Diagnose My Pains to Select the Correct Medical Tests and Treatment for Chronic Pain and Headache

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By

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For the 40%-80% of chronic pain and headache patients who are misdiagnosed
www.DiagnoseMyPains.com

A website created by former Johns Hopkins Hospital doctors, which gives diagnoses of chronic pain problems and headaches with a 94%-96% correlation with their own. Patients should take the results to their doctors.
www.PainValidityTest.com

A website for physicains and other professionals to supplement their evaluation of patients with chronic pain and headache

A book to help you find out why you are still in pain.

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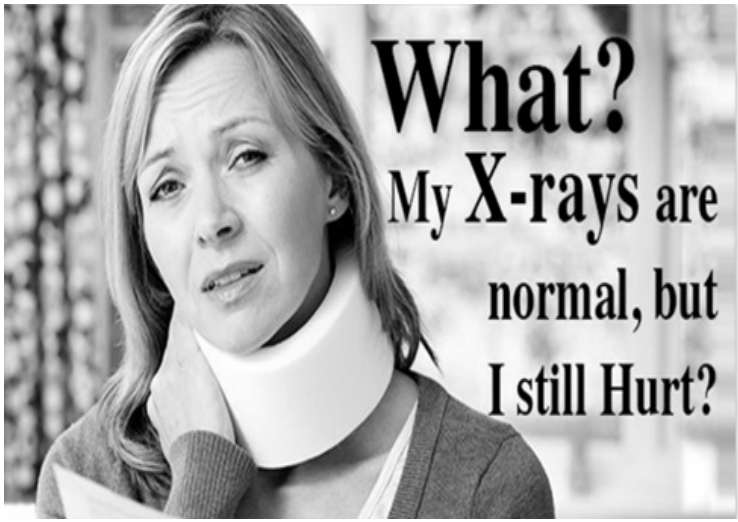
INTRODUCTION



In my academic and medical career, I have been blessed with exposure to some of the most creative thinkers in medicine. They were original thinkers, who looked at a problem differently than their colleagues, and developed new and innovative ways to approach problem solving. These gifted teachers all shared the same trait. They taught how to think about a problem, rather than what to think. They taught me principles and concepts as a Christmas tree, upon which I could hang all the facts they also taught me. This is an important distinction. Problem solving is at the root of all diagnosis, and diagnosis is at the root of all accurate medical evaluations, and accurate medical evaluations are are the root of all proper test selections, and proper test selection and interpretation is at the root of all successful treatment.

Bart Hoebel, PhD at Princeton University, my senior thesis advisor, taught me the concepts of opposing action with different chemicals in the very same area of the hypothalamus into which we were putting implants. One anatomical area could be dissected chemically, resulting in opposing

actions. William D. Blake, MD, my physiology thesis advisor, who was chairman of physiology at University of Maryland School of Medicine, was a student of Cannon's at Harvard. He taught me the difference in the correlation between two events and the need to determine a cause-effect relationship. Just because two events occur in sequence does not mean there was a cause-effect relationship. William F.L. Kerr, MD who was a professor of neurosurgery at Mayo Clinic in Rochester, Minnesota, supervised me for a summer externship in neurosurgery research. He taught me the need for precision in experimentation, and the value of an absolute rather than relative starting point. Horsley Gantt, MD, one of the last living students of Pavlov, was fond of telling the story of the inscription above the door of Pavlov's laboratory. It said "observation and observation and observation." I spent 9 exciting months with him at the Pavlovian Research Laboratory at Perry Point Veterans' Hospital, regaled by his stories of what it was like in Russia in the 1920s, and stories of Pavlov taking nude plunges into the river in the winter, documented by a full frontal shot of the great man with snow on the banks of the river in the background. Dr. Gantt insisted on brewed tea for lunch and afternoon breaks. I have never drunk more tea in my life before or since. Dr. Gantt taught me about the "effect of person," i.e. the mere entry of an experimenter to a room would increase the heart rate of a dog, but as the experimenter approached the dog's heart rate would drop; and in one extremely nervous pointer, he even recorded instances of cardiac stand still for several seconds. Joel Elkes, MD, chairman of psychiatry at Johns Hopkins Hospital when I was a resident there, was the first man in the world to use Thorazine on a psychiatric patient. His stories of the patients benefiting from a totally new drug class, instead of being subjected to the primitive way of treating psychiatric patients, were inspiring. I had the great fortune to have Sol Snyder, MD as one of my clinical supervisors during my residency. Dr. Snyder was a world class psychopharmacologist, who was credited with elucidating the dopamine theory of schizophrenia, and discovering the morphine receptors in the brain. He opened up the entire world of receptor specificity to me, and gave me my first big push into psychopharmacology by having me write the chapter on the pharmacology and physiology of lithium for the Handbook on Psychopharmacology, which he edited. Donlin Long, MD, PhD., was the chairman of neurosurgery at Johns Hopkins Hospital, and brought me into his department to assist with the newly formed Pain Treatment Center at the hospital. Dr. Long taught me more clinical medicine in one year than I had learned in all previous years, and we co-authored many articles together, as well as one book. He focused on establishing the cause of a

