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Evaluating Chronic Pain Patients Using Methods from Johns Hopkins Hospital Physicians

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Abstract

Chronic pain patients are misdiagnosed 40%-80% of the time, according to research from Johns Hopkins Hospital physicians. Methods to determine the validity of the complaint of pain, as well as clinical suggestions on methods to improve the accuracy of diagnosis and testing are summarized, as well as the description of an Internet based system which provides diagnoses with a 96% correlation with diagnoses of Johns Hopkins Hospital physicians.

Introduction

In a typical clinical setting, a physician has several major considerations when evaluating a patient with chronic pain. The first consideration is to determine if a patient is exaggerating his complaint of pain, for secondary gain, be it financial or psychological, or if he is using the totally subjective nature of pain to obtain narcotic medication, by totally fabricating his symptoms. This later case is real malingering which is defined as a conscious attempt to deceive for personal gain.

Various articles estimate fraudulent patient claims to range from 1% to 80% depending on unsubstantiated reports in the insurance literature [1-4]. This high index of suspicion has also permeated the medical literature, resulting in diagnoses of histrionic personality disorders, conversion hysteria , and malingering in patients who have not improved with treatment, and who have routine tests, such as MRI, CT and X-ray which are normal [5].

However, there is another explanation for the failure of a patient to improve. Researchers from Johns Hopkins Hospital have published articles demonstrating that 40% to 80% of chronic pain patients are misdiagnosed [6-10]. For special diagnoses, erroneous diagnoses may reach levels of 92% to 97% for victims of electrical shock, or those mistakenly called fibromyalgia [11,12].

There are two major factors causing misdiagnosis. An article from the Wall Street Journal quoted research from a 2013 study on 190 primary care patients. Physicians missed 68 diagnoses. The article attributes these oversights to two factors 1) doctors did not spend enough time with patients taking careful history: 2) doctors ordered the wrong tests [13].

Physicians need to remember that pain is a warning system for the body. It tells the organism that something is wrong, and sends this message to the brain, so that the organism can do something to avoid the pain. In this context, pain is a physiological condition. The easiest way to differentiate anatomical from physiological tests is to consider an oven on the wall. If a physician takes a picture of the oven, and hands it to a colleague, and asks him to look at the picture, to determine if the oven is hot, his colleague cannot do that. However, if the physician puts a thermometer in the oven, and it records 375°F. and then asks his colleague to look at the thermometer to determine if the oven is hot, the colleague can easily determine the temperature of the oven, and render an opinion.

Anatomical test are MRIs, CT, and static X-rays, which merely take pictures. However, pain fibers are so small that their damage or compression cannot be detected by merely anatomical testing. Physiological tests are flexion extension X-rays, provocative discogram, facet blocks, peripheral nerve block, Indium 111 scans, bone scans, and root blocks, to name a few. These tests measure the activity of certain bodily functions, either by electrical or chemical means. Some of the most commonly misused and overused diagnoses and medical tests are listed below.

The anatomical test most often used is the upright cervical or lumbar spine X-ray. These X-rays have no predictive value nor correlation with the severity of pain an individual experiences [14]. Most patients with back or neck pain complain of pain when they lean forward or lean backwards. Therefore, it would be logical to take X-rays while the patient is leaning forward leaning backwards, and not rely on only upright X-rays. Yet clinical experience revealed that in patients who complained of pain with either flexion or extension or both, over 99% of patients seen at one clinic had only upright X-rays performed by the referring physician. Had flexion-extension X-rays been obtained, the physician would be able to note either of anterior or posterior dislocation of a vertebral body on another or the separation of a pars inter-articularis break under mechanical stress, or neural foraminal stenosis with extension which would not be visible in the upright or flexion film.

MRIs are a second anatomical test which is overused. Jensen et al did lumbar MRIs on 98 patients with no back pain, and found that 27 had protruding disc (28% false positive rate) [15]. Additionally, Simmons and his group studied 164 patients with complaints of pain at various levels, requiring examination of several discs within a patient. They performed both MRI and provocative discograms (injection of a disc, while a patient is awake, and determining if the injection

reproduces the pain the patient normally feels) on multiple discs in each patient. They found that for discs with negative discograms, 37% were reported as abnormal on MRI [16].

Another anatomical assessment is vertebral body endplate signal intensity changes on magnetic resonance (MR) images. These are one of several findings a radiologist uses to diagnose degenerative disk disease and spondylosis of the lumbar spine. These signal intensity changes were first described and classified by Modic et al. [17]. Thompson, and his colleagues found that Modic type 1 changes had a high correlation with a positive provocative discogram [17]. The Modic type 1 vertebral body endplate change seen on MRI is described as endplate neovascularity which is hyperintense on T2-weighted images and hypointense on T1-weighted images [17]. This radiological finding is often missed by less experienced radiologists.

