ORIGINAL ARTICLE

Özgün Araştırma

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Geliş Tarihi : 31 October 2021
Received
Kabul Tarihi : 08 March 2022
Accepted
E Yayın Tarihi : 01 January 2024
Online published

Bu makalede yapılacak atıf
Cite this article as

Aksoy C, Cıra K, Koc K, Emir Yetim E, Durmus E, Ozbilek O.
The Impact of COVID-19 Pandemic on the Distribution of Radiology Examinations
Akd Med J 2024;10(1): 1-5

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DOI: 10.53394/akd.1016778

The Impact of COVID-19 Pandemic on the Distribution of Radiology Examinations

COVID-19 Pandemisi Radyoloji Tetkiklerinin Dağılımını Nasıl Etkiledi?

ABSTRACT

Objective:
The COVID-19 pandemic led to significant changes in healthcare practices. In the current study, we aim to determine the impact of the pandemic on imaging examinations in radiology department.

Material and Methods:
Medical records of the patients who underwent radiological imaging between March 10 and December 31, 2019, and March 10 and December 31, 2020 were retrospectively reviewed. The clinical patient data and radiological imaging details were collected from the SARUS information network.

Results:
A total of 603.384 radiological examinations were performed on 222.328 patients within the 18-month period in two consecutive years. The total imaging volume decreased by 54.8% in 2020 when compared to 2019 (415.819 vs 187.565). The decrease was significant in April and May 2020 and the volume increased again in June 2020. The imaging volume requested from the emergency unit revealed that it was reduced by 29.4%. The rate and number of thoracic imaging among all radiologic examinations increased in 2020 (6495, 1.6% vs. 8663, 4.6%). On the other hand, abdominal, breast, neuroradiology and cardiovascular imaging were the most affected procedures by the pandemic.

Conclusion:
Hospital admissions decreased due to patient anxiety and restrictions during the pandemic. It is important to perform the necessary imaging procedures on patients based on the indications to prevent diagnosis delays by considering hospital conditions and providing the precautions recommended by the protective equipment and guidelines.

Key Words:
COVID-19, Pandemic, Radiology

ÖZ

Amaç:

COVID-19 pandemisi rutin sağlık uygulamalarımızda ciddi değişiklilere neden oldu. Bu çalışma ile, pandeminin Radyoloji bölümündeki görüntüleme tetkikleri üzerine etkisini saptamayı amaçladık.

Gereç ve Yöntemler:

Antalya Atatürk Devlet Hastanesi Radyoloji Bölümü'ne 10 Mart–31 Aralık 2019 ve 10 Mart–31 Aralık 2020 tarihleri arasında yapılan istemler geriye dönük tarandı. Hastalara ait klinik özellikler ve radyolojik istemlerin içeriği SARUS bilgi ağı kullanılarak elde edildi.

Bulgular:

Ardışık iki yıla ait 18 aylık periyotta 222,328 hastaya 603,384 görüntüleme yapılmıştır. 2020 yılında yapılan toplam görüntüleme sayısı 2019 yılına göre %54,8 azalmıştır (415,819 vs 187,565). 2020 yılında özellikle Nisan ve Mayıs ayında gözlenen azalmanın Haziran ayı ile beraber yeniden artığı saptandı. Acil servis istemlerinde 2019 yılına göre gözlenen azalma %29,4 olarak bulundu. Toraks görüntülemelerinin 2020 yılında hem sayısı hem de tüm görünteleme yöntemleri arasındaki oranı artmış bulundu (6495, %1,6 vs 8663, %4,6). Buna karşın; 2020 yılında abdomen, meme, nöroradyoloji ve kardiyovasküler sisteme ait görüntülemelerin sayısının daha fazla etkilendiği gözlendi.

Sonuç:

Pandeminin başlangıcı ile beraber ortaya çıkan kaygı ve kısıtlamalar nedeni ile hastane başvuruları ve buna bağlı olarak görüntüleme sayıları azalmıştır. Tanıda gecikmeyi önlemek için; endikasyonu olan hastalarda gerekli görüntüleme tetkiklerinin zamanında yapılması önemlidir, bu konuda klavuzların önerdiği koruyucu ekipmanların sağlanması gereklidir.

