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Medicine & Health
RHODE ISLAND

The Spine

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Cover: "Erewhon Road," acrylic on canvas, by S. M. Aronson, MD. Stanley M. Aronson, MD is dean of medicine emeritus, Brown University and past editor of *Medicine & Health/Rhode Island*. A collection of his essays appear in *Medical Odysseys* along with essays by Joseph Friedman, MD (Mary Knorr, ed.). Information available at www.rimed.org.

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COMMENTARIES

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SPECIAL ISSUE: The Spine

Guest Editor: **Adetokunbo A. Oyelese, MD, PhD**

COLUMNS

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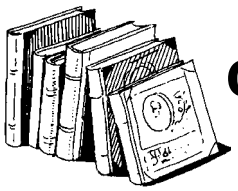

Commentaries

The End of *Medicine and Health/ Rhode Island* (on paper)

"Money makes the world go round." Or so it seems. I became editor-in-chief of this journal in January 1999, at a time when the journal was facing closure due to financial problems. Forces at the Medical Society were in conflict. Money was tight and some RIMS members thought the journal was a luxury that was no longer affordable. Luckily, a core group thought the journal's relatively low cost was worth the investment despite the financial crunch. I was given an uncertain, but short time to make the journal more solvent and somehow muddled through, until now. The RIMS has always been extremely supportive, but with the prolonged economic collapse all around us, the journal's support from outside organizations, the RI Department of Health, the American College of Physicians, RI Quality Partners and even Brown University, have dried up, leaving the RIMS with increasing financial responsibility and increasing cost for the journal.

With financing no longer possible, the journal, at the behest of the RIMS, has agreed to halt its publication in print. The journal will not, however, give up the ghost. We will continue, but in a new, web-based format. This will be new territory for this editorial staff and we hope you will make the transition with us. You can access new and old journal issues via the RIMS website, even if you're not a RIMS member. We invite your suggestions for the journal as we metamorphose. Our goals are in our mission statement below. We are open to change and welcome your thoughts.

– Joseph H. Friedman, MD

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MEDICINE & HEALTH/RHODE ISLAND: Its mission and its future.

The monthly medical journal of the Rhode Island Medical Society (RIMS), now called *Medicine & Health/ Rhode Island*, is an independent publication distributed to the physicians and medical students within this state as well as to selected medical libraries elsewhere in the United States. And while it attempts to reconcile the purposes of both the state's practicing medical community and its academic cadre of physician-teachers, the journal has and will continue to set its own independent agenda. It has no bylaws; and so the membership of its editorial board (and even the choice of its editor) has resulted from a series of informal, ad hoc decisions within the RIMS. Indeed, in the last six decades, the journal has had but three editors.

The funding of the journal, initially, has been borne solely by the RIMS. In recent years modest support has also been provided by the Rhode Island Department of Health, the Warren Alpert School of Medicine, Brown University, and the Rhode Island Quality Partners. And while the bulk of its operating costs has come primarily from the RIMS, the journal considers itself as reflecting the views and purposes of the entire medical community of Rhode Island: the state's practitioners, medical students, administrators, medical faculty, health professionals and medical research workers.

We see the Journal as a vehicle aimed at the practicing physicians of Rhode Island—whether they be in private practice, on the staff of the state's hospitals or as part of the many colleges and universities of the state. The journal offers a venue for them to express their clinical or investigative findings; for the academic faculty at Brown University to publish their clinical or research results; but also as a platform for local medical students, resident physicians and research fellows to learn the rudiments of medical writing; for medical professionals to make the community aware of testing or clinical expertise that may not be widely known to be available, even with our small state; and finally, as a forum where allied health professions such as local schools of public health, pharmacy and nursing, may share their concerns and aspirations as the business of health care takes on new and unanticipated challenges.

Joseph H. Friedman, MD
Stanley M. Aronson, MD
Sun Ho Ahn, MD

How Do We Know When a Medication Works?

Prior to the 19th century medicine was a stagnant art punctuated occasionally by evidence-based insights. Certainly medicine brought comfort to its patients; but rarely were medicine's therapeutic interventions responsible for the cure.

Science demands, amongst other strictures, an atmosphere of complete objectivity and relentless skepticism. Consider the following 15th century scenario: A patient seeks help because of an array of symptoms. Certain interventions are then prescribed including medications, changes in lifestyle, perhaps even a surgical procedure. And after some days the patient declares himself better.

May this 15th century physician now claim that his efforts effected the cure? Perhaps, but had this same physician been consulted by another patient (same age, same gender, same symptoms) and rather than intervene the physician had adopted a prudent waiting attitude; and after a week, the patient was felt to be improved, indeed, as improved as the treated patient. This physician, proud of his innate honesty, now suspects that his course of treatment was at best irrelevant and that the first patient's recovery was ascribable to causes other than his efforts. But the realities of medicine, centuries ago, did not allow for planned clinical experiments. Each new patient was a mystery unto himself and it was not in the physician's thinking to undertake extensive field trials or question the centuries-old therapies that he had used.

Historians regard the 19th century as pivotal in the evolution of modern medicine. A number of forces conjoined during that century to propel the art of medicine into the domain of the sciences.

The 19th century beheld the development of a host of diagnostic instruments, many portable, allowing the physician to extract objective data defining the functioning of his patient's body. These instruments included the thermometer to measure body heat, blood pressure contrivances to determine the pressure within the patient's arteries, ophthalmoscopes and otoscopes to view the interior of the sense organs, stethoscopes to evaluate cardiac contractions and discern pulmonary functions; and by the opening decades of this past century, the employment of X-rays to disclose the pathological secrets of the body.

In parallel with these diagnostic advances came the clinical laboratory to inform the physician about the biochemical status of the patient's body fluids. And the pathologist, aided by the microscope, could now announce the nature and prognosis of tissues removed surgically.

Medical education had been essentially an apprenticeship experience until the 20th century. An eager student might work for years as a physician's assistant. And after an ill-defined interval, he might then begin his own independent practice perhaps after some qualifying examination conducted by a guild of practitioners. Apprenticeship standards were loose, baccalaureate and university-based medical education rare and state governmental control of medical licensure inconsistent.

And the problem of how to know whether a particular treatment was effective or whether the cure was merely lucky happenstance? Only when field trials were planned and undertaken could such questions be answered. And the 18th and 19th century witnessed a number of such deliberate experiments.

Consider the vexatious problem of scurvy, a mysterious disease that killed more sailors than the combined casualties of naval warfare. Many empiric remedies had been devised over the centuries but it required a British Navy physician, James Lind (1716–1794) to devise a test to determine, with confidence, that lime juice prevented scurvy. He maintained one shipload of sailors on their customary diet with no fresh vegetables; and another ship's company with the same limited diet but now supplemented by a daily dose of lime juice. Those receiving lime juice remained free of scurvy; and thus, the British Navy (the Limies) continued to rule the 18th and 19th century high seas.

The efficacy of the newly devised vaccine against smallpox was also questioned; and so a similar field test was begun in East Boston on May 31, 1802. A temporary hospital was erected on Noddle's Island housing 13 boys who had previously received the Jenner vaccine and two who had not. All were then deliberately exposed to smallpox pus and only the two unvaccinated boys developed smallpox. The vaccination procedure was declared a success by the supervising committee (headed by a local business man named Paul Revere.) The morality of deliberately exposing humans to a deadly pathogen was left for the physicians of future centuries to ponder upon.

The 19th century was the turning point for the profession of medicine, witnessing the development of effective vaccines against smallpox, rabies and other pestilences; the development of purposeful diagnostic instruments; the standardization of medical education; and the increasing employment of field tests to determine the efficacy of new therapies. The 20th century saw yet further advances in these components of rational medicine as well as the emergence of a parallel discipline called medical ethics to protect the rights of those humans volunteering for field tests.

– Stanley M. Aronson, MD

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The author and his spouse/significant other have no financial interests to disclose.

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Diagnosis and Treatment of Lumbar Spinal Disorders – A Multidisciplinary Approach: Introduction

Adetokunbo A. Oyelese, MD, PhD

Lumbar spinal disorders are among the most common ailments afflicting patients in the United States and account for the second highest number of missed work days behind the common cold. As the lumbar spine is comprised of bony, neural, ligamentous and muscle elements, localizing the specific source of the pain (the pain generator) and the effective treatment can prove challenging for primary care physicians and spine specialists alike. The underlying cause may range from a simple "muscle strain", causing a back ache to a disc herniation impinging upon a nerve and causing radiculopathy or "sciatica" with pain down the leg. Degenerative changes of the lumbar spine in the disc and the facet joints may also lead to chronic back pain and conditions such as lumbar spinal stenosis in the elderly causing neurogenic- or pseudo-claudication which refers to pain in the back with radiation down the legs with ambulation. As such, the treatment of lumbar spinal disorders usually involves a number of different specialties and requires a multidisciplinary approach including physical therapy, chiropractic care, pain management and physiatry care and usually as a last resort, surgical intervention with a neurosurgical or orthopedic spine specialist. In this article, we have outlined the approach to lumbar spinal disorders from different disciplinary perspectives. In the first section, I give an overview of the approach to patients with low back pain, then Dr. Pradeep Chopra, a pain specialist discusses the indications for and the benefits of cortisone injections and other pain management strategies. Dr. Donald Murphy discusses a chiropractor's approach and perspective in the second section. The indications for and approach to surgical management are discussed in the following two sections by Dr Philip Lucas (orthopedic spine) and Drs. Heather Spader, Jonathan Grossberg and I (neurosurgery). Finally, we take a look at patients who have continued back pain after undergoing surgical intervention in a discussion of "failed back syndrome" by Dr. Daniel Aghion(neurosurgery), Dr. Pradeep Chopra (pain management) and myself.