problem, which of course necessitated getting a diagnosis. He was a teacher, a friend and a great hunting buddy for over 30 years.

I thank all of these teachers for always focusing on one concept…learn how to think about a problem. I hope this volume will assist you on the same quest.

Nelson Hendler, MD, MS
Former assistant professor of neurosurgery
Johns Hopkins University School of Medicine
Past president American Academy of Pain Management
Former associate professor of physiology
University of Maryland School of Dental Surgery

CHAPTER 1

THE MYTHS ABOUT CHRONIC PAIN

This chapter has no references. Rather it represents a series of observations drawn from 34 years experience seeing patients. It is based on comments they made to me while I was evaluating them, accusations they have been told, or statements made to me by other professionals involved in the care of the patients. Some statements are so outrageous that they should anger the reader. Others are so preposterous as to be laughable. Nonetheless, there is a lot of misinformation circulating about the evaluation and treatment of patients with chronic pain. Some are financially motivated, while others are just the result of "fuzzy thinking," an affliction affecting a number of people who lack intellectual rigor. The origin of these statements is best described by the type of thinking which was so well explained by Daniel Kahneman, PhD, in his book **"Thinking, Fast and Slow."** (Kahneman, D, Thinking Fast and Slow, Farrar, Straus, and Girous, New York, 2011). Kahneman, an Israeli-American, was a psychologist, a professor at the Woodrow Wilson School of Princeton University, and won the Nobel Prize for his work on the psychology of decision-making and its impact on behavioral economics. He described the thinking behind various frequently observed human errors in decision-making. The type of thought processes and comments listed below are the results of "System 1" type of thinking since the statements are often an immediate response to a situation and can easily be erroneous. Very often the statements mentioned below are issued by an individual to protect that individual from a narcissistic assault on his or her ego. They are based on snap judgments, prejudices, and using a small amount of information to form broad sweeping conclusions, without considering what information might be missing. People, when faced with complex situations, often resort to "System 1" type of thinking. Since chronic pain is a complex process, it often triggers "System 1" type of thinking. Hopefully, by the end of this book, you, as an informed reader, will be persuaded to use "System 2" type of thinking which requires a high level of effort and a thoughtful, or critical slower speed to evaluate problems.

The pain is all in your head.

This is a classic statement from physicians or health care professionals when all laboratory studies which they have ordered (which may be the wrong studies) are returned with normal results. This is also the attitude of insurance companies, when faced with a claimant who is taking longer to get well than expected. Basically, it says "I can't figure it out, so therefore it must be your fault." If a physician says this to you, get out of the office, and find yourself a physician who cares about patients.

The patient has a conversion reaction or "pain disorder."

When I hear this from a colleague, I cringe. In an elegant study done by Slater, at Queen Square, Hospital in London, he found that only 9% of patients previously diagnosed with "conversion reaction" did not have definable organic lesions on nine-year follow-up. The details and references on this study are found in one of the chapters in this book. Compounding this fallacious thinking is the definition of Pain Disorder (307.80- DSM-IV) defined as a pain for which there is no medical explanation. A diagnosis of this type immediately raises red flags. Talk about circular logic! We know 40% - 80% of chronic pain patients are misdiagnosed, and between 54% to 77 % of tests used to evaluate chronic pain patients have false negatives. So, we now give physicians a convenient out if they cannot diagnose a patient… blame the patient and call it "'a pain disorder." There is even an ICD-10 code for it, so physicians can bill insurance for their errors and be reimbursed for making mistakes.