Addtionally, Braithwaite studied 90 patients using both MRI and provocative discograms. In the patients with positive provocative discograms, only 23% had Modic changes on MRI and 77% had no changes in MRI [18]. Therefore, Braithwaite found a 77% false negative rate for MRI. Sandhu, and his group at Cornell, studied 53 patients with severe neck pain using both MRI and provocative discograms. Of these patients, 79.5% with concordant pain on provocative discograms had no endplate changes (Modic) on T1 and T2 MRI images [19]. Therefore, in this study, the MRI has a 79.5% false negative rate.

These studies confirm that MRI is of little use in determining which cervical or lumbar disc is damaged, since MRI has a 28%-37% false positive rate (28%-37% of the time the MRI tells you something is wrong when there is nothing wrong), and a 77%-79.5% false negative rate (77%-79.5% of the time, the MRI reports nothing is wrong, when there is something wrong).

The explanation for this type of error is simple. A disk is like a jelly doughnut, with the jelly being analogous to the nucleus pulposa, and the that doughnut portion being analogous to the annulus [20].

The annulus has pain fibers in the rear one 1/3 of doughnut portion surrounding the jelly. If the nucleus pulposa herniates into the rear one third of the annulus, even without nucleus pulposa protrusion, this produces a pain that is exactly like a "herniated disc." This is called “Internal Disc Disruption” or IDD [20].

A provocative discogram is a physiological test, where the rear one third of the annulus is injected with saline, to see if this reproduces the pain a patient normally feels. If it does, this is considered a positive provocation. Then, an anesthetic agent is injected into the same needle to see if this eliminates the pain on a temporary basis. If it does, the physician has conclusive proof that this damaged disk is the source of the pain [20].

EMG nerve conduction velocity studies primarily measured damage to motor nerves. When viewed in cross-section, 90% of the mixed motor-sensory nerves in the periphery are comprised of thick heavily myelinated motor nerves. Only 10% are the sparsely myelinated sensory nerves [21]. Therefore, it is very difficult to detect damage to sensory nerves using EMG-nerve conduction studies, because a loss of 10% of the electrical activity of a nerve, due to sensory nerve fiber damage, would not produce a significant change in the electrical activity of the nerve as recorded with nerve conduction studies. The sensory perception threshold test, which measures the small A delta, A beta, and C fibers is a much better sensory test. These fibers respond to Neurometer stimulation at 5 Hz, 250 Hz, and 2000 Hz and respond to the Stimpod at pulse widths of 0.1 msec, 0.3 msec, 0.5 msec, and 1.0 msec, both at 5 Hz and 2 Hz [22]. Either of these tests should be used to detect sensory nerve damage, in preference to EMG-Nerve conduction velocity studies.

Another overused test is the CT. Physicians mistakenly assume CT is as accurate for detecting bony lesions as the MRI is for detecting soft tissue injuries. However, research Johns Hopkins Hospital shows that a 3-D CAT scan can detect pathology missed by regular CAT scan 56% of the time. In patients who have had previous surgery, the 3D-CT will detect pathology missed by the regular CT 76% of the time [23]. In fact, in a group of patients with normal CT and MRI findings who had been labeled “psychogenic pain patients” the 3D CT was able to detect previously unnoticed pathology, and convert the diagnosis from a psychiatric one into a medical one [24]. It is surprising that the 3D CT is not more widely used, since the only expense in converting a regular CT into a 3D CT is the purchase of software package which costs $250,000. This certainly is well within the range of the average hospital or radiology center.

In addition to the incorrect medical tests, physicians fail to address the clinical features of the patients with chronic pain. One of the most overused group of diagnoses is sprains and strains. Sprains are defined as overstretching of the ligaments, the fibrous tissue which holds the bones together. trains are defined as an overextension of muscle tissue, which is attached to the bone by the ligaments [25]. Sprains and strains should last no longer than a month. After that period of time the problem is something other than a sprain or a strain. In fact, the Department of Health and Human Services of the US government has defined a strain as a disorder which causes an average of 7.5 days of restricted activity, two days of bed disability, and 2.5 days of work loss [26]. So any “sprain or strain” which persists beyond the month is incorrectly diagnosed 100% of the time, and requires a more directed medical evaluation.

One of the most commonly missed diagnoses, often called a lumbar sprain or strain, is facet syndrome. The clinical features of this syndrome are localized back pain or neck pain worsened with extension, improved with extension, and diagnosed with facet blocks. Lumbar facet joint degeneration is a source of chronic low back pain, with an incidence of 15% to 45% among patients with low back pain [27]. On occasion, radiological studies may show facet hypertrophy. One study reported in association between heavy physical activity and the development of CT confirmed lumbar zygapophyseal joint osteoarthritis [28].

