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REPORT

X-Rays vs. Sonograms

Does Overuse of X-Rays and Underuse of Sonograms Endanger Patient Health?

By Edward R. Rosick, DO, MPH, MS

It is easy to forget that a mere 120 years ago, physicians practiced medicine in much the same manner as physicians in ancient Rome. In the late 1800s, doctors had no antibiotics, possessed rudimentary surgical skills, and could only wonder about the marvels that lie inside a living human being.

In 1895, the world of medicine changed irrevocably with the discovery of x-rays by Willhelm Konrad Roentgen.

Following Roentgen's invention, it took less than a year for scientists and physicians to begin setting up and using x-ray machines. For physicians, the opportunity to be able to peer inside the body of a living human being was nothing short of a minor miracle. Soon, x-ray machines were being used to diagnose fractured bones, to image swallowed foreign bodies, and to locate bullets inside the bodies of soldiers wounded in battle. X-rays were also being touted, without any scientific evidence, as a cure for almost any and every malady, from acne to ringworms to depression.[1]

Ionizing radiation—potentially lethal

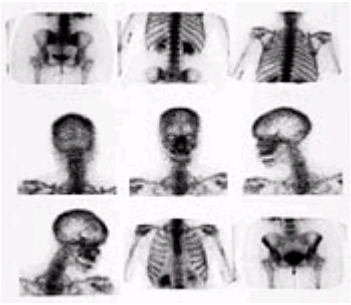
Although the medical and lay community embraced x-rays early on, some scientists soon came to see the dark side of this new technology. Thomas Edison, the great American inventor, quickly recognized the importance and possible practical implications of x-rays and soon set up his own x-ray laboratory. In 1896, Edison's "improved" x-ray machine, which he called a fluoroscope, was a hit at the National Electrical Exposition in New York City. Edison and his assistant, Clarence Dally, exposed themselves to x-rays multiple times each day as they showed off Edison's new machine.

The first published x-ray by Wilhelm Konrad Roentgren, December 22, 1895.

Unfortunately for Mr. Dally, exposure to x-rays from Edison's fluoroscope proved disastrous. Just a few months after the exhibition, Dally began suffering from debilitating fatigue, body aches, and multiple burn-like lesions on his hands. These lesions turned out to be cancer that rapidly spread throughout his body. Dally lost both his arms to these malignant lesions, and finally died a painful death in 1904. Thomas Edison was said to be haunted for the rest of his life by Dally's cancer and death, and adamantly refused to have anything more to do with x-rays for the rest of his life.[2]

While it was not known during Edison's time, it is now clear that x-rays exert their dangerous effects on the human body via ionizing radiation. This type of electromagnetic radiation is known to physicists as "high-energy," meaning that each x-ray particle is able to literally penetrate most solid substances, including the human body. In contrast, visible light, which is another form of radiation, is much less energetic, and is physically stopped by something as simple as paper or cloth. When ionizing radiation from x-rays enters the body, it transfers some of its energy to cells in the body as it passes through. This transfer of energy can cause complex, non-repairable damage to the cell and its genetic contents, which are coded by the cell's DNA and chromosomes. If the damage is great enough, the cell will die. If the cell does not die, however, the subsequent genetic damage caused by the ionizing radiation can induce both benign and malignant (i.e., cancerous) tumors. The cellular and genetic damage caused by x-rays is cumulative throughout a person's lifetime, with each dose of ionizing radiation causing more and more damage. It does not matter to your cells if an x-ray was given 20 years or 20 minutes ago—the cellular and genetic damage sustained will be the same.

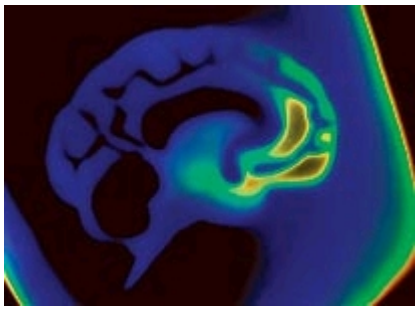
In 1927, Hermann J. Muller demonstrated that x-rays can cause irreversible genetic damage, work that eventually won him a Nobel Prize. Yet despite such solid scientific evidence and the tragic deaths suffered by radiation pioneers such as Clarence Dally and Marie Curie (who died of leukemia), many physicians and scientists continued to tout the benefits of x-rays and other forms of radiation well into the 1950s. Radioactive radium was the rage for decades and was recommended and used by physicians to treat impotence, ulcers, arthritis, and high blood pressure. As late as 1952, Life magazine published articles describing the beneficial health effects of inhaling radioactive radon gas, which is now known to be a significant cause of lung cancer.



