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The Physics Involved in Obstetric/Gynecological Diagnostic Measures

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Abstract

Examining how physics is involved in the various diagnostic measures used by obstetricians/gynecologists, this research aims to provide a deeper understanding of the role of physics in modern medicine. Through careful research into the inner workings of x-ray machines, ultrasound machines, and mammograms, this research project is able to simplify and demystify these machines that are so commonly found in doctors' offices today. In a modern culture of simply accepting the way things work without understanding the "how," this research helps to bridge the gap of understanding. And this understanding allows people to take their health into their own hands and as a result, make decisions that are both beneficial and safe for themselves.

Introduction

In the clinical field of Obstetrics and Gynecology, there are various forms of diagnostic scanning technologies used. In each of these scans, physics is applied. From sound waves to radiation, a good grasp of the applications of physical principles allows physicians and patients alike to better understand different medical conditions and develop effective treatment plans. Obstetrics and Gynecology is a branch of medicine that involves very high-risk patients, so the use of scanning machines is integral to the wellbeing and safety of many women and infants across the world. In Obstetrician/Gynecologists' (OB/GYN) offices, physics is at play in many of the imaging methods that are predominantly used, such as pelvic ultrasounds, pelvic x-rays, and mammograms.

Diagnostic Measures

Ultrasound

Ultrasonography is a type of imaging that involves using sound waves to create a 2-dimensional image and are noninvasive procedures that do not use radiation, unlike x-rays[1]. In order to perform an ultrasound, there are various pieces of equipment that are required: a *probe* that emits sound waves, *controls* that manipulate the amplitude and frequency of the sound waves coming from the probe, a *computer* that is able to synthesize the sound waves into an image, and a particular *gel* that is rubbed on the surface of the patient's body that is in contact with the probe.[2]

Figure 1: [3]Ultrasound machine.

After the probe has made contact with the surface of the patient's body, it emits continuous pulses of sound waves at a very high frequency.

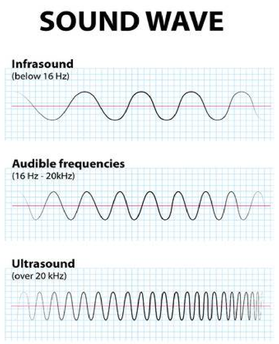

Figure 2: [4]Sound frequencies.

Moreover, the sound waves penetrate the patient's body and hit his/her tissues as the sound waves continue to go deeper into his/her body. The tissues act like 'barriers' that cause the sound waves to be reflected back to the probe. The probe sends this information to the computer which is able to produce a 2-D image by using the various distances the sound waves traveled from the skin to the tissues.

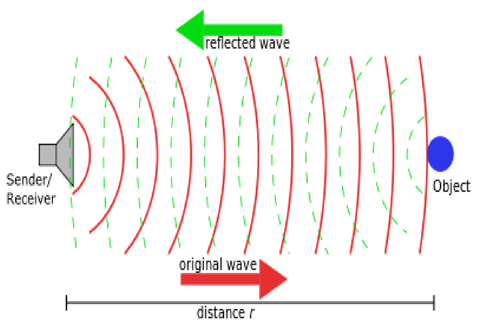

Figure 3: [5]Reflection of sound waves.

X-Ray

X-rays are routinely used in OB/GYNs' offices to monitor the health of the pelvic region in women. They are noninvasive procedures and use electromagnetic light radiation.

Figure 4: [6]X-ray machine.

In the x-ray tube of an x-ray machine, there is an anode (tungsten), which is positively charged, and a cathode (filament), which is negatively charged. As a filament electron knocks off an electron from a lower orbital of a tungsten atom, a tungsten electron in a higher orbital falls into the place of the vacant orbital. The large difference in energy between where the higher energy tungsten electron used to be and where it is now causes the release of excess energy stored as an x-ray photon.[7]

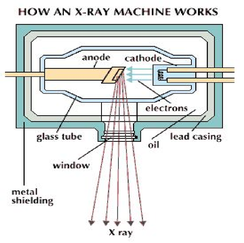

Figure 5: [8]Anodes and cathodes in an x-ray.

Larger atoms, such as calcium in human bones, absorb x-ray photons better than smaller atoms. Soft tissues, which have smaller atoms, can be viewed on x-rays with the use of barium contrast media, however.

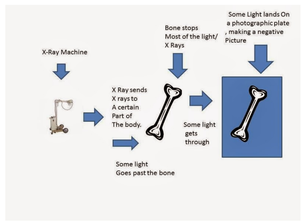

Figure 6: [9]How an x-ray works.

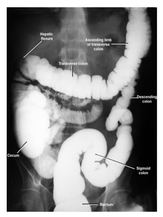

Figure 7: [10]X-ray of the GI tract with barium contrast media.

Mammogram

Also using electromagnetic radioactive light waves, mammograms test for breast cancer. Each breast is placed on one plate of the machine, and the other plate presses it from above to keep it in place for the x-ray scan. The primary purpose of a mammogram scan is to identify any dense, or heavy, regions of the breast.[11]

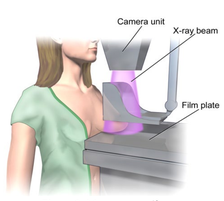

Figure 8: Mammogram.[12]

Figure 9: Mammogram machine.[13]

Conclusion

- Both ultrasound waves and electromagnetic radioactive light waves are extremely useful tools in the diagnosis of various health conditions or concerns.
- These scanning methods can be used as preventive measures, such as to prevent breast cancer by detecting warning signs of breast cancer early on through mammograms or to bring joy to an expecting parent as she finds out the sex of her baby.
- By knowing the purposes of these machines, patients will have more motivation to use them as preventive measures throughout their lives.
- Ultrasound waves and x-rays are invisible to the naked eye, but they are powerful tools.
- With a working knowledge of physical principles, these scanning methods can be appreciated and further experimented with to make scientific advancements.
- A greater understanding of how these scanning machines work will allow patients to take a more active role in their own health care.

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