You are faking your pain to get more money from a law suit.

This is the classic "compensation neurosis" found in many early textbooks, when describing patients involved in cases with litigation. Again, this type of thinking relieves the physician of exploring a medical problem in detail, and is especially useful in the presence of minimal or absent objective organic findings. Since many physicians are loath to get involved in medical legal cases, they often use this as a rationale for not evaluating accident cases in detail.

If you ignore it, the pain will go away.

This type of thinking must have derived from some frustrated athletic coach or overwrought mother, who just didn't have time to address the

needs of the injured party. It is a pretty heartless way of addressing someone's complaint. "Walk it off" is often not productive advice.

Nobody ever felt as bad as I do.

When a patient told me this, I knew I had a management problem on my hand. Pain is a totally subjective experience. There is no way to measure pain. Clearly, when patients told me this, I knew they required validation for the subjective complaint of pain, and were trying to evoke my sympathy by letting me know how horrible the pain was. I didn't blame them for this, because they had been assaulted by a number of professionals in the past. In rare instances, this is indicative of patients trying to explain their inactivity and disability often to family members.

You did something wrong in the past; you deserve the pain you have now.

This moralistic interpretation of unexplained pain is often invoked by ill-informed clergy and relatives.

Pain is the result of abusing your body.

This judgmental statement is neither diagnostic nor curative. Again, it is an attempt to blame the patient for the problems that they have and remove responsibility from the treating physician.

All pain is the same.

This statement reflects a total lack of knowledge of anatomy and physiology. The anatomical pathways of acute pain are different than those of chronic pain, and psychological response to pain differs between the two as well. Injury to different types of tissue creates a different type of pain. Nerve compression might produce tingling and pins and needles, while sectioning the nerve might produce numbness. Irritating a nerve produces a burning sensation. It is the responsibility of the physician to mentally dissect the type of pain the patient experiences, the location in the body, and the factors which make it worse or better.

You are depressed, and use pain as an explanation for your depression.

Earlier psychiatric literature, from the 1950's until 2000-2010, contain references to "depressive equivalents." This is some more of the illogical thinking which plagued medicine. The "dumb-think" went like this. If you

are depressed and have chronic pain, then you are using pain to explain why you are depressed. This was the result of viewing patients at a given point in time. Not one of the past psychiatric pundits ever thought about doing longitudinal studies. Why do doctors study anatomy before they study pathology? So that they can recognize damaged tissue from normal tissue. So, I asked the question "what happens over time to perfectly normal, well-adjusted individuals when they get a chronic pain situation?" They go through 4 stages in response to their pain, over a 3-to-12-year period of time. At first, there is no change in their personality, they expect to get well. Then they begin to focus on their pain, hoping it will go away, then get depressed when they realize the pain may not go away, and then they begin to accept it. We found that 79% of chronic pain patients are depressed, but 89% were never depressed before their pain problem. Chronic pain creates depression, not the other way around. This process is described in the chapter on the psychological response to pain. If you find texts which speak about "depressive equivalents" please disregard them. They are a perfect example of "psycho-babble."

You need MRIs, X-rays and CT scans to make a diagnosis.

An accurate diagnosis is made by history alone. The type of pain the patient experiences, the location in the body, and the factors which make it worse or better provide more diagnostic value than CTs, with a false negative rate of 54%, and MRIs, with a false negative rate of 77% for detecting disc disease. A "reductio ad absurdum" example demonstrates the fallacy of relying on medical tests, and the value of a careful medical history.

Scenario number one: A male patient comes into the office complaining of pain in his thumb. Without taking a further history, the doctor orders an X-ray of the patient's thumb to find the cause of the pain. The X-ray comes back with a picture of a vise clamped on the patient's thumb. The doctor declares that he is found the source of the pain, removes the vise, and the patient improves.

Scenario number two: A male patient comes into the office complaining of pain in his thumb. Without taking further history, the doctor orders an X-ray immediately. The X-ray comes back with a normal picture. The doctor says to the patient "Your X-ray is normal. I don't know what's causing your pain." The patient is then angry and frustrated, and goes to another doctor for help.