In the late 1950s, well after the devastation of Hiroshima and Nagasaki by atomic bombs had revealed the destructive power of radiation, a few brave voices in the medical and scientific world began to publicly speak about the dangers of x-rays and ionizing radiation. Among the loudest voices was Dr. Russell E. Morgan, the chairman of radiology at Johns Hopkins Medical School. In 1959 Dr. Morgan chaired a National Advisory Committee on the possible dangers of medical x-rays and ionizing radiation for the US government. In a 20-page report, the committee stated that "during the past several years, a number of scientific bodies, including the National Academy of Sciences of the United States (1956) and the United Nations Scientific Committee on the Effects of Atomic Radiation (1958), have reported extensively on the influence of ionizing radiation on biological systems. From these reports it is evident that serious health problems may be created by undue radiation exposure and that every practical means should be adopted to limit such exposure both to the individual and to the population at large."[3]

X-rays linked to heart disease, cancer

No longer should there be any debate about whether ionizing radiation from x-rays can cause cancer. A multitude of sound scientific studies clearly shows that exposure to x-rays, especially early in life, can directly cause cancer, including cancers of the breast, thyroid, lung, brain, stomach, colon, bladder, ovary, salivary glands, skin, and central nervous system, as well as leukemia.[4-7]



Recently, the hypothesis that medical x-rays are a significant cause of the current cancer and heart disease epidemic in America was put forth by Dr. John W. Gofman in his book entitled *Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease*.[8] This exhaustively researched, 699-page book presents data, based on mortality rates among 130-250 million people—the entire population of the US from 1940 to 1990—to support the hypothesis that, in the author's words, "over 50% of the death rate from cancer today, and over 60% of the death rate from ischemic heart disease today, are x-ray induced."

While Dr. Gofman presents chapter after chapter of meticulous studies to prove his hypothesis in a book that should be read by all physicians, he is by no means against the use of x-rays for clearly defined medical studies. In fact, he states, "the finding that radiation from medical procedures is a major cause of both cancer and ischemic heart disease does not argue against the use of x-rays, CT scans, fluoroscopy, and radioisotopes in diagnostic and interventional radiology." What Dr. Gofman does make clear is that physicians and others who use x-rays and other forms of ionizing radiation in their practices should, in the author's words, "treat dosages of ionizing radiation at least as carefully as we treat dosages from potent medications."

Sonograms: safe, effective alternative to x-rays

Many times in my medical practice, patients will come in with various complaints, from shoulder injuries to abdominal pain, and expect to get an x-ray. It seems that for many people, getting an x-ray at their physician's office is just a part of a "normal" exam. Of course, if an x-ray is warranted, then I certainly do not hesitate to order one; however, we now have multiple technological alternatives to x-rays and harmful ionizing radiation, with sonograms being one of the most useful.

Most people know abut sonograms, or ultrasounds, from the fuzzy pictures of babies in their mothers' wombs that are now routinely done in the obstetrician's office to check for any gross fetal abnormalities and also to determine the sex of the child before birth. While the importance of sono-grams in obstetrics should not be minimized, modern ultrasound machines have the potential to safely and effectively help prevent many devastating diseases without exposing patients to any amount of ionizing radiation.

The early 1900s saw the proliferation of x-ray machines in doctors' offices while another technology that would also have a great impact in medicine was being developed. Sonography, the use of sound waves to detect objects, was developed in 1915 to aid in the detection of submarines. While the military was quick to exploit this new technology, it took decades for medical researchers to realize

Table 1: Uses of Sonograms for Detecting and Evaluating Medical Conditions

Head and Neck:

- Detection and evaluation of stroke risk
- Detection, evaluation, and measurement of thyroid nodules and tumors

Ophthalmology:

- Detection and evaluation of tumors, including retinal melanomas
- Detection and evaluation of retinal detachment
- Detection, evaluation, and measurement of foreign bodies within the vitreous humor

Gynecology:

- Detection, measurement, and monitoring of uterine cysts, polyps, or fibromas
- Detection, measurement, and localization of ovarian and endometrial tumors
- Evaluation and measurement of fallopian tube

that sound waves could detect images in the human body just as they could detect submarines prowling deep in the ocean depths.

Like sonar used in the military, the ultrasound machines of today use an ultrasonic sound wave (inaudible to the human ear) that travels at the speed of 1,500 meters/second. These sound waves are sent into the body via an ultrasound transducer, a device that functions as both a loudspeaker (to create the sound waves) and microphone (to record the sound waves). When the transducer is passed over a person's body, harmless "waves" of sound are directed into the body; as the sound waves hit various body structures and organs, some of the waves bounce back and are captured by the transducer microphone. These recorded sounds are then instantly measured and analyzed by a computer and are turned into real-time pictures on a monitor. Through analysis of these pictures, doctors can tell how deep an organ or structure is in the body, its three-dimensional shape, how large it is, and whether it is hollow or solid. All this is done without any discomfort to the patient, and more important, without the use of ionizing radiation.

