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Are Computerized Tomography Scans Being Ordered More Than Necessary?

Bilgisayarlı Tomografi Tetkikleri Gerekenden Fazla mı İsteniyor?

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ABSTRACT

Objective: Computerized tomography (CT) is one of the most common diagnostic imaging methods used in all hospital admissions. The frequency of ordering CT scans has been rapidly increasing since its first use. Due to the X-rays, increased CT scans has been a concerns primarily for patients, and then for healthcare professionals who offer this service. In this study we aim to by determining the number and distribution of all CT scans performed in our hospital prevent the CT demands other than clinical necessity and to decrease the X-ray dose that the society is exposed to.

Materials and Method: Between January 1, 2013 and December 31, 2019, the number of CT scans performed in our hospital was determined according to the departments and compared with the number of patients.

Results: While the number of patients admitted to the emergency room (ER) is 30.90% of the total number of patients, the number of CTs performed in ER was 35.92% of the total number of CTs. CT scan was performed in 5.05% of the total number of patients who admitted to the hospital and this figure was 5.88% in ER patients. Changes in the number of CT scans are statistically significant ($p<0.005$).

Conclusion: Even though the changes in CT scan numbers were statistically significant, the results were not found to be clinically significant as there was no proportionally increasing demand according to the years. We link this positive result to the measures we have taken.

Key Words: Computed tomography, x-rays, number and diversity, statistical data

ÖZET

Amaç: Bilgisayarlı tomografi (BT), tüm hastane başvurularında en sık kullanılan tanısal görüntüleme yöntemlerinden biridir. BT kullanım sıklığı ilk kullanılmaya başlandığı yıllardan beri hızla artmaktadır. Artan BT incelemeleri X ışınından dolayı, öncelikle hastalar, sonrasında bu hizmeti sunan sağlık personelleri için endişe oluşturmaktadır. Bu çalışmada hastanemizde yapılan tüm BT incelemelerinin sayısını ve dağılımını belirleyerek klinik gereklilik dışındaki BT istemlerini önlemeyi ve toplumun maruz kaldığı X-ışını dozunu azaltmayı amaçladık.

Gereç ve Yöntem: 1 Ocak 2013 ve 31 Aralık 2019 tarihleri arasında hastanemizde yapılan BT incelemelerinin sayısı belirlenerek bölümlere göre dağılımı yapılmış ve hasta sayılarıyla karşılaştırılmıştır.

Bulgular: Acil servise başvuran hasta sayısı hastaneye başvuran toplam hasta sayısının %30,90'ı iken, acil servis kaynaklı BT sayısı, toplam BT sayısının %35,92'sidir. Hastaneye başvuran toplam hasta sayısının %5,05'ine BT çekilirken, acil servise gelen hastaların % 5.88'ine BT çekilmiştir. BT sayılarındaki değişiklikler istatiksel olarak anlamlıdır ($p<0,005$).

Tartışma: BT sayılarındaki değişiklikler istatiksel olarak anlamlı olsada oransal olarak yıllara göre devamlı bir artış olmadığından klinik olarak anlamlı bulunmadı. Bu olumlu sonucu almış olduğumuz tedbirlere bağlamaktayız.

Anahtar Kelimeler: Bilgisayarlı tomografi, x ışınları, sayı ve çeşitlilik, istatistiksel veri

Introduction

Since its first use in 1972, the invention of Computed Tomography (CT) has been a revolution for diagnostic radiology, and it has been an irrevocable diagnostic method of modern medicine (1). Use of Picture Archiving and Communication Systems (PACS), which enables archiving, access, distribution, and presentation of images, teleradiology, and voice recognition software, has made CT an indispensable method for all health units, particularly for emergency rooms (ER) (2). The frequency of ordering CT scans has been rapidly increasing since its first use. While approximately 3 million CT scans have been performed in the USA in 1980, this number has been estimated to be more than 62 million in 2006, and at least 4 million of these are pediatric CT scans (3,4). The main reason for this increase is that CT is a beneficial imaging method as it can adapt to technological progress very quickly; it allows rapid shooting and has increased image quality (1). In the CT scan, X-rays, that is, ionizing radiation, are used. Thus, the increasing use of CT scans has been a source of concern for health workers and especially

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for the patients (5). This situation raised questions about the clinical relevance of CT orders, and unnecessary use of CT has been attempted to be reduced (6,7).

