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Analysis of the Escalation in Radiological Imaging: Underlying Factors and Consequences

Radyolojik Görüntülemelerdeki Artışın Analizi: Altta Yatan Faktörler ve Sonuçları

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ABSTRACT
Since the discovery of X-rays, radiological examinations have held a crucial role in diagnosis. With the progression of technology over time, the diversity and applications of imaging methods have expanded significantly. In recent years, there has been a notable increase in the use of radiological examinations. This surge can have adverse effects in various domains, primarily impacting healthcare and the economy. In order to cope with the numerical increase in radiological imaging, excessive or unnecessary imaging should be taken under the spotlight. In this review, the reasons and consequences of the increase in the number of radiological examinations will be revealed.
Keywords: Computed tomography, magnetic resonance imaging, number of radiological examinations, radiological imaging, unnecessary imaging

ÖZ
Radyolojik tetkikler X ışınının keşfedilmesinden bu yana tanıda önemli bir yer tutmaktadır. Günümüze kadar olan süreçte ilerleyen teknoloji ile birlikte görüntüleme yöntemlerinin çeşitliği ve kullanım alanları genişlemiştir. Son yıllarda radyolojik tetkiklerin kullanımında sayısal olarak artış olduğu görülmektedir. Bu artış başta sağlık ve ekonomi olmak üzere birçok alanda olumsuz sonuçlar doğurabilmektedir. Radyolojik görüntülemelerdeki sayısal artışla baş edebilmek için aşırı sayıda ya da gereksiz yapılan görüntülemeler mercek altına alınmalıdır. Bu derlemede radyolojik tetkik sayısındaki artışın sebep ve sonuçları ortaya konulacaktır.
Anahtar Kelimeler: Bilgisayarlı tomografi, gereksiz görüntüleme, manyetik rezonans görüntüleme, radyolojik görüntüleme, radyolojik tetkik sayısı

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INTRODUCTION

Radiology has evolved tremendously since the discovery of X-ray. Advancements in the field of radiology have paved the way for new imaging modalities such as Computed Tomography (CT), Ultrasound Imaging (USI), Doppler Ultrasound, and Magnetic Resonance Imaging (MRI). In the subsequent years, the existing imaging modalities have undergone technological advancements, enabling faster and higher-resolution imaging. Initially employed for diagnostic purposes, radiological imaging has progressively found utility in post-treatment monitoring, cancer screening, and treatment procedures with imaging guidance. With the growth in technological innovations, accessibility, and expanding applications, the number of radiological imaging procedures has surged in recent times.[1,2]

The escalating demand for radiological examinations, coupled with the rapid increase in the volume of imaging studies, has led to an imbalance between the available resources and the rising need for such procedures. This imbalance involves not only the optimal staffing of radiologists, technicians, nurses, and other healthcare professionals but also non-personnel factors like economic resources, equipment availability, accessibility, radiation dosage, and more. This review aims to address the excessive utilization of radiological examinations in recent years, specifically focusing on USI, Doppler USI, CT, and MRI. The review will discuss the reasons behind the overuse or unnecessary application of these imaging modalities and the resulting

adverse consequences.

QUANTITATIVE ASSESSMENT OF THE UPTREND IN RADIOLOGY REQUESTS

The increase in radiological examinations is a multidimensional issue of concern to radiology professionals and patients. The numbers of USI, CT, and MRI examinations are on the rise worldwide. The utilization of USI is experiencing a rapid surge owing to factors such as its bedside applicability, repeatability, cost-effectiveness, and fast execution. With technological advancements, CT imaging has gained advantages such as reducing motion artefacts due to shorter scanning times, providing excellent visualization of contrast agents, and presenting anatomy exceptionally. On the other hand, MRI offers advantages like not containing ionizing radiation, good visualization of soft tissues, enabling functional and metabolic imaging such as diffusion, perfusion, spectroscopy, and utilizing contrast agents that are safer compared to iodinated contrasts.[3] A study published by Larson et al. in 2011 highlighted that the number of CT scans performed in emergency departments in the United States increased six-fold between 1995 and 2007, reaching 16.2 million scans.[4] With the increased accessibility of MRI, its utilization has also surged. Global publications emphasize the excessive rise in musculoskeletal MRI examination numbers. It has been reported that the rate of requesting MRI examinations without proper indication in patients presenting with back pain ranges from 35% to 70%, and even if the initial scan is normal, the examination is repeated on average after 2 years.[1,5,6] The increase in the number of examinations has brought up the issue of unnecessary utilization of radiological imaging. Studies have demonstrated that the rate of unnecessary requests for radiological examinations falls within the range of 10% to 40%.[3]

Organization for Economic Co-operation and Development (OECD) data emphasize the high number of MR and CT scans globally.[7] In a report published by the Turkish Society of Radiology (TSR) in 2018, Türkiye ranks first in terms of the number of MRI scans and 9th in CT scans, based on OECD data. According to the report, there are 144 MRI scans per 1000 people in Türkiye (compared to the OECD average of 57 scans), and 245 CT scans per 1000 people (compared to the OECD average of 143 scans). Furthermore, the report indicates that the number of radiologists per capita in Türkiye is relatively low, with around 5 radiologists per 100.000 people, which is half to one-third of the levels in most European countries. The need for more radiologists in proportion to the high number of scans underscores an overwhelming workload. This situation is quantified by data indicating that in some institutions, radiologists are obliged to interpret 200-300 scans per day, and the time dedicated to each examination has dropped below 5 minutes.[7] The potential adverse consequences brought forth by all these data will be discussed later.