A temporary facet block given at the level of suspected pain, and the level above and below the suspected level, since a facet joint has sensory innervation not only from the level of the pain, but receives contributions from the level above and below the area of physical damage. A facet denervation is the treatment of choice. However, a recent publication reported that the efficacy of the steroid injection was equal to radiofrequency denervation [27]

Another diagnosis overused by physicians who cannot accurately establish diagnosis is complex regional pain syndrome (CRPS) or reflex sympathetic dystrophy (RSD). Research shows that these patients have nothing more than undetected nerve entrapment syndrome 71%-80% of the time, and they respond to nerve decompression as their sole treatment [8,9].

The incidence of a mixture of RSD and nerve entrapment occurs 26% of the time [8]. Both disorders need to be treated, using surgeries specific for each, i.e. nerve decompression for nerve entrapment, and sympathectomy for the RSD. Unless both type of treatments are

applied, the patient will continue to have pain. Only 3% of the patients told that they had RSD actually had just this disorder [8].

The clinical features of CRPS or RSD are very discrete, and have been well described. The pain must have both thermal and mechanical allodynia. Allodynia is defined as a painful response to a normally non-painful stimulus. It is mistakenly called hypersensitivity, but this is not allodynia. Typically, the RSD limb feels cold to touch, but subjectively may feel either hot or cold. Another essential clinical feature of CRPS or RSD is that observation that pain is in a circumferential distribution, which means the pain is equal all around a limb [8]. This differs from nerve entrapment syndromes, where the pain is present is a discrete path of a well described sensory nerve, and often has only mechanical hypersensitivity. The Hendler test to differentiate RSD from nerve entrapment is simple and inexpensive. A physician uses an alcohol swab, and drops alcohol on the affected limb, and gently blows on it. If the patient says this is painful, then the patient has thermal allodynia. Then the left over alcohol pad is used to swipe the affected limb. If the patient says this is also painful, then the patient has mechanical allodynia. Both thermal and mechanical allodynia need to be present in order to have the diagnosis of reflex sympathetic dystrophy (RSD) [8]. The use of current perception threshold (Neurometer) or Stimpod also has been of great assistance diagnostically to delineate sensory nerve damage, as has thermography [21,22,29].

Another overused diagnosis is fibromyalgia. In research conducted at Mensana Clinic, 37 of 38 patients, (that is 97% of the patients) told they had fibromyalgia did not meet the diagnostic criteria [12]. The diagnostic criteria for fibromyalgia are very specific. The patient needs to have pain in the least 11 of 18 well-defined points in their body. Interestingly, these points overlap with common joint diseases, so that if a patient has pain in only three or four of the designated spots, the patient does not meet the diagnostic criteria for fibromyalgia. In the 37 so-called fibromyalgia patients, 133 other medical diagnoses, documented by objective medical test, were detected, which have been missed by the referring physician. These disorders range from an acromo-clavicular joint damage to Lyme's disease, and included hyperparathyroidism, Hashimoto's thyroiditis, thoracic outlet syndrome, and psoriatic arthritis [12].

Another commonly overlooked diagnoses is thoracic outlet syndrome. In 90% of these cases, compression of the brachial plexus between the anterior and medial scalene muscle is the source of the symptoms. Only 10% have vascular compression [30,31]. The EMG-nerve conduction studies are of little use in trying to establish this diagnosis, because the distance across Erb's point is less than 5 inches, which does not produce reliable EMG nerve conduction velocity study results.

Since the pathology of thoracic outlet syndrome is mostly neurological, or combination of neurological and vascular pathology, the best clinical tests is the Roos maneuver. A Roos maneuver consist of asking the patient to elevate their arms, with their elbows as high as their shoulders, and bent 90° at the elbow. The patient is then asked to hold that position for 2 min., and then asked what they feel in their fingertips. If the fingertips are numb, then this is a positive Roos test. The Adson maneuver consist of feeling the radial pulse and asking the patient to turn their head in the opposite direction. A diminution of the pulse is indicative of a positive Adson maneuver. Obviously, this maneuver detects vascular compression, which occurs less than 10% of the time in thoracic outlet syndrome, and even then it is unreliable.

However, when vascular compression does accompany thoracic outlet syndrome, the Roos maneuver is a better test than the Adson maneuver, as demonstrated by vascular flow studies with the arms up and arms down, in the bruise position, compared to the Adson maneuver. Over 80% of the time, vascular compression will be demonstrated by the Roos maneuver, but missed by the Adson maneuver. Again, as is true with all sensory nerve damage, the neurometer studies are useful for detecting sensory nerve damage, and are especially valuable, if the studies are conducted when the patient has their arms in the Roos position, compared to being at rest [30,31].