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Approach To the Patient With Low Back Pain

Adetokunbo A. Oyelese, MD, PhD

There are two important initial determinations to make in evaluating and assessing a patient with low back pain: The first is a determination as to whether or not the symptoms are indicative of a serious medical condition (such as an unstable fracture or severe spinal compression that could lead to significant neurological injury, a potentially life threatening infection or a malignant neoplastic process). The second determination is as to where specifically the pain is arising from (the so-called "pain generator"—intervertebral disc disruption, a pinched nerve, lumbar facet arthropathy etc). It is the answers to these two questions that directs the diagnostic work up and the ultimate approach to strategies for management of the patient's symptoms. A detailed clinical history, physical examination and judicious use of diagnostic testing are key in helping the ractitioner navigate this complex landscape.

Clinical History

The clinical history is critical in the initial evaluation of a patient presenting with a disorder of the lumbar spine. It is important to first distinguish between innocuous back pain (such as from a muscle strain suffered in a sporting or occupational activity), and pain from a potentially life threatening process (such as an infection or a malignancy). It is also important to identify potentially critical neurological symptoms affecting the patient that may lower the threshold for urgent diagnostic imaging and surgical intervention. Thus, a patient with mild to moderate pain or numbness in a radicular distribution (from a presumed disc herniation or stenosis) must be approached very differently than a patient complaining of significant leg weakness or bladder and bowel incontinence which may signify a cauda equina (multiple lumbosacral nerve root) compression syndrome. The evaluating healthcare provider should elicit a history detailing the onset, quality, duration and pattern of the pain as well as its location. Pain

from a spinal malignancy that is not due to spinal instability tends to be nocturnal as the patient's endogenous cortisol levels decrease and may improve during the day. This is in contrast to pain associated with spinal instability which is exacerbated by motion. Constitutional symptoms such as fevers, chills, sweats and weight loss may indicate the presence of an infectious or malignant process. Additionally, a history of chronic steroid use, immunosuppressive therapy or disease, IV drug abuse may be predictive of a compression fracture or an infectious process. Severe or rapid onset of pain and weakness in a particular root distribution usually indicates a significant degree of neural compression and is more concerning when several nerve roots are involved.

Another subset of patients in whom one must have a lower threshold for obtaining radiographic studies and suspecting a significant injury includes elderly osteoporotic patients and patients with spinal spondyloarthropathies such as ankylosing spondylitis and **diffuse idiopathic skeletal hyperostosis (DISH)**. In these patients, spinal biomechanics are significantly altered because of auto-fusion across multiple segments or decreased bone mass and a seemingly innocuous traumatic event (such as a tripping action without a fall) may produce a compression fracture or a severely unstable spinal fracture which may be neurologically catastrophic if unrecognized. If the clinical history and subsequent physical (and neurological) examination speak to a significant underlying pathological process, further immediate diagnostic testing including appropriate laboratory and radiological studies (see below) must be obtained. Conversely, if a benign process is suspected, it is likely to be a self-limiting process and one may institute a more conservative approach with rest, NSAID treatment or physical therapy and pursue further testing and work up only if the symptoms do not improve.

Social History

Social factors play a significant role in the development of symptoms in lumbar spinal pathology and may affect the response of the patient to treatment and their ultimate outcome. For instance, it has been noted that the incidence of back pain, sciatica and spinal degenerative disease is higher among patients with a significant history of tobacco use.[1] Smoking also delays healing following spinal fusion surgery and increases the rate of pseudoarthrosis or incomplete fusion.[1] Additionally, patients with a history of depression, a work injury, or who may be involved in litigation or have secondary gain have a less favorable outcome and response to treatment for lumbar spinal disorders. Patients who have been out of work because of a spinal problem for less than six months, one year and two years have a 50%, 20% and less than 5% chance respectively of returning to work.

Smoking also delays healing following spinal fusion surgery and increases the rate of pseudoarthrosis or incomplete fusion.

Physical Exam

The physical examination of a patient with low back pain begins with a visual examination of the unclothed spine to assess for normal alignment and curvature. Percussion or palpation may reveal areas of tenderness or muscle spasms with guarding which should alert the examiner to a potential underlying injury. Passive range of motion testing should be conducted with the patient flexing forward and extending backwards as well as bending laterally and it should be noted whether these motions elicit pain or discomfort. Back pain elicited with forward bending is thought to be related to disc disease (as the load-bearing shifts to the anterior column of the spine) while back pain with extension could be indicative of facet joint-mediated (posterior spinal column) pain. Leg pain with extension of the spine is usually indicative of spinal canal or neural foraminal stenosis. A thorough neurological examination is necessary and may help in the localization of the pathology within the spinal canal. Each spinal nerve exiting the spine at a particular level subserves sensory and motor function for a particular distribution within the lower extremities. The purpose of the neurological examination is to determine whether or not there is any neural compression and to use this "road map" to identify the spinal region or "neighborhood" where the compression or disturbance is occurring. The upper lumbar nerve roots (L1-3) primarily innervate the muscles of the upper leg involved in hip flexion (L1, L2) and knee extension (L3, L4) and convey sensation from the medial and anterior thigh region. The L4 and L5 nerve root are primarily involved in ankle and foot motion (dorsiflexion, extensor hallicus longus and eversion) and convey sensation over the antero-lateral thigh, medial leg, medial melleolus and over the dorsum of the foot. The gatrocnemius and soleus (calf) muscles utilized in plantar flexion (standing on the toes) are innervated by the S1 nerve roots which also convey sensation to the lateral aspect of the foot. Occasionally, a diminished patella (L3, L4) or Achilles tendon (S1) reflex may precede weakness that is noticeable to the patient or the examiner. Finally, radiating posterior thigh and leg pain on straight leg raising with the patient supine (Lasegue's sign) may indicate lower lumbar nerve root irritation from a disc herniation (L4-S1). A femoral nerve stretch test performed with the patient prone and with passive flexion of the thigh at the knee and extension of the hip producing anterior thigh pain indicates irritation of the upper lumbar nerve roots (L2-L4). Because hip pain can frequently mimic lumbar radiculopathy, testing of the hip joint with internal and external rotation (Patrick's maneuver) for groin pain and examination of the trochanteric bursa region should be performed when examining a patient for back pain and radicular symptoms.

Radiographic Assessment

Radiographic studies are a very useful adjunct in the diagnosis and treatment of disorders of the spine and are used to confirm or rule out what has already been suspected based upon the clinical history and physical examination. Radiographic tests ordered by treating physicians may include plain film x-rays, a **computed tomography (CT)** scan, **magnetic resonance imaging (MRI)** scan or a nuclear medicine study such as a bone scan. The

specific test should be tailored to the clinical situation in question. For instance, plain film xrays or a CT scan give a good overview of the bony anatomy and alignment (curvature—scoliosis, angulation—kyphosis) and are useful in assessing for fractures, dislocations or displacement and congenital spinal dysraphisms. These radiographic tests are also useful in evaluating a patient following a spinal arthrodesis and instrumentation operation to assess for adequate bony fusion and healing. X-rays with flexion and extension views (dynamic x-rays) may uncover an occult instability within a spinal segment particularly if there is an underlying spondylolisthesis (anterior or posterior displacement of one vertebral body with respect to another). A bone scan is useful in identifying hypermetabolic regions within the spine as may occur with an infectious or neoplastic process. Perhaps the imaging modality most utilized is the MRI because of the ability to examine in significant detail, the soft tissue elements of the spine such as the intervertebral discs, the spinal cord and nerve roots, **cerebrospinal fluid (CSF)**, and the paraspinal soft tissues, in addition to the bony vertebral elements. When coupled with the administration of intravenous gadolinium contrast dye, vascular lesions, neoplasms and infections are very well visualized. However, the high sensitivity of MR imaging has led to normal anatomical variation or age-related change in the spine such as disc degeneration being incorrectly identified as a cause for pain. A great many patients undergo surgical intervention in the United States every year with questionable diagnoses such as this and unsurprisingly, their post-operative outcomes are quite poor. Jensen and colleagues[2] demonstrated the presence of a disc bulge in a least one spinal level in 98 asymptomatic patients ages 20 to 80 years of age with the incidence of a disc bulge increasing with age. Notwithstanding, an MRI may provide information as to the presence of a disc herniation or protrusion compressing the thecal sac or a nerve root, arthropathy or degeneration and inflammation within the facet joints, spinal canal stenosis from facet joint and ligamentous hypertrophy. Modic[3] described and characterized changes within the bone marrow associated with inflammation and degeneration adjacent to the intervertebral disc based upon the appearance on distinct MRI sequences. Type I changes were associated with acute or subacute inflammation while types II and III were consistent with more chronic changes. The incidence of low back pain has been found to be greater in patients with Type I Modic vertebral endplate changes.[4,5]

Other Clinical Testing

Electrodiagnostic testing (EMG, Nerve conduction studies) maybe used as an adjunct to the other testing listed above in determining whether a patient's symptoms are consistent with a radiculopathy. Electrodiagnostic testing is also useful for determining whether numbness is due to diabetic neuropathy or nerve compression. Urodynamic testing of bladder function is useful in the diagnosis of a neurogenic bladder in patients with urinary incontinence or hesitancy from compression of the cauda equina or tethering of the spinal cord.

In summary, the practitioner must be part "detective" in gleaning critical information from the patient using the clinical history, physical examination and diagnostic testing, analyzing the data and coming up with a definitive diagnosis. Once it is determined that the condition is not life threatening, it is the responsibility of the practitioner as a "therapist" to devise an appropriate multimodality management strategy for the relief of the patient's symptoms with referrals to appropriate specialists when indicated and also to reassure the patient and encourage them to make the necessary lifestyle changes to improve the lumbar spinal health. The role of the specialist is explored in greater detail in the ensuing sections.