Scenario number three: A male patient comes in complaining of pain in his thumb. Before ordering an X-ray, the doctor asks a few simple questions, i.e. takes a history. The doctor asked the patient "what makes your pain worse?" Then the patient says "when I hit it with my hammer." The doctor then asks "what makes your pain better?" The patient says "when I stop hitting it with my hammer." The doctor then asks "what kind of work do you do?", "I am a carpenter" says the patient. "Well," says the doctor, "put your hammer away, and we're going to get you a nail gun, so you don't run the risk of hitting your thumb with a hammer." The patient gets well.

Several things happened as a result of taking a history. A diagnosis was established which gave insight into the cause of the pain. A laboratory study is not needed so the costs were avoided, and a treatment was effected based on establishing a diagnosis, because the diagnosis explained the etiology of the pain which then could be addressed clinically.

You have fibromyalgia.

Our research showed that 97% of patients told they have fibromyalgia did not meet the diagnostic criteria for this disorder. In the group with 37 patients misdiagnosed with this, we found 133 other medical diagnoses, missed by the referring physician, many of which required surgery to improve. Recent attempts to identify a blood biomarker showed some factors with a slight correlation, but no cause-effect relationship has ever been established.

You don't need a diagnosis to treat pain.

If a doctor chooses to begin the treatment of pain, this is analogous to giving the patient morphine for broken leg. There is a temporary amelioration of the symptom, but the underlying cause of the pain is not corrected. Therefore, when the symptomatic treatment wears off, you still have a broken leg. Low back pain, lumbago, chronic pain syndrome, psychogenic pain, chronic daily headaches, and chest pain are not diagnoses. They're merely a description of the symptoms a patient has.

You look so good! You can't hurt that bad. How can you have chronic pain?

A number of my patients told me that they heard this comment from friends and family members, or worse yet, from doctors. This is not unexpected. Pain is a totally subjective experience. It has no visible

manifestations, such as old missing limb, or a skin rash. So, the only way a patient can convey their discomfort to friends and family members is to exhibit "pain behavior," such as wincing when standing up, holding a hand to the head to indicate a headache, or moaning and groaning with certain movements. Worse than that, almost all chronic pain problems do not have objective pathology on anatomical test, i.e., there is no X-ray of a broken bone they can show to family and friends. Therefore, the credibility of the patient is immediately called into doubt.

You can learn to live with it.

Actually, that does happen to some degree, after 3 years or more. It is part of the acceptance phase of the 4 stages of chronic pain.

Medical science can cure anything.

Don't bet on this one. But the first step to a cure is obtaining a diagnosis. You can't fix a flat tire until you know why the tire is flat. More importantly, there may be not one, but two, or even three causes for the flat tire. Until you diagnose and fix all three causes, your tire is still going to be flat.

I won't have to live with this the rest of my life.

Unfortunately, this is wishful thinking, and is one of the statements in the early psychological stages of chronic pain… denial. After 6 months of pain, this gives way to depression. Research documents that 79% of patients with chronic pain get depressed. More importantly, 89% of these patients were never depressed before. The suicide rate for chronic pain patients is two to three times that of the general population.

My pain is my own – no-one knows how I feel.

Right… pain is totally subjective. So, this is not a myth. This is accurate.

Pain medicine and narcotics will help my chronic pain.

This is one of the worst myths of all. Acute pain travels to the brain using different neuro-anatomical pathways than chronic pain. Most studies show that opioids and narcotics work well in acute pain, but lose their effectiveness in chronic pain, especially if the pain is of neurological, or vascular origin. One of the chapters in this book explains this in more detail.

CHAPTER 2

THE PROBLEM AND THE SOLUTION USING INTERNET BASED QUESTIONNAIRES

Across the seven major markets (US, Japan, Germany, Italy, Spain, France, and the UK) it was estimated that 37,600,000 individuals suffered from neuropathic pain and 170,100,000 suffered from nociceptive pain (1). Other medical research puts the figure at 20% of any population in a developed country.

Data from the "NIH Guide: New Directions in Pain Research" says that the annual economic impact of pain experienced by the U.S. workforce, in terms of pain management and pain-related productivity, was more than $100 billion annually. Another study found that care for lower back pain alone, not including other pain conditions and not just limited to workers, amounted to nearly $86 billion per year.