All the above information can be confirmed by outcome studies. This is a valuable utilization of the concept of evidence-based medicine. Since chronic pain is a subjective experience, the most appropriate way to determine the efficacy of treatment is to measure a change in functionality. The quantifiable changes can be reduction in the use of medication, reduce doctor visits, returned to work, and cost savings for medical expenses. Using the techniques just outlined, Johns Hopkins hospital was able to save 54% on its workers' compensation costs [32]. Using these techniques, one clinic has documented cost savings between $20,000 and $175,000 for long-term cases.

One of the most easily quantifiable parameters of recovery is return to work. The insurance industry reports that if a worker is injured on the job and remains out of work for two years or more, there is less than a 1% chance that he'll return to work. However, when properly diagnosed, and correctly treated, for this same type of patient, one clinic had a return to work rate of 19% for workers' compensation cases, 62% for auto accident cases, and had a 90% reduction in narcotic medication and a 45% reduction in doctor visits [33].

Additional outcome studies were published by Dr. Long, who was chairman of neurosurgery at Johns Hopkins Hospital. His research group evaluated 70 patients, who had normal MRIs, CT's, and X -rays, and had been told that there is nothing to be done to help their neck pain and headaches. When the group utilized provocative discograms, facet blocks, and root blocks, they found that 44 of the patients (63%) were candidates for surgery. After surgery was performed, 93% of the patients reported improvement [34].

In order to address problems of diagnosis in chronic pain patients, a team of physicians from Johns Hopkins Hospital developed two Internet tests to improve diagnoses and treatment. The first test, the Pain Validity Test, has 33 questions and 256 possible answers. There have been seven articles about this test, involving research on 794 patients, authored by multiple authors. The Pain Validity Test has always been admitted as evidence in court cases, in over thirty cases in 9 states. It takes a patient 15 min. to complete the test. It can predict with 95% accuracy that will have abnormalities on the correct medical testing, and conversely predicts with 85% to 100% accuracy who will not have abnormalities on medical testing [35-38]. Clearly, the Pain Validity Test simplifies the process of determining if a patient has a valid complaint or not. The Pain Validity Test is available in English or Spanish in an Internet version, at www.MarylandClinicalDiagnostics.com [39]. The high degree of accuracy was obtained using predictive analytic techniques, based on both retrospective and prospective testing.

The Diagnostic Paradigm has 72 questions with 2008 possible answers, in both English and Spanish, and takes a patient 30 min. to 60 min. to complete. The Diagnostic Paradigm asks all the questions a conscientious physician should ask, if he spent enough time with the

patient to ask the questions. It gives diagnoses with a 96% correlation with diagnoses Johns Hopkins hospital doctors [40].

Based on the proper diagnosis from the Diagnostic Paradigm, the Treatment Algorithm recommends the correct medical test to use, utilizing the experiences at Johns Hopkins Hospital. The Treatment Algorithm recommends the standard anatomical tests, but then progresses to recommend the physiological tests used to diagnosis patients at Johns Hopkins Hospital. These tests allowed Dr. Long and his colleagues to better diagnosis 70 patients who had been told by their previous physicians that nothing could be done to help their headache and neck pain (34). This research, as well as earlier research by Hendler et al, on 180 patients, led to surgery in 50% to 63% of patients who had been previously told that there was no further treatment for their problems with chronic pain [6,7,34].

A recent study, conducted by Dr. Landi, from the Department of Neurosurgery at the University of Rome, found that Diagnostic Paradigm could predict with 100% accuracy, intraoperative findings, based on the diagnosis correctly established prior to surgery [41].

After the patient completes the Diagnostic Paradigm, results are scored available using Bayesian logic, based on over 10,000 chart reviews and 17 years of research. Bayesian logic is based on experiential history, and requires a large data base to compile statistically accurate results. This gave the Diagnostic Paradigm the 96% correlation with diagnoses of Johns Hopkins Hospital physicians, as opposed to other "expert systems" which used Boolean logic. These Boolean logic systems typical have accuracy of 65%-84% [42-45].

Conclusion

a) 40%-80% of chronic pain patients are misdiagnosed

b) The leading cause of misdiagnosis is A) failure to spend enough time with a patient to take a careful history, and B) using the wrong tests such as EMG, MRI and CT

c) Correctly diagnosed and properly tested patients have documented improvement far in excess of current levels

d) Johns Hopkins Hospital doctors have developed Internet questionnaires, using predictive analytic techniques and Bayesian analysis of answers, which

e) Can predict with 95% accuracy who will have abnormal medical tests,

f) Have a 96% correlation with diagnoses of Johns Hopkins Hospital doctors,

g) 100% prediction rate of intra-operative findings

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