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Interventional Approach To Low Back Pain

Pradeep Chopra, MD

This is the brief treatise on the interventional approach to managing spinal pain with special reference to low back pain. This article discusses predominantly low back pain but the same principles apply to neck pain and thoracic pain, with some variation. I also want to stress that the treatment of spinal pain, as in most chronic pain conditions, must have a multidisciplinary approach. There is no one single modality that is most effective for treating spinal pain. In most cases, a few of these modalities have to be done simultaneously. For example, physical therapy in conjunction with interventional pain management or weight loss, smoking cessation in conjunction with core strengthening exercises.

According to the **American Society of Interventional Pain Physicians (ASIPP)**, interventional pain management is "a discipline of medicine devoted to the diagnosis and treatment of pain related disorders." For patients with back pain, interventional pain management techniques are especially useful both from a diagnostic as well as a therapeutic point of view. Interventional pain physicians have a wide array of treatment modalities that they can use to manage spinal pain.

In order to understand treatment of low back pain one has to understand the anatomy. Briefly, the spine is composed of bones, nerves, ligaments, joints, muscles and a unique structure called the intervertebral disc.

Lumbar vertebrae

There are five lumbar vertebrae. The anterior part of each vertebra is called the vertebral body. It is a box shaped structure. The top and bottom surfaces are smooth and perforated by tiny holes. Projecting from the back of the vertebral body are two solid pillars of bone called pedicles. There is a sheet of bone that projects from each pedicle towards the midline called the lamina, thus forming a neural arch. The arch surrounds the nerve elements that pass through the spine. Narrowing of this arch is known as central stenosis. Projecting from the posterior aspect of the vertebra are four articular processes. These articulate with the vertebrae above and below to form facet joints. As with joints elsewhere in the body, the facet joints are lined with a cartilage and surrounded by a capsule. The facet joints are prone to age-related arthritis, arthrosis (age-related degenerative changes) and injury.

When the spine is viewed from the side, one can see the intervertebral foramina, an oval opening through which the spinal nerves exit the spinal canal. These are formed by the pedicles of the vertebrae above and below and are bordered by the disc anteriorly and the facet joint posteriorly. The height (size) of the foramen is thus determined by the height of the intervertebral disc but, may also be narrowed by hypertrophy or overgrowth of the facet joint with arthritis. Narrowing of the intervertebral foramen is called foraminal stenosis and, when there is associated impingement of the nerves, it may result in radiating pain down the leg or "radiculopathy."

Inflammation of the nerves has been proposed as a significant contributor towards low back pain.

Intervertebral disc

The intervertebral disc is a layer of strong, soft tissue interposed between the vertebral bodies. It is deformable. The structure of the intervertebral disc is unique. It is designed to transfer the load from the upper vertebra to the lower vertebra without collapsing; deformable enough to accommodate rocking movement of the spine; and sufficiently strong to be not injured during movement. The intervertebral disc has a central soft core known as the nucleus pulposus. It is surrounded by collagen fibers arranged in a highly organized pattern called annulus fibrosus. The third component of the intervertebral disc is the vertebral endplate. These are two layers of cartilage which from the upper and lower aspects of the disk.

The Sacroiliac Joint

The pelvic girdle is formed by the iliac bones and the sacrum. The sacrum forms a joint on each side with the iliac bones called the sacroiliac joints. It does not exhibit active movement but does move passively. Its chief role is to act as a stress relieving joint. As with joints elsewhere, the sacroiliac joint is also prone to arthritic changes and injury. The sacroiliac joint is a very common site for low back pain, especially in women. Sacroilitis is recognized as part of the spectrum of ankylosing spondylitis and other spondylarthropathies, psoriatic arthritis and arthritis related to inflammatory bowel disease such as Ulcerative Colitis and Crohn's disease. The more common condition is Sacroiliac Joint Dysfunction often attributed to hypermobility or hypomobility of the joint. It may also be seen in some patients who have a long-standing history of lumbar fusion. These patients usually present with lower back pain, gluteal pain and hip joint pain. The pain radiates into the groin and lower extremities. The pain increases with sitting, weight-bearing as in standing, walking up the stairs, forward flexion, sexual intercourse and menstrual periods. Pain from the sacroiliac joint is best diagnosed clinically. There is no value to a radiological examination. The treatment is usually a fluoroscopically guided intra-articular steroid injection. Radiofrequency rhizotomy of the sacroiliac joint is also an option.

Muscles of the lower back

There are three major groups of muscles in the lower back: the Psoas major which lies on the anterolateral aspect of the lumbar spine; the Quadratus Lumborum and the intertransversarii laterales connect the lateral aspect of the spine and the posterior lumbar paraspinous muscles, which cover the posterior aspect of the spine.

Piriformis muscle

The piriformis muscle lies anterior to the gluteal muscles. It originates from the sacrum and attaches to the greater trochanter of the femur. The sciatic nerve usually passes below the piriformis muscle, but in approximately 15% of cases it passes through the muscle. A spasm of the piriformis muscle will irritate the sciatic reproducing radicular symptoms to the lower extremity. The piriformis muscle is closely related to the sacroiliac joint and the hip joint. Dysfunction of the sacroiliac joint may cause spasm of the piriformis muscle inducing radicular symptoms in the lower extremity. It is diagnosed by stretching the muscle, which reproduces the pain. An EMG of the muscle may be helpful in detecting hyperactivity or spasms that may result in irritation or compression of the sciatic nerve. The treatment is to stretch the muscle with or without trigger point injections. In some of the more refractory cases botulinum toxin injections have been helpful.

Radiculopathy or radiculitis

Radicular pain is a result of inflammation or irritation of the spinal nerve or its roots. The characteristic radicular pain (nerve root pain) is usually described by patients as a well defined shooting or stabbing pain in the lower back that extends into the leg. In most patients with lumbar radiculopathy the pain radiates into the leg below the knee after the ankle level. The distal symptoms are usually numbness and tingling. Radiculopathy and radiculitis are usually in a specific dermatomal distribution. This implies that a nerve root has been affected. This is distinct from radiation which is not in any specific dermatomal distribution and is considered a referred pain For example, consider a patient presenting with pain in the lower back and leg: if it is because of a nerve inflammation from the nucleus pulposus it would be in a very specific sensory dermatome; if it is because of inflammation of the lumbar facet joint, then it is not along a sensory distribution.

Pain from lumbar facet joints is predominantly in the lower back, with radiation into the leg usually above the knee. It is in a non-specific sensory dermatomal distribution. Some of the causes of lumbar facet joint pain are osteoarthritis, rheumatoid arthritis, fracture of the facet joint and capsular tear. It is exacerbated with extension of the spine or axial rotation of the spine. Radiofrequency rhizotomy is a long-term option for lumbar facet joint pain. It is a procedure in which pain signals are "turned off" through the use of heated electrodes applied to the sensory nerves from the facet joints. Once the pain from the lumbar facet joints is decreased, patients benefit from lumbar stabilization or core strengthening exercises.

Hip joint

Pain from the hip joint may radiate into the lower back, gluteal region or the groin. It may also radiate down the leg. Prolonged hip joint pain can result in sacroiliac joint dysfunction and muscle spasms in the lower back.

A patient presenting with low back pain and lower extremity pain may be suffering from:

Discogenic pain

Injury to the disk can be painful due to two mechanisms. The nerve endings in the annulus fibrosus are exposed to enzymes and breakdown products as a result of the deterioration process of the disk. Inflammatory chemical mediators are released that trigger nociceptive pain at the nerve endings. This causes an inflammation of the spinal nerve root resulting in radicular pain to the lower extremity. Radicular pain caused by a herniated nucleus pulposus is aggravated by activities such as lifting, bending, straightening, sneezing or coughing or any activity that increases nerve root tension such as straight leg raising. Pain is often relieved by standing or sleeping with a pillow under the knees. An epidural steroid injection performed under fluoroscopy guidance at the correct level helps decrease inflammation.

Facet joint pain

Inflammation of the facet joints causes pain in the lower lumbar region with a referral pattern to the lower extremity. Management of this pain is usually lumbar facet intra articular steroid injection under fluoroscopy guidance, or radiofrequency rhizotomy.

Sacroiliac joint pain

Sacroiliac joint dysfunction or sacroiliitis presents as a pain in the lumbosacral region, usually with radiation to the leg. It may are may not be associated with piriformis muscle spasm, in which case the patient presents with radicular pain. Management of this pain is usually a sacroiliac intra articular joint injection under fluoroscopy, or trigger point injections to the piriformis muscle followed by stretching.

Hip joint pain

This usually presents as pain in the lower back, gluteal region, groin, upper thigh or outer buttocks. The pain may radiate down the leg. It may also be associated with piriformis syndrome. An intra-articular steroid injection is diagnostic as well as therapeutic. It is performed under fluoroscopy guidance.

Trochanteric bursitis

The greater trochanteric bursa is situated between the femur and the insertion of the gluteus medius and minimus muscles into the greater trochanter of the femur. Inflammation of the trochanteric bursa presents as pain over the lateral aspect of the thigh with radiation down the leg, usually as far as the knee. Patients with low back pain often have a compensated gait resulting in trochanteric bursitis. Very often lateral hip pain may be caused by tendinitis of the gluteal muscles which in turn inflames the trochanteric bursa. It is very common in middle aged women and is also associated with obesity and arthritis. Diagnosis may be made by eliciting tenderness over the lateral hip or asking the patient to stand on one leg at a time which reproduces the pain. Treatment is to correct the etiology of the bursitis, NSAID's, or a steroid injection into the bursa.

Knee and ankle joint pain

Although pain from these joints does not cause lower back pain patients have an antalgic gait, resulting in exacerbation of their lower back pain.

Muscular pain

This is a very common cause of acute lower back pain. Trigger point injections are injections of local anesthetic performed into a muscle. On examination

they present as taut bands with hyperirritable spots. Stretching exercises in conjunction with trigger point injections helps relieve this myofascial pain.