Anahtar Sözcükler:

COVID-19, Pandemi, Radyoloji

INTRODUCTION

COVID-19 disease is caused by the SARS-CoV-2 virus and was first identified in Wuhan, China. The World Health Organization (WHO) declared the COVID-19 pandemic on March 11, 2020. The first COVID-19 case was identified in Turkey on March 10, 2020. As of October 29, 2021, 245 million COVID-19 cases were recorded globally and more than 4.9 million individuals died of COVID-19 (World Health Organization web site). In the early stages of the pandemic, similar to several countries, non-urgent procedures were discontinued in Turkey, patient follow-ups were conducted with telemedicine as far as possible; thus, a significant decrease was observed in hospital admissions. The patient follow-up periods recommended by the guidelines were delayed with the mutual consensus of the doctors and the patients. These conditions also affected various radio-diagnostic procedures.

Neuroradiological imaging figures decreased by 50% during the pandemic when compared to the pre-pandemic figures (1). A study that analyzed weekly variations in imaging after the COVID-19 pandemic conducted in Stanford reported that breast imaging, nuclear methods and musculoskeletal system imaging figures decreased significantly when compared to the pre-pandemic period (2). In a study carried out in Cleveland, it was observed that the pandemic led to a significant decrease in the number of mammographies and nuclear imaging (93% and 61%, respectively) (3). Vagal et al. compared the total imaging procedures in March and April, the initial months of the pandemic, and the same period in 2019, and reported that there was a 53.4% decrease (4). A decrease of 40.5% was observed in the requests of hospitalized patients, 72.3% in the requests of outpatient patients and 48.9% in the requests of emergency patients (4).

Although the COVID-19 pandemic affected the whole world, the time and severity of the pandemic varied between the continents and countries. The current study aimed to analyze the impact of the COVID-19 pandemic on imaging volume and variety of imaging modalities.

MATERIAL and METHODS

The medical records of the patients who underwent imaging procedures at Antalya Atatürk Public Hospital Radiology Department between March 10 and December 31, 2019, and March 10 and December 31, 2020 were reviewed retrospectively. The clinical patient data, the imaging types, and the departmental patient information were recorded on the electronic medical data network. Patients with incomplete medical records were excluded from the study. Patients were classified based on the age groups as recommended by the World Health Organization; 0-17 years old children, 18-65 years old young individuals, 66-79 years old adults and 80-99 years old seniors. Furthermore, since the patient age was higher than 50 years, a risk factor for COVID-19, the study group was categorized as younger and older individuals than 50 years. Our research was carried out in accordance with publication ethics and necessary permissions were obtained from the institution where the study was conducted. The study was approved by the Antalya Training and Research Hospital Ethics Committee (04.03.2021/2021-005). Informed consent forms were not signed by the participating patients due to the retrospective nature of the study. The study was conducted in accordance with the Helsinki Declaration principles. Since the study investigated the effects of COVID-19, Scientific Research Application approval was obtained from the Republic of Turkey Ministry of Health (Cihat Aksoy-2020-12-27T12_05_44)

Descriptive statistics are presented as frequencies, percentages, means, standard deviations (SD), medians, and interquartile ranges (IQR). The Shapiro Wilk test, histogram, and Q-Q graphics were employed to test normal distribution of the data. The chi-square analysis was conducted to analyze the correlations between categorical variables. "Student t-test" was used to determine the differences between the two independent group means, and "Kruskal Wallis" test was used for two or more groups. Statistical analyses were conducted with the SPSS version 21.0 software for Windows (IBM, Armonk, NY). A P value of <0.05 was accepted statistically significant.

RESULTS

A total of 603,384 radiologic examinations were performed on 222.328 patients during the 18-month period in 2019 and 2020. The mean patient age was 41.47 ± 20.80 and 44.0% of the participants were male. The total imaging volume decreased by 54.8% in 2020 when compared to 2019 (415.819 vs 187.565).

The age, age group and application unit of the patients who underwent radiological evaluation in 2019 and 2020 were compared (Table I). The mean age of the patients in 2020 was found to be lower than in 2019, and the decrease in imaging volume of the old and elderly patients were more significant compared to the study population in that year (Table I).

Table I. Demographic and imaging characteristics of patients who underwent imaging in 2019 and 2020.