In this study, we want to create statistical data by determining the number, diversity, and distribution of all CT scans performed at our University's Faculty of Medicine between January 2013 and December 2019. With the data we will obtain, we aim to prevent CT requests other than clinical necessity and to reduce the X-ray dose that the society is exposed to.

Materials and Methods

This study was designed as a retrospective study, and the Local Ethics Committee approved the study (17.01.2020/01-17). The number of patients admitted to ER, and other departments between January 1st, 2013, and December 31st, 2019, were classified according to the year of admittance. The number of CT scans performed in the same date range was determined and distributed according to departments. The number of CT scans were compared to the number of total patients. Types of CT scans were determined according to frequency.

CT scans were performed by two different scanners in our hospital. The first scanner was a 16 slice CT [Siemens Somatom Emotion - syngo CT VC30, Siemens AG, Munich, Germany], and the other one was 128 slice CT [Siemens Definition AS + (Plus) Siemens AG, Munich, Germany].

Inclusion and Exclusion Criteria: CT scans performed in our hospital between January 1st, 2013, and December 31st, 2019, were included in the study. The patients who were ordered a scan but not scanned were not included in the study.

Statistical Analysis: Descriptive statistics for the studied variables (characteristics) were presented as count and percent. A Chi-square test was performed to determine the relationship between categorical variables. Two proportions Z test was also performed to compare proportions. Statistical significance levels were considered as 5%, and MINITAB for windows (ver: 14) statistical program was used for all statistical computations.

Results

According to the hospital records, in a 7-year period between January 1st, 2013 and December 31st, 2019: While the number of ER patients is 30.90% of the total number of patients, the number of CTs performed in ER was 35.92% of the total number of CTs and this was the largest proportion compared to other departments. During this 7-year period, CT scan was performed in 5.05% (range 4.2-6.16) of the total number of patients admitted to the hospital, and this figure was 5.88% (range 4.16-7.37) in ER patients. Changes in the number of CT scans are statistically significant ($p<0.005$). The distribution and ratio of the number of CT scans by years are given in table 1.

Department of internal medicine has many subspecialties, and it is the department ordering the most CT after the emergency department. During the 7-year period, the number of CT scans ordered in internal medicine was 44.344, and this number makes 20.78% of all CT scans. The majority (37.367, 17.51%) of this number comes from departments of medical oncology, gastroenterology, and general internal practice.

We also investigated the number of CT scans according to the area of interest and found that an abdominal CT scan was the most ordered scan (35.53%), followed by brain CT (20.79%), and thorax CT (19.53%) and others (51,519, 24.15%). Details are presented in table 2.

Discussion

CT is one of the most common diagnostic imaging methods used in all hospital admissions. With CT, it is possible to perform a cross-sectional examination of almost all organs in the body. The advantage of CT compared to other diagnostic imaging methods is the short examination time, three-dimensional (3D) imaging possibility, and high image quality. However, a high dose of radiation is a serious disadvantage (8).

A few studies have shown that the number of CT and other imaging modalities has increased in all departments, especially in the ER (9-11). In the USA, the number of CT scanning in the ER has increased from 2.2% to 9.4% in 10 years, between 2001 and 2010 (12).

The main reasons for the increased number of CT scans may be: Rapid shooting technique and improved image quality due to advances in CT technology (1), increased diagnosis rates accordingly (13), the threat of malpractice cases (14), and financial incentives for CT use (15).

Between 2013-2019, the number of patients admitted to all hospital and ER have increased continuously. During this 7-year period, a CT scan was performed in 5.05% of the total number of patients who have admitted to the hospital, and in 5.88% of ER patients. Despite the fact that the total number of CT scans has increased in number every year except 2019, only in 2014, a proportional increase has been observed.