Johns Hopkins Hospital doctors have published a number of studies documenting that 40% to 80% of chronic pain and headache patients are misdiagnosed. This percentage is even higher for disorders such as Complex Regional Pain Syndrome (CRPS) or Reflex Sympathetic Dystrophy (RSD) where the rate is 71% to 80% over diagnosed with this, i.e. they don't have this disorder, or fibromyalgia, where 97% of patients told they have this disorder do not meet the diagnostic criteria (2,3,4,5,6,7,8).

THE ECONOMICS

Overall, recent US expenditures for healthcare reached $3.5 trillion dollars, according to U.S. Centers for Medicare and Medicaid Services (CMS) (https://www.reuters.com/article/us-usa-healthcare-spending-idUSKCN1FY2ZD).

Some of the most expensive elements of chronic pain injuries are workers' compensation, automobile injuries, and third-party claims, as the result of property and casualty accidents. These three segments of the insurance

market are expensive because the insurance carrier is responsible not only for the medical care, but also the lost wage of the injured party, which typically represents 67% of the total cost of a claim.

According to the National Council on Compensation Insurance, the workers compensation premiums for 2013 for private carriers and state funds increased to $41.9 billion, the highest level since 2007. Premiums for private carriers alone grew to $37 billion from $35.1 billion, a jump of 5.4% from 2012 as employment figures moved up toward pre-financial crisis levels (http://www.iii.org/issue-update/workers-compensation). Lower back pain and headaches account for the majority of reduced productivity in the workplace, in workers who do not file workers compensation claims, with work-place losses estimated to be $61.2 billion a year. These are pain-related lost-productive-time estimates, which accounted for 27% of the total estimated work-related cost of pain conditions in the US workforce (9).

Workers' compensation, automobile accident, and property and casualty claimants are very often accused of prolonging their injury, to receive the lost wage benefit, while incurring unnecessary medical cost. This is termed "claimant fraud." Nothing could be further from the truth. Elaine Howle, the State Auditor of California, reports that the Workers Compensation Commission of California cannot document the cost effectiveness of the $30,000,000 a year spent on current methods of claimant fraud detection use in California, such as Independent Medical Examinations (IME), Functional Capacity Evaluations (FCE), or surveillance (10).

The more important reason for the failure to return to work is improper diagnosis. Physicians from Johns Hopkins Hospital reported that 40% to 80% of chronic pain patients are misdiagnosed (2,3,4,5,6,7,8). Clearly, fraud is less of a problem than misdiagnosis. Applying this concept, Bernacki, at Johns Hopkins Hospital, was able to save 54% on the workers' compensation cost of the hospital by requiring that all workers injured at Johns Hopkins Hospital see Johns Hopkins Hospital doctors, instead of less qualified physicians in the community who were misdiagnosing patients 40% to 80% of the time (11).

THE SOLUTION

Motivated by this information on misdiagnosis, and the desire to help patients improve, these Johns Hopkins Hospital physicians developed an

Internet test, The Pain Diagnostic Test, which generates diagnoses which have a 96% correlation with the diagnoses of Johns Hopkins Hospital staff members (12). Surgery was recommended 50% to 55% of the time, for previously misdiagnosed "lumbar and cervical sprain" cases (2, 3), and 63% of the time is misdiagnosed "whiplash" cases (7). One clinic used this technique and reduced the use of narcotic medication 89%, and reduced doctor visits 45% while increasing return to work rates from the typical 1% for cases more than 2 years old, to 19% for workers' comp and 62% for auto accident cases (13). The resulting cost savings ranged from $20,000 to $175,000. These outcome studies were verified by an 83-patient study, and over 1,000 anecdotal confirmations of patient improvement and cost savings. This clearly is "evidence-based medicine" proving the efficacy of this expert system for chronic pain.

There are three B2B Internet based tests to address these issues, available in both English and Spanish, at www.PainValidityTest.com, and this offers the testing results listed below. These are available only to medical professionals. There is also B2C testing, found at www.DiagnoseMy Pains.com, which offers only the Pain Diagnostic Test and Headache Diagnostic Test, with output limited to a narrative summary and diagnoses, but no recommendations for testing and treatment. Recommendations for treatment are considered "practicing medicine without a license" in that state, and are prohibited by medical societies and state attorney generals.

