Pediatric Patients Undergoing Interventional Neuroradiology Procedures' Radiation Dose and Subsequent Risk of Developing Brain Tumors

Abstract

Dosimetric data from the Radiation Doses in Interventional Radiology Study for 49 pediatric patients who underwent neuroradiological procedures were used to calculate the average dose to the entire brain. Published algorithms based on data from A-bomb survivors were used to estimate the lifetime risk of developing radiation-related brain tumors. The size of the field and how the patient moves during the procedure can have a significant impact on how the dose is distributed within the brain. Organ-averaged brain dose was estimated to range from 6 to 1600 mGy, depending on the patient's age and exposure conditions. Depending on the dose taken, age at exposure, and gender, the lifetime risk of being diagnosed with a brain tumor was estimated to be 3 to 40% higher than the normal background rate of 57 cases per 10,000. While critical vulnerabilities are related with these evaluations, we have measured the scope of conceivable portion and spread the vulnerability to determine a trustworthy scope of assessed lifetime risk for each subject. The best methods for reducing radiation dose and the risk of future tumor induction are collimation and limiting fluoroscopy time and dose rate.

Keywords: Radiation • Protection • Neuroradiology• Endovascular surgery

Introduction

Other specialties have also seen an increase in the number and complexity of interventional fluoroscopy procedures over the past two decades [1]. The medical and radiation protection communities have become concerned about these procedures because they require a lot of radiographic images and a lot of fluoroscopic guidance. In addition to the possibility of stochastic effects like cancer induction, the dose may be high enough to produce deterministic effects. Children are more susceptible to the harmful effects of radiation and have a longer life expectancy, making it necessary to take extra precautions when performing interventional fluoroscopy procedures on them. As a result, children are more likely to develop radiation-related cancers than adults. Since the beginning of the 1980s, studies of patient doses from cardiac procedures have been conducted [2]. However, there are very few published data on radiation doses from pediatric interventional fluoroscopy procedures that are not performed on the heart. After neuroradiological procedures, two studies evaluated the entrance dose or the dose to the skin, but neither study estimated the dose to the brain [3]. We analyzed dosimetric data from pediatric patients participating in the Radiation Doses in Interventional Radiology Study (RAD-IR) over a three-year period in seven medical centers in the United States in order to provide estimates of brain doses in pediatric patients who have undergone interventional neuroradiology procedures [4]. The skin dose of patients undergoing interventional fluoroscopy procedures by interventional radiologists was the goal of RAD-IR. From April 1999 to January 2002, prospective demographic and radiation dose data were gathered. On children, a total of 85 procedures were carried out. Because these children tended to be exposed to more radiation than those who underwent other types of interventions,

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Received: 01-April-2023, Manuscript No. ipdr-23-94089; Editor assigned: 03-April-2023, Pre-QC No. ipdr-23-94089 (PQ); Reviewed: 18-April-2023, QC No. ipdr-23-94089; Revised: 21-April-2023, Manuscript No. ipdr-23-94089 (R); Published: 28-April-2023, DOI: 10.37532/ ipdr.2023.6(2).22-24 the subset of pediatric patients who underwent cerebral embolization is of particular interest [5]. The Hyman Newman Institute of Neurology and Neurosurgery, Beth Israel Medical Centre's Center for Endovascular Surgery, and Northwestern University's Feinberg School of Medicine's Department of Radiology treated the majority of these patients in the RAD-IR study's seven centers [6]. One of the largest collections of dosimetric data on pediatric neuroradiology cases is the data we gathered from these patients, which we used to devise a method for estimating the radiation doses to their brains. We estimated the lifetime risk of developing radiation-related benign and malignant central nervous system tumors using the estimated doses absorbed.

Materials and Methods

Estimates of the brain's absorbed dose

The X-ray entrance field size, location, and air kerma incident on the skin are all calculated by Care Graph, a skin dose mapping software program that incorporates a mathematical model of the patient's location and surface shape [7]. Skin irradiation is monitored in real time using the measured dose-area product (DAP), collimator position, table top position, and C-arm angulation. On a graphical representation of the skin surface, the peak air kerma level (PSD) and the spatial distribution of the dose on the skin (skin dose map) are displayed. The software also shows the size of the skin area that was exposed to dose levels higher than the patient's 95th percentile. To evaluate the performance of dosimeters, comprehensive evaluations and consistency checks were carried out frequently on each fluoroscopy unit. Although the environments might have been different at different institutions, they were probably similar. Age, which is related to brain size and the degree of self-shielding attenuation in the brain, was necessary information for dose calculations [8]. At the conclusion of each procedure, the number of images fluoroscopy time, DAP, and peak skin dose were also recorded. In the RAD-IR study, the maximum air kerma without backscatter on any part of the skin during a procedure was the definition of peak skin dose. Our assessment of portion got by the mind depended on the recorded greatest skin portion (MSD). Using correction factors derived from measurements taken on an anthropomorphic phantom, we modified the peak skin dose to include backscatter radiation and converted the recorded values of peak skin dose into MSD [9]. The Care

Graph software's systemic dose estimation errors were also corrected during the MSD conversion, necessitating a 3% increase in peak skin dose for the frontal plane and a 67% increase for the lateral plane.

Brain simulation

The Society of Nuclear Medicine's Medical Internal Radiation Dose Committee. The cranium and brain are represented in this model as two half-ellipsoids at ages 0, 1, 5, 10, and 15 for both children and adults. It provides a description of their size, composition, and density. Boucher. Provide the dimensions and elemental composition of the model's cranium and brain [10]. The cerebellum, white matter, cerebral cortex, and basal ganglia structures were not differentiated in our study, but the Bouchet model's dimensions and skull thickness were used to model the brain itself. The cuts in the least layers are shortened from full ellipsoids to reproduce the locale of the cerebrum stem and cerebellum. The volume of the model, as defined by Bouchet, for our dosimetry purposes. Each age was divided into layers that were one centimetre thick and contained an array of voxels with a cubic volume of one centimetre three, as shown.

Discussion

As a result, we devised a dose calculation method to estimate the organ's average dose and spatial pattern. If the patient's age at exposure, the proportion of exposure from each field, and the MSD are reasonably well known, this method can be used to estimate the lifetime risk of developing radiogenic tumors. The average dose to the brain is significantly influenced by four variables: age (related to the size, density, and thickness of the brain and cranium), the length of time fluoroscopy was performed, how much of the brain was irradiated, and how much radiation fields overlapped. As can be seen in the table that summarizes our dose results, maximum skin doses are lower for younger children. However, due to the infant cranium's low attenuation, the youngest patients are likely to receive the highest average absorbed dose to the brain per unit MSD. As can be seen, the ratio of the maximum skin dose to the brain dose for new-borns is twice as high as it is for adolescents.

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Mini Review

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