The use of sonograms continues to grow as technology has allowed doctors to use ultrasound technology to study almost any part of the body. Table 1 shows just a sampling of the parts of the body on which ultrasound can be used, and some common maladies that sonograms can detect.

abnormalities
in cases of infertility

Breast:

- Detection and measurement of tumors in dense breasts
- Measurement and monitoring of breast tumors during therapy
- Evaluation and measurement of skin tumor infiltration

Prostate:

- Detection, evaluation, and measurement of prostate tumors, including adenofibromas, neoplasms, and papillomas
- Evaluation and measurement of tumors during therapy

Gastrointestinal:

- Detection, evaluation, and measurement of aortic aneurysms
- Detection and evaluation of fistulas, Crohn's disease, and appendicitis
- Detection and evaluation of liver, spleen, and gallbladder abnormalities

Musculoskeletal:

- Detection and evaluation of degenerative disc disease
- Detection and evaluation of a broken or fractured patella (kneecap)
- Detection and evaluation of tendonitis

Sonograms shown useful in preventing strokes

A cursory glance at Table 1 shows that sonograms can help detect and prevent many potentially deadly health conditions, including stroke. Cerebrovascular accidents, or strokes, occur when the blood flow to the brain is compromised in some way, such as by the rupture of a blood vessel in the brain or by blockage of blood vessels by cholesterol-derived plaque that has built up in the carotid arteries. No matter the cause, when a stroke occurs there is immediate brain damage, and if the damage is severe enough, death. Strokes strike approximately 700,000 Americans a year, and are the third leading cause of death (killing approximately 160,000 Americans each year) after heart disease and cancer.9 Strokes are the number-one cause of serious, long-term disability in the US and affect both men and women; although more men than women suffer strokes (57% vs. 43%), women are more likely then men to die from strokes.10 While strokes are often thought of as something that happens only to the elderly, nearly 30% of people who have a stroke are under 65 years of age, and each year approximately 120,000 women and 105,000 men under 45 years of age suffer strokes.[11]

With such grim statistics, it is disheartening to think that just a few short years ago, one of the only ways doctors had to detect strokes was to use a stethoscope to listen for evidence of plaque buildup in their patients' carotid arteries, the same way that doctors examined patients for stroke risk 100 years ago. Through the use of specialized sonograms, however, doctors can now detect deleterious changes in carotid arteries and also in the arteries inside the brain itself, and thereby help prevent strokes.

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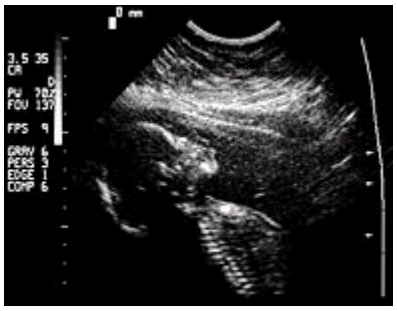

Multiple studies have been published showing that ultrasound can safely and effectively detect pathological changes in the carotid arteries that can lead to a stroke.[12,13] A recent study published in the *New England Journal of Medicine* reported on the use of sonograms to detect thickening in the walls of the carotid arteries, a condition that strongly correlates with increased stroke risk. Using ultrasound, the researchers measured the carotid arteries of nearly 4,500 patients with an average age of 72 for a six-year period. Study participants who had the thickest arterial walls had more than three times the risk of suffering a stroke or heart attack compared to those whose carotid arteries showed little to no thickening. These results indicate that thickened walls of carotid arteries are a better indicator of increased risk for stroke or heart attack than high cholesterol or increased blood pressure. Unfortunately, ultrasound scans of the carotid arteries to prevent strokes are still thought of as “experimental” by most mainstream physicians.

Transcranial Doppler ultrasound (TCD) is another type of sonogram that can aid doctors in preventing strokes.[14,15] TCD measures blood flow in the brain and can detect abnormalities in brain blood vessels that may be a precipitating factor for a stroke. TCD can also be used on patients before they undergo surgical procedures to determine whether they are at risk for strokes or other cerebrovascular problems that often manifest under significant stressors such as surgery. Like carotid ultrasound scans, however, TCD scans are still not part of routine physical visits.