1) **The Pain Diagnostic Test**, which generates diagnoses which have a 96% correlation with the diagnoses of Johns Hopkins Hospital staff members (12). The resulting cost-savings ranged from $20,000 to $175,000. The output of the test consists of a narrative summary, diagnoses, and differential diagnoses, ranked in order from most likely, to least likely, and a Treatment Algorithm (see # 2 below). This test is also able to predict intra-operative findings with 100% accuracy, according to research by Dr. Alessandro Landri, professor of neurosurgery, University of Rome (14).

1A) **The Treatment Algorithm.** Based on the results of the Pain Diagnostic Test, The Treatment Algorithm provides a list of the correct medical tests to order, of the tests currently used at Johns Hopkins Hospital, to confirm each diagnoses. These tests are far more accurate than X-rays, MRIs, and CT scans, and allow doctors to obtain the same impressive results which Johns Hopkins Hospital did. These tests are facet blocks, root blocks, provocative discograms, peripheral nerve blocks, Indium scans, Gallium scans, 3D-CT, functional MRI, cine-MRI, and a host of other tests

infrequently used outside of an academic medical setting (15,16,17,18,19,20).

2) **The Pain Validity Test** is capable of predicting which claimant would have moderate or severe abnormalities on objective medical testing, with 95% accuracy, and which claimant would not have abnormalities, with 85% to 100% accuracy. It also can be used to detect drug seeking behavior and fraud. The Pain Validity Test has been admitted as evidence in over 30 legal cases in 9 states, and costs far less when compared to current methods of fraud detection which cost $5,000 or more, and don't stand up in court (13,21,22,23,24,25,26,27,28,29).
3) Headache Diagnostic Test. There are over 60 different types of headaches. The medical literature reports that 35% to 70% of patients told they have migraine headache do not meet the diagnostic criteria. As with musculoskeletal chronic pain, if the doctor has the wrong diagnosis, the patient is going to receive the wrong treatment, and not improve. This diagnostic test has both B2C applications, and B2B applications, since headache and neck and back pain are the leading cause of reduced workplace performance (9). This questionnaire gives diagnoses with a 94% correlation with diagnoses of Johns Hopkins Hospital doctors (30).

The Pain Diagnostic Test and Headache Diagnostic Test are also available in a B2C version, at www.DiagnoseMyPains.com, which has a limited output, consisting of just the narrative summary and the most likely diagnoses. There are over 1,000,000,000 Internet users in countries which speak English or Spanish. Since 20% of the population of any developed country suffers from some sort of chronic pain, there are 200,000,000 potential B2C test users world wide.

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CHAPTER 3

HOW PAIN WORKS IN THE BODY

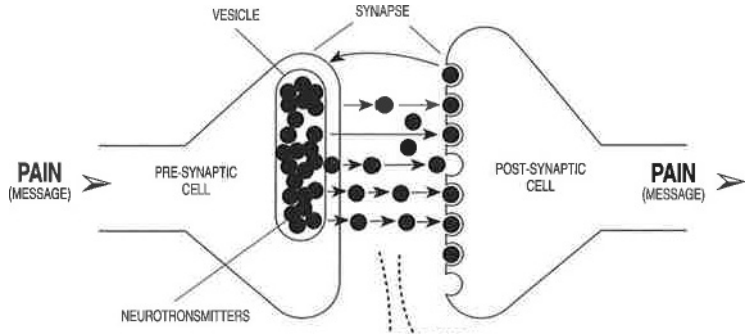
Pain has long been a puzzle to man. But like a jigsaw puzzle, the pieces that explain it are finally being identified one by one and slowly fitted together to form a big picture.

Pain is a significant event in the body that directly involves all the components of the central nervous system: the brain, the spinal cord, and the acres of nerves. The central nervous system controls the actions of the voluntary muscles, the ones you consciously control. These muscles include the ones you use for walking, waving your hand, or bending your head. Pain also affects the sympathetic nervous system, a component of the autonomic system. The autonomic nervous system controls the involuntary muscles, the ones that you rarely think about. These include the heart muscle that keeps blood pumping, the muscles that open and close (dilate and contract) the diameter of blood vessels, the muscles that contract the pupils in the eyes and the muscles of respiration that breathe for you without your consciously thinking about it. The sympathetic nerves go to all the arteries in the body, which in turn control the amount of blood flow to the muscles.