The role of steroids in spinal pain

Inflammation of the nerves has been proposed as a significant contributor towards low back pain. Nerve roots have been shown to be swollen and inflamed on myelography and during surgery. The nucleus pulposus induces marked inflammatory change in the nerve roots dura mater and the spinal cord. High levels of inflammatory phospholipase A2 activity have been recorded in lumbar disc herniations.

Steroids decrease inflammation by inhibiting the action of phospholipase A2. Phospholipase A is an enzyme responsible for the release of arachidonic fatty acids from cell membranes at the site of inflammation. This is the rate limiting step in the production of prostaglandins and leukotriens.

They also block transmission of nociceptive C fiber. Blocking the transmission of nociceptive input is attributed to a direct membrane action and not to an anti-inflammatory effect of the steroid.

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Surgery In the Treatment of Lower Back Pain I

Philip Lucas, MD

Lower back pain is a very common problem with up to 85% of adults being affected sometime in their life time.[1] Most patients who experience back pain will improve regardless of treatment but a small percentage go on to experience chronic or recurrent episodes of often incapacitating pain.

Surgery has proven to be successful in the treatment of some spinal problems that have been unresponsive to non-surgical treatment. These include sciatica secondary to herniated disc and spinal stenosis. In addition, cases of instability secondary to trauma, infection or cancer have responded well to surgical intervention. There is a group of patients, generally in the 30 to 50 age group who do not carry the aforementioned diagnosis and who will experience chronic recurrent episodes of incapacitating back pain. They often try a myriad of non-surgical treatments without success. Their daily activities are often dictated by their pain. These individuals typically will describe pain across the lower back without leg pain. Their exam shows limited and painful range of motion without neurologic deficit. Routine diagnostic tests including x-rays, CAT scans and even MRI may best show some degeneration within the disc and adjacent facet joints.

Before surgery can be discussed as a treatment option for those without herniated disc or stenosis the source or etiology of their pain must be determined. Over the years numerous structures including sacroiliac joints, intervertebral discs, facet joints, ligaments and muscles have been described as being a source of low back pain. Routine diagnostic studies including x-rays, CAT scan and MRI may appear similar in symptomatic and asymptomatic patients and often do not show significant structural abnormality.[2] These findings have led MRI studies with greater sensitivity in addition to the development of diagnostic studies that involve injections to either provoke or eliminate pain temporarily in attempt to find the pain-generator structure. These tests do carry a relatively high false positive rate and this must be kept in mind in attempting to decide the role of surgical intervention.

Indication for surgery in the treatment of low back pain remains controversial.[3] However, it appears that there is a small group of individuals who present with chronic or recurrent episodes of pain who fail a minimum of six months of non-surgical treatment who may be candidates for surgical intervention. These individuals will have diagnostic studies that show degenerative changes within the disc and have positive injection studies. In addition, they are not involved in litigation, have no recognizable secondary gain and have a normal psychological profile.[4]

Treatment of low back pain without clear cut structural abnormality remains difficult. Most of these patients will respond to non-surgical modalities but a small group of patients will continue to have disabling back pain affecting their day to day activities.

There are two options regarding surgical treatment. The first being an arthrodesis or fusion and the other being a type of motion sparing procedure. If pain is discogenic in origin it would appear that removal of the disc will eliminate the pain-generator. Unfortunately if one does a complete disc removal, an unstable segment develops, necessitating stabilization or fusion. Fusion may be performed through an anterior or posterior approach. At times a combined or 360° fusion is recommended.

Numerous studies have been conducted assessing fusion rates and patient satisfaction.[5] The goal of surgery is to bring about a solid arthrodesis. Patient satisfaction and pain relief does not correlate with a successful fusion. Analysis studies looking at patient satisfaction regarding fusion averages about 68% with fusion rates averaging in the 85 to 90% rate. One of the complications related to spinal fusion is that of adjacent segment disease.[6] Up to 25% of individuals who undergo a fusion may develop degenerative changes at adjacent levels. A certain percentage of these individuals may become symptomatic enough to warrant further surgical intervention. As a result of these findings motion-sparing technology has evolved. These include flexible polymer rods, nucleus pulpulsos replacement with injection of disc biochemical polymer compounds and total disc replacement. At this time only total disc replacement is FDA approved.[7]

At first glance total disc replacement seems like an ideal treatment for discogenic back pain. However, results following disc replacement do not appear to be any better than spinal fusion. The long term results are still pending.

Treatment of low back pain without clear cut structural abnormality remains difficult. Most of these patients will respond to non-surgical modalities but a small group of patients will continue to have disabling back pain affecting their day to day activities.

In this group it is imperative to carry out a thorough history and examination in attempt to localize the etiology or pain-generator. If this can be attained a small group of patients can expect a successful outcome with surgical intervention. Fusion appears to still be the gold standard with total disc replacement alternative and possibly the treatment of choice in the future.[8]

Ultimately our goal in the treatment of recurrent or chronic back pain would be to have a minimally invasive method of eliminating the pain-generator allow-

ing these patients to live an active lifestyle without incapacitating pain.

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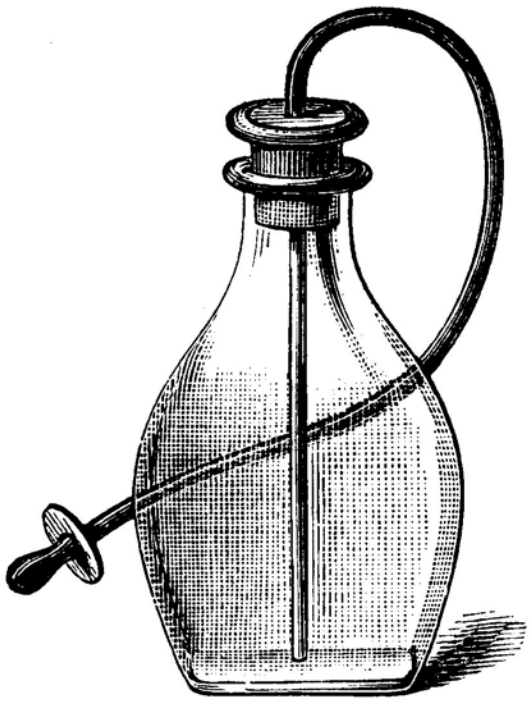

Surgery In the Treatment of Lower Back Pain II – Lumbar Stenosis and Disc Herniations

Heather Spader, MD, Jonathan Grossberg, MD, Adetokunbo A. Oyelese, MD, PhD

Low back pain is one of the most common health problems encountered by the general population with a lifetime incidence of 70-80%.[1] While there are numerous causes of low back pain, this article will deal with two of the most common etiologies found in the US population: lumbar disc disease and lumbar spinal stenosis.

Lumbar Disc Disease

While the first anatomical descriptions of the lumbar disc can be traced back to Vesalius in the 16th century, the first lumbar laminectomy was not reported until 1829 by AG Smith. It was nearly a century later when Mixter and Barr first described neural compression from a herniated lumbar disc.[2] While trauma was thought to be the etiology of lumbar disc disease, it is now known that the majority of lumbar disc disease is the result of a normal degenerative cascade in the annulus itself.

The diagnosis of lumbar disc disease is often a clinical one with the most common symptoms being back pain, radicular pain, numbness, and weakness. Imaging studies such as **magnetic resonance imaging** (**MRI**) can also help with the diagnosis, but only in the correct clinical scenario, as studies have shown that the prevalence of degenerative discs increases with age, and that by age 70, 80% of lumbar MRIs were abnormal.[3] In addition, **electromyography** (**EMG**) can help pinpoint the location of a patient's symptoms.

The majority of cases of pain due to lumbar disc disease will resolve over a six week period with a trial of anti-inflammatory medication and physician therapy. In more recalcitrant cases, epidural steroid injections can assist in pain management.[4]

The indications for operative management of herniated lumbar discs include: severe, unremitting pain, neurologic deficit, and patient preference. The Main Lumbar Spine Study on Sciatica found that patients with severe symptoms benefited more from surgery than conservative management (71% vs. 43%).[5]

The operative technique for lumbar discectomy has evolved over the last three decades. In the late 1970s, the microscope was first used to assist in the surgery, and technological advantages today include endoscopic and minimally invasive techniques that offer the potential of less peri-operative pain, smaller incisions, and faster recovery and return to work.

Non-operative management of stenosis includes physical therapy, oral pain medication, and invasive pain management, such as steroid injections.

Lumbar Spinal Stenosis

Lumbar stenosis is defined as narrowing of the central spinal canal, lateral recesses, or neural foramen which causes impingement on the neural elements. The word stenosis is etymologically derived from the Greek term for "choke," but while Hippocrates described low back pain and sciatica, it was not until 1911 that Bailey and Casamajor postulated that chronic compression of the spinal roots may result from narrowing of the spinal canal or foramina.[6]

The incidence of spinal stenosis is 50/100,000 and it is estimated that 13-14% of specialist visits for low back pain involve lumbar stenosis. The disease most often affects the L4-5 and L3-4 levels, and is responsible for approximately half of all cases of neurogenic claudication.

The diagnosis of lumbar stenosis is made by a combination of clinical symptoms and radiographic images. The most common symptoms are back and leg pain, subjective weakness exacerbated by walking, and lower extremity numbness. These symptoms are classically exacerbated by extension and improved with flexion. MRI is the imaging study of choice to document spinal cord compression in lumbar stenosis, while **computed tomography** (**CT**) helps demonstrate bony compression in the disease. Electrophysiological studies, such as EMG, can aid in the diagnosis in more complicated cases.

Non-operative management of stenosis includes physical therapy, oral pain medication, and invasive pain management, such as steroid injections.