	2019	2020	Delta*
Mean age (years)	46.44±20.77	44.39±20.08	-
Age group, %, (n)			
Children	43736	19615	55.1 %
Young	286643	138284	51.7 %
Old	16377	5643	65.5 %
Elderly	69063	24023	65.2 %
Age, %, (n)			
< 50 years	220022	109323	50.3 %
> 50 years	195797	78242	60.0 %
Gender, %, (n)			
Male	159364	82521	48.2%
Female	253328	103394	59.1%
Screening method, (n)			
X-ray	236302	110321	53.3%
USG	92936	29215	68.5%
BT	33791	24293	28.1%
MRG	52790	23736	55.0%
Admission unit (n)			
Emergency room	80660	56892	29.4%
Inpatient	19627	8418	57.1%
Outpatient	312539	120712	61.3%
Intensive care unit	2993	1543	48.4%

* The delta definition reflects the difference between 2020 and 2019.

In 2020, the reduction in the volume across patients who were older than 50 was higher when compared to the patients who were younger than 50 (47.1% vs 41.7%; p<0.001).

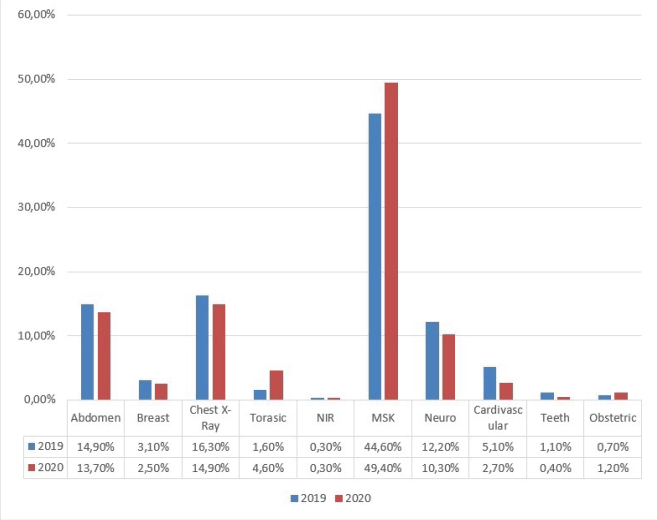
The monthly distribution of radiologic examinations was reviewed in both years, and the highest decrease in imaging volume was determined April and May 2020 when compared to the previous year, and the radiologic examination volume increased in June, 2020 (Table II).

Table II. Distribution of imaging by months in 2019 and 2020.

Months	2019	2020	Delta
March	36657.00	15489.00	57.7%
April	45161.00	7645.00	83.0%
May	43332.00	9996.00	76.9%
June	34502.00	24855.00	27.9%
July	44892.00	23925.00	46.7%
August	32226.00	20746.00	35.6%
September	43072.00	21109.00	50.9%
October	46395.00	21560.00	53.5%
November	44776.00	22943.00	48.7%
December	44806.00	19296.00	56.9%

Radiologic examinations were reviewed based on the admission unit, and it was determined that the volume of imaging procedures conducted on patients admitted by the emergency department decreased by 29.4% in 2020 when compared to 2019; however, its share in all radiologic examinations increased from 19.4% to 30.3% in 2020. The decrease in the number of radiologic examinations was 61.3% in outpatients, 57.1% in inpatients, and 48.4% in intensive care patients in 2020 (Table I). In 2020, while the rate of ultrasonography in all radiologic examinations decreased from 22.4% to 15.6%, the rate of tomographies in all examinations increased from 8.1% to 13.0%. In 2020, the decreases in the imaging volume were mostly observed in ultrasonography procedures, followed by MRI, X-ray and tomography (68.5%, 55.0%, 53.3% and 28.1%, respectively). The imaging methods were also analyzed separately, and it was observed that abdominal, breast, neuroradiology and cardiovascular procedures decreased in 2020 when compared to 2019 (Figure 1).

Figure 1. Distribution of imaging rates by systems evaluated in 2019 and 2020.



NIR: Nonvascular interventional radiology

MSK: Musculoskeletal radiology

It was determined that the count and rate of Chest X-ray imaging did not increase in 2020. However, the thoracic imaging volume and its rate in all imaging procedures increased in 2020 (6495, 1.6% vs. 8663, 4.6%) (Figure 1). The frequency of male patients who underwent Chest CT were similar in 2019 and 2020 (56.7% vs. 57.9%, p=0.060).