Detecting breast and ovarian cancer, aortic aneurysms

Despite decades and hundreds of millions of dollars of research, cancer still strikes hundreds of thousands of Americans a year. Breast cancer, the second leading cancer killer of women, affects 180,000 women every year, causes 42,000 deaths each year, and is the leading cause of death in 40- to 44-year-old women. While 30 million x-ray breast mammograms are done each year to help detect this deadly disease, researchers are now showing that through the use of sonograms, doctors may be able to detect breast cancers they previously missed with mammograms.

A Japanese study in 2001 looked at the usefulness of combining mammograms with ultrasound during breast cancer screening.[16]

The researchers evaluated 15,139 women during a five-year period and found that the combination of mammograms and ultrasounds increased a doctor’s ability to detect breast cancer by an impressive 29%. They also found that cancers detected with the addition of ultrasound screening were more likely to be discovered earlier, and therefore were more susceptible to treatment.

An even more recent study published this year examined the ability of sonograms on their own to detect breast cancers in women with dense breasts, as mammograms done on women with dense breasts are less sensitive at detecting cancer. This study, done between January 2000 and January 2002, examined 1,517 women with dense breasts and normal mammograms.[17] Sonograms done on these women detected seven cancers, leading the researchers to conclude that “screening breast sonography in a population of women with dense breast tissue is useful in detecting small breast cancers that are not detected on mammography or clinical breast examination. The use of sonography as an adjunct to screening mammography in women with increased risk of breast cancer and dense breasts may be especially useful.”

While breast cancer gets the most press in terms of female cancers, ovarian cancer is also a major threat to women, being the leading cause of death from gynecological malignancies. Approximately 15,000 women a year in America will die from ovarian cancer. The prognosis for women diagnosed with ovarian cancer has not significantly improved over the past 10 years, despite more aggressive surgery and chemotherapy.

One reason ovarian cancer continues to be a stubborn killer is that currently there are no well-accepted screening tests to detect ovarian cancer at its earliest stages. This is now changing with the publication of studies showing that transvaginal ultrasound can safely and effectively detect ovarian cancer at its earliest stages when it is most amenable to treatment and cure. A six-year study done at the University of Kentucky looked at the use of sonograms as a reliable screening method for the detection of early ovarian cancer in 6,470 women. The researchers found transvaginal ultrasound screening was, in their own words, “a safe, time-efficient screening method [for ovarian cancer] which is well accepted by patients.”[18] Even more important, the authors of this study showed that sonograms could detect early-stage ovarian cancer and therefore significantly improve the chances of curing the women with cancer.

Few people are aware of the presence of deadly aortic aneurysms, a condition marked by a weakness or defect in the aorta, the largest blood vessel in the human body. If this defect grows to affect enough of the aorta, that part of the blood vessel can rupture, causing immediate and fatal results. This silent but deadly condition has been estimated to affect 7% of all men over the age of 60 and is responsible for the deaths of at least 30,000 Americans yearly. Dr. Paul Segall, a leading figure in the anti-aging and life extension field, recently passed away at the age of 60 due to this deadly condition. It is known that hypertension, smoking, and increased blood cholesterol levels are important risk factors, though the exact cause of aneurysms is unknown. While aneurysms can sometimes be detected during a physical examination, sonograms are proving to be the gold standard in aneurysm detection. Studies have shown that sonograms are effective in detecting aneurysms;[19] furthermore, they are inexpensive, quite painless, and can change an almost certain death into a survival rate of 96-99%.

With the advent of modern antibiotics, many infectious killers of yesteryear such as smallpox and polio have largely been relegated to medical history books. Taking their place are chronic, debilitating killers such as heart disease, cancer, and other conditions that mainstream medicine has struggled to overcome. Taking appropriate supplements and getting annual preventive health examinations that include sonograms will help us improve our chances of living longer and healthier lives.

How to Talk to Your Doctor About Sonograms

One of the hardest things patients often face is talking to their physician about “alternative” medical practices, such as the routine use of sonograms. Many patients feel that they do not have the right or the knowledge to question their physicians about any type of treatment that is sometimes viewed with skepticism by mainstream practitioners. With a little foresight and preparation, however, you can quickly gain the confidence and skills needed to discuss alternative practices with your physician.

When talking to your physician about the use of sonograms, especially in the place of x-rays, you first need to educate yourself about the fundamental uses of sonograms. By reading this article, you have done just that. Second, either make a copy of this article for your physician to read or look up and copy some of the more specific references I used in writing this article. Finally, go to your physician with an open mind; remember that with the time constraints imposed on the vast majority of physicians by HMOs and ever-widening government regulations, it is near impossible for any doctor to stay up to date on all the changes in medicine. If you take the time to let your doctor know that you have read up on the use of sonograms to maintain your health, your doctor will be much more apt to take time out of his or her busy schedule to discuss with you the appropriateness of using sonograms for your particular need or condition.

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