Operative management of lumbar spinal stenosis should only be considered after patients have failed conservative therapy. The rationale behind surgical management is to improve the patient's symptoms, and accordingly most of the procedures involve decompression of the spinal cord and nerve roots. Operative management for lumbar stenosis ranges from surgical decompression via a laminectomy approach to fusion with instrumentation for more complex and mechanically unstable patients. Our preference is to perform the procedure through a small incision and with the use of an operative microscope. Studies have shown that older patients with increased comorbidities have higher rates of surgical complication, and as a result there is a trend towards minimally invasive decompression and fusion, which have the potential advantages of decreased blood loss and shorter operative time.[7] Although much advertised, the use of lasers in spinal surgery has not been proven safe or effective, particularly in comparison to the well-studied benefits of traditional minimally invasive surgery. Unlike the use of laser instruments in ophthalmology or dermatology, laser surgery in the spine still requires an incision and

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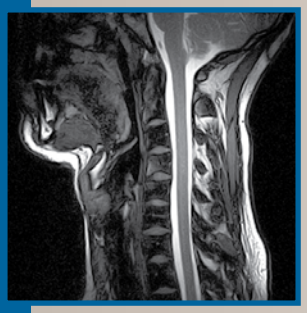

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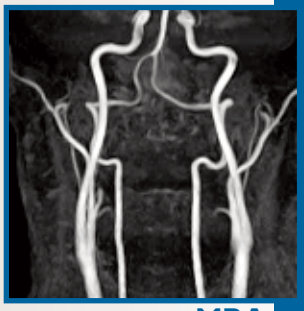

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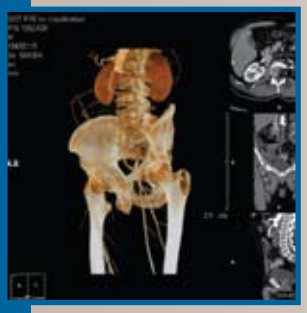

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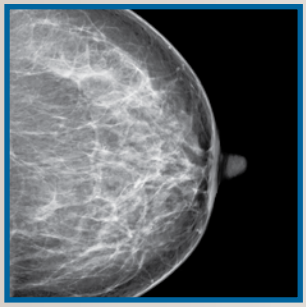

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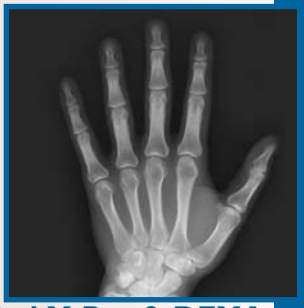

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endoscopic dilatation, with the sole difference being the use of laser instruments to cut away the disc fragment. Incidents of significant arterial bleeding have been reported, and the procedure is limited in its ability to remove larger disc fragments or visualize and control spinal fluid leaks.

The Maine Lumbar Spine Study prospectively compared operative and non-operative intervention for stenosis and found that 55% of patients in the surgical arm had improvement in their symptoms at one year compared with 28% in the non-surgical arm.[8] The randomized SPORT trial found that there was no difference in clinical outcomes between surgical and non-surgical patients in its intent-to-treat analysis. The study, however, was flawed by its high rate of cross-over between the arms, and when the patients were analyzed in an as-treated method, there was a significant advantage for surgery at three months, one year, and two years.[9]

In conclusion, patients with pain from a lumbar disc herniation or neurogenic claudication from lumbar spinal stenosis who have not responded to conservative, non-surgical intervention may benefit from and often so well with surgical intervention. However, proper selection of these patients is crucial in order to avoid poor functional outcomes which unfortunately are not uncommon with surgery for patients suffering from lumbar spinal disorders.

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Failed Back Syndrome

Daniel Aghion, MD, Pradeep Chopra, MD, Adetokunbo A. Oyelese, MD, PhD

Approximately 250,000 surgeries for low back pain are performed annually in the USA.[1] Approximately 40% of patients undergoing lumbar surgery continue to report significant pain after surgery, and a significant portion of these will result in **failed back syndrome (FBS)**. FBS is defined as persistent or recurrent chronic pain after one or more surgical procedures on the lumbosacral spine. The incidence of true FBS is as high as 15%. Unfortunately, the diagnosis of FBS does not point to the actual cause for treatment failure. Multiple factors can contribute to the development of this syndrome such as residual or recurrent disc herniation, persistent post-operative radiculopathy, joint instability, scar tissue, or muscular deconditioning. Furthermore, patients may be predisposed to FBS due to systemic disorders such as diabetes, autoimmune disease, psychiatric disease, or vascular disease. Overall, it is clear that both biological and psychological issues play a significant role in the outcome of lumbar spine surgery.

The specific causes of FBS have been a topic of much debate. Patients with this syndrome can be divided into one of two groups: 1. Patients in whom surgery was never indicated, or the surgery performed carried a low likelihood of achieving the desired result. 2. Patients in whom the surgery was indicated but the surgical procedure was inadequately or incompletely performed, failing to achieve the intended result.

There have been several studies that have suggested that up to 95% of FBS cases are related to inappropriate surgery on patients with myofascial pain from muscle denervation, symptoms of fibromuscular dysplasia, or quadratus lumborum, iliopsoas and gluteal muscle syndromes which may mimic the pain distribution of a herniated disc.[2] Operative intervention in these cases would carry a low likelihood of success and as such, surgery should not be entertained in these scenarios. Furthermore, it has been generally agreed that patients with predominantly radicular pain will have better outcomes following surgery than those with predominant complaints of back pain.[3] This is because it is usually more straightforward to identify the source of pain or "pain generator" on an MRI in the case of a pinched nerve causing radicular symptoms than it is to identify the pain generator causing low back pain. Thus, many patients with asymptomatic but abnormal appearing degenerated discs on MRI or with myofascial pain may be subjected to inappropriate lumbar surgery with resulting poor outcomes.

One of the most common and most overlooked causes of FBS is inappropriate patient selection. Appropriate patient selection is one of the most important factors in the outcome of any spinal surgery.

The second group of patients with FBS includes those for whom surgery was indicated but in whom incomplete or inadequate operations were performed. This may happen after a standard laminectomy and discectomy or after a lumbar fusion. FBS after a laminectomy/discectomy may ensue due to a laminectomy being done at the incorrect level, an inadequate amount of bony removal, or the targeted fragment of disk was not removed. Waguespack et al showed that the most common diagnosis for FBS was residual lateral recess or foraminal stenosis from an inadequate bony decompression.[4] Discectomies or laminectomies done to decompress the central canal without addressing underlying lateral recess or foraminal stenosis can lead to continued radicular symptoms and disappointing results. Additionally, an inadequate surgical exposure can lead to significant nerve root injury (2-3%) because more retraction on the neural elements is necessary to gain access to the disc pathology. Conversely, excessive bone removal as with a laminectomy, in which a significant amount of facet joint removal is performed, may lead to spinal instability and pain.

FBS after a lumbar fusion can ensue due to extensive instrumentation or fusion across multiple segments. This can result in a 'flat back syndrome' or loss of normal lumbar lordosis leading to FBS. Pseudoarthrosis and non-union (incomplete fusion; 5-35%), or hardware failure (fracture or loosening) may also contribute to continued back pain and FBS. Transitional or adjacent segment syndrome may also be a cause of FBS after lumbar fusion. This is where accelerated degenerative changes occur at levels adjacent to a spinal fusion resulting in instability that is characterized by hypermobility, kyphosis or scoliosis above or below a spinal fusion segment.

One of the most common and most overlooked causes of FBS is inappropriate patient selection. Appropriate patient selection is one of the most important factors in the outcome of any spinal surgery. In a retrospective study of patients who had low back surgery, less than half met the standard criteria for surgery, emphasizing that failure of initial surgery is not an indication for a second surgery.

Psychological, social, and behavioral issues play a significant role in the outcome of the surgery as well, since patients with chronic low back pain as a result of FBS frequently have psychological illnesses. These psychopathologies include depressive disorders, anxiety, and somatization, all of which may be undertreated. A patient's psychopathology is thought to influence the pain level and outcome from aggressive spine surgeries. In cases where there is pre-existing neural damage, it is important to not have unrealistic expectations of a complete return to full premorbid condition. Patients must understand that they may continue to have some residual pain as a result of pre-existing nerve injury. Partial

relief from their pain can sometimes help patients improve their quality of life and help them tolerate any residual pain. In addition to pre-operative expectations, limited social support may contribute to a poor outcome after spine surgery.

Motivational problems or secondary gain may be the source of long-term pain complaints. Patients presenting with work related low back pain tend not to show the same benefit from any of the common modalities of treatment as non-work related problems. In a prospective two year study, patients with low back pain, who had been off work for more than 90 days from work related injuries, did not show any improvement from medical interventions including surgery.[5] Even when objective findings are present in a psychologically unstable patient or there are compensation and litigation factors present, the outcome from back surgery is doubtful.

The key to evaluating a patient with multiple lumbar surgeries or failed back surgery is to gather all the information in a very organized fashion. Testing in FBS patients is done to confirm a diagnosis rather than to 'fish' for a diagnosis. A good history and focused physical exam is very important, as is reviewing of all radiological data. Seek answers to questions such as pre-operative versus post-operative complaints. Knowing the duration of relief from symptoms after the surgery may help determine whether there is a recurrence of a herniated disk or residual lateral recess stenosis. A history of systemic complaints such as irritability, fatigue, fever and weight loss, and back pain as compared to leg pain should be elicited to rule out post-operative infections. Factors that exacerbate the pain such as flexion (anterior column pain), extension (posterior column pain), sitting (Sacroiliac joint) are important components of a history that may provide successful results.

