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Weighing the Risks and Benefits of Radiation Exposure and Diagnostic X-Rays in Children

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Abstract

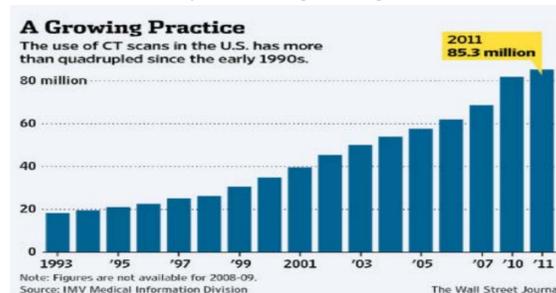
The number of X-rays, specifically CT scans, performed on patients in the United States is increasing exponentially every year. Children are at most risk for long term damage from this increase in radiation exposure. This study explores how much risk children are being exposed to and how we can, as practitioners, make informed decisions about when or when not to order CT scans. The purpose of this paper is to provide practitioners the information needed to help patients decide if the long-term risks of cancer from medical radiation outweigh the potential benefit of diagnostic or therapeutic radiation. The review of literature looked at both sides of this question. Some researchers claim that the risk of radiation has been overblown and exploited by a news-hungry press. However, all the researchers report that there are real concerns about radiation dose and dose adjustments for pediatric patients. It was found that by reviewing the studies that have been performed, clinicians can reach a middle ground in which no unnecessary radiation exposure is allowed, but the use of extremely helpful diagnostic tools, like CT scan, are employed to diagnose and treat conditions as early in the disease process as possible.

Introduction

- Since the discovery of X-rays by Roentgen in 1895, the benefits have been extremely helpful to the medical profession.
- However, the risks have also been evident as seen in early technician's radiation dermatitis and in the death's of Marie Curie and her daughter, Irene, related to radiation poisoning.
- The principles of time, distance and shielding became the mainstay of protection.
- The number of CT scans performed in the US has increased dramatically in the past 30 years
- Children are at the most risk for long term damage from ionizing radiation because of their longer life expectancy and the greater risk of DNA damage.

Statement of the Problem

- In today's litigious society, health care providers are faced with choosing to order high dose ionizing radiation in the form of CT scans to obtain the highest resolution images, or choosing not to, thereby limiting the amount of radiation a patient receives, and risk missing important diagnostic information.
- It is estimated that up to 30% of CT scans are unnecessary when other options such as MRI and ultrasound could be used (Oikarinen et al., 2009).
- Children are at the greatest risk for long term damage from ionizing radiation based on their greater life expectancy and on the risk of DNA damage that is greater in children than in adults (D. Brenner, Elliston, Hall, & Berdon, 2001).
- Providers need decision making guidelines so that no unnecessary radiation exposure is allowed, but the use of extremely helpful diagnostic tools, like CT scan, are employed to diagnose and treat conditions as early in the disease process as possible.



Research Question

- Is there an actual increased risk of long term damage in the form of cancer to children who undergo routine CT-scanning?
- What can we do as providers to minimize this risk?
- It is worth stating that the benefit of early and accurate diagnosis of life-threatening conditions greatly outweighs the very small risk of cancer, but only if the CT scan is justified.

Literature Review

- ❖ Berrington de Gonzalez et al (2009) published an article in the JAMA Internal Medicine that is widely accepted as the first analysis of the current data in regards to the number of CT scans performed in the United States and the projected risk of CT-related cancer deaths.
 - Projected that there may be 29,000 cancer deaths occurring in the future based on the numbers of CT scans performed in 2007 alone.
 - Women are projected to have 2/3 of these projected cancer deaths because of the higher risk of breast and lung cancer when exposed to radiation of the chest.
- ❖ Pearce et al. reported in the Lancet in 2012 that a long-term, large cohort study of radiation exposure from CT scans in childhood in the UK revealed small, but real increased risk of leukemia and brain tumors.
 - This was the first study of its kind, as the cancer risk from atomic bomb exposure in Japan had been the only way the scientific community could study the long term effects of radiation.
 - The relative risk (RR) of leukemia for patients who received radiation doses of at least 30 mGy was 3.18 (95% CI 1.46-6.94).
 - The RR of brain tumors for patients receiving 50 mGy or more was 3.32 (95% CI 1.84-6.42).
 - To put this into perspective, 5 head CTs results in about a 50 mGy red bone marrow dose, and 2 head CTs results in about a 60 mGy brain dose.
 - Risk of leukemia is tripled by 5 head CTs, and the risk of brain tumors is tripled by 2 head CTs.
- ❖ More recently, an Australian study (Mathews et al., 2013) assessed the cancer risk of pediatric patients who had received CT scans.
 - This study was possible because Australia has a high per capita CT scan usage, and the Medicare system pays for most of these scans.
 - The estimate for excess cancer caused by a single CT scan is 1 cancer for every 1800 CT scans.
- ❖ Some studies showed no increased risk of certain kinds of cancer (Bailey et al., 2010 and Khan et al., 2010) when plain X-rays were performed, but both of these studies encouraged further studies when children were exposed to radiation from CT-scans.
- ❖ Krille et al. propose to use electronically gathered data from several large hospitals in Germany and examine data from 1980 through 2010. The subjects will be children no older than 15 who underwent at least one CT scan. The authors expect to use 85,000 patients in this cohort study, which will be about 800,000 person-years. The information is expected to complement the currently used extrapolation of risk from the BEIR report that is commonly used. It is hoped that the information from this study will be pooled with similar studies being done in other European countries providing more statistical power.

Discussion

The epidemiological studies by Pearce et al. and Mathews et al. have put to rest any doubt that CT scan usage in pediatric patients has a very small, but real, risk for future cancer. This small risk is magnified by the greatly increasing numbers of CT scans performed in the United States. Efforts are underway to decrease the amount of radiation patients are exposed to during CT scans, and protocols for ordering practitioners are being developed to prevent unjustified CT scans.

- **Is there an actual increased risk of long term damage in the form of cancer to children who undergo routine CT-scanning?**
 - ❖ The estimated risks of cancer from CT scans that have been proposed in the past (Berrington de Gonzalez et al., 2009) were sometimes criticized as being sensationalized and based on faulty science (Hendee & O'Connor, 2012).
 - Atomic bomb exposure was whole body. CT scan exposure is confined to body
 - Japanese bomb survivors had malnutrition and widespread contagious diseases to contend with in the years immediately following the bombs, which could amplify the effects of the radiation exposure.
 - Other effects of the bombs including heat and pressure damage, fire, flying debris, and the psychological effects of the terror induced by the bombs make this population even more different than the population of patients receiving medical imaging in the rest of the world.
 - For these reasons, some scientists doubted the estimated thousands of cancer deaths that were predicted from the increasing use of CT scans.
 - ❖ However, recent studies (Mathews et al., 2013; Pearce et al., 2012b) have been reported that show statistical evidence of increased risk, however small, of CT scans inducing cancer.
 - The small risk is magnified by the ever-increasing numbers of CT scans performed in the United States every year.
 - Even though the amount of radiation from natural sources has not changed, the average radiation dose of a person in the United States has more than doubled in the past 30 years (D. J. Brenner, 2012b).
 - The largest contributor to this massive increase in radiation exposure is from CT scans (Sarma et al., 2012).



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thanks . . .

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