CAUSES OF EXCESSIVE OR UNNECESSARY IMAGING REQUESTS

With the advent of technological advancements, the utilization of advanced diagnostic imaging modalities has been on the rise globally. The escalation in the number of diagnostic imaging studies may be attributed to various factors. These factors encompass the increasing average age of the population, technological advancements, an increase in imaging indications, augmented accessibility to imaging devices, and an upsurge in the number of radiologists. Clinicians assume a fundamental role in the requisition of radiological examinations, thereby rendering the conduct of clinicians a pivotal determinant in the workload of radiology. The utilization patterns of imaging modalities by clinicians are influenced by factors such as patient expectations, indecision or suspicion, time constraints during examinations, defensive medicine practices, payment systems, and more. These factors can vary across countries and even institutions.[8]

The European Referral Guidelines for Imaging highlights key contributors to excessive radiological test requests, including redundant test repetitions, inadequate reliance on non-imaging tests for patient management, overutilization of imaging, incorrect radiological test requisitions, insufficient knowledge about test indications, and the clinicians' sense of security both for themselves and the patients.[8]

The American Board of Radiology Foundation has also identified factors contributing to excessive radiological test requests. These factors include the fear of malpractice, reimbursement issues, physician self-referral for diagnostic imaging, the need for repeat imaging due to inadequate quality, patients' requests for imaging, lack of knowledge, and non-adherence to guidelines.[3]

One contributing factor behind excessive test requests is reimbursement concerns. Due to higher reimbursements for radiological tests compared to other services, clinicians outside of radiology may request more tests to increase their revenue.[9] Self-referral involves non-radiologist physicians ordering and interpreting diagnostic imaging studies in their clinics. Examples include obstetricians and gynecologists performing USI and Doppler USI, orthopedists requesting extremity radiographs and musculoskeletal MRIs, and various departments conducting procedures with imaging guidance.[9]

Patients, often armed with preconceived notions based on their research, may seek specific diagnostic

imaging modalities before even visiting a clinician. However, patients can misinterpret or overlook their clinical conditions while researching, and the reliability of the sources they access can be questionable. Consequently, patients who encounter alarming information may request imaging from clinicians to either reach a definitive conclusion or rule out concerning conditions. Factors contributing to unnecessary radiological test requests include the need to ensure patient satisfaction, challenges in providing detailed explanations during brief consultation times, patients' concerns about their conditions triggering malpractice fears in clinicians, and the risk of violence directed towards healthcare professionals.[10] A study by Studdert et al. emphasized that radiological tests ordered due to malpractice concerns are more prevalent than other forms of defensive medicine practices.[10]

Repeating radiological tests is another factor contributing to unnecessary test requests. Test repetition can arise from various reasons, such as inadequate image quality necessitating a repeat scan for proper diagnosis. In some cases, incomplete knowledge about which test to order and limited communication between clinicians and radiologists can lead to redundant test requests. Instances of imaging being performed on the wrong anatomical region or opting for contrast imaging instead of non-contrast when it's not required can also occur. Furthermore, performing contrast imaging unnecessarily, while not directly related to unnecessary radiological tests, can lead to extra costs within the field of radiology.

The report by the Turkish Society of Radiology in 2018 also analyzed the number of radiological tests, and the primary factors contributing to excessive test requests in Türkiye were outlined in the following five points:[7]

1. Insufficient clinician-to-population ratio leading to shortened consultation times,
2. The necessity of ensuring patient satisfaction and meeting healthcare service expectations,
3. A low number of radiologists per population,
4. Patients' requests for radiological tests from clinicians,
5. Defensive medicine (clinicians resorting to imaging methods to achieve quick and secure diagnoses due to limited consultation times) and the risk of violence towards healthcare professionals.