Treatment

Treatment options for FBS are numerous and depend upon the specific underlying cause. Conservative care of the FBS patient is a necessary starting point. Only a few clinical circumstances would preclude a conservative approach and these include severe spinal instability, infection, or impending neurologic dysfunction. Most patients should be given the opportunity to improve without additional surgeries. Comprehensive programs have demonstrated effectiveness in relieving pain, myositis, inflammation, spasm, and restoration of range of motion. Vigorous physical therapy and behavioral therapy aimed at the elimination of local mechanical issues has been shown to improve function and patient satisfaction. While conservative measures are being implemented, specialized pain management may also offer improvement in the functional outcome. For neuropathic pain, a series of anticonvulsants such as Tegretol and Neurontin have been found to be useful.[6] Tricyclic antidepressants have also proved beneficial, though may be limited by anticholinergic and central effects.[7] When pain is of somatic origin, NSAID's have been a mainstay of treatment.

The key to evaluating a patient with multiple lumbar surgeries or failed back surgery is to gather all the information in a very organized fashion.

Identifying the pain generator may be quite frustrating and, because of this, provocative diagnostic blockades have been explored. These may be both diagnostic and therapeutic and include zygopophyseal joints, single or multiple lumbar nerve root blocks, and intradiscal blockade.

Spinal cord stimulation (SCS) is a treatment modality that has been in use for over 30 years and has been widely utilized with good outcomes in FBS. The ideal patient is one who suffers from intractable sciatic pain. This method involves placing percutaneous leads in the epidural or intrathecal space and providing electrical stimulation over a specified portion of the spinal cord based on the patient's pain pattern. Thorough testing and trials of SCS prior to final implantation has been shown to provide the best results. Infection, lead migration or breakage, CSF leak, and weakness are some of the complications associated with these devices. Success rates are on the order of 50% improvement in 50% of patients at specialized centers.[7]

Spinal narcotics may be administered epidurally or intrathecally for pain relief in the form of a permanent delivery system such as pain pump. Morphine is the most common analgesic agent used, though other medications have been trialed in patients who have inadequate pain relief or adverse effects from morphine.[8] FBS is the most common indication for pain pump insertion, and anywhere from 60-80% of patients achieve good pain relief from intrathecal drug administration.[6] Pump malfunction causing overdose or withdrawal symptoms, infection, meningitis, or respiratory failure are some of the complications associated with these devices.

Additional surgery for FBS is controversial and several general principles must be taken into account. If root compression syndromes or instability is the cause of the syndrome, those patients will respond to a second operation with almost the same outcomes as would have attended first surgery.[9] Beyond a second operation, however, there is usually declining efficacy and success rates drop to 15% after the third and 5% after the fourth.[9] Surgery designed to correct anatomical abnormalities or to restore sagittal alignment and balance (reversal of flat back syndrome) are more likely to be successful than simple revision of a prior surgery. The initial indications for surgery must thoroughly be reviewed and a specific pathology must be identified and reasonable chance of correcting it must be determined prior to undergoing another procedure.

Conclusion

The key to understanding FBS is individualization of evaluation and therapy. Correlation of key anatomical abnormalities to a patient's clinical complaints is vital to a successful operation. Unfortunately, the diagnosis of FBS does not point to the actual cause for treatment failure. The treating physician must be aware that the etiologies of this syndrome are numerous and consist of several surgi-

cal and nonsurgical etiologies. Physicians treating patients with FBS must approach this complex problem in a very organized fashion and with a multidisciplinary perspective. In addition to structural abnormalities, psychosocial factors and complex peripheral and central processing of nociceptive information may contribute to low back pain.

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Adetokunbo A. Oyelese, MD, PhD, is a teaching consultant (honoraria) for Depuy-Synthes Spine.

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The Impact of the 2007–2009 US Recession On the Health of Children With Asthma: Evidence From the National Child Asthma Call-Back Survey

Deborah N. Pearlman, PhD, Tracy L. Jackson, MPH, Annie Gjelsvik, PhD, Samara Viner-Brown, MS and Aris Garro, MD, MPH

Given the relationship between family circumstances and child well-being, the impact of the recent US recession on the health of children is of great concern.[1] Between 2007 and 2009, the US economy experienced a severe recession that had a profound effect on workers and families.[2] Workers aged 25 to 34, who were most likely to be heading households with children in the home, were the hardest hit by the loss of jobs, which have yet to return to their pre-recession levels.[3, 4] The percentage of US children living below the federal poverty level increased from 18% in 2007 to 22% in 2010;[5] the highest percentage since 1993.[6] Limited data are available on the potential impact of the US recession on the health of children with asthma.

Due to loss of income and/or the loss of health insurance, there may be direct costs of complying with an asthma management plan for parents of children with asthma. Medications and health care visits may no longer be affordable. Furthermore, unexpectedly high levels of unemployment during a recession, and uncertainty about future job security can create anxiety, stress and depression for both employed and unemployed workers, which may make it more difficult for parents to cope and care for their child's asthma.[7] In this paper, we estimate the prevalence of poorly controlled asthma in a nationally representative sample of children with asthma and provide new findings on the factors associated with poorly controlled asthma during the "official" US economic recession.

Methods

Data were from the national 2007-2009 Child Asthma Call-Back Survey; an in-depth asthma survey jointly administered with the **Behavioral Risk Factor Surveillance System (BRFSS)**. The BRFSS is a state-specific, population-based survey of the noninstitutionalized U.S. adult population aged ≥18 years and older. BRFSS respondents who were the parent/guardian of a randomly selected child (aged 2–17 years) with current doctor-diagnosed asthma and who lived in one of the 50 states or District of Columbia at the time of the survey were included in the study sample.

The 2007 **National Heart, Lung, Blood Institute (NHLBI) Expert Panel Report 3 (EPR3)** Guidelines for the Diagnosis and Management of Asthma were used to define asthma control.[8] In order to be considered well controlled, a child with asthma must meet the five age-specific criteria listed next to "Impairment" in Table 1. The Asthma Call-Back Survey does not include a question on lung functioning. Thus, the current study may underestimate the prevalence of poorly controlled asthma.

The average state-level unemployment rate was selected as an indicator of economic conditions because unemployment best captures harsh economic conditions for working age adults when there is a downturn in the US economy. States with unemployment rates significantly higher than the US unemployment rate for three consecutive years between 2007 and 2010 were defined as high unemployment states and compared with all other states. These included California, Florida, Illinois, Kentucky, Michigan, Nevada, North Carolina, Ohio, Oregon, Rhode Island and South Carolina. Five of the 11 states (Florida, Kentucky, Nevada, North Carolina, and South Carolina) did not participate in the 2007-2009 Child Asthma Call-Back Survey and thus were not included in the final sampling frame.

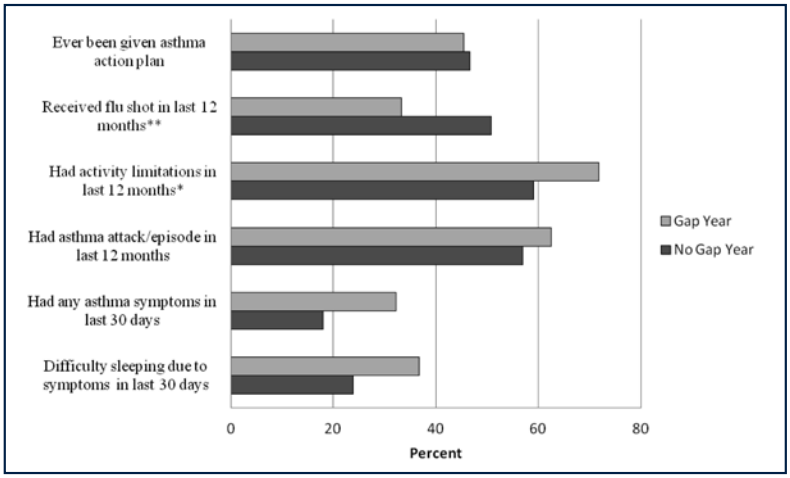
Parent-level characteristics included smoking

Table 1. Clinical guidelines for pediatric asthma control

		Well Controlled		Poorly Controlled*	
		Ages 2-11 yrs	Ages 12+ yrs	Ages 2-11 yrs	Ages 12+ yrs
Impairment	Symptoms	≤ 2 days/week		>2 days/week	
	Nighttime Awakenings	≤ 1x /months	≤ 2x /month	> 1x /month	> 2x /month
	Interference with normal activity	None		At least some limitation	
	Short acting beta-antagonist use for symptom control	≤ 2 days /week		> 2 days /week	
	Lung function[a]: FEV_1 (predicted) or peak flow personal best; or FEV_1/FVC	>80%		≤ 80%	

[a]FEV_1 is n/a for children aged 4 years and under.
Source: National Heart Lung and Blood Institute, National Asthma Education and Prevention Program, Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma, 2007

Figure 1. Selected asthma management indicators among children 2-18 years old with current asthma, by gap in health insurance



*p<.05; **p<.01

Table 2. Factors associated with out of control asthma among asthmatic children: logistic regression

	Adjusted Odds Ratio	95% Confidence Intervals
High unemployment state		
No	1.00	
Yes	0.98	0.76 – 1.27
Parent household income		
$50K or higher	1.00	
$35K to < 50K	1.16	0.83 – 1.63
$20K to <35K	1.45	1.01– 2.09
$<10K to < 20K	0.78	0.51– 1.19
Unknown	0.68	0.39 – 1.16
Parent unemployed		
Currently employed	1.00	
Out of workforce (student, retired)	1.13	0.85 – 1.50
Unemployed past 1- 2 years	0.69	0.39 – 1.25
Parent poor mental health score		
0	1.00	
1	1.37	1.01 – 1.88
2+	1.72	1.13 – 2.60
Parent current smoker		
No	1.00	
Yes	1.03	0.75 – 1.42
Child age		
2-5 years	1.37	0.98 – 1.91
6-11 years	1.13	0.89 – 1.44
12-18 years	1.00	
Child sex		
Male	1.00	
Female	1.12	0.89 – 1.40
Child race/ethnicity		
Non-Hispanic white	1.00	
Non-Hispanic black	1.27	0.87 – 1.86
Non-Hispanic other races	0.90	0.59 – 1.36
Hispanic	1.23	0.83 – 1.84
Child gap in health insurance or uninsured		
No	1.00	
Yes	1.74	1.07 – 2.83

Data source: 2007-2009 national BRFSS Child Asthma Survey; weighted data.

status, mental health, household income, and employment status. Mental health status was measured using a composite variable for poor mental health that included dissatisfaction with one's life, not getting emotional social support needed, and frequent mental distress (≥ 14 days of poor mental health in the previous month). Scores ranged from zero to three (with higher scores indicating poorer overall mental health) with a mean of 0.45 and a standard error of 0.02. Scores of two and three were combined due to the small sample size for scores of three. Child-level characteristics included age, sex, race/ethnicity, and whether the child experienced a gap in health insurance coverage in the past 12 months.