Nerves are key pieces in the pain puzzle. Nerve endings pick up the pain messages that are started by a stimulus (something that incites action). A pinprick, for example, is a stimulus that starts a pain message. The nerve endings impregnate skin, muscle, and bone—all of the tissue that makes up the human body. Hair, fingernails, and toenails do not have nerve endings, which is why you can cut these parts without feeling pain.

After the nerve endings pick up a pain message, it is carried to its final destination by the nerves, which function like a conveyor belt, trundling signals to the brain and back to the site where the message began. There are untold numbers of different nerves throughout the body. The brain alone has billions of nerves and nerve endings. Try to picture nerves as whitish fibers. Some nerves come in bundles, like the bundles of fibers that make up rope, and other nerves may consist of a single strand of

material. Some parts of the nerve are coated with a substance called myelin. Myelinated nerves are somewhat like insulated wire; the myelin comes in various thicknesses and acts as an insulator for the electrical charge of the nerve.



Thousands of nerves throughout the body have been designated by nature as pain nerves. When a stimulus activates a pain-nerve's endings, a message of pain travels as an electrical impulse over the nerve fiber from cell to cell along a pathway that takes the impulse to the spinal cord and then to different parts of the brain. The message travels from cell to cell by a complex series of electrical and chemical processes.

Each nerve cell has transmitter and receiver branches, called axons (transmitters) and dendrites (receivers), that help carry the pain message. The message as an electrical impulse travels from the axons of one cell to the dendrites of a neighboring cell. In order for the message to get to the neighboring cell, it must travel over a gap between the cells. This gap, or junction, is called the synapse. It is at the synapse that the pain message impulse is deciphered and sorted, or "zip coded," so that it travels on in the proper manner. After a message is "zip coded," it might simply move on to the neighboring cell, it might stop at the synapse or it might be changed at the synapse.

In recent years, researchers have identified the synapse as the center of chemical activity in the nerves and the key to continued transmission of all message impulses.

There are chemical substances associated with the synapse called neurotransmitters (or neurosynaptic transmitters, as they are also known). Neurotransmitters are stimulated into action by the messages carried by the nerve cell. The neurotransmitter is released into the synapse from the

little vessels that hold the substance within the (pre-synaptic) cell. There, the neurotransmitter chemical acts as a messenger itself (the means by which the nerve cells communicate with each other).

When the neurotransmitter chemical is released, it reacts with a receptor, the receiving site of the neigh-boring (post-synaptic) cell, and conveys or transmits the electrical impulse. You can think of the receptor as a lock and the neurotransmitter as a key. When it turns in the lock properly, everything clicks into place, and the message travels as it was originally intended.

Sometimes, however, the message is changed because of the way the neurotransmitter reacts with the receptor part of the neighboring cell. Things don't click, and the message becomes distorted. In other words, the response of the neighboring cell depends on the ability of its receptor site to recognize and react properly with the neurotransmitter. Most often, the receptor cell does react appropriately, and the message moves across the synapse and becomes a guided electrical impulse again. The whole process occurs in a fraction of a second and is repeated at each synapse as the message makes its way to its destination.

The transmission process, however, can be reduced (inhibited) or increased (excited), mimicked, or totally blocked-by drugs. A pain message can also be affected by another message traveling along the same nerve pathway, but traveling at a faster speed than the pain message.

Several different chemicals have been identified as neurotransmitters and can be synthesized in a laboratory. These include nor-adrenaline, also known as nor-epinephrine, acetylcholine, dopamine, serotonin, and dozens of other less important ones. Different nerve tracts, with their thousands of neurons, contain different neurotransmitters and communicate (innervate) the nervous energy, or message, to different parts of the brain.

To recap: A pain message begins its journey to the brain in a specialized nerve ending somewhere in the body after it is activated by a stimulus. With the aid of chemicals called neurotransmitters, the pain message travels as an electrical impulse from neuron to neuron across the synapses that divide the body's cells from one another, until it reaches its destination in the brain.