RISKS AND ADVERSE OUTCOMES RESULTING FROM EXCESSIVE OR UNNECESSARY IMAGING REQUESTS

With the increasing number of radiological tests, one of the primary challenges that emerge is the potentially harmful effects stemming from ionizing radiation. It is well-established that these detrimental effects are contingent upon the dosage and duration of exposure to X-rays. Within radiological imaging, the primary concern lies in the radiation dosage, with a particular focus on its potential to induce the development of cancer. Notably, the escalated risk is primarily attributed to the exponential rise in usage, notably in CT imaging due to its comparatively higher dosage. The advent of multidetector CT technology has led to the utilization of imaging techniques such as CT angiography, cardiac CT, and dynamic contrast-enhanced CT, contributing to increased dosage exposure.[3] Moreover, available data has demonstrated that the widespread adoption of CT for cancer screening could potentially elevate the risk of cancer at the population level as well.[11]

The utilization of intravenous (IV) iodinated contrast agents for various purposes in CT imaging has also become more prevalent with the increasing number of CT scans. The widespread use of contrast agents not only carries economic implications but also gives rise to potential consequences that could negatively impact public health. Hypersensitivity reactions, for instance, are one such consequence, occurring at a rate of approximately 5-12%, with a mortality rate of around 1 in 75.000. This range of reactions encompasses a broad clinical spectrum, from urticaria to anaphylaxis. Contrast-induced nephropathy and thyrotoxicosis are also undesirable clinical conditions associated with contrast agents.[3]

Radiological examinations hold a significant place within countries' healthcare expenditures. With the increasing number of diagnostic tests, their share in healthcare spending has also risen.[9] However, whether this escalated cost translates into an improvement in the quality of healthcare services is a subject of debate. A study conducted in the United States revealed that regions with higher imaging utilization and expenditures did not necessarily yield better patient outcomes compared to regions with lower utilization.[12] Moreover, certain studies have indicated that high-tech imaging modalities contribute significantly less (20-50%) to patient outcomes.[9] Considering the time invested by radiologists in unnecessary test interpretations and the overutilization of imaging equipment, the cost-effective utilization of healthcare spending can diminish. On the other hand, unnecessary tests may lead to false positive results, resulting in additional secondary tests and interventions, thereby imposing an extra burden on healthcare expenditures. In conclusion, the volume of imaging tests has become a crucial factor in controlling healthcare costs.

In recent years, technological advancements and the widespread adoption of imaging modalities have contributed to enhancing patients' quality and duration of life.[9] However, the excessive or unnecessary use of these modalities can also yield adverse outcomes concerning the quality of healthcare services.

The time loss incurred by these examinations, the reduction in report quality due to the workload on radiologists, and unnecessary interventions resulting from false-positive diagnoses all contribute to a decline in service quality. The excessive increase in the number of radiological tests unnecessarily intensifies the workload of radiologists during both regular and on-call hours. Consequently, this situation leads to professional burnout among radiologists and radiology technicians. A recent study conducted in Western Europe revealed a dramatic rise in radiology on-call duty intensity over the past 15 years, primarily attributed to the surge in CT requests in emergency departments.[13] The extended working hours and lack of sufficient rest for radiologists, the necessity to expedite report interpretations within shorter timeframes, and the inability to communicate with clinicians in complex cases all can result in diagnostic errors. The decline in service quality has adverse implications for patients who benefit from these services. The time wasted and anxiety caused by unnecessary tests, radiation exposure, and secondary tests or interventions all contribute to reduced patient satisfaction and confidence. Moreover, for patients with serious health issues or urgent imaging needs, access to imaging examinations can become challenging due to the heightened workload, potentially leading to delays in diagnosis.

Excessive or unnecessary radiological tests pose professional risks for radiologists. The demand for radiological images to be reported in a timeframe shorter than what is appropriate can lead to diagnostic errors and expose radiologists to significant legal risks.[7] The increase in workload also brings about consequences such as fatigue, stress, burnout, decreased job satisfaction, and a propensity to leave the profession. Additionally, the escalation in radiation exposure potentially carries health risks, the most serious of which is the risk of developing cancer. On the other hand, a review stated that there is no evidence to support an increased cancer risk among radiologists working over the past 30-40 years.[14] Another study comparing cancer incidence and mortality rates of radiologists who worked after 1940 with those of psychiatrists and the general population found that they were not significantly elevated.[15] However, the rapidly increasing number of tests in recent years raises questions on this matter and necessitates further investigation.

Due to the increased workload of radiologists, there is a reduction in the time allocated to fundamental imaging techniques such as X-rays or complex procedures like interventional radiology.[7] Basic imaging methods like X-ray, commonly used as a primary diagnostic tool, provide crucial insights into certain clinical conditions. Initiating radiological imaging with more advanced techniques can lead to missed diagnostic clues from X-ray images that are not examined or reported due to radiologists' workload. Neglecting both practical evaluations of X-rays and utilizing diagnostic hints can lead to the unnecessary use of advanced imaging methods, thus increasing costs. Additionally, this circumstance can compromise healthcare quality by delaying diagnoses. Interventional radiology, an increasingly popular field for diagnosing and treating diseases, has been impacted by the growing workload of radiologists. Especially in hospitals lacking interventional radiology units, the increased workload hinders radiologists from employing interventional techniques.

In conclusion, the escalation in radiological imaging poses challenges that demand a concerted effort from the medical community and policymakers. By addressing the underlying factors driving excessive requests, implementing evidence-based guidelines, and fostering collaborative practices, we can strike a balance between the benefits of advanced imaging techniques and the judicious use of resources. In doing so, we can ensure the delivery of high-quality healthcare services while minimizing the potential drawbacks associated with the escalating demand for radiological examinations.

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