Sampling weights that correct for unequal probabilities of sample selection and adjust for non-response and telephone non-coverage were applied to the BRFSS and Child Asthma Call-Back Survey to obtain a nationally representative sample of parents with a child in the home with current asthma. A multivariable logistic regression model measured the strength of the association between study variables and poorly controlled asthma.

Results

Of the 5,138 children aged two to 17 years included in the present analysis, 69.1% were classified as having poorly controlled asthma. The prevalence of poorly controlled asthma did not vary significantly by children's age, gender, or race/ethnicity. However, children who had a gap in health insurance in the 12 months before the Asthma Call-back Survey were significantly more likely than children with continuous health care coverage to have poorly controlled asthma (No Gap: 68.0%, 95% Confidence Intervals [CI] 65.5-70.5; Gap: 80.6%, 95% CI 73.7-87.8).

Analyses of various indicators of asthma management revealed that less than 50% of children aged two to 18 years with current asthma received an asthma action plan or a flu shot in the last year, despite the fact that the 2007 NHLBI guidelines recommend that individuals with asthma have an asthma action plan that is reviewed at every health care visit and receive a flu shot each year.[8] Additionally, one-fourth of children had nighttime asthma symptoms (25.1%), more than half (57.4%) had at least one asthma attack or episode in the past year, and more than half (60.2%) reported activity limitations due to asthma. Comparisons between those who had a gap in insurance coverage and those who did not have a gap in coverage are displayed in Figure 1. Those who had a gap in insurance coverage were significantly more likely than those who had continuous coverage to experience activity limitations (p<.05) and were significantly less likely to have received a flu shot (p<.01).

In multivariable regression analyses adjusted for all study variables, poorly controlled asthma was significantly associated with a household income between 20K and <35K, a parent reporting poor mental health, and a gap in the child's health care coverage during the 12 months preceding the survey (Table 2).

Conclusion

Our results showed that children who experienced a gap in health insurance during the recent economic recession were at increased risk of poorly controlled asthma compared to children with continuous health insurance coverage. Consistency of insurance coverage for children with asthma is especially important. Recent studies have found that discontinuous health insurance is associated with poorer overall quality of care for children with asthma and greater burden on families.[9-11] These studies, like our study, support efforts to prevent children with asthma from falling through the cracks of the health insurance system.

Between 2007 and 2010, the number of children with employer-based coverage fell by 3.4 million as unemployment remained stubbornly high. We hypothesized that children with asthma in states severely affected by high unemployment, such as Rhode Island, would be the most likely to experience poor asthma control, but this was not the case. The historic expansion of the **State Children's Health Insurance Program (S-CHIP)** in 2009 offset the loss of employer coverage for income eligible children.[12, 13] While 4.6 million children gained Medicaid or CHIP coverage between 2007 and 2010, eight million children remained uninsured.[14]

This study also found that children in households with incomes of 20K to <35K, were more likely than children in the lowest and highest income families to have poorly controlled asthma. Increased federal and state investments in Medicaid and S-CHIP did not help all eligible households in need. Some states chose not to expand eligibility to the S-CHIP program.

Some low wage workers with dependent children may not have qualified for their state's S-CHIP program as they cycled in and out of the labor market entering and then exiting the ranks of the unemployed. It is worth noting that the Child Asthma Call-back Survey did not include all states with above average high unemployment rates, or information on states' eligibility criteria for S-CHIP, which may have affected our findings.

The expansion of S-CHIP was an important investment in children's well-being and a policy deserving of support in the wake of the recent recession and its aftermath. Still, access to health insurance is not synonymous with receipt of health care. Although children with health insurance receive more consistent care and have better health outcomes than children who lack coverage,[1, 15] access to publicly funded health insurance does not guarantee access to quality health care or the receipt of consistent preventive asthma care for children with asthma.

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The authors and/or their spouses/significant others have no financial interests to disclose.

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Images In Medicine

Left Atrial Myxoma Presenting With Cerebral Embolism

Thomas J. Earl, MD, and Athena Poppas, MD

A 48-YEAR-OLD MAN WITH A HISTORY OF HYPERTENSION PRESENTED TO the emergency department with acute onset of left-sided weakness and dysarthria. Computed tomography scan of the head revealed a right middle cerebral artery infarct as well as a hyperdensity seen within the right middle cerebral artery and its branches consistent with clot. Subsequent **transthoracic echocardiography** (**TTE**) revealed a large (approximately 11 cm^2), mobile mass attached to the distal left atrial septum which prolapsed across the mitral valve (Figure 1) resulting in partial obstruction of left ventricular inflow (Figure 2). This mass was consistent with an atrial myxoma and was presumed to be the etiology of his stroke.

Primary tumors of the heart are rare, with reported incidence at autopsy ranging between 0.002% to 0.3%.[1] Often times these tumors are recognized incidentally through an imaging study performed for an unrelated symptom or condition. Clinical presentation of cardiac tumors is varied and includes signs and symptoms of intracardiac obstruction such as pulmonary venous congestion, presyncope, or syncope, signs of systemic embolization such as seen in this patient, or constitutional symptoms such as fever, fatigue, or weight loss.[2]

Most primary cardiac tumors are benign, with the most common pathologic subtype being the myxoma. The vast majority of myxomas are found in the left atrium, where they may result in obstruction of blood flow across the mitral valve or mitral regurgitation.

It is estimated that approximately 15% of ischemic cerebrovascular accidents are cardioembolic in origin.[3] TTE provides a non-invasive, widely available, and highly sensitive modality for the initial evaluation of a suspected atrial myxoma. Furthermore, TTE is useful in evaluating the hemodynamic consequences of myxomas as a result of obstruction to left atrial emptying. When more detailed information is needed, cardiac magnetic resonance imaging or computed tomography can be utilized.

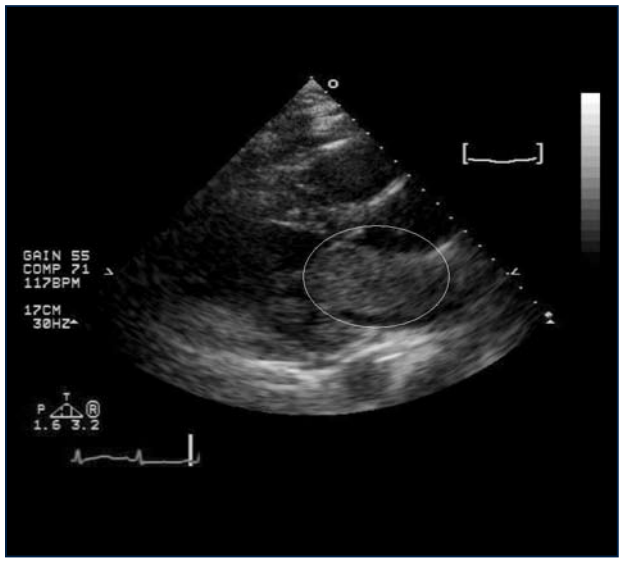

Figure 1. Transthoracic echocardiogram in the left parasternal long axis view showing an approximately 11 cm^2 left atrial mass (outlined) attached to the distal atrial septum consistent with myxoma.

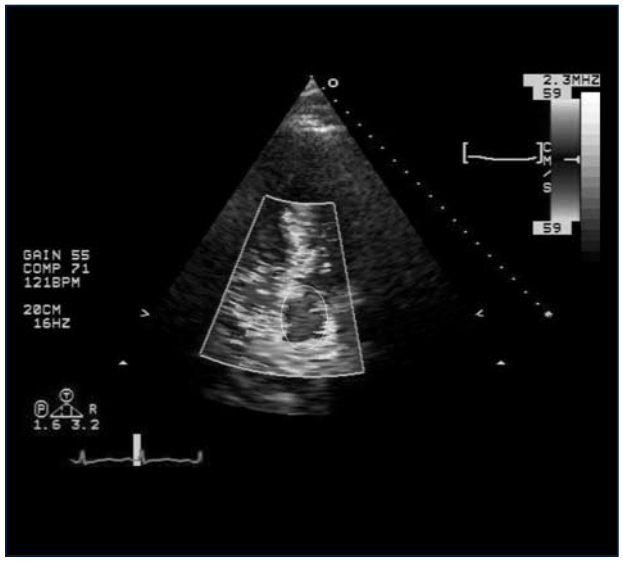

Figure 2. Transthoracic echocardiogram in a limited apical view showing color flow acceleration around the left atrial myxoma (outlined) suggesting obstruction to left ventricular inflow.

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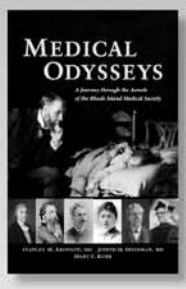
RIMS is commemorating its bicentennial with a series of events and observances that will leave a lasting legacy.