Scientists have identified two specific pain pathways to the brain. First, though, the pain message travels through the spinal cord along a single pathway called the spinothalamic tract. This pathway forks at the brain

stem in your neck. One branch travels through brain gray matter, the thalamus, and the hypothalamus (an ancient part of man's brain). This branch is called the paleospinothalamic pathway, and it is along this route that most dull pain travels (interestingly, the majority of chronic pain is described as dull pain, or a variation of dull pain, or a throbbing ache). The paleospinothalamic pathway takes the message to the limbic system of the brain or the portion that controls food intake, sexual activity, and the emotions. This helps to explain why most chronic pain has an emotional component to it.

The other pain message branch is called the neospinothalamic pathway, and it conducts sharp localized pain—a good description of most acute pain.

The way pain travels through the spinal cord on its way to the brain is an area of some controversy with pain theorists. A "gate-control" theory was proposed some 30 years ago by researchers Ronald Melzak and Patrick Wall, and its merits are still being debated today.

This gate theory suggests that there is a control mechanism that exists in the "substantia gelatinosa" cells of the spinal cord, a portion of the butterfly-shaped area of the cord. If the gate is open, pain messages will pass through, reach the brain, and make their impact. If the gate is closed, the message will not reach the brain, and, theoretically, you should feel no pain. Melzak and Wall suggest that the "gatekeepers" are nerve-fiber bundles. According to this theory, small nerve-fiber bundles keep the pathway open, and large bundles, whose signals travel faster than the signals on the small bundles, can close the gate. So, the pain of a stubbed toe is transmitted slowly along the small-nerve fibers (designated Delta A and C), and your response of rubbing the painful area stimulates a faster message along the large nerve-fiber bundles (Beta), causing the gate to close and creating a minimum sensation of pain.

The theory also suggests that the small nerve fibers can multiply the effect of the sensory input to different parts of the brain. Such augmented input, the theorists say, would initiate reactive messages from the brain in nerve fibers that descend through the spinal cord. When enough of these small fibers are activated, a critical threshold is reached in the gate system, a point at which another system is activated by the brain. This is the avoidance system, a reflect phenomenon. It theoretically controls reflex reactions (those performed without thinking) to pain-including the rubbing and scratching you do after stubbing a toe, the swelling and itching that

accompany an insect bite, crying "ouch," or withdrawing a finger or hand from a hot stove. These reactions can be initiated at the spinal cord without any brain (cortical) involvement at all.

While the gate-control theory has yet to be fully accepted by the scientific community, other researchers have gone on to identify an important component of the body's own mechanism for controlling pain. In 1977, researchers discovered that bodies internally produce pain killers, endorphins and enkephalins, chemicals similar in molecular structure to potent opiate narcotics such as morphine and heroin. Scientists had theorized since 1973 that chemicals like the endorphins and enkephalins had to exist, because they discovered the brain has many opiate receptor sites. These are sites on cells to which opium and its derivatives, including morphine, heroin, Dilaudid, Talwin, Demerol, Darvon, and Percodan, attach themselves in order to produce their analgesic and euphoric effects. The scientists (notably Snyder, Hughes, and Kosterlitz) reasoned that since such opiates are man-made and not native to the body (yet there are cells in the body that have a specific affinity for these foreign substances) then the body must produce its own opiate-like substances to attach to the receptor sites.

The opiate receptor sites are located all along the spinal cord in the substantia gelatinosa, and they densely populate the paleospinothalamic pathway in the brain. Because this pain pathway goes to the limbic system (which controls emotions), the receptor sites here probably enhance the euphoric effect of the opiates, while the analgesic effect probably begins in the spinal cord.

Scientists have evidence that the endorphins and enkephalins are neurotransmitters, acting at the brain's neuron synapses to influence the integration of sensory information such as pain and emotional behavior.

It is possible that people who seem to feel more pain more often than others may lack endorphins or may have a deficiency of receptor sites. Endorphins may someday be used as a prescription drug to combat depression and schizophrenia. An increase in endorphins may elevate a person's mood by creating a sense of well-being with an absence of pain everywhere in the body.

The perception of pain, however, is influenced not only by the body's chemical system, but also by as many as twenty-seven factors identified by researchers investigating the mystery of pain.