Table 1. The number of CT scans and the ratio according to patient number

	2013	2014	2015	2016	2017	2018	2019	Total
A	414.380	482.769	540.589	572.614	646.149	745.977	815.386	4.217.864
B	20.791 (%5.01)	29.739 (%6.16)	30.108 (%5.56)	30.828 (%5.38)	33.087 (%5.12)	34.514 (%4.62)	34.300 (%4.20)	213.367 (%5.05)
C	131.907	150.704	169.826	185.754	203.109	217.177	244.964	1.303.441
D	7.207 (%5.46)	11.113 (%7.37)	11.554 (%6.80)	12.469 (%6.71)	11.118 (%5.47)	12.970 (%5.97)	10.204 (%4.16)	76.635 (%5.88)

A: Total number of patients admitted to the hospital
B: Number and ratio of total CT scan in the hospital
C: Number of patients admitted to ER
D: Number and ratio of CT scans in ER

Table 2. Distribution and ratio of CT scans according to years

Name of CT scan	2013	2014	2015	2016	2017	2018	2019	Total and (%)
Abdomen	7.381	11.113	10.766	10.692	13.162	11.023	11.685	75.822 (%35.53)
Brain	5.851	7.247	6.700	6.219	5.391	6.698	6.259	44.365 (%20.79)
Thorax	3.221	4.903	5.564	6.265	6.979	7.205	7.524	41.661 (%19.53)
Others	4.338	6.476	7.078	7.652	7.555	9.588	8.832	51.519 (%24.15)
Total	20.791	29.739	30.108	30.828	33.087	34.514	34.300	213.367 (%100)

There was a proportional decrease in the following years. Different data were obtained with increases and decreases in numbers and rates of CT scans performed in the ER. Even though the changes in the number of CT scans are statistically significant, the results were not found to be clinically significant as there was no proportionally increasing demand according to the years. All studies conducted in the USA, showing that the number of CT scans has increased, cover a time period beginning from the 1980s until the early 2000s. Our study covers a 7-year period between 2013 and 2019, and we do not have older data. We did not see any similar studies in the literature, which covers the same or a recent period as our study. Therefore, we think that it is not righteous to compare the studies.

Increasing the number of CT scans based on ER more than others may be due to an excessive number of traumatic patients, workload, agitated patients and relatives, the experience of the physician, wish for avoiding the risk and legal concerns. It may also be a factor in directing patients to the ER for imaging.

Another important result of our study is that subspecialties of internal medicine such as medical oncology, gastroenterology, and general internal practice constitute 17.51% of all CT scans. This may be an indicator of the high rate of malignant diseases in our region, mainly originated from the gastrointestinal tract. A few studies have shown that the number of malignancies originating from the gastrointestinal tract, especially in the stomach and esophagus, is high in our region (16-18).

In adults, approximately half of the CT scans are abdominal CTs, and one third is head CTs (3). In our study, 35.53% of all scans were scans of the abdomen, 20.79% were of the brain, and 19.53% were of the thorax, and the data we obtained were similar to previous studies in terms of ranking.

Factors that may limit the increase in demand for CT scans may include economic issues (6), the discordance of CT orders with the clinical picture, which is a medical problem (19), and concerns about radiation exposure (20).

There are three ways to reduce the dose of CT-induced radiation to which the population is exposed: The first option is to use dose reduction and management tools available in new generation scanning machines (21). Second, the necessity of a CT scan may be substituted by other imaging modalities such as ultrasonography and magnetic resonance imaging systems, where available (22,23). The third and most effective way is to reduce the number of orders (24). In our hospital, we use all three methods. We believe that the lack of a significant increase in the number of CT scans is due to these measures.

CT causes overdiagnoses with incidental findings other than radiation exposure. This can lead to unnecessary treatments and increased costs (25).

The limitations of our study are as follows: First, we do not have the older data in which similar studies

have been performed. The other is, we were not able to make a solid comparison with previous studies, as there were no studies in the literature belonging to the same period or recent past.

As a result, our data show that changes in CT scan numbers are not clinically significant. We link this positive result to the measures we have taken. We also think that these and similar studies may lead to the development of an auto-control mechanism.

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