MEDICAL ODYSSEYS
RIMS published this anthology of essays by Dr. Stanley Aronson, Dr. Joseph Friedman, and editor Mary Korr.

HAY LIBRARY EXHIBIT
Items from RIMS' collection, dating from the 16th century to the present, were on display for the first time in decades.

PORTRAIT RESTORATION
The 1795 portrait of RIMS' first president, Amos Throop, was restored to optimal condition for public display.

BICENTENNIAL GALA
A festive black tie evening of dinner, dancing, and entertainment was held at Rosecliff Mansion in Newport in April.

COMMEMORATIVE VIDEO
"Celebrating 200 Years of the Rhode Island Medical Society," produced for the bicentennial, premiered at the Gala.

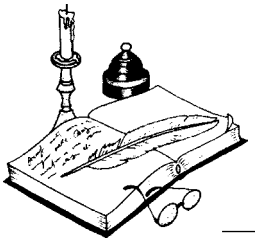
ANNUAL MEDICAL STUDENT AWARDS
RIMS' first annual Amos Throop Prize and Herbert Rakatansky Prize were presented to deserving medical students on May 25, 2012.

LOBSTER BAKE
NORCAL will host this July 20 event for RIMS members on the grounds of the Naval War College Museum in Newport.

PHOTO: NAVAL WAR COLLEGE

NEUROBIOLOGY SYMPOSIUM
RIMS will sponsor a lecture series this autumn in cooperation with the Brown Institute for Brain Science and the Norman Prince Neurosciences Institute.

NEW RIMS HISTORY
A new account of RIMS' history is under the pen of Executive Director Newell Warde, PhD.



Physician's Lexicon

The Straight and Narrow Words of Medicine

The Greek word, *orthos*, conveys the sense of straightness, directness, correctness or something free of structural or moral deviousness. And as a prefix, *ortho-,* it has adorned countless words in both the general and medical vocabularies.

The word orthodox, descends from the Greek noun, *doxa,* meaning an opinion and the verb, *dokein,* meaning to think; in combination, then, orthodox means having the correct opinion via the original Greek and later the ecclesiastical Latin, *orthodoxus*.

Other words employing the *ortho-* prefix, in general usage, include orthography (the art of spelling words in accordance with accepted usage); orthotropic (plants that grow vertically); orthoptera (insects with vertically oriented wings such as locusts); orthogonal (in architecture, any structure that is vertically oriented); and orthoscopy (normal vision.)

Amongst the many medical terms that include the *ortho-* prefix:

- Orthopedics: A medical term original meaning the medical science of achieving straight or undeformed children by surgical or manipulative interventions (from *pais,* Greek, meaning child.)
- Orthodontia: The dental specialty concerned with malocclusions and other structural deformities of teeth, particularly in childhood.
- Orthognathic: An adjective defining facial contour without visible jaw abnormalities. From the Greek, *gnathos*, meaning jaw.
- Orthokinetics: A branch of physiotherapy which attempts to modify skeletal muscle activity around joints affected by deformative arthritis.
- Orthodromic: An adjective describing the proper direction of axonal nerve impulses.
- Orthophrenia: A quaint 19th Century medical term describing those who think directly or correctly. Compare with schizophrenia, literally a divided mind; phrenology, an obsolete belief in the specific anatomic location of various mental faculties; and phrenetic, sometimes spelled frenetic, meaning excessively manic. The same Greek root, *phren*, has also described the diaphragm, its nerve supply (phrenic nerve) and its diseases such as phrenitis.
- Orthothanasia: The disputed and contentious, and perhaps illusive, art of dying gracefully and naturally.
- And finally, orthobiosis, that wonderfully Victorian noun, from the Greek, *bios,* meaning life, defining the art of living correctly both in mind and body.

– Stanley M. Aronson, MD

Rhode Island Department of Health
Michael Fine, MD
Director of Health

Vital Statistics

Edited by Colleen Fontana, State Registrar

Rhode Island Monthly Vital Statistics Report Provisional Occurrence Data from the Division of Vital Records

Underlying Cause of Death	Reporting Period			
	December 2011	12 Months Ending with December 2011		
	Number (a)	Number (a)	Rates (b)	YPLL (c)
Diseases of the Heart	198	2,446	232.2	3,862.0
Malignant Neoplasms	178	2,199	208.8	5,482.5
Cerebrovascular Diseases	40	424	40.3	565.0
Injuries (Accidents/Suicide/Homicide)	59	702	66.7	9,452.5
COPD	65	536	50.9	525.0

Vital Events	Reporting Period		
	June 2012	12 Months Ending with June 2012	
	Number	Number	Rates
Live Births	1,018	11,853	11.3*
Deaths	760	9,511	9.0*
Infant Deaths	(9)	(79)	6.7#
Neonatal Deaths	(8)	(60)	5.1#
Marriages	857	6,451	6.1*
Divorces	251	3,296	3.1*
Induced Terminations	282	3,876	327.0#
Spontaneous Fetal Deaths	18	590	49.8#
Under 20 weeks gestation	(11)	(486)	51.1#
20+ weeks gestation	(7)	(104)	8.8#

(a) Cause of death statistics were derived from the underlying cause of death reported by physicians on death certificates.

(b) Rates per 100,000 estimated population of 1,052,567. (www.census.gov)

(c) Years of Potential Life Lost (YPLL).

Note: *Totals represent vital events that occurred in Rhode Island for the reporting periods listed above. Monthly provisional totals should be analyzed with caution because the numbers may be small and subject to seasonal variation.*

* Rates per 1,000 estimated population
\# Rates per 1,000 live births

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Ninety Years Ago, December, 1922

Frank T. Fulton, MD, presents an article on the endocrine glands to review some of the normal functions of the ductless glands as far as known, to touch upon some of the disturbances of function which are fairly well understood, and to present some of the conflicting views without arguing for any conclusion. The author identifies to main groups of individuals who are actively engaged in studying the subject. One group is strictly scientific and is composed of physiologists and experimental pathologists who try to reproduce in animals some of the recognized conditions which are believed to be due to disturbed endocrine function. The other group is made up of clinicians, some of whom have had laboratory training, are conservative, have critical judgement and are contributing valuable observations. However, many, the author notes, lose sight of the scientific side, are fascinated by the wonderful variety of symptoms and conditions and are carried away by theories until their enthusiasm warps their judgement that their conclusions are of little value.

In regards to chiropractics and public health legislation, an editorial presents the following commentary: "Occupying as he does the position of a protector of humanity against disease, it is quite remarkable that the average physician should feel that he is belittling his dignity in defending from open assault this acknowledged right. Yet this is the attitude assume by many, whenever it has become our unfortunate privilege and necessity to appear before committees of legislative bodies at the State Capitol to protest the passage of laws inimical to public health. The average law-maker is the average man, usually desirous of equalizing opportunities and his knowledge of what constitutes public health is vague; he is not a physiologist and he may believe with Still, the osteopath, that the human body is a machine. Still did not and the law-maker does not visualize its complexity, however, or the problem of metabolism, for with either, these things have never existed. Our law-maker may sympathize with these persons who practice chiropractic. These followers of Palmer, who believe (or they do not) that all diseases originate from a common cause, to wit, the maladjustment of one or more vertebrae--whether mumps, pneumonia, appendicitis, erysipelas or toothache. Preventive medicine, sanitation, and research are meaningless terms in the chiropractic code and it is most probably to these people unknown. Education and not altogether censure should be our attitude toward the legislator, therefore, bearing in mind that any cult or 'ism tinctured with a little mysticism still has, even in these modern days of disillusion, its followers and its lure."

Fifty Years Ago, December, 1962

A. A. Savastano, MD, opens the topic of the sport of boxing with the death of Benny "Kid" Paret from head injuries received in the championship prize fight on March 24, 1962, at Madison Square Garden and the resultant firestorm of criticism regarding boxing as it is currently conducted. The author states a long history of enthusiasm for the sport--having treated many boxers, particularly during his time as staff surgeon at the Polyclinic Hospital and Medical School in New York City. He also presents a short history of the sport going as far back as the year 4000 BC with the ancient Egyptians. Savastano acknowledges that the chief argument against boxing is that the contents of the skull (the brain and its appendages) are the chief target. Severe brain damage and death are not uncommon in the sport, making its future, in the author's opinion, dubious with public opinion, in a large sense, opposed to the continuation of the sport. The author expresses hope that the Boxing Education and Research Foundation will develop some sound ideas regarding safety, and that an insurance, welfare, and pension plan can be established, such as exists in some other sports.

Laurence A. Senseman, MD, reports on visiting hospitals in Africa. He describes conditions and populations of various hospitals, clinical practices, attitudes, and resources. He closes: "One month spent on this, the second largest continent, is hardly enough to permit one to draw any conclusions, except that it offers the physicians a tremendous challenge. That the "Dark Continent" is awakening is an understatement. It is alive, vital, and progressive. The new countries are struggling for their survival, identity, and independence. They look to us for understanding, assistance, and medical aid. Many physicians are needed if only for a short period of service in the native hospitals. Such an opportunity to be a good will ambassador is indeed a wonder experience and privilege."

Twenty-five Years Ago, December, 1987

Much of this issue is devoted to the Pawtucket Heart Health Program. With public health advocates seeking to determine how best to influence positive lifestyle changes on a board scale, the individual physician, while a vital factor in education and direction of his patients, is limited by the scope of his practice. Rhode Island, however, is privileged to be the site of a world-renowned research project that may produce a compendium of answers to the goal of effective community-wide intervention.

The Pawtucket Heart Health program serves as an inspiration to those in the public health field, and thanks to that and its precursors, the community will become increasingly skilled in reducing cardiovascular disease through community action. The corollary may be parallel efforts in the future to reduce the incidence of other diseases that have stubbornly resisted the best efforts of the medical-scientific community.

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