, 4,600 lumbar spine CT scans were performed. In this scan data, we identified 430 patients who underwent two CT examinations of the lumbar spine during the study period. A total of 322 patients were excluded due to a medical history that mandated repeat imaging, notably a history of trauma or spine surgery between CT examinations (185 patients) or "red flag" indications related to a known or suspected neoplastic or other underlying disease (127 patients). Exams for 108 patients (64 males [59.3%] and 44 females [40.7%]; mean age 47.7 years) were included in the study (Fig. 1). The mean interval between CT studies was 24.3 ± standard deviation of 11.3 months.

The indication for the index examination, as stated by the referring physician, was low back pain in 60 patients (55.6%), radicular pain in 46 (42.6%), and nonspecific back pain in two patients (1.9%) (Table 1). Indications for repeat CT scan were identical to the index procedure in 102 patients (94.4%) and changed in six (5.6%).

3.2. Pathology

On the index examination, there were 292 disc pathologies in 98 patients (90.7%); CT scan was normal in 10 patients (9.3%) with no pathology revealed in either the index or follow-up examination.

Pathology included disc bulging, herniation, sequestrum, and degeneration, spinal stenosis, and facet joint arthropathy. The pathologies were dispersed throughout the lumbar spine; however, most were located in the lower segments (Table 2). At repeat examination, 269/292 (92.1%) disc space pathologies did not change, 10 (3.4%) pathologies improved or disappeared, and eight pathologies worsened (2.8%); however, none of the changes altered patient care. Five new pathologies were found, including three new disc herniations and two osteophytes. New pathologies were located at L4–L5 in three patients and L5–S1 in two.

There was no association between patient age, complaint, and change in disc pathology. Among the 60 patients referred for a CT scan due to low back pain, pathologies stayed the same or improved in 58 and changed in two patients (3%) at the second CT scan ($p < 0.05$). In the 46 patients referred due to radiculopathy, pathology was unchanged in 36 (78%) and changed in 10 (22%).

4. Discussion

In this study we evaluated findings in 108 patients suffering from low back or radicular pain who were sent for a repeat CT scan of the lumbar spine by their health care providers at a mean interval of 32 months. We found that over 90% of the disc pathologies identified on index CT scan did not change significantly in this time frame. Overall, only 8/292 (2.7%) pathologies seen on the index CT scan had worsened at the repeat study. Changes were seen in only 3% of patients presenting with low back pain, as opposed 22% of those referred due to radicular pain. None of the changes seen led to a change in patient care. This suggests that the clinical value of repeated CT scan in this time frame was limited in the current study population.

There are several "red flags" that mandate repeated imaging [8], for example pain in patients under the age of 18 or over 60, pain associated with unexplained weight loss, nocturnal back pain or night sweats, and pain subsequent to trauma or surgery. Patients presenting with back pain in these settings were excluded from the study.

The clinical course of patients with distinctive spine disease, such as spinal claudication due to spinal stenosis, was assessed in the Spinal Patient Outcomes Research Trial (SPORT) [9], which determined that patients with symptomatic spinal stenosis who undergo surgical intervention do better than those managed conservatively. This suggests that repeat imaging within a 2 year window is indicated in patients with spine disease, as compared to those presenting with nonspecific back or radicular pain.

The natural history of disc herniation, especially large herniations, has been studied [10]. Extruded herniation regresses over time, mainly due to an inflammatory macrophage-induced response [10]. This was shown by Bush et al. [11] and Masui et al. [12], who found that 71% of extruded disc fragments that were followed for several years reduced over time without