DISCUSSION

In the current study, it was determined that the imaging volume in 2020 was approximately half of the imaging volume during the same period in the previous year. Also, the decrease was higher at the beginning of the pandemic and increased in the second half of the year; however, the cumulative volume did not reach the volume in the previous year. Similar to our study, a 50-70% decrease was reported in studies conducted in different regions of the USA that investigated the impact of the pandemic on radiological imaging (3,5). The decrease in imaging volume was determined by the surveys conducted with the radiologists

employed in different states, who stated that the reasons for this decrease included the postponement of elective procedures and a lack of adequate protective equipment against the disease. It should be noted that 16% of the radiologists participating in the survey were COVID-19 positive (5). Madhuripan et al. reported a 30-60% decrease in radiological imaging volume by early March, while the imaging volume began to increase in late April (2).
The maximum decrease in the imaging volume in 2020 was in elderly patients. At the onset of the pandemic in Turkey, the restrictions implemented to minimize the spread of the virus were more effective on the elderly population when compared to young age groups. In this period, the anxiety of leaving home and the fear of entering crowded settings such as hospitals decreased hospital admission rates across elderly individuals (2). It is known that the males require more intensive care and prone to mortality associated with COVID-19 (6,7). We suggest that the decrease in the imaging volume across the male patients when compared to the female patients reported in our study was associated with the correlation between COVID-19 and the male gender.

During the pandemic, we observed that the decrease in ultrasonographic examinations was higher when compared to other imaging methods. The review of the variations based on the examination system revealed that the decrease was prevalent in abdominal, breast, neurological and cardiovascular examinations. González-Ortiz et al., analyzed the variations in neuroradiological imaging during the pandemic, and claimed that the reduction observed during the peak of the pandemic could be applied carefully in patients with post-peak indication (1). In the study that reviewed March and April figures, mammography and nuclear imaging methods were most affected by the pandemic (3). In our study, we observed that thoracic imaging volume and its share in all imaging methods increased in 2020 when compared to 2019 (1.6% vs 4.6%). In a survey conducted by the Italian Society of Medical and Interventional Radiology, radiologists asked the question "What should be the first imaging method performed in the patients admitted with COVID-19 diagnosis," and 76.3% replied that it should be chest X-ray, 39.4% preferred chest CT, and 9.3% chest ultrasound (8). Our findings demonstrated that the X-ray volume decreased in our hospital, and chest CT was preferred in suspected patients.
Our study has some limitations. The study findings could not be generalized to the entire country since it reflects the experiences in a single center and the city where the study was conducted was not among the cities that reported highest cases in Turkey. Furthermore, since the clinical patient data were not included in the study, the correlation between clinical findings and radiological imaging was not investigated.

CONCLUSION

Elective radiological imaging procedures were postponed in the early stages of the pandemic to reduce the spread of the virus and to ensure that imaging centers operated properly in the pandemic environment. Thus, it was observed that the imaging volume decreased by more than 50% when compared to the previous year. Considering the hospital conditions, the necessary imaging procedures should be performed on patients with an indication by following the precautions recommended by the protective equipment and guidelines. The current study would contribute to the literature since it analyzed the impact of the pandemic on radiological imaging methods in Turkey, and will be a helpful resource for future studies.

Ethics Committee Approval:
The current study was approved by the following ethics committee from Antalya Training and Research Hospital (decision no: 2021-005, date:04.03.2021). The study was conducted in accordance with the Helsinki Declaration principles (04.03.2021/2021-005).

Informed Consent:
Since the study data were based on retrospective medical data, informed consent was not obtained.

Author Contributions:
Concept – C.A.; Design – K.Ç.; Supervision – K.Ç.; Resources-C.A.; Funding – none; Materials – K.K.; Data Collection and/or Processing– E.D..; Analysis and/or Interpretation – E.E.Y.; Literature Review – Ö.Ö; Writing – C.A.; Critical Review – K.Ç.

Conflict of Interest:
The authors declare no conflict of interest.
Financial Disclosure: The authors declare that this study received no financial support.

Presented Congress:
It was presented as an oral presentation at the TURKRAD 2021 congress held in Antalya between 26-31 October 2021.

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